

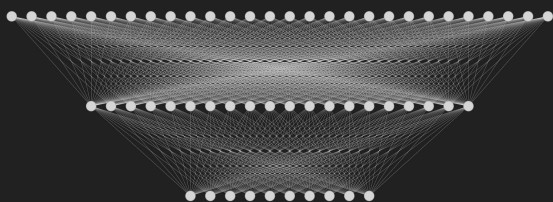
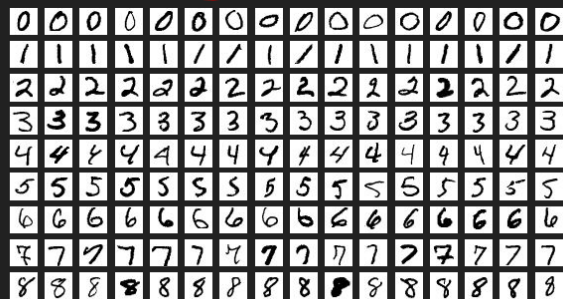
# Make Your Own Neural Network with Ruby

Arto Bendiken



# Agenda

1. Motivation
2. Demo
3. Theory
4. Tech
5. Code
6. Study
7. Bibliography
8. Q & A



## Ruby 2D

MAKE YOUR  
OWN  
NEURAL NETWORK



*A gentle journey through the mathematics of  
neural networks, and making your own  
using the Python computer language.*

TARIQ RASHID

# Motivation

“People worry that computers will get too smart and take over the world, but **the real problem is that they're too stupid and they've already taken over the world.**”

— [Pedro Domingos](#), author of [\*The Master Algorithm\*](#)

“Amid all this activity, a picture of our AI future is coming into view, and it is not the HAL 9000—a discrete machine animated by a charismatic (yet potentially homicidal) humanlike consciousness—or a Singularitan rapture of superintelligence.

“The AI on the horizon looks more like [AWS]—**cheap, reliable, industrial-grade digital smartness running behind everything, and almost invisible except when it blinks off.** This common utility will serve you as much IQ as you want but no more than you need.”

— [Kevin Kelly](#), co-founder of *Wired Magazine*,  
in [The Three Breakthroughs That Have Finally Unleashed AI on the World](#) (2004)

“Like all utilities, AI will be supremely boring, even as it transforms the Internet, the global economy, and civilization. It will enliven inert objects, much as electricity did more than a century ago.

**Everything that we formerly electrified we will now cognitize.**

“There is almost nothing we can think of that cannot be made new, different, or interesting by infusing it with some extra IQ. In fact, the business plans of the next 10,000 startups are easy to forecast:

**Take X and add AI.”**

— [Kevin Kelly](#), co-founder of *Wired Magazine*,  
in [The Three Breakthroughs That Have Finally Unleashed AI on the World](#) (2004)

**“Deep Learning is a superpower.** With it you can make a computer see, synthesize novel art, translate languages, render a medical diagnosis, or build pieces of a car that can drive itself. If that isn’t a superpower, I don’t know what is.”

— [Andrew Ng](#), co-founder of Google Brain & Coursera

Machine Learning  
(ML)

**Neural Networks  
(NNs)**

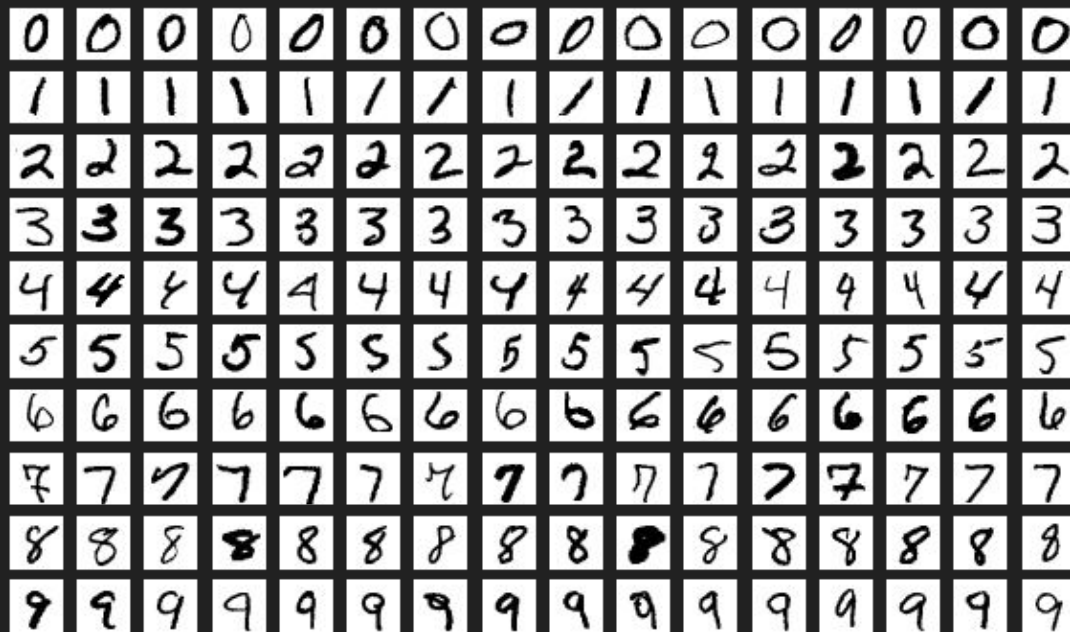
Deep Learning  
(DL)



Demo

# The MNIST Dataset

- Large database of handwritten digits, widely used in machine learning
- Grayscale images
- **28×28 pixel resolution**
- **60,000 training images**
- **10,000 testing images**
- Convolutional neural networks have achieved 99.79% accuracy on this dataset (Ukraine, 2016)



# Examine the MNIST Dataset

```
$ ./mnist_render.rb
```

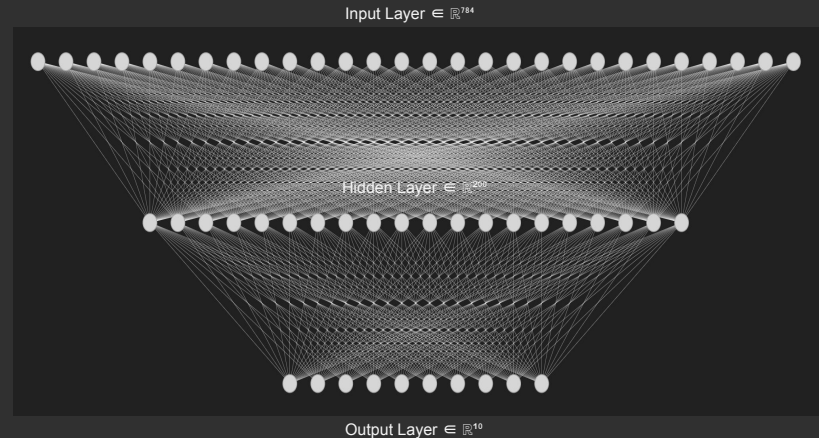
Press <UP> or <DOWN> to navigate  
records, and <SPACE> to view the  
assigned label



# Train the Neural Network

```
$ ./mnist_train.rb
```

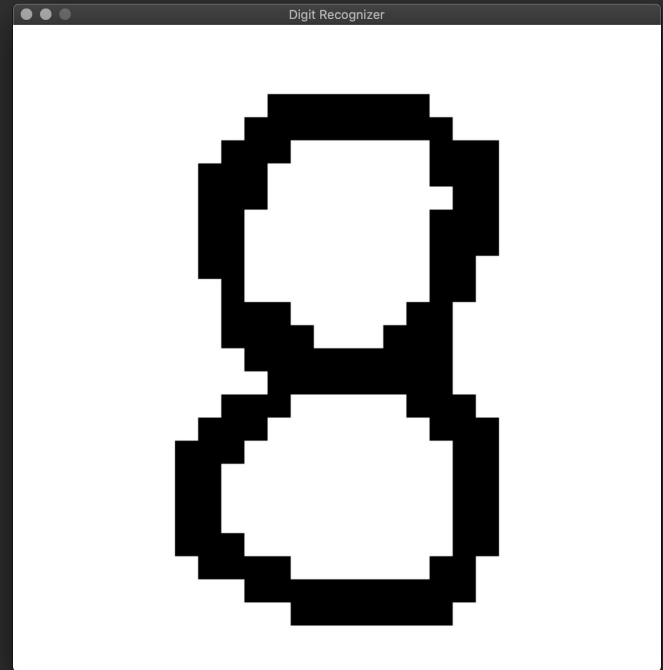
It will take a couple of minutes when  
using the CPU (GPU is faster)



# Practice Drawing Digits

```
$ ./mnist_draw.rb
```

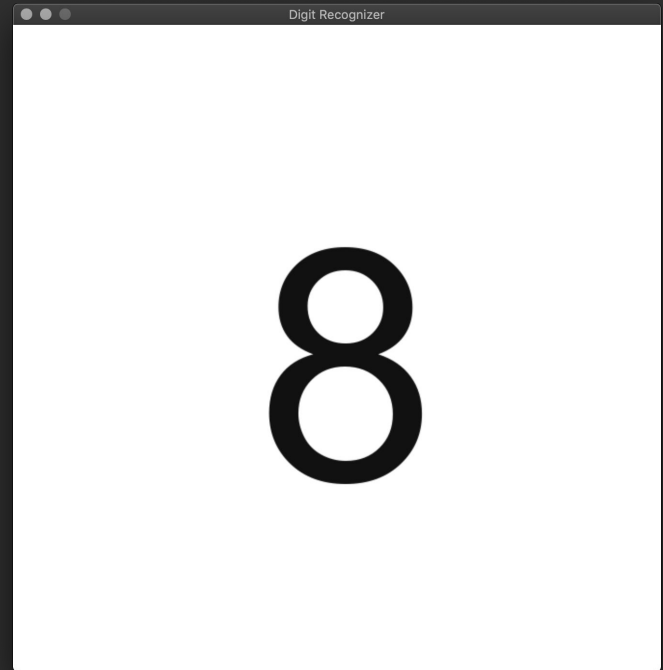
Press down your (left) mouse button  
to draw your digit



# Run the Neural Network

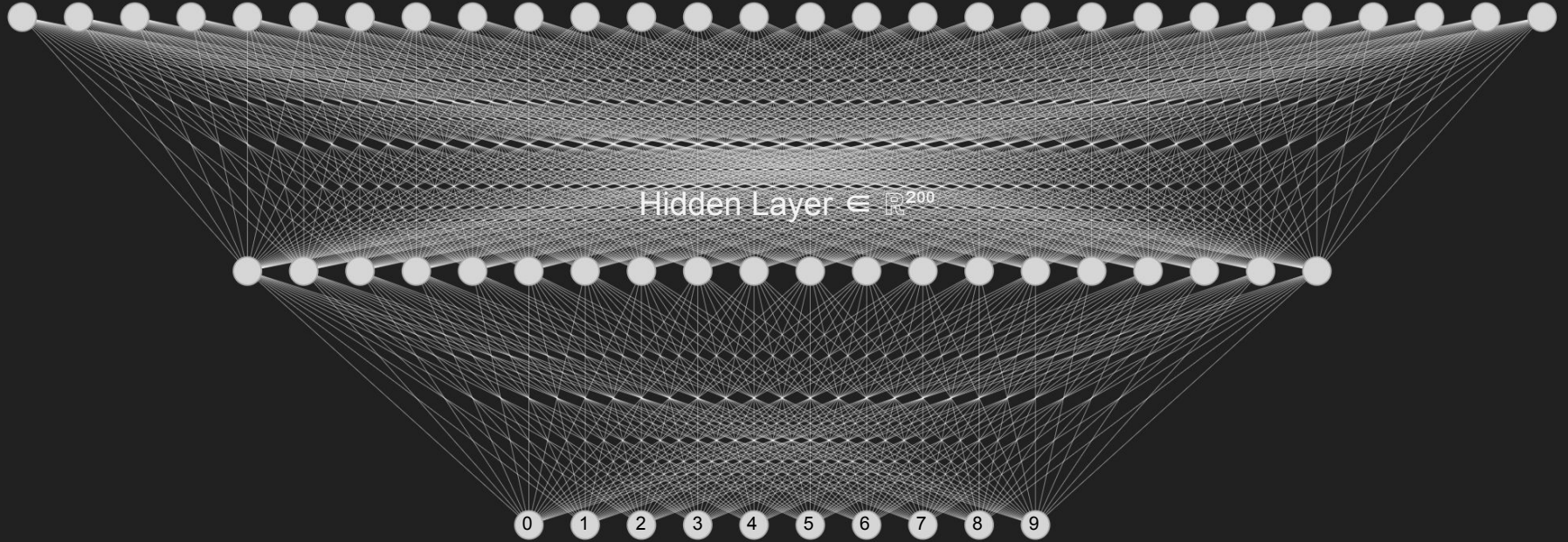
```
$ ./mnist_draw.rb
```

Press `<SPACE>` to attempt to  
recognize the hand-drawn digit



Theory

Input Layer  $\in \mathbb{R}^{784} *$

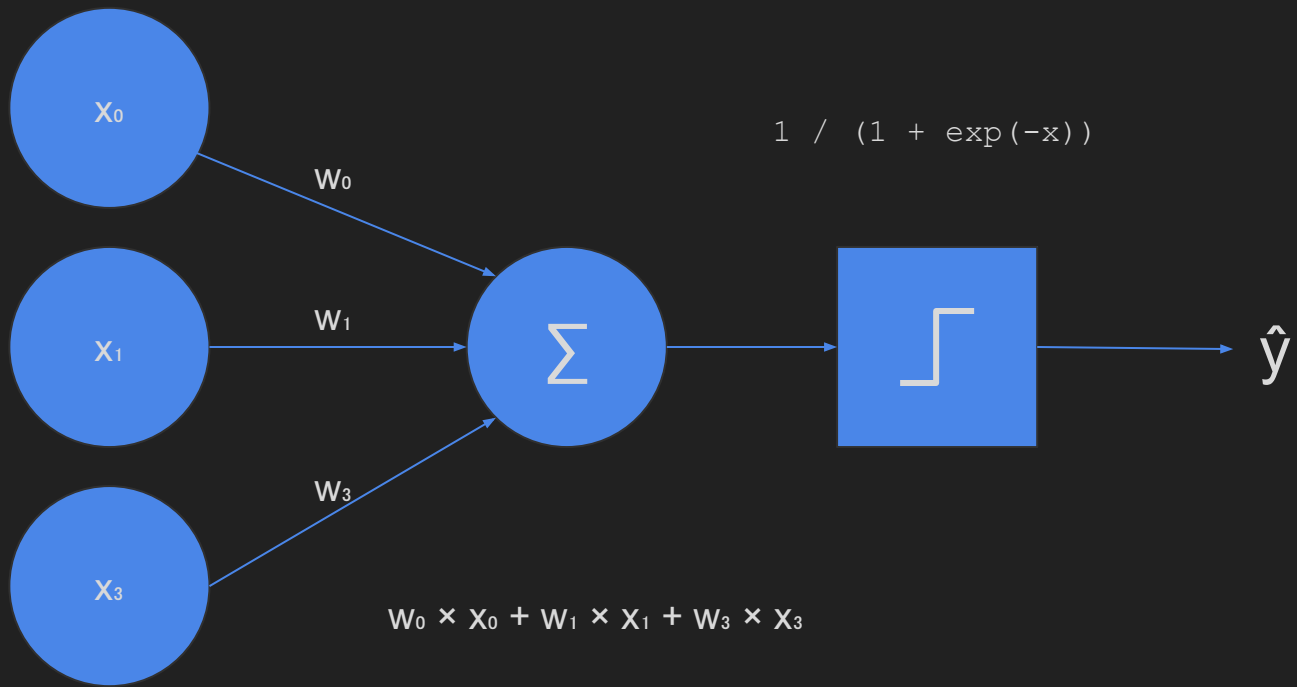


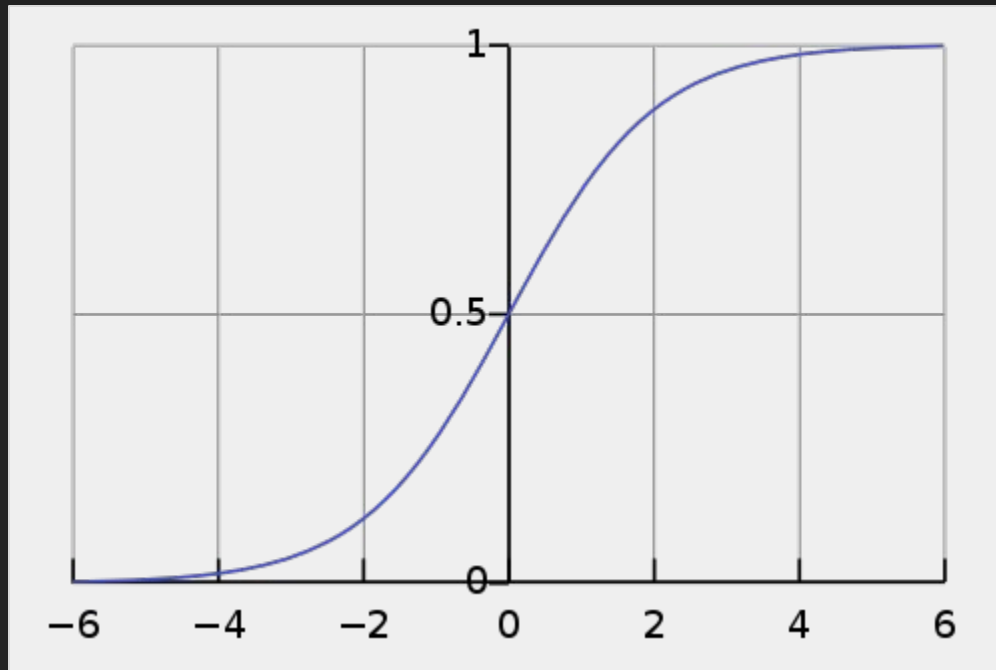
Hidden Layer  $\in \mathbb{R}^{200}$

Output Layer  $\in \mathbb{R}^{10}$

(\*)  $28 \times 28 = 784$







The [logistic sigmoid](#) activation function

Tech

# Challenges Encountered & Overcome

- Ruby isn't *obviously* a suitable programming language for this task
  - But it's feasible nonetheless, if the heavy lifting can be outsourced to BLAS libraries
- Ruby doesn't have as mature numeric computing support as Python
  - A fragmented ecosystem with accumulated sedimentary layers
  - The new [Numo](#) project for Ruby is promising and aims to cover the same ground as NumPy
- The UX and the performance isn't quite comparable as yet
  - NumPy "just works" after installation, with the best possible performance
  - Numo more than likely will need some manual configuration with OpenBLAS, MKL, etc
  - On my laptop, Numo with OpenBLAS doesn't run multi-threaded (hence trains the NN some 4x slower than NumPy does) ...this will need more troubleshooting
  - If you have an NVIDIA graphics card, [Cumo](#) should help speed you up
- [Ruby 2D](#) was a superb find for quick & easy GUI visualization

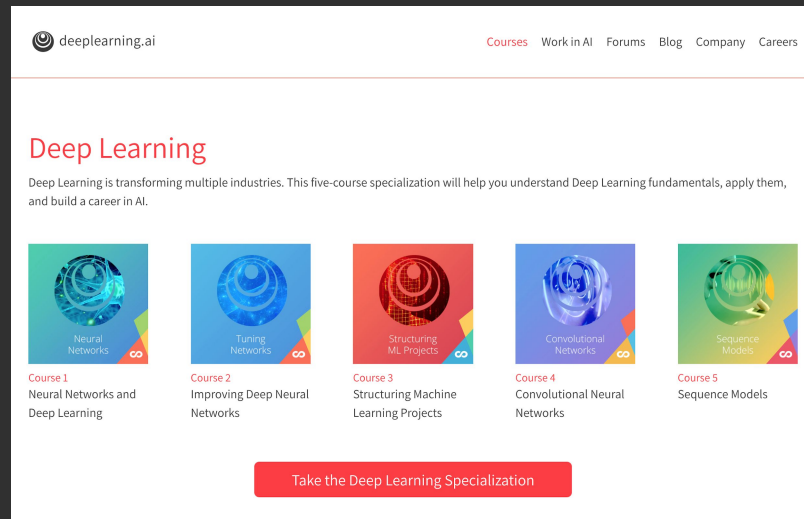
Code

Study

# deeplearning.ai

## Deep Learning Specialization

16 weeks of study, 3-6 hours per week



The screenshot shows the deeplearning.ai website. At the top left is the logo and name 'deeplearning.ai'. At the top right are navigation links: 'Courses', 'Work in AI', 'Forums', 'Blog', 'Company', and 'Careers'. The main heading is 'Deep Learning' in red. Below it is a paragraph: 'Deep Learning is transforming multiple industries. This five-course specialization will help you understand Deep Learning fundamentals, apply them, and build a career in AI.' Below this are five course cards, each with a colorful circular icon and a title. At the bottom right is a red button that says 'Take the Deep Learning Specialization'.

deeplearning.ai

Courses Work in AI Forums Blog Company Careers

## Deep Learning

Deep Learning is transforming multiple industries. This five-course specialization will help you understand Deep Learning fundamentals, apply them, and build a career in AI.

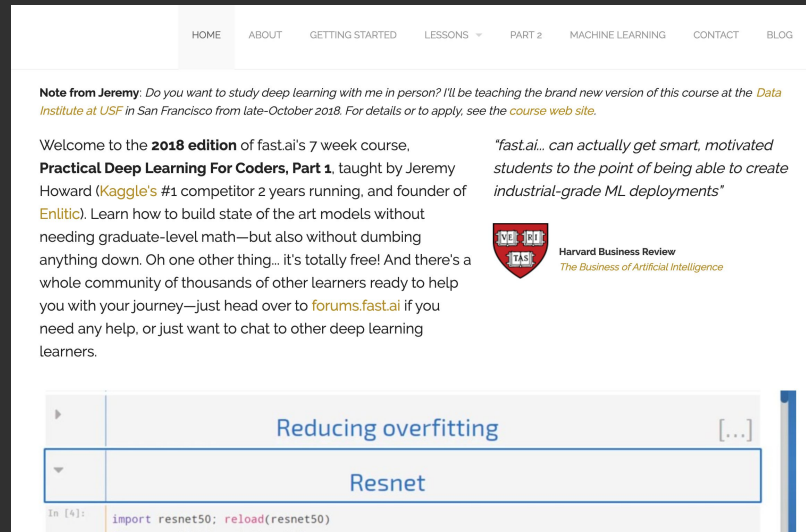
- Course 1**  
Neural Networks and Deep Learning
- Course 2**  
Improving Deep Neural Networks
- Course 3**  
Structuring Machine Learning Projects
- Course 4**  
Convolutional Neural Networks
- Course 5**  
Sequence Models

Take the Deep Learning Specialization

# fast.ai

## Practical Deep Learning for Coders

7 weeks of study, 10 hours per week




HOME ABOUT GETTING STARTED LESSONS ▾ PART 2 MACHINE LEARNING CONTACT BLOG

**Note from Jeremy:** Do you want to study deep learning with me in person? I'll be teaching the brand new version of this course at the [Data Institute at USF in San Francisco](#) from late-October 2018. For details or to apply, see the [course web site](#).

Welcome to the **2018 edition** of fast.ai's 7 week course, **Practical Deep Learning For Coders, Part 1**, taught by Jeremy Howard (Kaggle's #1 competitor 2 years running, and founder of [Enlitic](#)). Learn how to build state of the art models without needing graduate-level math—but also without dumbing anything down. Oh one other thing... it's totally free! And there's a whole community of thousands of other learners ready to help you with your journey—just head over to [forums.fast.ai](#) if you need any help, or just want to chat to other deep learning learners.

*"fast.ai... can actually get smart, motivated students to the point of being able to create industrial-grade ML deployments"*

 Harvard Business Review  
The Business of Artificial Intelligence

▶ Reducing overfitting [...] [..]

▼ Resnet

```
In [4]: import resnet50; reload(resnet50)
```

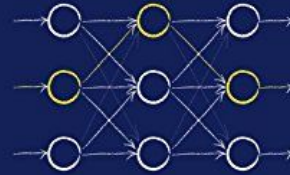


# Bibliography

# Make Your Own Neural Network by Tariq Rashid

- The **single best quick & short introduction** to the principles and mathematics underlying neural networks
- Can be read in one sitting in a couple of hours
- Example code in Python available [at GitHub](#) in the form of a Jupyter Notebook

## MAKE YOUR OWN NEURAL NETWORK

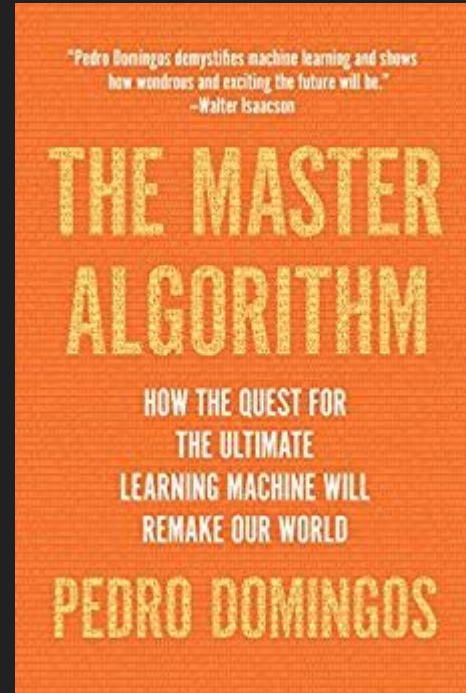


*A gentle journey through the mathematics of neural networks, and making your own using the Python computer language.*

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# The Master Algorithm by Pedro Domingos

- Outlines the five tribes of machine learning:
  - the symbolists (inductive reasoning),
  - **the connectionists (backpropagation)**,
  - the evolutionaries (genetic programming),
  - the Bayesians (Bayesian inference), and
  - the analogizers (support vector machines)



# Дякую!

Find me at:

<https://ar.to>