WILLIAM B. FEDUS

EDUCATION

University of Montreal   September 2020 (Expected)
Doctor of Philosophy in Computer Science
Montreal, QC
Advisors: Yoshua Bengio and Hugo Larochelle

University of California, San Diego   June 2016
Masters of Science in Physics
La Jolla, CA
Advisors: David Meyer (Math) and Garrison Cottrell (CSE)

Massachusetts Institute of Technology   June 2010
Bachelors of Science, Physics
Cambridge, MA

University of Cambridge, Robinson College   June 2009
Physics (Junior Year)
Cambridge, England

RESEARCH AND EXPERIENCE

Google Brain   April 2018 - Present
Student Researcher Scholar Program, Montreal, QC and Mountain View CA
- Led three projects on fundamental reinforcement learning (RL) research. The first characterized time-preferences of reinforcement learning (RL) agents and designed new agents with more flexible discount functions. The second empirically established the issue of catastrophic forgetting for RL agents within a single environment. The third formed the connection between n-step returns and the experience replay capacity.
- Helped build a python API and benchmark the first neural network architectures as part of a hybrid research-engineering team designing a large-scale distributed infrastructure for massive, asynchronous, shared models.
- Co-leading an extension of mixture-of-expert neural (MoE) Transformer networks two orders of magnitude (1T+ parameters) on self-supervised natural language fill-in-the-blank tasks.

Montreal Institute of Learning Algorithms (Mila) at UdeM   September 2017 – Present
Graduate Student Researcher, Montreal, QC
- Co-led a branch of reinforcement learning (RL) research investigating intrinsically motivated agents that learn by discovering controllable and independently variable factors of the environment.
- Co-advised in research in Generative Adversarial Networks (GANs) for natural language which established new quality-diversity metrics analogous to a receiver-operating curve to assess progress.

Google Brain   December 2016 - August 2017
Software Engineering and Research Intern, Mountain View, CA
- Extended Generative Adversarial Networks (GANs) to natural language processing tasks by using a discriminator to set rewards in order to train a generative model in a reinforcement learning environment – proposed fill-in-the-blank natural language task for bidirectional sequence models later extended in BERT, XLNet and ELECTRA.
- Co-led an investigation into dynamics of GAN-training which empirically questioned the viewpoint that divergence minimization was governing learning dynamics.

Google Research, Accelerated Sciences   June 2016 - December 2016
Software Engineering and Research Intern, Mountain View, CA
- Designed, in collaboration with Calico, a spatiotemporal 3D convolutional model with temporal dilation to perform semantic segmentation in microscopy video to identify Yeast cell-types.
- Benchmarked scaling properties of a convolutional neural network (CNN) that predicts the fluorescent labels using only the transmitted light of unlabeled fixed of biological samples.

Zillow Group   Summer 2015
Data Scientist Intern, Seattle, WA
- Co-led the first use of deep convolutional neural networks (CNN) for home value assessment based on images and developed a recurrent neural architecture employing Long Short-Term Memory (LSTM) cells to process sets of images.
- This approach improved the home valuation algorithm, the Zestimate, and has been deployed since 2019.

Garrison Cottrell Group at UCSD   October 2015 – June 2016
Graduate Student Researcher, La Jolla, CA
- Deep learning research on recurrent neural network (RNN) architectures with attention mechanisms.
- Teaching assistant for three courses in machine learning and artificial intelligence and served as head-TA for the graduate neural networks course.

David Meyer Group at UCSD   June 2014 – June 2016
Graduate Student Researcher, La Jolla, CA
- Applied research in persistent homology, a topological data analysis technique, for modeling the topological structure of data.

Compact Muon Solenoid (CMS) Experiment at CERN   April 2013– June 2014
Graduate Student Researcher, La Jolla, CA
- Redesigned and improved late-iteration seeding algorithms for particle track reconstruction for the CMS collaboration.
- This demonstrated the feasibility and efficacy of a more efficient seeding algorithm: an algorithm which generates candidate particle tracks. This sped-up the entire track reconstruction process without reducing efficiency of finding charged particle tracks.

Fidelity Management and Research Company   August 2010 – March 2013
Global Equity Research Associate, Boston, MA
- Equity research analyst for $200M-20B companies using a combination of fundamental and quantitative techniques in two fields: oil and gas and technology and media – top performance in a synthetic technology and media model portfolio.
- Developed a model of explorer and producer oil and gas companies which used Monte-Carlo simulations to better assess risk profiles across drilling portfolio.

MIT Dark Matter Detection (DMTPC Group)   June 2007 – June 2010
Undergraduate Student Researcher, Cambridge, MA
- Designed and optimized our working prototype by analyzing calibration data and devising new mechanical systems for gas flow.
- Researched physically motivated classification algorithms to improve DMTPC's sensitivity to incident dark matter directionality.

Fidelity Management and Research Company   Summer 2008 & 2009
Global Equity Research Associate Intern, Boston, MA
- Analyzed the impact of global telecom non-SMS mobile data adoption and completed an investment breakdown of the water industry. Correctly identified top performing and worst performing equities within my assigned sector.

Undergraduate Student Researcher, Cambridge, MA
- Developed & tested nine atmospheric science experiments now used in the curricula at MIT and five other universities.

PUBLICATIONS AND PRESENTATIONS

[1] W. Fedus, C. Gelada, Y. Bengio, M. G. Bellemare, H. Larochelle. Learning Multiple Time Horizons for Improved Performance and Generalized Discounting. *(In review at ICML)*, 2020.

[2] W. Fedus, P. Ramachandran, R. Agarwal, Y. Bengio, M. Rowland, W. Dabney. Revisting Fundamentals of Experience Replay. *(In review at ICML)*, 2020.

[3] W. Fedus*, D. Ghosh*, J. D. Martin, Y. Bengio, M. G. Bellemare, H. Larochelle. On Catastrophic Forgetting in Atari 2600 Games. *(In review at ICML)*, 2020.

[4] W. Fedus*, D. Ghosh*, J. Martin, M. G. Bellemare, H. Larochelle. MEMENTO: Further Progress Through Forgetting. *NeurIPS BARL Workshop* (Oral Presentation), 2019.

[5] V. Jain, W. Fedus, H. Larochelle, D. Precup, M. G. Bellemare. Algorithmic Improvements for Deep Reinforcement Learning applied to Interactive Fiction. *AAAI*, 2020 (Oral Presentation).

[6] A. Ali Taiga, W. Fedus, M. Machado, A. Courville, M. G. Bellemare. Benchmarking Bonus-Based Exploration Methods on the Arcade Learning Environment. *ICML Exploration Workshop*, 2019 (Oral Presentation; Best Paper Award) and *ICLR*, 2020.

[7] W. Fedus, C. Gelada, Y. Bengio, M. G. Bellemare, H. Larochelle. Hyperbolic Discounting and Learning Over Multiple Horizons. *RLDM*, 2019 (Oral presentation; Best Paper Award).

[8] P. Veličković, W. Fedus, W.L. Hamilton, P. Liò, Y. Bengio, R.D. Hjelm. Deep Graph Infomax. *NeurIPS Workshop*, 2018 and *ICLR 2019*.

[9] M. Caccia*, L. Caccia*, W. Fedus, H. Larochelle, J. Pineau, L. Charlin. Language GANs Falling Short. *NeurIPS Critiquing Machine Learning Trends Workshop*, 2018; *ICLR*, 2020.

[10] A. Goyal, P. Brakel, W. Fedus, T. Lillicrap, S. Levine, H. Larochelle, Y. Bengio. Recall Traces: Backtracking Models for Efficient Reinforcement Learning. *ICLR, 2019.*

[11] V. Thomas*, E. Bengio*, W. Fedus*, J. Pondard, P. Beaudoin, H. Larochelle, J. Pineau, D. Precup, Y. Bengio. Disentangling the independently controllable factors of variation by interacting with the world. *NIPS Workshop*, 2017 (Spotlight presentation).

[12] W. Fedus*, M. Rosca*, B. Lakshminarayanan, A. M. Dai, S. Mohamed, I. Goodfellow. Many Paths to Equilibrium: GANs Do Not Need to Decrease a Divergence At Every Step. *ICLR*, 2018.

[13] W. Fedus, I. Goodfellow, A. M. Dai. MaskGAN: Better Text Generation via Filling in the _____. *ICLR*, 2018.

[14] E. Christiansen, S. Yang, D. Ando#, A. Javaherian#, G. Skibinski#, S. Lipnick#, E. Mount†, A. O'Neil†, K. Shah†, A. K. Lee†, P. Goyal†, W. Fedus†, R. Poplin†, A. Esteva, L. Rubin, P. Nelson*, S. Finkbeiner* . In Silico Labeling. *Cell Journal*, 2018.

[15] W. Fedus, M. Gartner, A. Georges, D. A. Meyer, D. Rideout. Persistent Homology for Mobile Phone Data Analysis. *Netmob 2015 Conference at MIT*, 2015.

[16] J.P. Lopez, S. Ahlen, J. Battat, T. Caldwell, M. Chernicoff, C. Deaconu, D. Dujmic, A. Dushkin, W. Fedus, P. Fisher, F. Golub, S. Henderson, A. Inglis, A. Kaboth, G. Kohse, L. Kirsch, R. Lanza, A. Lee, J. Monroe, H. Ouyang, T. Sahin, G. Sciolla, N. Skvorodnev, H. Tomita, H. Wellenstein, I. Wolfe, R. Yamamoto, H. Yegoryan. Background Rejection in the DMTPC Dark Matter Search Using Charge Signals. *Proceedings of the DPF-2011 Conference*, 2011.

[17] S. Ahlen, J. B. R. Battat, T. Caldwell, C. Deaconu, D. Dujmic, W. Fedus, P. Fisher, F. Golub, S. Henderson, A. Inglis, A. Kaboth, G. Kohse, R. Lanza, A. Lee, J. Lopez, J. Monroe, T. Sahin, G. Sciolla, N. Skvorodnev, H. Tomita, H. Wellenstein, I. Wolfe, R. Yamamoto, H. Yegoryan. First Dark Matter Search Results from a Surface Run of the 10-L DMTPC Directional Dark Matter Detector. *Physics Letters B*, 695 (124), 2011.

[18] J.B.R. Battat, S. Ahlen, T. Caldwell, C. Deaconu, D. Dujmic, W. Fedus, P. Fisher, F. Golub, S. Henderson, A. Inglis, A. Kaboth, G. Kohse, R. Lanza, A. Lee, J. Lopez, J. Monroe, T. Sahin, G. Sciolla, N. Skvorodnev, H. Tomita, H. Wellenstein, I. Wolfe, R. Yamamoto, H. Yegoryan. DMTPC:

Dark matter detection with directional sensitivity. *International Journal of Modern Physics A*, 25:1-51,2010.

[19] W. Fedus. Reconstructing Nuclear Recoil Tracks in the Dark Matter Time Projection Chamber. *Senior Undergraduate Thesis*, 2010.

[20] S. Ahlen et al. The case for a directional dark matter detector and the status of current experimental efforts. *International Journal of Modern Physics A*, 25(1), 2010.

ACHIEVEMENTS AND HONORS
- Student Prize at NeurIPS 2019 BARL Workshop from UNIQUE Research Center
- Best Paper Award at ICML 2019 Exploration Workshop
- Best Paper Award at RLDM 2019
- PBEEE fellowship. Doctoral research scholarships program for foreign students for $35,000
- Amazon Web Services Research Grant for $7,500
- Temporal Dynamics of Learning Center (TDLC) Small Grant for $2,000
- Frontiers of Innovation Scholars Program (FISP) Fellowship for $25,000
- UCSD Physics Excellence Grant for $15,000
- UCSD SHORE Recruiting Award
- SMART Grant, Maine State Scholarship, ACT Grant at MIT
- 5th-Place Quantum Quandaries Event at National Science Olympiad
- National Society of Scholars

TEACHING AND SERVICE
- Reviewer for ICML
- Reviewer for ICLR
- Reviewer for NeurIPS
- Reviewer for AAAI
- Reviewer for Nature
- Reviewer for ICML Exploration workshop
- UCSD CSE 253, Head TA of Graduate Neural Networks. Professor Garrison Cottrell, Winter 2015.
- UCSD CSE 190, Undergraduate Neural Networks. Professor Garrison Cottrell, Fall 2015.
- UCSD CSE 150, Artificial Intelligence. Professor Garrison Cottrell, Spring 2015.
- UCSD CSE 150, Artificial Intelligence. Professor Lawrence Saul, Winter 2014.
- UCSD PHYS 2B, Electricity and Magnetism. Professor Ivan Schuller, Fall 2014.
- High School and Undergraduate tutor for Physics, Math and Computer Science, 2014-Present.
- UCSD Young Physicists Program (YPP), outreach program to junior high and high school students.