ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE

Plan d’études

Systèmes de communication

2 0 15 - 2 0 1 6

arrêté par la direction de l'EPFL le 18 mai 2015

Directeur de section	**Prof. P. Thiran**
Conseillers d'études :	
Année propédeutique	**Prof. A. Shokrollahi**
1ère année cycle bachelor	**Prof. J.-P. Hubaux**
2ème année cycle bachelor	**Prof. M. Gastpar**
1ère année cycle master	**Prof. K. Aberer**
2ème année cycle master	**Prof. M. Grossglauser**
Projet de master	**Prof. A. Wegmann**
Responsable passerelle HES	**Mme S. Dal Mas**
Délégué à la mobilité	**M. J.-L. Benz**
Coordinatrice des stages d’ingénieur	**Mme S. Dal Mas**
Adjointe du directeur de section	**Mme S. Dal Mas**
Secrétariat Bachelor	**Mme M. Emery**
Secrétariat Master	**Mme N. Dahmouni Martin**

Aux cycles bachelor et master, selon les besoins pédagogiques, les heures d’exercices mentionnées dans le plan d’études pourront être intégrées dans les heures de cours ; les scolarités indiquées représentent les nombres moyens d’heures de cours et d’exercices hebdomadaires sur le semestre.

2015-2016 **SYSTÈMES DE COMMUNICATION** **Cycle Propédeutique**

Cursus commun IN-SC

Code	Matières	Type de branches	Enseignants sous réserve de modification	Sections	Semestres BA1 c	BA1 e	BA1 p	BA2 c	BA2 e	BA2 p	Coeff.	Période des épreuves	Type examen
	Bloc 1 :										**34**		
MATH-101e	Analyse I (en français) ou		Lachowska	MA									
MATH-101d	Analyse I (en allemand) ou	Polytechnique	Kressner/Krumscheid	MA	**4**	**2**					6	H	écrit
MATH-101e	Analyse I (en anglais)		Hausel	MA									
MATH-106e	Analyse II (en français) ou		Lachowska	MA									
MATH-106d	Analyse II (en allemand) ou	Polytechnique	Shokrollahi	MA				**4**	**2**		6	E	écrit
MATH-101e	Analyse II (en anglais)		Hesthaven	MA									
MATH-111e	Algèbre linéaire (en français) ou		Jetchev	MA									
MATH-111d	Algèbre linéaire (en allemand) ou (pas donné en 15-16)	Polytechnique	Eisenbrand	MA	**4**	**2**					6	H	écrit
MATH-111e	Algèbre linéaire (en anglais)		Pach	MA									
CS-150	Discrete structures	Spécifique	Shokrollahi	IN	**4**	**2**					6	H	écrit
PHYS-101g	Physique générale I (en français) ou		Fuerbringer	PH									
PHYS-101d	Physique générale I (en allemand) ou	Polytechnique	Gruetter	PH	**3**	**2**					5	H	écrit
PHYS-101en	Physique générale I (en anglais)		Manley	PH									
COM-101	Information sciences	Spécifique	Rimoldi	SC				**3**	**2**		5	E	écrit
	Bloc 2 :										**27**		
CS-173	Conception de systèmes numériques	Spécifique	Sanchez	IN				**4**		**2**	6	sem P	
HUM-1nn	Enjeux mondiaux	Polytechnique	Divers enseignants	CDH				**2**		**2**	4	sem P	
CS-110e	Information, computation, communication	Polytechnique	Lenstra	SC	**2**	**1**					3	sem A	
CS-107	Introduction à la programmation	Polytechnique	Sam	IN	**2**	**3**					5	sem A	
CS-108	Pratique de la programmation orientée-objet	Spécifique	Schinz	IN				**2**	**2**	**6**	9	sem P	
	Totaux :				**19**	**12**	**0**	**15**	**6**	**10**	**61**		
	Totaux par semaine :					**31**			**31**				

2015-201 SYSTÈMES DE COMMUNICATION **Cycle Bachelor**

Code	Matières	Enseignants sous réserve de modification	Sections	Filières	BA3 c	BA3 e	BA3 p	BA4 c	BA4 e	BA4 p	BA5 c	BA5 e	BA5 p	BA6 c	BA6 e	BA6 p	Crédits 2e	Crédits 3e	Période des épreuves	Type examen
	Bloc A																**11**			
COM-208	Computer networks	Argyraki/Dobrescu/Ford	SC/IN	1	2	2											5		sem A	
MATH-232	Probability and statistics	Davison	MA	1				4	2								6		E	écrit
	Bloc B																**17**			
CS-250	Algorithms	Svensson	IN	2	4	2											6		H	écrit
CS-208	Architecture des ordinateurs	Ienne	IN		2		2										4		sem A	
CS-207	Programmation orientée système	Chappelier	IN					1	2								3		sem P	
CS-251	Theory of computation	Vishnoi	IN	2				2	2								4		sem P	
	Bloc C																**19**			
MATH-203	Analyse III	Nguyen H-M	MA		2	2											4		H	écrit
MATH-207	Analyse IV	Nguyen H-M	MA	3				2	2								4		E	écrit
EE-204	Circuits et systèmes I	Rachidi	EL	3	2	1											3		H	écrit
EE-205	Circuits and systems II	Gastpar	SC	3				2	1								4		E	écrit
PHYS-114	General physics II	Dil	PH		2	2											4		H	écrit
	Bloc D																	**18**		
COM-300	Modèles stochastiques pour les communications	Thiran	SC	1							4	2						6	H	écrit
COM-302	Principles of digital communications	Urbanke	SC	1										4	2			6	E	écrit
COM-303	Signal processing for communications	Prandoni	SC	3										4	2			6	E	écrit
	Bloc E																	**7**		
MATH-310	Algèbre	Chabloz	MA	2							2	1						3	H	écrit
COM-301	Sécurité des réseaux	Oechslin	SC	2							2	1						4	H	écrit
	Groupe "projet"																	**8**		
COM-307	Projet en Systèmes de Communication I	Divers enseignants									←			2		→		8	sem A ou P	
	Groupe options				←					**32**						→	**9**	**23**		
CS-209	Architecture des Systems-on-Chip	Ienne	IN	4				2		2							4		sem P	
CS-308	Calcul quantique	Macris	SC											3	1			4	E	écrit
CH-nnn	Chimie générale avancée (cours selon disponibilité horaire)	Divers enseignants	CGC	7							3	2						6	H	écrit
CS-320	Computer Language Processing	Kuncak	IN	5							2	2	2					6	sem A	
EE-200	Électromagnétisme I : lignes et ondes	Mosig/Mattes	EL								2	1						3	H	écrit
EE-201	Électromagnétisme II : calcul des champs	Mosig/Mattes	EL											2	1			3	E	écrit
EE-202b	Electronique I	Zysman	SC		2	1											4		sem A	
EE-203b	Électronique II	Zysman	SC								2	2						4	sem A	
EE-381	Electronique III	Zysman	SC											2	1			3	sem P	
CS-210	Functional programming	Kuncak/Odersky	IN	5	2	2											5		sem A	
CS-321	Informatique du temps réel	Decotignie	SC								3		1					4	H	écrit
CS-330	Intelligence artificielle	Faltings	IN											2		2		4	sem P	
COM-308	Internet analytics (pas donné en 15-16)	Grossglauser	SC											2	1	2		5	E	écrit
CS-211	Introduction à l'informatique visuelle	Dillenbourg	IN	6				2		2							4		E	écrit
BIO-107	Introduction aux sciences du vivant (pour IC)	Zufferey R.	SV	7										4	2			6	E	écrit
CS-341	Introduction to computer graphics	Pauly	IN	6										2	1	2		6	E	écrit
CS-310	Introduction to computer vision	Süsstrunk	SC	6							2	2						4	H	écrit
CS-322	Introduction to database systems	Ailamaki	IN	5										2	1	1		4	E	écrit
CS-307	Introduction to multiprocessor achitecture	Falsafi	IN	4							2		1					3	semA	
CS-323	Operating systems	Zwaenepoel	IN	5										2	2			4	sem P	
CS-206	Parallelism and concurrency	Kuncak/Odersky	IN	5				1	1	2							4		sem P	
CS-309	Projet de Systems-on-Chip	Beuchat	IN	4										1		2		3	sem P	
CS-207a	Projet programmation système	Bugnion/Chappelier	IN	5						2							2		sem P	
CS-212	Reactive programming (pas donné en 15-16)	Kuncak/Odersky	IN	5				1	1								2		sem P	
MGT-365	Ressources humaines dans les projets	Monnin	SC								2							2	sem A	
CS-305	Software engineering	Larus	IN	5							2		3					6	sem A	
CS-352	Theoretical computer science (pas donné en 15-16)	vacat	IN								2	1						4	sem A	
COM-309	Traitement quantique de l'information	Macris	SC								3	1						4	H	écrit
	Bloc D "SHS transversal" :																**8**			
HUM-nnn	SHS : Cours à choix I selon Plan d'études SHS	Divers enseignants	SHS		2												2		sem A	
HUM-nnn	SHS : Cours à choix II selon Plan d'études SHS	Divers enseignants	SHS					2									2		sem P	
HUM-nnn	SHS : Cours à choix III selon Plan d'études SHS	Divers enseignants	SHS								2							2	sem A	
HUM-nnn	SHS : Cours à choix IV selon Plan d'études SHS	Divers enseignants	SHS											2				2	sem P	
	Totaux:																**60**	**60**		

Filières obligatoires :
- Networks and Communications (1)
- Security, Cryptography, and Privacy (2)
- Signal and Image Processing (3)

Filières optionnelles :
- Computer Engineering (4)
- Software Construction (5)
- Visual Computing (6)
- Biocomputing (7)

2015-2016 **SYSTÈMES DE COMMUNICATION** **Cycle Bachelor**

Code	Matières	Enseignants sous réserve de modification	Sections	Crédits 2e	Crédits 3e	Période des cours
Obligatoire	**Filière 1 "Networks and Communications"**			**23**		
COM-208	Computer networks*	Argyraki/Dobrescu/Ford	SC/IN	5		A
COM-300	Modèles stochastiques pour les communications*	Thiran	SC		6	A
COM-302	Principles of digital communications*	Urbanke	SC		6	P
COM-308	Probability and statistics*	Davison	MA	6		P
Obligatoire	**Filière 2 "Security, Cryptography, and Privacy"**			**17**		
CS-250	Algorithms*	Svensson	IN	6		A
MATH-310	Algèbre*	Chabloz	MA		3	A
COM-301	Sécurité des réseaux*	Oechslin	SC		4	A
CS-251	Theory of computation*	Vishnoi	IN	4		P
Obligatoire	**Filière 3 "Signal and Image Processing"**			**17**		
MATH-207b	Analyse IV*	Nguyên H.-M.	MA	4		P
EE-204	Cricuits et systèmes I*	Rachidi	EL	3		A
EE-205	Circuits and systems II*	Gastpar	SC	4		P
CM-303	Signal processing for communications*	Prandoni	SC		6	P
Optionnel	***Filière 4: "Computer Engineering"***			**7 / *10***		
CS-209	Architecture des Systems-on-Chip*	Ienne	IN	4		p
CS-307	Introduction to multiprocessor architecture*	Falsafi	IN		3	A
CS-309	*Projet de Systems-on-Chip*	*Beuchat*	*IN*		3	P
Optionnel	***Filière 5 "Software Construction"***			**23 / *27***		
CS-210	Functional programming*	Kuncak/Odersky	IN	5		A
CS-322	Introduction to database systems*	Ailamaki	IN		4	P
CS-323	Operating systems*	Zwaenepoel	IN		4	P
CS-206	Parallelism and concurrency*	Kuncak/Odersky	IN	4		P
CS-207a	*Projet programmation système*	*Bugnion/Chappelier*	*IN*	2		P
CS-212	*Reactive programming* (pas donné en 15-16)	*Kuncak/Odersky*	*IN*	2		P
CS-305	Software engineering*	Larus	IN		6	A
Optionnel	***Filière 6 "Visual Computing"***			**14**		
CS-211	Introduction à l'informatique visuelle*	Dillenbourg	IN	4		P
CS-341	Introduction to computer graphics*	Pauly	IN		6	P
CS-310	Introduction to computer vision*	Süsstrunk	SC		4	A
Optionnel	***Filière 7 "Biocomputing"***			**12**		
CH-nnnn	Chimie générale avancée (cours selon disponibilité horaire)*	Divers enseignants	CGC		6	A
BIO-107	Introduction aux sciences du vivant (pour IC)	Zufferey R.	SV		6	P

* cours obligatoire dans la filière
en italique : cours optionnel dans la filière

2015-2016 SYSTÈMES DE COMMUNICATION — Cycle Master

Code	Matières	Enseignants sous réserve de modification	Sections	Spécialisations	Semestres MA1 c	MA1 e	MA1 p	MA2 c	MA2 e	MA2 p	Crédits	Période des épreuves	Type examen
	Groupe "Core courses et options"										**72**		
	Groupe 1 "Core courses"										**min. 30**		
COM-510	Advanced digital communications	Gastpar	SC	A	**4**	**2**					7	H	écrit
COM-401	Cryptography and security	Vaudenay	SC	C E G	**4**	**2**					7	H	écrit
CS-451	Distributed algorithms	Guerraoui	SC	E	**2**	**1**					4	H	écrit
CS-423	Distributed information systems	Aberer	SC	C E				**2**	**1**		4	E	écrit
COM-404	Information theory and coding	Telatar	SC	A	**4**	**2**					7	H	écrit
COM-405	Mobile networks	Hubaux	SC	A C E G				**2**	**1**		4	E	écrit
CS-433	Pattern classification and machine learning	Khan E	IN	B	**4**	**2**					7	H	écrit
COM-500	Statistical signal and data processing through applications	Ridolfi	SC	A B				**2**	**2**		5	E	écrit
COM-407	TCP/IP networking	Le Boudec	SC	C G	**2**	**2**					5	H	écrit
	Groupe 2 "Options"	**(la somme des crédits des groupes 1 et 2 doit être de 72 crédits au minimum)**											
---	Cours à option	Divers enseignants	Divers										
	Bloc "Projets et SHS" :										**18**		
COM-416	Projet en systèmes de communication II	divers enseignants	SC		◄		**2**			►	12	sem A ou P	
HUM-nnn	SHS : introduction au projet	divers enseignants	SHS		**2**		**1**				3	sem A	
HUM-nnn	SHS : projet	divers enseignants	SHS							**3**	3	sem P	
	Total des crédits du cycle master										**90**		

Spécialisations :
A : Wireless Communications
B : Signals, Images, and Interfaces
C : Networking and Mobility
E : Internet Computing
G : Information Security

Stage d'ingénieur :
Stage obligatoire pour les étudiants commençant le master à partir de l'automne 2010
Voir les modalités dans le règlement d'application

Mineurs :
Le cursus peut être complété par un des mineurs figurant dans l'offre de l'EPFL (renseignements à la page sac.epfl.ch/mineurs),
à l'exclusion des mineurs "Information security" et "Systèmes de communication" qui ne peuvent pas être choisi.
Parmi les mineurs offerts par l'EPFL, la section recommande à ses étudiants les mineurs suivants :
- Biocomputing (SIN)
- Études asiatiques contemporaines (CDH)
- Management de la technologie et entrepreneuriat (SMTE)
- Technologies biomédicales (SMT)
- Technologies spatiales (SEL)
Le choix des cours de tous les mineurs se fait sur conseil de la section de l'étudiant et du responsable du mineur.

2015-201 SYSTÈMES DE COMMUNICATION - Options

Cycle Master

Code	Matières	Enseignants sous réserve de modification	Sections	Spécialisations	Semestres						Crédits	Période des épreuves	Type examen	Cours biennaux donnés en
					MA1			MA2						
					c	e	p	c	e	p				
CS-450	Advanced algorithms	Moret B.	IN	C E G				4	2	1	7	sem P		
MATH-40	Advanced analysis I	Ruppen	MA		2	2					4	H	oral	
MATH-401	Advanced analysis II	Ruppen	MA					2	2		4	E	oral	
CS-470	Advanced computer architecture	Ienne	IN	G				2		2	4	E	oral	
CS-440	Advanced computer graphics	Pauly	IN	B	2	1					4	sem A		
COM-501	Advanced cryptography	Vaudenay	SC	G				2	2		4	E	écrit	
CS-471	Advanced multiprocessor architecture	Falsafi	IN		4						6	sem A		2015-2016
COM-417	Advanced probability and applications	Lévêque	SC	A	3	2					6	H	écrit	
CS-435	Analytic Methods in Algorithms and Complexity	Vishnoi	IN		2	1					4	sem A		
COM-415	Audio signal processing and virtual acoustics	Faller/Kolundzija/Schröder	SC	B	2	2					4	H	écrit	
EE-592	Automatic speech processing	Bourlard	EL	B	2	1					3	H	écrit	
BIO-465	Biological modeling of neural networks	Gerstner	IN					2	2		4	E	écrit	
EE-554	Biomedical signal processing	Vesin	EL	B	4		2				6	H	écrit	
EE-591	Biometrics	Drygajlo	EL	G	2	1					4	H	oral	
CS-490	Business Design for IT services	Wegmann	SC					3			3	E	oral	
BIO-105	Cellular biology and biochemistry for engineers	Hirling	SV		2	2					4	H	écrit	
CS-441	Color reproduction	Hersch	IN	B				2		2	4	E	oral	
CS-551	Computational molecular biology	Moret	IN					3	2		5	sem P		2015-2016
CS-413	Computational Photography	Süsstrunk	SC	B				2		2	5	E	oral	
CS-442	Computer vision	Fua	IN	B				2	1		4	E	écrit	
CS-453	Concurrent algorithms	Guerraoui	SC	C	2	1					4	H	écrit	
CS-454	Convex optimization and applications	Lebret	MTE	A				1	2		4	sem P		
CS-422	Database systems	Koch	IN	E				3	2	2	7	sem P		
CS-472	Design technologies for integrated systems	De Micheli	IN		3		2				6	sem A		
CS-446	Digital 3D Geometry Processing (pas donné en 2015-2016)	Pauly	IN	B				2	1	1	5	E	oral	
CS-411	Digital Education & Learning Analytics	Dillenbourg/Jermann	IN		2		2				4	H	oral	
CS-412	Discrete Computational Geometry (pas donné en 2015-2016)	Moret B.	IN					2		2	4	sem P		2016-2017
ENG-466a	Distributed intelligent systems	Martinoli	SIE		2	2	1				5	H	oral	
COM-502	Dynamical system theory for engineers	Thiran P.	SC		2	1					4	H	écrit	
CS-473	Embedded systems	Beuchat	IN		2		2				4	H	oral	
CS-491	Enterprise and service-oriented architecture	Wegmann	SC	E				6			6	E	oral	
MATH-48	Gödel and recursivity (pas donné en 2015-2016)	Duparc	HEC/UNIL		2	2					5	E	écrit	2016-2017
CS-486	Human-computer interaction	Pu	IN	E				2	1	1	4	sem P		
EE-550	Image and video processing	Ebrahimi	EL	B	4		2				6	H	oral	
EE-551	Image communication	Frossard	EL					2		2	4	sem P		
MICRO-51	Image processing I	Van De Ville	MT	B	3						3	H	écrit	
MICRO-51	Image processing II	Unser/Van De Ville	MT	B				3			3	E	écrit	
CS-487	Industrial automation	Pignolet/Tournier	SC					2		1	3	E	oral	
CS-430	Intelligent agents	Faltings	IN	E	3	3					6	sem A		
CS-431	Introduction to natural language processing	Chappelier/Rajman	IN	E				2	2		4	E	écrit	
COM-514	Mathematical Foundations of Signal Processing	Bejar/Kolundzija/Parhizkar/ Vetterli	SC	B	3	2					6	H	écrit	
EE-552	Media security	Ebrahimi	EL	G				2	1		6	E	écrit	
CS-474	Microelectronics for systems on chips	Beuchat/Piguet	IN		2		2				4	H	oral	
EE-445	Microwaves	Skrivervik	EL	A	2	2					4	sem A		
CS-478	Model-based system design	Sifakis	IN					2	2		4	sem P		
COM-512	Networks out of control	Thiran P./Celis	SC	A C E				2	1		4	E	écrit	2015-2016
COM-507	Optional project in Communication Systems	Divers enseignants	SC				2				8	sem A ou P		
COM-503	Performance evaluation (pas donné en 2015-2016)	Le Boudec	SC	C E				3	1	2	7	E	oral	2016-2017
CS-489	Personal interaction studio	Huang	IN	B				2		4	6	sem P		
CS-522	Principles of computer systems	Bugnion/Koch/Argyraki/Ford	SC/IN		2	2	2				7	sem A		
COM-516	Random walks	Lévêque/Macris	SC					2	2		4	E	écrit	
CS476	Real-time embedded systems	Beuchat	IN					2		2	4	sem P		
COM-413	Real-time networks	Decotignie	SC	C				2			3	E	oral	
COM-414	Satellite communications systems and networks	Farserotu	SC	A C	2	1					3	H	écrit	
EE-532	Sensors in medical instrumentation	Aminian	EL	B				2	1		3	E	écrit	
MATH-31	Set theory	Duparc	HEC/UNIL					2	2		5	E	écrit	2015-2016
EE-472	Smart Grid Technologies	Le Boudec/Paolone	SC/EL					2	1	2	5	E	écrit	
EE-593	Social Media	Gillet	EL	E				1		1	2	sem P		
COM-511	Software-defined radio: A hands-on course	Rimoldi	SC	A B C	2	1					5	sem A		
COM-421	Statistical Neuroscience (pas donné en 2015-2016)	Gastpar	SC					2	2		4	E	écrit	
COM-506	Student seminar : Security protocols and applications	Oechslin/Vaudenay	SC	G				2			3	E	écrit	
CS-550	Synthesis, analysis and verification (pas donné en 2015-2016)	Kuncak	IN					2	2	2	6	sem P		2016-2017
CS-410	Technology Ventures in IC	Bugnion	IN					2		2	4	sem P		
CS-455	Topics in Theoretical Computer Science	Svensson	IN					3	1		4	sem P		
CS-434	Unsupervised and reinforcement learning in Neural Networks	Gewaltig	SV		2	2					4	H	oral	
CS-444	Virtual reality	Boulic	IN	B				2	1		4	sem P		

2015-2016 **SYSTÈMES DE COMMUNICATION - Spécialisations**

Les enseignants, les crédits et la période des cours sont indiqués sous réserve de modification.

Code	Matières	Enseignants	Sections	Crédits	Période des cours	
	Spécialisation A. "WIRELESS COMMUNICATIONS"	**Responsable : Prof. E. Telatar**		**51**		
COM-510	Advanced digital communications	Gastpar	SC	7	A	
COM-417	Advanced probability and applications	Lévêque	SC	6	A	
CS-454	Convex optimization and applications	Lebret	MTE	4		P
COM-404	Information theory and coding	Telatar	SC	7	A	
EE-445	Microwaves	Skrivervik	EL	3	A	
COM-405	Mobile networks	Hubaux	SC	4		P
COM-512	Networks out of control	Thiran P./Celis	SC	4		P
EE-345 *	Rayonnement et antennes	Mosig/Skrivervik	EL	3	A	
COM-414	Satellite communications systems and networks	Farserotu	SC	3	A	
COM-511	Software-defined radio : A hands-on course	Rimoldi	SC	5	A	
COM-500	Statistical signal and data processing through applications	Ridolfi	SC	5		P
	Spécialisation B. "SIGNALS, IMAGES, AND INTERFACES"	**Responsables : Prof. R. Hersch et Prof. M. Vetterli**		**89**		
CS-440	Advanced computer graphics	Pauly	IN	4	A	
COM-415	Audio signal processing and virtual acoustics	Faller/Schröder/Kolundzija	SC	4	A	
EE-554	Automatic speech processing	Bourlard	EL	3	A	
EE-512	Biomedical signal procesing	Vesin	EL	6	A	
CS-441	Color reproduction	Hersch	IN	4		P
CS-413	Computational Photography	Süsstrunk	SC	5		P
CS-442	Computer vision	Fua	IN	4		P
CS-446	Digital 3D Geometry Processing (pas donné en 2015-2016)	Pauly	IN	5		P
EE-550	Image and video processing	Ebrahimi	EL	6	A	
MICRO-511	Image processing I	Van De Ville	MT	3	A	
MICRO-512	Image processing II	Unser/Van De Ville	MT	3		P
CS-341	Introduction to computer graphics	Pauly	IN	6		P
COM-514	Mathematical Foundations of Signal Processing	Kolundzija/Vetterli/Bejar/Parhizkar	SC	6	A	
CS-433	Pattern classification an machine learning	Khan	IN	7	A	
CS-489	Personal interaction studio	Huang	IN	6		P
EE-511	Sensors in medical instrumentation	Aminian	EL	3		P
COM-511	Software-defined radio: A hands-on course	Rimoldi	SC	5	A	
COM-500	Statistical signal and data processing through applications	Ridolfi	SC	5		P
CS-444	Virtual reality	Boulic	IN	4		P
	Spécialisation C. "NETWORKING AND MOBILITY"	**Responsable : Prof. J.-Y. Le Boudec**		**46**		
CS.450	Advanced algorithms	Moret B.	IN	7		P
CS.453	Concurrent algorithms	Guerraoui	SC	4	A	
COM-401	Cryptography and security	Vaudenay	SC	7	A	
CS-423	Distributed information systems	Aberer	SC	4		P
COM-405	Mobile networks	Hubaux	SC	4		P
COM-512	Networks out of control	Thiran P./Celis	SC	4		P
COM-503	Performance evaluation (pas donné en 2015-2016)	Le Boudec	SC	7		P
COM-413	Real-time networks	Decotignie	SC	3		P
COM-414	Satellite communications systems and networks	Farserotu	SC	3	A	
COM-511	Software-defined radio: A hands-on course	Rimoldi	SC	5	A	
COM-407	TCP/IP networking	Le Boudec	SC	5	A	

Légende :

* = cours hors plan d'études pour les étudiants ne faisant pas la spécialisation

A = automne, P = printemps - 1 semestre comprend 14 semaines

2015-2016 SYSTÈMES DE COMMUNICATION - Spécialisations

Les enseignants, les crédits et la période des cours sont indiqués sous réserve de modification.

Code	Matières	Enseignants	Sections	Crédits	Période des cours	
	Spécialisation E - "INTERNET COMPUTING"	**Responsables : Prof. K. Aberer et Prof. B. Faltings**		**67**		
CS-450	Advanced algorithms	Moret B.	IN	7		P
COM-401	Cryptography and security	Vaudenay	SC	7	A	
CS-422	Database systems	Koch	IN	7		P
CS-451	Distributed algorithms	Guerraoui	SC	4	A	
CS-423	Distributed information systems	Aberer	SC	4		P
*	E-Business	Pigneur	HEC	6	A	
*	Emerging distributed architectures	Garbinato	HEC	6		P
CS-491	Enterprise and service-oriented architecture	Wegmann	SC	6		P
CS-486	Human-computer interaction	Pu	IN	4		P
CS-430	Intelligent agents	Faltings	IN	6	A	
CS-431	Introduction to natural language processing	Chappelier/Rajman	IN	4		P
COM-405	Mobile networks	Hubaux	SC	4		P
COM-512	Networks out of control	Thiran P./Celis	SC	4		P
COM-503	Performance evaluation (pas donné en 2015-2016)	Le Boudec	SC	7		P
EE-593	Social Media	Gillet	EL	2		P
	Spécialisation G - "INFORMATION SECURITY"	**Responsable : Prof. A. Lenstra**		**52**		
CS-450	Advanced algorithms	Moret B.	IN	7		P
CS-470	Advanced computer architecture	Ienne	IN	4		P
COM-501	Advanced cryptography	Vaudenay	SC	4		P
EE-431 *	Advanced VLSI design	Leblebici/Burg	EL	4		P
EE-513	Biometrics	Drygajlo	EL	4	A	
COM-401	Cryptography and security	Vaudenay	SC	7	A	
EE-429 *	Fundamentals of VLSI Design	Leblebici/Burg	EL	4	A	
EE-552	Media security	Ebrahimi	EL	6		P
COM-405	Mobile networks	Hubaux	SC	4		P
COM-506	Student seminar : security protocols and applications	Oechslin/Vaudenay	SC	3		P
COM-407	TCP/IP Networking	Le Boudec	SC	5	A	

Légende :

* = cours hors plan d'études pour les étudiants ne faisant pas la spécialisation

A = automne, P = printemps - 1 semestre comprend 14 semaines

2015-2016

Information security
Mineur disciplinaire

Section de Systèmes de communication
Responsable : Prof. A. Lenstra

Les enseignants, les crédits et la période des cours sont indiqués sous réserve de modification. **#REF!** **crédits offerts**
Les cours déjà suivis au bachelor ou au master ne peuvent pas être pris également dans un mineur.

Codes	Matières (liste indicative)	Enseignants	Livret des cours	Crédits	Période des cours	
CS-450	Advanced algorithms	Moret B.	IN	7		P
CS-470	Advanced computer architecture	Ienne	IN	4		P
COM-501	Advanced cryptography*	Vaudenay	SC	4		P
EE-431	Advanced VLSI design	Leblebici/Burg	EL	2		P
MATH-310	Algèbre	Chabloz	MA	3	A	
CS-250	Algorithms	Svensson	IN	6	A	
EE-513	Biometrics*	Drygajlo	EL	4	A	
COM-208	Computer networks	Argyraki/Dobrescu/Ford	SC/IN	5	A	
COM-401	Cryptography and security*	Vaudenay	SC	7	A	
CS-150	Discrete structures	Shokrollahi	IN	6	A	
EE-429	Fundamentals of VLSI design	Leblebici/Burg	EL	2	A	
EE-552	Media security*	Ebrahimi	EL	6		P
COM-405	Mobile networks*	Hubaux	SC	4		P
COM-301	Sécurité des réseaux	Oechslin	SC	4	A	
COM-506	Student seminar : security protocols and applications*	Oechslin/Vaudenay	SC	3		P
COM-407	TCP/IP Networking	Le Boudec	SC	5	A	

Crédits obligatoires
*pour le Mineur en Information Security, au moins 17 crédits parmi ces cours doivent obligatoirement être acquis.
** For the Minor in Information Security it will be mandatory to accumulate at least 17 credits from these courses.*

Légende :
A = automne, P = printemps

2015-2016 **Systèmes de Communication** **Section de Systèmes de communication**

Mineur disciplinaire **Responsable : Mme S. Dal Mas**

Les enseignants, les crédits et la période des cours sont indiqués sous réserve de modification. **100** **crédits offerts**

Les cours déjà suivis au bachelor ou au master ne peuvent pas être pris également dans un mineur.

Codes	Matières (liste indicative)	Enseignants	Livret des cours	Crédits	Période des cours	
EE-204	Circuits et systèmes I	Rachidi	EL	3	A	
EE-205	Circuits and systems II	Gastpar	SC	4		P
COM-208	Computer networks	Argyraki/Dobrescu/Ford	SC/IN	5	A	
COM-300	Modèles stochastiques pour les communications	Thiran	SC	6	A	
COM-302	Principles of digital communications	Urbanke	SC	6		P
COM-301	Sécurité des réseaux	Oechslin	SC	4	A	
COM-303	Signal processing for communications	Prandoni	SC	6		P
CS-341	Introduction to computer graphics	Pauly	IN	6		P
COM-308	Internet analytics (pas donné en 15-16)	Grossglauser	SC	5		P
CS-321	Informatique du temps réel	Decotignie	SC	4	A	
EE-290	Electronique I	Zysman	SC	4	A	
EE-203b	Electronique II	Zysman	SC	4	A	
COM-507	Optional project in Communication Systems*	divers	SC	8	A ou P	
COM-510	Advanced digital communications *	Gastpar	SC	7	A	
COM-401	Cryptography and security *	Vaudenay	SC	7	A	
COM-404	Information theory and coding	Telatar	SC	7	A	
COM-405	Mobile networks	Hubaux	SC	4		P
COM-500	Statistical signal and data processing through applications *	Ridolfi	SC	5		P
COM-407	TCP/IP networking	Le Boudec	SC	5	A	

* pour étudiants titulaires d'un Bachelor en Systèmes de communication et Informatique

Légende :

A = automne, P = printemps

1 semestre comprend 14 semaines.

RÈGLEMENT D'APPLICATION DU CONTRÔLE DES ÉTUDES DE LA SECTION DE SYSTÈMES DE COMMUNICATION
pour l'année académique 2015-2016
du 18 mai 2015

La direction de l'École polytechnique fédérale de Lausanne

vu l'ordonnance sur la formation menant au bachelor et au master de l'EPFL du 14 juin 2004,
vu l'ordonnance sur le contrôle des études menant au bachelor et au master à l'EPFL du 14 juin 2004,
vu le plan d'études de la section de systèmes de communication

arrête:

Article premier - Champ d'application

Le présent règlement fixe les règles d'application du contrôle des études de bachelor et de master de la section de systèmes de communication qui se rapportent à l'année académique 2015-2016.

Art. 2 – Étapes de formation

1. Le bachelor est composé de deux étapes successives de formation :
- le cycle propédeutique d'une année dont la réussite se traduit par 60 crédits ECTS acquis en une fois, condition pour entrer au cycle bachelor. Le cycle propédeutique est commun avec celui de la section informatique.
- le cycle bachelor s'étendant sur deux ans dont la réussite implique l'acquisition de 120 crédits, condition pour entrer au master.

2. Le master effectué à l'EPFL est composé de deux étapes successives de formation :
- le cycle master d'une durée de 3 semestres dont la réussite implique l'acquisition de 90 crédits, condition pour effectuer le projet de master.
- le projet de master, d'une durée de 17 semaines à l'EPFL ou de 25 semaines hors EPFL (industrie ou autre haute école) et dont la réussite se traduit par l'acquisition de 30 crédits. Il est placé sous la responsabilité d'un professeur ou MER affilié à la section de systèmes de communication..

Art 3 – Sessions d'examen

1. Les branches d'examen sont examinées par écrit ou par oral pendant les sessions d'hiver ou d'été. Elles sont mentionnées dans le plan d'études avec la mention H ou E.

2. Les branches de semestre sont examinées pendant le semestre d'automne ou le semestre de printemps. Elles sont mentionnées dans le plan d'études avec la mention sem A ou sem P.

3. Une branche annuelle, c'est à dire dont l'intitulé tient sur une seule ligne dans le plan d'étude, est examinée globalement pendant la session d'été (E).

4 Pour les branches de session, la forme écrite ou orale de l'examen indiquée pour la session peut être complétée par des contrôles de connaissances écrits ou oraux durant le semestre, selon indications de l'enseignant.

Chapitre 1 : Cycle propédeutique

Art. 4 - Examen propédeutique

1 L'examen propédeutique comprend des branches « Polytechniques » pour 35 coefficients et des branches « Spécifiques » pour 26 coefficients, distribuées indifféremment sur deux blocs.

2 Le premier bloc de branches correspond à 34 coefficients et le second bloc de branches correspond à 27

Chapitre 2 : Cycle bachelor

Art. 5 - Organisation

1 Les enseignements du bachelor sont répartis en cinq blocs, le groupe « projet », le groupe « options » et le bloc transversal SHS.

2 Le groupe « options » se compose de toutes les branches à option figurant dans la liste du plan d'études de 2ème année et 3ème année. 32 crédits doivent être obtenus individuellement dans le groupe « options », dont 9 crédits dans les options de 2ème année. Les crédits pris en supplément des 9 crédits exigés de 2ème année peuvent être validés comme crédits à options de 3ème année.

3 En 3ème année, des cours comptant pour un maximum de 10 crédits au total peuvent être choisis en dehors de la liste du plan d'études. Les cours pris en dehors de cette liste doivent être acceptés préalablement par le directeur de la section.

Art. 6 – Filières

1 Les filières obligatoires sont acquises automatiquement par la réussite des blocs A, B C, D et E.

2 Les étudiants doivent réussir au minimum une filière optionnelle parmi les quatre proposées

3 Une filière est réussie lorsque tous les crédits des cours obligatoires de la filière sont obtenus individuellement.

Art. 7 - Examen de 2ème année

1 Les **11 crédits** du plan d'études sont obtenus lorsque le bloc A est réussi.

2 Les **17 crédits** du plan d'études sont obtenus lorsque le bloc B est réussi.

3 Les **19 crédits** du plan d'études sont obtenus lorsque le bloc C est réussi.

4 Les **9 crédits de 2ème année** du groupe « options » s'acquièrent de façon indépendante, par réussite individuelle de chaque branche.

Art. 8 - Examen de 3e année

1 Les **18 crédits** du plan d'études sont obtenus lorsque le bloc D est réussi.

2 Les **7 crédits** du plan d'études sont obtenus lorsque le bloc E est réussi.

3 Les **8 crédits** du groupe « projet » s'acquièrent de façon indépendante, par réussite individuelle du projet.

4 Les **23 crédits de 3ème année** du groupe « options » s'acquièrent de façon indépendante, par réussite individuelle de chaque branche.

Art. 9 - Examen de 2e et 3e années

Le bloc « SHS transversal » est réussi lorsque les **8 crédits** du plan d'études sont obtenus.

Chapitre 3 : Cycle master

Art. 10 - Organisation

1. Les enseignements du cycle master sont répartis en deux groupes et un bloc dont les crédits doivent être obtenus de façon indépendante. Ils peuvent donner lieu à l'obtention d'une spécialisation ou d'un mineur.

2. Le bloc « Projets et SHS » est composé d'un projet de 12 crédits et de l'enseignement SHS.

3. Le groupe 1 « Core courses » est composé des cours de la liste du plan d'études dans la rubrique « Master ».

4. Le groupe 2 « Options » est composé
   - des cours de la liste du groupe 2 « options » du plan d'études dans la rubrique « Master » ;
   - des crédits surnuméraires obtenus dans le groupe 1 « Core courses » ;
   - d'un projet optionnel de 8 crédits suivant l'alinéa 5 ;
   - de cours hors plan d'études suivant l'alinéa 6 ;
   - de cours liés à une spécialisation ou un mineur suivant l'art. 13.

5. Le projet du bloc « Projets et SHS » et le projet optionnel du groupe 2 ne peuvent être effectués dans le même semestre.

6. Des cours, comptant pour un maximum de 15 crédits au total, peuvent être choisis en dehors de la liste des cours du plan d'études dans la rubrique « Master ». Le choix de ces cours doit être accepté préalablement par le directeur de la section qui peut augmenter le maximum de 15 crédits si la demande est justifiée.

Art. 11 - Examen du cycle master

1. Le bloc « Projets et SHS » est réussi lorsque **18 crédits** sont obtenus.

2. Le groupe « Core courses et Options », composé du groupe 1 « Core courses » et du groupe 2 « Options » est réussi lorsque **72 crédits** sont obtenus.

3. Le groupe 1 « Core courses » est réussi lorsqu'**au moins 30 crédits** sont obtenus.

Art. 12 - Enseignement SHS

1. La formation SHS au cycle master commence uniquement en automne. Le semestre d'automne est un enseignement présentiel qui prépare à la réalisation du projet au second semestre. La branche SHS donne lieu à 3 crédits par semestre.

2. Lorsque, pour un motif important et dument justifié, l'étudiant est dans l'impossibilité de réaliser son projet immédiatement après le premier semestre, il peut être autorisé à le délivrer durant l'un des semestres de l'année académique suivante.

3. Toute dérogation à ces principes doit être dûment documentée et sollicitée par écrit auprès de la direction du Collège des Humanités.

Art. 13 – Mineurs et spécialisations

1. Afin d'approfondir un aspect particulier de sa formation ou de développer des interfaces avec d'autres sections, l'étudiant peut choisir la formation offerte dans le cadre d'un mineur figurant dans l'offre de l'EPFL ou d'une spécialisation de la section de systèmes de communication.

2. Le choix des cours qui composent un mineur se fait avec la section de systèmes de communication et avec le responsable du mineur. Les mineurs « Information security » et « Systèmes de Communication » ne peuvent pas être choisis.

3. Le choix des cours qui composent une spécialisation est soumis, pour concertation à la section de systèmes de communication.

4. L'étudiant annonce le choix d'un mineur à sa section au plus tard à la fin du premier semestre des études de master.

5. L'étudiant qui choisit une spécialisation dans la liste figurant dans le plan d'études s'inscrit au plus tard au début du troisième semestre des études de master.

6. Un mineur ou une spécialisation est réussi quand 30 crédits au minimum sont obtenus parmi les branches avalisées.

Chapitre 4 : Stage et Projet de master

Art. 14 – Stage d'ingénieur

1. Les étudiants commençant leur cycle master doivent effectuer un stage d'ingénieur durant leur master :
- soit un stage d'été de minimum 8 semaines u
- soit un stage de minimum 6 mois en entreprise (en congé durant un semestre)
- soit un Projet de Master de 25 semaines en entreprise (valide le stage et le Projet de Master)

2. Le stage peut être effectué dès le 2ème semestre du cycle master, mais avant le projet de master.

3. Le responsable du stage de la section évalue le stage, par l'appréciation « réussi » ou « non réussi ». Sa réussite sera une condition pour l'admission au projet de master. En cas de non réussite, il pourra être répété une fois, en règle générale dans une autre entreprise.

4. Il est validé avec les 30 crédits du projet de master.

5. Les modalités d'organisation et les critères de validation du stage font l'objet d'une directive interne à la section.

Chapitre 5 : Mobilité

Art. 15 – Périodes de mobilité autorisées

Les étudiants de la section des systèmes de communication peuvent effectuer un séjour de mobilité en 3ème année de bachelor et/ou dans le cadre du projet de master.

Art. 16 - Conditions

1. Pour une mobilité en 3ème année de bachelor, l'étudiant doit avoir réussi l'examen propédeutique avec une moyenne minimale de 4,5 et ne pas avoir de retard dans l'acquisition des 60 crédits de la 2ème année de bachelor.

2. Pour une mobilité au projet de master, l'étudiant doit avoir réussi le cycle master.

3. Des conditions spécifiques existant en fonction des destinations, l'accord du délégué à la mobilité est nécessaire pour partir en séjour de mobilité.

Au nom de la direction de l'EPFL

Le président, P. Aebischer
Le vice-président pour les affaires académiques, P. Gillet

Lausanne, le 18 mai 2015

ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE

SECTION DE SYSTEMES DE COMMUNICATION

Cycle

Propédeutique

(1ère année)

2015 / 2016

MATH-111(e)

Algèbre linéaire

Jetchev Dimitar Petkov

Cursus	Sem.	Type
Informatique	BA1	Obl.
Systèmes de communication	BA1	Obl.

Langue	français
Coefficient	6
Session	Hiver
Semestre	Automne
Examen	Ecrit
Charge	180h
Semaines	14
Heures	**6 hebdo**
Cours	4 hebdo
Exercices	2 hebdo

RESUME

L'objectif du cours est d'introduire les notions de base de l'algèbre linéaire et ses applications.

CONTENU

1. Systèmes linéaires;
2. Algèbre matricielle;
3. Espaces vectoriels et applications linéaires;
4. Bases et dimension;
5. Valeurs propres et vecteurs propres;
6. Produit scalaire, orthogonalité, formes quadratiques.

MOTS-CLES

espace vectoriel, linéarite, matrice, déterminant, orthogonalité, produit scalaire

COMPETENCES REQUISES

Cours prérequis indicatifs
cours de base

ACQUIS DE FORMATION

A la fin de ce cours l'étudiant doit être capable de:

- Effectuer des calculs standards en algèbre linéaire et en interprêter les résultats;
- Définir des concepts théoriques relevants de l'algèbre linéaire et en donner des exemples illustratifs;
- Identifier des exemples de concepts théoriques relevants de l'algèbre linéaire;
- Construire rigoureusement un raisonnement logique simple;
- Identifier quelques liens entre l'algèbre linéaire et d'autres branches des mathématiques.

METHODE D'ENSEIGNEMENT

Cours ex cathedra, exercices en salle

METHODE D'EVALUATION

examen écrit

ENCADREMENT

Office hours	Non
Assistants	Oui

Forum électronique Non

RESSOURCES

Bibliographie

Algèbre linéaire et applications, David C. Lay, 4e edition, editeur: Pearson, ISBN: 978-2-7440-7583-4

Ressources en bibliothèque

- Algèbre linéaire et applications / Lay

Références suggérées par la bibliothèque

PREPARATION POUR

Algèbre Linéaire II; Analyse II

MATH-111(de) **Algèbre linéaire (allemand)**

Cursus	Sem.	Type
Chimie et génie chimique	BA1	Obl.
Génie civil	BA1	Obl.
Génie mécanique	BA1	Obl.
Génie électrique et électronique	BA1	Obl.
Informatique	BA1	Obl.
Microtechnique	BA1	Obl.
Science et génie des matériaux	BA1	Obl.
Sciences et ingénierie de l'environnement	BA1	Obl.
Sciences et technologies du vivant	BA1	Obl.
Systèmes de communication	BA1	Obl.

Langue	allemand
Coefficient	6
Session	Hiver
Semestre	Automne
Examen	Ecrit
Charge	180h
Semaines	14
Heures	**6 hebdo**
Cours	4 hebdo
Exercices	2 hebdo

REMARQUE

pas donné en 2015-16

RESUME

Das Ziel des Kurses ist es, die grundlegenden Konzepte der linearen Algebra und ihre Anwendungen vorzustellen.

CONTENU

Vorlesungsinhalt:
1. Lineare Gleichungssysteme;
2. Matrizenalgebra;
3. Vektorräume und lineare Abbildungen;
4. Basen und Dimension;
5. Eigenwerte und Eigenvektoren;
6. Skalarprodukträume.

MOTS-CLES

Vektorraum, Linearität, Matrix, Determinante, Orthogonalität, Skalarprodukt

ACQUIS DE FORMATION

A la fin de ce cours l'étudiant doit être capable de:

- Effectuer Um die Klausur für diese Vorlesung zu bestehen, sollte ein Student in der Lage sein :
- Définir Grundlegende Berechnungen der Linearen Algebra auszuführen und deren Ergebnisse zu interpretieren;
- Identifier Wichtige theoretische Konzepte der Linearen Algebra zu definieren und illustrierende Beispiele hierzu anzugeben;
- Construire Beispiele für die wichtigen theoretischen Konzepte der Linearen Algebra zu identifizieren;
- Identifier Ein einfaches logisches Argument präzise auszuführen;

METHODE D'ENSEIGNEMENT

Logisches Argument präzise auszuführen;

METHODE D'EVALUATION

Schriftliche Prüfung

ENCADREMENT

Office hours	Non
Assistants	Oui
Forum électronique	Non

PREPARATION POUR

Algèbre linéaire II; Analyses II

MATH-111(en) **Algèbre linéaire (anglais)**

Pach János

Cursus	Sem.	Type
Chimie et génie chimique	BA1	Obl.
Génie civil	BA1	Obl.
Génie mécanique	BA1	Obl.
Génie électrique et électronique	BA1	Obl.
Informatique	BA1	Obl.
Microtechnique	BA1	Obl.
Science et génie des matériaux	BA1	Obl.
Sciences et ingénierie de l'environnement	BA1	Obl.
Sciences et technologies du vivant	BA1	Obl.
Systèmes de communication	BA1	Obl.

Language	English
Coefficient	6
Session	Winter
Semester	Fall
Exam	Written
Workload	180h
Weeks	14
Hours	**6 weekly**
Lecture	4 weekly
Exercises	2 weekly

SUMMARY

The purpose of the course is to introduce the basic notions of linear algebra and its applications.

CONTENT

1. Linear systems;
2. Matrix algebra;
3. Vector spaces and linear applications;
4. Bases and dimension;
5. Eigenvalues and eigenvectors;
6. Inner product, orthogonality, quadratic forms.

KEYWORDS

vector space, linearity, matrix, determinant, orthogonality, inner product

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Accurately make standard computations relevant to linear algebra and interpret the results;
- Define and provide illustrative examples of relevant theoretical notions;
- Identify examples of relevant theoretical notions;
- Construct a simple logical argument rigorously;
- Identify some connections between linear algebra and other branches of mathematics.

TEACHING METHODS

Lectures and exercises in the classroom

ASSESSMENT METHODS

Written exam

SUPERVISION

Office hours	No
Assistants	Yes
Forum	No

PREREQUISITE FOR

linear algebra II; Analysis II

MATH-101(e) **Analyse I**

Lachowska Anna

Cursus	Sem.	Type
Informatique	BA1	Obl.
Systèmes de communication	BA1	Obl.

Langue	français
Coefficient	6
Session	Hiver
Semestre	Automne
Examen	Ecrit
Charge	180h
Semaines	14
Heures	**6 hebdo**
Cours	4 hebdo
Exercices	2 hebdo

RESUME

Étudier les concepts fondamentaux d'analyse et le calcul différentiel et intégral des fonctions réelles d'une variable.

CONTENU

- Raisonner, démontrer et argumenter en mathématiques
- Nombres, structures et fonctions
- Suites, limites et continuité
- Séries numériques
- Fonctions réelles et processus de limite
- Calcul différentiel et intégral

MOTS-CLES

nombres réels, fonction, suite numérique, suite convergente/divergente, limite d'une suite, sous-suite, fonction, limite d'une fonction, fonction continue, série numérique, série convergente/divergente, convergence absolue, dérivée, classe C^k, théorème(s) des accroissements finis, développement limité, série entière, intégrale de Riemann, primitive, théorème de la valeur moyenne

ACQUIS DE FORMATION

- Le but fondamental de ce cours est d'acquérir les compétences suivantes :
- Raisonner rigoureusement pour analyser des problèmes
- Choisir ou sélectionner les outils d'analyse pertinents pour résoudre des problèmes
- Identifier les concepts inhérents à chaque problème
- Appliquer efficacement les concepts pour résoudre les exercices similaires aux exemples et exercices traités au cours
- Se montrer capable d'analyser et de résoudre des problèmes nouveaux
- Résoudre les problèmes de convergence, de suites et de séries
- Maîtriser les techniques du calcul différentiel et intégral
- Parmi les outils de base, on trouve les notions de convergence, de suites et de séries. Les fonctions d'une variable seront étudiées rigoureusement, avec pour but une compréhension approfondie des techniques du calcul différentiel et intégral.

METHODE D'ENSEIGNEMENT

Cours ex cathedra et exercices en salle

METHODE D'EVALUATION

Examen écrit

ENCADREMENT

Office hours	Non
Assistants	Oui
Forum électronique	Non
Autres	Tutorat des exercices autres mesures à définir

RESSOURCES

Bibliographie

Jacques Douchet and Bruno Zwahlen: Calcul différentiel et intégral. PPUR, 2011.

MATH-101(de) **Analyse I (allemand)**

Kressner Daniel, Krumscheid Sebastian

Cursus	Sem.	Type
Chimie et génie chimique	BA1	Obl.
Génie civil	BA1	Obl.
Génie mécanique	BA1	Obl.
Génie électrique et électronique	BA1	Obl.
Informatique	BA1	Obl.
Microtechnique	BA1	Obl.
Science et génie des matériaux	BA1	Obl.
Sciences et ingénierie de l'environnement	BA1	Obl.
Sciences et technologies du vivant	BA1	Obl.
Systèmes de communication	BA1	Obl.

Langue	allemand
Coefficient	6
Session	Hiver
Semestre	Automne
Examen	Ecrit
Charge	180h
Semaines	14
Heures	**6 hebdo**
Cours	4 hebdo
Exercices	2 hebdo

RESUME

Étudier les concepts fondamentaux d'analyse et le calcul différentiel et intégral des fonctions réelles d'une variable.

CONTENU

- Raisonner, démontrer et argumenter en mathématiques
- Nombres, structures et fonctions
- Suites, limites et continuité
- Séries numériques
- Fonctions réelles et processus de limite
- Calcul différentiel et intégral

MOTS-CLES

nombres réels, fonction, suite numérique, suite convergente/divergente, limite d'une suite, sous-suite, fonction, limite d'une fonction, fonction continue, série numérique, série convergente/divergente, convergence absolue, dérivée, classe C^k, théorème(s) des accroissements finis, développement limité, série entière, intégrale de Riemann, primitive, théorème de la valeur moyenne

ACQUIS DE FORMATION

- Le but fondamental de ce cours est d'acquérir les compétences suivantes :
- Raisonner rigoureusement pour analyser des problèmes
- Choisir ou sélectionner les outils d'analyse pertinents pour résoudre des problèmes
- Identifier les concepts inhérents à chaque problème
- Appliquer efficacement les concepts pour résoudre les exercices similaires aux exemples et exercices traités au cours
- Se montrer capable d'analyser et de résoudre des problèmes nouveaux
- Résoudre les problèmes de convergence, de suites et de séries
- Maîtriser les techniques du calcul différentiel et intégral
- Parmi les outils de base, on trouve les notions de convergence, de suites et de séries. Les fonctions d'une variable seront étudiées rigoureusement, avec pour but une compréhension approfondie des techniques du calcul différentiel et intégral.

METHODE D'ENSEIGNEMENT

Cours ex cathedra et exercices en salle

METHODE D'EVALUATION

Examen écrit

ENCADREMENT

Office hours	Non
Assistants	Oui
Forum électronique	Non
Autres	Tutorat des exercices autres mesures à définir

RESSOURCES

Bibliographie

Jacques Douchet and Bruno Zwahlen: Calcul différentiel et intégral. PPUR, 2011.

PREPARATION POUR

Analysis II

MATH-101(en) **Analyse I (anglais)**

Hausel Tamás

Cursus	Sem.	Type
Chimie et génie chimique	BA1	Obl.
Génie civil	BA1	Obl.
Génie mécanique	BA1	Obl.
Génie électrique et électronique	BA1	Obl.
Informatique	BA1	Obl.
Microtechnique	BA1	Obl.
Science et génie des matériaux	BA1	Obl.
Sciences et ingénierie de l'environnement	BA1	Obl.
Sciences et technologies du vivant	BA1	Obl.
Systèmes de communication	BA1	Obl.

Language	English
Coefficient	6
Session	Winter
Semester	Fall
Exam	Written
Workload	180h
Weeks	14
Hours	**6 weekly**
Lecture	4 weekly
Exercises	2 weekly

SUMMARY

We study the fundamental concepts of analysis, calculus and the integral of real-valued functions of a real variable.

CONTENT

- Reasoning , proving and arguing in mathematics
- Numbers, structures and functions
- Sequences, limit and continuity
- Series of reals
- Real-valued functions of a real variable and convergence
- Differential Calculus and the Integral

KEYWORDS

real numbers, function, sequence,convergent/divergent sequence, limit, subsequence, limit of a function, continuous function, series of real numbers, convergent/divergent series, absolute convergence, derivative, class C^k, mean value theorem, Taylor's theorem, Taylor series, Riemann integral, indefinite integral, intermediate valuetheorem

LEARNING OUTCOMES

- The intended learning outcomes of this course are that students acquire the following capacities:
- Reason rigorously to analyse problems
- Choose appropriate analytical tools for problem solving.
- Be able to conceptualise in view of the applications of analysis.
- Apply efficiently mathematical concepts for problem solving by means of examples and exercises
- Analyze and to solve new problems.
- Master the basic tools of analysis as, for example, notions of convergence, sequences and series.
- Studying rigorously real functions we intend that students will demonstrate a deep understanding of calculus

TEACHING METHODS

Ex cathedra lecture and exercises in the classroom

ASSESSMENT METHODS

Written exam

SUPERVISION

Office hours	No
Assistants	Yes
Forum	No
Others	Tutoring of exercises other measures to be defined

MATH-106(e) **Analyse II**

Lachowska Anna

Cursus	Sem.	Type
Informatique	BA2	Obl.
Systèmes de communication	BA2	Obl.

Langue	français
Coefficient	6
Session	Eté
Semestre	Printemps
Examen	Ecrit
Charge	180h
Semaines	14
Heures	**6 hebdo**
Cours	4 hebdo
Exercices	2 hebdo

RESUME

Étudier les concepts fondamentaux d'analyse et le calcul différentiel et intégral des fonctions réelles de plusieurs variables.

CONTENU

- L'espace R^n
- Calcul différentiel des fonctions à plusieurs variables
- Intégrales multiples
- Équations différentielles ordinaires

MOTS-CLES

Espace vectoriel euclidien, , dérivée partielle, différentielle, matrice jacobienne, théorème de la valeur moyenne, matrice hessienne, développement limité, gradient, divergence, rotationnel, Laplacien, règle de composition, théorème des fonctions implicites, multiplicateur de Lagrange, intégrale multiple, équation différentielle ordinaire

COMPETENCES REQUISES

Cours prérequis obligatoires

Analyse I, Algèbre linéaire I

Cours prérequis indicatifs

Analyse I, Algèbre linéaire I

Concepts importants à maîtriser

-

ACQUIS DE FORMATION

- Le but fondamental de ce cours reste, comme pour la partie I, d'acquérir les capacités suivantes :
- Appliquer
- avec aisance et approfondir les compétences et connaissances acquises en Analyse I :
- Raisonner
- rigoureusement pour analyser les problèmes
- Choisir ou sélectionner
- les outils d'analyse pertinents pour résoudre des problèmes
- Identifier
- les concepts inhérents à chaque problème

- Appliquer
- efficacement les concepts pour résoudre les exercices similaires aux exemples et exercices traités au cours
- Se montrer capable d'analyser et de résoudre des problèmes nouveaux
- Maîtriser les techniques du calcul différentiel et intégral.
- Maîtriser les équations différentielles élémentaires, l'espace R^n, les fonctions de plusieurs variables, les dérivées partielles et les intégrales multiples.

METHODE D'ENSEIGNEMENT

Cours ex cathedra et exercices en salle

METHODE D'EVALUATION

Examen écrit

ENCADREMENT

Office hours	Non
Assistants	Oui
Forum électronique	Non
Autres	Tutorat des exercices autres mesures à définir

RESSOURCES

Bibliographie

Jacques Douchet and Bruno Zwahlen: Calcul différentiel et intégral. PPUR, 2011.
L'enseignant précisera les manuels recommandés dans son cours.

MATH-106(de) **Analyse II (allemand)**

Shokrollahi Mohammad Amin

Cursus	Sem.	Type
Chimie et génie chimique	BA2	Obl.
Génie civil	BA2	Obl.
Génie mécanique	BA2	Obl.
Génie électrique et électronique	BA2	Obl.
Informatique	BA2	Obl.
Microtechnique	BA2	Obl.
Science et génie des matériaux	BA2	Obl.
Sciences et ingénierie de l'environnement	BA2	Obl.
Sciences et technologies du vivant	BA2	Obl.
Systèmes de communication	BA2	Obl.

Langue	allemand
Coefficient	6
Session	Eté
Semestre	Printemps
Examen	Ecrit
Charge	180h
Semaines	14
Heures	**6 hebdo**
Cours	4 hebdo
Exercices	2 hebdo

RESUME

Es werden die Grundlagen der Analysis sowie der Differential- und Integralrechnung von Funktionen mehrerer reeller Veränderlicher erarbeitet.

CONTENU

- Der Raum R^n
- Differenzialrechnung von Funktionen mehrerer Veränderlicher
- Integrale ueber Teilmengen des R^n
- Gewöhnliche Differentialgleichungen (wenn nicht schon im Teil I behandelt)

MOTS-CLES

Euclidische Raeume, totale und partielle Ableitungen, Jacobideterminante, Hess'sche, Gradient, Laplaceoperator, Kettenregel, Satz ueber implizite Funktionen, Lagrange Multiplikatoren, Integrale ueber Gebiete des R^n, Differentialgleichungen

COMPETENCES REQUISES

Cours prérequis obligatoires

Analysis I, Lineare Algebra (I)

Concepts importants à maîtriser

- Differential- und Integralrechnung in einer reellen Variablen
- Konvergenz
- Vektorraeume, Matritzen, Eigenwerte

ACQUIS DE FORMATION

- Das Ziel dieser Vorlesung, wie auch fuer Analysis I, ist, dass Studenten die folgenden Faehigkeiten entwickeln:
- Vertiefen der Fertigkeiten und Kentnisse aus der Vorlesung Analysis I
- Strenges argumentieren und analysieren von Problemen
- Auswaehlen von angemessenen analytischen Werkzeugen zur Loesung von Problemen
- Conzeptualisieren von Problemen
- Effizientes Anwenden von mathematischen Konzepten an Hand von Beispielen und Uebungen der Vorlesung

• Analysieren und Loesen von neuen Problemen

• Meistern einfacher Techniken der Differential- und Integralrechnung

• Meistern einfacher Differentialgleichungen, den Raum R^n, Funktionen auf Gebieten des R^n, ihren Ableitungen und Integralen.

METHODE D'ENSEIGNEMENT

Ex Cathedra Vorlesungen und Uebungen in Gruppen

METHODE D'EVALUATION

Schriftliches Examen

ENCADREMENT

Office hours	Non
Assistants	Oui
Forum électronique	Oui
Autres	Tutorat bei den Uebungen

RESSOURCES

Bibliographie

Jacques Douchet and Bruno Zwahlen: Calcul différentiel et intégral. PPUR, 2011.

Liens Moodle

http://moodle.epfl.ch

PREPARATION POUR

Analyse III

MATH-106(en) **Analyse II (anglais)**

Hesthaven Jan Sickmann

Cursus	Sem.	Type
Chimie et génie chimique	BA2	Obl.
Génie civil	BA2	Obl.
Génie mécanique	BA2	Obl.
Génie électrique et électronique	BA2	Obl.
Informatique	BA2	Obl.
Microtechnique	BA2	Obl.
Science et génie des matériaux	BA2	Obl.
Sciences et ingénierie de l'environnement	BA2	Obl.
Sciences et technologies du vivant	BA2	Obl.
Systèmes de communication	BA2	Obl.

Language	English
Coefficient	6
Session	Summer
Semester	Spring
Exam	Written
Workload	180h
Weeks	14
Hours	**6 weekly**
Lecture	4 weekly
Exercises	2 weekly

SUMMARY

The course studies fundamental concepts of analysis and the calculus of functions of several variables.

CONTENT

-The Euclidean space R^n.
-Vector functions and curves
-Differentiation of functions of several variables.
-Multiple integrals
-Ordinary differential equations.

KEYWORDS

Euclidean vector space, partial derivative,differential, Jacobian, Hessian, Taylor expansion, gradient, chain rule, implicit function theorem, Lagrange multipliers, multiple integrals, ordinary differential equation

LEARNING PREQUISITES

Required courses

Analysis I, Linear Algebra I

Important concepts to start the course

-

LEARNING OUTCOMES

- The goal of this course consists as for Analysis 1 is that students acquire the following capacities:
- Consolidate the skills and knowledge they acquired in Analysis 1.
- Reason
- rigorously and to analyse problems
- Choose
- appropriate analytical tools for problem solving.
- Conceptualize problems
- Apply

• efficiently mathematical concepts for problem solving by means of examples and exercises

• Analyze

• and to solve new problems.

• Master the basic tools of analysis

• Master the basic tools of elementary ordinary differential equations, the Euclidean space R^n and functions of several variables

TEACHING METHODS

Ex cathedra lectures, exercises sessions in the classroom.

ASSESSMENT METHODS

Written exam

SUPERVISION

Office hours	No
Assistants	Yes
Forum	No
Others	Tutoring of exercises other measures to be defined

RESOURCES

Bibliography

Jacques Douchet and Bruno Zwahlen: Calcul différentiel et intégral. PPUR, 2011.

Websites

http://mcss.epfl.ch/page-105207-en.html

CS-173 **Conception de systèmes numériques**

Sanchez Eduardo

Cursus	Sem.	Type
Informatique	BA2	Obl.
Systèmes de communication	BA2	Obl.

Langue	français
Coefficient	6
Session	Eté
Semestre	Printemps
Examen	Pendant le semestre
Charge	180h
Semaines	14
Heures	**6 hebdo**
Cours	4 hebdo
Projet	2 hebdo

RESUME

Les étudiants se familiarisent avec les composants numériques de base des systèmes de traitement de l'information, et apprennent à utiliser des méthodes modernes d'analyse et de synthèse des systèmes combinatoires et séquentiels, à l'aide notamment des langages tels que VHDL.

CONTENU

1. Numérique vs analogique. Logique : principes et opérateurs
2. Algèbre booléenne. Synthèse combinatoire. Table de Karnaugh
3. Technologie
4. Dispositifs combinatoires
5. Elément de mémoire. Bascule bistable
6. Machines séquentielles : modes de représentation et d'analyse
7. Machines séquentielles : synthèse
8. Les mémoires et les circuits programmables
9. Structure d'un processeur: unité de contrôle et unité de traitement
10. Le langage VHDL pour la synthèse de systèmes numériques

MOTS-CLES

Systémes numériques, portes logiques, algèbre booléenne, systèmes combinatoires, systèmes séquentiels, systèmes de numération, VHDL, architecture des processeurs

COMPETENCES REQUISES

Cours prérequis obligatoires
Rien

Cours prérequis indicatifs
Rien

ACQUIS DE FORMATION

A la fin de ce cours l'étudiant doit être capable de:

- Expliquer le fonctionnement des éléments de base d'un ordinateur.
- Utiliser les principaux dispositifs logiques et arithmétiques des systèmes de traitement de l'information.
- Expliquer les modes de représentation des systèmes combinatoires et séquentiels.
- Utiliser des méthodes modernes de synthèse et de simplification des systèmes combinatoires et séquentiels.
- Utiliser un langage tel que VHDL pour la synthèse d'éléments numériques complexes.
- Expliquer les modes de représentation des principaux types de données.

• Choisir ou sélectionner les composants et les méthodes de synthèse pour concevoir un système numérique complexe.

• Développer des systèmes numériques complexes.

METHODE D'ENSEIGNEMENT

Cours ex cathedra, exercices et projets de laboratoire

TRAVAIL ATTENDU

L'étudiant doit assister au cours, préparer et résoudre les exercices, préparer et réaliser les projets de laboratoire

METHODE D'EVALUATION

Test intermédaire (50%)
Examen final (50%)

RESSOURCES

Bibliographie

W. J. Dally and R. C. Harting, *Digital design : A systems approach*, Cambridge University Press, 2012
J. Wakerly, *Digital design (4th edition)*, Prentice Hall, 2005
P. J. Ashenden, *The student's guide to VHDL (2nd edition)*, Morgan Kaufmann, 2008
C. Maxfield, *Bebop to the boolean boogie: An unconventional guide to electronics (3rd edition)*, Newnes, 2008

Ressources en bibliothèque

- Digital design : A systems approach / Dally
- Digital design / Wakerly
- The student's guide to VHDL
- Bebop to the boolean boogie / Maxfield

Références suggérées par la bibliothèque

Polycopiés

Copies des transparents disponibles sur le site web du cours

PREPARATION POUR

Architecture des ordinateurs (CS-270)

CS-150 **Discrete structures**

Shokrollahi Mohammad Amin

Cursus	Sem.	Type
Information security minor	H	Opt.
Informatique	BA1	Obl.
Systèmes de communication	BA1	Obl.

Language	English
Credits	6
Session	Winter
Semester	Fall
Exam	Written
Workload	180h
Weeks	14
Hours	**6 weekly**
Lecture	4 weekly
Exercises	2 weekly

SUMMARY

Discrete mathematics is a discipline with applications to almost every area of study, and provides an indispensable set of tools to computer science in particular. This course introduces students to topics as diverse as mathematical reasoning, combinatorics, discrete structures, algorithmic thinking

CONTENT

I. Mathematical reasoning: propositional logic, propositional functions, quantifiers, rules of inference.

II. Sets and counting: cardinalities, inclusion/exclusion principle, sequences and summations.

III. Algorithms and complexity: basic algorithms, computational complexity, big-O notation.

IV. Basic number theory: modular arithmetic, integer division, prime numbers, hash functions, pseudorandom number generation; applications.

V. Induction and recursion: mathematical induction, recursive definitions and algorithms.

VI. Basic combinatorial analysis: permutations, binomial theorem, Catalan numbers, basic generating functions.

VII. Basic probability: events, independence, random variables, Bayes' theorem.

VIII. Structure of sets: relations, equivalence relations, power set, posets.

IX. Elementary graph theory: graphs, Euler and Hamilton paths, Dijkstra's algorithm, spanning trees.

KEYWORDS

Propositional logic, counting, complexity, modular arithmetic, induction, combinatorial analysis, graph theory.

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Recognize mistakes in proofs
- Apply general problem-solving techniques
- Recognize the mathematical structures present in applications
- Apply the tools studied in class to solve problems
- Demonstrate familiarity with mathematical reasoning
- Formulate complete, clear mathematical proofs

Transversal skills

• Assess one's own level of skill acquisition, and plan their on-going learning goals.

• Continue to work through difficulties or initial failure to find optimal solutions.

TEACHING METHODS

Ex cathedra lectures and in class exercises

ASSESSMENT METHODS

Graded homeworks 10%, midterm 30%, final examination 60%.

SUPERVISION

Office hours	Yes
Assistants	Yes
Forum	Yes

RESOURCES

Bibliography

"Discrete Mathematics and Its Applications", Kenneth H. Rosen, 7th ed, McGraw-Hill 2012.

Ressources en bibliothèque

• Discrete Mathematics and its applications / Rosen

Références suggérées par la bibliothèque

Websites

http://ipg/doku.php?id=en:courses:2014-2015:ds

Moodle Link

http://moodle.epfl.ch/enrol/index.php?id=14043

CS-110(e) **Information, computation, communication**

Lenstra Arjen

Cursus	Sem.	Type
Informatique	BA1	Obl.
Systèmes de communication	BA1	Obl.

Language	English
Coefficient	3
Session	Winter
Semester	Fall
Exam	During the semester
Workload	90h
Weeks	14
Hours	**3 weekly**
Lecture	2 weekly
Exercises	1 weekly

SUMMARY

The course is structured into 3 modules. Module 1 present the concepts of algorithms and representation of information. Module 2 focuses on sampling and compression. Module 3 offer an overview of systems: CPU, memory, communication and security.

CONTENT

Module 1 : Computation

- Computation and algorithms
- Computation strategies
- Theory of Computation
- Representation of Information

Module 2 : Information

- Sampling of a signal
- Reconstruction of a signal from samples
- Data compression

Module 3 : Systems

- von Neumann architecture
- Memory hierarchy
- Communication networks
- Security

KEYWORDS

Computer, algorithm, information, computation, communication

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Express an algorithm
- Design an algorithm
- Explain what can be solved with an algorithm
- Explain what can be solved efficiently with an algorithm
- Expound how to represent numbers and symbols
- Expound how to sense physical reality with numbers
- Explain how to rebuild reality from numbers

- Expound how to measure information in data
- Explain how to store data while using the least possible space

TEACHING METHODS

Ex cathedra

ASSESSMENT METHODS

3 exams during the semester, 33% each.

COM-101 Information sciences

Rimoldi Bixio

Cursus	Sem.	Type
Informatique	BA2	Obl.
Systèmes de communication	BA2	Obl.

Language	English
Coefficient	5
Session	Summer
Semester	Spring
Exam	Written
Workload	150h
Weeks	14
Hours	**5 weekly**
Lecture	3 weekly
Exercises	2 weekly

SUMMARY

Files exchanged over the Internet or stored in a device contain information that eventually becomes sounds, images or text. How is the information measured? compressed? protected? secured?

CONTENT

I. How to measure information. Sources and probability. Entropy, entrpoy per symbol. Source coding. Compression and the first theorem of information theory.
II. Cryptography and information security. Modular arithmetic, modern algebra and numer theory. The Chinese remainder theorem and RSA.
III. Protecting information. A few finite fields. Linear spaces. Hamming distance. Linear codes. Reed Solomon codes.

KEYWORDS

Shannon's entropy
Linear codes
Reed-Solomon codes
Number theory
Asymetric Cryptography, RSA

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Understand Shannon's entropy
- Compute an optimal code
- Understand elementary number theory
- Know what an abelian group is
- Recognize a hidden isomorphism
- Know how RSA works
- Know a few linear codes on simple finite fields

Transversal skills

- Take feedback (critique) and respond in an appropriate manner.
- Assess one's own level of skill acquisition, and plan their on-going learning goals.

TEACHING METHODS

Ex cathedra with clickers + exercises

EXPECTED STUDENT ACTIVITIES

One homework (graded written) every week

ASSESSMENT METHODS

Continuous evaluations 10% and exam final 90%

RESOURCES

Bibliography

"Sciences de l'information", J.Y. Le Boudec, R. Urbanke et P. Thiran, online

Websites

http://cours-scienceinfo.epfl.ch

Moodle Link

http://moodle.epfl.ch/course/view.php?id=851

PREREQUISITE FOR

CS-108 Pratique de la programmation orientée-objet

CS-107 **Introduction à la programmation**

Sam Jamila

Cursus	Sem.	Type
Informatique	BA1	Obl.
Systèmes de communication	BA1	Obl.

Langue	français
Coefficient	5
Session	Hiver
Semestre	Automne
Examen	Pendant le semestre
Charge	150h
Semaines	14
Heures	**5 hebdo**
Cours	2 hebdo
Exercices	3 hebdo

RESUME

Ce cours aborde les concepts fondamentaux de la programmation et de la programmation orientée objet (langage JAVA). Il permet également de se familiarier avec un environnement informatique (station de travail sous UNIX)

CONTENU

• Introduction à l'environnement UNIX (connection, multi-fenêtrage, édition de textes, email, ...), éléments de base du fonctionnement d'un système informatique et prise en main d'un environnement de programmation (éditeur, compilateur, ...).

• Initiation à la programmation (langage JAVA) : variables, expressions, structures de contrôle, modularisation, entrées-sorties

• Introduction à la programmation objet (langage JAVA) : objets, classes, méthodes, encapsulation, héritage, polymorphisme

• Pratique de concepts algorithmques fondamentaux (récursion, recherche, tri etc.).

MOTS-CLES

Java, programmation orientée-objet, Unix.

COMPETENCES REQUISES

Cours prérequis obligatoires
Aucun

Cours prérequis indicatifs
Aucun

Concepts importants à maîtriser
Aucun

ACQUIS DE FORMATION

A la fin de ce cours l'étudiant doit être capable de:

• Concevoir des algorithmes résolvant des tâches simples

• Transcrire un algorithme en son programme équivalent en Java

• Modéliser en langage Java une situation simple du monde réelle

• Structurer un problème complexe en sous-problèmes

• Analyser un code pour en décrire le résultat ou le corriger

• Argumenter la validité de décision de conception de base dans un programme orienté-objet

• Tester l'adéquation du résultat d'un programme par rapport à la tâche visée

• Réaliser de façon autonome une application de petite taille au moyen du langage Java et en utilisant les concepts fondamentaux de la programmation orientée objet

Compétences transversales

• Utiliser les outils informatiques courants ainsi que ceux spécifiques à leur discipline.

• Persévérer dans la difficulté ou après un échec initial pour trouver une meilleure solution.

• Utiliser une méthodologie de travail appropriée, organiser un/son travail.

• Accéder aux sources d'informations appropriées et les évaluer.

METHODE D'ENSEIGNEMENT

Ex cathedra, travaux pratiques sur ordinateur et support en ligne MOOC

TRAVAIL ATTENDU

participation au cours, résolutions d'exercices.

METHODE D'EVALUATION

1- Examen écrit individuel (50%)
2- Mini-projet 1 (20%)
3- Mini-projet 2 (30 %)
Les mini-projets se font à deux.

ENCADREMENT

Office hours	Non
Assistants	Oui
Forum électronique	Oui

RESSOURCES

Bibliographie

Notes de cours disponibles en ligne. Livre(s) de référence indiqué(s) en début de semestre

Liens Moodle

http://moodle.epfl.ch/enrol/instances.php?id=14847

PREPARATION POUR

Pratique de la programmation orientée-objet (CS-108)

PHYS-101(g) **Physique générale I**

Fuerbringer Jean-Marie

Cursus	Sem.	Type
Systèmes de communication	BA1	Obl.

Langue	français
Coefficient	5
Session	Hiver
Semestre	Automne
Examen	Ecrit
Charge	150h
Semaines	14
Heures	**5 hebdo**
Cours	3 hebdo
Exercices	2 hebdo

RESUME

Le but du cours de physique générale est de donner à l'étudiant les notions de base nécessaires à la compréhension des phénomènes physiques. L'objectif est atteint lorsque l'étudiant est capable de prévoir quantitativement les conséquences de ces phénomènes avec des outils théoriques appropriés.

CONTENU

Introduction et Cinématique : référentiels, trajectoire, vitesse, accélération, coordonnées cartésiennes et cylindriques.
Dynamique du point matériel : quantité de mouvement, lois de Newton, forces fondamentales, empiriques et de liaison, mouvement oscillatoire, moment cinétique.
Travail, puissance, énergie : énergies cinétique, potentielle, mécanique, lois de conservation, mouvements gravitationnels, collisions.
Changement de référentiels : dynamique dans les référentiels non inertiels
Dynamique des systèmes : centre de masse, moment cinétique, énergie
Solide indéformable : moment cinétique, moment d'inertie, effets gyroscopiques

Compléments
L'enseignement peut contenir, mais pas exclusivement, les éléments suivants: mécanique analytique, coordonnées sphériques, relativité restreinte

MOTS-CLES

Physique générale, mécanique du point matériel, mécanique du solide, coordonnées, cinématique, relativité, énergie, travail

COMPETENCES REQUISES

Cours prérequis indicatifs

- Niveau mathématique de la maturité fédérale, voir par exemple "www.vsmp.ch/crm/cat.htm"
- "Savoir-Faire en Maths - bien commencer ses études scientifiques", Y. Biollay, A. Chaabouni, J. Stubbe, PPUR, 2010

Concepts importants à maîtriser

Espace vectoriel, produit scalaire et produit vectoriel, dérivation et intégration d’une fonction réelle, équations différentielles ordinaires

ACQUIS DE FORMATION

A la fin de ce cours l'étudiant doit être capable de:

- Elaborer un modèle physique d'un système mécanique
- Démontrer un savoir-faire dans la résolution de problèmes
- Structurer les modèles en termes d'équations différentielles

• Formuler et utiliser des hypothèses simplificatrices pour décrire une expérience
• Utiliser les modèles théoriques qui décrivent la Nature
• Estimer les ordres de grandeur
• Relier les notions de cours et les observations du monde quotidien

Compétences transversales

• Utiliser une méthodologie de travail appropriée, organiser un/son travail.

METHODE D'ENSEIGNEMENT

Cours, exercices en salle et travail personnel

METHODE D'EVALUATION

Examen écrit à la session d'hiver

RESSOURCES

Bibliographie

Livre de cours:

• "Mécanique", J.-Ph. Ansermet, Presses polytechniques universitaires romandes, 2009, ISBN 978-2-88074-829-6

MOOC:

• "Mécanique", J.-Ph. Ansermet, www.coursera.org/course/mecanique, 2013

Autres références:

• Physique Générale (vol.1) 2ème édition, Alonso & Finn, InterEditions, Paris, 1988
• Physics for scientists and engineers, 4ème édition, Giancoli. International Edition, Prentice Hall
• Conceptual Physics, 10th edition, Paul G. Hewitt, City college San Francisco, 2005

Ressources en bibliothèque

• Physics for scientists and engineers / Giancoli
• La Mécanique / Ansermet
• Mécanique / Ansermet
• Physique Générale / Alonso
• Conceptual Physics / Hewitt

Polycopiés

Copie des transparents et autres ressources disponibles sur le site web du cours dans moodle.

Sites web

http://moodle.epfl.ch/course/view.php?id=2531

Liens Moodle

http://moodle.epfl.ch/course/view.php?id=2531

PREPARATION POUR

Physique générale II

PHYS-101(de) **Physique générale I (allemand)**

Gruetter Rolf

Cursus	Sem.	Type
Chimie et génie chimique	BA1	Obl.
Génie civil	BA1	Obl.
Génie mécanique	BA1	Obl.
Génie électrique et électronique	BA1	Obl.
Informatique	BA1	Obl.
Mathématiques	BA1	Obl.
Microtechnique	BA1	Obl.
Science et génie des matériaux	BA1	Obl.
Sciences et ingénierie de l'environnement	BA1	Obl.
Sciences et technologies du vivant	BA1	Obl.
Systèmes de communication	BA1	Obl.

Langue	allemand
Coefficient	5
Session	Hiver
Semestre	Automne
Examen	Ecrit
Charge	150h
Semaines	14
Heures	**5 hebdo**
Cours	3 hebdo
Exercices	2 hebdo

RESUME

Die Studenten erwerben die Grundkenntnisse zum Verständnis von physikalischen Phänomenen der Mechanik. Sie entwickeln die Fähigkeit, die Auswirkungen dieser Phänomene mit den entsprechenden theoretischen Werkzeugen quantitativ zu bestimmen.

CONTENU

Enleitung und Kinematik: Abschätzen von Grössenordnungen, physikalische Denkweise, Bezugssysteme, Bahnkurve, Geschwindigkeit, Beschleunigung, kartesische und zylindrische Koordinatensysteme
Dynamik des Massenpunktes: Impuls, Newton's Axiome, grundlegende und empirische Kräfte(verhältnisse), Mechanische Schwingungen, Drehimpuls.
Arbeit, Leistung, Energie: Kinetische, potentielle und mechanische Energie, Erhaltungssätze, Gravitation. Kollisionen.
Aenderung der Bezugssysteme: beschleunigte Bezugssysteme
Mechanik von Systemen: Massenzentrum, (Dreh)impuls, Energie
Mechanik starrer Körper: Drehimpuls, Trägheitsimpuls, Hebelgesetz, gyroskopische Effekte
Ergänzungen: Der Stoff kann folgende nicht-inklusive Elemente beinhalten: sphärische Koordinatensystem, Einführung in die spezielle Relativitätstheorie

MOTS-CLES

Allgemeine Physik, Koordinaten, Kinematik, Energie, Arbeit, Mechanik des starren Körpers, Koordinaten, Relativität.

COMPETENCES REQUISES

Cours prérequis indicatifs

Ausgezeichnete Grundkenntnisse der Mathematik Niveau Schweizerische Maturitätsprüfung (zB. http://www.math.ch/kanon/)

Concepts importants à maîtriser

Vektoralgebra: Skalar- und Vektorprodukt, Zerlegen von Vektoren. Beziehungen des rechtwinkligen Dreiecks.
Lösung von linearen Gleichungsystemen mit 2 oder 3 Unbekannten.
Integration/Differentiation von Funktionen und Vektoren.
Umwandlung physikalischer Einheiten

ACQUIS DE FORMATION

A la fin de ce cours l'étudiant doit être capable de:

- Erstellen eines physikalischen Modells eines mechanischen Systems.
- Know-how entwickeln, um ein Problem zu lösen
- Erkennen der korrekten Einheiten
- Beurteilen benutzter vereinfachender Annahmen
- Identifizieren des vorhergesehenen qualtitativen Verhaltens
- Abschätzen von Größenordnungen
- Zusammenhänge zwischen Vorlesung und Alltag erkennen
- Berücksichtigen der signifikanten Stellen
- Herleiten der Bewegungsgleichungen

Compétences transversales

- Utiliser une méthodologie de travail appropriée, organiser un/son travail.

METHODE D'ENSEIGNEMENT

Kurs, Ubungen im Saal und persönliche Arbeit.

TRAVAIL ATTENDU

Neben der Vorlesung und Ubungs-sessionen (Diese Zeitangaben können von der geleisteten Vorbereitung aufs Studium und der Qualität der Arbeitsorganisation abhangen):
Vor der Vorlesung, ca. 2 bis 3 Seiten im Vorlesungswerk lesen (ca. 15 min)
Nach der Vorlesung, eine ZUsammenfassung/Formelsammlung erstellen (ca. 30 min.), gefolt von mehreren Vorbereitungsübungen (ca. 60 min)
Ubungen vervollständigen (ca. 3 h), online quiz beantworten (ca. 15 min)

METHODE D'EVALUATION

schriftliche Prüfung

ENCADREMENT

Office hours	Oui
Assistants	Oui

RESSOURCES

Bibliographie

- Physics for scientists and engineers, 4ème édition, Giancoli. International Edition, Pearson/Prentice Hall
- Mathematics for physics with calculus, Das, Pearson/Prentice Hall
- W. Demtröder, Experimentalphysik 1, Springer Verlag

Ressources en bibliothèque

- Experimentalphysik / Demtröder

Références suggérées par la bibliothèque

Polycopiés

Eine Spezialausgabe von Giancoli/Das ist in der Buchhandlung La Fontaine erhältlich.

Sites web

http://lifmet.epfl.ch

Liens Moodle

http://moodle.epfl.ch/course/view.php?id=14481

PREPARATION POUR

Physik II

PHYS-101(en) **Physique générale I (anglais)**

Manley Suliana

Cursus	Sem.	Type
Chimie et génie chimique	BA1	Obl.
Génie civil	BA1	Obl.
Génie mécanique	BA1	Obl.
Génie électrique et électronique	BA1	Obl.
Informatique	BA1	Obl.
Mathématiques	BA1	Obl.
Microtechnique	BA1	Obl.
Science et génie des matériaux	BA1	Obl.
Sciences et ingénierie de l'environnement	BA1	Obl.
Sciences et technologies du vivant	BA1	Obl.
Systèmes de communication	BA1	Obl.

Language	English
Coefficient	5
Session	Winter
Semester	Fall
Exam	Written
Workload	150h
Weeks	14
Hours	**5 weekly**
Lecture	3 weekly
Exercises	2 weekly

SUMMARY

Students will learn the principles of mechanics to enable a better understanding of physical phenomena, such as the kinematics and dyamics of point masses and solid bodies. Students will acquire the capacity to quantitatively analyze these effects with the appropriate theoretical tools.

CONTENT

The course may contain, but not exclusively, the following elements :

Mechanics

Introduction and kinematics
Reference frames, trajectories, velocity, acceleration, Cartesian, spherical and cylindrical coordinates.

Dynamics of the point mass and solid body
Momentum, Newton's laws, fundamental forces, empirical forces and constraints. Oscillatory motion, Angular momentum.

Work, power, energy
Kinetic energy, potential energy, conservation laws, gravitational motion. Collisions.

KEYWORDS

General physics, point masses, coordinates, kinematics, energy, work

LEARNING PREQUISITES

Recommended courses

Math level required for "maturité fédérale", see on the left the hyperlinks and the book, indicative of the level of math appropriate for a good start at EPFL.

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Develop a know-how to solve a problem
- Structure models in terms of differentials equations
- Apply simplifying assumptions to describe an experience

• Estimate orders of magnitude
• Distinguish the theoretical models describing Natura
• Contextualise theoretical models in every day life
• Formulate a physical model

Transversal skills

• Use a work methodology appropriate to the task.

TEACHING METHODS

Lectures + exercises

ASSESSMENT METHODS

The course concludes with a written exam

RESOURCES

Bibliography

• Serway, Physics for Scientists and Engineers.
• Douglas Giancoli. Physics for Scientists and Engineers. 4th Edition.
• D. Halliday, R. Resnick, K. S. Krane. Physics, Volume 1.

Ressources en bibliothèque

• La Mécanique / Ansermet
• Conceptual Physics / Hewitt
• Physique Générale / Alonso
• Physics for scientists and engineers / Giancoli
• Mooc-Mécanique / Ansermet

Références suggérées par la bibliothèque

PREREQUISITE FOR

General physics II

CS-108 **Pratique de la programmation orientée-objet**

Schinz Michel

Cursus	Sem.	Type
Informatique	BA2	Obl.
Systèmes de communication	BA2	Obl.

Langue	français
Coefficient	9
Session	Eté
Semestre	Printemps
Examen	Pendant le semestre
Charge	270h
Semaines	14
Heures	**10 hebdo**
Cours	2 hebdo
Exercices	2 hebdo
Projet	6 hebdo

RESUME

Les étudiants perfectionnent leurs connaissances en Java et les mettent en pratique en réalisant un projet de taille conséquente. Ils apprennent à utiliser et à mettre en œuvre les principaux types de collections (listes, ensembles, tables associatives), et examinent quelques patrons de conception.

CONTENU

Approfondissement des connaissances du langage Java, en particulier des concepts suivants :

- généricité (polymorphisme paramétrique),
- classes imbriquées et anonymes,
- fonctions anonymes.

Introduction à différents aspects de la bibliothèque standard Java : collections, entrées-sorties, interfaces utilisateur graphiques, etc.
Etude des mises en œuvre des collections par chaînage, arbres binaires de recherche ou hachage.
Introduction aux patrons de conception (*design patterns*) et examen des plus importants (*Decorator*, *Composite*, *Builder*, etc.).
Examen de l'utilisation judicieuse de l'héritage et de l'immutabilité.
Réalisation d'un projet de programmation conséquent en Java.

MOTS-CLES

Java, programmation orientée-objets, collections, patrons de conception.

COMPETENCES REQUISES

Cours prérequis obligatoires

Introduction à la programmation.

ACQUIS DE FORMATION

A la fin de ce cours l'étudiant doit être capable de:

- Concevoir et écrire des programmes Java de taille moyenne.
- Utiliser à bon escient la totalité des concepts de Java.
- Utiliser et concevoir des classes et méthodes génériques en Java.
- Utiliser et implémenter les principales sortes de collection (listes, ensembles, tables associatives).
- Utiliser judicieusement l'héritage et la mutabilité dans les langages orienté-objets.
- Reconnaitre et savoir utiliser plusieurs patrons de conception.

Compétences transversales

• Utiliser les outils informatiques courants ainsi que ceux spécifiques à leur discipline.

METHODE D'ENSEIGNEMENT

Ex-cathedra.

TRAVAIL ATTENDU

Participation au cours, réalisation des exercices, réalisation du projet.

METHODE D'EVALUATION

Durant le semestre : projet (60%), examen intermédiaire (15%) et examen final (25%).

ENCADREMENT

Office hours	Non
Assistants	Oui
Forum électronique	Oui

RESSOURCES

Sites web

http://cs108.epfl.ch/

ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE

SECTION DE SYSTEMES DE COMMUNICATION

Cycle

Bachelor

(2ème et 3ème année)

2015 / 2016

MATH-310

Algèbre

Chabloz Philippe

Cursus	Sem.	Type
Chimie	BA5	Obl.
HES -SC	H	Obl.
Information security minor	H	Opt.
Informatique	BA5	Opt.
Systèmes de communication	BA5	Obl.

Langue	français
Crédits	3
Session	Hiver
Semestre	Automne
Examen	Ecrit
Charge	90h
Semaines	14
Heures	**3 hebdo**
Cours	2 hebdo
Exercices	1 hebdo

RESUME

Le but de ce cours est d'introduire et d'étudier certaines notions fondamentales de l'algèbre qui sont particulièrement utiles dans des applications.

CONTENU

1. Basic arithmetic
2. Congruences and congruence classes
3. Rings and fields
4. Groups
5. Polynomials
6. Finite fields

COMPETENCES REQUISES

Cours prérequis indicatifs

Obligatoire pour IN/SC: Analyse III, Physique générale I, Physique générale II et Probabilités et statistique

ACQUIS DE FORMATION

A la fin de ce cours l'étudiant doit être capable de:

- Construire des connaissances sur les bases de l'algèbre

RESSOURCES

Bibliographie

L.N. Childs "A concrete introduction to higher Algebra", Springer

Ressources en bibliothèque

- A concrete introduction to higher Algebra / Childs

Références suggérées par la bibliothèque

CS-250 **Algorithms**

Svensson Ola Nils Anders

Cursus	Sem.	Type
HES - IN	H	Obl.
HES -SC	H	Obl.
Information security minor	H	Opt.
Informatique	BA3	Obl.
Mathématiques	BA5	Opt.
Science et ing. computationelles	MA1, MA3	Opt.
Systèmes de communication	BA3	Obl.

Language	English
Credits	6
Session	Winter
Semester	Fall
Exam	Written
Workload	180h
Weeks	14
Hours	**6 weekly**
Lecture	4 weekly
Exercises	2 weekly

SUMMARY

The students learn the theory and practice of basic concepts and techniques in algorithms. The course covers mathematical induction, techniques for analyzing algorithms, elementary data structures, major algorithmic paradigms such as dynamic programming, sorting and searching, and graph algorithms.

CONTENT

Mathematical Induction

- Mathematical background, Euler's formula for trees, Schwartz-Zippel lemma.

Analysis of Algorithms

- O-notation, time and space complexity, recurrence relations, probabilistic analysis.

Data structures

- Arrays, linked lists, trees, heaps, hashing, graphs.

Design of algorithms by induction

- Evaluating polynomials, divide-and-conquer algorithms, dynamic programming.

Greedy Algorithms

- Spanning tree and shortest path algortihms

Sorting and searching

- Merge sort, bucket sort, quicksort, heapsort, binary search.

Graphs algorithms and data structures

- Graphs traversals, shortest paths, spanning trees, transitive closure, decompostitions, matching, network flows.

Complexity

- Polynomial reductions, NP-completeness.

KEYWORDS

algorithms, data structures, efficiency, problem solving

LEARNING PREQUISITES

Recommended courses
Algorithmic

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Illustrate the execution of algorithms on example inputs
- Describe basic data structures such as arrays, lists, stacks, queues, binary search trees, heaps, and hash tables

- Analyze algorithm efficiency
- Compare alternative algorithms and data structures with respect to efficiency
- Choose which algorithm or data structure to use in different scenarios
- Use algorithms and data structures taught in the course on concrete problem instances
- Design new algorithms and data structures based on known methods
- Prove the correctness of an algorithm

TEACHING METHODS

Ex cathedra lecture, exercises in classroom

ASSESSMENT METHODS

Continuous assessment with final exam.

RESOURCES

Bibliography

Thomas Cormen, Charles Leiserson, Ronald Rivest, Clifford Stein: *Introduction to algorithms*, Third Edition, MIT Press, 2009.

Ressources en bibliothèque

- Introduction to algorithms / Cormen

Références suggérées par la bibliothèque

Websites

http://theory.epfl.ch/courses/algorithms

MATH-203(c)

Analyse III

Nguyên Hoài-Minh

Cursus	Sem.	Type
HES - IN	H	Obl.
HES -SC	H	Obl.
Informatique	BA3	Obl.
Systèmes de communication	BA3	Obl.

Langue	français
Crédits	4
Session	Hiver
Semestre	Automne
Examen	Ecrit
Charge	120h
Semaines	14
Heures	**4 hebdo**
Cours	2 hebdo
Exercices	2 hebdo

RESUME

Le cours étudie les concepts fondamentaux de l'analyse vectorielle et l'analyse de Fourier en vue de leur utilisation pour résoudre des problèmes pluridisciplinaires d'ingénierie scientifique.

CONTENU

Le cours contient deux parties:
1) Analyse vectorielle
Les opérateurs gradient, rotationnel et divergence. Intégrales curvilignes et intégrales de surfaces. Champs vectoriels et potentiels. Théorèmes de Green, de la divergence et de Stokes.
2) Analyse de Fourier
Séries de Fourier. Identité de Parceval. Transformées de Fourier. Identité de Plancherel.

COMPETENCES REQUISES

Cours prérequis obligatoires

Analyse I, Analyse II, Algèbre linéaire.

ACQUIS DE FORMATION

A la fin de ce cours l'étudiant doit être capable de:

- Comprendre et maîtriser les notions, les concepts et les méthodes étudiés au cours.
- Comprendre et maîtriser les notions, les concepts et les méthodes pratiqués dans les séries d'exercices.

METHODE D'ENSEIGNEMENT

Cours ex cathedra, exercices en salle.

METHODE D'EVALUATION

Examen écrit.

ENCADREMENT

Assistants Oui

RESSOURCES

Bibliographie

B. Dacorogna et C. Tanteri, *Analyse avancée pour ingénieurs,* PPUR 2011.

Ressources en bibliothèque

- Analyse avancée pour ingénieurs / Dacorogna

Références suggérées par la bibliothèque

PREPARATION POUR

Analyse IV.

MATH-207(b) **Analyse IV**

Nguyên Hoài-Minh

Cursus	Sem.	Type
HES -SC	E	Obl.
Informatique	BA4	Opt.
Systèmes de communication	BA4	Obl.

Langue	français
Crédits	4
Session	Eté
Semestre	Printemps
Examen	Ecrit
Charge	120h
Semaines	14
Heures	**4 hebdo**
Cours	2 hebdo
Exercices	2 hebdo

RESUME

Analyse complexe: emploi de fonctions multivoques, équations de Cauchy-Riemann, intégration complexe, théorème de Cauchy, formule de Cauchy, séries de Laurent, théorème des résidus. Distributions tempérées sur la droite réelle: définition, exemples, calcul sur les distributions tempérées.

CONTENU

Analyse complexe: intégration complexe, équations de Cauchy-Riemann, théorème de Cauchy et formule de Cauchy, séries de Laurent, théorème des résidus. Distributions tempérées sur la droite réelle: définition et exemples, opérations sur les distributions tempérées.

COMPETENCES REQUISES

Cours prérequis obligatoires

Algèbre linéaire, Analyse I, II, III

Concepts importants à maîtriser

ACQUIS DE FORMATION

A la fin de ce cours l'étudiant doit être capable de:

- Comprendre et maîtriser les notions, les concepts et les méthodes étudiés au cours
- Comprendre et maîtriser les notions, les concepts et les méthodes pratiqués en exercices

METHODE D'ENSEIGNEMENT

Cours ex cathedra et exercices en salle

RESSOURCES

Bibliographie

B. Dacorogna et C. Tanteri, Analyse avancée pour ingénieurs, PPUR, 2e édition.
S. D. Fisher, Complex Variables, Dover.
D. W. Kammler, A first course in Fourier analysis, Prentice Hall.
E. Kreyszig, Advanced engineering mathematics, Wiley.

Ressources en bibliothèque

- Advanced engineering mathematics / Kreyszig
- Analyse avancée pour ingénieurs / Dacorogna
- A first course in Fourier analysis / Kammler

- Complex Variables / Fisher

Références suggérées par la bibliothèque

CS-208

Architecture des ordinateurs

Ienne Paolo

Cursus	Sem.	Type
HES - IN	H	Obl.
Informatique	BA3	Obl.
Systèmes de communication	BA3	Obl.

Langue	français
Crédits	4
Session	Hiver
Semestre	Automne
Examen	Pendant le semestre
Charge	120h
Semaines	14
Heures	**4 hebdo**
Cours	2 hebdo
Projet	2 hebdo

RESUME

Le cours introduit les étudiants aux concepts de base de l'architecture des ordinateurs et en particulier au choix du répertoire d'instructions et à la hiérarchie mémoire des ordinateurs contemporains.

CONTENU

• Systèmes logiques complexes en VHDL.
• Composants de base d'un ordinateur.
• Architecture au niveau du répertoire d'instructions.
• Programmation en langage assembleur.
• Implémentation multi-cycle des processeurs.
• Caches.
• Mémoire virtuelle.

MOTS-CLES

Architecture des ordinateurs, Architecture des processeurs, Sets d'instructions, Caches, Mémoire virtuelle.

COMPETENCES REQUISES

Cours prérequis obligatoires

• Systèmes logiques I and II (livret de cours jusqu'à 2013-2014).
• Conception de systèmes numériques (livret de cours dès 2014-2015).

ACQUIS DE FORMATION

A la fin de ce cours l'étudiant doit être capable de:

• Concevoir et implémenter un processeur au niveau "Register Transfer" en utilisant des outils de synthèse logiques et des simulateurs.

• Réaliser des programmes en langage assembleur.

• Justifier l'organisation de systèmes de mémoires modernes y compris la hiérarchie et mémoire virtuelle.

METHODE D'ENSEIGNEMENT

Cours et travaux pratiques sur une carte FPGA dediée.

METHODE D'EVALUATION

Examen de fin de trimestre et examen final.
Sessions de travaux pratiques hebdomadaires notés.

RESSOURCES

Bibliographie

David A. Patterson and John L. Hennessy, Computer Organization and Design: The Hardware/Software Interface, Morgan Kauffman, 5th edition, 2013.

Sites web

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PREPARATION POUR

- Architecture des systems-on-chip.

CS-209 **Architecture des systems-on-chip**

Ienne Paolo

Cursus	Sem.	Type
HES - IN	E	Obl.
Informatique	BA4	Obl.
Systèmes de communication	BA4	Opt.

Langue	français
Crédits	4
Session	Eté
Semestre	Printemps
Examen	Pendant le semestre
Charge	120h
Semaines	14
Heures	**4 hebdo**
Cours	2 hebdo
TP	2 hebdo

RESUME

Le cours continue l'introduction des étudiants aux concepts de base de l'architecture des ordinateurs (entrée/sorties, interruptions et exceptions). Il aborde aussi le thème du parallélisme au niveau des instructions (pipelines, etc.) et les problèmes de la hiérarchie mémoire des multiprocesseurs.

CONTENU

- Entrées/sorties et interruptions.
- Exceptions.
- Accès directe à la mémoire.
- Performance des ordinateurs.
- Pipelines.
- Processeurs à ordonnancement dynamique.
- Processeurs superscalaires et VLIW.
- Multiprocesseurs.

MOTS-CLES

Architecture des ordinateurs, Systèmes-on-chip, Processeurs, Interruptions et exceptions, Parallélisme au niveau des instructions, Multiprocesseurs.

COMPETENCES REQUISES

Cours prérequis obligatoires

- Systèmes logiques I and II (livret de cours jusqu'à 2013-2014).
- Conception de systèmes numériques (livret de cours dès 2014-2015).
- Architecture des ordinateurs.

ACQUIS DE FORMATION

A la fin de ce cours l'étudiant doit être capable de:

- Réaliser des gestionnaires d'exception simples en langage assembleur.
- Concevoir au niveau "Register Transfer Logic" des systèmes digitaux en pipeline.
- Optimiser la performance d'un pipeline en réordonnançant les opérations.
- Illustrer es difficultés liées à la construction de systèmes multiprocesseurs.

METHODE D'ENSEIGNEMENT

Cours et travaux pratiques sur une carte FPGA dediée.

METHODE D'EVALUATION

Examen final plus jusqu'à 1 point bonus pour les travaux pratiques.

ENCADREMENT

Office hours	Non
Assistants	Oui
Forum électronique	Oui

RESSOURCES

Bibliographie

David A. Patterson and John L. Hennessy, Computer Organization and Design: The Hardware/Software Interface, Morgan Kauffman, 5th edition, 2013.

Ressources en bibliothèque

- Computer Organization and Design / Patterson

Références suggérées par la bibliothèque

Sites web

-

PREPARATION POUR

Advanced Computer Architecture.

CS-308 **Calcul quantique**

Macris Nicolas

Cursus	Sem.	Type
Informatique	BA6	Opt.
Systèmes de communication	BA6	Opt.

Langue	français
Crédits	4
Session	Eté
Semestre	Printemps
Examen	Ecrit
Charge	120h
Semaines	14
Heures	**4 hebdo**
Cours	3 hebdo
Exercices	1 hebdo

REMARQUE

Cours indépendant de "Traitement quantique de l'information" (COM-309)

RESUME

Avec la miniaturisation des ordinateurs nous sommes conduits à réviser les paradigmes du calcul classique pour développer des modèles de calcul quantique. Le cours introduit les notions de bit quantique, les portes logiques et circuits quantiques, puis traite les principaux algorithmes quantiques.

CONTENU

Intrduction au calcul quantique
- Calcul classique: modèle des circuits classiques, calcul réversible.
- Bits quantiques, espace de Hilbert de N qubits, transformations unitaires et portes logiques élémentaires, postulat de la mesure.
- Modèle des circuits quantiques, portes universelles.
- Problème de Deutsch et Josza.

Algorithmes de base
- Sous espace vectoriel cache et algorithme de Simon.
- Intermède mathématique: factorisation d'un entier et période de fonctions discrètes. Notions sur les fractions continuées.
- Transformée de Fourier quantique et algorithme de recherche de la période d'une fonction discrète.
- Algorithme de factorisation de Shor.
- Algorithme de Grover pour la recherche dans une base de donnée.

Intrication (sujet a choix et facultatif)
- Etats intriques et circuits associés.
- Protocoles avec opérations locales quantiques + communication classique.
- Protocole de distillation et mesure de l'intrication.

Codage (sujet a choix et facultatif)
- Modèles de bruit et erreurs dans les états quantiques**.**
- Code correcteurs de Shor et Steane.
- Codes stabilisateurs.

MOTS-CLES

Calcul quantique, circuits quantiques, portes universelles, transformée de Fourier quantique, algorithme de Shor, Grover, intrication, codes quantiques.

COMPETENCES REQUISES

Cours prérequis obligatoires

Algèbre linéaire.

Concepts importants à maîtriser

Matrices, valeurs et vecteurs propres, produit scalaire, nombre complexes.

ACQUIS DE FORMATION

A la fin de ce cours l'étudiant doit être capable de:

- Expliquer le concept d'algorithme quantique sur le modèle des circuits.
- Connaitre les portes universelles utilisées dans un circuit quantique.
- Expliquer les principaux algorithmes quantiques
- Calculer l'évolution d'un état à travers un circuit quantique
- Appliquer le postulat de la mesure
- Faire des calculs algébriques impliquant des états à plusieurs qubits en notation de Dirac

METHODE D'ENSEIGNEMENT

Ex-Cathedra. Exercices. Lectures d'articles pedagogiques sur les sujets a choix.

TRAVAIL ATTENDU

Participation au cours, exercices et lectures pedagogiques sur les sujets a choix.

METHODE D'EVALUATION

Examen ecrit.

RESSOURCES

Bibliographie

N. David Mermin: *Quantum Computer Science, an introduction.* *Cambridge University Press*
Nielsen and Chuang: *Quantum Computation and Information.* *Cambridge University Press*

Polycopiés

Notes de cours

Sites web

http://ipg.epfl.ch/doku.php?id=en:courses

PREPARATION POUR

COM-611 Quantum Information Theory and Computation

CH-160

Chimie générale avancée (à choix)

Profs divers *

Cursus	Sem.	Type
Informatique	BA5	Opt.
Systèmes de communication	BA5	Opt.

Langue	
Crédits	6
Session	
Semestre	Automne
Examen	
Charge	180h
Semaines	14
Heures	**5 hebdo**
Cours	3 hebdo
Exercices	2 hebdo

REMARQUE

Choisir un des cours de chimie générale avancée selon disponibilité horaire

CONTENU

EE-204

Circuits et systèmes I

Rachidi-Haeri Farhad

Cursus	Sem.	Type
Génie électrique et électronique	BA3	Obl.
HES - EL	H	Opt.
HES -SC	H	Obl.
Informatique	BA3	Opt.
Systèmes de communication	BA3	Obl.

Langue	français
Crédits	3
Session	Hiver
Semestre	Automne
Examen	Ecrit
Charge	90h
Semaines	14
Heures	**3 hebdo**
Cours	2 hebdo
Exercices	1 hebdo

RESUME

Ce cours présente une introduction à la théorie et aux méthodes d'analyse et de résolution des circuits électriques.

CONTENU

1. Concepts de base et lois fondamentales
- charge, courant, tension
- puissance et énergie
- éléments de circuits (R, L, C, sources indép. et commandées, inductances couplées)
- lois de Kirchhoff
- limitations des équations de Kirchhoff
- Combinaison d'éléments/méthodes de réduction de circuit
- Diviseurs de tension/courant
- Substitution de source

2. Théorèmes fondamentaux
- Théorème de Thévenin
- Théorème de Norton
- Transfert maximal de puissance
- Théorème de Superposition

3. Méthodes d'analyse
- Analyse nodale
- Analyse de maille

5. Analyse des circuits en régime sinusoïdal
- Phaseurs et calcul complexe
- Impédance et admittance
- Puissance active et réactive
- Théorèmes de Thévenin et Norton en régime sinusoïdal
- Transfert de Puissance active
- Optimisation pour la transmission d'information et pour la transmission d'énergie

6. Circuits en régime triphasé
- Systèmes triphasés symétriques
- Transformation triangle-étoile
- Puissances en régime triphasé
- Systèmes triphasés asymétriques

7. Régimes transitoires
- Réponse impulsionnelle et indicielle
- Méthode d'analyse
- Réponse indicielle des circuits du premier ordre, constantes de temps
- Réponse indicielle de circuits du second ordre

8. Quadripôles
- Paramètres d'impédance et d'admittance
- Paramètres hybrides
- Paramètres de transmission
- Relation entre paramètres

COMPETENCES REQUISES

Cours prérequis indicatifs

Analyse I et II, Algèbre linéaire

ACQUIS DE FORMATION

A la fin de ce cours l'étudiant doit être capable de:

- Analyser un circuit électrique en régime permanent et transitoire.
- Analyser

Compétences transversales

- Communiquer efficacement et être compris y compris par des personnes de languages et cultures différentes.
- Utiliser une méthodologie de travail appropriée, organiser un/son travail.

METHODE D'ENSEIGNEMENT

Ex cathedra. Exercices sur papier.

METHODE D'EVALUATION

Examen écrit.

ENCADREMENT

Office hours	Oui
Assistants	Oui
Forum électronique	Oui

RESSOURCES

Bibliographie

M. Jufer et Y. Perriard, Electrotechnique, PPUR, 2e édition, 2014.
C.K. Alexander et M.N.O. Sadiku, Analyse des circuits électriques, De Boeck, 2012
K.C.A. Smith and R.E. Alley, Electrical Circuits: An Introduction, Cambridge University Press, 1992.
James W. Nilsson et al.,"Electric Circuits". Prentice Hall, 7th ed., 2005.
Circuits et Systèmes, Martin Hasler, Notes de cours, Edition 1999, EPFL.
Support distribué au cours

Ressources en bibliothèque

- Analyse des circuits électriques / Alexander
- Electrotechnique / Jufer
- Electrical Circuits / Smith
- Signals and Systems / Oppenheim
- Electric Circuits / Nilsson
- Circuits et Systèmes / Hasler

Références suggérées par la bibliothèque

Liens Moodle

http://moodle.epfl.ch/enrol/index.php?id=14240

PREPARATION POUR

Circuits et systèmes II, Filtres électriques, Automatique, Réseaux électriques.

EE-205

Circuits and systems II

Gastpar Michael Christoph

Cursus	Sem.	Type
Génie électrique et électronique	BA4	Obl.
HES - EL	E	Opt.
HES -SC	E	Obl.
Informatique	BA4	Opt.
Systèmes de communication	BA4	Obl.

Language	English
Credits	4
Session	Summer
Semester	Spring
Exam	Written
Workload	120h
Weeks	14
Hours	**3 weekly**
Lecture	2 weekly
Exercises	1 weekly

SUMMARY

This class teaches the theory of linear time-invariant (LTI) systems. These systems serve both as models of physical reality (such as the wireless channel) and as engineered systems (such as electrical circuits, filters and control strategies).

CONTENT

The design of advanced systems (such as WiFi, cell phones, drones, airplanes) requires a thorough theoretical underpinning. This class teaches one of the most powerful and important pillars: The theory of linear time-invariant (LTI) systems. These systems serve both as models of physical reality (such as the wireless channel) and as engineered systems (such as filters and control strategies).
The class will cover the following topics:

1. Systems: Definitions (1 week)
2. LTI Systems (3 weeks)
3. The Frequency Response of stable LTI Systems (1 week)
4. Fourier Techniques for stable LTI Systems (3 weeks); with applications to Communication Systems and Signal Processing
5. The Transfer Function of LTI Systems (1 week)
6. Laplace and Z-Transform Techniques for LTI Systems (5 weeks); with applications to Control Systems

KEYWORDS

Systems, Circuits, Signals, Frequency Response, Transfer Function, Fourier Transform, Laplace Transform, Z Transform, Stability, Causality, Sampling

LEARNING PREQUISITES

Required courses
Analysis I, II, III. Linear algebra I. Circuits and Systems I

Recommended courses
Linear algebra II

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Describe properties of LTI systems
- Solve for poles and zeros of IIR filters
- Recall properties of CT Fourier transform

- Implement basic Matlab scripts
- Analyze filter by spectral analysis
- Operate with Fourier series
- Work out / Determine impulse response of CT LTI

TEACHING METHODS

- Classroom lectures
- Written exercises
- Graded homework problems

EXPECTED STUDENT ACTIVITIES

- Read course book in english (the course is taught in english)

ASSESSMENT METHODS

Homeworks and written mid-term exam and final exams

RESOURCES

Bibliography

The following is a recommended (but not required) book:
A. V. Oppenheim and A. S. Willsky, with S. Hamid Nawab, Signals and Systems. Upper Saddle River, NJ: Prentice Hall, 2nd ed., 1996.

Ressources en bibliothèque

- Signals and Systems / Oppenheim

Références suggérées par la bibliothèque

Notes/Handbook

will be made available

CS-320

Computer language processing

Kuncak Viktor

Cursus	Sem.	Type
Informatique	BA5	Opt.
Systèmes de communication	BA5	Opt.

Language	English
Credits	6
Session	Winter
Semester	Fall
Exam	During the semester
Workload	180h
Weeks	14
Hours	**6 weekly**
Lecture	2 weekly
Exercises	2 weekly
Practical work	2 weekly

SUMMARY

We teach the fundamental aspects of analyzing and interpreting computer languages, including the techniques to build compilers. The new title is "Computer Language Processing".

CONTENT

1. Overview, source languages and run-time models
2. Review of formal languages
3. Lexical analysis
4. Syntactic analysis (parsing)
5. Name analysis
6. Type checking
7. Code generation
8. Data-flow analysis
9. Run-time organization and memory management

KEYWORDS

programming language;
compiler;
interpreter;
regular expression;
context-free grammar;
type system;
code generation;
static code analysis

LEARNING PREQUISITES

Recommended courses

Discrete structures
Theoretical computer science
Programming in Scala
Computer architecture I

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Design a programming language

- Construct a compiler
- Coordinate development with project partner
- Formulate correctness conditions for compiler
- Estimate time to implement a programming language feature
- Produce a working programming language implementation
- Decide which language features make implementation difficult
- Specify programming language and compiler functionality

Transversal skills

- Assess progress against the plan, and adapt the plan as appropriate.
- Evaluate one's own performance in the team, receive and respond appropriately to feedback.
- Respect the rules of the institution in which you are working.
- Continue to work through difficulties or initial failure to find optimal solutions.
- Demonstrate a capacity for creativity.
- Take feedback (critique) and respond in an appropriate manner.
- Make an oral presentation.
- Write a scientific or technical report.

TEACHING METHODS

- Ex catedra
- Exercises on whiteboard
- Exercises using dedicated software
- Project work, indepdently and under supervision of assistants

ASSESSMENT METHODS

- 50% Project
- 25% Mid-term quiz
- 25% End-of-term quiz in December

RESOURCES

Bibliography

Andrew W. Appel, **Modern compiler implementation in Java** (or **ML**), Addison-Wesley 1997 (full PDF available from EPFL library)
Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman: **Compilers: Principles, Techniques, and Tools** (2nd Edition, 2006)
Niklaus Wirth: **Compiler Construction,** neat textbook from a prominent classical authority. Freely available **http://www.ethoberon.ethz.ch/WirthPubl/CBEAll.pdf**

Ressources en bibliothèque

- Additionally, all material
- Modern compiler implementation in Java / Appel
- Compiler Construction / Wirth
- Compilers, principle, techniques and tools / Aho

Références suggérées par la bibliothèque

Notes/Handbook

http://lara.epfl.ch/w/cc

Faboulous and gently paced videos: https://www.coursera.org/course/compilers

PREREQUISITE FOR

Synthesis, analysis and verification
Advanced compiler construction
Recommended for Foundations of software

COM-208

Computer networks

Argyraki Aikaterini, Dobrescu Mihai, Ford Bryan Alexander

Cursus	Sem.	Type
HES - IN	H	Obl.
HES -SC	H	Obl.
Information security minor	H	Opt.
Informatique	BA3	Obl.
Systèmes de communication	BA3	Obl.

Language	English
Credits	5
Session	Winter
Semester	Fall
Exam	During the semester
Workload	150h
Weeks	14
Hours	**4 weekly**
Lecture	2 weekly
Exercises	2 weekly

SUMMARY

This course provides an introduction to computer networks. It describes the principles that underly modern network operation and illustrates them using the Internet as an example.

CONTENT

- Overview of Internet operation (main components and protocols).
- Application layer (web, cookies, ads, email, peer to peer).
- Socket programming (how to write a very simple network application).
- Transport layer (UDP, TCP, congestion control).
- Network layer (IP forwarding and basic routing).
- Data link layer (switching and basic shared access protocols).
- Security (secure email, SSL, IPsec).

KEYWORDS

- Computer networks
- Internet
- HTTP
- Peer-to-peer networks
- Sockets, TCP/IP, congestion control, routing, switching, network security.

LEARNING PREQUISITES

Required courses

- CS 106 - Introduction to programming
- COM 101 - Information sciences

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Design simple network applications.
- Choose which functions to implement at each network layer.
- Compare different network protocols.

- Perform simple network troubleshooting.
- Use simple network monitoring tools.
- Implement simple client-server applications.
- Investigate simple network attacks.
- Explain how basic Internet applications work.
- Explain how TCP/IP works.

TEACHING METHODS

- Lectures
- Reading sssignments
- Homework problems
- Hands-on exercises

EXPECTED STUDENT ACTIVITIES

The students are expected to:

- attend the lectures
- read the assigned book sections
- complete homework problems
- complete hands-on exercises.

ASSESSMENT METHODS

- Quizzes and short essay (bonus points that can contribute up to 10% of the grade).
- Midterm exam (40% of the grade).
- Final exam (60% of the grade).

SUPERVISION

Office hours	Yes
Assistants	Yes
Forum	No

RESOURCES

Bibliography

Computer Networking: A Top-Down Approach by James F. Kurose and Keith W. Ross.

Ressources en bibliothèque

- Computer Networking / Kurose

Références suggérées par la bibliothèque

Websites

http://compnet.epfl.ch

EE-200

Electromagnétisme I : lignes et ondes

Mattes Michael, Mosig Juan Ramon

Cursus	Sem.	Type
Génie électrique et électronique	BA3	Obl.
HES - EL	H	Obl.
Informatique	BA5	Opt.
Systèmes de communication	BA5	Opt.

Langue	français
Crédits	3
Session	Hiver
Semestre	Automne
Examen	Ecrit
Charge	90h
Semaines	14
Heures	**3 hebdo**
Cours	2 hebdo
Exercices	1 hebdo

RESUME

Le signal électrique est un vecteur essentiel pour la transmission d'information et d'énergie. En haute fréquence elle se manifeste comme un signal électromagnétique dont l'étude demande le développement de modèles physiques et mathématiques spécifiques basés sur les équations d'onde.

CONTENU

1) Le signal électromagnétique
Aspects spécifiques du signal électromagnétique: Signaux scalaires et vectoriels. Signaux guidés et rayonnés. Domaines temporels et fréquentiel. Affaiblissement, dispersion et distorsion. Puissance transmise et vecteur de Poynting.
2) Lignes de transmission et circuits HF
Dimensions du circuit, fréquence et longueur d'onde. Eléments discrets (localisés) et distribués. Circuits à un et à plusieurs accès, éléments réciproques et sans pertes, bilan de puissance. Matrice de répartition d'un quadripôle. Vitesses de phase et de groupe, impédance caractéristique, réflexion et transmission, ondes stationnaires, transfert de puissance et méthodes d'adaptation. Abaque de Smith
3) Propagation d'ondes
Analogie avec la théorie des lignes de transmission. Equations de Maxwell. Polarisation linéaire, circulaire et elliptique. Incidence normale et oblique sur un obstacle plan. Réflexion et transmission. Diffraction. Étude de cas particuliers.
4) Rayonnement et antennes
Mécanisme de rayonnement d'une antenne, sources élémentaires de rayonnement. Paramètres caractéristiques d'une antenne: impédance, diagramme de rayonnement, gain, directivité, rendement, polarisation, bande passante, température de bruit. Quelques antennes particulières. Introduction aux réseaux.

MOTS-CLES

Signal électromagnétique, Lignes de transmission, Ondes électromagnétiques, Réflexion et transmission, Circuits équivalents, Circuits radiofréquences, Propagation et Rayonnement, Antennes

COMPETENCES REQUISES

Cours prérequis obligatoires
Electrotechnique

Cours prérequis indicatifs
Algèbre, Analyse I et II, Physique générale

Concepts importants à maîtriser
Propriétés du signal électromagnétique: vitesse, fréquence, longueur d'onde. Nature et comportement des signaux et ondes électromagnétiques: propagation guidée unidimensionnelle (lignes de transmission), champs électromagnétiques, polarisation, interaction avec la matière, réflexion et transmission, rayonnement

ACQUIS DE FORMATION

A la fin de ce cours l'étudiant doit être capable de:

- Analyser un système des lignes de transmission
- Calculer les impédances et paramètres électriques associés d'un circuit radiofréquence
- Modéliser une interaction simple entre onde électromagnétique et matière

METHODE D'ENSEIGNEMENT

Ex cathedra avec exercices en salle et exemples traités à l'ordinateur (MatLab).

TRAVAIL ATTENDU

Participation active au cours et aux séances d'exercices.

METHODE D'EVALUATION

Examen écrit.

ENCADREMENT

Office hours	Oui
Assistants	Oui

RESSOURCES

Bibliographie

1) "Électromagnétisme", Vol. III du Traité d'électricité de l'EPFL - 2) Ramo: "Fields and Waves in Communication Electronics" - 3) Notes supplémentaires polycopiées

Ressources en bibliothèque

- Fields and Waves in Communication Electronics / Ramo
- Electromagnétisme / Gardiol

Références suggérées par la bibliothèque

Sites web

http://lema.epfl.ch/content/view/21/47/

Liens Moodle

http://moodle.epfl.ch/enrol/index.php?id=14046

PREPARATION POUR

Transmissions Hyperfréquences et Optiques, Télécommunications, Rayonnement et Antennes, Propagation, Audio, cycle Master EPFL-SEL et EPFL-SC

EE-201

Electromagnétisme II : calcul des champs

Mattes Michael, Mosig Juan Ramon

Cursus	Sem.	Type
Génie électrique et électronique	BA4	Obl.
HES - EL	E	Obl.
Informatique	BA6	Opt.
Systèmes de communication	BA6	Opt.

Langue	français
Crédits	3
Session	Eté
Semestre	Printemps
Examen	Ecrit
Charge	90h
Semaines	14
Heures	**3 hebdo**
Cours	2 hebdo
Exercices	1 hebdo

RESUME

Après une révision des concepts de base d'Electrostatique et Magnetostatique, on décrit les modèles mathématiques liant les sources (charges, courants électriques) aux effets (champs électriques et magnétiques, capacités, inductances)et les techniques mathématiques pour leur calcul.

CONTENU

1) Révision des notions de base
Charges et champs électriques. Courants et champs magnétiques. Equations de l'électromagnétisme. Electrostatique et magnétostatique. Conditions aux limites. Potentiels, flux et énergie. Distribution de charges électriques. Champ électrique et potentiel électrostatique. Capacité et inductance. La matière: conducteurs électriques et magnétiques; milieux diélectriques et magnétiques. Permittivité et perméabilité.
2) Champs statiques : méthodes intégrales
Champs créés par distributions simples de charges et courants. Distributions continues de sources. Singularités des champs. Formulation intégrales et matrices de Green. Champs propres, crées par des distributions de sources sur elles mêmes. Exemples : résolution numérique de problèmes canoniques, capacités d'un résonateur plan, capacités et inductances d'une ligne imprimée ouverte.
3) Champs statiques : méthodes différentielles
Equations de Laplace et de Poisson. Conditions aux limites. Techniques de solution directe. Exemples : la jonction à semiconducteurs p-n, la ligne coaxiale. Techniques analytiques: méthode des images, séparation de variables (coordonnées cartésiennes, cylindriques, sphériques), transformation conforme. Méthodes numériques pour traitement à l'ordinateur : différences finies, éléments finis. Exemples: capacités et inductances d'une ligne imprimée blindée.
4) Problèmes inverses : méthodes numériques
Calcul et estimation des sources à partir des champs. Existence et unicité des solutions. Méthodes différentielles et ses limitations. Linéarisation des problèmes inverses. Equations intégrales et fonctions de Green. La méthode des moments en Electromagnétisme.

MOTS-CLES

Electrostatique, magnétostatique, distributions de charges et courants électriques, champs électriques et magnétiques, capacité, inductance, équations différentielles et intégrales, méthodes numériques

COMPETENCES REQUISES

Cours prérequis obligatoires
Physique Générale

Cours prérequis indicatifs
Analyse I et II, Electrotechnique

ACQUIS DE FORMATION

A la fin de ce cours l'étudiant doit être capable de:

• Evaluer les champs électriques et magnétiques crées par des distributions de charges et des courants électriques

• Déterminer les distributions de sources électriques à partir de leurs effets

• Calculer les inductances et les capacités associées à des géométries simples par des méthodes analytiques ou numériques

METHODE D'ENSEIGNEMENT

Ex cathedra avec exercices en salle et exemples traités à l'ordinateur (MatLab).

TRAVAIL ATTENDU

Participation active au cours et aux séances d'exercices.

METHODE D'EVALUATION

Examen écrit.

ENCADREMENT

Office hours	Oui
Assistants	Oui

RESSOURCES

Bibliographie

1) "Électromagnétisme", Vol. III du Traité d'électricité de l'EPFL
2) Ramo: "Fields and Waves in Communication Electronics"
3) Notes supplémentaires polycopiées

Ressources en bibliothèque

• Electromagnétisme / Gardiol

• Fields and Waves in Communication Electronics / Ramo

Références suggérées par la bibliothèque

Polycopiés

Disponible sur Moodle

Sites web

http://lema.epfl.ch/index.php/teaching/bachelor-level/electromagnetisme-ii

Liens Moodle

http://moodle.epfl.ch/enrol/index.php?id=14047

PREPARATION POUR

Transmissions Hyperfréquences et Optiques, Télécommunications, Orientation Communications mobiles, Rayonnement et Antennes, Propagation, Audio

EE-202(b) **Electronique I**

Zysman Eytan

Cursus	Sem.	Type
Informatique	BA3	Opt.
Systèmes de communication	BA3	Opt.

Langue	français
Crédits	4
Session	Hiver
Semestre	Automne
Examen	Pendant le semestre
Charge	120h
Semaines	14
Heures	**3 hebdo**
Cours	2 hebdo
Exercices	1 hebdo

RESUME

Découvrir le monde de l'électronique depuis les lois fondamentales des composants discrets linéaires et non linéaires. Les circuits obtenus avec des assemblages de composants nécessitent de nombreuses techniques de modélisation et d'analyse ainsi que des vérification exploitant un simulateur

CONTENU

Cours

- Composants passifs linéaires
- Techniques de résolution de circuits linéaires
- Les diodes
- introduction aux transistors
- Techniques de modélisation des composants non linéaires
- Simulation électronique

Exercices

L'étudiant appliquera les nombreuses méthodes vues en cours pour résoudre des exercices pratiques qui pourront être vérifiés avec la simulation.

MOTS-CLES

Composants passifs, composants actifs, composants linéaires, composants non linéaires, diodes, transistors, modélisation, simulation, Lois de Kirchhoff, Thévenin-Norton, Superposition, impédances complexes, fonctions de transfert, Bode, concept d'amplification.

COMPETENCES REQUISES

Cours prérequis obligatoires

Cours d'analyse: équation différentielles du premier et second ordre, nombres complexes, résolution de système d'équations linéaires.

Cours prérequis indicatifs

Electricité de base: électrostatique, électrocinétique.

ACQUIS DE FORMATION

A la fin de ce cours l'étudiant doit être capable de:

- Analyser des circuits complexes
- Modéliser des composants non linéaires
- Modéliser des circuits complexes

• Raisonner à partir de méthode d'observation

• Dessiner des comportements temporels et fréquentiels

• Interpréter des signaux de natures diverses

• Utiliser les bonnes méthodes de résolution

Compétences transversales

• Utiliser les outils informatiques courants ainsi que ceux spécifiques à leur discipline.

• Auto-évaluer son niveau de compétence acquise et planifier ses prochains objectifs d'apprentissage.

METHODE D'ENSEIGNEMENT

Cours ex cathedra et exercices dirigés en salle.

METHODE D'EVALUATION

Plusieurs quiz répartis sur le semestre
Travail écrit

ENCADREMENT

Office hours	Non
Assistants	Oui
Forum électronique	Oui

RESSOURCES

Bibliographie

• **Principes d'électronique: cours et exercices corrigés. Albert Paul Malvino ; trad. de l'américain par Bernard Boittiaux ; Paris : Dunod, 2002**

Ressources en bibliothèque

• Principes d'électronique / Malvino

Références suggérées par la bibliothèque

Polycopiés

• liste de sites approfondissant les notions vues en cours

• Diapositives du cours

• Diapositives commentées

• Exercices et corrigés.

• Développements en cours sur Tablet

Liens Moodle

http://moodle.epfl.ch/course/view.php?id=13726

PREPARATION POUR

Électronique II

EE-203(b) **Electronique II**

Zysman Eytan

Cursus	Sem.	Type
Informatique	BA5	Opt.
Systèmes de communication	BA5	Opt.

Langue	français
Crédits	4
Session	Hiver
Semestre	Automne
Examen	Pendant le semestre
Charge	120h
Semaines	14
Heures	**4 hebdo**
Cours	2 hebdo
Exercices	2 hebdo

RESUME

Maîtriser des blocs fonctionnels nécessitant un plus haut niveau d'abstraction. Réalisation de fonctions électroniques de haut niveau exploitant les amplificateurs opérationnels.

CONTENU

Cours

- Modèles d'amplificateurs
- Bande passante des amplificateurs
- Familles logiques
- l'amplificateur opérationnel en réaction négative
- l'amplificateur opérationnel en réaction positive
- les filtres actifs d'ordre N
- l'amplificateur opérationnel et ses imperfections
- les bascules

Exercices et travaux pratiques

Comme en électronique I, l'étudiant appliquera de nombreuses méthodes vues en cours pour résoudre des exercices pratiques qui pourront être vérifiés avec la simulation.

MOTS-CLES

Amplificateur, Modèle de quadripôle, polarisation, schéma petit signaux, Filtres, bande passante, puissante statique, puissance dynamique, Slew-rate, Tchebychev, Butterworth, Trigger de Schmitt, comparateur, intégrateur, différentiateur, monostable, bistable, astable, générateur de signaux, marge de bruit, Fan-In, Fan-Out, Puissance dissipée, tension d'offset.

COMPETENCES REQUISES

Cours prérequis indicatifs

Électronique I

ACQUIS DE FORMATION

A la fin de ce cours l'étudiant doit être capable de:

- Concevoir des filtres actifs
- Concevoir des circuits amplificateurs
- Comparer les différentes familles logiques
- Analyser la bande passante d'une fonction électronique

- Exploiter des blocs fonctionnels de haut niveau
- Représenter la notion de temps
- Synthétiser des circuits logiques

Compétences transversales

- Utiliser les outils informatiques courants ainsi que ceux spécifiques à leur discipline.
- Auto-évaluer son niveau de compétence acquise et planifier ses prochains objectifs d'apprentissage.

METHODE D'ENSEIGNEMENT

Cours ex cathedra et exercices dirigés en salle.

METHODE D'EVALUATION

Plusieurs quiz répartis sur le semestre
Travail écrit

ENCADREMENT

Office hours	Non
Assistants	Oui
Forum électronique	Oui

RESSOURCES

Bibliographie

Principes d'électronique: cours et exercices corrigés. Albert Paul Malvino ; trad. de l'américain par Bernard Boittiaux ; Paris : Dunod, 2002

Ressources en bibliothèque

- Principes d'électronique / Malvino

Références suggérées par la bibliothèque

Polycopiés

- liste de sites approfondissant les notions vues en cours
- Diapositives du cours
- Diapositives commentées
- Exercices et corrigés.
- Développements en cours sur Tablet

Liens Moodle

http://moodle.epfl.ch/course/view.php?id=13727

PREPARATION POUR

Electronique III

EE-381

Electronique III

Zysman Eytan

Cursus	Sem.	Type
Informatique	BA6	Opt.
Systèmes de communication	BA6	Opt.

Langue	français
Crédits	3
Session	Eté
Semestre	Printemps
Examen	Pendant le semestre
Charge	90h
Semaines	14
Heures	**3 hebdo**
Cours	2 hebdo
Exercices	1 hebdo

RESUME

Comparaison entre les systèmes à composants discrets et les systèmes intégrés. Introduction aux systèmes électroniques numériques et analogiques et à leur interfaçage. Analyse sous forme d'un projet d'un cahier des charges d'un système intégré mixte analogique/numérique.

CONTENU

Cours

- Cellules analogiques: miroir de courant, paire différentielle, Push-pull,...
- Conversion A/N et N/A : introduction - définitions, conversion numérique/analogique, conversion analogique/numérique.
- Oscillateur et boucles à verrouillage de phase ou Phase-Locked Loops (PLL)
- Introduction aux technologies mixtes analogiques et numériques
- Techniques de conception de circuits intégrés
- Application aux ASIC analogiques/numériques

Exercices

l'étudiant analysera et simulera de nombreux blocs fonctionnels vus en cours

projet

L'étudiant fera la conception d'un petit système électronique mixte analogique et numérique et évaluera sa complexité sous forme de circuit intégré.

MOTS-CLES

paire différentielle, miroir de courant, structure cascod, charge active, Push-Pull, Darlington, Wilson, Widlar, Full Custom, Semi-custom, Librairie de cellules, FPGA, EPLD, PLA, ROM, Architecture de circuit intégré, Technologie des semiconducteurs, PLL, Stabilité, Oscillateur, Convertisseur incrémental, convertisseur logarithmique, convertisseur flash et semi Flash, Sigma/Delta.

COMPETENCES REQUISES

Cours prérequis indicatifs

Cours d'électronique de base I et II

Concepts importants à maîtriser

Automates de Moore et de Mealy.
Transformée de Laplace.

ACQUIS DE FORMATION

A la fin de ce cours l'étudiant doit être capable de:

- Analyser un cahier des charges en électronique
- Concevoir un système électronique
- Décrire le comportement du circuit sous forme algorithmique
- Estimer la complexité et les performances du circuit

Compétences transversales

- Fixer des objectifs et concevoir un plan d'action pour les atteindre.
- Planifier des actions et les mener à bien de façon à faire un usage optimal du temps et des ressources à disposition.
- Communiquer efficacement et être compris y compris par des personnes de languages et cultures différentes.
- Utiliser les outils informatiques courants ainsi que ceux spécifiques à leur discipline.
- Accéder aux sources d'informations appropriées et les évaluer.
- Ecrire un rapport scientifique ou technique.
- Faire une présentation orale.

METHODE D'ENSEIGNEMENT

- Cours ex cathedra et exercices dirigés en salle.
- Animation de séances de projet

TRAVAIL ATTENDU

- Remise d'un rapport d'analyse de système électronique

METHODE D'EVALUATION

- Travail écrit
- Rapport et présentation orale du projet

ENCADREMENT

Office hours	Non
Assistants	Non
Forum électronique	Oui

RESSOURCES

Bibliographie

Traité de l'électronique analogique et numérique , 1, Techniques analogique et numérique, Paul Horowitz, Winfield Hill, Elektor, 2009

Ressources en bibliothèque

- Traité de l'électronique analogique et numérique / Horrowitz

Références suggérées par la bibliothèque

Polycopiés

- liste de sites approfondissant les notions vues en cours
- Diapositives du cours
- Diapositives commentées
- Exercices et corrigés.
- Développements en cours sur Tablet
- Cahier des charges du projet

CS-210

Functional programming

Kuncak Viktor, Odersky Martin

Cursus	Sem.	Type
Informatique	BA3	Obl.
Systèmes de communication	BA3	Opt.

Language	English
Credits	5
Session	Winter
Semester	Fall
Exam	During the semester
Workload	150h
Weeks	14
Hours	**4 weekly**
Lecture	2 weekly
Exercises	2 weekly

SUMMARY

Understanding of the principles and applications of declaratative programming, the fundamental models of program execution, application of fundamental methods of program composition,meta-programming through the construction of interpreters and advanced programming techniques.

CONTENT

Introduction to programming in Scala
Expressions and functions
Classes and objects
Evaluation by rewriting
Pattern matching
Polymorphism
Evaluation strategies
Domain-specific languages
Constraint programming
Language interpretation
An interpreter for Lisp
An interpreter for Prolog

LEARNING PREQUISITES

Required courses
Introduction to the programming objet
Theory and practice of programming

Important concepts to start the course
Compiler Construction
Foundations of Software

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Create functional programs
- Design robust and readable software
- Formalize program correctness
- Interpret programs automatically
- Prove correctness using induction
- Construct software

Transversal skills

• Demonstrate a capacity for creativity.
• Use a work methodology appropriate to the task.
• Set objectives and design an action plan to reach those objectives.
• Give feedback (critique) in an appropriate fashion.

TEACHING METHODS

MOOC. Ex Cathedra. Exercises and projects

ASSESSMENT METHODS

Continuous and written test at the end of the course

RESOURCES

Bibliography
Abelson/Sussman : Structure and Interpretation of Computer Programs, MIT Press

Ressources en bibliothèque

• Structure and Interpretation of Computer Programs / Abelson
Références suggérées par la bibliothèque
Websites
http://Lampwww.epfl.ch/teaching

PHYS-114

General physics II

Dil Jan Hugo

Cursus	Sem.	Type
HES - IN	H	Obl.
HES -SC	H	Obl.
Informatique	BA3	Obl.
Systèmes de communication	BA3	Obl.

Language	English
Credits	4
Session	Winter
Semester	Fall
Exam	Written
Workload	120h
Weeks	14
Hours	**4 weekly**
Lecture	2 weekly
Exercises	2 weekly

SUMMARY

The course first develops the basic laws of electricity and magnetism and illustrates the use in understanding various electromagnetic phenomena.

CONTENT

ELECTRICITY AND MAGNETISM
Electric fields: electric charges and fields; Coulomb's law; Gauss's law
Electric potential and energy: potential; energy; capacitance and capacitors; dielectric materials
Magnetism: magnetic forces and fields; Ampere's law; Biot-Savart law
Electromagnetism: electromotive force; Farady's law; inductance and inductors; Maxwell's equations
Electromagnetic waves: electromagnetic spectrum; antennas

LEARNING PREQUISITES

Recommended courses

General Physics I

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Formulate approach for solving physics problems
- Analyze physical systems
- Establish competence in complex problem solving

Transversal skills

- Use a work methodology appropriate to the task.
- Take feedback (critique) and respond in an appropriate manner.
- Access and evaluate appropriate sources of information.

TEACHING METHODS

Ex cathedra with demonstrations, exercises in class

SUPERVISION

Assistants Yes

RESOURCES

Bibliography

polycopiés / course notes

CS-321 **Informatique du temps réel**

Decotignie Jean-Dominique

Cursus	Sem.	Type
Informatique	BA5	Opt.
Systèmes de communication	BA5	Opt.

Langue	français
Crédits	4
Session	Hiver
Semestre	Automne
Examen	Ecrit
Charge	120h
Semaines	14
Heures	**4 hebdo**
Cours	3 hebdo
Projet	1 hebdo

RESUME

A l'issue du cours, l'étudiant aura acquis les connaissances principales liées à la conception et à la réalisation des systèmes temps réel. Les différentes notions seront illustrées par des exercices et des laboratoires.

CONTENU

1. Introduction sur l'informatique du temps-réel et ses particularités
2. Modélisation des systèmes temps-réel - contexte, types
3. Modélisation asynchrone du comportement logique - Réseaux de Petri
4. Modélisation des systèmes temps-réels - GRAFCET
5. Types de programmation (polling, par interruption, par états, exécutifs cycliques, coroutines, tâches)
6. Noyaux et systèmes d'exploitation temps-réel - problèmes, principes, mécanismes (tâches synchrones et asynchrones, synchronisation des tâches, gestion du temps et des événements)
7. Ordonnancement - problèmes, contraintes, nomenclature
8. Ordonnancement à priorités statiques (Rate Monotonic) et selon les échéances (EDF)
9. Ordonnancement en tenant compte des ressources, des relations de précédence et des surcharges
10. Ordonnancement de tâches multimédia
11. Evaluation des temps d'exécution
12. Introduction aux systèmes répartis temps réel

MOTS-CLES

temps réel, systèmes embarqués, systèmes enfouis, noyaux, ordonnancement, modélisation, GRAFCET, réseaux de Petri.

COMPETENCES REQUISES

Cours prérequis obligatoires
aucun

Cours prérequis indicatifs
Programmation

ACQUIS DE FORMATION

A la fin de ce cours l'étudiant doit être capable de:

- maîtrise des différentes techniques d'ordonnancement
- capacité de vérifier la garantie des contraintes temporelles
- modélisation des applications et vérifications de leurs proporiétés
- large connaissance de l'architecture des systèmes embarqués

METHODE D'ENSEIGNEMENT

Ex cathedra + laboratoires + exercices

TRAVAIL ATTENDU

apprentissage de la matière du cours, résoudre les exercices, réalisation des expériences pratiques

METHODE D'EVALUATION

Examen final 100%

ENCADREMENT

Office hours	Non
Assistants	Oui
Forum électronique	Oui

RESSOURCES

Bibliographie

G. Buttazzo, "Hard Real-Time Computing Systems", Kluwer Academic, Boston
P. Laplante, "Real-Time Systems Design & Analysis : An Engineer's Handbook", IEEE
R. David, A. Alla, "Petri nets and Grafcet", Prentice Hall

Ressources en bibliothèque

- Petri nets and Grafcet / David
- Hard Real-Time Computing Systems / Buttazzo
- Real-Time Systems Design & Analysis / Laplante

Références suggérées par la bibliothèque

Sites web

-

Liens Moodle

http://moodle.epfl.ch/course/view.php?id=10751

PREPARATION POUR

Embedded systems, Real-time embedded systems, Real-time networks

CS-330 **Intelligence artificielle**

Faltings Boi

Cursus	Sem.	Type
Informatique	BA6	Opt.
Systèmes de communication	BA6	Opt.

Langue	français
Crédits	4
Session	Eté
Semestre	Printemps
Examen	Pendant le semestre
Charge	120h
Semaines	14
Heures	**4 hebdo**
Cours	2 hebdo
Projet	2 hebdo

RESUME

Introduction aux techniques de l'Intelligence Artificielle, complémentée par des exercices de programmation qui montrent les algorithmes et des exemples de leur application à des problèmes pratiques.

CONTENU

Le cours comporte trois segments qui traitent les 3 différents formes d'inférence logique : déduction, abduction et induction :

1. Représentation de connaissances en logique de prédicats, algorithmes d'inférence
2. Systèmes experts
3. Raisonnement imprécis et incertain
4. Algorithmes de recherche
5. Satisfaction de Contraintes
6. Diagnostic et Planification
7. Apprentissage supervisé et non-supervisé

COMPETENCES REQUISES

Cours prérequis indicatifs

Programmation avancée

Concepts importants à maîtriser

Logique de prédicats
Algorithmes de base
Théorie de probabilités
Programmation

ACQUIS DE FORMATION

A la fin de ce cours l'étudiant doit être capable de:

- Choisir le bon type d'inférence pour une application
- Choisir la méthode la plus appropriée pour un certain type d'inférence
- Evaluer la faisabilité d'une application de l'Intelligence Artificielle
- Choisir, implémenter et décrire des algorithmes d'inférence déductive sur la base de calcul de prédicats
- Formuler des connaissances utilisant la logique des prédicats
- Décrire des méthodes d'inférence avec des informations imprécises et incertaines
- Choisir, implémenter et décrire des algorithmes de recherche et de satisfaction de contraintes

- Choisir et décrire des méthodes pour le diagnostic
- Choisir, implémenter et décrire des méthodes pour la planification
- Choisir, implémenter et décrire des méthodes d'apprentissage supervisé sur la base d'exemples
- Choisir, implémenter et décrire des méthodes d'apprentissage non-supervisé

METHODE D'ENSEIGNEMENT

Ex cathedra, travaux pratiques sur ordinateur

TRAVAIL ATTENDU

Participation au cours et exercices: 4 heures/semaine
Lecture: 2 heures/semaine
Travail independant: 3 heures/semaine

METHODE D'EVALUATION

Exercices 30%, examens intermediaire et final 70%

RESSOURCES

Bibliographie
Boi Faltings, Michael Schumacher : Intelligence Artificielle par la pratique, PPUR
(Russel & Norvig : Artificial Intelligence : A Modern Approach / Prentice Hall)

Ressources en bibliothèque

- Artificial Intelligence / Russell
- Intelligence Artificielle par la pratique / Faltings

Références suggérées par la bibliothèque
Sites web
-

PREPARATION POUR

Intelligent Agents

COM-308

Internet analytics

Cursus	Sem.	Type
Informatique	BA6	Opt.
Systèmes de communication	BA6	Opt.

Language	English
Credits	5
Session	Summer
Semester	Spring
Exam	Written
Workload	150h
Weeks	14
Hours	**5 weekly**
Lecture	2 weekly
Exercises	1 weekly
Project	2 weekly

REMARQUE

pas donné en 2015-16

SUMMARY

Internet analytics is the collection, modeling, and analysis of user data in large-scale online services, such as social networking, e-commerce, search, and advertisement. This class explores a number of the key functions of such online services that have become ubiquitous over the past decade.

CONTENT

The class seeks a balance between foundational but relatively basic material in algorithms, statistics, graph theory and related fields, with real-world applications inspired by the current practice of internet and cloud services.
Specifically, we look at social & information networks, recommender systems, clustering and community detection, search/retrieval/topic models, dimensionality reduction, stream computing, and online ad auctions. Together, these provide a good coverage of the main uses for data mining and analytics applications in social networking, e-commerce, social media, etc.
The course is combination of theoretical materials and weekly laboratory sessions, where we explore several large-scale datasets from the real world.
In this course you have the great opportunity to work with a dedicated Hadoop infrastructure and learn the MapReduce programming model.

KEYWORDS

data mining; machine learning; social networking; map-reduce; hadoop; recommender systems; clustering; community detection; topic models; information retrieval; stream computing; ad auctions

LEARNING PREQUISITES

Required courses

Stochastic models in communication (COM-300)

Recommended courses

Basic linear algebra
Algorithms & data structures

Important concepts to start the course

Graphs; linear algebra; Markov chains; Java

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Explore real-world data from online services
- Develop frameworks and models for typical data mining problems in online services
- Analyze the efficiency and effectiveness of these models
- data-mining and machine learning techniques to concrete real-world problems

TEACHING METHODS

Ex cathedra + homeworks + lab sessions

EXPECTED STUDENT ACTIVITIES

Lectures with associated homeworks explore the basic models and fundamental concepts. The labs are designed to explore very practical questions based on a number of large-scale real-world datasets we have curated for the class. The labs draw on knowledge acquired in the lectures, but are hands-on and self-contained.

ASSESSMENT METHODS

Project 20%, midterm 30%, final exam 50%

RESOURCES

Bibliography

C. Bishop, Pattern Recognition and MachineLearning, Springer, 2006
A. Rajaraman, J. D. Ullman: Mining of Massive Datasets, 2012
M. Chiang: Networked Life, Cambridge, Cambridge, 2012
D. Easley, J. Kleinberg: Networks, Crowds, and Markets, Cambridge, 2010
Ch. D. Manning, P. Raghavan, H. Schütze: Introduction to Information Retrieval, Cambridge, 2008
M.E.J. Newman: Networks: An Introduction, Oxford, 2010

Websites

http://icawww1.epfl.ch/ix/

CS-211 **Introduction à l'informatique visuelle**

Dillenbourg Pierre

Cursus	Sem.	Type
Informatique	BA4	Opt.
Systèmes de communication	BA4	Opt.

Langue	français
Crédits	4
Session	Eté
Semestre	Printemps
Examen	Ecrit
Charge	120h
Semaines	14
Heures	**4 hebdo**
Cours	2 hebdo
Projet	2 hebdo

RESUME

Ce cours constitue le point d'entrée du thème 'visual computing' qui se continue dans le curriculum en informatique au bachelor et au master. Il explore le rôle des images, statiques ou animées, dans l'interaction entre un ordinateur, les utilisateurs et leur environnement.

CONTENU

1. *Introduction à "Computer graphics" : Comment produire une image 2D à partir d'un ensemble d'objets 3D? Comment modifier cet image en cas de déplacement de la caméra, de rotation des objects, de translation des pojets, etc. ?*
2. *Introduction à "Computer Vision": Comment reconnâitre le contour d'un objet? comment identifier des "blobs" ?*
3. *Introduction à l'interaction personne-machine (HCI): Styles d'iteraction, princioes de design, vision humaine, mémoire de travail et charge cognitive, metacognition, mesures de 'usability' et conception d'expérirence.*
4. *Jeux: Mécanismes du jeu, théorie du 'flow', effets du jeu sur le cerveau,*

MOTS-CLES

Informatique visuelle, traitement de l'image, graphisme, visualisation, jeux

COMPETENCES REQUISES

Cours prérequis obligatoires
Programmation en JAVA

ACQUIS DE FORMATION

A la fin de ce cours l'étudiant doit être capable de:

- Expliquer les effets d'images en termes de processus cognitfs
- Réaliser un jeu de réalité agumentée
- Décrire un dispositif expérimenzal
- Expliquer les erreurs d'un utilisateur
- Critiquer une interface
- Appliquer des algorithmes de graphisme
- Appliquer des algorithmes de vision

METHODE D'ENSEIGNEMENT

Cours participatif et projet concernant la mesure empirique des effets d'apprentissage d'une technologie.

TRAVAIL ATTENDU

Le projet comprendra plusieurs étapes de rendu au cours du semestre

METHODE D'EVALUATION

- Projet + Exam
- 50 / 50

ENCADREMENT

Office hours	Non
Assistants	Oui
Forum électronique	Oui

RESSOURCES

Liens Moodle
http://moodle.epfl.ch/course/view.php?id=14247

BIO-109

Introduction aux sciences du vivant (pour IC)

Zufferey Romain

Cursus	Sem.	Type
Informatique	BA6	Opt.
Mineur en Biocomputing	E	Opt.
Systèmes de communication	BA6	Opt.

Langue	français
Crédits	6
Session	Eté
Semestre	Printemps
Examen	Ecrit
Charge	180h
Semaines	14
Heures	**6 hebdo**
Cours	4 hebdo
Exercices	2 hebdo

RESUME

Ce cours présente les principes fondamentaux à l'oeuvre dans les organismes vivants. Autant que possible, l'accent est mis sur les contributions de l'Informatique aux progrès des Sciences de la VIe.

CONTENU

Le cours aborde la plupart des concepts fondamentaux des Sciences de la Vie.
Les sujets développés parce qu'ils sont à l'interface avec l'informatique incluent :
- alignement des séquences, assemblage de séquences en génome
- matrice de distances et déduction d'un arbre phylogénétique
- détection de domaines transmembranaires et de signaux de localisation subcellulaire dans une séquence d'acides aminés.
- compositon en bases d'un génome entier, deuxième loi de parité de Chargaff, variations locales de la densité en CpG
- optimisation des codons dans diverses application pratiques.

MOTS-CLES

Bioinformatique, génome, séquençage, évolution, communication intercellulaires

ACQUIS DE FORMATION

A la fin de ce cours l'étudiant doit être capable de:

- Identifier les principales structures cellulaires et comprendre les méthodes utilisées pour les observer
- Identifier les segments informatifs d'un génome
- Appliquer des algorithmes pour résoudre des questions en relation avec les Sciences de la Vie
- Expliquer le processus de l'expression génique
- Analyser des données expérimentales brutes et en tirer des conclusions sensées

Compétences transversales

- Accéder aux sources d'informations appropriées et les évaluer.
- Communiquer efficacement et être compris y compris par des personnes de languages et cultures différentes.

TRAVAIL ATTENDU

En plus de la participations active aux cours et aux exercices, 4 heures de travail personnel sont attendues.

METHODE D'EVALUATION

Examen écrit durant la session d'été.

ENCADREMENT

Office hours	Oui
Assistants	Oui
Forum électronique	Non

RESSOURCES

Polycopiés

Les dias du cours et les séries d'exercices sont mises à disposition du Moodle.

CS-341 **Introduction to computer graphics**

Pauly Mark

Cursus	Sem.	Type
Génie électrique et électronique	MA2	Opt.
Informatique	BA6	Opt.
Systèmes de communication	BA6	Opt.

Language	English
Credits	6
Session	Summer
Semester	Spring
Exam	Written
Workload	180h
Weeks	14
Hours	**5 weekly**
Lecture	2 weekly
Exercises	1 weekly
Practical work	2 weekly

SUMMARY

The students study and apply fundamental algorithms for realtime rendering and geometry synthesis. They design and implement their own interactive graphics programs using the OpenGL graphics API.

CONTENT

This course provides an introduction to the field of Computer Graphics with a focus on image synthesis. We will first cover the basic mathematical concepts, such as 2D and 3D transformations, examine the interaction of light with geometry to derive suitable shading models, and discuss elementary rendering algorithms, such as rasterization or visibility computations. We will then investigate how these fundamental components are integrated in current graphics processors and study the corresponding programming APIs, in particular OpenGL.
Students will experiment with modern graphics programming and build small interactive demos in OpenGL. Complemented by some theoretical exercises, these programming tasks lead to a graphics software project, where small teams of students design and implement a complete graphics application.

KEYWORDS

Pixels and images, 2D and 3D transformations, perspective transformations and visibility, rasterization, interpolation and lighting, OpenGL graphics API, shader programming, texture mapping, procedural modeling, curves and surfaces

LEARNING PREQUISITES

Required courses
Nothing

Recommended courses
Linear Algebra

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Explain and apply the fundamental mathematical concepts computer-based image synthesis
- Implement a basic rendering pipeline based on rasterization and z-buffer visibility
- Explain the core functionalities of the OpenGL graphics API
- Develop simple graphics programs in OpenGL using shader programming
- Design and implement geometry synthesis methods based on procedural techniques
- Coordinate a team during a software project

TEACHING METHODS

Lectures, interactive demos, theory and programming exercises, programming project, project tutoring

EXPECTED STUDENT ACTIVITIES

The student are expected to study the provided reading material and actively participate in class. They should prepare and resolve the exercises, prepare and carry out the programming project. Exercises and project are done in groups of three students.

ASSESSMENT METHODS

Exercises and Project: 50%, Final Examination: 50%

SUPERVISION

Office hours	Yes
Assistants	Yes
Forum	Yes

RESOURCES

Bibliography
A list of books will be provided at the beginning of the class

Notes/Handbook
Slides and online resources will be provided in class

Websites
http://lgg.epfl.ch/ICG

PREREQUISITE FOR

Advanced Computer Graphics

CS-310

Introduction to computer vision

Süsstrunk Sabine

Cursus	Sem.	Type
Informatique	BA5	Opt.
Systèmes de communication	BA5	Opt.

Language	English
Credits	4
Session	Winter
Semester	Fall
Exam	Written
Workload	120h
Weeks	14
Hours	**4 weekly**
Lecture	2 weekly
Exercises	2 weekly

SUMMARY

Advanced Image Processing, Computer Vision, Computational Photography, and Computer Graphics classes all require mastery of physical concepts and mathematical tools. Also required is an understanding of image formation and perception processes. This course aims at supplying this knowledge.

CONTENT

Course Topics:

- Human perception.
- Cameras and optics
- Light, light sources, shadows, and shading.
- Measuring and sampling light.
- Color models and color encoding.
- Basic image filtering (Linear filters, convolution, domain transform)
- In-camera processing (noise removal, white-balancing, high-dynamic range image rendering, video, compression).

Exercises:

- The exercises consist of implementing selected topics using Matlab.

KEYWORDS

human perception, camera, image formation, digital photography, computer vision, basic linear filtering.

LEARNING PREQUISITES

Required courses
Linear Algebra

Recommended courses
Introduction to Visual Computing

Important concepts to start the course

- Linear Algebra
- Basic physics
- An interest how a computer "sees."

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Synthesize knowledge in digital imaging
- Judge the performance of a digital camera
- Develop basic image processing algorithms in Matlab
- Differentiate how the human visual system and a machine vision system process visual information
- Categorize different components of a digital imaging system

Transversal skills

- Demonstrate a capacity for creativity.
- Use both general and domain specific IT resources and tools
- Demonstrate the capacity for critical thinking

TEACHING METHODS

- Ex cathedra Lecture
- Practical exercises coded in Matlab

EXPECTED STUDENT ACTIVITIES

- Attend the lectures.
- Attend the exercise sessions.
- Read the articles, book chapters corresponding to the lectures.
- Implement the exercises in Matlab (you need to birng your own laptop with Matlab installed, which is free for EPFL students).

ASSESSMENT METHODS

Graded Matlab exercises, quizzes, final exam

SUPERVISION

Office hours	Yes
Assistants	Yes
Forum	Yes

RESOURCES

Bibliography

- E. Allen and S. Triantaphillidou, The Manual of Photography, 10ed., Focal Press, 2011.
- MATLAB Primer, a quick guide to Matlab.
- R. Szeliski, Computer Vision: Algorithms and Applications, 2010.
- A. Zisserman and R. Hartley, Multiple View Geometry in Computer Vision, Cambridge University Press, 2003.
- R. Lukac, Computational Photography: Methods and Applications, CRC Press, 2010.
- R.C. Gonzalez, R.E. Woods, S.L. Eddins, Digital Image Processing using Matlab, 2nd ed., Gatesmark Publishing, 2009.

Notes/Handbook

The slides will be posted on moodle.

Websites

http://tbd

Moodle Link
http://tbd

PREREQUISITE FOR

Computer Vision, Computational Photography

CS-322 **Introduction to database systems**

Ailamaki Anastasia

Cursus	Sem.	Type
Energie et construction durable	MA2	Opt.
HES - IN	E	Obl.
Informatique	BA6	Obl.
Sciences et ingénierie de l'environnement	MA2, MA4	Opt.
Systèmes de communication	BA6	Opt.

Language	English
Credits	4
Session	Summer
Semester	Spring
Exam	Written
Workload	120h
Weeks	14
Hours	**4 weekly**
Lecture	2 weekly
Exercises	1 weekly
Project	1 weekly

SUMMARY

This course provides a deep understanding of traditional and modern big data management systems. It covers fundamental data management topics such as system architecture, data models, query processing and optimization, database design, storage organization, and transaction management.

CONTENT

This course allows the student to acquire a database specialist/administrator profile, while providing a deep understanding of the entire design of a data management system.
During this course, the students will learn about:

- The Entity-relationship and Relational Models
- Relational Algebra and Calculus
- The SQL Query Language
- Traditional and Modern Data Storage, File Organizations, and Indexing
- Hashing and Sorting
- Query Evaluation and Relational Operators
- Query Optimization
- Schema Refinement
- Transaction Management (Concurrency Control and Recovery)

Homework
Homeworks will be assigned to aid and assess comprehension of the above material. Homework will be either done using pen and paper or they will be programming exercises. During the semester the students will be asked to do a project to gain experience on how to build a database application, and to apply what they learn in class.

KEYWORDS

databases, database design, data modeling, normalization, database management systems (DBMS), files, indexes, storage, external sorting, queries, query evaluation, query optimization, transactions, concurrency, recovery, SQL

LEARNING PREQUISITES

Required courses
Data structures

Recommended courses
For the practical part of the course (project) the following skills will be needed:

• System oriented programming, with focus on scripting languages to enhance the parsing process of raw data.

• Building user interfaces, either web (e.g., PHP, JSP, ASP, ...) or application GUI (e.g., java).

Important concepts to start the course
Before the beginning of the course students must be familiar with:

• Data structures

• Algorithms concepts

LEARNING OUTCOMES

By the end of the course, the student must be able to:

• Express application information requirements

• Use a relational DBMS

• Create a database on a relational DBMS

• Design a database with a practical application in mind

• Model the data of an application using ER and relational modeling

• Explore how a DBMS performs its work

• Report performance and possible optimizations for applications using DBMS

• Justify design and implementation choices

Transversal skills

• Assess progress against the plan, and adapt the plan as appropriate.

• Evaluate one's own performance in the team, receive and respond appropriately to feedback.

• Write a scientific or technical report.

• Make an oral presentation.

TEACHING METHODS

Ex cathedra; including exercises in class, practice with pen and paper or with a computer, and a project

EXPECTED STUDENT ACTIVITIES

During the semester, the students are expected to:

• attend the lectures in order to ask questions and interact with the professor,

• attend the exercises session to solve and discuss exercises abou the recently taught material,

• work on a project during the semester which covers the practical side of building an application using a database system,

• take a midterm

• take a final exam

ASSESSMENT METHODS

Homework, project, written examinations and continuous control.

SUPERVISION

Office hours	Yes
Assistants	Yes
Forum	Yes

RESOURCES

Bibliography

Slides, list of books, additional material (research articles), all indicated and/or available on moodle page.

Notes/Handbook
The slides that are used in the class are available for the students.

Websites
-

Moodle Link
http://moodle.epfl.ch/course/view.php?id=198

CS-307

Introduction to multiprocessor architecture

Falsafi Babak

Cursus	Sem.	Type
Informatique	BA5	Obl.
Systèmes de communication	BA5	Opt.

Language	English
Credits	3
Session	Winter
Semester	Fall
Exam	During the semester
Workload	90h
Weeks	14
Hours	**3 weekly**
Lecture	2 weekly
Project	1 weekly

SUMMARY

This course builds upon the important pre-requisites (computer architecture, system-on-chip and concurrency) to provide the students with the foundations of multiprocessor architecture, which are the building blocks in all modern digital platforms from embedded systems to supercomputers.

CONTENT

- Cache coherence
- Memory consistency
- Synchronization hardware
- Interconnection networks
- Multicore cache hierarchies

KEYWORDS

Multiprocessors, multicores, manycores, cache coherence, memory consistency models, memory ordering, manycore cache hierarchies, interconnection networks, synchronization

LEARNING PREQUISITES

Required courses
CS-206 Concurrency
CS-208 Computer architecture / Architecture des Ordinateurs

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Design and evaluate a snoopy cache-coherent multicore processor
- Design and evaluate memory consistency models
- Design architectural support for synchronization
- Design and evaluate on-chip interconnection networks

TEACHING METHODS

Lectures, homework and project

ASSESSMENT METHODS

mid-term and final

COM-300 **Modèles stochastiques pour les communications**

Thiran Patrick

Cursus	Sem.	Type
HES -SC	H	Obl.
Informatique	BA5	Opt.
Systèmes de communication	BA5	Obl.

Langue	français
Crédits	6
Session	Hiver
Semestre	Automne
Examen	Ecrit
Charge	180h
Semaines	14
Heures	**6 hebdo**
Cours	4 hebdo
Exercices	2 hebdo

RESUME

L'objectif de ce cours est la maitrise des outils des processus stochastiques utiles pour un ingénieur en systèmes de communication et en informatique.

CONTENU

- Rappels de probabilité: axiomes de probabilité, variable aléatoire et vecteur aléatoire.
- Processus stochastiques à temps continu et à temps discret : analyse du second ordre (stationarité, ergodisme, densité spectrale, relations de Wiener-Khintchine, réponse d'un système linéaire invariant à des entrées aléatoires, processus gaussien, processus ARMA, filtres de Wiener). Application à des cas simples de détection optimale, de restauration et de compression d'image.
- Processus de Poisson et bruit impulsif de Poisson. Application aux transmissions sur fibres optiques.
- Chaînes de Markov à temps discret. Chaînes ergodiques, comportement asymptotique, chaînes absorbantes, temps d'atteinte, marches aléatoires simples, processus de branchement.
- Chaînes de Markov à temps continu. Processus de naissance et de mort à l'état transitoire et stationnaire. Files d'attente simples: définition, loi de Little, files M/M/1... M/M/s/K, M/G/1.

MOTS-CLES

Probabilité, Processus stochastique, Moments, stationarité, Processus gaussien, Processus de Poisson, Chaîne de Markov, File d'attente.

COMPETENCES REQUISES

Cours prérequis obligatoires

Algèbre linéaire, analyse et premier cours de probabilité (MATH-232 ou équivalent).

Cours prérequis indicatifs

Circuits et systèmes I et II (EE 204/205 ou équivalent), pour les notions de base de théorie des systèmes linéaires.

Concepts importants à maîtriser

Notions d'algèbre linéaire, en particulier opérations matricielles (inversion, diagonalisation, vaelurs propres d'unematrice).
Notions d'analyse (équations différentielles ordinaires linéaires)

ACQUIS DE FORMATION

A la fin de ce cours l'étudiant doit être capable de:

- Modéliser un système aléatoire.

- Analyser un processus stochastique.
- Evaluer les solutions d'un problème avec composante aléatoire.

METHODE D'ENSEIGNEMENT

- Ex cathedra (au tableau), 4h par semaine.
- Séances d'exercices, 2h par semaine.

TRAVAIL ATTENDU

- Exercices en séance et à domicile

METHODE D'EVALUATION

- Examens intermédiaires 20%
- Examen final 80%

ENCADREMENT

Office hours	Oui
Assistants	Oui
Forum électronique	Oui

RESSOURCES

Bibliographie

Polycopié; textes de référence sur la page web du cours.

Polycopiés

Polycopié disponilbe au début du cours.

Sites web

http://moodle.epfl.ch/course/view.php?id=14236

PREPARATION POUR

Tous les cours en systèmes de communication et informatique (Bachelor et Master) utilisant des modèles stochastiques ou des méthodes aléatoires.

CS-323

Operating systems

Zwaenepoel Willy

Cursus	Sem.	Type
HES - IN	E	Obl.
Informatique	BA6	Obl.
Systèmes de communication	BA6	Opt.

Language	English
Credits	4
Session	Summer
Semester	Spring
Exam	During the semester
Workload	120h
Weeks	14
Hours	**4 weekly**
Lecture	2 weekly
Exercises	2 weekly

SUMMARY

Introduction to basic concepts of operating systems.

CONTENT

Function and general structure of an operating system.
Process management.
Memory management.
File systems.
Virtualization and virtual machines.

LEARNING PREQUISITES

Required courses
CS-206 Concurrency
CS-207 Systems programming

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Design key components of operating system
- Integrate new software into large software systems
- Assess / Evaluate performance implications

TEACHING METHODS

Ex cathedra, exercise sessions and programming projects.

EXPECTED STUDENT ACTIVITIES

Programming projects.

ASSESSMENT METHODS

Continuous.Written midterm exam 30%, written final exam 30%, programming projects 40%

SUPERVISION

Office hours	Yes
Assistants	Yes
Forum	Yes

RESOURCES

Bibliography

A. Silberschatz, Operating Systems Concepts, 9th edition.

Ressources en bibliothèque

- Operating Systems Concepts / Silberschatz

Références suggérées par la bibliothèque

Websites

http://moodle.epfl.ch/course/view.php?id=7241

CS-206 **Parallelism and concurrency**

Kuncak Viktor, Odersky Martin

Cursus	Sem.	Type
HES - IN	E	Obl.
Informatique	BA4	Obl.
Systèmes de communication	BA4	Opt.

Language	English
Credits	4
Session	Summer
Semester	Spring
Exam	During the semester
Workload	120h
Weeks	14
Hours	**4 weekly**
Lecture	1 weekly
Exercises	1 weekly
Project	2 weekly

SUMMARY

The course introduces parallel programming models, algorithms, and data structures, map-reduce frameworks and their use for data analysis, as well as shared-memory concurrency.

CONTENT

Parallel programming & execution models
Functional parallelism
Data-level parallelism
Threads and fork/join parallelism
Synchronization
Cache coherence
Memory models
Threads and Shared Memory in Java
Performance optimization

KEYWORDS

Parallelism, threads, synchronization, locks, memory models.

LEARNING PREQUISITES

Required courses

- Functional programming (CS-210)
- Algorithms (CS-250)
- Computer Architecture (CS-208)

Recommended courses

System oriented programming (CS-207)

Important concepts to start the course

Functional programming and functional data structures
Algorithms and data structures

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Construct parallel software.
- Perform tuning parallel software.

TEACHING METHODS

Ex cathedra, labs, exercices

ASSESSMENT METHODS

With continuous control

RESOURCES

Notes/Handbook

Lecture notes, copies of the slides

COM-302 **Principles of digital communications**

Urbanke Rüdiger

Cursus	Sem.	Type
HES -SC	E	Obl.
Informatique	BA6	Opt.
Systèmes de communication	BA6	Obl.

Language	English
Credits	6
Session	Summer
Semester	Spring
Exam	Written
Workload	180h
Weeks	14
Hours	**6 weekly**
Lecture	4 weekly
Exercises	2 weekly

SUMMARY

This course is on the foundations of digital communication. The focus is on the transmission problem (rather than being on source coding).

CONTENT

Optimal receiver for vector channels
Optimal receiver for waveform (AWGN) channels
Various signaling schemes and their performance
Efficient signaling via finite-state machines
Efficient decoding via Viterbi algorithm
Communicating over bandlimited AWGN channels
Nyquist Criterion
Communicating over passband AWGN channels

KEYWORDS

Detection, estimation, hypothesis testing, Nyquist, bandwidth, error probability, coding, decoding, baseband, passband, AM, QAM, PSK.

LEARNING PREQUISITES

Required courses

Signal processing for communications and modèles stochastiques pour les communications

Important concepts to start the course

Linear algebra, probability.

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Estimate the error probability of a communication link
- Design a "physical layer" communication link
- Implement a prototype of a "physical layer" transmitter/receiver via Matlab

TEACHING METHODS

Ex cathedra + exercises + project. Lots of reading at home and exercises in class.

ASSESSMENT METHODS

With continuous control

RESOURCES

Websites

http://moodle.epfl.ch

PREREQUISITE FOR

Advanced Digital Communications
Software-Defined Radio: A Hands-On Course

MATH-232 **Probability and statistics**

Davison Anthony C.

Cursus	Sem.	Type
HES - IN	E	Obl.
HES -SC	E	Obl.
Informatique	BA4	Obl.
Systèmes de communication	BA4	Obl.

Language	English
Credits	6
Session	Summer
Semester	Spring
Exam	Written
Workload	180h
Weeks	14
Hours	**6 weekly**
Lecture	4 weekly
Exercises	2 weekly

SUMMARY

A basic course in probability and statistics

CONTENT

Revision of basic set theory and combinatorics.
Elementary probability: random experiment; probability space; conditional probability; independence.
Random variables: basic notions; density and mass functions; examples including Bernoulli, binomial, geometric, Poisson, uniform, normal; mean, variance, correlation and covariance; moment-generating function; joint distributions, conditional and marginal distributions; transformations.
Many random variables: notions of convergence; laws of large numbers; central limit theorem; delta method; applications.
Descriptive statistics: basic graphs and statistics; notions of robustness.
Statistical inference: different types of estimator and their properties and comparison; confidence intervals; hypothesis testing; likelihood inference and statistical modelling; Bayesian inference and prediction; examples.

LEARNING PREQUISITES

Required courses
Analyse I, II
Algèbre linéaire

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Interpret data through simple graphics
- Compute probabilities based on simple combinations of logical statements
- Contrast probability models and data
- Construct confidence intervals for inference under uncertainty
- Infer characteristics of probability models from empirical data
- Derive probabilities and other properties of random samples
- Compute measures of location, scale and association for simple datasets
- Formulate probability models appropriate for simple problems

TEACHING METHODS

Ex cathedra lectures, exercises and problems

ASSESSMENT METHODS

Quizzes, mid-term test, final exam

SUPERVISION

Office hours	No
Assistants	Yes
Forum	Yes

RESOURCES

Bibliography

Ross, S. (2012) A first course in probability (9th edition). Pearson.
Aussi disponible en traduction française (PPUR): `Initiation aux probabilités'.
A polycopié of the course notes, with the problems etc., will also be available.

Moodle Link

http://moodle.epfl.ch/course/view.php?id=14411

PREREQUISITE FOR

Electrométrie, Théorie du signal, Télécommunications, Information et codage, Fiabilités, ...

CS-207 **Programmation orientée système**

Chappelier Jean-Cédric

Cursus	Sem.	Type
HES - IN	E	Obl.
HES -SC	E	Obl.
Informatique	BA4	Obl.
Systèmes de communication	BA4	Obl.

Langue	français
Crédits	3
Session	Eté
Semestre	Printemps
Examen	Pendant le semestre
Charge	90h
Semaines	14
Heures	**3 hebdo**
Cours	1 hebdo
Exercices	2 hebdo

RESUME

Cours de programmation en langage C se focalisant sur l'utilisation des ressources système, en particulier la gestion de la mémoire (pointeurs).

CONTENU

Initiation à la programmation en C : variables, expressions, structures de contrôle, fonctions, entrées-sorties, ...

Approfondissement des spécificités de la programmation système rudimentaire : gestion de la mémoire (pointeurs), des fichiers et autres entrées/sorties.

Les concepts théoriques introduits lors des cours magistraux seront mis en pratique dans le cadre d'exercices sur machine.

MOTS-CLES

Programmation, langage C, pointeurs, gestion mémoire

COMPETENCES REQUISES

Cours prérequis indicatifs

Introduction à la programmation (CS-107) + Pratique de la programmation orientée-objet (CS-108)

Concepts importants à maîtriser

bases de programmation

ACQUIS DE FORMATION

A la fin de ce cours l'étudiant doit être capable de:

- Modéliser en langage C une situation simple du monde réelle décrite en Français
- Analyser un problème complexe relatifs aux systèems d'information pour le décomposer en sous-problèmes
- Concevoir des algorithmes résolvant des tâches simple à avancées relatives au systèmes informatiques
- Réaliser de façon autonome une application de petite taille au moyen du langage C
- Analyser du code C pour en décrire le résultat ou le corriger s'il est erroné
- Tester l'adéquation du résultat d'un programme par rapport à la tâche demandée
- Transcrire un algorithme en son programme équivalent en C

Compétences transversales

- Utiliser les outils informatiques courants ainsi que ceux spécifiques à leur discipline.
- Persévérer dans la difficulté ou après un échec initial pour trouver une meilleure solution.
- Accéder aux sources d'informations appropriées et les évaluer.
- Utiliser une méthodologie de travail appropriée, organiser un/son travail.
- Recevoir du feedback (une critique) et y répondre de manière appropriée.
- Gérer ses priorités.

METHODE D'ENSEIGNEMENT

Ex cathedra, travaux pratiques sur ordinateur

TRAVAIL ATTENDU

participation au cours et aux exercices ; travail personnel à la maison.

METHODE D'EVALUATION

2 exercices à rendre (17 %), 1 série pratique notée (33%) et examen final papier (50%)

ENCADREMENT

Office hours	Non
Assistants	Oui
Forum électronique	Oui

RESSOURCES

Bibliographie

Notes de cours

Liens Moodle

http://moodle.epfl.ch/course/view.php?id=6731

PREPARATION POUR

Introduction au bases de données (CS-322) ; Concurrence (CS-206) ; Systèmes d'exploitation (CS-323) ; Genie logiciel (CS-305)

CS-309 **Projet de Systems-on-Chip**

Beuchat René

Cursus	Sem.	Type
Informatique	BA6	Opt.
Systèmes de communication	BA6	Opt.

Langue	français
Crédits	3
Session	Eté
Semestre	Printemps
Examen	Pendant le semestre
Charge	90h
Semaines	14
Heures	**3 hebdo**
Projet	3 hebdo

RESUME

Les étudiants mettront en pratique leurs connaissances en génie informatique, principalement au niveau du matériel. Ils utiliseront des micro-contrôleurs et des systèmes sur FPGA & ARM. Ils utiliseront des outils de cross-développement ainsi que des analyseurs logiques et oscilloscopes.

CONTENU

Ce cours est centré sur des laboratoires pratiques à réaliser par les étudiants. Généralement une introduction d'une heure est suivie de 1 à 3 sessions pour réaliser des mini-projets par groupes.
Lors des laboratoires, les travaux seront effectués sur des cartes FPGA-SOC avec processeurs embarqués sous forme softcore (NIOSII) et/ou hardcore (ARM). Des interfaces programmables simples et complexes seront développées en VHDL pour s'interfacer avec des modules externes à contrôler. La méthodologie pas-à-pas sera utilisée pour arriver à la réalisation de systèmes relativement complexe.
Les sujets suivants seront étudiés et implémentés :

1. Analyse du système : Multicore ARMs, FPGA, I/Os, et interfaces programmables spécialisées ;
2. Design et simulation d'une interface programmable réalisée en VHDL (I, II) ;
3. Design et simulation d'un accélérateur spécifique réalisé en VHDL (I,II, III) ;
4. Test du système spécifique avec développement de logiciel en C avec des outils de cross-debugging (baremetal coding)(I) ;
5. Boot et test d'un système embarqué, baremetal design (I, II) ;
6. Installation d'un OS: Adaptation et compilation de Linux pour la carte de laboratoire (I, II) ;
7. Développement d'un logiciel de démonstration (I, II) ;
8. Présentation des résultats.

MOTS-CLES

Micro-controllers, Micro-contrôleurs, FPGA, SOC, Embedded Systems, Logic Analyzer, Oscilloscope, projects, work in groups, C, VHDL.

COMPETENCES REQUISES

Cours prérequis obligatoires

- CS-173: Conception de systèmes numériques
- CS-208: Architecture des ordinateurs
- CS-209: Architecture des Systems-on-Chip
- CS-307: Architectures parallèles

Concepts importants à maîtriser

Les étudiants doivent connaître l'architecture d'un processeur, d'un système informatique, quelques notions de programmation en C, en langage assembleur et en VHDL.

ACQUIS DE FORMATION

A la fin de ce cours l'étudiant doit être capable de:

- Analyser le problème à résoudre ;
- Planifier le travail à réaliser ;
- Créer l'architecture du système à réaliser ;
- Coordonner le travail ;
- Concevoir le système à réaliser ;
- Implémenter la solution ;
- Intégrer les modules disponibles ;
- Expliquer la solution développée.

Compétences transversales

- Planifier des actions et les mener à bien de façon à faire un usage optimal du temps et des ressources à disposition.
- Fixer des objectifs et concevoir un plan d'action pour les atteindre.
- Communiquer efficacement et être compris y compris par des personnes de languages et cultures différentes.
- Persévérer dans la difficulté ou après un échec initial pour trouver une meilleure solution.
- Faire preuve d'esprit critique
- Utiliser les outils informatiques courants ainsi que ceux spécifiques à leur discipline.

METHODE D'ENSEIGNEMENT

- Travail par groupes de 4 étudiants ;
- Laboratoires pratiques ;
- Mini-projets spécifiques par groupe ;
- Travaux avec des outils de développement croisé et de systèmes matériels réels ;
- Utilisation des outils de débogage tels que oscilloscopes et analyseurs logiques ;
- Les travaux sont réalisés sur les systèmes matériels réels avec des micro-contrôleurs et FPGA.

TRAVAIL ATTENDU

- Brainstorming par groupe ;
- Répartition de la charge de travail à travers le groupe ;
- Gestion de la planification ;
- Analyse des données des data-sheet des composants utilisés ;
- Résolution de problèmes pratiques sur des systèmes matériels ;
- Développement de modules FPGA en VHDL ;
- Développement de logiciels en C et observation en assembleur du déroulement du programme ;
- Configuration et construction d'un Linux sur un système embarqué.

METHODE D'EVALUATION

1. Rapports réguliers (50%)
2. Présentation orale finale (25%)

3. Démonstration (25%)

ENCADREMENT

Office hours	Non
Assistants	Non
Forum électronique	Oui

RESSOURCES

Liens Moodle
http://moodle.epfl.ch/course/view.php?id=14480

PREPARATION POUR

CS-473: Embedded Systems
CS-476: Real Time Embedded systems

COM-307

Projet en systèmes de communication I

Profs divers *

Cursus	Sem.	Type
Systèmes de communication	BA5, BA6	Obl.

Langue	français
Crédits	8
Session	Hiver, Eté
Semestre	Automne
Examen	Pendant le semestre
Charge	240h
Semaines	14
Heures	**2 hebdo**
Projet	2 hebdo

RESUME

Travaux de recherche individuelle à effectuer pendant le semestre selon les directives d'un professeur ou d'un assistant.

CONTENU

Sujet de travail à choisir parmi les domaines proposés sur le site web :

http://ic.epfl.ch/page-24761-fr.html

ACQUIS DE FORMATION

A la fin de ce cours l'étudiant doit être capable de:

- Organiser un projet
- Evaluer sa progression au cours du projet
- Représenter un projet

Compétences transversales

- Ecrire un rapport scientifique ou technique.
- Ecrire une revue de la littérature qui établit l'état de l'art.

METHODE D'EVALUATION

Rapport écrit et présentation orale

RESSOURCES

Sites web

http://ic.epfl.ch/page-24758-fr.html

CS-207(a)

Projet programmation système

Bugnion Edouard, Chappelier Jean-Cédric

Cursus	Sem.	Type
HES - IN	E	Obl.
Informatique	BA4	Obl.
Systèmes de communication	BA4	Opt.

Langue	français
Crédits	2
Session	Eté
Semestre	Printemps
Examen	Pendant le semestre
Charge	60h
Semaines	14
Heures	**2 hebdo**
Projet	2 hebdo

RESUME

L'objectif de ce cours à projet est de donner aux étudiants une expérience de la pratique de la programmation système : écriture, correction, amélioration et analyse critique de leur code.

CONTENU

- Ce cours sera enseigné en parallèle du cours « Programmation Orientée Système » (CS-207). Il offre aux étudiants l'opportunité de développer dans un cadre pratique à large échelle les concepts présentés dans cet autre cours. Les étudiants devront en effet non seulement développer leur propre code à partir de rien sur un cas concret, mais aussi lire du code professionnel développé par d'autres de sorte à pouvoir s'en inspirer.
- Ce cours consistera en un projet constitué de plusieurs parties réparties sur le semestre. Il insistera sur les concepts clés présentés dans les autres cours liés au domaine de la programmation système (systèmes de fichiers, réseaux, accès mémoire, concurrence, …), mais mettra aussi en place de façon pratique plusieurs élémens qui seront approfondis plus tard dans le cursus (aspects réseaux avancés, planification, etc.) dans le but d'offrir aux étudiants une première approche pratique à ces concepts.

MOTS-CLES

- programmation système, gestion mémoire, système de fichiers

COMPETENCES REQUISES

Cours prérequis obligatoires

- Programmation Orientée Système (CS-207)
- Parallelism & Concurrency (CS-206)

Cours prérequis indicatifs

- Computer Networks

Concepts importants à maîtriser

- programmation
-

parallélisme et concurrence

ACQUIS DE FORMATION

A la fin de ce cours l'étudiant doit être capable de:

- Modéliser en langage C des problèmes système typiques
- Analyser des problèmes complexes relatifs aux sytèmes informatiques et les décomposer en sous-problèmes
- Réaliser des applications de taille moyenne en langage C
- Analyser des projet en langage C pour être capable de comprendre ce qu'ils font et comment ils sont organisés
- Tester les résultat d'un projet en langage C et le corriger là où cela est nécessaire

Compétences transversales

- Accéder aux sources d'informations appropriées et les évaluer.
- Recevoir du feedback (une critique) et y répondre de manière appropriée.
- Utiliser les outils informatiques courants ainsi que ceux spécifiques à leur discipline.
- Gérer ses priorités.
- Persévérer dans la difficulté ou après un échec initial pour trouver une meilleure solution.

METHODE D'ENSEIGNEMENT

projet

TRAVAIL ATTENDU

- écrire le code et la documentation d'un projet de groupe

METHODE D'EVALUATION

- rendu du projet en 3 étapes : 30 % pour les deux premières et 40 % pour le rendu final

ENCADREMENT

Office hours	Non
Assistants	Oui
Forum électronique	Oui

PREPARATION POUR

- CS-323 (Operating Systems)

CS-212

Reactive programming

Kuncak Viktor, Odersky Martin

Cursus	Sem.	Type
Informatique	BA4	Opt.
Systèmes de communication	BA4	Opt.

Language	English
Credits	2
Session	Summer
Semester	Spring
Exam	During the semester
Workload	60h
Weeks	14
Hours	**2 weekly**
Lecture	1 weekly
Exercises	1 weekly

REMARQUE

pas donné en 2015-16

SUMMARY

The course introduces reactive programming. We present notions of signals, futures, and actors.

CONTENT

Parallel programming

- parallel operations on sequences and sets
- parallel sorting, merging, and medians
- parallel operations on strings
- basics of Map-Reduce, along with commutativity and associativity conditions

Reactive Programming

- Futures
- Reactive streams
- Actor model of concurrency
- Supervision and failure handling
- Reliable message delivery and management of conversational state in actors

LEARNING PREREQUISITES

Required courses

- Functional programming (CS-210)
- Algorithms (CS-250)

Recommended courses

- Concurrency (CS-206)
- System oriented programming (CS-207)

Important concepts to start the course

- Functional programming and functional data structures
- Algorithms and data structures

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Construct parallel software
- Produce reactive distributed software

Transversal skills

- Resolve conflicts in ways that are productive for the task and the people concerned.
- Respect relevant legal guidelines and ethical codes for the profession.
- Demonstrate the capacity for critical thinking
- Use both general and domain specific IT resources and tools
- Use a work methodology appropriate to the task.
- Access and evaluate appropriate sources of information.

TEACHING METHODS

- Ex catedra
- MOOC
- Exercises

RESOURCES

Bibliography

- **Programming in Scala 2nd editio, http://www.chegg.com/textbooks/programming-in-scala-2nd-edition-9780981531649-0981531644?trackid=mqNK**

MGT-365

Ressources humaines dans les projets

Monnin Catherine

Cursus	Sem.	Type
Informatique	BA5	Opt.
Systèmes de communication	BA5	Opt.

Langue	français
Crédits	2
Session	Hiver
Semestre	Automne
Examen	Pendant le semestre
Charge	60h
Semaines	14
Heures	**2 hebdo**
Cours	2 hebdo

RESUME

Comprendre l'importance et le rôle du facteur humain au sein d'un projet. Responsabilité de chaque individu au sein d'un groupe dans la performance collective. Capacités relation. pour communiquer efficacement et s'affirmer positivement. Compréhension et confiance en soi pour coopérer efficacement.

CONTENU

RECONNAISSANCE INDIVIDUELLE ET INTELLIGENCE COLLECTIVE
Confiance en soi - Respect de soi - Estime de soi
Savoir s'affirmer dans milieu professionnel - Assertivité
Affirmation de soi
LE CONCEPT DE PROJET
Définition et caractéristiques d'un projet
LA DYNAMIQUE DU GROUPE DANS LES PROJETS
Les caractéristiques du groupe
Le fonctionnement des groupes
Les fonctions interpersonnelles
Les règles de comportement
Les rôles dans un groupe
La prise de décision
LE TRAVAIL D'EQUIPE
Coopérer efficacement au sein d'une équipe- Délégation, favoriser l'autonomie
Acteurs d'un projet -Manager une équipe - projet
Le leadership trois types de leadership
Motivation et communication en situation professionnelle
LA GESTION DES CONFLITS
Les signes de reconnaissance
S'exprimer en situations conflictuelles
Attitude à adopter face à la critique
LA CONDUITE D'UNE REUNION-PROJET
La préparation -Le but de la réunion -Le rôle de l'animateur
Le guide d'animation

MOTS-CLES

Communication intra et interpersonnelle - motivation - potentiel humain-projet

COMPETENCES REQUISES

Cours prérequis obligatoires

Pas de prérequis

Concepts importants à maîtriser

ACQUIS DE FORMATION

A la fin de ce cours l'étudiant doit être capable de:

- Prendre conscience de l'importance du facteur humain dans la réussite du projet
- Prendre conscience du potentiel humain de chaque acteur du projet
- Prendre conscience de ses atouts et de son potentiel d'amélioration
- Etre sensibilisé aux bases de la communication intra et interpersonnelle verbale et non verbale
- Etre sensibilisé à la présentation par équipe d'un projet

METHODE D'ENSEIGNEMENT

Théorético-pratique
Méthode très interactive
Cous avec des mises en situation, jeux de rôle etc.
Feedback personnalisé

TRAVAIL ATTENDU

Participation au cours, participation aux mises en situation
Réalisation de mini-projets
Motivation des étudiants prêts à s'investir

METHODE D'EVALUATION

Projet de groupe

RESSOURCES

Bibliographie

Références bibliographiques données au cours

Polycopiés

Polycopiés

COM-301

Sécurité des réseaux

Oechslin Philippe

Cursus	Sem.	Type
Information security minor	H	Opt.
Informatique	BA5	Obl.
Systèmes de communication	BA5	Obl.

Langue	français
Crédits	4
Session	Hiver
Semestre	Automne
Examen	Ecrit
Charge	120h
Semaines	14
Heures	**3 hebdo**
Cours	2 hebdo
Exercices	1 hebdo

RESUME

Comprendre les menaces présentes dans les réseaux informatiques et savoir comment protéger un réseau par des moyens techniques et organisationnels.

CONTENU

Menaces :

- Spam, phishing, virus, chevaux de Troie, dénis de service,exploitation de failles.

Mesures de protection :

- Firewalls, proxys, anti-virus, détection d'intrusion

Protocoles et applications :

- Messageries sécurisés (PGP, S/MIME)
- PPTP, L2TP, IPSec, HTTPS, SSL/TLS, SSH

Aspects organisationnels :

- Analyse de risques et politique de sécurité
- Normes et standards

Aspects réglementaire :

- Droit concernant les systèmes d'information

COMPETENCES REQUISES

Cours prérequis indicatifs

Notions de base de TCP/IP
Notions de base de programmation

ACQUIS DE FORMATION

A la fin de ce cours l'étudiant doit être capable de:

- Discuter les mécanismes des attaques informatiques.
- Evaluer l'impact d'une attaque informatique.
- Concevoir des mesures de protection d'un réseau informatique.
- Expliquer les protocoles cryptographiques vu au cours.
- Analyser un protocole cryptographique basé sur des primitives standard.
- Décrire un système de gestion de la sécurité de l'information.

METHODE D'ENSEIGNEMENT

Ex cathedra et exercices en salle

METHODE D'EVALUATION

Examen écrit

RESSOURCES

Bibliographie

Sécurité Informatique, cours et exercices corigés, Gildas Avoine, Pascal Junod et Philippe Oechslin, 2ème édition, Vuibert, 2010, ISBN:978-2-7117-4860-0

Ressources en bibliothèque

- Sécurité Informatique / Avoine

Références suggérées par la bibliothèque

Sites web

http://lasec.epfl.ch/teaching.shtml

COM-303

Signal processing for communications

Prandoni Paolo

Cursus	Sem.	Type
HES -SC	E	Obl.
Informatique	BA6	Opt.
Ing.-math	MA2, MA4	Opt.
Mathématicien	MA2	Opt.
Science et ing. computationelles	MA2	Obl.
Systèmes de communication	BA6	Obl.

Language	English
Credits	6
Session	Summer
Semester	Spring
Exam	Written
Workload	180h
Weeks	14
Hours	**6 weekly**
Lecture	4 weekly
Exercises	2 weekly

SUMMARY

Students learn digital signal processing theory, including discrete time, Fourier analysis, filter design, sampling, interpolation and quantization; they are introduced to image processing and data communication system design.

CONTENT

1. Basic discrete-time signals and systems: signal classes and operations on discrete-time signals, signals as vectors in Hilbert space
2. Fourier Analysis: properties of Fourier transforms, DFT, DTFT; FFT.
3. Discrete-Time Systems: LTI filters, convolution and modulation; difference equations; FIR vs IIR, stability issues.
4. Z-transform: properties and regions of convergence, applications to linear systems.
5. Filter Design: FIR design methods, IIR design methods, filter structures.
6. Stochastic Signal Processing: random processes, spectral representation.
7. Interpolation and Sampling: the continuous-time paradigm, interpolationthe sampling theorem, aliasing.
8. Quantization: A/D and D/A converters.
9. Multi-rate signal processing: upsampling and downsampling, oversampling.
10. Multi-dimensional signals and processing: introduction to Image Processing.
11. Practical applications: digital communication system design, ADSL.

KEYWORDS

signal processing, discrete-time, continuous-time, filter, filter design, sampling, aliasing, DSP, Fourier transform, FFT, modem, ADSL

LEARNING PREQUISITES

Required courses
calculus, linear algebra

Recommended courses
Circuits and systems, basic probability theory

Important concepts to start the course
vectors and vector spaces, functions and sequences, infinite series

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Identify signals and signal types
- Recognize signal processing problems
- Apply the correct analysis tools to specific signals
- Check system stability
- Manipulate rational transfer functions
- Implement signal processing algorithms
- Design digital filters
- Interpret complex signal processing systems

Transversal skills

- Use a work methodology appropriate to the task.
- Assess one's own level of skill acquisition, and plan their on-going learning goals.
- Use both general and domain specific IT resources and tools

TEACHING METHODS

Course with exercises in class and on the computer

EXPECTED STUDENT ACTIVITIES

complete weekly homework, write numerical routines to implement core concepts

ASSESSMENT METHODS

midterm exam for bonus points and final exam for final grade.

RESOURCES

Bibliography

Signal processing for Communications, EPFL Press, 2008, by P. Prandoni and M. Vetterli. The book is available for sale in printed form online and in bookstores; in iBook format on the Apple store and is also available as a free pdf file at http://www.sp4comm.org/

Ressources en bibliothèque

- Signal processing for Communications / Prandoni

Références suggérées par la bibliothèque

Websites

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PREREQUISITE FOR

adaptive signal processing, image processing, audio processing, advanced signal processing

CS-305 **Software engineering**

Larus James Richard

Cursus	Sem.	Type
HES - IN	H	Obl.
Informatique	BA5	Obl.
Science et ing. computationelles	MA1, MA3	Opt.
Systèmes de communication	BA5	Opt.

Language	English
Credits	6
Session	Winter
Semester	Fall
Exam	During the semester
Workload	180h
Weeks	14
Hours	**5 weekly**
Lecture	2 weekly
Project	3 weekly

SUMMARY

Covers basic aspects of modern software development tools and practices: the foundation of software engineering, thinking about software, structuring it, modifying it, and improving it. Also, covers the software development process, an Agile methods, and working as part of a team of developers.

CONTENT

- Object-oriented design and reasoning
- Design patterns
- Principles of building reliable and secure software
- Performance tuning
- Testing and debugging
- Code layout and style
- Development processes
- Software project management
- Tools for source code management and tools for writing and analyzing code

KEYWORDS

1. software development, software engineering, software design, software development tools, development processes, Agile, Android

LEARNING PREQUISITES

Required courses

This course builds on material taught in these courses, so you are required to have mastered their content:

- CS-107 Introduction to Programming
- CS-108 Practical of Object-Oriented Programming
- CS-210 Functional Programming
- CS-206 Concurrency
- CS-207 System-oriented Programming

Recommended courses

The material in the following courses may be helpful, but it is not required:

- COM-208 Computer networks

• CS-208/209 Computer architecture

Important concepts to start the course

• Object-oriented programming in Java
• Using version control systems (e.g., Git)
• Using the Android emulator

LEARNING OUTCOMES

By the end of the course, the student must be able to:

• Design software that is reliable, secure, user-friendly, performant, and safe
• Implement (in software) sophisticated designs and algorithms
• Specify requirements for software systems
• Develop code that is maintainable
• Organize a team to execute a medium-sized software project

TEACHING METHODS

• Online video lectures
• Physical in-class recitations and lab sessions
• Homework exercises
• Course project

EXPECTED STUDENT ACTIVITIES

• Watch online lectures
• Attend assigned recitations
• Read assigned materials
• Complete programming assignments and attend lab sessions
• Work with team members to complete substantial project

ASSESSMENT METHODS

Throughout the semester (contrôle continu). The final grade will be determined:

• 10% for 2 homework assignments done individually
• 50% for the project (done in teams of approximately 8 people)
• 40% based on two exams (contrôle continu) and several online quizzes

SUPERVISION

Office hours	Yes
Assistants	Yes
Forum	Yes
Others	See http://sweng.epfl.ch/

RESOURCES

Bibliography

See http://sweng.epfl.ch for up-to-date bibliography

Websites

http://sweng.epfl.ch/

CS-352 **Theoretical computer science**

Cursus	Sem.	Type
Informatique	BA5	Opt.
Systèmes de communication	BA5	Opt.

Language	English
Credits	4
Session	Winter
Semester	Fall
Exam	During the semester
Workload	120h
Weeks	14
Hours	**3 weekly**
Lecture	2 weekly
Exercises	1 weekly

REMARQUE

pas donné en 2015-16

SUMMARY

An in-depth introduction to some of the key ideas and tools of Theoretical Computer Science. Covered material touches upon: streaming algorithms, spectral graph theory, interactive and zero-knowledge proofs, pseudorandomness, algorithmic game theory, and quantum computing.

CONTENT

- Basics of streaming algorithms
- Fundamentals of spectral graph theory
- The power of randomness and interaction (zero-knowledge proofs and PCP theorem)
- Theory of pseudorandomness and one-way functions
- Introduction to algorithmic game theory
- Nature-inspired models of computations (quantum computing)

KEYWORDS

theoretical computer science, algorithms, computational complexity, streaming algorithms, spectral graph theory, randomness, pseudorandomness, algorithmic game theory, quantum computing

LEARNING PREQUISITES

Required courses
CS-150 Discrete Structures
CS-250 Algorithms
CS-251 Theory of Computation (former name: Theoretical Computer Science/Informatique théorique)
Mathematical maturity, i.e., ability to read and write mathematical proofs

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Analyze computational models
- Apply mathematical tools to understand computational processes
- Design space-/time-efficient algorithms for graph and estimation problems
- Formalize properties of interactive and cryptographic protocols
- Describe quantum model of computation

- Model game-theoretic aspects of real-world scenarios
- Explain the concept of pseudorandomness
- Perform a rigorous study of performance of an algorithm or a protocol

Transversal skills

- Use a work methodology appropriate to the task.
- Continue to work through difficulties or initial failure to find optimal solutions.

TEACHING METHODS

Ex cathedra with exercises

ASSESSMENT METHODS

Continuous control (problem sets and exams during the semester, no final exam)

CS-251 **Theory of computation**

Vishnoi Nisheeth

Cursus	Sem.	Type
HES - IN	E	Obl.
Informatique	BA4	Obl.
Systèmes de communication	BA4	Obl.

Language	English
Credits	4
Session	Summer
Semester	Spring
Exam	During the semester
Workload	120h
Weeks	14
Hours	**4 weekly**
Lecture	2 weekly
Exercises	2 weekly

SUMMARY

This course constitutes an introduction to theory of computation. It discusses the basic theoretical models of computing (finite automata, Turing machine), as well as, provides a solid and mathematically precise understanding of their fundamental capabilities and limitations.

CONTENT

- Basic models of computation (finite automata, Turing machine)
- Elements of computability theory (undecidability, reducibility)
- Introduction to complexity theory (time and space complexity, P vs. NP problem, theory of NP-completeness)

KEYWORDS

theory of computation, Turing machines, P vs. NP problem, complexity theory, computability theory, finite automata, NP-completeness

LEARNING PREQUISITES

Required courses
CS-150 Discrete Structures
CS-250 Algorithms

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Perform a rigorous study of performance of an algorithm or a protocol
- Classify computational difficulty of a decision problem
- Define the notion of NP-completeness
- Analyze various computation models
- Design a reduction between two computational problems
- Characterize different complexity classes
- Explain P vs. NP problem

Transversal skills

- Use a work methodology appropriate to the task.
- Continue to work through difficulties or initial failure to find optimal solutions.

TEACHING METHODS

Ex cathedra with exercises

ASSESSMENT METHODS

Written exam and continuous control

COM-309 **Traitement quantique de l'information**

Macris Nicolas

Cursus	Sem.	Type
Informatique	BA5	Opt.
Systèmes de communication	BA5	Opt.

Langue	français
Crédits	4
Session	Hiver
Semestre	Automne
Examen	Ecrit
Charge	120h
Semaines	14
Heures	**4 hebdo**
Cours	3 hebdo
Exercices	1 hebdo

RESUME

L'information est traitée et stockée dans des composants matériels. Avec leur miniaturisation, il faut remplacer le concept de bit classique doit être remplacé par la notion de bit quantique. Ce cours développe le sujet des communications, de la cryptographie et des corrélations quantiques.

CONTENU

Introduction a la mecanique quantique des systemes discrets.
- Polarisation des photons, états quantiques, règle de Born.
- Expérience de Stern-Gerlach, spin 1/2, états quantiques sur la sphère de Bloch.
- Dynamique du spin, Oscillations de Rabi et manipulations de l'état quantique.
- Notion abstraite de qubit. Etats à plusieurs qubits.

Cryptographie, Communications et Corrélations
- Génération d'une clé secrète: protocoles BB84 et B92.
- Intrication: paires de Einstein-Podolsky-Rosen.
- Inégalités de Bell. Expériences d'Aspect-Grangier. Protocole de Ekert pour une clé secrète.
- Protocoles de téléportation et dense coding.

MOTS-CLES

Polarisation, spin, bit quantique, intrication, téléportation, cryptographie quantique.

COMPETENCES REQUISES

Cours prérequis obligatoires
Algèbre linéaire.

Cours prérequis indicatifs
physique de base: mécanique et ondes.

Concepts importants à maîtriser
Matrices, valeurs et vecteurs propres, produit scalaire, manipulations algébriques de base avec des nombres complexes.

ACQUIS DE FORMATION

A la fin de ce cours l'étudiant doit être capable de:

- Expliquer les principes de la physique quantique pour les systèmes discrets
- Expliquer le concept de qubit et donner quelques exemples
- Décrire comment manipuler des qubits
- Connaitre les protocoles de base de la cryptographie quantique.

• Connaitre les protocoles de dense coding et de téléportation.

• Expliquer ce qu'est l'intrication.

METHODE D'ENSEIGNEMENT

Ex-Cathedra. Séances d'exercices. Discussions des lectures pédagogiques proposées aux étudiants.

TRAVAIL ATTENDU

Participation au cours. Résolution d'exercices. Lectures de revues pédagogiques.

METHODE D'EVALUATION

Examen écrit.

RESSOURCES

Bibliographie

David Mermin, ***Quantum computer science, An introduction*****,** *Cambridge university press 2000.* Livre écrit pour des informaticiens et qui ne requiert pas de connaissances en physique..
Michel Le Bellac, ***A short introduction to quantum information and quantum computation,*** *Cambridge University Press. Pour l'édition en francais voir Editions Belin 2005.* Un livre pédagogique qui introduit quelques aspects physiques elementaires du sujet.
Neil Gershenfeld. *The physics of information technology.* *Cambridge University Press*. Un livre original sur les technologies de base utiles en informatique et communication classique et/ou quantique.

Ressources en bibliothèque

• A short introduction to quantum information and quantum computation / Le Bellac

• Quantum computer science / Mermin

Références suggérées par la bibliothèque

Polycopiés

Notes fournies en classe. Revues sur le sujet. exercices et corrigés fournis en cours d'année.

Sites web

https://ipg.epfl.ch/doku.php?id=en:courses

PREPARATION POUR

Calcul quantique

ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE

SECTION DE SYSTEMES DE COMMUNICATION

Cycle

Master

2015 / 2016

CS-450

Advanced algorithms

Moret Bernard

Cursus	Sem.	Type
Information security minor	E	Opt.
Informatique et communications		Obl.
Informatique	MA2	Obl.
SC master EPFL	MA2, MA4	Opt.
Science et ing. computationelles	MA2	Opt.

Language	English
Credits	7
Session	Summer
Semester	Spring
Exam	During the semester
Workload	210h
Weeks	14
Hours	**7 weekly**
Lecture	4 weekly
Exercises	2 weekly
Project	1 weekly

SUMMARY

A first graduate course in algorithms, this course assumes minimal background, but moves rapidly. The objective is to learn the main techniques of algorithm analysis and design, with an emphasis on randomization, while building a repertory of basic algorithmic solutions to problems in many domains.

CONTENT

Algorithm analysis techniques: worst-case and amortized, average-case, randomized, competitive. Basic algorithm design techniques: greedy, iterative, incremental, divide-and-conquer, dynamic programming, and randomization. Examples from graph theory, linear algebra, geometry, biology, operations research, and finance.

KEYWORDS

See content.

LEARNING PREQUISITES

Required courses

An undergraduate course in Discrete Structures / Discrete Mathematics, covering formal notation (sets, propositional logic, quantifiers), proof methods (derivation, contradiction, induction), enumeration of choices and other basic combinatorial techniques, graphs and simple results on graphs (cycles, paths, spanning trees, cliques, coloring, etc.).

Recommended courses

An undergraduate course in Data Structures and Algorithms.
An undergraduate course in Probability and Statistics.

Important concepts to start the course

Basic data structures (arrays, lists, stacks, queues,trees) and algorithms (binary search; sorting; graph connectivity); basic discrete mathematics (proof methods, induction, enumeration and counting, graphs); elementary probability and statistics (random variables, distributions, independence, conditional probabilities); data abstraction.

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Use a suitable analysis method for any given algorithm
- Prove correctness and running-time bounds
- Design new algorithms for variations of problems studied in class
- Select appropriately an algorithmic paradigm for the problem at hand

• Define formally an algorithmic problem

TEACHING METHODS

Ex cathedra lecture, reading

EXPECTED STUDENT ACTIVITIES

In addition to the usual study of course material, weekly homework in teams, written using LaTeX and turned in as PDF files.

ASSESSMENT METHODS

Three tests during the semester; students whose grades improve during the semester will be assigned semester grades above their average grade.
Graded weekly homework (except in the first and last weeks and in test weeks) helps decide grades for those whose results are midway between two groups.

SUPERVISION

Office hours	Yes
Assistants	Yes
Others	For details, see the course web page.

RESOURCES

Bibliography

See web page for the course.

Ressources en bibliothèque

- Randomized Algorithms / Motwani
- Approximation Algorithms / Vazirani
- Quantum Computation and Quantum Information / Nielsen
- Algebraic Complexity Theory / Buergisser
- Computational Complexity / Papadimitrou

Références suggérées par la bibliothèque

Notes/Handbook

Class notes from past years are available from the course web page.
Class notes for the running semester will be provided as needed within a few days after each lecture.

Websites

http://lcbb.epfl.ch/algs14/

MATH-400 Advanced analysis I

Ruppen Hans-Jörg

Cursus	Sem.	Type
Bioingénierie	MA1, MA3	Opt.
SC master EPFL	MA1, MA3	Opt.
Sciences du vivant	MA1, MA3	Opt.

Language	English
Credits	4
Session	Winter
Semester	Fall
Exam	Oral
Workload	120h
Weeks	14
Hours	**4 weekly**
Lecture	2 weekly
Exercises	2 weekly

REMARQUE

Advanced Analysis I and Advanced Analysis II must be taken together as a whole

SUMMARY

Getting access to the concept of measures and probabilities, to that of Lebesgue's integral as well as to the idea of Fourier.

CONTENT

1. Measuring sets
2. Integrating measurable functions
3. Convergence theorems
4. Fubini's theorem
5. Normed spaces
6. Banach spaces

KEYWORDS

System of sets, fields, Lebesgu-Stieltjes measures, probabilities measures generated by monotn mappings, Lebesgue's integral, integrability and quasi-integrability, monotone convergence theorem, deminated convergence theorem, Fubini's therem, noremd Spaces, Banach spaces, Lp-spaces

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Characterize the domain of a measure
- Construct measures and probability spaces
- Explain Lebesgue's integral
- Compare different notions of integrals
- Formulate hypotheses for the validity of results as interchanging the order of sums, integrals and limits
- Explain the main concepts and propositions presented in the lecture
- Exploit the main propositions in concrete examples

Transversal skills

- Assess one's own level of skill acquisition, and plan their on-going learning goals.
- Continue to work through difficulties or initial failure to find optimal solutions.
- Communicate effectively with professionals from other disciplines.

TEACHING METHODS

Ex cathedra lecture with exercises

EXPECTED STUDENT ACTIVITIES

Understanding the mathematical language necessary for a deep understanding of the notions of measure and integral as well as of the notion of function spaces.

ASSESSMENT METHODS

Oral exam

SUPERVISION

Office hours	No
Assistants	No
Forum	No

RESOURCES

Bibliography

M. Capinski, E. Kopp : Measure, Integral and probability, Springer.
Y. M. Berezansky, Z. G. Sheftel, G. F. Us: Functiona Analysis (I & II), Birkhäuser ISBN 3-7643-5344-9
C. Gasquet, P. Witomski: Fourier Analysis and Applications, Springer, ISBN 0-387-98485-2
W. Kammler: A First Course in Fourier AnalysisDavid, Online ISBN: 9780511619700 Hardback ISBN: 9780521883405 Paperback ISBN: 9780521709798

Ressources en bibliothèque

- A First Course in Fourier Analysis David / Kammler
- Functiona Analysis / Berezansky
- Fourier Analysis and Applications / Gasquet
- Measure, Integral and probability / Capinski

Références suggérées par la bibliothèque

Notes/Handbook

Lecture notes: Advanced Analysis I by Hans-Jörg Ruppen (Librairie La Fontaine)

Websites

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PREREQUISITE FOR

Advanced Analysis II, probabilities, signal processing

MATH-401 **Advanced analysis II**

Ruppen Hans-Jörg

Cursus	Sem.	Type
Bioingénierie	MA2, MA4	Opt.
SC master EPFL	MA2, MA4	Opt.
Sciences du vivant	MA2, MA4	Opt.

Language	English
Credits	4
Session	Summer
Semester	Spring
Exam	Oral
Workload	120h
Weeks	14
Hours	**4 weekly**
Lecture	2 weekly
Exercises	2 weekly

REMARQUE

Advanced Analysis I and Advanced Analysis II must be taken together as a whole

SUMMARY

Getting access to the use of Banach spaces, Hilbert spaces, Fourier series, Fourier tansforms and distributions.

CONTENT

1. Inner product spaces and Hilbert spaces
2. L2 spaces
3. Orthonormal sets in Hilbert spaces: Fourier coefficients, Bessel inequality and equality
4. Periodic signals and Fourier series
5. Fourier Transform in L1 and in L2
6. Distrribution spaces
7. Tempered distributions and Fourier transform

KEYWORDS

inner product spaces, Hilbert spaces, Lp spaces, orthonoral sets, Fourier coefficients, Fourier transform, distributions, tempered distributions, peridoic signals, Dirac comb, sampling of a signal

LEARNING PREQUISITES

Recommended courses

Advanced Analysis I

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Explain the main concepts and propositions presented in the lecture
- Detect the main properties (as Banach, Hilbert, norm, inner product) in examples
- Exploit the main propositions in concrete examples
- Formalize the main tools used for signals (sampling,...)
- Theorize the environment in which Fourier analysis is permormed

Transversal skills

- Assess one's own level of skill acquisition, and plan their on-going learning goals.

• Continue to work through difficulties or initial failure to find optimal solutions.

• Communicate effectively, being understood, including across different languages and cultures.

TEACHING METHODS

Ex cathedra lecture and exercises in the classroom

EXPECTED STUDENT ACTIVITIES

Understanding the mathematical language necessary for a deep understanding of signals and their transforms, of the Lebesgue spaces and the distribution spaces

ASSESSMENT METHODS

Oral exam

RESOURCES

Bibliography

C. Gasquet, P. Witomski: Fourier Analysis and Applications, Springer, ISBN 0-387-98485-2
W. Kammler: A First Course in Fourier AnalysisDavid, Online ISBN: 9780511619700 Hardback ISBN: 9780521883405 Paperback ISBN: 9780521709798

Ressources en bibliothèque

- Fourier Analysis and Applications / Gasquet
- A First Course in Fourier AnalysisDavid / Kammler

Références suggérées par la bibliothèque

Notes/Handbook

Lecture notes: Advanced Analysis II by Hans-Jörg Ruppen (Librairie La Fontaine)

Websites

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PREREQUISITE FOR

Diploma

CS-470

Advanced computer architecture

Ienne Paolo

Cursus	Sem.	Type
Génie électrique et électronique	MA2	Opt.
Information security minor	E	Opt.
Informatique	MA2	Obl.
SC master EPFL	MA2, MA4	Opt.

Language	English
Credits	4
Session	Summer
Semester	Spring
Exam	Oral
Workload	120h
Weeks	14
Hours	**4 weekly**
Lecture	2 weekly
Project	2 weekly

SUMMARY

The course studies the most important techniques to exploit Instruction-Level Parallelism and discusses the relation with the critical phases of compilation. It also analyses emerging classes of processors for complex single-chip systems.

CONTENT

Pushing processor performance to its limits:

- Principles of Instruction Level Parallelism (ILP).
- Register renaming techniques.
- Prediction and speculation.
- Simultaneous multithreading.
- VLIW and compiler techniques for ILP.
- Dynamic binary translation.

Embedded processors:

- Specificities over stand-alone processors.
- Overview of DSPs and related compilation challenges.
- Configurable and customisable processors.

KEYWORDS

Processors, Instruction Level Parallelism, Systems-on-Chip, Embedded Systems.

LEARNING PREQUISITES

Required courses

- Architecture des ordinateurs I (coursebook until 2013-2014).
- Architecture des ordinateurs (coursebook since 2014-2015).

Recommended courses

- Architecture des ordinateurs II (coursebook until 2013-2014).
- Architecture des systèmes-on-chip (coursebook since 2014-2015).

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Design strategies to exploit instruction level parallelism in processors.
- Contrast static and dynamic techniques for instruction level parallelism.

• Design effective processor (micro-)architectures for which efficient compilers can be written.

TEACHING METHODS

Courses, labs, and compulsory homeworks.

ASSESSMENT METHODS

Final oral exam.

SUPERVISION

Office hours	No
Assistants	Yes
Forum	No

RESOURCES

Bibliography

• John L. Hennessy and David A. Patterson, Computer Architecture: A Quantitative Approach, Morgan Kaufman, 5th edition, 2011.

Ressources en bibliothèque

• Computer Architecture / Hennessy

Références suggérées par la bibliothèque

Websites

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CS-440

Advanced computer graphics

Pauly Mark

Cursus	Sem.	Type
Informatique	MA1, MA3	Opt.
SC master EPFL	MA1, MA3	Opt.

Language	English
Credits	4
Session	Winter
Semester	Fall
Exam	During the semester
Workload	120h
Weeks	14
Hours	**3 weekly**
Lecture	2 weekly
Exercises	1 weekly

SUMMARY

Students study and apply the core concepts of photorealistic rendering algorithms and physics-based animation systems. Monte Carlo methods for global illumination, core algorithms for particle systems, deformable models, rigid body simulation, fluid animation, are discussed.

CONTENT

This course covers advanced topics in computer graphics. We will focus on two specific questions: How to create photo-realistic renderings and how to create physically plausible animations?

To answer the first question, we will first discuss and analyze the classical raytracing algorithm. With an understanding of the limitations of raytracing, we will look at a more principled way of image synthesis based on the physics of light transport. After studying the basic physical quantities of light transport and corresponding local illumination models, we will derive the global rendering equation as a model for image synthesis. We then discuss Monte Carlo methods for evaluating this integral equation leading to several Monte Carlo rendering algorithms such as path tracing or photon mapping.

In the second part of the course we will study concepts and algorithms for the animation of solids and fluids. Starting with simple particle systems and mass-spring networks, we will discuss numerical time integration methods commonly applied for computer animation. Rigid body simulation and elastic materials will also be covered. We then look at how the approximate solutions of the Navier-Stokes equations can be computed to simulate fluid flow.

LEARNING PREQUISITES

Required courses
Nothing

Recommended courses
Introduction to Computer Graphics

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Analyze the basic raytracing algorithm and explain its limitations
- Explain a local illumination model and derive the rendering equation
- Design and implement a rendering algorithm based on Monte Carlo path tracing
- Explain the physical laws of motion relevant for computer animation
- Design and implement a basic simulation system
- Assess / Evaluate the performance and conceptual limits of the implemented simulation code
- Coordinate a team during a software project

TEACHING METHODS

Lectures, interactive demos, theory and programming exercises, programming project, project tutoring

EXPECTED STUDENT ACTIVITIES

The student are expected to study the provided reading material and actively participate in class. They should prepare and resolve the exercises, prepare and carry out the programming project. Exercises and project are done in groups of three students.

ASSESSMENT METHODS

Exercises & project (40%), final examination (60%)

SUPERVISION

Office hours	Yes
Assistants	Yes
Forum	Yes

RESOURCES

Bibliography

A list of books will be provided at the beginning of the class

Notes/Handbook

Slides and online resources will be provided in class

Websites

http://lgg.epfl.ch/ACG

COM-501 Advanced cryptography

Vaudenay Serge

Cursus	Sem.	Type
Information security minor	E	Opt.
SC master EPFL	MA2, MA4	Opt.

Language	English
Credits	4
Session	Summer
Semester	Spring
Exam	Written
Workload	120h
Weeks	14
Hours	**4 weekly**
Lecture	2 weekly
Exercises	2 weekly

SUMMARY

This course reviews some failure cases in public-key cryptography. It introduces some cryptanalysis techniques. It also presents fundamentals in cryptography such as interactive proofs. Finally, it presents some techniques to validate the security of cryptographic primitives.

CONTENT

1. **Public-key cryptography:** Factoring, RSA problem, discrete logarithm problem, attacks based on subgroups
2. **Conventional cryptography:** differential and linear cryptanalysis, hypothesis testing, decorrelation
3. **Interactive proofs:** NP-completeness, interactive systems, zero-knowledge
4. **Proofs techniques:** Security of encryption, random oracles, game reduction techniques

KEYWORDS

cryptography, cryptanalysis, interactive proof, security proof

LEARNING PREQUISITES

Required courses

- Cryptography and security (COM-401)

Important concepts to start the course

- Cryptography
- Mathematical reasoning
- Number theory and probability theory
- Algorithmics
- Complexity

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Assess / Evaluate the security deployed by cryptographic schemes
- Prove or disprove security
- Justify the elements of cryptographic schemes

- Analyze cryptographic schemes
- Implement attack methods
- Model security notions

TEACHING METHODS

ex-cathedra

EXPECTED STUDENT ACTIVITIES

- active participation during the course
- take notes during the course
- do the exercises during the exercise sessions
- complete the regular tests and homework
- read the material from the course
- self-train using the provided material
- do the midterm exam and final exam

ASSESSMENT METHODS

Mandatory continuous evaluation:

- homework (30%)
- regular graded tests (30%)
- midterm exam (40%)

Final exam averaged (same weight) with the contiuous evaluation, but with final grade between final_exam-1 and final_exam+1.

SUPERVISION

Office hours	No
Assistants	Yes
Forum	No
Others	Lecturers and assistants are available upon appointment.

RESOURCES

Bibliography

- Communication security: an introduction to cryptography. Serge Vaudenay. Springer 2004.
- A computational introduction to number theory and algebra. Victor Shoup. Cambridge University Press 2005.
- Algorithmic cryptanalysis. Antoine Joux. CRC 2009.

Ressources en bibliothèque

- Algorithmic cryptanalysis / Joux
- Communication security / Vaudenay
- A computational introduction to number theory and algebra / Shoup

Références suggérées par la bibliothèque

Websites

http://lasec.epfl.ch/teaching.shtml

COM-510

Advanced digital communications

Gastpar Michael Christoph

Cursus	Sem.	Type
SC master EPFL	MA1, MA3	Obl.

Language	English
Credits	7
Session	Winter
Semester	Fall
Exam	Written
Workload	210h
Weeks	14
Hours	**6 weekly**
Lecture	4 weekly
Exercises	2 weekly

SUMMARY

Digital communication systems are basic workhorses behind the information age. Examples include high-speed wired and wireless networks, but also CDs, hard drives, and flash memory. This class presents the tools and concepts behind present and emerging systems, including OFDM, GSM, 3G, and 4G/LTE.

CONTENT

Digital communication systems are basic workhorses behind the information age. Examples include high-speed wired and wireless networks, but also storage technologies such as CDs, hard drives, and flash memory. Yet another example is the Global Positioning System (GPS), which is also based on digital communications. This course is an introduction to the foundational principles underlying the design and analysis of digital communication systems. Principled approaches and mathematical sophistication have had an exceptionally profound impact on the development of these systems. The class will provide the student with a command of the tools and concepts behind present and emerging systems, including OFDM, GSM, 3G, 4G/LTE, and more.

1. Foundations of Signalling, Detection and Estimation (3 weeks)
2. Wired Communication: OFDM, the foundations behind ADSL and beyond (3 weeks)
3. Wireless Communication: Diversity and the foundations behind LTE/4G Wireless and emerging wireless technologies, including multi-user communication (4 weeks)
4. Coding Techniques (3 weeks)

KEYWORDS

Wireless, OFDM, ADSL, Fading, Diversity, Coding, Modulation, Multi-user communication, GSM, 3G, 4G, LTE

LEARNING PREQUISITES

Required courses

"Principles of Digital Communications"

Recommended courses

"Circuits and Systems" / "Signals and Systems" (in particular, Fourier and Z-transforms).
"Linear Algebra" (concepts of matrices, vectors, eigenvalues)

Important concepts to start the course

Basic familiarity with Fourier transforms, vectors, matrices and eigenvalues, will be an advantage in this class.

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Assess / Evaluate an ADC (advanced digital communication) system (data rate, spectral bandwidth, energy requirements, error probability, implementation complexity)

• Design an ADC system (data rate, spectral bandwidth, energy requirements, error probability, implementation complexity)

• Formalize an ADC system (data rate, spectral bandwidth, energy requirements, error probability, implementation complexity)

• Model physical properties of wired and wireless communication channels

TEACHING METHODS

1. Lectures (using blackboard and projector), 4h per week
2. Exercise session, 2h per week

EXPECTED STUDENT ACTIVITIES

There will be weekly homework assignments, with the following emphasis:

1. Paper-pencil studies of communication system design (70%)
2. Matlab (or other numerical tools) to evaluate performance (30%)

ASSESSMENT METHODS

1. Weekly Homework (10%)
2. Midterm Exam (40%)
3. Final Exam (50%)

SUPERVISION

Office hours	Yes
Assistants	Yes
Forum	Yes

RESOURCES

Bibliography

There is a plethora of books on the topic of Digital Communications. The class will give specific pointers, also via the lecture notes that will be distributed in class.

Notes/Handbook

A set of lecture notes will be provided to the students at the beginning of the class.

Websites

http://linx.epfl.ch

Moodle Link

http://moodle.epfl.ch

CS-471 **Advanced multiprocessor architecture**

Falsafi Babak

Cursus	Sem.	Type
Génie électrique et électronique	MA1, MA3	Opt.
Informatique et communications		Opt.
Informatique	MA1, MA3	Opt.
SC master EPFL	MA1, MA3	Opt.
Science et ing. computationelles	MA1, MA3	Opt.

Language	English
Credits	6
Session	Winter
Semester	Fall
Exam	During the semester
Workload	180h
Weeks	14
Hours	**4 weekly**
Lecture	4 weekly

SUMMARY

Multiprocessors are now the defacto building blocks for all computer systems. This course will build upon the basic concepts offered in Computer Architecture I to cover the architecture and organization of modern multiprocessors from mobile and embedded platforms to servers, data centers and cloud computing platforms.

CONTENT

Introduction to multiprocessor systems, parallel programming models including Pthreads, MPI, hardware and software transactional memory, synchronization primitives, memory consistency mdels, cache coherence, on-chip shared cache architectures, on-chip interconnects, multi-chip interconnects, multi-chip bus-based and general-purpose interconnect-based shared-memory systems, clusters.
The course will include weekly readings, discussions, and student reviews and reports on publications (besides the text book) of seminal and recent contributions to the field of computer architecture. Student reviews, class discussions, and an independent research project will account for a significant fraction of the grade. Feedback on performance will be given only upon request by a student. There will be no recitation classes.
The course will also include an independent and original research project, in which students study, improve, and evaluate multiprocessor innovations using a software simulation infrastructure. There will be a list of project ideas given out, but students can suggest and work on their own ideas with potentials for advancing the state of the art.

LEARNING PREQUISITES

Recommended courses

Computer Architecture I, basic C/C++ systems programming.

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Design and evaluate parallel computer organizations
- Develop parallel programs and benchmarks for parallel systems
- Design the basic components of modern parallel systems including multiple processors, cache hierarchies and networks
- Quantify performance metrics for parallel systems
- Interpret and critique research papers
- Plan , propose and conduct a research project empirically
- Present research contributions

TEACHING METHODS

Lectures, homeworks, and a research project

ASSESSMENT METHODS

Continuous control :
Homework : 30 %, Project 15 %, Midterm test : 20 %,
End term test : 35 %

RESOURCES

Websites

http://lsi-www.epfl.ch/dtis/

COM-417 **Advanced probability and applications**

Lévêque Olivier

Cursus	Sem.	Type
Informatique et communications		Obl.
Informatique	MA1, MA3	Opt.
SC master EPFL	MA1, MA3	Opt.

Language	English
Credits	6
Session	Winter
Semester	Fall
Exam	Written
Workload	180h
Weeks	14
Hours	**5 weekly**
Lecture	3 weekly
Exercises	2 weekly

SUMMARY

In this course, various aspects of probability theory are considered. The first part is devoted to the main theorems in the field (law of large numbers, central limit theorems), while the second part focuses on the theory of martingales in discrete time.

CONTENT

I. Probability
- sigma-fields, probability measures, random variables
- independence, expectation
- convergence of sequences of random variables
- laws of large numbers- central limit theorem
- concentration inequalities
- moments

II. Martingales
- conditional expectation
- definition and properties of a martingale
- stopping times, optional stopping theorem
- maximal inequalities
- convergence theorems

KEYWORDS

probability, measure theory, martingales, convergence theorems

LEARNING PREQUISITES

Required courses
Basic probability course
Calculus courses

Recommended courses
complex analysis

Important concepts to start the course
This course is NOT an introductory course on probability: the students should have a good understanding and practice of basic probability concepts such as: distribution, expectation, variance, independence, conditional probability.
The students should also be at ease with calculus. Complex analyisis is a plus, but is not required.
On the other hand, no prior background on measure theory is needed for this course: we will go through the basic conspets one by one at the beginning.

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Understand the foundations of probability theory
- Acquire a solid knowledge of martingale theory

TEACHING METHODS

Ex cathedra + exercises

EXPECTED STUDENT ACTIVITIES

active participation to exercise sessions

ASSESSMENT METHODS

Midterm 10%, homeworks 10%, exam 80%

RESOURCES

Bibliography

Sheldon M. Ross, Erol A. Pekoz, A Second Course in Probability,1st edition, www.ProbabilityBookstore.com, 2007.
Jeffrey S. Rosenthal, A First Look at Rigorous Probability Theory,2nd edition, World Scientific, 2006.
Geoffrey R. Grimmett, David R. Stirzaker, Probability and Random Processes,3rd edition, Oxford University Press, 2001.
Richard Durrett, Probability: Theory and Examples,4th edition, Cambridge University Press, 2010.

Ressources en bibliothèque

- A Second Course in Probability / Ross
- Probability: Theory and Examples / Durrett
- Probability and Random Processes / Grimmett
- A First Look at Rigorous Probability Theory / Rosenthal

Références suggérées par la bibliothèque

Notes/Handbook

available on the course website

PREREQUISITE FOR

Advanced classes requiring a good knowledge of probability

CS-435 **Analytic methods in algorithms and complexity**

Vishnoi Nisheeth

Cursus	Sem.	Type
Informatique	MA1, MA3	Opt.
SC master EPFL	MA1, MA3	Opt.

Language	English
Credits	4
Session	Winter
Semester	Fall
Exam	During the semester
Workload	120h
Weeks	14
Hours	**3 weekly**
Lecture	2 weekly
Exercises	1 weekly

SUMMARY

In the last decade, many fundamental problems in algorithms and complexity have benefited from viewing the underlying discrete problems through the lens of analytic methods. In this course we will introduce a selection of such techniques and explore their applications in algorithms and complexity.

CONTENT

Basics: linear algebra, calculus, convexity, Gaussian spaces.
Graphs and Eigenvalues
Spectral algorithms for graph problems
The Laplacian paradigm
Gradient Descent and variants
The Multiplicative Weight Update method
Online convex optimization
Interior point methods for solving convex programs
Dynamical system and optimization*
Measure concentration and isoperimetry in Gaussian spaces
Applications

* Tentative

KEYWORDS

Convex optimization, Spectral methods, Gaussian spaces

LEARNING PREQUISITES

Required courses

Calculus (MATH105), Linear Algebra (MATH110), Algorithms (CS250), Theory of Computation (CS251) or equivalents.

Important concepts to start the course

Mathematical maturity including multivariate calculus, linear algebra, analysis and introductory probability. Basic background in algorithms and theory of computation.

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Learn fundamental techniques which apply continuous methods to discrete problems
- Apply analytic techniques to a variety of related problems

• Read, understand, and explain state of the art papers in this area

ASSESSMENT METHODS

Homeworks, Scribe Notes, Exam and Project/Presentation.

SUPERVISION

Office hours	Yes
Assistants	Yes
Forum	No

RESOURCES

Bibliography

Books relevant to the course:
Vishnoi - Lx=b
Nesterov - Introductory lectures on convex optimization
Shalev-Schwartz - Online learning and online convex optimization
Renegar - A mathematical view of interior point methods in convex optimization

References for Basics:
Apostol - Calculus I and II
Strang - Linear algebra and its applications
Boyd and Vanderberghe - Convex optimization
Janson - Gaussian Hilbert Spaces
Strogatz - Nonlinear dynamics and Chaos

COM-415

Audio signal processing and virtual acoustics

Faller Christof, Kolundzija Mihailo, Schröder Dirk

Cursus	Sem.	Type
Informatique	MA1, MA3	Opt.
SC master EPFL	MA1, MA3	Opt.

Language	English
Credits	4
Session	Winter
Semester	Fall
Exam	Written
Workload	120h
Weeks	14
Hours	**4 weekly**
Lecture	2 weekly
Exercises	2 weekly

SUMMARY

The objective of the course is to introduce theory, methods, and basic psychoacoustics that is needed to understand state-of-the-art techniques used in pro audio and consumer audio, including microphones, surround sound, auralization, virtual acoustics, mixing, and audio coding.

CONTENT

Acoustics and audio is covered and the manipulation and processing of audio signals. It is shown how Fourier analysis of the soundfield yields to the representation of a soundfield with plane waves. These and other acoustic insights are used to explain microphone techniques and reproduction of the soundfield.
Spatial hearing is covered in detail and used to motivate stereo and surround mixing and audio playback. In addition, insights on the principles of auralization and virtual acoustics are given, and the simulation of sound propagation in rooms will be further discussed.
The short-time Fourier transform is introduced as a tool for flexible manipulation of audio signals, suchs as filtering, delaying and other spectral modification. Matrix surround, audio coding, and beamforming are also treated.

KEYWORDS

acoustics, virtual acoustics, microphones, surround sound, matrix surround, audio coding, audio processing, 3d sound reproduction, spatialization, psychoacoustics, human hearing, binaural hearing, dummy head recordings, wave propagation, simulation techniques, geometrical acoustics, auralization, sonification, audio, signal processing

LEARNING PREQUISITES

Recommended courses

Fourier transform, signal processing basics (sampling, filtering, discrete Fourier transform).

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Apply Basics of Acoustics, Signal Processing, Reproduction, Simulation Techniques
- Implement Basics of Audio Signal Processing, Filtering, Multi-Channel Loudspeaker Setups
- Operate Room acoustics simulation programs

TEACHING METHODS

Class + mini project

ASSESSMENT METHODS

With continuous control

RESOURCES

Bibliography

* C. Faller, "Signal Processing for Audio and Acoustics" complete lecture notes in book form.
* J. Blauert, "Spatial Hearing : The Psychophysics of Human Sound Localization", MIT Press, 2001.
* F. Rumsey, "Spatial Audio", Focal Press, 2001.
* M. Vorländer, "Auralization - Fundamentals of Acoustics, Modelling, Simulation, Algorithms and Acoustic Virtual Reality", 2010

Ressources en bibliothèque

- Signal Processing for Audio and Acoustics / Faller
- Spatial Hearing / Blauert
- Auralization / Vorländer
- Spatial Audio / Rumsey

Références suggérées par la bibliothèque

EE-554

Automatic speech processing

Bourlard Hervé

Cursus	Sem.	Type
Génie électrique et électronique	MA1, MA3	Opt.
Informatique	MA1, MA3	Opt.
SC master EPFL	MA1, MA3	Opt.

Language	English
Credits	3
Session	Winter
Semester	Fall
Exam	Written
Workload	90h
Weeks	14
Hours	**3 weekly**
Lecture	2 weekly
Exercises	1 weekly

SUMMARY

The goal of this course is to provide the students with the main formalisms, models and algorithms required for the implementation of advanced speech processing applications (involving, among others, speech coding, speech analysis/synthesis, and speech recognition).

CONTENT

1. Introduction: Speech processing tasks, language engineering applications.

2. Basic Tools: Analysis and spectral properties of the speech signal, linear prediction algorithms, statistical pattern recognition, dynamic programming.

3. Speech Coding: Human hearing properties, quantization theory, speech coding in the temporal and frequency domains.

4. Speech Synthesis: Morpho-syntactic analysis, phonetic transcription, prosody, speech synthesis models.

5. Automatic Speech Recognition: Temporal pattern matching and Dynamic Time Warping (DTW) algorithms, speech recognition systems based on Hidden Markov Models (HMMs).

6. Speaker recognition and speaker verification: Formalism, hypothesis testing, HMM based speaker verification.

7. Linguistic Engineering: state-of-the-art and typical applications

KEYWORDS

speech processing, speech coding, speech analysis/synthesis, automatic speech recognition, speaker identification, text-to-speech

LEARNING PREQUISITES

Required courses

Basis in linear algebra, signal processing (FFT), and statistics

Important concepts to start the course

Basic knowledge in signal processing, linear algebra, statistics and stochastic processes.

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- speech signal properties
- Exploit those properties to speech codign, speech synthesis, and speech recognition

Transversal skills

- Use a work methodology appropriate to the task.
- Access and evaluate appropriate sources of information.
- Use both general and domain specific IT resources and tools

TEACHING METHODS

Lecture + lab exercises

EXPECTED STUDENT ACTIVITIES

Attending courses and lab exercises. Read additional papers and continue lab exercises at home if necessary. Regulary answer list of questions for feedback.

ASSESSMENT METHODS

Written exam without notes

SUPERVISION

Office hours	No
Assistants	Yes
Forum	No

RESOURCES

Ressources en bibliothèque

- Traitement de la parole / Boite

Références suggérées par la bibliothèque

Websites

http://lectures.idiap.ch

BIO-465 **Biological modeling of neural networks**

Gerstner Wulfram

Cursus	Sem.	Type
Génie électrique et électronique	MA2	Opt.
Informatique	MA2	Opt.
Ing.-math	MA2, MA4	Opt.
Mathématicien	MA2	Opt.
Mineur en Biocomputing	E	Opt.
Mineur en Neuroprosthétiques	E	Opt.
Mineur en Neurosciences computationnelles	E	Opt.
Mineur en Technologies biomédicales	E	Opt.
Neurosciences		Opt.
SC master EPFL	MA2, MA4	Opt.
Science et ing. computationelles	MA2	Opt.
Sciences du vivant	MA2, MA4	Opt.

Language	English
Credits	4
Session	Summer
Semester	Spring
Exam	Written
Workload	120h
Weeks	14
Hours	**4 weekly**
Lecture	2 weekly
Exercises	2 weekly

SUMMARY

In this course we study mathematical models of neurons and neuronal networks in the context of biology and establish links to models of cognition.

CONTENT

I. Models of single neurons1. Introduction: brain vs computer and a first simple neuron model 2. Models on the level of ion current (Hodgkin-Huxley model)3. Two-dimensional models and phase space analysis ***II. Syanaptic changes and learning***4. Synaptic Plasticity and Long-term potentiation (Hebb rule, mathematical formulation) 5. Network Dynamics and Associative Memory (Hopfield Model, spin analogy) 6: Neuronal adaptation and optimization of neuron models7. Complements and hand-out of miniproject***III. Noise and the neural code***8. Noise and variability of spike trains (point processes, renewal process, interval distribution)9: Spike Response Models and the neural code revisited (Reliability of neurons, predicting spike times, timing codes10. Population dynamics and membrane potential distribution (Fokker-Planck equation)11. population rate models and coding (PSTH, reverse correlation, population transients)***IV. Networks*** 12. perception and Spatially structured networks (field models) 13. Decision making in populations of neurons

KEYWORDS

neural networks, neuronal dynamics, computational neuroscience, mathematical modeling in biology, biological modelling, applied mathematics, brain, cognition, neurons, memory, learning, plasticity

LEARNING PREQUISITES

Recommended courses

Analysis I-III, linear algebra, probability and statistics
For SSV students: Dynamical Systems Theory for Engineers or "Mathematical and Computational Models in Biology" course, Felix Naef

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Analyze two-dimensional models in the phase plane
- Solve linear one-dimensional differential equations
- Develop a simplified model by separation of time scales

- Analyze connected networks in the mean-field limit
- Formulate stochastic models of biological phenomena
- Formalize biological facts into mathematical models
- Prove stability and convergence
- Apply model concepts in simulations
- Predict outcome of dynamics
- Describe neuronal phenomena

Transversal skills

- Plan and carry out activities in a way which makes optimal use of available time and other resources.
- Collect data.
- Write a scientific or technical report.

TEACHING METHODS

Classroom teaching, exercises and miniproject

EXPECTED STUDENT ACTIVITIES

miniprojects

ASSESSMENT METHODS

Written exam (67%) & miniproject (33%)

RESOURCES

Bibliography

Dayan & Abbott : Theoretical Neuroscience, MIT Press 2001; Gerstner & Kistler : Spiking Neuron Models, Cambridge Univ. Press

Ressources en bibliothèque

- Theoretical Neuroscience / Dayan

Références suggérées par la bibliothèque

Videos

http://lcn.epfl.ch/~gerstner/VideoLecturesGerstner.html

EE-512 **Biomedical signal processing**

Vesin Jean-Marc

Cursus	Sem.	Type
Génie électrique et électronique	MA1, MA3	Opt.
Informatique	MA1, MA3	Opt.
Ing.-math	MA1, MA3	Opt.
Mathématicien	MA1, MA3	Opt.
Mineur en Technologies biomédicales	H	Opt.
SC master EPFL	MA1, MA3	Opt.

Language	English
Credits	6
Session	Winter
Semester	Fall
Exam	Written
Workload	180h
Weeks	14
Hours	**6 weekly**
Lecture	4 weekly
Project	2 weekly

SUMMARY

The goal of this course is to introduce the techniques most commonly used for the analysis of biomedical signals, and to present concrete examples of their application for diagnosis purposes.

CONTENT

1. Generalities on biomedical signal processing
2. Digital signal processing - basics

- sampling
- Fourier transform
- filtering
- stochastic signals correlation, and pwoer spectral density

3. Time-frequency analysis

- short-term Fourier transform
- time-frequency distributions, Cohen's class
- wavelet transform

4. Linear modeling

- autoregressive models
- linear prediction
- parametric spectral estimation
- criteria for model selection

5. Adaptive filtering

- adaptive predictione
- adaptive estimation of transfert functions
- adaptive interference cancellation

6. Miscellaneous

- polynomial models
- singular value decomposition
- principal component analysis

KEYWORDS

signal processing, biomedical engineering, signal modeling, spectral analysis, adaptive filtering

LEARNING PREQUISITES

Recommended courses

Signal processing for telecommunications COM-303
Signal processing EE-350

TEACHING METHODS

lectures, lab sessions using Matlab

ASSESSMENT METHODS

1 point for lab/exercise sessions reports
2 exams: end of November 2points - final exam 3 points

SUPERVISION

Office hours	Yes
Assistants	Yes

EE-513

Biometrics

Drygajlo Andrzej

Cursus	Sem.	Type
Information security minor	H	Opt.
SC master EPFL	MA1, MA3	Opt.
UNIL - Sciences forensiques	H	Opt.

Language	English
Credits	4
Session	Winter
Semester	Fall
Exam	Oral
Workload	120h
Weeks	14
Hours	**3 weekly**
Lecture	2 weekly
Exercises	1 weekly

SUMMARY

This course is an introduction to analysis, modeling and interpretation of biometric data for biometric person recognition, forensic biometrics and behavioral biometrics in man-machine communication.

CONTENT

Fundamentals of Biometrics
Identity and Biometrics, Individuality of Biometric Data, Recognition, Verification, Identification and Authentication
Analysis, Modeling and Interpretation of Biometric Data
Mathematical Tools for Biometric Signal Processing, Pattern Recognition and Machine Learning, Sensing and Storage, Representation and Feature Extraction, Models of Features for Recognition and Classification, Enrollment and Template Creation, Biometric System Errors, Evaluation of Biometric Systems
Leading Biometric Technology
Biological Characteristics (fingerprints, face (2D and 3D), hand palms, veins and geometry, eye irises and retinas), Behavioral Characteristics (dynamic signature, voice, gait, keystroke dynamics), Biological Traces (DNA, odour), Technologies under development, Synthetic Biometric Data Generation
Multimodal Biometrics
Biometric Standards
Biometric Systems
Small, Medium and Large Scale Biometric Systems, Integration of biometrics with other existing technologies (identity documents, smart cards, smart phones and mart pads, databases, e-technologies, transmission of biometric data), Behavioral Biometrics in Human-Machine Communication
Securing Biometric Data/Systems and Biometric Encryption
Biometric Applications
Security (Physical and Logical Access), Law Enforcement and Forensic Applications, Government and Military Sector, Financial Sector, Healthcare, Travel and Immigration,
Privacy and Legal Issues

KEYWORDS

biometrics, identity verification, biometric recognition, fingerprint, face, iris, signature, voice, DNA

LEARNING PREQUISITES

Recommended courses

Statistical signal and data processing through applications, Pattern classification and machine learning

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Choose biometric methods and technologies
- Analyze biometric data
- Model biometric features

- Develop biometric systems
- Implement biometric systems
- Assess / Evaluate biometric systems
- Integrate biometric technologies
- Apply biometric systems

Transversal skills

- Use a work methodology appropriate to the task.
- Use both general and domain specific IT resources and tools
- Give feedback (critique) in an appropriate fashion.
- Communicate effectively with professionals from other disciplines.
- Respect relevant legal guidelines and ethical codes for the profession.
- Set objectives and design an action plan to reach those objectives.

TEACHING METHODS

Ex cathedra with exercises and demonstrations in classroom

EXPECTED STUDENT ACTIVITIES

attendance at lectures, completing exercises and applying demonstrations at home

ASSESSMENT METHODS

Oral exam

SUPERVISION

Assistants Yes

RESOURCES

Bibliography

Books, reports and papers (e.g., A.K. Jain, A. Ross, K. Nandakumar, "Introduction to Biometrics", Springer-Verlag, New York, 2011)

Ressources en bibliothèque

- Introduction to Biometrics / Jain

Références suggérées par la bibliothèque

Notes/Handbook

Handbooks (e.g., A.K. jain, P. Flynn, A. Ross, "Handbook of Biometrics", Springer-Verlag, New York, 2008)

Moodle Link

http://http://moodle.epfl.ch/enrol/index.php?id=9061

PREREQUISITE FOR

Semester project, Master thesis, Doctoral thesis

CS-490 **Business design for IT services**

Wegmann Alain

Cursus	Sem.	Type
Informatique	MA2	Opt.
SC master EPFL	MA2, MA4	Opt.

Language	English
Credits	3
Session	Summer
Semester	Spring
Exam	Oral
Workload	90h
Weeks	14
Hours	**3 weekly**
Lecture	3 weekly

SUMMARY

Students practice business design on their own business idea. They learn how to apply some of the key business design heuristics. They learn how to compare these heuristics using the same systemic framework (SEAM). Students also practice methods and discover issues related to entrepreneurship.

CONTENT

Individually, the students have to read the book and the papers listed below. They make a synthesis of their contents. They need to apply the concepts presented in these book/papers on case studies (e.g. Amazon) and on their own idea.

The students also have to work in groups. They have to run a project in which they:
(1) Imagine a new IT service to develop,
(2) Identify and analyze the relevant segments,
(3) Validate their model with real customers and potential partners,
(4) Define the qualitative and quantitative goals for the new IT service.

To represent their business idea, the students use Trade Your Mind - a web-based business modelling service,

KEYWORDS

Business services, IT services, business design, innovation in startups, revolutionary ventures and corporate initiatives; entrepreneur profiles.

Business design, service design, house of quality, SEAM modeling (eco-system, supplier-adopter relationship, motivation models)

Segmentation, value networks, PESTLE analysis, 5 forces analysis, core competency, coopetition, blue ocean, resource based modeling, transaction cost.
Integrated marketing concept, SWOT analysis, strategy canvas.

New technology adoption, crossing-the chasm, decision making units.

Pricing strategy, cashflow management, break-event time

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Create a precise and detailed description for a new business design
- Analyze environmental as well as organizational factors in a business design
- Design a business model in details (ecosystem, value, finance)
- Assess / Evaluate alternative business and technical strategies
- Synthesize multiple marketing theories (from seminal publications)
- Represent the key concepts of a business design (ecosystem, value, finance)

• Interpret evidences

• Investigate innovative views of a business design

Transversal skills

• Collect data.

• Access and evaluate appropriate sources of information.

• Write a scientific or technical report.

• Make an oral presentation.

• Summarize an article or a technical report.

TEACHING METHODS

Problem-based teaching + group work

ASSESSMENT METHODS

With continuous control.

RESOURCES

Bibliography

Bhide, A. (2000). The Origin and Evolution of New businesses: Oxford University Press.

Hauser, J. R., & Clausing, D. (1988). The house of Quality. Harvard Business Review.
https://hbr.org/1988/05/the-house-of-quality

Golnam, A., Regev, G., Ramboz, J., Laprade, P., & Wegmann, A. (2011). Aligning Value and Implementation in Service Design - A Systemic Approach. International Journal of Service Science, Management, Engineering, and Technology (IJSSMET), 3(1), 19-36.

Porter, M. E. (2008). The Five Competitive Forces That Shape Strategy. Harvard Business Review.
https://hbr.org/2008/01/the-five-competitive-forces-that-shape-strategy

Levitt, T. (1960). Marketing Myopia. Harvard Business Review.
https://hbr.org/2004/07/marketing-myopia

Prahalad, C., & Hamel, G. (1990). The Core Competence of the Corporation. Harvard Business Review.
https://hbr.org/1990/05/the-core-competence-of-the-corporation

Brandenburger, A. M., & Nalebuff, B. J. (1995). The Right Game: Use Game Theory to Shape Strategy. Harvard Business Review.
https://hbr.org/1995/07/the-right-game-use-game-theory-to-shape-strategy

Hagel, J., & Singer, M. (1999). Unbundling the Corporation. Harvard Business Review.
https://hbr.org/1999/03/unbundling-the-corporation

Kim, W. C., & Mauborgne, R. (2004). Blue Ocean Strategy, Havard Business Review.
https://hbr.org/2004/10/blue-ocean-strategy

Collis, D., & Montgomery, C. (2008). Competing on Resources: Strategy in the 90's. Harvard Business Review.
https://hbr.org/2008/07/competing-on-resources

Reeves, M. , Haanaes, K., & Sinha, J. (2015). Navigating the Dozens of Different Strategy Options. Harvard Business Review.
https://hbr.org/2015/06/navigating-the-dozens-of-different-strategy-options

Tools: Trade Your Mind – Business modeling tool on the web
www.tradeyourmind.com

Ressources en bibliothèque

- A Framework for Modeling Value in Service-Oriented Business Models / Golnam
- The origin and evolution of new businesses / Bhide
- The structure of "unstructured" decision processes / Mintzberg
- Value Map / Golnam
- A Modeling Framework for Analyzing the Viability of Service Systems / Golnam
- Unbundling the corporation / Hagel
- Blue Ocean Strategy / Kim
- Competitive advantage / Porter
- Marketing myopia / Levitt
- The core competence of the corporation / Prahalad
- Aligning Value and Implementation in Service Design / Golnam
- The house of quality / Hauser
- Coopetition within andbetween value networks / Golnam

Références suggérées par la bibliothèque

BIO-105 **Cellular biology and biochemistry for engineers**

Hirling Harald

Cursus	Sem.	Type
Informatique	MA1, MA3	Opt.
Mineur en Neuroprosthétiques	H	Opt.
Mineur en Technologies biomédicales	H	Opt.
SC master EPFL	MA1, MA3	Opt.

Language	English
Credits	4
Session	Winter
Semester	Fall
Exam	Written
Workload	120h
Weeks	14
Hours	**4 weekly**
Lecture	2 weekly
Exercises	2 weekly

SUMMARY

Basic course in biochemistry as well as cellular and molecular biology for non-life science students enrolling at the Master or PhD thesis level from various engineering disciplines. It reviews essential notions necessary for a training in biology-related engineering fields

CONTENT

The course gives basic knowledge on various phenoma taking place within a cell, and among cells within tissues and organs. The course gives an integrated view of various molecular mechanisms (rather in the second half of the class). It should therefore allow engineering students involved in future projects touching on biomedical problems to better integrate the constraints of a biological system and to enable them to communicate with specialists in both fields.
Due to significant overlap, this course is not available to students having previously taken the course BIO-109 "Introduction to Life Sciences for Information Sciences" or any other basic cell biology or biochemistry class at the bachelor or master level at EPFL.

KEYWORDS

The course contains chapters on the following subjects:
1.Cells and Organs
2.Chemical components of cells
3.Proteins, Enzymes
4.Energy, Metabolism
5.DNA, Chromosomes, Replication
6.Gene expression
7.Recombinant techniques
8.Membrane and Transport
9.Intracellular trafficking
10.Cytoskeleton
11.Cell division, Mitosis
12.Genetics, Meiosis
13.Cell communication, Signaling
14.Tissue, Tissue regeneration

LEARNING PREQUISITES

Required courses
Bachelor degree in engineering or other non-life science discipline

Recommended courses
Some basic knowledge in chemistry can help, but not required

Important concepts to start the course
Curiosity about how biological systems work, willingness to acquire a certain amount of knowledge

necessary to understand and discuss the various molecular mechanisms present in cells or related to modern biology

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Describe the basic components and functions found in cells
- Draw schemes explaining essential cellular phenomena
- Explain which are the important metabolic pathways
- Translate information from genetic code
- Verify statements about specific cellular mechanisms
- Integrate knowledge from different cellular mechanisms

Transversal skills

- Access and evaluate appropriate sources of information.

TEACHING METHODS

2 hours of ex cathedra-type of lecture
2 hours of exercises: the instructor gives out appr. 10 questions out (through Moodle and in the beginning of the session). The questions have different formats, and can in some cases just retrieve the acquired facts, in others have a more integrative problem-based learning approach.

EXPECTED STUDENT ACTIVITIES

- review regularly the presented lectures.
- participate actively in the exercise sessions when the questions and problems are discussed altogether

ASSESSMENT METHODS

- a blank exam is performed around early December (does not give credits or bonus)
- a written exam at the winter exam session

SUPERVISION

Office hours	Yes
Assistants	No
Forum	No
Others	- the teacher can always be reached through Email or phone to fix a one-to-one discussion about specific subjects - whether assistants will be involved depends on the number of students registered

RESOURCES

Bibliography

The lecture is aligned to selected chapters in the following book (recommended although not required):
"Essential Cell Bioogy" by B Alberts et al. , 3rd edition, Garland Science Taylor & Francis Group

Ressources en bibliothèque

- Essential Cell Biology / Alberts

Références suggérées par la bibliothèque

CS-441

Color reproduction

Hersch Roger

Cursus	Sem.	Type
Informatique	MA2	Opt.
SC master EPFL	MA2, MA4	Opt.

Language	English
Credits	4
Session	Summer
Semester	Spring
Exam	Oral
Workload	120h
Weeks	14
Hours	**4 weekly**
Lecture	2 weekly
Project	2 weekly

SUMMARY

Understand the interaction between light, ink halftones and substrates and model the elements of the color reproduction workflow (cameras, displays, printers).

CONTENT

*Color theory:*Illuminants, spectral sensibility of the eye, colorimetric equalization, the CIE-XYZ, xyY, CIELAB, RGB, YIQ, CMYK color systems.
Interaction between light and color prints: Elements of radiometry, Beer's law, the Saunderson correction (multiple reflections) and the Clapper-Yule spectral reflection prediction model.
Color devices: Modellization of scanners (+ cameras), cameras, displays and printers, black-white and color printing, density measurements, color separation, device characterization(scanner, display, printer), gamut mapping, color prediction models (Neugebauer, Yule-Nielson), dot gain models, fitting of unknown parameters by optimization techniques.
Halftoning algorithms: Clustered-dot dithering, dispersed-dot dithering, super-cells, error diffusion, moiré phenomena between color layers, color halftoning.
The course is coupled with laboratories in *MatLab* which enable exercising the concepts presented during the lectures. A small R&D project enables every student to gain concrete experience with topics related to the course.

KEYWORDS

Color reproduction, cameras, displays, printers, color imaging

LEARNING PREQUISITES

Important concepts to start the course

Working knowledge of matlab

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Explain how the CIE-XYZ colorimetric system was established.
- Model the behaviors of scanners and cameras, displays and printers.
- Establish a color reproduction worklfow.
- Explain the differences between the different color halftone prediction models.
- Solve problems related to the reproduction of color images.
- Understand the reasons for establishing the CIELAB colorimetric system.
- Understand the interaction between light, ink halftones and the substrate.
- Understand the fundaments of halftoning and gamut mapping.

TEACHING METHODS

Lecture, laboratories and small R&D project

ASSESSMENT METHODS

With continuous control : Laboratories, mini-project and oral final exam

SUPERVISION

Assistants	Yes
Others	Answer to questions during laboratory sessions

RESOURCES

Bibliography
Digital Color Imaging Handbook (ed. G. Sharma), CRC Press, 2003
Colorimetry, fundamentals and applications, N. Ohta, A.R. Robertson, Wiley 2005

Ressources en bibliothèque

- Colorimetry, fundamentals and applications / Ohta
- Digital Color Imaging Handbook / Sharma

Références suggérées par la bibliothèque
Notes/Handbook
Color reproduction: Slides of course notes,
Color reproduction: Laboratories.

Websites
http://lsp.epfl.ch/page-16625-en.html

PREREQUISITE FOR

Master project in the field (possibly in industry)

CS-551 **Computational molecular biology**

Moret Bernard

Cursus	Sem.	Type
Informatique	MA2	Opt.
Mineur en Biocomputing	E	Opt.
SC master EPFL	MA2, MA4	Opt.
Science et ing. computationelles	MA2	Opt.

Language	English
Credits	5
Session	Summer
Semester	Spring
Exam	During the semester
Workload	150h
Weeks	14
Hours	**5 weekly**
Lecture	3 weekly
Exercises	2 weekly

SUMMARY

This course covers discrete models and associated algorithms used in computational molecular biology, through a combination of lectures, exercises, readings, and class presentations.

CONTENT

Specific problems to be covered include sequencing and assembly, multiple sequence alignment, phylogenetic reconstruction, and whole-genome comparisons and evolution. Three quarters of the course is lectures, while the last quarter is devoted to presentations and discussions of current research papers by student teams.
The emphasis throughout is on algorithmic design and analysis, including proofs of correctness and new designs, using both combinatorial and statistical approaches. Most of the algorithms are based on divide-and-conquer, dynamic programming, and various heuristics; statistical methods introduced in the course include Hidden Markov models and randomized algorithms; combinatorial aspects of the genome are stressed throughout.

KEYWORDS

algorithms, genomic evolution, genomic sequence, machine learning, hidden Markov models, dynamic programming

LEARNING PREQUISITES

Required courses

A basic course on probability and statistics and one of (i) a course on molecular evolution or (ii) a standard algorithms course.

Important concepts to start the course

On the biology side: very general notions of cell, DNA, heredity, evolution.
On the CS/Math side: basic statistics (distribution, expectation, conditional probability), some introduction to algorithms.

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Model an evolutionary process acting on the genome
- Solve various algorithmic questions about molecular evolution
- Design an algorithm for variations of problems studied in the course
- Propose new computational research questions in evolutionary molecular biology

Transversal skills

- Make an oral presentation.

• Summarize an article or a technical report.

• Communicate effectively, being understood, including across different languages and cultures.

TEACHING METHODS

Lectures ex cathedra for 70% of the course (on the board).
Student presentations of papers with class discussion for the other 30%.

EXPECTED STUDENT ACTIVITIES

Reading, solving homework questions, presenting papers, and participating in the discussions.
Attendance at lectures is recommended, but not mandatory; however, attendance at student presentations of papers and class discussions of these papers is required.

ASSESSMENT METHODS

Assessment based on graded homework assignments, quality of presentations, and participation in the discussions.

SUPERVISION

Office hours	Yes
Assistants	Yes
Forum	No

RESOURCES

Bibliography

See website for the course.

Websites

http://lcbb.epfl.ch/compbio14/

CS-413 **Computational photography**

Süsstrunk Sabine

Cursus	Sem.	Type
Informatique	MA2	Opt.
SC master EPFL	MA2, MA4	Opt.

Language	English
Credits	5
Session	Summer
Semester	Spring
Exam	Oral
Workload	150h
Weeks	14
Hours	**4 weekly**
Lecture	2 weekly
Project	2 weekly

SUMMARY

The students will gain the theoretical knowledge in computational photography, which allows recording and processing a richer visual experience than traditional digital imaging. They will also execute practical group projects to develop their own computational photography application.

CONTENT

Computational photography is the art, science, and engineering of creating a great (still or moving) image. Information is recorded in space, time, across visible and invisible radiation and from other sources, and then post-processed to produce the final - visually pleasing - result.

Basics: Human vision system, Light and illumination, Geometric optics, Color science, Sensors, Digital camera systems.
Generalized illumination: Structured light, High dynamic range (HDR) imaging, Time-of-flight.
Generalized optics: Coded Image Sensing, Coded aperture, Focal stacks.
Generalized sensing: Low light imaging, Depth imaging, Plenoptic imaging, Light field cameras.
Generalized processing: Super-resolution, In-painting, Compositing, Photomontages, Panoramas, HDR imaging, Multi-wavelength imaging, Dynamic imaging.
Generalized display: Stereoscopic displays, HDR displays, 3D displays, Mobile displays.

KEYWORDS

Computational Photography, Coded Image Sensing, Non-classical image capture, Multi-Image & Sensor Fusion, Mobile Imaging.

LEARNING PREQUISITES

Required courses

- A basic Signal Processing, Image Processing, and/or Computer Vision course.
- Linear Algebra.

Recommended courses

- Introduction to Computer Vision.
- Signal Processing for Communications.

Important concepts to start the course

- Basic signal processing.
- Basic computer vision.
- Basic programming (iOS, Android, Matlab).

LEARNING OUTCOMES

- Identify the main components of a computational photography system.
- Contextualise the main trends in computational optics, sensing, processing, and displays.
- Create a computational photography application on a mobile platform.
- Design a computational photography solution to solve a particular imaging task.
- Assess / Evaluate hardware and software combinations for their imaging performance.
- Formulate computational photography challenges that still need to be resolved.

Transversal skills

- Evaluate one's own performance in the team, receive and respond appropriately to feedback.
- Continue to work through difficulties or initial failure to find optimal solutions.

TEACHING METHODS

The course consists of 2 hours of lectures per week that will cover the theoretical basics. An additional 2 hours per week are dedicated to a group project designing, developing, and programming a compuational photography application on a mobile plateform (iOS, Android).

EXPECTED STUDENT ACTIVITIES

The studens is expected to attend the class and actively participate in the practical group project, which requires coding on either Android or iOS plateform. The student is also required to read the assigned reading material (book chapters, scientific articles).

ASSESSMENT METHODS

The theoretical part will be evaluated with an oral exam at the end of the semester, and the practical part based on the students' group projects.

SUPERVISION

Office hours	Yes
Assistants	Yes
Forum	Yes

RESOURCES

Bibliography

- Selected book chapters
- Course notes (on moodle)
- Links to relevant scientific articles and on-line resources will be given on moodle.

CS-442 **Computer vision**

Fua Pascal

Cursus	Sem.	Type
Informatique	MA2	Opt.
SC master EPFL	MA2, MA4	Opt.

Language	English
Credits	4
Session	Summer
Semester	Spring
Exam	Written
Workload	120h
Weeks	14
Hours	**3 weekly**
Lecture	2 weekly
Exercises	1 weekly

SUMMARY

Computer Vision aims at modeling the world from digital images acquired using video or infrared cameras, and other imaging sensors. We will focus on images acquired using digital cameras. We will introduce basic processing techniques and discuss their field of applicability.

CONTENT

Introduction

- History of Computer Vision
- Human vs Machine Vision
- Image formation

Extracting 2D Features

- Contours
- Texture
- Regions

3D Shape Recovery

- From one single image

From multiple images

LEARNING PREQUISITES

Recommended courses
Foundations of Image Science

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Choose relevant algorithms in specific situations
- Perform simple image-understanding tasks

TEACHING METHODS

Ex cathedra lectures and programming exercises using matlab.

ASSESSMENT METHODS

With continuous control

RESOURCES

Bibliography

• R. Szeliski, Computer Vision: Computer Vision: Algorithms and Applications, 2010.

• A. Zisserman and R. Hartley, Multiple View Geometry in Computer Vision, Cambridge University Press, 2003.

Ressources en bibliothèque

• Computer Vision: Algorithms and Applications / Szeliski

• Multiple View Geometry in Computer Vision / Zisserman

Références suggérées par la bibliothèque

Websites

http://cvlab.epfl.ch/

Moodle Link

http://moodle.epfl.ch/course/view.php?id=472

CS-453

Concurrent algorithms

Guerraoui Rachid

Cursus	Sem.	Type
Informatique	MA1, MA3	Opt.
SC master EPFL	MA1, MA3	Opt.

Language	English
Credits	4
Session	Winter
Semester	Fall
Exam	Written
Workload	120h
Weeks	14
Hours	**3 weekly**
Lecture	2 weekly
Exercises	1 weekly

SUMMARY

With the advent of multiprocessors, it becomes crucial to master the underlying algorithmics of concurrency. The objective of this course is to study the foundations of concurrent algorithms and in particular the techniques that enable the construction of robust such algorithms.

CONTENT

Model of a parallel system
A Multicore architect
Processes and objects
Safety and liveness

Parallel programming
Automatic parallelism
Mutual exclusion and locks
Non-blocking data structures

Register Implementations
Safe, regular and atomic registers
General and limited transactions
Atomic snapshots

Hierarchy of objects
The FLP impssibility
The consensus number
Universal constructions
Transactional memories
Transactional algorithms
Opacity and obstruction-freedom

KEYWORDS

Concurrency, parallelism, algorithms, data structures

LEARNING PREQUISITES

Required courses
ICC, operatings systems

Recommended courses
Algorithms, concurency

Important concepts to start the course

Processes, threads, datas structures

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Reason in a precise manner about concurrency
- Design a concurrent algorithm

TEACHING METHODS

Lectures and exercises

EXPECTED STUDENT ACTIVITIES

Attendance at lectures completing exercise and sometimes doing a project

ASSESSMENT METHODS

With continuous control, mid-term final exams and sometimes project

SUPERVISION

Office hours	Yes
Assistants	Yes
Forum	No

RESOURCES

Websites
http://lpd.epfl.ch/site/education

CS-454

Convex optimization and applications

Lebret Hervé

Cursus	Sem.	Type
Informatique	MA2	Opt.
Mineur en Systems Engineering	E	Opt.
SC master EPFL	MA2, MA4	Opt.
Science et ing. computationelles	MA2	Opt.

Language	English
Credits	4
Session	Summer
Semester	Spring
Exam	During the semester
Workload	120h
Weeks	14
Hours	**3 weekly**
Lecture	1 weekly
Exercises	2 weekly

SUMMARY

Optimization is not only a major segment of applied mathematics, it is also a critical problem in many engineering and economic fields. In any situation where resources are limited, decision makers try to solve problems they face in the best possible manner. The course provides theory and practice.

CONTENT

The class will cover topics such as:
Convex sets and functions
Recognizing convex optimization problems
Optimality Conditions and Duality
Linear Programming (geometry of linear programming, applications in network optimization, the simplex method)
Least squares and quadratic programs
Semidefinite programming
Interior point methods

KEYWORDS

Convex Optimisation

LEARNING PREQUISITES

Required courses

A good background in linear algebra. Mastering MATLAB is a plus!

Recommended courses

Basic Linear Algebra

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Solve Convex optimization problems

TEACHING METHODS

Ex-cathedra lectures and exercise sessions(in English).

ASSESSMENT METHODS

Midterm (25%) and final exam (50%). Small personal project (25%). Exams are open-text and on paper (no use of computers)

RESOURCES

Bibliography
Book : Convex Optimization by Stephen Boyd and Lieven Vandenberghe

Ressources en bibliothèque

- Convex Optimization / Boyd

Références suggérées par la bibliothèque

COM-401

Cryptography and security

Vaudenay Serge

Cursus	Sem.	Type
Information security minor	H	Opt.
Informatique et communications		Obl.
Informatique	MA1, MA3	Obl.
SC master EPFL	MA1, MA3	Obl.

Language	English
Credits	7
Session	Winter
Semester	Fall
Exam	Written
Workload	210h
Weeks	14
Hours	**6 weekly**
Lecture	4 weekly
Exercises	2 weekly

SUMMARY

This course introduces the basics of cryptography. We review several types of cryptographic primitives, when it is safe to use them and how to select the appropriate security parameters. We detail how they work and sketch how they can be implemented.

CONTENT

1. **Ancient cryptography**: Vigenère, Enigma, Vernam cipher, Shannon theory
2. **Diffie-Hellman cryptography**: algebra, Diffie-Hellman, ElGamal
3. **RSA cryptography**: number theory, RSA, factoring
4. **Elliptic curve cryptography**: elliptic curves over a finite field, ECDH, ECIES
5. **Symmetric encryption**: block ciphers, stream ciphers, exhaustive search
6. **Integrity and authentication**: hashing, MAC, birthday paradox
7. **Applications to symmetric cryptography**: mobile telephony, Bluetooth, WiFi
8. **Public-key cryptography**: cryptosystem, digital signature
9. **Trust establishment**: secure communication, trust setups
10. **Case studies**: Bluetooth, TLS, SSH, PGP, biometric passport

KEYWORDS

cryptography, encryption, secure communication

LEARNING PREQUISITES

Required courses

- Algebra (MATH-310)
- Probabilities and statistics (MATH-310)
- Algorithms (CS-250)

Recommended courses

- Network security (COM-301)

Important concepts to start the course

- Mathematical reasoning
- Probabilities
- Algebra, arithmetics

- Algorithmics

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Choose the appropriate cryptographic primitive in a security infrastructure
- Judge the strength of existing standards
- Assess / Evaluate the security based on key length
- Implement algorithms manipulating big numbers and use number theory
- Use algebra and probability theory to analyze cryptographic algorithms
- Identify the techniques to secure the communication and establish trust

TEACHING METHODS

ex-cathedra

EXPECTED STUDENT ACTIVITIES

- active participation during the course
- take notes during the course
- do the exercises during the exercise sessions
- complete the regular tests and homework
- read the material from the course
- self-train using the provided material
- do the midterm exam and final exam

ASSESSMENT METHODS

Mandatory continuous evaluation:

- homework (30%)
- regular graded tests (30%)
- midterm exam (40%)

Final exam averaged (same weight) with the contiuous evaluation, but with final grade between final_exam-1 and final_exam+1.

SUPERVISION

Office hours	No
Assistants	Yes
Forum	No
Others	Lecturers and assistants are available upon appointment.

RESOURCES

Bibliography

- Communication security: an introduction to cryptography. Serge Vaudenay. Springer 2004.
- A computational introduction to number theory and algebra. Victor Shoup. Cambridge University Press 2005.

Ressources en bibliothèque

- Communication security / Vaudenay
-

Références suggérées par la bibliothèque
Websites
http://lasec.epfl.ch/teaching.shtml

PREREQUISITE FOR

- Advanced cryptography (COM-401)
- Algorithms in public-key cryptography (COM-408)

CS-422 **Database Systems**

Koch Christoph

Cursus	Sem.	Type
Informatique et communications		Opt.
Informatique	MA2	Obl.
SC master EPFL	MA2, MA4	Opt.

Language	English
Credits	7
Session	Summer
Semester	Spring
Exam	During the semester
Workload	210h
Weeks	14
Hours	**7 weekly**
Lecture	3 weekly
Exercises	2 weekly
Project	2 weekly

SUMMARY

This course is intended for students who want to understand modern large-scale data analysis systems and database systems. It covers a wide range of topics and technologies, and will prepare students to be able to build such systems as well as read and understand recent research publications.

CONTENT

- Database systems and data warehouse systems architecture
- Big data storage and processing systems; Map/reduce
- Query processing and optimization
- Tuning data management systems
- Parallel and distributed query processing
- Parallel programming
- Foundations of query processing and analytics
- Online analytics; data stream and complex event processing, incremental view maintenance, and sampling-based online aggregation
- Transaction processing. OLTP systems and concurrency control algorithms
- Modern programming systems and compiler techniques for database systems architecting

LEARNING PREREQUISITES

Required courses

- CS-150: Discrete structures
- CS-322: Introduction to database systems
- CS-105: Introduction to object-oriented programming

Recommended courses

- CS-323: Operating systems
- CS-452: Foundations of software

LEARNING OUTCOMES

By the end of the course, the student must be able to:

• large databases
• Design big data analysis systems
• analysis algorithms

TEACHING METHODS

Lectures, Reversed classroom teaching (video lectures plus in-classroom discussion and group work), project, homework, exercises

ASSESSMENT METHODS

• 70% exams
• 30% project

SUPERVISION

Others	Office hours on request. Q&A sessions in lectures and exercises.

RESOURCES

Bibliography

J. Hellerstein & M. Stonebraker, Readings in Database Systems, 4th Edition, 2005
R. Ramakrishnan & J. Gehrke: "Database Management Systems", McGraw-Hill, 3rd Edition, 2002.
A. Rajaraman & J. Ullman: "Mining of Massive Datasets", Cambridge Univ. Press, 2011.

CS-472

Design technologies for integrated systems

De Micheli Giovanni

Cursus	Sem.	Type
Génie électrique et électronique	MA1, MA3	Opt.
Informatique et communications		Opt.
Informatique	MA1, MA3	Opt.
SC master EPFL	MA1, MA3	Opt.

Language	English
Credits	6
Session	Winter
Semester	Fall
Exam	During the semester
Workload	180h
Weeks	14
Hours	**5 weekly**
Lecture	3 weekly
Project	2 weekly

SUMMARY

Hardware compilation is the process of transforming specialized hardware description languages into circuit descriptions, which are iteratively refined, detailed and optimized. The course presents algorithms, tools and methods for hardware compilation and logic synthesis.

CONTENT

The course will present the most outstanding features of hardware compilation, as well as the techniques for optimizing logic representations and networks. The course gives a novel, uptodate view of digital circuit design. Practical sessions will teach students the use of current design tools.Syllabus1) Modeling languages and specification formalisms;2) High-level synthesis and optimization methods (scheduling, binding, data-path and control synthesis);3) Representation and optimization of combinational logic functions (encoding problems, binary decision diagrams);4) Representation and optimization of multiple-level networks (algebraic and Boolean methods, "don't care" set computation, timing verification and optimization);5) Modeling and optimization of sequential functions and networks (retiming);6) Semicustom libraries and library binding.

KEYWORDS

Hardware, VLSI, Synthesis, Optimization, Algorithms

LEARNING PREQUISITES

Required courses

No specific course

Recommended courses

Knowledge of digital design, algorithm design and programming.

Important concepts to start the course

Knowledge of digital design, algorithm design and programming.

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Recognize important problems in digital design
- Examine and evaluate available design tools and methods
- Decide upon a design tool flow to perform a digital design

Transversal skills

- Plan and carry out activities in a way which makes optimal use of available time and other resources.

ASSESSMENT METHODS

Continuous control :
Homework : 30 %, Project 15 %, Midterm test : 20 %,
End term test : 35 %

RESOURCES

Bibliography

G. De Micheli, Synthesis and Optimization of Digital Circuits, McGraw'Hill.

Ressources en bibliothèque

- Synthesis and Optimization of Digital Circuits / De Micheli

Références suggérées par la bibliothèque

Notes/Handbook

Copies of the slides used for lectures will be given in class and posted.

Websites

http://lsi-www.epfl.ch/dtis/

CS-446 **Digital 3D Geometry Processing**

Pauly Mark

Cursus	Sem.	Type
Informatique	MA2	Opt.
SC master EPFL	MA2, MA4	Opt.
Science et ing. computationelles	MA2	Opt.

Language	English
Credits	5
Session	Summer
Semester	Spring
Exam	Oral
Workload	150h
Weeks	14
Hours	**4 weekly**
Lecture	2 weekly
Exercises	1 weekly
Project	1 weekly

REMARQUE

pas donné en 2015-16

SUMMARY

Students study & apply core concepts and algorithms for digital geometry processing & 3D content creation. They create their own digital and physical geometry in a group project that follows the digital 3D content creation pipeline from data acquisition, geometry processing, to physical fabrication

CONTENT

The course will follow the digital 3D content creation pipeline. We will first discuss 3D acquisition methods for scanning physical objects. Given this raw geometric data, we analyze and implement several geometry processing methods for data enhancement and manipulation. We will discuss the fundamentals of geometry representations and cover introductory continuous and discrete differential geometry concepts. Polygon mesh representations will be at the center of our investigations. We derive the core processing methods for triangle meshes, such as surface smoothing, parameterization, decimation, remeshing or deformation. Finally, we will study methods to bring digital geometric models back into the physical worlds through 3D printing and other computer-controlled fabrications methods.

LEARNING PREQUISITES

Required courses

Nothing

Recommended courses

Introduction to Computer Graphics

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Explain and contrast fundamental geometry representations
- Explain and apply basic concepts from discrete differential geometry
- Analyze the 3D content creation pipeline and understand its limitations
- Implement and evaluate basic geometry processing algorithms, such as smoothing, decimation, and remeshing
- Create digital 3D models from photographs and process the acquired raw geometry to build physical prototypes
- Coordinate a team during a software project

TEACHING METHODS

Lectures, interactive demos, theory and programming exercises, programming project, project tutoring

EXPECTED STUDENT ACTIVITIES

The student are expected to study the provided reading material and actively participate in class. They should prepare and resolve the exercises, prepare and carry out the programming project. Exercises and project are done in groups of three students.

ASSESSMENT METHODS

Exercises (20%), project (30%), final examination (50%)

SUPERVISION

Office hours	Yes
Assistants	Yes
Forum	Yes

RESOURCES

Bibliography

A list of books will be provided at the beginning of the class

Notes/Handbook

Slides and online resources will be provided in class

Websites

http://lgg.epfl.ch/DGP

CS-411

Digital education & learning analytics

Dillenbourg Pierre, Jermann Patrick

Cursus	Sem.	Type
Informatique	MA1, MA3	Opt.
SC master EPFL	MA1, MA3	Opt.

Language	English
Credits	4
Session	Winter
Semester	Fall
Exam	Oral
Workload	120h
Weeks	14
Hours	**4 weekly**
Lecture	2 weekly
Project	2 weekly

SUMMARY

This course addresses the relationship between specific technological features and the learners' cognitive processes. It also covers the methods and results of empirical studies on this topic: do student actually learn due to technologies?

CONTENT

Learning theories and learning processes. Instructional design: methods, patterns and principles. Orchestration graphs. On-line education. Effectiveness of learning technologies. Methods for empirical research. Learning analytics. History of learning technologies.

KEYWORDS

learning, pedagogy, teaching, online education, MOOCs

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Describe the learning processes triggered by a technology-based activity
- Explain how a technology feature influences learning processes
- Elaborate a study that measures the learning effects of a digital environment
- Select appropriately a learning technology given the target audience and the expected learning outcomes

TEACHING METHODS

The course will combine participatory lectures with a project around an empirical measure of learning technology effects

EXPECTED STUDENT ACTIVITIES

The project will include several milestones to be delivered along the semester.

ASSESSMENT METHODS

- Project + exam
- 50 / 50

SUPERVISION

Office hours	No
Assistants	Yes
Forum	Yes

RESOURCES

Moodle Link
http://moodle.epfl.ch/course/view.php?id=14248

CS-412 **Discrete computational geometry**

Cursus	Sem.	Type
Informatique	MA2	Opt.
SC master EPFL	MA2, MA4	Opt.

Language	English
Credits	4
Session	Summer
Semester	Spring
Exam	During the semester
Workload	120h
Weeks	14
Hours	**4 weekly**
Lecture	2 weekly
Project	2 weekly

REMARQUE

pas donné en 2015-16

SUMMARY

This course covers the algorithmic aspects of discrete computational geometry, with most of the problems presented and solved in 2 dimensions, and the others generalized to arbitrary dimensions. Typical questions include containement, intersection, geometric loci, route planning, collision detectio

CONTENT

Introduction to discrete geometry : objects and questions. Line and segments, arrangements, geometric duality. Segment intersections, concept of output-sensitive algorithms. Polygons, convexity, simplicity, containment, tessellations and triangulations, point location. Randomized incremental construction, persistent and dynamic data structures.
High-dimensional problems ; dimensionality reduction through sweeps and through randomized projections. Motion planning, visibility graphs, kinetic data structures, moving objects in the presence of obstacles.

KEYWORDS

Discrete geometry, arrangements, geometric loci, paths, point location, tessellations divide-and-conquer, sweep, randomization, incremental construction, projections, dynamic data structures.

LEARNING PREQUISITES

Required courses

Introduction to Algorithms, Introduction to the Theory of Computation, Probability and Statistics.

Recommended courses

Advanced Algorithms.

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Use a variety of algorithms in 2D computational geometry
- Generalize 2D method to 3D applications
- Integrate computational geometry techniques in other algorithmic contexts
- Apply computational geometry in computer graphics and computer vision tasks

TEACHING METHODS

Lectures are the main teaching tool; most will use the blackboard, but some will use algorithm animation run from a laptop. Weekly exercises will enrich the lectures by encouraging students to explore variations on the methods presented.

EXPECTED STUDENT ACTIVITIES

Learning and problem solving.

ASSESSMENT METHODS

Weekly homework sets and 2-3 tests during the semester.

SUPERVISION

Office hours	Yes
Assistants	Yes
Forum	Yes

RESOURCES

Bibliography

Moodle (to be set up)
Textbook:
Mark de Berg, Otfried Cheong, Marc van Kreveld, and Mark Overmars. Computational Geometry: Algorithms and Applications (3rd ed.), Springer Verlag, 2008.

Notes/Handbook

Supplementary notes or extracts from other texts will be provided as necessary.

Websites

http://lcbb.epfl.ch/compgeo15/

CS-451 **Distributed algorithms**

Guerraoui Rachid

Cursus	Sem.	Type
Informatique	MA1, MA3	Obl.
SC master EPFL	MA1, MA3	Obl.

Language	English
Credits	4
Session	Winter
Semester	Fall
Exam	Written
Workload	120h
Weeks	14
Hours	**3 weekly**
Lecture	2 weekly
Exercises	1 weekly

SUMMARY

Computing is often distributed over several machines, in a local IP-like network, a cloud or in a P2P network. Failures are common and computations need to proceed despite partial failures of machines or communication links. The foundations of reliable distributed computing will be studied.

CONTENT

Reliable broadcast
Causal Broadcast
Total Order Broadcast
Consensus
Non-Blocking Atomic Commit
Group Membership, View Synchrony
Terminating Reliable Broadcast
Shared Memory in Message Passing System
Byzantine Fault Tolerance
Self Stabilization
Population protocols (models of mobile networks)

KEYWORDS

Distributed algorithms, checkpointing, replication, consensus, atomic broadcast, ditributed transactions, atomic commitment, 2PC.

LEARNING PREQUISITES

Required courses

Basics of Algorithms, networking and operating systems

Recommended courses

The lecture is orthogonal to the one on concurrent algorithms: they can be taken in parallel.

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Choose an appropriate abstraction to model a distributed computing problem
- Specify the abstraction
- Present an implementation of it
- Analyze its complexity

TEACHING METHODS

Ex cathedera

ASSESSMENT METHODS

Mid-term and final exams.

SUPERVISION

Office hours	Yes
Assistants	Yes
Forum	Yes

RESOURCES

Notes/Handbook

Reliable and Secure Distributed Programming
Springer Verlag
C. Cachin, R. Guerraoui, L. Rodrigues

Websites

http://lpdwww.epfl.ch/education

Videos

http://wandida.com

CS-423

Distributed information systems

Aberer Karl

Cursus	Sem.	Type
Energie et construction durable	MA2	Opt.
Génie électrique et électronique	MA2	Opt.
Informatique	MA2	Obl.
Mineur en Biocomputing	E	Opt.
SC master EPFL	MA2, MA4	Obl.
Sciences et ingénierie de l'environnement	MA2, MA4	Opt.

Language	English
Credits	4
Session	Summer
Semester	Spring
Exam	Written
Workload	120h
Weeks	14
Hours	**3 weekly**
Lecture	2 weekly
Exercises	1 weekly

SUMMARY

This course introduces in detail several key technologies underlying today's distributed information systems, including distributed and Web data management, information retrieval and data mining.

CONTENT

Data Storage: distributed relational databases - data fragmentation; semi-structured databases - graph data model
Information Search: Web search - vector space retrieval, advanced retrieval models, inverted files; P2P search - unstructured and structured overlay networks
Information Dissemination: Mobile data broadcast
Big Data Analystics: Data mining - associations rules, clustering, classification, model selection; Crowd-sourcing; Recommender systems - collaborative filtering and content-based recommendation

LEARNING PREQUISITES

Recommended courses

Introduction to Database Systems

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Characterize the main tasks performed by information systems, namely data, information and knowledge management
- Apply algorithms for efficient distributed data management in the context of different network models: distribute databases, mobile communication and decentralized (peer-to-peer) networks
- Apply semi-structured data models, their representation through Web standards and algorithms for storing and processing semi-structured data
- Apply fundamental models and techniques of text retrieval and their use in Web search engines
- Apply main categories of data mining techniques, local rules, predictive and descriptive models, and master representative algorithms for each of the categories

TEACHING METHODS

Ex cathedra + exercises

ASSESSMENT METHODS

25% Continuous evaluations with bonus system during the semester
75% Final written exam (180 min) during exam session

SUPERVISION

Office hours	Yes
Assistants	Yes
Forum	Yes

RESOURCES

Websites

http://lsir.epfl.ch/teaching/current-courses/

Moodle Link

http://moodle.epfl.ch/course/view.php?id=4051

ENG-466

Distributed intelligent systems

Martinoli Alcherio

Cursus	Sem.	Type
Energie et construction durable	MA1, MA3	Opt.
Informatique	MA1, MA3	Opt.
Microtechnique	MA1, MA3	Opt.
Mineur en Biocomputing	H	Opt.
SC master EPFL	MA1, MA3	Opt.
Science et ing. computationelles	MA1, MA3	Opt.
Sciences et ingénierie de l'environnement	MA1, MA3	Opt.

Language	English
Credits	5
Session	Winter
Semester	Fall
Exam	Written
Workload	150h
Weeks	14
Hours	**5 weekly**
Lecture	2 weekly
Exercises	2 weekly
Project	1 weekly

SUMMARY

The goal of this course is to provide methods and tools for modeling distributed intelligent systems as well as designing and optimizing coordination strategies. The course is a well-balanced mixture of theory and laboratory exercises using simulation and real hardware platforms.

CONTENT

- Introduction to key concepts such as self-organization and software and hardware tools used in the course
- Examples of natural, artificial and hybrid distributed intelligent systems
- Modeling methods: sub-microscopic, microscopic, macroscopic, multi-level; spatial and non-spatial; mean field, approximated and exact approaches
- Machine-learning methods: single- and multi-agent techniques; expensive optimization problems and noise resistance
- Coordination strategies and distributed control: direct and indirect schemes; algorithms and methods; performance evaluation
- Application examples in distributed sensing and action

KEYWORDS

Artificial intelligence, distributed robotics, sensor networks, modeling, machine-learning, control

LEARNING PREQUISITES

Required courses

Fundamentals in analysis, probability, and programming for both compiled and interpreted languages

Recommended courses

Basic knowledge in statistics, specific programming language used in the course (C and Matlab), and signals and systems

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Design a reactive control algorithm
- Formulate a model at different level of abstraction for a distributed intelligent system
- Analyze a model of a distributed intelligent system

• Analyze a distributed coordination strategy/algorithm
• Design a distributed coordination strategy/algorithm
• Implement code for single robot and multi-robot systems
• Carry out systematic performance evaluation of a distributed intelligent system
• Apply modeling and design methods to specific problems requiring distributed sensing and action
• Optimize a controller or a set of possibly coordinated controllers using model-based or data-driven methods

Transversal skills

• Use both general and domain specific IT resources and tools

TEACHING METHODS

Ex-cathedra lecture, assisted exercises, and course project involving teamwork

ASSESSMENT METHODS

Continuous control with final written exam

SUPERVISION

Office hours	Yes
Assistants	Yes
Forum	No

RESOURCES

Bibliography

Lecture notes, selected papers and book chapters distributed at each lecture.

Websites

http://disal.epfl.ch/teaching/distributed_intelligent_systems/

Moodle Link

http://moodle.epfl.ch/course/view.php?id=6391

PREREQUISITE FOR

R&D activities in engineering

COM-502

Dynamical system theory for engineers

Thiran Patrick

Cursus	Sem.	Type
Bioingénierie	MA1, MA3	Opt.
Informatique	MA1, MA3	Opt.
Mineur en Biocomputing	H	Opt.
Mineur en Neurosciences computationnelles	H	Opt.
Mineur en Systems Engineering	H	Opt.
SC master EPFL	MA1, MA3	Opt.
Science et ing. computationelles	MA1, MA3	Opt.
Sciences du vivant	MA1, MA3	Opt.

Language	English
Credits	4
Session	Winter
Semester	Fall
Exam	Written
Workload	120h
Weeks	14
Hours	**3 weekly**
Lecture	2 weekly
Exercises	1 weekly

SUMMARY

Linear and nonlinear dynamical systems are found in all fields of science and engineering. After a quite thorough study of linear system theory, the class will explain and develop the main tools for the qualitative analysis of nonlinear systems, both in discrete-time and continuous-time.

CONTENT

- **Introduction:** Dynamics of linear and non linear systems. Definitions; Unicity of a solution; Limit Sets, Attractors.
- **Linear Systems:** Solutions; Stability of autonomous systems, Geometrical analysis; BIBO stability, connection with frequency domain analysis.
- **Nonlinear Systems:** Solutions; Examples. Large-scale notions of stability (Lyapunov functions). Small-scale notions of stability (Linearization; stability and basin of attraction of an equilibrium point, stability of a periodic solutions and Floquet Multipliers). Graphical methods for the analysis of low-dimensional systems; Introduction to structural stability, Bifurcation theory. Introduction to chaotic systems.

KEYWORDS

Dynamical Systems, Attractors, Equilibrium point, Limit Cycles, Stability, Lyapunov Functions, Bifurcations.

LEARNING PREQUISITES

Required courses

Linear algebra (MATH 111 or equivalent) and calculus I, II, III (MATH 101, 106, 203 or equivalent).

Recommended courses

A BS-level Circuits & Systems class (EE204/205 or equivalent) or a Systems & Signals class (MICRO310/311 or equivalent) is recommended.

Important concepts to start the course

Linear Algebra, in particular matrix operations (inverting/diagonalizing/computing the eigenvalues of a matrix).
Calculus (linear ordinary differential equations).

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Analyze a linear or nonlinear dynamical system.
- Anticipate the asymptotic behavior of a dynamical system.
- Assess / Evaluate the stability of a dynamical system.

- Identify the type of solutions of a dynamical sytem.

TEACHING METHODS

- Lectures (blackboard), 2h per week
- Exercise session, 1h per week.

EXPECTED STUDENT ACTIVITIES

Exercises in class/at home:

- Paper and pencil problems (80%)
- Matlab (20%)

ASSESSMENT METHODS

1. Mid-term 20%
2. Final exam 80%

SUPERVISION

Office hours	Yes
Assistants	Yes
Forum	Yes

RESOURCES

Bibliography

Course notes; textbooks given as reference on the moodle page of the course.

Notes/Handbook

Course notes, exercises and solutions provided on the moodle page of the course.

Websites

http://moodle.epfl.ch/course/view.php?id=303

Moodle Link

http://moodle.epfl.ch/course/view.php?id=303

PREREQUISITE FOR

Any class using dynamical systems.

CS-473 **Embedded systems**

Beuchat René

Cursus	Sem.	Type
Génie électrique et électronique	MA1, MA3	Opt.
Informatique	MA1, MA3	Opt.
SC master EPFL	MA1, MA3	Opt.

Language	English
Credits	4
Session	Winter
Semester	Fall
Exam	Oral
Workload	120h
Weeks	14
Hours	**4 weekly**
Lecture	2 weekly
Project	2 weekly

SUMMARY

The comprehension of a general embedded systems and the design of an embedded system on a programmable circuit (FPGA) are the main subjects of this course. The student will design a camera or a LCD controller on an FPGA associated with a softcore processor. VHDL design and C programming.

CONTENT

- Microcontroller and associated programmable interfaces (GPIO, Timer, SPI, A/D, PWM, interrupts)
- Hardcore/softcore processors (ie. NIOS II, ARM)
- Memory organization, little/big endian
- Synchronous bus, dynamic bus sizing (ie. Avalon Bus in Memory Mapped mode)
- Processor bus, bus realized in a FPGA
- Serial bus (ie. UART, SPI, i2c, ...)
- How a LCD graphical screen and a CMOS camera work
- FPGA Embedded systems conception methodology
- Embedded systems with processor on FPGA

• Laboratories provide knowledge & practice to develop an embedded system based on FPGA4u module (http://fpga4u.epfl.ch).

KEYWORDS

microprocessors, microcontroller, FPGA, embedded systems, SoC, programmable interface

LEARNING PREQUISITES

Required courses

Introduction to computing systems, Logic systems, Computer architecture

Recommended courses

Electronic, Programming (C/C++)

Important concepts to start the course

Computer architecture (processor, memory, programmable interfaces)
Processor Architecture (PC, registers, ALU, instruction decoding, instruction exécution)
C programming language knowledge,
VHDL knowledge

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Design an embedded system on an FPGA
- Analyze a specific problem to solve and propose an system on FPGA to solve it
- Implement a solution to resolve the proposed problem
- Realize and simulate the design
- Test the developed solution on an FPGA
- Use complexe developping tools and hardware tools as logic analyzer and oscilloscope

Transversal skills

- Use a work methodology appropriate to the task.
- Negotiate effectively within the group.
- Set objectives and design an action plan to reach those objectives.
- Continue to work through difficulties or initial failure to find optimal solutions.
- Use both general and domain specific IT resources and tools
- Make an oral presentation.

TEACHING METHODS

Ex cathedra and exercises, mini-project

EXPECTED STUDENT ACTIVITIES

- Reading and deepening of course concepts
- Preparation of exercises performed in the laboratory
- Writing reports on different labs
- Realization of a final mini-project by group with oral presentation, report and demonstration

ASSESSMENT METHODS

With continuous control.
all labos 25%, mini-projet 25%, oral exam 50%

SUPERVISION

Office hours	No
Assistants	Yes
Forum	Yes
Others	Course on Moodle with forum

RESOURCES

Bibliography

Teaching notes and suggested reading material on moodle
Specialized datasheet (micro-controllers, FPGA) and norms (ie, SPI, i2c, Amba, Avalon, etc)

Notes/Handbook

Documents and slides provided on moodle

Websites

http://fpga4u.epfl.ch

Moodle Link
http://moodle.epfl.ch/course/view.php?id=1231

PREREQUISITE FOR

Real-time embedded systems

CS-491

Enterprise and service-oriented architecture

Wegmann Alain

Cursus	Sem.	Type
Informatique	MA2	Opt.
SC master EPFL	MA2, MA4	Opt.

Language	English
Credits	6
Session	Summer
Semester	Spring
Exam	Oral
Workload	180h
Weeks	14
Hours	**6 weekly**
Lecture	6 weekly

SUMMARY

The student learns business and IT alignment through: 1) experiencing business operations in a serious game; 2) analyzing business requirements and designing business & IT services; 3) implementing a workflow prototype (BPMN). The student is exposed to standards (ISO 9K,ITIL) & frameworks (SOA,EA).

CONTENT

1) Business Part (4 weeks): practical experimentation and theoretical understanding of the key business processes of a manufacturing company : rfq process, development, planning, quality management and accounting.
2) Business / IT Part (6 weeks): specification of an IT system that provides after-sales service. We teach the following techniques : interviews, root cause analysis, analysis/design of the business services and of the IT services. The underlying theory is system thinking (Weinberg, Vickers) and the ISO/IEC standard RM-ODP.
3) IT Part (2 weeks): implementation - using BPMN visual programming - of an IT system prototype. Overview of the technological aspects of service-oriented architecture (wsdl, bpel, soap).
4) Enterprise Architecture & Conclusions (2 weeks): Overview of the enterprise architecture frameworks (Zachman, TOGAF, Urba-EA). Synthesis and key learning points of the course.

KEYWORDS

RFQ, quotation, purchase order, leadtime, bill of material, development process, V process, spirale process, manufacturing planning, quality system, traceability, ISO 9000, financial statements, year-end book closing, ERP, interview, contextual inquiry, root-cause analysis, ITIL, business service, IT service, requirements engineeing, SEAM system modeling, SEAM goal-belief modeling, SEAM behavior modeling, Vickers appreciative system, behavioral refinment, information modeling,
service-oriented architecture (SOA), BPMN, BPEL, WSDL, SOAP,
enterprise architecture (EA), Zachman, TOGAF, Urba-EA.
Systemic paradigm, epistemology, ontology, axiology, ethics.

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Describe business processes (sales, engineering, manufacturing, accounting)
- Assess / Evaluate business processes using ISO9000
- Coordinate business operations (role play)
- Analyze business needs for an IT system design
- Assess / Evaluate the IT processes using ITIL
- Conduct interviews with business stakeholders
- Formalize business requirements for an IT system design
- Design BPMN / BPEL workflow

Transversal skills

• Continue to work through difficulties or initial failure to find optimal solutions.

• Use both general and domain specific IT resources and tools

• Write a scientific or technical report.

• Collect data.

• Make an oral presentation.

• Summarize an article or a technical report.

TEACHING METHODS

Problem-based teaching

ASSESSMENT METHODS

With continous control

RESOURCES

Bibliography

Beyer, H. and K. Holtzblatt (1999). "Contextual design." interactions **6**(1): 32-42.
http://dl.acm.org/citation.cfm?id=291229

Beyer, H. R. and K. Holtzblatt (1995). "Apprenticing with the customer." Commun. ACM **38**(5): 45-52.
http://dl.acm.org/citation.cfm?id=203365

Carr, N. G. (2003). "IT Doesn't matter", Harvard Business Review
https://hbr.org/2003/05/it-doesnt-matter

OMG (2004), Introduction to BPMN
http://www.omg.org/bpmn/Documents/Introduction_to_BPMN.pdf

Regev, G., H. Olivier, et al. (2011). Service Systems and Value Modeling from an Appreciative System Perspective. Second International Conference on Exploring Services Sciences. Geneva Switzerland, Springer-Verlag New York, Ms Ingrid Cunningham, 175 Fifth Ave, New York, Ny 10010 Usa. **82:** 146-157.
http://infoscience.epfl.ch/record/163961

Regev, G. and A. Wegmann (2004). Defining Early IT System Requirements with Regulation Principles: The Lightswitch Approach. Proceedings of the 12th IEEE International Requirements Engineering Conference (REí04). Kyoto, Japan**:** 144-153.
http://infoscience.epfl.ch/record/112299

Regev, G. and A. Wegmann (2005). Where do Goals Come from: the Underlying Principles of Goal-Oriented Requirements Engineering. Proceedings of the 13th IEEE International Conference on Requirements Engineering, IEEE Computer Society**:** 253-362.
http://infoscience.epfl.ch/record/112298

Rychkova, I., G. Regev, et al. Declarative Specification and Alignment Verification of Services in ITIL. First International Workshop on Dynamic and Declarative Business Processes (DDBP 2008). Munich, Germany.
http://infoscience.epfl.ch/record/129324

ITSMF (2007). An Introductory Overiew of ITIL v3
http://www.best-management-practice.com/gempdf/itSMF_An_Introductory_Overview_of_ITIL_V3.pdf

Wegmann, A. (2003). On the Systemic Enterprise Architecture Methodology (SEAM)**:** 483-490.
http://infoscience.epfl.ch/record/89690

Wegmann, A., A. Kotsalainen, et al. (2008). Augmenting the Zachman Enterprise Architecture Framework with a Systemic Conceptualization. Proceedings of the 2008 12th International IEEE Enterprise Distributed Object Computing Conference, IEEE Computer Society: 3-13.

http://infoscience.epfl.ch/record/126293

Zachman, J. A. (1987). "A framework for information systems architecture." IBM Syst. J. **26**(3): 276-292. http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=5387107

Tools:
Alloy **http://alloy.mit.edu/alloy/**

Intalio **http://ww.intalio.com/**

SeamCAD **htt://lams.epfl.ch/seamcad/**

Ressources en bibliothèque

- Declarative Specification and Alignment Verification of Services in ITIL / Rychkova
- Service Systems and Value Modeling from an Appreciative System Perspective / Regev
- Where do Goals Come from: the Underlying Principles of Goal-Oriented Requirements Engineering / Regev
- Contextual design / Beyer
- Quality Management Systems / ISO
- Introduction to BPMN / White
- Intalio
- On the Systemic Enterprise Architecture Methodology / Wegmann
- Defining Early IT System Requirements with Regulation Principles / Regev
- A Langage and Tool for relational models
- Augmenting the Zachman Enterprise Architecture Framework with a Systemic Conceptualization / Wegmann
- A framework for information systems architecture / Zachman
- An Introductory Overiew of ITIL v3 / ITSMF

Références suggérées par la bibliothèque

MATH-483 **Gödel and recursivity**

Cursus	Sem.	Type
Informatique	MA1, MA3	Opt.
Ing.-math	MA1, MA3	Opt.
Mathématicien	MA1, MA3	Opt.
Mathématiques pour l'enseignement	MA1	Opt.
SC master EPFL	MA1, MA3	Opt.

Language	English
Credits	5
Session	Winter
Semester	Fall
Exam	Written
Workload	150h
Weeks	14
Hours	**4 weekly**
Lecture	2 weekly
Exercises	2 weekly

REMARQUE

pas donné en 2015-16

SUMMARY

Gödel incompleteness theorems and mathematical foundations of computer science

CONTENT

Gödel's theorems:
Peano and Robinson Arithmetics. Representable functions. Arithmetic of syntax. Incompleteness, and undecidability theorems.

Recursivity :
Turing Machines and variants. The Church-Turing Thesis. Universal Turing Machine. Undecidable problems (the halting and the Post-Correspondance problems). Reducibility. The arithmetical hierarchy. Relations to Turing machines. Turing degrees.

KEYWORDS

Gödel, incompleteness theorems, Peano arithmetic, Robinson arithmetic, decidability, recursively enumerable, arithmetical hierarchy, Turing machine, Turing degrees, jump operator, primitive recursive functions, recursive functions, automata, pushdown automata, regular languages, context-free languages, recursive languages, halting problem, universal Turing machine, Church thesis.

LEARNING PREQUISITES

Recommended courses
Mathematical logic (or equivalent)

Important concepts to start the course
1st order logic: syntax, semantics, proof theory, completeness theorem, compactness theorem, Löwenheim-Skolem theorem.

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Estimate whether a given theory, function, language is recursive or no
- Decide the class that a language belongs to (regular, context-free, recursive,...)
- Elaborate an automaton
- Design a Turing machine
- Formalize a proof in Peano arithmetic

• Sketch the incompleteness theorems

• Propose a non-standard model

• Argue why Hilbert program failed

TEACHING METHODS

Ex cathedra lecture and exercises

ASSESSMENT METHODS

Written: 3 hours

SUPERVISION

Office hours	Yes
Assistants	Yes
Forum	Yes

RESOURCES

Bibliography

Set Theory:

• Thomas Jech: Set theory, Springer 2006

• Kenneth Kunen: Set theory, Springer, 1983

• Jean-Louis Krivine: Theory des ensembles, 2007

• Patrick Dehornoy: Logique et théorie des ensembles; Notes de cours, FIMFA ENS: http://www.math.unicaen.fr/~dehornoy/surveys.html

• Yiannis Moschovakis: Notes on set theory, Springer 2006

• Karel Hrbacek and Thomas Jech: Introduction to Set theory, (3d edition), 1999

Recursion Theory :

• Micheal Sipser: Introduction to the Theory of Computation, Thomson Course Technology Boston, 2006

• Piergiorgio Odifreddi: Classical recursion theory, vol. 1 and 2, Springer, 1999

• Robert I. Soare: Recursively Enumerable Sets and Degres, A Study of Computable Functions and Computably Generated Sets, Springer-Verlag 1987

• Nigel Cutland: Computability, an introduction to recursive function theory, 1980

• Raymond M. Smullyan: recursion theory for methamathematics, Oxford, 1993

Proof theory :

• Wolfram Pohlers: Proof Theory, the first step into impredicativity, Springer, 2008

• A. S. Troelstra, H. Schwichtenberg, and Anne S. Troelstra: Basic proof theory, Cambridge, 2000

• S.R. Buss: Handbook of proof theory, Springer, 1998

Gödel's results :

• Raymond M. Smullyan: Gödel's incompleteness theorems, Oxford, 1992

• Peter Smith: An introduction to Gödel's theorems, Cambridge, 2008

• Torkel Franzen: Inexhaustibility, a non exhaustive treatment, AK Peteres, 2002

• Melvin Fitting: Incompleteness in the land of sets, King's College, 2007

• Torkel Franzen: Gödel's theorem: an incomplete guide to its use and abuse, AK Peters, 2005

Ressources en bibliothèque

• Théorie des ensembles / Krivine

• Introduction to Set theory / Hrbacek

• Proof Theory / Pohlers

- Notes on theory / Moschovakis
- Basic proof theory / Troelstra
- Introduction to the Theory of Computation / Sipser
- Handbook of proof theory / Buss
- Set theory / Jech
- Classical recursion theory / Odifreddi
- Recursion theory for methamathematics / Smullyan
- Set theory / Kunen
- Incompleteness in the land of sets / Fitting
- Recursively Enumerable Sets and Degres / Soare
- Gödel's theorem / Franzen
- Computability, an introduction to recursive function theory / Cutland
- Logique et théorie des ensembles / Dehornoy
- Gödel's incompleteness theorems / Smullyan
- An introduction to Gödel's theorems / Smith
- Inexhaustibility, a non exhaustive treatment / Franzen

Références suggérées par la bibliothèque

Websites

http://www.hec.unil.ch/logique/enseignement/recursivity

CS-486

Human computer interaction

Pu Faltings Pearl

Cursus	Sem.	Type
Informatique	MA2	Opt.
SC master EPFL	MA2, MA4	Opt.

Language	English
Credits	4
Session	Summer
Semester	Spring
Exam	During the semester
Workload	120h
Weeks	14
Hours	**4 weekly**
Lecture	2 weekly
Exercises	1 weekly
Project	1 weekly

SUMMARY

User experience design is concerned with the usability and enjoyability of software products. This course teaches you the basic methods of user experience design (UX), and introduces you to design thinking.

CONTENT

Basic concepts of human-computer interaction
Definition of user experience design: what are its aims and goals
Introduction to the goal-directed design method
How to interview users
How to identify design requirements after interviewing users
How to design using context scenario and storyboarding methods
How to perform usability testing
Basic concepts from cognitive science
How users interact with computers
How users learn and how they memorize
Human Perceptual Systems
Visual Interafce Design

LEARNING PREQUISITES

Recommended courses

Open to students renrolled in the Master and PhD programs in IC.

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Interview users and elicit their needs using the goal-directed design method
- Design interfaces and intearctions
- Project management: set objectives and device a plan to achieve them
- Group work skills: discuss and identify roles, and assume those roles including leadership
- Communication: writing and argumentation skills

TEACHING METHODS

Lectures, written assignments, one design project

EXPECTED STUDENT ACTIVITIES

Reading, case studies, peer discussions

ASSESSMENT METHODS

Written assignments, group project and project presentation

SUPERVISION

Office hours	Yes
Assistants	Yes

RESOURCES

Bibliography

About Face 3: The Essentials of Interaction Design by Alan Cooper et al. (available as e-book at NEBIS)
100 Things Every Designer Needs to Know about People by Susan Weinschenk (avaiable as e-book at NEBiS)

Ressources en bibliothèque

- About Face 3 / Cooper
- 100 Things Every Designer Needs to Know about People / Weinschenk

Références suggérées par la bibliothèque

Moodle Link

http://moodle.epfl.ch/course/view.php?id=12291

EE-550

Image and video processing

Ebrahimi Touradj

Cursus	Sem.	Type
Génie électrique et électronique	MA1, MA3	Opt.
Informatique	MA1, MA3	Opt.
SC master EPFL	MA1, MA3	Opt.

Language	English
Credits	6
Session	Winter
Semester	Fall
Exam	Oral
Workload	180h
Weeks	14
Hours	**6 weekly**
Lecture	4 weekly
Project	2 weekly

SUMMARY

This course covers fundamental notions in image and video processing, as well as covers most popular tools used, such as edge detection, motion estimation, segmentation, and compression. It is composed of lectures, laboratory sessions, and mini-projects.

CONTENT

Introduction, acquisition, restitution
Two-dimensionnal signals and systems, Elementary signals, Properties of two-dimentional Fourier transform, Discretization (spatial and spatio-temporal artefacts), Two-dimensional digital filters, Two-dimensional z-transform, Transfer function. Captors, monitors, printers, half-toning, color spaces.
Multi-dimensional filtres
Design of Infinite Impulse Response and Finite Impulse Response filters, Implementation of multi-dimensional filters, Directional decomposition and directional filters, M-D Sub-band filters, M-D Wavelets.
Visual perception
Neural system, Eye, Retina, Visual cortex, Model of visual system, Special effects, Mach phenomena and lateral inhibition, Color, Temporal vision.
Contour and feature extraction, segmentation
Local methods, Region based methods, Global methods, Canny, Mathematical morphology. Segmentation, Motion estimation
Visual information coding
Overview of the information theory and basics of rate-distortion, Conventional techniques : predictive coding, transform coding, subband coding, vector quantization, Advanced methods : multiresolution coding, perception based coding, region based coding, directional coding, fractals, Video coding : motion compensation, digital TV, High definition TV. Standards: JPEG, MPEG, H.261, H.263

KEYWORDS

Contour detection, motion estimation, segmentation, human visual system, image compression, video compression

LEARNING PREQUISITES

Required courses
Fundamental notions of signal processing

Recommended courses
Signal processing for communication

Important concepts to start the course
Sampling, quantization, transforms, programming, algorithms, systems

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Create simple image processing systems
- Create simple video processing systems
- Compare image processing tools
- Compare video processing tools
- Select appropriately optimal image and video processing tools

Transversal skills

- Make an oral presentation.
- Write a scientific or technical report.

TEACHING METHODS

Ex cathedra, laboratory sessions, mini-projects

EXPECTED STUDENT ACTIVITIES

Written report of laboratory sessions, oral presentation of mini-projects, comprehension of various notions presented during the course, resolve simple problems of image and video processing.

ASSESSMENT METHODS

Laboratories, mini-project, oral exam

SUPERVISION

Office hours	No
Assistants	Yes
Forum	Yes
Others	Students are encouraged to ask for appoitment with the professor any time outside of teaching hours

RESOURCES

Bibliography

handouts of image and video processing course
Fundamentals of Digital Image Processing, A. K. Jain

Ressources en bibliothèque

- Fundamentals of Digital Image Processing / Jain

Références suggérées par la bibliothèque

Moodle Link

http://moodle.epfl.ch/enrol/index.php?id=333

PREREQUISITE FOR

Semester projects , master thesis projects, doctoral thesis

EE-551

Image communication

Frossard Pascal

Cursus	Sem.	Type
Génie électrique et électronique	MA2	Opt.
SC master EPFL	MA2, MA4	Opt.

Language	English
Credits	4
Session	Summer
Semester	Spring
Exam	During the semester
Workload	120h
Weeks	14
Hours	**4 weekly**
Lecture	2 weekly
Project	2 weekly

SUMMARY

This class presents the main concepts underlying image and video compression and transmission, and discusses current applications in multimedia communication.

CONTENT

Recall
Basics of rate-distortion theory, basics of quantization, basics of DPCM, basics of Fourier and wavelets transforms.

Image and video compression
Overview of image compression, multiresolution and wavelet coding, still image compression standards, motion estimation, overview of video coding, video compression standards.

Multimedia Networking
Basics of networking, multimedia networking protocols, multimedia traffic and network infrastructures.

Image Communication
Internet video and multiview video streaming, wireless video streaming, error resilient image communication, rate control, content distribution networks.

LEARNING PREQUISITES

Recommended courses

Introduction to signal processing, Image processing

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Analyze multimedia transmission systems
- Construct image compression and transmission methods
- multimedia transmission systems

Transversal skills

- Assess progress against the plan, and adapt the plan as appropriate.
- Use both general and domain specific IT resources and tools
- Access and evaluate appropriate sources of information.
- Write a scientific or technical report.
- Make an oral presentation.

TEACHING METHODS

Ex cathedra with exercices in classroom and using computer

ASSESSMENT METHODS

Continuous control

RESOURCES

Notes/Handbook

Image Communication, EPFL Master optional class, Prof. Pascal Frossard

PREREQUISITE FOR

Semester projects, master thesis projects and doctoral thesis

MICRO-511

Image processing I

Van De Ville Dimitri

Cursus	Sem.	Type
Bioingénierie	MA1, MA3	Opt.
Informatique	MA1, MA3	Opt.
Microtechnique	MA1, MA3	Opt.
Mineur en Biocomputing	H	Opt.
Mineur en Neuroprosthétiques	H	Opt.
Mineur en Neurosciences computationnelles	H	Opt.
SC master EPFL	MA1, MA3	Opt.
Science et ing. computationelles	MA1, MA3	Opt.
Sciences du vivant	MA1, MA3	Opt.

Language	English
Credits	3
Session	Winter
Semester	Fall
Exam	Written
Workload	90h
Weeks	14
Hours	**3 weekly**
Lecture	3 weekly

SUMMARY

Introduction to the basic techniques of image processing. Introduction to image processing software development and prototyping in JAVA; application to real-world examples in industrial vision and biomedical imaging.

CONTENT

- Introduction. Image processing versus image analysis. Applications. System components.
- Characterization of continuous images. Image classes. 2D Fourier transform. Shift-invariant systems.
- Image acquisition. Sampling theory. Acquisition systems. Histogram and simple statistics. Linear and Max-Lloyd Quantization.
- Characterization of discrete images and linear filtering. z-transform. Convolution. Separability. FIR and IIR filters.
- Image processing operations. Point operators (thresholding, histogram modification). Spatial operators (smoothing, enhancement, non-linear filtering). Morphological operators.
- Introduction to image analysis and computer vision. Segmentation, edge detection, objet detection, image comparison.

LEARNING PREQUISITES

Required courses
Signals and Systems I & II (or equivalent)

Important concepts to start the course
1-D signal processing: convolution, Fourier transform, z-transform

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Exploit the multidimensional Fourier transform
- Select appropriately Hilbert spaces and inner-products
- Optimize 2-D sampling to avoid aliasing
- Formalize convolution and optical systems
- Design digital filters in 2-D
- Analyze multidimensional linear shift-invariant systems
- Apply image-analysis techniques

- Construct image-processing software
- Elaborate morphological filters

Transversal skills

- Use a work methodology appropriate to the task.
- Manage priorities.
- Use both general and domain specific IT resources and tools

MICRO-512

Image processing II

Unser Michaël, Van De Ville Dimitri

Cursus	Sem.	Type
Bioingénierie	MA2, MA4	Opt.
Informatique	MA2	Opt.
Microtechnique	MA2	Opt.
Mineur en Biocomputing	E	Opt.
Mineur en Neuroprosthétiques	E	Opt.
Mineur en Neurosciences computationnelles	E	Opt.
SC master EPFL	MA2, MA4	Opt.
Science et ing. computationelles	MA2	Opt.
Sciences du vivant	MA2, MA4	Opt.

Language	English
Credits	3
Session	Summer
Semester	Spring
Exam	Written
Workload	90h
Weeks	14
Hours	**3 weekly**
Lecture	3 weekly

SUMMARY

Study of advanced image processing; mathematical imaging. Image processing software development and prototyping in JAVA; application to real-world examples in industrial vision and biomedical imaging.

CONTENT

- **Review of fundamental notions.** Multi-dimensional Fourier transform. Convolution. z-transform. Digital filters.
- **Continuous representation of discrete data.** Splines. Interpolation. Geometric transformations. Multi-scale decomposition (pyramids and wavelets).
- **Image transforms.** Karhunen-Loève transform (KLT). Discrete cosine transform (DCT). JPEG coding. Image pyramids. Wavelet decomposition.
- **Reconstruction from projections.** X-ray scanners. Radon transform. Central slice theorem. Filtered backprojection. Iterative methods.
- **Deconvolution.** Inverse and Wiener filtering. Matrix formulations. Iterative techniques (ART).
- **Statistical pattern classification.** Decision making. Bayesian classification. Parameter estimation. Supervised learning. Clustering.
- **Image analysis.** Pixel classification. Contour extraction and representation. Shape. Texture. Snakes and active contours.

LEARNING PREQUISITES

Required courses

Image Processing I

Recommended courses

Signals and Systems I & II, linear algebra, analysis

Important concepts to start the course

Basic image processing and related analytical tools (Fourier transform, z-tranform, etc.)

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Construct interpolation models and continuous-discrete representations
- Analyze image transforms

- Design image-reconstruction algorithms
- Formalize multiresolution representations using wavelets
- Design deconvolution algorithms
- Perform image analysis and feature extraction
- Design image-processing software (plugins)
- Synthesize steerable filters

Transversal skills

- Plan and carry out activities in a way which makes optimal use of available time and other resources.
- Manage priorities.
- Access and evaluate appropriate sources of information.
- Use both general and domain specific IT resources and tools

CS-487 **Industrial automation**

Pignolet-Oswald Yvonne Anne, Tournier Jean-Charles

Cursus	Sem.	Type
Génie électrique et électronique	MA2	Opt.
Informatique	MA2	Opt.
SC master EPFL	MA2, MA4	Opt.

Language	English
Credits	3
Session	Summer
Semester	Spring
Exam	Oral
Workload	90h
Weeks	14
Hours	**3 weekly**
Lecture	2 weekly
Project	1 weekly

REMARQUE

This course can be taken by students of all engineering sections.

SUMMARY

This course consists of two parts: 1) architecture of control systems, hands-on lab 2) handling of faults and failures in real-time systems, including fault-tolerant computing

CONTENT

1. Processes and plants, control system architecture
2. Instrumentation, Programmable Logic Controllers and embedded computers
3. Industrial communication networks, field busses
4. Field device access protocols and application program interfaces
5. Human interface and supervision
6. Manufacturing Execution Systems (optional*)
7. Plant configuration and commissioning (optional*)
8. Real-time response and performance analysis
9. Dependability
9.1 Reliability, Availability, Safety
9.2 Evaluation of dependability
9.3 Safe and Reliable communication
9.4 Fault-tolerant computers
9.5 Software reliability
9.6 Safety evaluation
In addition, a workshop giving hands-on experience and a factory visit are included.
(*) If time permits this part will be covered.

KEYWORDS

Industrial Automation considers the control, command and communication in real-time systems: factories, energy production and distribution, vehicles and other embedded systems.
Industrial Automation encompasses the whole chain from sensors, motors, controllers, communication networks, operator visualization, archiving and up to manufacturing execution systems and enterprise resource management. It includes fault-tolerance against hardware and software faults and the evaluation methods.
This application-oriented course does not require previous knowledge in control theory. It complements communication systems courses with a focus on industrial application.

LEARNING PREQUISITES

Recommended courses

Communication networks

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Characterize the architecture of a control system
- Apply methods and trade-offs in real-time systems
- Analyze a plant
- Propose suitable automation solutions meeting the requirements
- Analyze the reliability, availability, safety of a system

Transversal skills

- Communicate effectively with professionals from other disciplines.
- Keep appropriate documentation for group meetings.
- Use both general and domain specific IT resources and tools
- Access and evaluate appropriate sources of information.

TEACHING METHODS

Oral presentation aided by slides, exercises as part of the lecture, practical work (workshop at Siemens and independent homework).

EXPECTED STUDENT ACTIVITIES

- Understand material presented during lectures by asking questions and/or independent (online) searches
- Attend Siemens workshop (one full day on Siemens premises in Renens)
- Work on one of three possible homework projects independently
- Hand-in report and slides for homework on time

ASSESSMENT METHODS

Individual assignment 25% and final oral exam 75%

RESOURCES

Bibliography

Nussbaumer, Informatique Industrielle (EPFL)
Olsson, Gustav & Rosen, Christian - industrial automation,Dept. of Industrial Electrical Engineering and Automation, Lund University, Lund, Sweden.

Ressources en bibliothèque

- Informatique Industrielle / Nussbaumer

Références suggérées par la bibliothèque

Websites

http://lamspeople.epfl.ch/kirrmann/

Moodle Link

http://moodle.epfl.ch/course/view.php?id=14114

PREREQUISITE FOR

Work in companies

COM-404

Information theory and coding

Telatar Emre

Cursus	Sem.	Type
Génie électrique et électronique	MA1, MA3	Opt.
Informatique et communications		Obl.
Informatique	MA1, MA3	Obl.
Ing.-math	MA1, MA3	Opt.
Mathématicien	MA1, MA3	Opt.
SC master EPFL	MA1, MA3	Obl.

Language	English
Credits	7
Session	Winter
Semester	Fall
Exam	Written
Workload	210h
Weeks	14
Hours	**6 weekly**
Lecture	4 weekly
Exercises	2 weekly

SUMMARY

The mathematical principles of communication that govern the compression and transmission of data and the design of efficient methods of doing so.

CONTENT

1. Mathematical definition of information and the study of its properties.
2. Source coding: efficient representation of message sources.
3. Communication channels and their capacity.
4. Coding for reliable communication over noisy channels.
5. Multi-user communications: multi access and broadcast channels.
6. Lossy source coding : approximate representation of message sources.

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Formulate the fundamenal concepts of informatoin theory such as entropy, mutual information, channel capacity
- Elaborate the principles of source coding and data transmission
- Analyze source codes and channel codes
- Apply information theoretic methods to novel settings

TEACHING METHODS

Ex cathedra + exercises

ASSESSMENT METHODS

With continuous control

RESOURCES

Ressources en bibliothèque

- Elements of Information Theory / Cover

Références suggérées par la bibliothèque
Websites
http://ipg/doku.php?id=en:courses:2009-2010:itc

CS-430 **Intelligent agents**

Faltings Boi

Cursus	Sem.	Type
Energie et construction durable	MA1, MA3	Opt.
Informatique et communications		Opt.
Informatique	MA1, MA3	Opt.
Ing. finance	MA1, MA3	Opt.
SC master EPFL	MA1, MA3	Opt.

Language	English
Credits	6
Session	Winter
Semester	Fall
Exam	During the semester
Workload	180h
Weeks	14
Hours	**6 weekly**
Lecture	3 weekly
Exercises	3 weekly

SUMMARY

Software agents are widely used to control physical, economic and financial processes. The course presents practical methods for implementing software agents and multi-agent systems, supported by programming exercises, and the theoretical underpinnings including computational game theory.

CONTENT

The course contains 4 main subject areas:

1) Basic models and algorithms for individual agents:
game-playing algorithms, reactive agents and reinforcement learning. Models and algorithms for rational, goal-oriented behavior in agents.
2) Multi-agent systems:
multi-agent planning, distributed algorithms for constraint satisfaction, coordination techniques for multi-agent systems.
3) Self-interested agents:
Models and algorithms for implementing self-interested agents motivated by economic principles: elements of computational game theory, models and algorithms for automated negotiation, social choice, mechanism design, electronic auctions and marketplaces.
4) Implementing multi-agent systems:
Agent platforms, ontologies and markup languages, web services and standards for their definition and indexing.

LEARNING PREQUISITES

Recommended courses

Intelligence Artificielle or another introductory course to AI

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Choose and implement methods for rational decision making in software agents, based on decision processes and AI planning techniques
- Choose and implement methods for efficient rational decision making in teams of multiple software agents
- Model scenarios with multiple self-interested agents in the language of game theory
- Evaluate the feasibility of achieving goals with self-interested agents using game theory
- Design, choose and implement mechanisms for self-interested agents using game theory
- Implement systems of software agents using agent platforms

TEACHING METHODS

Ex cathedra, practical programming exercises

EXPECTED STUDENT ACTIVITIES

Lectures: 3 hours
Reading: 3 hours
Assignments/programming: 4 hours

ASSESSMENT METHODS

Mini-projects and exercises 40%, final exam 60%

RESOURCES

Bibliography

Michael Wooldridge : An Introduction to MultiAgent Systems - Second Edition, John Wiley & Sons, 2009Stuart Russell and Peter Norvig: Artificial Intelligence: A Modern Approach (2nd/3rd Edition), Prentice Hall Series in Artificial Intelligence, 2003/2009.

Ressources en bibliothèque

- Artificial Intelligence: A Modern Approach / Russell
- An Introduction to MultiAgent Systems / Wooldridge

Références suggérées par la bibliothèque

Websites

-

CS-431

Introduction to natural language processing

Chappelier Jean-Cédric, Rajman Martin

Cursus	Sem.	Type
Informatique	MA2	Opt.
SC master EPFL	MA2, MA4	Opt.

Language	English
Credits	4
Session	Summer
Semester	Spring
Exam	Written
Workload	120h
Weeks	14
Hours	**4 weekly**
Lecture	2 weekly
Exercises	2 weekly

SUMMARY

The objective of this course is to present the main models, formalisms and algorithms necessary for the development of applications in the field of natural language information processing. The concepts introduced during the lectures will be applied during practical sessions.

CONTENT

Several models and algorithms for automated textual data processing will be described: (1) morpho-lexical level: electronic lexica, spelling checkers, ...; (2) syntactic level: regular, context-free, stochastic grammars, parsing algorithms, ...; (3) semantic level: models and formalisms for the representation of meaning, ...

Several application domains will be presented: Linguistic engineering, Information Retrieval, Text mining (automated knowledge extraction), Textual Data Analysis (automated document classification, visualization of textual data).

KEYWORDS

Natural Language Processing; Computationnal Linguisitics; Part-of-Speech tagging; Parsing

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Compose key NLP elements to develop higher level processing chains
- Assess / Evaluate NLP based systems
- Choose appropriate solutions for solving typical NLP subproblems (tokenizing, tagging, parsing)
- Describe the typical problems and processing layers in NLP
- Analyze NLP problems to decompose them in adequate independant components

TEACHING METHODS

Ex cathedra ; practical work on computer

EXPECTED STUDENT ACTIVITIES

attend lectures and practical sessions, answer quizzes.

ASSESSMENT METHODS

4 quiz during semester 25%, final exam 75%

SUPERVISION

Office hours	No
Assistants	No

Forum No

RESOURCES

Bibliography

1. M. Rajman editor, "*Speech and Language Engineering*", EPFL Press, 2006.

2. Daniel Jurafsky and James H, Martin, "*Speech and Language Processing"*, Prentice Hall, 2008 (2nd edition)

3. Christopher D. Manning and Hinrich Schütze, "*Foundations of Statistical Natural Language Processing*", MIT Press, 2000

4. Christopher D. Manning, Prabhakar Raghavan and Hinrich Schütze, *Introduction to Information Retrieval*, Cambridge University Press. 2008

5. Nitin Indurkhya and Fred J. Damerau editors, "*Handbook of Natural Language Processing*", CRC Press, 2010 (2nd edition)

Ressources en bibliothèque

- Handbook of Natural Language Processing / Indurkhya
- Introduction to Information Retrieval / Manning
- Speech and Language Processing / Jurafsky
- Speech and Language Engineering / Rajman
- Foundations of Statistical Natural Language Processing / Manning

Références suggérées par la bibliothèque

Websites

http://coling.epfl.ch

COM-514 **Mathematical foundations of signal processing**

Bejar Haro Benjamin, Kolundzija Mihailo, Parhizkar Reza, Vetterli Martin

Cursus	Sem.	Type
Informatique et communications		Obl.
Informatique	MA1, MA3	Opt.
Mineur en Systems Engineering	H	Opt.
SC master EPFL	MA1, MA3	Opt.
Science et ing. computationelles	MA1, MA3	Opt.

Language	English
Credits	6
Session	Winter
Semester	Fall
Exam	Written
Workload	180h
Weeks	14
Hours	**5 weekly**
Lecture	3 weekly
Exercises	2 weekly

SUMMARY

Signal processing tools are presented from an intuitive geometric point of view which is at the heart of all modern signal processing techniques. Student will develop the mathematical depth and rigor needed for the study of advanced topics in signal processing.

CONTENT

From Euclid to Hilbert (vector spaces; Hilbert spaces; approximations, projections and decompositions; bases)
Sequences and Discrete-Time Systems (sequences; systems; discrete-time Fourier transform; z-transform; DFT; multirate sequences and systems)
Functions and Continuous-Time Systems (functions; systems; Fourier transform; Fourier series)
Sampling and Interpolation (sampling and interpolation with finite-dimensional vectors, sequences, functions and periodic functions)
Approximation and Compression (approximation by polynomials, splines, and series truncation)
Localization and Uncertainty (localization for functions, sequences and bases; local Fourier and wavelet bases; time, frequency and resolution in the real world)
Compressed Sensing (overview and definitions; reconstruction methods and applications)

LEARNING PREQUISITES

Required courses
Circuits and Systems

Recommended courses
Signal processing for communications (recommended)

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Master the right tools to tackle advanced signal and data processing problems
- Develop an intuitive understanding of signal processing through a geometrical approach
- Get to know the applications that are of interest today
- Learn about topics that are at the forefront of signal processing research

TEACHING METHODS

Ex cathedra with exercises

EXPECTED STUDENT ACTIVITIES

Attending lectures, completing exercises

ASSESSMENT METHODS

Homeworks 20%, midterm (written) 30%, final exam (written) 50%

SUPERVISION

Office hours	Yes
Assistants	Yes
Forum	No

RESOURCES

Bibliography

M. Vetterli, J. Kovacevic and V. Goyal, *"Signal Processing: Foundations"*, Cambridge U. Press, 2014.
Available in open access at http://www.fourierandwavelets.org

Ressources en bibliothèque

- Signal Processing: Foundations / Vetterli

Références suggérées par la bibliothèque

Websites

http://lcav.epfl.ch/SP_Foundations

Moodle Link

http://moodle.epfl.ch/course/view.php?id=13431

EE-552

Media security

Ebrahimi Touradj

Cursus	Sem.	Type
Génie électrique et électronique	MA2	Opt.
Information security minor	E	Opt.
SC master EPFL	MA2, MA4	Opt.

Language	English
Credits	6
Session	Summer
Semester	Spring
Exam	Written
Workload	180h
Weeks	14
Hours	**3 weekly**
Lecture	2 weekly
Exercises	1 weekly

SUMMARY

This course provides attendees with theoretical and practical issues in media security. In addition to lectures by the professor, the course includes laboratory sessions, a mini-project, and a mid-term exam.

CONTENT

Media security problems:
Rights protection, content integrity verification, conditional access, confidentionality, privacy, steganography and data hiding.

Media access problems:
Access control, conditional access, access over time, copyright.

Media security tools and solutions:
Robust watermarking, fragile watermarking, selective encryption, monitoring, robust hashing, content identification, visual password.

Media security standards:
Secure JPEG 2000 (JPSEC), security tools in the MPEG family of standards from MPEG-1 to MPEG-21.

Applications:
Surveillance with privacy, image abd video right protection, security in digital cinema, etc.

KEYWORDS

watermarking, robust hashing, privacy, conditional access, integrity verification, surveillance, visual password

LEARNING PREQUISITES

Required courses
Any course that covers basic concepts of data encryption or security

Recommended courses
Any course covering basics of image and video processing

Important concepts to start the course
Basic knowledge of data encryption and security
Basic knowledge of image and video processing

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Reason the level of security in a multimedia systems

- Formulate the level of security in multimedia systems
- Explain concepts needed in multimedia systems
- Create secure multimedia systems

Transversal skills

- Summarize an article or a technical report.
- Write a scientific or technical report.
- Make an oral presentation.

TEACHING METHODS

Lectures, mini-project, laboratory sessions, mid-term exam, final exam

EXPECTED STUDENT ACTIVITIES

Prepare and present a specific topic in media security as part of the mini-projet
Perform laboratory sessions and write a report

ASSESSMENT METHODS

Final exam will be in oral if less than 20 students.
Final exam will be written if more than 20 students.
Final mark will be a weighted sum of the marks of final, and intermedia exams, as well as mini-project and laboratory sessions.

SUPERVISION

Office hours	No
Assistants	Yes
Forum	Yes
Others	Students are encouraged to contact the professor at any time if they have any questions or need any clarification of any of the concepts presented during the course.

RESOURCES

Bibliography
Lecture notes, selected articles.

Notes/Handbook
Print-out of slides presented

Moodle Link
http://moodle.epfl.ch/course/view.php?id=235

CS-474

Microelectronics for systems on chips

Beuchat René, Piguet Christian

Cursus	Sem.	Type
Génie électrique et électronique	MA1, MA3	Opt.
Informatique	MA1, MA3	Opt.
SC master EPFL	MA1, MA3	Opt.

Language	English
Credits	4
Session	Winter
Semester	Fall
Exam	Oral
Workload	120h
Weeks	14
Hours	**4 weekly**
Lecture	2 weekly
Project	2 weekly

SUMMARY

VLSI technology allows the development of processors and memories. Significant improvements, by at least a factor of 1000, are still expected over the next 15 years. Influence of technology and mainly power consumption constraints are key elements on the architecture of Systems On Chip.

CONTENT

- Evolution of VLSI technologies
- SIA Roadmap predictions (2012-2027)
- Future technologies and new circuit techniques
- Asynchronous and adiabatic circuits
- Low-power microcontrollers
- Low-power microprocessors
- Low-power memories and cache memories
- Low-power DSP and parallel machines
- Integrated memories classification
- Complex dynamic RAM memories

KEYWORDS

VLSI, Memories, RAM, DRAM, DSP, Low Power, Roadmap, Technologie evolution

LEARNING PREQUISITES

Required courses
Electronic, Digital Systems

Recommended courses
Microprocessor Systems, Digital Logic Design

Important concepts to start the course
Bases in digital system, bases in electronic, bases in processor architecture

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Argue the technology evolution
- Anticipate the forthcoming technologies and their capacities
- Justify those evolutions
- Estimate the capabilitties of the new technologies
- Analyze un technical problem in the VLSI are to propose new realization solutions

- Use tools to design simple VLSI circuits
- Describe the new technologies in electronic memories and their architecture

Transversal skills

- Use both general and domain specific IT resources and tools
- Access and evaluate appropriate sources of information.

TEACHING METHODS

Ex cathedra with laboratories
personal oral presentation on a selected topic on memories

EXPECTED STUDENT ACTIVITIES

Laboratory to self appropriate technologies and methodologies.
Preparing a presentation summarizing new technology with class presentation.

ASSESSMENT METHODS

Oral examination 90 % and oral presentation during the semester 10%

SUPERVISION

Office hours	No
Assistants	No
Forum	Yes

RESOURCES

Bibliography
Course notes on moodle

Websites
http://lap.epfl.ch/page73398.html

Moodle Link
http://moodle.epfl.ch/course/view.php?id=4191

EE-445

Microwaves

Skrivervik Favre Anja

Cursus	Sem.	Type
Génie électrique et électronique	MA1, MA3	Obl.
SC master EPFL	MA1, MA3	Opt.

Language	English
Credits	4
Session	Winter
Semester	Fall
Exam	During the semester
Workload	120h
Weeks	14
Hours	**4 weekly**
Lecture	2 weekly
Exercises	2 weekly

SUMMARY

This course is n introduction to microwaves and microwave passive circuits. A special attention is given to the introduction of the notion of distributed circuits and to the scattering matrix

CONTENT

Introduction: Definition of the basic notions, applications: radar, communications, satellites, space probes, microwave ovens, atomic clocks, biological effects
Microwave networks: S-parameters and scattering matrix
Microwave circuits: Description of devices with 1, 2, 3 and 4 ports. Ferrite devices: The gyromagnetic effect, isolators, circulators, switches, llimiters, component insertion, filters
Device and signal measurements: Basic principles, reflectometry, vector network analyzer, attenuation and phaseshift, TDR. Calibration for error compensation and deembedding. Measurement of frequency and power.

KEYWORDS

microwaves, S-parameters, passive devices

LEARNING PREQUISITES

Recommended courses

Electromagnetics

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Analyze Microwave circuits
- Create Microwave components
- Formalize S-parameter model

Transversal skills

- Use a work methodology appropriate to the task.

TEACHING METHODS

Ex cathedra with demonstrations and exercises

ASSESSMENT METHODS

With mandatory continuous control

RESOURCES

Bibliography
Handouts

Websites
http://lema.epfl.ch/content/view/25/51/

PREREQUISITE FOR

Microwaves, practical work and projects

COM-405

Mobile networks

Hubaux Jean-Pierre

Cursus	Sem.	Type
Génie électrique et électronique	MA2	Opt.
Information security minor	E	Opt.
Informatique	MA2	Opt.
SC master EPFL	MA2, MA4	Obl.

Language	English
Credits	4
Session	Summer
Semester	Spring
Exam	Written
Workload	120h
Weeks	14
Hours	**3 weekly**
Lecture	2 weekly
Exercises	1 weekly

SUMMARY

This course provides a detailed description of the organization and operating principles of mobile communication networks.

CONTENT

Introduction to wireless networks
Organization of the MAC layer
Wireless Local Area Networks - WiFi
Cellular networks
Mobility at the network and transport layers
Security and privacy in mobile networks

KEYWORDS

Communication networks, protocols, mobility

LEARNING PREQUISITES

Required courses

Computer Networks

Recommended courses

Principles of Digital Communications
Network security

Important concepts to start the course

Operating principles of communication protocols and layer organization.

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Synthesize the way a mobile network operates
- Interpret the behavior of such networks
- Propose evolutions to existing protocols
- Identify weaknesses, bottlenecks and vulnerabilities

TEACHING METHODS

Ex cathedra lectures
Weekly quizzes

Exercise sessions
Hands-on exercises

EXPECTED STUDENT ACTIVITIES

Class participation, quizzes, homework, hands-on exercises

ASSESSMENT METHODS

Quizzes + final exam

SUPERVISION

Office hours	No
Assistants	Yes
Forum	No
Others	The lecturer will be present at most of the exercise sessions.

RESOURCES

Bibliography

Handouts, recommended books (see course URL)

Websites

http://mobnet.epfl.ch/

CS-478

Model-based system design

Sifakis Joseph

Cursus	Sem.	Type
Informatique	MA2	Opt.
SC master EPFL	MA2, MA4	Opt.

Language	English
Credits	4
Session	Summer
Semester	Spring
Exam	During the semester
Workload	120h
Weeks	14
Hours	**4 weekly**
Lecture	2 weekly
Exercises	2 weekly

SUMMARY

We will discuss foundational and practical aspects of model-based system design. We consider design as a formal process leading from formal requirements to mixed HW/SW systems that are trustworthy and optimal.

CONTENT

- Transition Systems – Operational Semantics
- Predicate Transformers, Invariants
- Petri Nets
- Process Algebras
- Timed & Hybrid Systems
- Requirements Specification - Temporal Logics
- Algorithmic Verification
- Model-Based Design in BIP

KEYWORDS

Model-based system design, correctness, requirements specification, temporal logic, modeling, domain-specific languages, process algebra, timed automata, hybrid systems, verification, model-checking, synthesis, correctness-by-construction, components, source-to-source transformation, code generation.

LEARNING PREQUISITES

Required courses

CS-206 Concurrency

Recommended courses

CS-453 Concurrent algorithms
CS-305 Software engineering

Important concepts to start the course

- Basic set theory
- Automata theory and formal languages
- Logics (axiomatization, proof methods, semantics)

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Identify key issues and methodological aspects in system design.
- Discuss strengths and limitations of formal methods and their applications in system design.
- Select appropriately the modelling formalism suitable for a particular system.
- Analyze the system requirements and structure.
- Structure a system as a family of functionally meaningful, self contained components
- Design faithful models.
- Contrast parallel composition operators in component frameworks
- Apply existing modelling, simulations and analysis tools to system models.

Transversal skills

- Use a work methodology appropriate to the task.
- Access and evaluate appropriate sources of information.
- Summarize an article or a technical report.

TEACHING METHODS

- Ex-cathedra
- Exercises

EXPECTED STUDENT ACTIVITIES

- Attending lectures and exercise sessions
- Discussing with fellow students
- Realising a project

ASSESSMENT METHODS

- Continuous control during the semester
- Project presentation

SUPERVISION

Office hours	No
Assistants	Yes
Forum	Yes

RESOURCES

Bibliography

Hermann Kopetz Real-Time Systems: Design Principles for Distributed Embedded Applications 1441982361 978-1441982360
Peter Marwedel Embedded System Design: Embedded Systems Foundations of Cyber-Physical Systems 9400702566 978-9400702561
Alan Burns Real Time Systems & Programming Language 0321417453 978-0321417459
Zohar Manna, Amir Pnueli Temporal Verification of Reactive Systems: Safety 0387944591 978-0387944593
Zohar Manna, Amir Pnueli The Temporal Logic of Reactive and Concurrent Systems: Specification 0387976647 978-0387976648
Edmund M. Clarke Jr., Orna Grumberg, Doron A. Peled Model Checking 0262032708 978-0262032704

Wan Fokkink Introduction to Process Algebra 354066579X 978-3540665793
Glynn Winskel Formal Semantics of Programming Languages 0262731037 978-0262731034

Ressources en bibliothèque

- Real Time Systems And Programming Language / Burns
- Design Principles for Distributed Embedded Applications / Kopetz
- The Temporal Logic of Reactive and Concurrent Systems / Manna
- Temporal Verification of Reactive Systems / Manna
- Formal Semantics of Programming Languages / Winskel
- Peled Model Checking / Grumberg
- Introduction to Process Algebra / Fokkink
- Embedded System Design / Marwedel

Références suggérées par la bibliothèque
Moodle Link
http://moodle.epfl.ch/course/view.php?id=13958

Videos
http://artist-summer-school.epfl.ch/speakers

COM-512 **Networks out of control**

Celis Laura Elisa, Thiran Patrick

Cursus	Sem.	Type
Informatique	MA2	Opt.
Mineur en Systems Engineering	E	Opt.
SC master EPFL	MA2, MA4	Opt.

Language	English
Credits	4
Session	Summer
Semester	Spring
Exam	Written
Workload	120h
Weeks	14
Hours	**3 weekly**
Lecture	2 weekly
Exercises	1 weekly

SUMMARY

The goal of this class is to acquire mathematical tools and engineering insight about networks whose structure is random, as well as decentralized processes that take place on these networks.

CONTENT

- Course Introduction, Tree Percolation, Branching Processes
- Random Graphs 1: Models, Threshold Functions, Appearance of Subgraphs
- Random Graphs 2: Giant Component and Connectivity
- Random Graphs 3: Other models: the Random Regular Graph, Small World Networks, Scale-Free Networks.
- Random Geometric Graphs: Introduction to Percolation Theory.
- Evolution and Dynamics 1: Epidemics, Network and Source Discovery
- Evolution and Dynamics 2: Information Cascades
- Evolution and Dynamics 3: Network Navigation and Price of Anarchy
- Applications 1: Network Formation Games
- Applications 2: Homophily, Structural Balance.

KEYWORDS

Random graphs, percolation theory, social networks, communication networks.

LEARNING PREQUISITES

Required courses
Stochastic models in communication (COM-300), or equivalent.

Important concepts to start the course
Basic probability and stastistics; Markov chains; basic combinatorics.

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Analyze social and communication systems
- Model such systems as stochastic models
- Compute key properties of these models

TEACHING METHODS

Ex cathedra lectures, exercises, mini-project

EXPECTED STUDENT ACTIVITIES

Attending lectures, bi-weekly homeworks, mini-project incl. student presentation at the end of semester, final exam.

ASSESSMENT METHODS

1. Homeworks 10%
2. Mini-project 40%
3. Final exam 50%.

SUPERVISION

Office hours	Yes
Assistants	Yes
Forum	No

RESOURCES

Bibliography

• A. D. Barbour, L. Holst and S. Janson, Poisson Approximation, Oxford Science Publications, 1992.

• B. Bollobas, Random Graphs (2nd edition), Cambridge University Press, 2001.

• R. Durrett, Random Graph Dynamics, Cambridge University Press, 2006 (electronic version).

• D. Easley, J. Kleinberg. Networks, Crowds, and Markets: Reasoning About a Highly Connected World, Cambridge University Press, 2010 (electronic version).

• G. Grimmett, Percolation (2nd edition), Springer, 1999.

• S. Janson, T. Luczak, A. Rucinski, Random Graphs, Wiley, 2000.

• R. Meester and R. Roy, Continuum Percolation, Cambridge University Press, 1996.

Ressources en bibliothèque

- Random Graphs / Bollobas
- Random Graphs / Janson
- Continuum Percolation / Meester
- Random Graph Dynamics / Durrett
- Networks, Crowds and Markets / Easley
- Poisson Approximation / Barbour
- Percolation / Grimmett

Références suggérées par la bibliothèque

Notes/Handbook

Class notes will be available on the course website.

Websites

http://icawww1.epfl.ch/class-nooc/

COM-507

Optional project in communication systems

Profs divers *

Cursus	Sem.	Type
SC master EPFL	MA1, MA2, MA3, MA4	Opt.

Language	English
Credits	8
Session	Winter, Summer
Semester	Fall
Exam	During the semester
Workload	240h
Weeks	14
Hours	**2 weekly**
Project	2 weekly

SUMMARY

Individual research during the semester under the guidance of a professor or an assistant.

CONTENT

Subject to be chosen among the themes proposed on the web site :

http://ic.epfl.ch/page-29961-en.html

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Organize a project
- Assess / Evaluate one's progress through the course of the project
- Present a project

TEACHING METHODS

Individual and independant work, under the guidance of a professor or an assistant.

ASSESSMENT METHODS

Oral presentation and written report.

RESOURCES

Websites
http://ic.epfl.ch/page-29175-en.html

CS-433 **Pattern classification and machine learning**

Khan Mohammad Emtiyaz

Cursus	Sem.	Type
Informatique et communications		Obl.
Informatique	MA1, MA3	Obl.
Mineur en Biocomputing	H	Opt.
Mineur en Neurosciences computationnelles	H	Opt.
Neurosciences		Obl.
SC master EPFL	MA1, MA3	Obl.
Sciences du vivant	MA1, MA3	Obl.

Language	English
Credits	7
Session	Winter
Semester	Fall
Exam	Written
Workload	210h
Weeks	14
Hours	**6 weekly**
Lecture	4 weekly
Exercises	2 weekly

SUMMARY

Pattern classification occupies a central role in machine learning from data. In this course, basic principles and methods underlying machine learning will be introduced. The student will learn few basic methods and their relations to each other.

CONTENT

1. Basic regression and classification methods: Linear regression, Ridge regression, logistic regression, and k-NN.
2. Basic concepts: cost-functions and optimization, corss-validation and bias-variance trade-off, curse of dimensionality.
3. Advanced regression and classification methods: generalized linear model, SVM and Kernel methods, Gaussian processes and Bayesian methods, Neural network and deep learning, random forest and boosting.
4. Clustering: Mixture model, k-means, Gaussian mixture model and EM algorithm.
5. Dimensionality reduction: PCA and matrix factorization.
6. Time-series: Bayesian network, Kalman filters and HMM, belief propagation.

LEARNING PREQUISITES

Required courses

• Analysis I, II, III

• Linear Algebra

• Probability and Statistics (MATH-232)

Recommended courses

• Introduction to differentiable optimization (MATH-365)

• Linear Models (MATH-341)

Important concepts to start the course

• Programming in Matlab (basic skills)

• Basic probability and statistics (conditional and joint distribution, independence, Bayes rule, random variables, expectation, mean, median, mode, central limit theorem)

• Basic linear algebra (system of linear equations and SVD)

• Basic multivariate calculus (derivative wrt vector and matrix)

• Univariate and multivariate Gaussian distribution (joint, conditional, and marginals)

LEARNING OUTCOMES

By the end of the course, the student must be able to:

• Define the following basic machine learning problems: Regression, classification, clustering, dimensionality reduction, time-series

• Explain main differences between them.

• Describe a few important models and algorithms for them.

• Implement these methods

• Apply them to real-world problems

• Compare their performaces

• Design new methods

• Choose for the real-world problem in hand

• Critique them

• Defend them

• Derive the theory behind ML methods taught in the course

• Generalize them to new problems

Transversal skills

• Continue to work through difficulties or initial failure to find optimal solutions.

• Assess one's own level of skill acquisition, and plan their on-going learning goals.

TEACHING METHODS

• Lectures

• Lab sessions

• Projects

EXPECTED STUDENT ACTIVITIES

• Students must attend lectures every week and take notes during the lecture

• Students must attend lab sessions every week and write their own code

• Students must work on groud projets where they use the code developed during labs

• Students should read lecture note and complete weekly assignments

ASSESSMENT METHODS

• Continuous control

• Final exam

RESOURCES

Bibliography

The following books will be used for further readings.

• G. James, D. Witten, T. Hastie and R. Tibshirani: ***An introduction to statistical learning,*** free download from http://www-bcf.usc.edu/~gareth/ISL/

• T. Hastie, R. Tibshirani and J. Friedman: ***Elements of statistical learning,*** free download from http://statweb.stanford.edu/~tibs/ElemStatLearn/

• C. Bishop: ***Pattern Recognition and Machine Learning***

• K. Murphy: ***Machine Learning: A Probabilistic Perspective***

Ressources en bibliothèque

- Pattern Recognition and Machine Learning / Bishop
- Neural Networks for Pattern Recognition / Bishop
- Pattern Classification / Duda
- Macine learning / Murphy

Références suggérées par la bibliothèque

Notes/Handbook

The course comes with partially-filled lecture notes which will be available to students before each lecture. These notes will not be complete and students are supposed to complete them during/after a lecture. This way students will be able to create their own written notes on top of the one provided to them.

Websites

http://icapeople.epfl.ch/mekhan/pcml15.html

Moodle Link

http://moodle.epfl.ch/enrol/index.php?id=14221

COM-503 Performance evaluation

Cursus	Sem.	Type
Informatique et communications		Opt.
Informatique	MA2	Opt.
SC master EPFL	MA2, MA4	Opt.

Language	English
Credits	7
Session	Summer
Semester	Spring
Exam	Oral
Workload	210h
Weeks	14
Hours	**6 weekly**
Lecture	3 weekly
Exercises	1 weekly
Project	2 weekly

REMARQUE

pas donné en 2015-16

SUMMARY

In this course you will learn the methods and techniques that are used to perform a good performance evaluation during a research or development project.

CONTENT

MethodologyA Performance Evaluation Methodology. The scientific method. Dijkstra and Occam's principle.
Statistics and Modeling.
Statistics and modeling, why and how. Comparing systems using sampled data. Regression models. Factorial analysis. Stochastic load and system models. Load forecasting. The Box-Jenkins method.
Practicals.
Using a statistics package (Matlab). Measurements. Discrete event simulation. Stationarity and Steady State. Analysis of simulation results. Perfect Simulations.
Elements of a Theory of Performance. Performance of systems with waiting times. Utilization versus waiting times. Operational laws. Little's formula. Forced flows.law. Stochastic modeling revisited. The importance of the viewpoint. Palm calculus. Application to Simulation Performance patterns in complex systems. Bottlenecks. Congestion phenomenon. Performance paradoxes.

Mini-Project proposed by student.

LEARNING PREQUISITES

Required courses
A first course on probability
A first course on programming

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Estimate confidence intervals
- Design a simulation method
- Critique performance metrics and factors
- Organize a performance evaluation study
- Quantify performance
- Conduct a performance analysis
- Synthesize performance results

• Systematize factors and metrics

Transversal skills

• Use a work methodology appropriate to the task.

• Demonstrate the capacity for critical thinking

TEACHING METHODS

Lectures + labs + miniproject

ASSESSMENT METHODS

With continuous control

RESOURCES

Bibliography

Performance Evaluation of Computer and Communication Systems, Le Boudec Jean-Yves, EPFL Press 2010 also available online at perfeval.epfl.ch

Ressources en bibliothèque

• Performance evaluation of computer and communication systems / Le Boudec

Références suggérées par la bibliothèque

Websites

http://perfeval.epfl.ch

CS-489

Personal interaction studio

Huang Jeffrey

Cursus	Sem.	Type
Informatique	MA2	Opt.
SC master EPFL	MA2, MA4	Opt.

Language	English
Credits	6
Session	Summer
Semester	Spring
Exam	During the semester
Workload	180h
Weeks	14
Hours	**6 weekly**
Lecture	2 weekly
Project	4 weekly

CONTENT

The module will provide an overview of research in ubiquitous and pervasive computing, including: mobile devices and mobile interaction; ambient computing and responsive environments; embedded interaction and tangible interfaces; social issues: privacy and disruption; evaluation: what should be measured and what cannot be.
From the technology point of view the class project will include the design, development and testing of a mobile phone interactive application in response to a brief. The application will generally require sensing, analysis and display of information on the mobile phone and on embedded devices. The platform for the project will be smart phones based on Symbian OS, programmed in a C++ dialect and (optionally) in J2ME. Projects will generally involve interfacing with wireless sensors and actuator/displays based on micro controllers programmable in C.

LEARNING PREQUISITES

Recommended courses

Object oriented programming in C++ (preferred) or Java. Understanding of networking concepts, electronics principles and embedded systems.

TEACHING METHODS

Studio (Project + lectures + readings)

ASSESSMENT METHODS

Continuous control and project

CS-522 **Principles of computer systems**

Argyraki Aikaterini, Bugnion Edouard, Ford Bryan Alexander, Koch Christoph

Cursus	Sem.	Type
Informatique et communications		Obl.
Informatique	MA1, MA3	Opt.
SC master EPFL	MA1, MA3	Opt.

Language	English
Credits	7
Session	Winter
Semester	Fall
Exam	During the semester
Workload	210h
Weeks	14
Hours	**6 weekly**
Lecture	2 weekly
Exercises	2 weekly
Project	2 weekly

SUMMARY

This advanced graduate course focuses on key design principles underlying successful computer and communication systems, and teaches how to solve real problems using ideas, techniques, and algorithms from operating systems, networks, databases, programming languages, and computer architecture.

CONTENT

A modern computer system spans many layers: applications, libraries, operating systems, networks, and hardware devices. Building a good system entails making the right trade-offs (e.g., between performance, durability, and correctness) and understanding emergent behaviors - the difference between great system designers and average ones is that the really good ones make these trade-offs in a principled fashion, not by trial-and-error.
In this course we develop such a principled framework for system design, covering the following topics:

- Modularity, Abstraction, and Layering
- Indirection and Naming
- Locality
- End-to-end / State partitioning
- Virtualization
- Atomicity and Consistency
- Redundancy and Availability
- Interpretation, Simulation, Declarativity
- Laziness vs. Speculation
- CAP Theorem, DQ Principle, Harvest/Yield
- Least Privilege, Minimum TCB

LEARNING PREQUISITES

Required courses

Principles of Computer Systems (POCS) is targeted at students who wish to acquire a deep understanding of computer system design or pursue research in systems. It is an intellectually challenging, fast paced course, in which mere survival requires a solid background in operating systems, databases, networking, programming languages, and computer architecture. The basic courses on these topics teach how the elemental parts of modern systems work - POCS picks up where the basic courses leave off and focuses on how the pieces come together to form useful, efficient systems. To do well in POCS, a student must master the material of the following courses:

- COM-208 Computer networks
- CS-270/271 Computer architecture

- CS-205 Programming principles
- CS-305 Software engineering
- CS-322 Introduction to database systems
- CS-323 Operating systems

Recommended courses
The following EPFL courses cover material that significantly help students' understanding of POCS concepts; however, these courses are not strictly required:

- CS-320: Compiler construction
- CS-470: Advanced computer architecture
- CS-422: Advanced databases
- COM-407: TCP/IP networking

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Design computer and communication systems that work well
- Make design trade-offs (e.g., performance vs. correctness, latency vs. availability)
- Anticipate emergent system behaviors (e.g., failure cascades, security vulnerabilities)
- Integrate multiple techniques, ideas, and algorithms from different fields of computing/communication into a working system

TEACHING METHODS

- Online video lectures
- Ex cathedra
- Small-group discussions and exercises
- Projects

EXPECTED STUDENT ACTIVITIES

- Complete assigned reading and writing assignments
- Assimilate online video lectures
- Attend recitations and plenary sessions
- Participate actively in class (physically and online)
- Work in a team on design projects

ASSESSMENT METHODS

Throughout semester

- 20% homework
- 40% design projects
- 40% exam during semester

SUPERVISION

Office hours	Yes
Assistants	Yes
Forum	Yes
Others	See http://pocs.epfl.ch/

RESOURCES

Bibliography

See http://pocs.epfl.ch for up-to-date bibliography.

Websites

http://pocs.epfl.ch

COM-416

Projet en systèmes de communication II

Profs divers *

Cursus	Sem.	Type
SC master EPFL	MA1, MA2, MA3, MA4	Obl.

Langue	français
Crédits	12
Session	Hiver, Eté
Semestre	Automne
Examen	Pendant le semestre
Charge	360h
Semaines	14
Heures	**2 hebdo**
Projet	2 hebdo

RESUME

Travaux de recherche individuelle à effectuer pendant le semestre, selon les directives d'un professeur ou d'un assistant.

CONTENU

Sujet de travail à choisir parmi les domaines proposés sur le site web :

http://ic.epfl.ch/page-29961-fr.html

ACQUIS DE FORMATION

A la fin de ce cours l'étudiant doit être capable de:

- Organiser a projet
- Evaluer sa progression au cours du projet
- Représenter un projet

Compétences transversales

- Ecrire une revue de la littérature qui établit l'état de l'art.
- Ecrire un rapport scientifique ou technique.

METHODE D'EVALUATION

Rapport écrit et présentation orale

RESSOURCES

Sites web
http://ic.epfl.ch/page-29175-en.html

COM-516

Random walks

Lévêque Olivier, Macris Nicolas

Cursus	Sem.	Type
Informatique	MA2	Opt.
SC master EPFL	MA2, MA4	Opt.

Language	English
Credits	4
Session	Summer
Semester	Spring
Exam	Written
Workload	120h
Weeks	14
Hours	**4 weekly**
Lecture	2 weekly
Exercises	2 weekly

SUMMARY

The study of random walks finds many applications in computer science and communications. The goal of the course is to get familiar with the theory of random walks, and to get an overview of some applications of this theory to problems of interest in communications, computer and network science.

CONTENT

Part 1: Markov chains (~6 weeks):
- basic properties: irreducibility, periodicity, recurrence/transience, stationary and limiting distributions,
- ergodic theorem: coupling method
- detailed balance
- convergence rate to the equilibrium, spectral gap, mixing times
- cutoff phenomenon

Part 2: Sampling (~6 weeks)
- classical methods, importance and rejection sampling
- Markov Chain Monte Carlo methods, Metropolis-Hastings algorithm, Glauder dynamics, Gibbs sampling
- applications: function minimization, coloring problem, satisfiability problems, Ising models
- coupling from the past and exact simulation

KEYWORDS

random walks, stationarity, ergodic, convergence, spectral gap, mixing time, sampling, Markov chain Monte Carlo, coupling from the past

LEARNING PREQUISITES

Required courses
Basic probability course
Basic linear algebra and calculus courses

Recommended courses
Stochastic Models for Communications (COM-300)

Important concepts to start the course
Good knowledge of probability and analysis.
Having been exposed to the theory of Markov chains.

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Analyze the behaviour of a random walk
- Assess / Evaluate the performance of an algorithm on a graph

• Implement efficiently various sampling methods

TEACHING METHODS

ex-cathedra course

EXPECTED STUDENT ACTIVITIES

active participation to exercise sessions and implementation of a sampling algorithm

ASSESSMENT METHODS

midterm, mini-project, written exam

SUPERVISION

Office hours	Yes
Assistants	Yes
Forum	No

RESOURCES

Bibliography

Various references will be given to the students during the course, according to the topics discussed in class.

Notes/Handbook

Lecture notes will be provided

Websites

http://ipg.epfl.ch/~leveque/Random_Walks/

PREREQUISITE FOR

This course is not so to speak a prerequisite for other courses, but could complement well the course COM-512 on Networks out of control, as well as other courses in statistics.

CS-476 **Real-time embedded systems**

Beuchat René

Cursus	Sem.	Type
Génie électrique et électronique	MA2	Opt.
Informatique	MA2	Opt.
SC master EPFL	MA2, MA4	Opt.

Language	English
Credits	4
Session	Summer
Semester	Spring
Exam	During the semester
Workload	120h
Weeks	14
Hours	**4 weekly**
Lecture	2 weekly
Project	2 weekly

SUMMARY

A real time system has to accept important temporal constraints. Design of a multiprocessor on an FPGA for a data acquisition system as a Web server is done. Multiprocessors, accelerators, custom instructions, specialized hardware are some ways to improve the performance of a specific application.

CONTENT

During this course, measures of response time to interruptions are studied and tested in laboratories, such as for example the influence of dynamic memories, cache memories, option of compilation. Measurements of response time to the interruptions, task's commutations, primitives of synchronizations are carried out on an embarked system based on a FPGA.
The course includes the study of models of management of an embedded system by polling, interruptions and using a real time kernel with its primitives of tasks management and synchronizations.
Specialized programmable interfaces are carried out in VHDL to help with these measurements. A real time kernel is studied and used at the time of the laboratories. A system of acquisition is carried out and the gathered data transmitted by an embedded Web server. To ensure the real time acquisition and reading by the Web server, a multiprocessor system is developed and carried out on FPGA. An Accelerator designed in VHDL makes it possible to facilitate the optimization of functions by hardware on FPGA. Cross development tools are used.
Each topic is treated by a theoretical course and an associated laboratory. The laboratories are realized on a FPGA board especially developed for teaching. A real time operating system is studied and used with the laboratories.

KEYWORDS

Real Time, FPGA, SOC, microprocessor, hardware accelerator, custom instruction, Real Time OS

LEARNING PREQUISITES

Required courses
Introduction to computing systems, Logic systems, Computer architecture

Recommended courses
Embedded Systems, Real time Programming

Important concepts to start the course
Programmable Logic Architecture (FPGA), Computer Architecture, VHDL, C programming, Real Times basic knowledge (sémaphore, synchronization)

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Design a multiprocessor system on FPGA

• Analyze the performance of a real time embedded system
• Use design tools for Soc conception on FPGA
• Implement a complete Web Server and a multiprocessor on a FPGA
• Test the realized system
• Defend the choises during the design phases

Transversal skills

• Set objectives and design an action plan to reach those objectives.
• Communicate effectively, being understood, including across different languages and cultures.
• Continue to work through difficulties or initial failure to find optimal solutions.
• Make an oral presentation.
• Write a scientific or technical report.

TEACHING METHODS

Ex cathedra, laboratories and a mini-project

EXPECTED STUDENT ACTIVITIES

• 4 groups of laboratories on specific topics, with a report by group for each of them, 1-2 weeks/topic;
• A final mini-project to practically synthetize the content of the course, with the design of a multiprocessor system on FPGA, including for example a Web-server, a camera controller, a specific algorithm to transpose in FPGA hardware accelerator, 3~4 weeks for this mini-project

ASSESSMENT METHODS

Continuous control with reports and oral presentation
all labos 50% + final mini-project 50%

SUPERVISION

Office hours	No
Assistants	Yes
Forum	Yes

RESOURCES

Bibliography
Teaching notes and suggested reading material.
Specialized datasheet (ie.ex. FPGA et specific microcontrollers) and norms

Notes/Handbook
Slides and documents on moodle

Websites
http://fpga4u.epfl.ch

Moodle Link
http://moodle.epfl.ch/course/view.php?id=391

COM-413 **Real-time networks**

Decotignie Jean-Dominique

Cursus	Sem.	Type
Energie et construction durable	MA2	Opt.
Informatique	MA2	Opt.
SC master EPFL	MA2, MA4	Opt.

Language	English
Credits	3
Session	Summer
Semester	Spring
Exam	Oral
Workload	90h
Weeks	14
Hours	**2 weekly**
Lecture	2 weekly

SUMMARY

At the completion of the course, the student will have mastered the main problems and solutions related to communications under real-time constraints in transportation systems and in the control of industrial processes. Applications to multimedia will also be sketched.

CONTENT

1. Introduction (hierarchy in communications, motivation for networks, types of applications)
2. Requirements (delay, jitter, predictability, topology, cost, etc.)
3. Communication systems architecture and its influence on temporal behavior(OSI model, communication models, real-time paradigms : Time-Triggered vs. Event-Triggered, interworking)
4. Fieldbusses and how real-time performance assessment : FIP and CAN as examples
5. Ethernet, industrial Ethernet and real-time Ethernet
6. Wireless communications and their impact on real-time guarantees
7. IEEE 802.11 and IEEE 802.11e
8. Bluetooth, IEEE 802.15.4 (ZigBee) and wireless sensor networks
9. Real-time in wireless sensor networks

KEYWORDS

real-time, networking, wireless, wireless sensor networks, medium access control, quality of service

LEARNING PREQUISITES

Required courses
none

Recommended courses
real-time systems, protocols

Important concepts to start the course
Protocols and real-time system background

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- master real-time techniques in wired and wireless networking
- modelling of quality of service requirements
- deep knowledge of real-time medium access control techniques
- exercize the real-time garantee evaluation techniques
- capability to design a new real-time solution

Transversal skills

• Communicate effectively, being understood, including across different languages and cultures.

TEACHING METHODS

Ex cathedra + student presentations + exercises

EXPECTED STUDENT ACTIVITIES

Learning the course material, reading, presentation and discussion of a scientific paper as an introduction to research

ASSESSMENT METHODS

Mid-term presentation 50% and final exam 50%

SUPERVISION

Office hours	No
Assistants	No
Forum	Yes

RESOURCES

Bibliography

See course URL

Websites

-

Moodle Link

http://moodle.epfl.ch/course/view.php?id=10761

COM-414

Satellite communications systems and networks

Farserotu John

Cursus	Sem.	Type
Mineur en Technologies spatiales	H	Opt.
SC master EPFL	MA1, MA3	Opt.

Language	English
Credits	3
Session	Winter
Semester	Fall
Exam	Written
Workload	90h
Weeks	14
Hours	**3 weekly**
Lecture	2 weekly
Exercises	1 weekly

SUMMARY

Study of satellite communication (SATCOM) systems and IP satellite networks.

CONTENT

Introduction to satellite communication
- Systems and services (e.g. INMARSAT)
- SATCOM transmitters, receivers and antennas
- SATCOM link budget analysis

Mobile satellite channel
- Multipath, shadowing, Doppler spread, delay spread
- Waveform design implications

SATCOM multiple access and access control
- FDMA, TDMA, CDMA and capacity and trades
- Random access and MAC (e.g. FAMA, DAMA)

SATCOM modulation, error correction and control
- MPSK, MPSK TCM modulation and demodulation
- Convolutional coding, Viterbi decoding, error control

SATCOM antennas
- Satellite phased array and mobile terminal antennas
- Antenna diversity combining techniques

TCP/IP over SATCOM
- TCP/IP over satellite performance issues
- Satellite IP enhancements, routing, congestion control

IP/ATM over satellite networks
-Introduction to IP/ATM over SATCOM
- IP/ATM SATCOM network integration

Emerging systems and issues
- Broadand and Satellite UMTS (S-UMTS)
- SATCOM system cost considerations

Special topics in wireless communication
- High Altitude Platforms (HAPs)

KEYWORDS

SATCOM, satellite channel, SATCOM multiple access, modulation, antennas, TCP/IP, IP/ATM

LEARNING PREQUISITES

Recommended courses

No prerequisite courses

Important concepts to start the course

BS engineering

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Perform a SATCOM system design and analysis

SUPERVISION

Office hours	No
Assistants	Yes
Forum	No

RESOURCES

Moodle Link
http://moodle.epfl.ch/enrol/index.php?id=2551

EE-511 **Sensors in medical instrumentation**

Aminian Kamiar

Cursus	Sem.	Type
Bioingénierie	MA2, MA4	Opt.
Génie électrique et électronique	MA2	Opt.
Informatique	MA2	Opt.
Microtechnique	MA2	Opt.
Mineur en Technologies biomédicales	E	Opt.
SC master EPFL	MA2, MA4	Opt.
Sciences du vivant	MA2, MA4	Opt.

Language	English
Credits	3
Session	Summer
Semester	Spring
Exam	Written
Workload	90h
Weeks	14
Hours	**3 weekly**
Lecture	2 weekly
Exercises	1 weekly

SUMMARY

Fundamental principles and methods used for physiological signal conditioning. Resistive, capacitive, inductive, piezoelectric and optical techniques used to detect and convert physiological information's to electrical signals. Laboratory and ambulatory devices for monitoring and therapy.

CONTENT

1. **Physiological Mesurands**
Biopotentials; bioimpedance; mechanical, acoustic and thermal signals
2. **Noise in medical instrumentation**
Source and nature of the noise; noise reduction; instrumentation amplifier for biopotential measurement
3. **Biopotential measurement**
Electrodes; ECG, EMG and EEG measurement
4. **Resistive sensors**
Thermistor and its biomedical applications; strain gage for the measurement of blood pressure; force and accelerations of the body
5. **Inductive sensors**
Simple and mutual inductance and its medical applications
6. **Capacitive sensors**
Respiratory flow measurement by the gradient of pressure
7. **Piezoelectric sensors**
Force platform, accelerometer, angular rate sensor for the measurement of tremors and body movements, ultrasound transducer : measurement of pressure and flow rate
8. **Optical sensors**
Photoplethysmography; pulsed oxymetry
9. **Example of applications**

KEYWORDS

sensors, instrumentation, biomedical devices, physiological measurement, monitoring

LEARNING PREQUISITES

Required courses
courses en electrical circuit, basic electronics

Recommended courses
measuring systems or electronics or sensors

Important concepts to start the course
basic electronics, basic physics

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Choose techniques detecting and convert physiological information's to electrical signals
- Exploit fundamental principles and methods used for physiological signal conditioning
- Design measuring devices
- Interpret error, noise in biomedical measuring systems

Transversal skills

- Use a work methodology appropriate to the task.
- Communicate effectively with professionals from other disciplines.

TEACHING METHODS

Ex cathedra, with exercises

EXPECTED STUDENT ACTIVITIES

home work, short quizzes during semester

ASSESSMENT METHODS

Written

RESOURCES

Bibliography

Medical Instrumentation : Application and design, JG Webster

Ressources en bibliothèque

- Medical Instrumentation / Webster

Références suggérées par la bibliothèque

Notes/Handbook

Slides copies (to be completed during the lectures)
Polycopies (in French only)

PREREQUISITE FOR

Semester project and Master project

MATH-318 **Set theory**

Duparc Jacques

Cursus	Sem.	Type
Informatique	MA1, MA3	Opt.
Ing.-math	MA1, MA3	Opt.
Mathématicien	MA1, MA3	Opt.
Mathématiques pour l'enseignement	MA1	Opt.
SC master EPFL	MA1, MA3	Opt.

Langue	français
Crédits	5
Session	Hiver
Semestre	Automne
Examen	Ecrit
Charge	150h
Semaines	14
Heures	**4 hebdo**
Cours	2 hebdo
Exercices	2 hebdo

RESUME

La Théorie des Ensembles comme fondation des mathématiques. Consistance relative de l'Axiome du Choix et de l'Hypothèse du Continu.

CONTENU

Théorie des ensembles : ZFC. Extensionalité et Compréhension. Relations, fonctions et bon-ordre. Ordinaux. Classe et récurrence transfinie. Cardinaux. Relations bien-fondées, Axiome de Fondation, constructions inductives et hiérachie de von Neumann. Relativisation, absoluité et théorèmes de réflection. L'univers L des constructibles de Gödel. Axiome du Choix et Hypothèse du Continu dans L. Ensembles héréditairement définissables en termes d'ordinaux et Axiome du Choix : indépendance de l'axiome du choix. Po-sets, filtres et extensions génériques. Forcing. ZFC dans les extensions génériques. Forcing de Cohen. Indépendance de l'Hypothèse du Continu.

MOTS-CLES

Théorie des ensembles, Consistance relative, ZFC, Ordinal, Cardinal, Récurrence transfinie, Relativisation, Absoluité, Univers constructible, L, Axiome du Choix, Hypothèse du Continu, Forcing, Extension Generique

COMPETENCES REQUISES

Cours prérequis indicatifs

Logique mathématique (ou cours équivalent)

Concepts importants à maîtriser

- Logique du 1er ordre
- Bases de théorie de la démonstration
- Bases de théorie des modèles
- Théorème de compacité
- Théorème de Löwenheim-Skolem

ACQUIS DE FORMATION

A la fin de ce cours l'étudiant doit être capable de:

- Développer un modèle de ZFC
- Prouver des résultats de consistence relative
- Produire une extension générique
- Argumenter par récurrence transfinie
- Décider si ZFC prouve sa propre consistance
- Formaliser les axiomes de ZF, AC, CH, DC

- Concevoir une réduction au modèle intérieur
- Justifier l'axiome de foundation

METHODE D'ENSEIGNEMENT

Cours ex cathedra et exercices

TRAVAIL ATTENDU

- Participation au cours
- Résolution des exercices

METHODE D'EVALUATION

Ecrit (3 heures)

ENCADREMENT

Office hours	Oui
Assistants	Oui
Forum électronique	Non

RESSOURCES

Bibliographie

1. Thomas Jech: Set theory, Springer 2006
2. Kenneth Kunen: Set theory, Springer, 1983
3. Jean-Louis Krivine: Theorie des ensembles, 2007
4. Patrick Dehornoy: Logique et théorie des ensembles; Notes de cours, FIMFA ENS: http://www.math.unicaen.fr/~dehornoy/surveys.html
5. Yiannis Moschovakis: Notes on set theory, Springer 2006
6. Karel Hrbacek and Thomas Jech: Introduction to Set theory, (3d edition), 1999

Ressources en bibliothèque

- Introduction to Set theory / Hrbacek
- Set theory / Jech
- Logique et théorie des ensembles / Dehorny
- Set theory / Kunen
- Notes on set theory / Moschovakis
- Theorie des ensembles / Krivine

Références suggérées par la bibliothèque

Sites web

http://www.hec.unil.ch/logique/enseignement

EE-472

Smart grids technologies

Le Boudec Jean-Yves, Paolone Mario

Cursus	Sem.	Type
Energie et construction durable	MA2	Opt.
Génie électrique et électronique	MA2	Obl.
Informatique	MA2	Opt.
Mineur en Énergie	E	Opt.
SC master EPFL	MA2, MA4	Opt.

Language	English
Credits	5
Session	Summer
Semester	Spring
Exam	Written
Workload	150h
Weeks	14
Hours	**5 weekly**
Lecture	2 weekly
Exercises	1 weekly
Practical work	2 weekly

SUMMARY

Learn the technologies and methodologies used in the context smart electrical grids and be able to deploy/implement/test them in a lab environment.

CONTENT

1. Modern monitoring: phasor measurement units technology, synchrophasors extraction processes and time alignement
2. Smart grid communication; reliability, real time and security issues
3. Topology assessment and contingency analysis of power grids
4. Admittance matrix calculus, numerical solution of the load flow problem and state estimation
5. Demand response, real-time and non real-time, forecasting methods applied to renewables and demand
6. Energy management and dispatch plans, the optimal power flow problem

KEYWORDS

Smart grid, power systems

LEARNING PREQUISITES

Required courses

Electric power systems, power distribution networks, TPC/IP Networking

Recommended courses

Signal processing, discrete optimization methods, model predictive control, industrial electronics.

Important concepts to start the course

Understanding of electrical grids and communication networks.

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Design monitoring and control platforms for smart grids
- Test a smart grid
- Implement a smart grid
- Analyze performance of a smart grid

Transversal skills

• Plan and carry out activities in a way which makes optimal use of available time and other resources.

• Continue to work through difficulties or initial failure to find optimal solutions.

• Demonstrate the capacity for critical thinking

• Manage priorities.

• Use both general and domain specific IT resources and tools

TEACHING METHODS

Ex cathedra, classroom integrated exercises and computer laboratory sessions.

EXPECTED STUDENT ACTIVITIES

Attend lectures and labs
Do lab homeworks
Attend test sessions with clickers

ASSESSMENT METHODS

Tests during semester (20%), Written exam (30%) and graded lab reports (50%)

SUPERVISION

Office hours	No
Assistants	Yes
Forum	Yes

RESOURCES

Moodle Link
http://moodle.epfl.ch/course/view.php?id=14163

PREREQUISITE FOR

Master projects in the areas of power systems and energy conversion systems.

EE-593

Social media

Gillet Denis

Cursus	Sem.	Type
Informatique	MA2	Opt.
SC master EPFL	MA2, MA4	Opt.

Language	English
Credits	2
Session	Summer
Semester	Spring
Exam	During the semester
Workload	60h
Weeks	14
Hours	**2 weekly**
Lecture	1 weekly
Project	1 weekly

SUMMARY

The objective is to enable students to critically apprehend the Human Computer Interaction (HCI) challenges associated with the design and the exploitation of social media platforms.

CONTENT

- Social media platforms and the long tail (definition and typology)
- Usability and adoption of social media platforms
- Web 2.0 features and adoption factors
- Privacy, trust and reputation models
- Identities, traces, and Web analytics
- Interplay, between platforms and communities (interdisciplinary perspective)
- Opportunities, requirements and constraints for organization and enterprises
- Participatory design methodologies
- Future ad hoc social applications

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Choose
- Design
- Critique
- Defend

Transversal skills

- Set objectives and design an action plan to reach those objectives.
- Plan and carry out activities in a way which makes optimal use of available time and other resources.
- Use a work methodology appropriate to the task.
- Communicate effectively, being understood, including across different languages and cultures.
- Communicate effectively with professionals from other disciplines.
- Evaluate one's own performance in the team, receive and respond appropriately to feedback.
- Negotiate effectively within the group.

• Assess one's own level of skill acquisition, and plan their on-going learning goals.

TEACHING METHODS

Lectures, invited speakers, individual work and teamwork

ASSESSMENT METHODS

One individual project and one teamwork with combined peer and expert assesment (reports and presentations)

SUPERVISION

Office hours	No
Assistants	Yes
Forum	No

RESOURCES

Bibliography

• Chris Anderson (2006) - The Long Tail: Why the Future of Business is Selling Less of More. New York, NY: Hyperion. ISBN 1-4013-0237-8.

• Joshua Porter - Designing for the Social Web

• Matthew A. Russel - Mining the Social Web: Analyzing Data from Facebook, Twitter, LinkedIn, and Other Social Media Sites. O¿Reilly 2011

Ressources en bibliothèque

• Designing for the Social Web / Porter

• Mining the Social Web / Russel

• The Long Tail / Anderson

Références suggérées par la bibliothèque

COM-511

Software-defined radio: A hands-on course

Rimoldi Bixio

Cursus	Sem.	Type
Informatique	MA1, MA3	Opt.
SC master EPFL	MA1, MA3	Opt.

Language	English
Credits	5
Session	Winter
Semester	Fall
Exam	During the semester
Workload	150h
Weeks	14
Hours	**3 weekly**
Lecture	2 weekly
Exercises	1 weekly

SUMMARY

The idea is to complement the theoretical knowledge learned in Principles of Digital Communications (and perhaps in Advanced Digital Communications), with hands-on exercises based on Matlab.

CONTENT

1. Software radio : key concepts.
2. Matlab implementation of the signal processing chain to the level of detail in *Principles of Digital Communications*.
3. Decoding of a GPS signal and positioning.
4. Modern advanced techniques such as CDMA, OFDM, LDPC codes, equalization, and iterative decoding methods.

KEYWORDS

Software, communication

LEARNING PREQUISITES

Required courses

Principles of Digital Communications or equivalent.

Recommended courses

Advanced digital communications.

Important concepts to start the course

Matlab

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Implement in Matlab various parts of a "physical-layer" digital communication system.

TEACHING METHODS

Ex cathedra and exercises (Matlab)

EXPECTED STUDENT ACTIVITIES

Matlab programming

ASSESSMENT METHODS

Continuous control (TP and written test)

RESOURCES

Bibliography
Lectures notes, articles

Websites
http://moodle.epfl.ch

COM-597

Stage d'ingénieur crédité avec le PDM (master en Systèmes de communication)

Profs divers *

Cursus	Sem.	Type
SC master EPFL	MA1, MA2, MA3, MA4	Opt.

Langue	français
Crédits	0
Session	Hiver, Eté
Semestre	Automne
Examen	Mémoire
Charge	0h
Semaines	
TP	320 hebdo

REMARQUE

L'étudiant doit effectuer un stage de 8 semaines pendant l'été ou de 6 mois après un semestre de Master.

RESUME

Le stage d'ingénieur fait partie intégrante du cursus des étudiants en master. Ils rejoignent des entreprises en Suisse ou à l'étranger pour effectuer un stage ou leur projet de master dans un domaine d'activité où les compétences du futur ingénieur en Systèmes de Communication sont mises en valeur.

CONTENU

Les stages représentent une expérience importante pour les étudiants en leur permettant notamment d'atteindre les buts suivants :
- S'immerger dans le monde professionnel
- Mettre en évidence l'importance du travail en équipe
- Prendre en considération des impératifs d'une entreprise dans ses processus
- Mettre en pratique les connaissances acquises du plan d'études

Les 3 formes de stages suivantes sont possibles dans le cadre du plan d'études master :
- Stage court de 8 semaines pendant l'été uniquement
- Stage long de 6 mois durant le master (l'étudiant est en congé pendant un semestre)
- Projet de master en entreprise (25 semaines)

MOTS-CLES

Stage; industrie; projet; immersion; connaissances

COMPETENCES REQUISES

Cours prérequis obligatoires

- Avoir effectué un semestre de master pour les étudiants ayant obtenu leur Bachelor à l'EPFL
- Avoir effectué deux semestres de master pour les étudiants venant d'une autre université

Concepts importants à maîtriser

Importance de l'engagement

ACQUIS DE FORMATION

A la fin de ce cours l'étudiant doit être capable de:

- Etre conscient de l'importance des directives légales et du code éthique de la profession
- Communiquer efficacement et être compris
- Auto-évaluer son niveau de compétence acquise et planifier ses prochains objectifs
- Gérer ses priorités
- Recevoir et donner du feedback (une critique) et y répondre de manière appropriée

TRAVAIL ATTENDU

L'étudiant s'engage à faire son stage avec professionnalisme

METHODE D'EVALUATION

- Stages courts : évaluation électronique à la fin du stage
- Stages longs : évaluation électronique à la fin du stage
- Projets de Master en entreprise : *voir la fiche "Projet de Master"*

ENCADREMENT

Autres	Superviseur en industrie Superviseur à l'EPFL

RESSOURCES

Polycopiés

Directives des stages : http://ic.epfl.ch/files/content/sites/ic/files/Stages2%20-%20Directives%20FR.pdf

Sites web

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COM-421 **Statistical neurosciences**

Cursus	Sem.	Type
Informatique	MA2	Opt.
Mineur en Neurosciences computationnelles	E	Opt.
Neurosciences		Opt.
SC master EPFL	MA2, MA4	Opt.
Sciences du vivant	MA2, MA4	Opt.

Language	English
Credits	4
Session	Summer
Semester	Spring
Exam	Written
Workload	120h
Weeks	14
Hours	**4 weekly**
Lecture	2 weekly
Exercises	2 weekly

REMARQUE

pas donné en 2015-16

SUMMARY

In neuroscience, new measurement techniques have permitted to acquire a wealth of experimental data, both scientific and commercial. This class introduces the student to a variety of statistical tools, tailored to the special case of neural data. Students will work with various real data sets.

CONTENT

Examples of the latter include neuromarketing and the control of computer machinery via brain signals. This opens the door for large-scale statistical approaches. The class introduces the student to a variety of statistical tools , tailored to the special case of neural data. An integral part of the class is for the student to work with real data, choosing from a number of data sets and applying the techniques studied in class.

1. Tuning Curves and Receptive Fields (spatio-temporal and spectro-temporal) (5 weeks)
2. Statistical Models, Gaussian Process Factor Analysis (2 weeks)
3. Information-theoretic Techniques (3 weeks)
4. Network Science (2 weeks)

KEYWORDS

Neuroscience, Statistics, Regression, Entropy, Information Theory, Information Measures, Graphical Models

LEARNING PREQUISITES

Required courses

- The class assumes a basic understanding of probability: coin tossing and the standard Gaussian (normal) distribution.
- The class also assumes a basic understanding of linear algebra: vectors, matrices, eigenvalues, eigenvectors.

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Analyze neuroscience data
- Argue in a precise statistical way about neuroscience data
- Interpret neuroscience data
- Justify conclusions about neuroscience data

TEACHING METHODS

Ex cathedra + exercises

ASSESSMENT METHODS

4 homework sets 20%, midterm exam 30% and Matlab project 50%

SUPERVISION

Office hours	Yes
Assistants	Yes
Forum	Yes

RESOURCES

Bibliography

Here are two books that are related to the class. We do *not* require that you buy these books - but they are recommended reading. (There will be lecture notes for the class.)

1. P. Dayan and L. F. Abbott. *Theoretical Neuroscience*, MIT Press, Cambridge, MA, 2001.In this class, we cover Part I of the book; we will not touch upon Parts II and III.

2. D. Freedman, R. Pisani, and R. Purves. *Statistics*, W. W. Norton & Company, 2007 (4th edition).This is a general-purpose statistics book for all those who do not like excessive mathematical notation,with very good intuitive explanations of many statistical phenomena.

Ressources en bibliothèque

- Theoretical Neuroscience / Dayan
- Statistics / Freedman

Références suggérées par la bibliothèque

Notes/Handbook

Lecture notes will be handed out in class and/or made available on Moodle.

Websites

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Moodle Link

http://moodle.epfl.ch

COM-500

Statistical signal and data processing through applications

Ridolfi Andrea

Cursus	Sem.	Type
Informatique	MA2	Opt.
Ing.-math	MA2, MA4	Opt.
Mathématicien	MA2	Opt.
SC master EPFL	MA2, MA4	Obl.

Language	English
Credits	5
Session	Summer
Semester	Spring
Exam	Written
Workload	150h
Weeks	14
Hours	**4 weekly**
Lecture	2 weekly
Exercises	2 weekly

SUMMARY

Building up on the basic concepts of sampling, filtering and Fourier transforms, we address spectral analysis, estimation and prediction, classification, and adaptive filtering, with an application oriented approach.

CONTENT

1. Fundamentals of Statistical Signal Processing : Signals and systems from the deterministic and stochastic point of view.
2. Models, Methods, and algorithms : Parametric and non-parametric signal models (wide sense stationary, Gaussian, Markovian, auto regressive and white noise signals); Linear prediction and estimation (orthogonality principale and Wiener filter); Maximum likehood estimation and Bayesian a priori.
3. Statistical Signal Processing Tools for Spread Spectrum wireless transmission : Coding and decoding of information using position of pulses (annihilating filter approach); Avoiding interference with GPS(spectral mask and periodogram estimation); Spectrum estimation for classical radio transmissions (estimating frequencies of a harmonic signal).
4. Statistical Signal Processing Tools for the Analysis of Neurobiological Signals : Identification of spikes (correlation-bases methods); Characterization of multiple state neurons (Markovian models and maximum likelihood estimation); Classifying firing rates of neuron (Mixture models and the EM algorithm); Principal Component Analysis.
5. Statistical Signal Processing Tools for Echo cancellation : Adaptive filtering (least mean squares and recursive least squares).

KEYWORDS

Statistical tools, spectral analysis, prediction, estimation, annihilating filter, mixture models, principal component analysis, stochastic processes, adaptive filtering.

LEARNING PREQUISITES

Required courses
Stochastic Models in Communications (COM-300), Signal Processing for Communications (COM-303).

Recommended courses
Mathematical Foundations of Signal Processing (COM-514).

Important concepts to start the course
Algebra, Fourier Transform, Z Transform, Probability, Linear Systems, Filters.

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Choose appropriate statistical tools to solve signal processing problems;
- Analyze real data;

- Interpret spectral content of signals;
- Develop appropriate models for observed signals;
- Assess / Evaluate advantages and limitations of different statistical tools for a given signal processing problem.

TEACHING METHODS

Ex cathedra with exercises, numerical examples, computer session.

EXPECTED STUDENT ACTIVITIES

Attendance at lectures, completing exercises, testing presented methods with a mathematical computing language (Matlab or similar).

ASSESSMENT METHODS

- Midterm exam enabling to get a bonus grade from 0 to 1 to be added to the final grade;
- Final exam enabling to obtain a final grade between 1 and 6.

SUPERVISION

Office hours	Yes
Assistants	Yes
Forum	Yes

RESOURCES

Bibliography

Background texts

- P. Prandoni, *Signal Processing for Communications*, EPFL Press;
- A.V. Oppenheim, R.W. Schafer, *Discrete Time Signal Processing*, Prentice Hall, 1989;
- B. Porat, *A Course in Digital Signal Processing*, John Wiley & Sons,1997;
- C.T. Chen, *Digital Signal Processing*, Oxford University Press;
- D. P. Bertsekas, J. N. Tsitsiklis, *Introduction to Probability,* Athena Scientific, 2002 (excellent book on probability).

More advanced texts

- L. Debnath and P. Mikusinski, *Introduction to Hilbert Spaces with Applications*, Springer-Verlag, 1988;
- A.N. Shiryaev, *Probability*, Springer-Verlag, New York, 2nd edition, 1996;
- S.M. Ross, *Introduction to Probability Models*, Third edition, 1985;
- P. Bremaud, *An Introduction to Probabilistic Modeling*, Springer-Verlag, 1988;
- S.M. Ross, *Stochastic Processes*, John Wiley, 1983;
- B. Porat, *Digital Processing of Random Signals*, Prentice Hall,1994;
- P.M. Clarkson, *Optimal and Adaptive Signal Processing*, CRC Press, 1993;
- P. Stoïca and R. Moses, *Introduction to Spectral Analysis*, Prentice-Hall, 1997.

Ressources en bibliothèque

- Probability / Shiryaev
- Stochastics Processes / Ross
- Discrete Time Signal Processing / Oppenheim
- Introduction to Spectral Analysis / Stoïca
- Digital Processing of Random Signals / Porat
- Introduction to Probability / Bertsekas

- Introduction to Probability Models / Ross
- Signal Processins for Communications / Prandoni
- An Introduction to Probabilistic Modeling / Bremaud
- A Course in Digital Signal Processing / Porat
- Optimal and Adaptive Signal Processing / Clarkson
- Digital Signal Processing / Chen
- Introduction to Hilbert Spaces with Applications / Debnath

Références suggérées par la bibliothèque

Notes/Handbook

- Slides handouts;
- Lecture notes;
- Collection of exercises.

Websites

http://lcav.epfl.ch/cms/site/lcav/lang/en/teaching/statistical_sp_and_applications

Moodle Link

http://moodle.epfl.ch/course/view.php?id=422

COM-506

Student seminar: security protocols and applications

Oechslin Philippe, Vaudenay Serge

Cursus	Sem.	Type
Information security minor	E	Opt.
SC master EPFL	MA2, MA4	Opt.

Language	English
Credits	3
Session	Summer
Semester	Spring
Exam	Written
Workload	90h
Weeks	14
Hours	**2 weekly**
Lecture	2 weekly

SUMMARY

This seminar introduces the participants to the current trends, problems, and methods in the area of communication security.

CONTENT

We will look at today's most popular security protocols and new kinds of protocols, techniques, and problems that will play an emerging role in the future. Also, the seminar will cover methods to model and analyze such security protocols. This course will be held as a seminar, in which the students actively participate. The talks will be assigned in the first meeting to teams of students, and each team will have to give a 45 minutes talk, react to other students' questions, and write a 3-4 pages summary of their talk.

KEYWORDS

network security, security protocols, cryptography

LEARNING PREQUISITES

Required courses

- Network security (COM-301)
- Cryptography and security (COM-401)

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Synthesize some existing work on a security protocol
- Analyze a security protocol
- Present a lecture

Transversal skills

- Make an oral presentation.
- Summarize an article or a technical report.

EXPECTED STUDENT ACTIVITIES

- prepare a lecture (presentation and a 4-page report)
- present the lecture
- attend to others' lectures and grade them
- do the final exam

ASSESSMENT METHODS

- lecture and attendance to others' lectures (50%)
- final exam (50%)

SUPERVISION

Office hours	No
Assistants	Yes
Forum	No
Others	Lecturers and assistants are available upon appointment.

RESOURCES

Websites

http://lasec.epfl.ch/teaching.shtml

CS-550 **Synthesis, analysis and verification**

Cursus	Sem.	Type
Informatique et communications		Opt.
Informatique	MA2	Opt.
SC master EPFL	MA2, MA4	Opt.

Language	English
Credits	6
Session	Summer
Semester	Spring
Exam	During the semester
Workload	180h
Weeks	14
Hours	**6 weekly**
Lecture	2 weekly
Exercises	2 weekly
Project	2 weekly

REMARQUE

pas donné en 2015-16

SUMMARY

The course presents theory, algorithms, and tools for reasoning about computer systems, including techniques for software and hardware verification and synthesis.

CONTENT

Motivation:
Tools for automated analysis and verification of software can improve reliability of software that we use every day. The underlying techniques are also used for compiler optimizations and program understanding. In recent years, new algorithms and combinations of existing techniques have made such tools more effective than in the past. This course will give an overview of basic techniques, as well as the recent advances that made this progress possible.
In many years the course also contains guest lectures presenting recent research results.

Topics covered include:

- Logic and relational program semantics
- Verification condition generation and Hoare logic
- Synthesis of programs from relations
- Abstract interpretation and data flow analysis
- Predicate abstraction
- Modular verification
- Decision procedures, SMT solvers, and resolution-based provers

LEARNING PREQUISITES

Required courses

Theoretical computer science and discrete mathematics course, or equivalent background and fluency in discrete mathematics and introductory theoretical computer science concepts (e.g. M. Sipser textbook)
Functional programming in Scala, or ability to pick up Scala quickly (students knowing Haskell or ML generally have no trouble).

Recommended courses

The knowledge of mathematical logic and combinatorial optimization is beneficial

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Formalize program correctness
- Prove correctness of programs on paper
- Sketch an automated verification algorithm
- Interpret results of verification systems
- Create a simple program verifier
- Construct a constraint solver
- Systematize approaches to software correctness
- Choose an appropriate technique for improving software reliability

Transversal skills

- Assess progress against the plan, and adapt the plan as appropriate.
- Respect the rules of the institution in which you are working.
- Demonstrate a capacity for creativity.
- Make an oral presentation.
- Summarize an article or a technical report.
- Write a scientific or technical report.
- Communicate effectively with professionals from other disciplines.
- Identify the different roles that are involved in well-functioning teams and assume different roles, including leadership roles.

TEACHING METHODS

Ex catedra
Exercise sessions
Practical work on projects under supervision of teaching assistants

EXPECTED STUDENT ACTIVITIES

Attending lectures
Exercises in class
Homeworks
Mid-term exam
Practical project on modifying a verification system

ASSESSMENT METHODS

- 30% common project in first part of semester (in stages and feedback after each, but grade only after all of them)
- 40% quiz in 2nd part of semester
- 30% individual projects by the project deadline

SUPERVISION

Office hours	Yes
Assistants	Yes
Forum	Yes

RESOURCES

Bibliography

The Calculus of Computation: Decision Procedures with Applications to Verification. **Bradley**, Aaron R., **Manna**, Zohar, Springer, 2007. ISBN 978-3-540-74113-8.

Notes/Handbook
http://lara.epfl.ch/w/sav13:top

Websites
http://lara.epfl.ch/w/sav

Videos
https://www.youtube.com/watch?v=rm_kqt61JQ8

COM-407 **TCP/IP networking**

Le Boudec Jean-Yves

Cursus	Sem.	Type
Génie électrique et électronique	MA1, MA3	Opt.
Information security minor	H	Opt.
Informatique	MA1, MA3	Opt.
SC master EPFL	MA1, MA3	Obl.

Language	English
Credits	5
Session	Winter
Semester	Fall
Exam	Written
Workload	150h
Weeks	14
Hours	**4 weekly**
Lecture	2 weekly
Exercises	2 weekly

SUMMARY

In the lectures you will learn and understand the main ideas that underlie and the way networks are built and run. You will be able to apply the concepts to the smart grid. In the labs you will exercise practical configurations.

CONTENT

LECTURES: 1. The TCP/IP architecture 2. Layer 2 networking; Bridging; the Spanning Tree Protocol. Bellman Ford. 3. The Internet protocol versions 4 and 6 4. The transport layer, TCP, UDP, sockets 5. Distance vector, link state routing. Optimality of routing. Interdomain routing, BGP. 6. Congestion control principles. Application to the Internet. The fairness of TCP. Flow based networking. Reservations for quality of service. 7. Hybrid constructions and tunnels, MPLS, VPNs. VPNs. 8. Selected advanced topic.
LABS: 1. Configuration of a network, virtual machines and GNS3 2. MAC; NATs and troubleshooting 3. Socket programming 4. Interior routing 5. Congestion control and flow management 6. BGP

KEYWORDS

TCP/IP
Computer Networks

LEARNING PREQUISITES

Required courses

A first programming course

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Run and configure networks
- Understand the main ideas that underlie the Internet
- Write simple communicating programs
- Use communication primitives for internet applications or in the smart grid

Transversal skills

- Access and evaluate appropriate sources of information.
- Continue to work through difficulties or initial failure to find optimal solutions.

TEACHING METHODS

Lectures with clickers
Labs on student's computer and in the Internet Engineering Workshop

EXPECTED STUDENT ACTIVITIES

Participate in lectures
Participate in graded clicker test every other week
Make one lab assignment every other week, including handing in a written report
Optional: research exercise: gather information about a specific topic and explain it to class

ASSESSMENT METHODS

Theory grade = max(40% clicker test + 60% final exam, final exam)
Practice grade = average of labs
Final grade = harmonic mean of theory grade and practice grade.
The research exercice may give a bonus of at most 0.5 points in 1-6 scale.

SUPERVISION

Office hours	Yes
Assistants	Yes
Forum	Yes

RESOURCES

Bibliography

"Computer Networking : Principles, Protocols and Practice", O. Bonaventure, open source textbook, http://inl.info.ucl.ac.be/CNP3

Ressources en bibliothèque

- Computer Networking / Bonaventure

Références suggérées par la bibliothèque

Notes/Handbook

Slides are on moodle

Websites

http://moodle.epfl.ch/course/view.php?id=523

Moodle Link

http://moodle.epfl.ch/course/view.php?id=523

Videos

http://moodle.epfl.ch/course/view.php?id=523

CS-410 **Technology ventures in IC**

Bugnion Edouard

Cursus	Sem.	Type
Informatique	MA2	Opt.
SC master EPFL	MA2, MA4	Opt.

Language	English
Credits	4
Session	Summer
Semester	Spring
Exam	During the semester
Workload	120h
Weeks	14
Hours	**4 weekly**
Lecture	2 weekly
Project	2 weekly

SUMMARY

This hands-on class gives graduate students in IC interested in startups the opportunity to learn and put in practice the fundamental skills required to assess a technology concept in the context of a business opportunity. This class is focused only on business opportunities where high-technology

CONTENT

Working in teams, students will learn the fundamentals of:

- *Opportunity assessement*
- *Customer development and validation*
- *Business model alternatives*
- *Intellectual Property*
- *Strategy and Financial planning*
- *Go-to-market, launch, and growth*

This is a hands-on class where students start the class with their own technology venture concept (e.g. the work done as part of their PhD, or some well-formed idea, maybe with a prototype). During the class, they convert their concept into a integrated business plan.

KEYWORDS

Entrepreneurship, startups, technology transfer, intellectual property

LEARNING PREQUISITES

Required courses

- *None – but available to MS and Ph.D. students only*

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Analyze a business plan
- Create a business plan

TEACHING METHODS

- Short ex-cathedra presentations of each topic
- Hands-on seminar with many short student presentations

- Presentations from invited guests, in particluar industry executives and entrepeneurs
- Discussion and case studies

ASSESSMENT METHODS

- In-class participation (30%)
- In-class presentations (30%)
- Final pitch (40%)

SUPERVISION

Office hours	Yes
Assistants	No
Forum	Yes

CS-455

Topics in theoretical computer science

Svensson Ola Nils Anders

Cursus	Sem.	Type
Informatique	MA2	Opt.
SC master EPFL	MA2, MA4	Opt.

Language	English
Credits	4
Session	Summer
Semester	Spring
Exam	During the semester
Workload	120h
Weeks	14
Hours	**4 weekly**
Lecture	3 weekly
Exercises	1 weekly

SUMMARY

The students gain an in-depth knowledge of several current and emerging areas of theoretical computer science. The course familiarizes them with advanced techniques, and develop an understanding of fundamental questions that underlie some of the key problems of modern computer science.

CONTENT

Examples of topics to be covered include the following:

- Complexity classes (time, space, nondeterminism)
- Boolean circuits and nonuniform computation
- Role of randomness in computation (extractors, pseudo-random generators)
- Interactive proofs and zero knowledge proofs
- Probabilistically checkable proofs and their characterization of the complexity class NP (PCP Theorem)
- Communication complexity

KEYWORDS

algorithms, communication complexity, computational complexity, randomness, interactive proofs, probabilistically checkable proofs, theoretical computer science

LEARNING PREQUISITES

Required courses

Bachelor courses on algorithms, complexity theory, and discrete mathematics.

Recommended courses

Theory of computing (3rd year bachelor course) and advanced algorithms (master)

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Demonstrate an understanding of computational complexity and the P vs NP problem
- Formalize and analyze abstractions of complex scenarios/problems
- Express a good understanding of different concepts of proofs
- Prove statements that are similar to those taught in the course
- Use and understand the role of randomness in computation

• Illustrate a basic understanding of probabilistically checkable proofs and their characterization of the class NP (the PCP-Theorem)

• Explain recent exciting developments in theoretical computer science

TEACHING METHODS

Ex cathedra lectures, exercises, presentations and classroom discussions

ASSESSMENT METHODS

continuous assessment including tests, homeworks and in-class presentations

RESOURCES

Bibliography

Sanjeev Arora and Boaz Barak: *Computational Complexity: A Modern Approach,* Cambridge University Press, 2009.

Websites

http://theory.epfl.ch/courses/topicstcs/

CS-434

Unsupervised and reinforcement learning in neural networks

Gewaltig Marc-Oliver

Cursus	Sem.	Type
Informatique	MA1, MA3	Opt.
Mineur en Biocomputing	H	Opt.
Mineur en Neurosciences computationnelles	H	Opt.
Neurosciences		Opt.
SC master EPFL	MA1, MA3	Opt.
Sciences du vivant	MA1, MA3	Opt.

Language	English
Credits	4
Session	Winter
Semester	Fall
Exam	Oral
Workload	120h
Weeks	14
Hours	**4 weekly**
Lecture	2 weekly
Exercises	2 weekly

SUMMARY

Learning is observable in animal and human behavior, but learning is also a topic of computer science. This course links algorithms from machine learning with biological phenomena of synaptic plasticity. The course covers unsupervised and reinforcement learning, but not supervised learning.

CONTENT

I. unsupervised learning
1. Neurons and Synapses in the Brain. Synaptic Changes
2. Biology of unsupervised learning, Hebb rule and LTP .
3. Hebb rule in a linear neuron model and PCA
4. Analysis of Hebb rule and application to development
5. Plasticity and Independent Component Analysis (ICA)
6. Competitive Learning and Clustering
7. Kohonen networks

II. Reinforcement learning
8. The paradigm of reward-based learning
in biology and theoretical formalisation
9. Reinforcement learning in discrete spaces
10. Eligibity traces and reinforcement learning in continuous spaces and applications

III. Can the brain implement Unsupervised and Reinforcement learning?
11. Spiking neurons and learning: STDP
12. Neuromodulators and Learning
13. Long-term stability of synaptic memory
14. Unsupervised learning from an optimality
viewpoint: Information Maximization

KEYWORDS

synaptic plasticity
learning rules
learning algorithms
neural networks

LEARNING PREQUISITES

Required courses
Analysis I-III, linear algebra, probability and statistics

Recommended courses
Analysis I-III, linear algebra, probability and statistics

Important concepts to start the course
mathematical abstractions

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Design learning algorithms
- Analyze learning algorithms and plasticity rules
- Classify learning algorithms and plasticity rules
- Prove convergence of batch learning rules
- Develop a learning rule based on optimization principles
- Formulate on-line plasticity rules
- Apply unsupervised and reinforcement learning rules

Transversal skills

- Write a scientific or technical report.
- Collect data.
- Negotiate effectively within the group.

TEACHING METHODS

Classroom teaching, exercises and miniproject

EXPECTED STUDENT ACTIVITIES

solve paper and pencil exercises
participate in class
run simulations for miniproject
write report

ASSESSMENT METHODS

Oral Exam & miniproject

SUPERVISION

Office hours	No
Assistants	Yes
Forum	No

RESOURCES

Bibliography
Dayan & Abbott : Theoretical Neuroscience, MIT Press 2001; Gerstner & Kistler : Spiking Neuron Models, Cambridge Univ. Press

Ressources en bibliothèque

- Theoretical Neuroscience / Dayan
- Spiking Neuron Models / Gerstner

Références suggérées par la bibliothèque
Moodle Link
http://moodle.epfl.ch/course/view.php?id=1241

CS-444

Virtual reality

Boulic Ronan

Cursus	Sem.	Type
Informatique	MA2	Opt.
SC master EPFL	MA2, MA4	Opt.

Language	English
Credits	4
Session	Summer
Semester	Spring
Exam	During the semester
Workload	120h
Weeks	14
Hours	**3 weekly**
Lecture	2 weekly
Exercises	1 weekly

SUMMARY

The goal of VR is to embed the users in a potentially complex virtual environment while ensuring that they are able to react as if this environment were real. The course provides a human perception-action background and describes the key techniques for achieving efficient VR applications.

CONTENT

The first lectures focus more on the technical means (hw & sw) for acheiving the hands-on sessions:

- Visual display (CAVE and stereoscopy)
- Interaction devices and sensors
- Software environment

The proportion of more theoretical VR and Neuroscience background increases over the semester:

- Key Human perception abilities, Immersion, presence and flow
- Basic 3D interaction techniques: Magic vs Naturalism
- The perception of action
- Haptic interaction
- What makes a virtual human looking alive ?
- Motion capture for full-body interaction
- VR, cognitive science and true experimental design

KEYWORDS

3D interaction, display, sensors, immersion, presence

LEARNING PREQUISITES

Required courses

(CS 341) Introduction to Computer Graphics

Important concepts to start the course

from Computer Graphics:
- perspective transformations
- representation of orientation
- 3D modelling hierarchy
- matrix algebra: translation, orientation, composition

LEARNING OUTCOMES

By the end of the course, the student must be able to:

- Describe how the human perception-action system is exploited in VR
- Apply the concepts of immersions, presence and flow
- Give an example of applications of VR in different industrial sectors
- Choose a method of immersion suited for a given 3D interaction context

TEACHING METHODS

Ex cathedra + Hands-on sessions on VR devices in the first half of the semester,
a mini-project in groups will have to integrate some open source components of 3D real-time interaction

EXPECTED STUDENT ACTIVITIES

exploit citation analysis tools to evaluate a scientific paper
combine open-source libraries to produce an original 3D interaction
experiment the hands-on practical work in the lab
synthesize the knowledge acquired in course and hands-on in the quizzes and final oral

ASSESSMENT METHODS

Throughout semester: 4 TPs (4%), 3 Quizzes (15%), 1 paper citation study (15%), 1 mini-project (36%), 1 oral (30%)

SUPERVISION

Assistants	Yes
Forum	Yes

RESOURCES

Bibliography

- Course notes will be updated and made available after each course, with links to key sites and on-line documents
- Le Traité de Réalité Virtuelle (5 vol.) Presses des Mines, ParisTech, 2006-2009, available on-line, free for student upon registration.
- Doug A. Bowman, Ernst Kruijff, Joseph J. LaViola, and Ivan Poupyrev. 2004. 3D User Interfaces: Theory and Practice. Addison Wesley Longman Publishing Co., Inc., Redwood City, CA, USA.

Ressources en bibliothèque

- Le Traité de Réalité Virtuelle
- 3D User Interfaces: Theory and Practice / Bowman

Références suggérées par la bibliothèque

Notes/Handbook

pdf of slides are made visible after the ex-cathedra courses

Moodle Link

http://moodle.epfl.ch/course/view.php?id=6841

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