Intro to Artificial Intelligence, & Machine Learning

September 8, 2019

Huntsville AI

What we cover:

- Application - how to solve a problem with a technology
- Theory - for those times when knowing “How” something works is necessary
- Social / Ethics - Human / AI interaction
- Brainstorming - new uses for existing solutions
- Hands on Code - for those times when you just have to run something for yourself
- Coworking Night - maybe have combined sessions with other groups to discuss application in their focus areas

https://www.facebook.com/groups/hsvai/

https://www.meetup.com/Huntsville-AI/

https://www.linkedin.com/groups/12177562/

About me...

J. Langley

Chief Technical Officer at CohesionForce, Inc & Founder of SessionBoard, Huntsville AI

Involved in Open Source (Eclipse & Apache Foundations)

Started working with AI about 15 years ago when Intelligent Agents were all the rage.

Developed a Naive Bayes approach for text classification, a Neural Network for audio classification, heavily into NLP.

Intro to a REALLY BIG TOPIC

So...

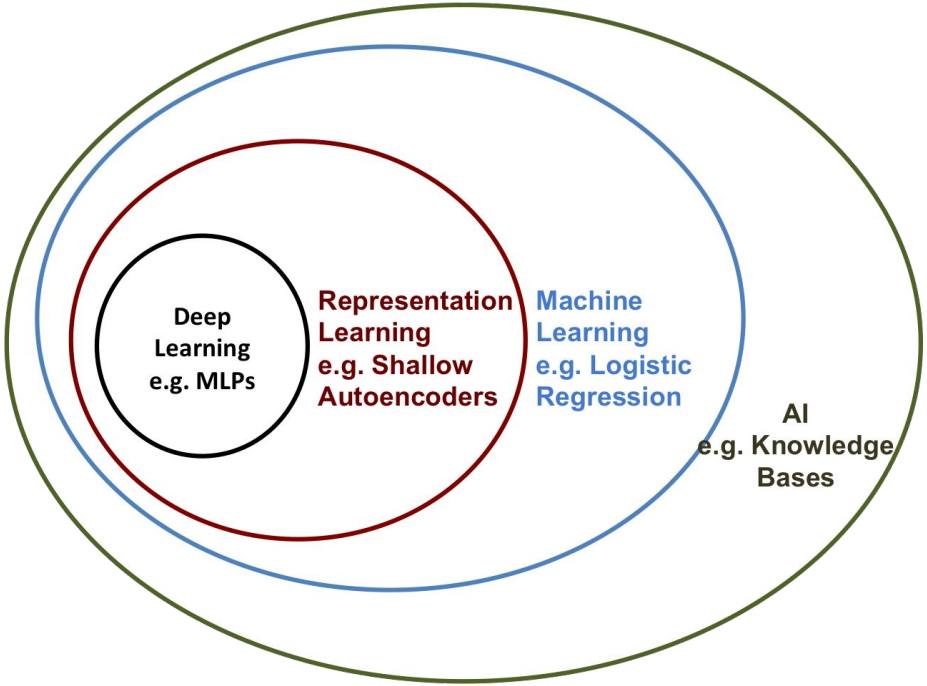
Artificial Intelligence and Machine Learning are pretty big topics to cover.

This session will attempt to help you categorize the types of problems that AI is best suited to solve.

We will cover a bit of history to give an idea of how fast things are changing.

We will also cover several of the tools and resources used by people working in this field.

Intro to a REALLY BIG TOPIC

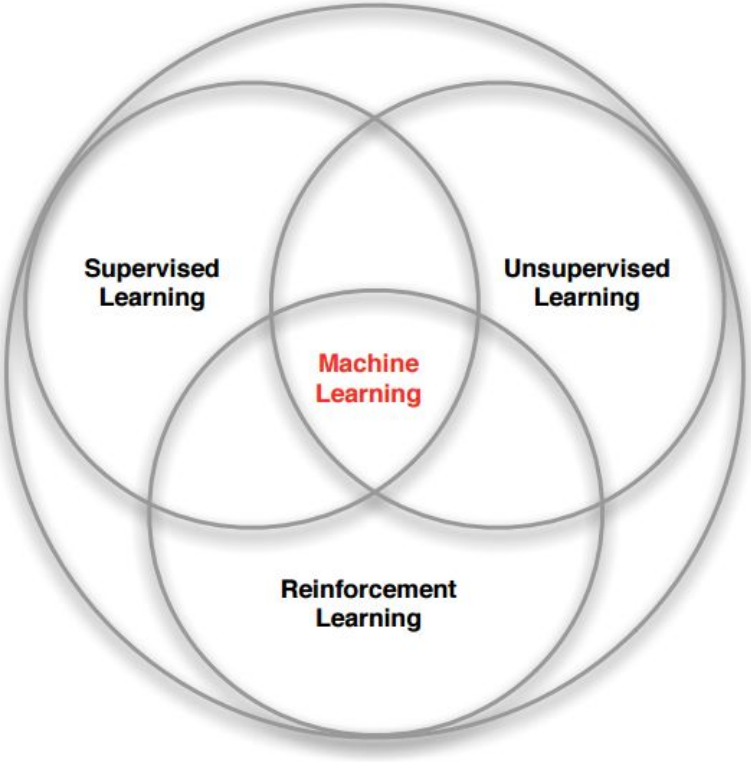


Here's a useful way to think about the relationship between AI, ML, and Deep Learning.

This is adapted from Ian Goodfellows book:

Deep Learning : https://www.deeplearningbook.org/

Intro to a REALLY BIG TOPIC



Here's a another way to break down the topic of AI, ML, and Deep Learning.

Supervised Learning - Labelled data is used to create a model which is applied to similar data

Unsupervised Learning - used to draw inferences from datasets consisting of input data without labeled responses.

Reinforcement Learning - concerned with how software agents ought to take actions in an environment so as to maximize some notion of cumulative reward.

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Here's the part where I put up an eye chart and everyone pretends that they can read it.

Each node on this subway map is marked with an AI/ML topic that you may want to learn.

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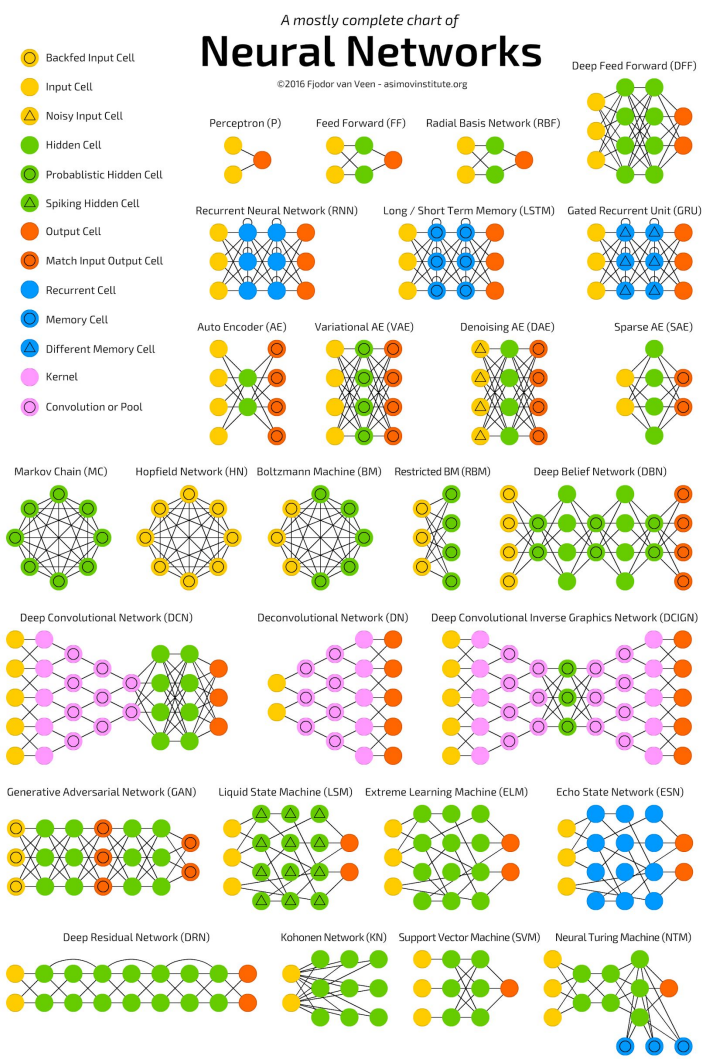
You will soon learn that you are no match for my eye charts...

Here's a diagram of existing Neural Network architectures from 2016.

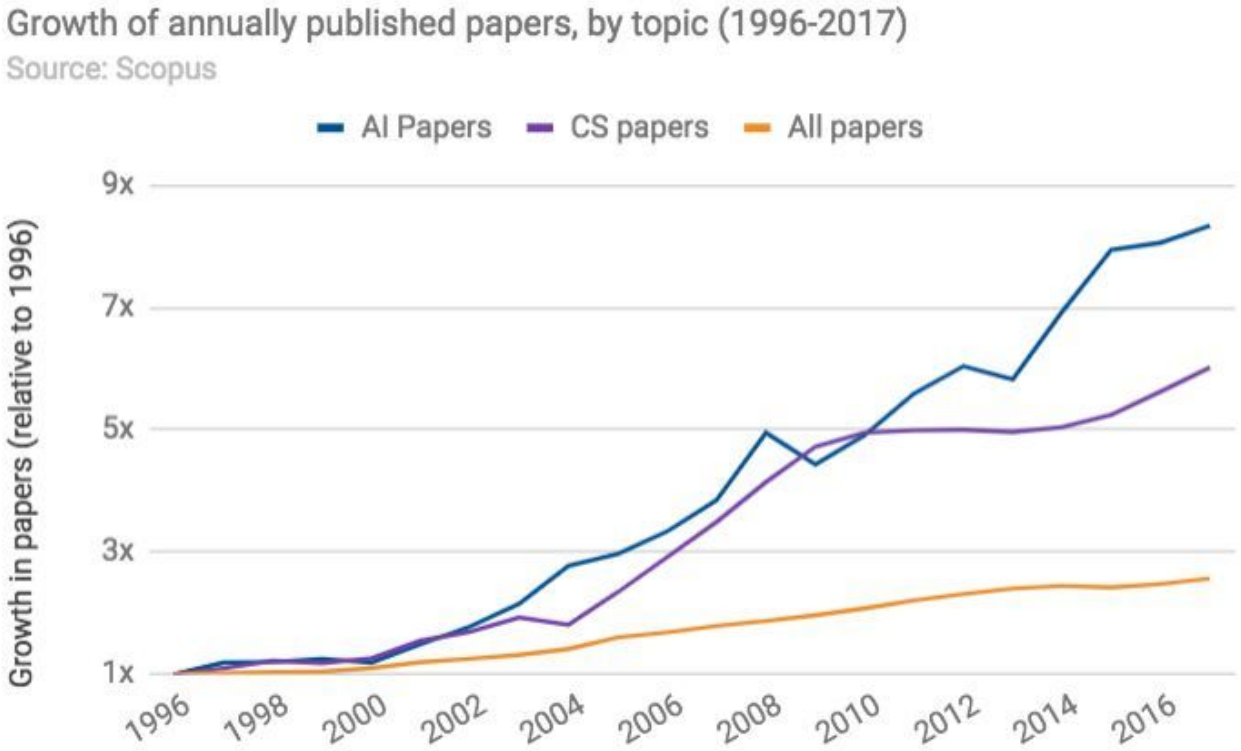


Catching up with a moving target

Another difficulty with AI/ML is the speed at which advancements are occuring.

Next, we'll look at some statistics from the AI Index 2018 Report: http://cdn.aiindex.org/2018/AI%20Index%202018%20Annual%20Report.pdf

Catching up with a moving target



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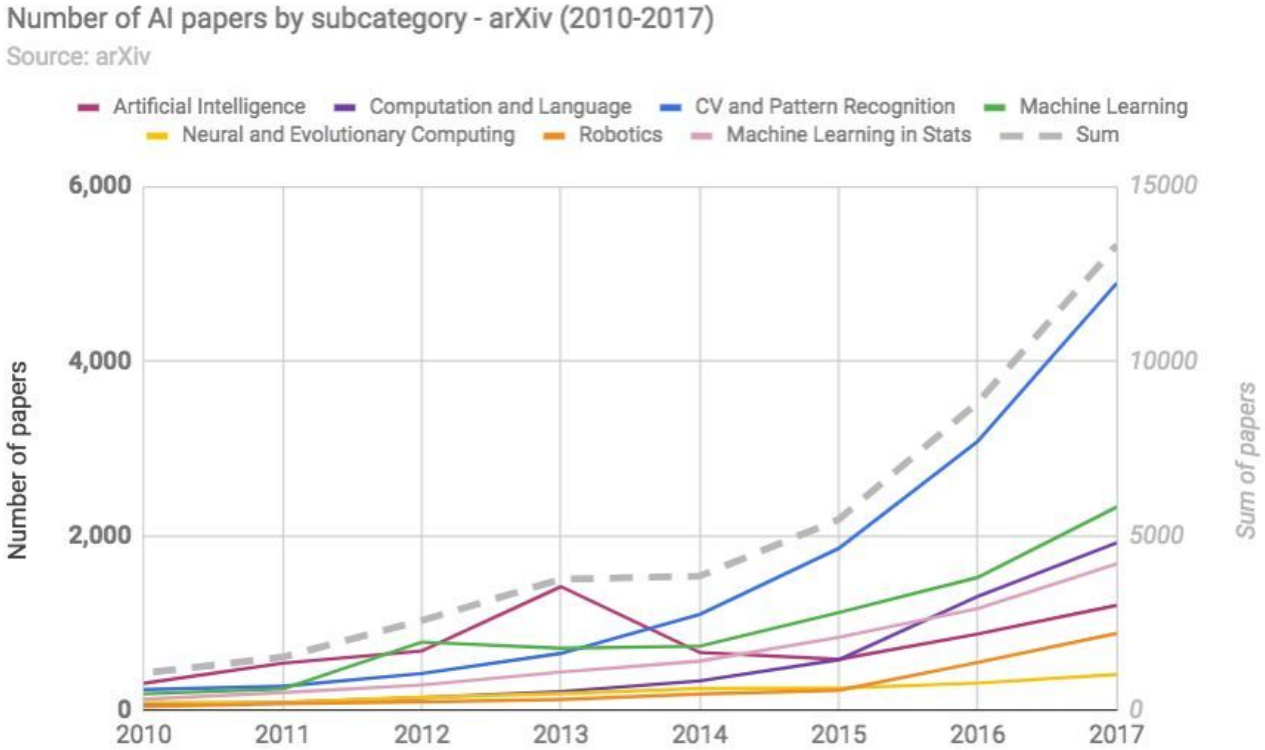

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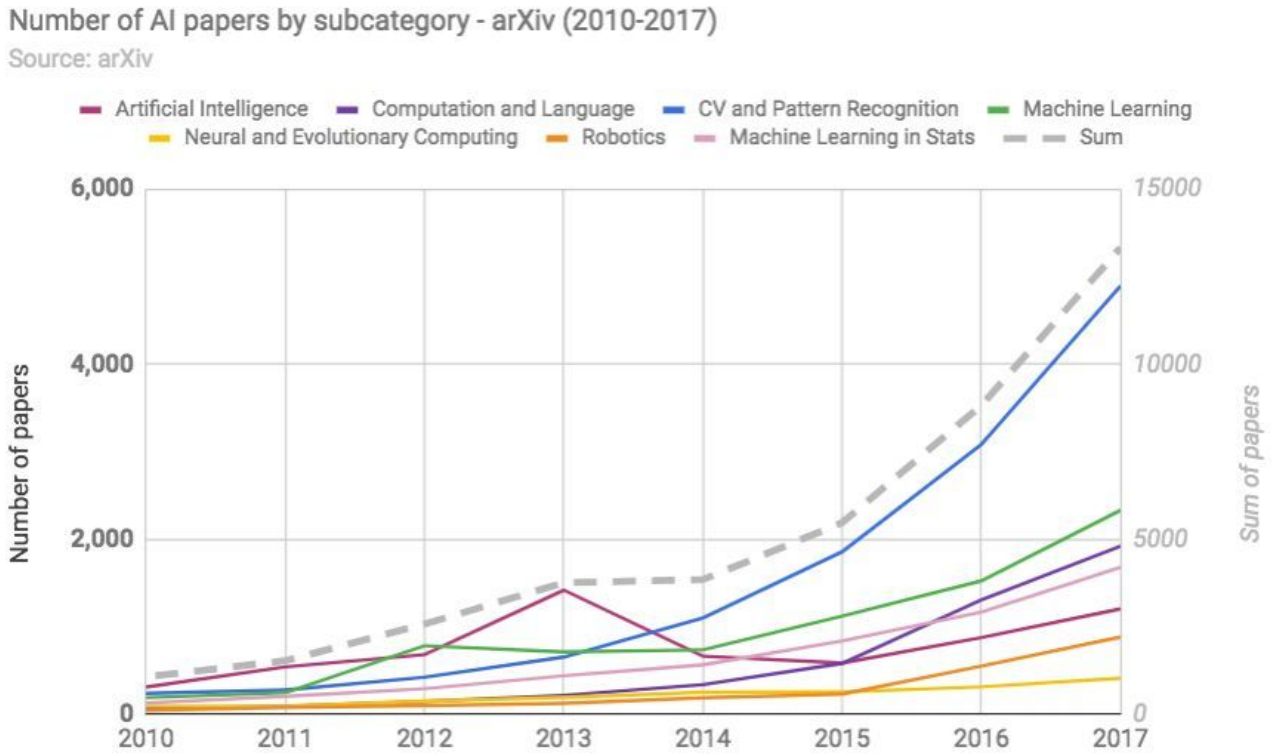

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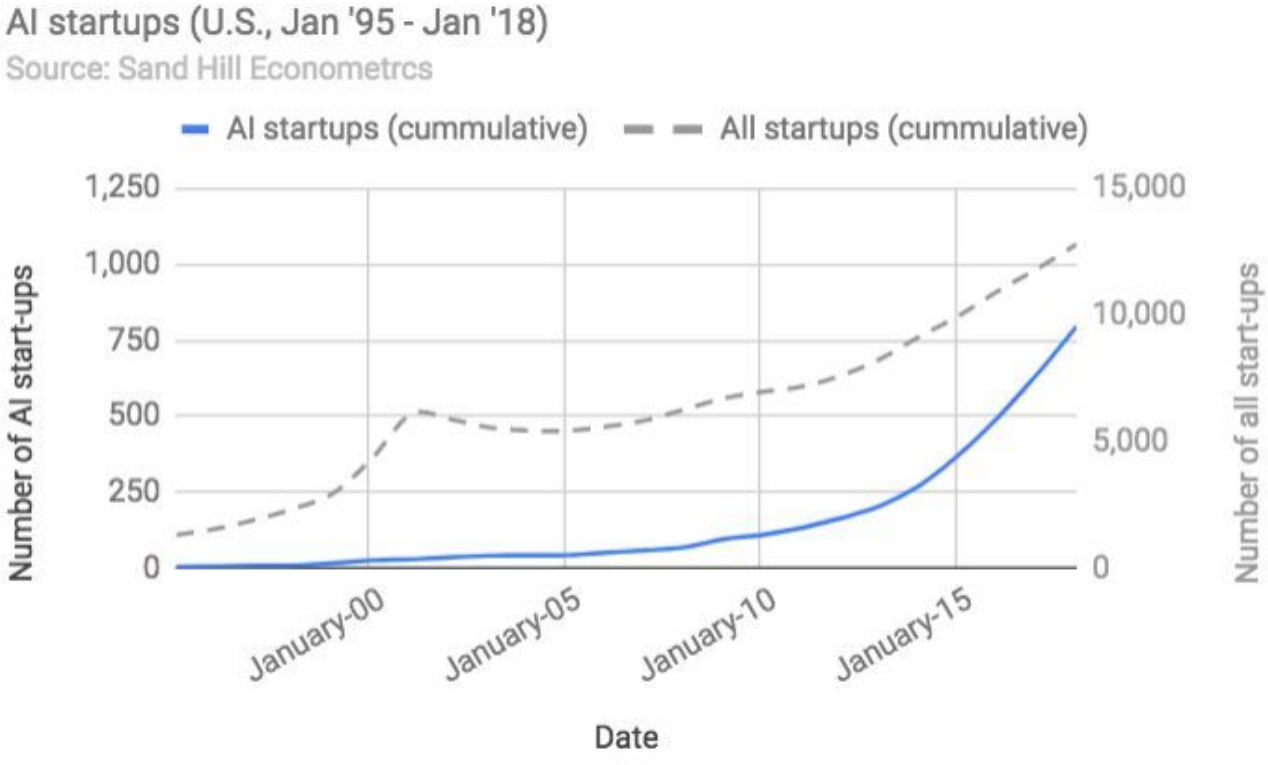
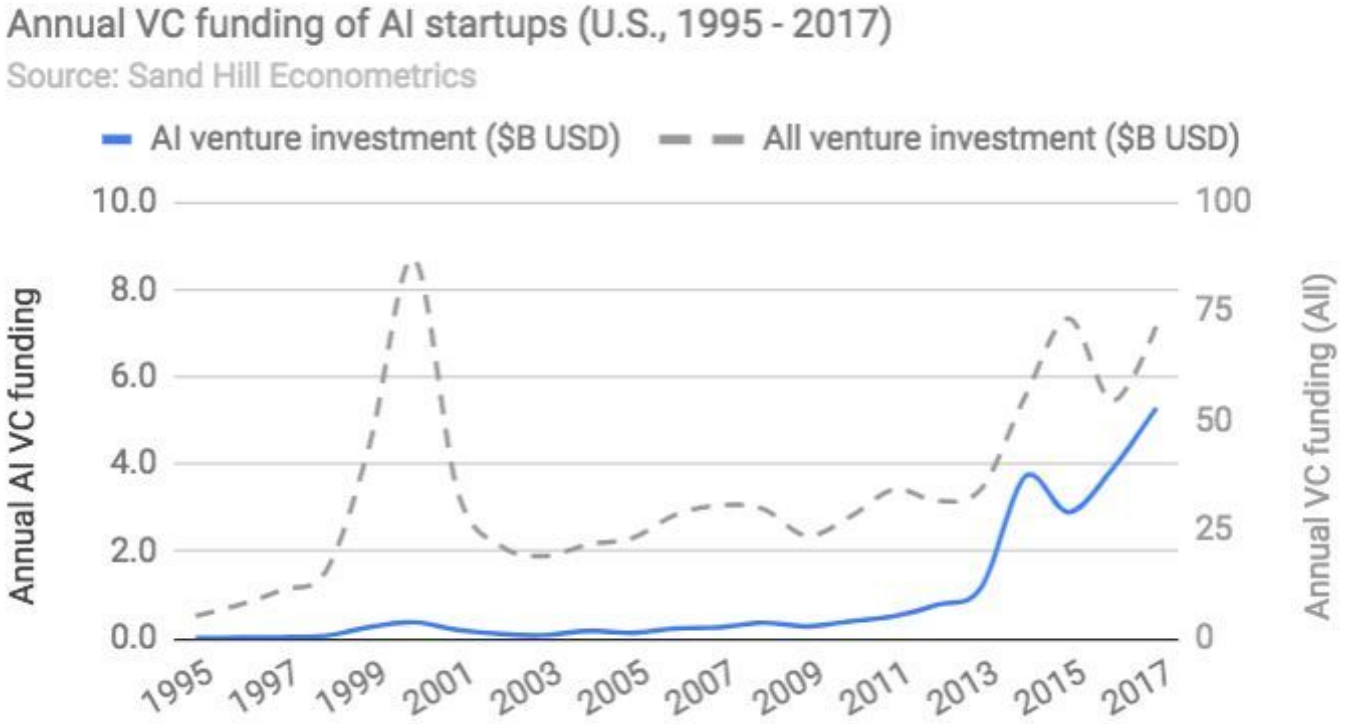


Catching up with a moving target



Keeping up with a moving target

So how do you learn and keep up with Artificial Intelligence and Machine Learning?

- Higher Education
- Local Communities - https://hsv-ai.com
- Global Communities - https://twimlai.com/
- Online Courses (see next slide)

Keeping up with a moving target

Ian Goodfellow - http://www.deeplearningbook.org/

Google - https://ai.google/education/

Machine Learning course from Stanford: https://www.coursera.org/learn/machine-learning

Intro to Tensorflow for Deep Learning from Google:
https://www.udacity.com/course/intro-to-tensorflow-for-deep-learning--ud187

Machine Learning course from Columbia: https://www.edx.org/course/machine-learning

Fast.ai: https://www.fast.ai/

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Reminder

Don’t forget to quit talking and ask for questions!

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TECHNICAL SYMPOSIUM

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It's time for time travel!

How about a shallow history of deep learning?

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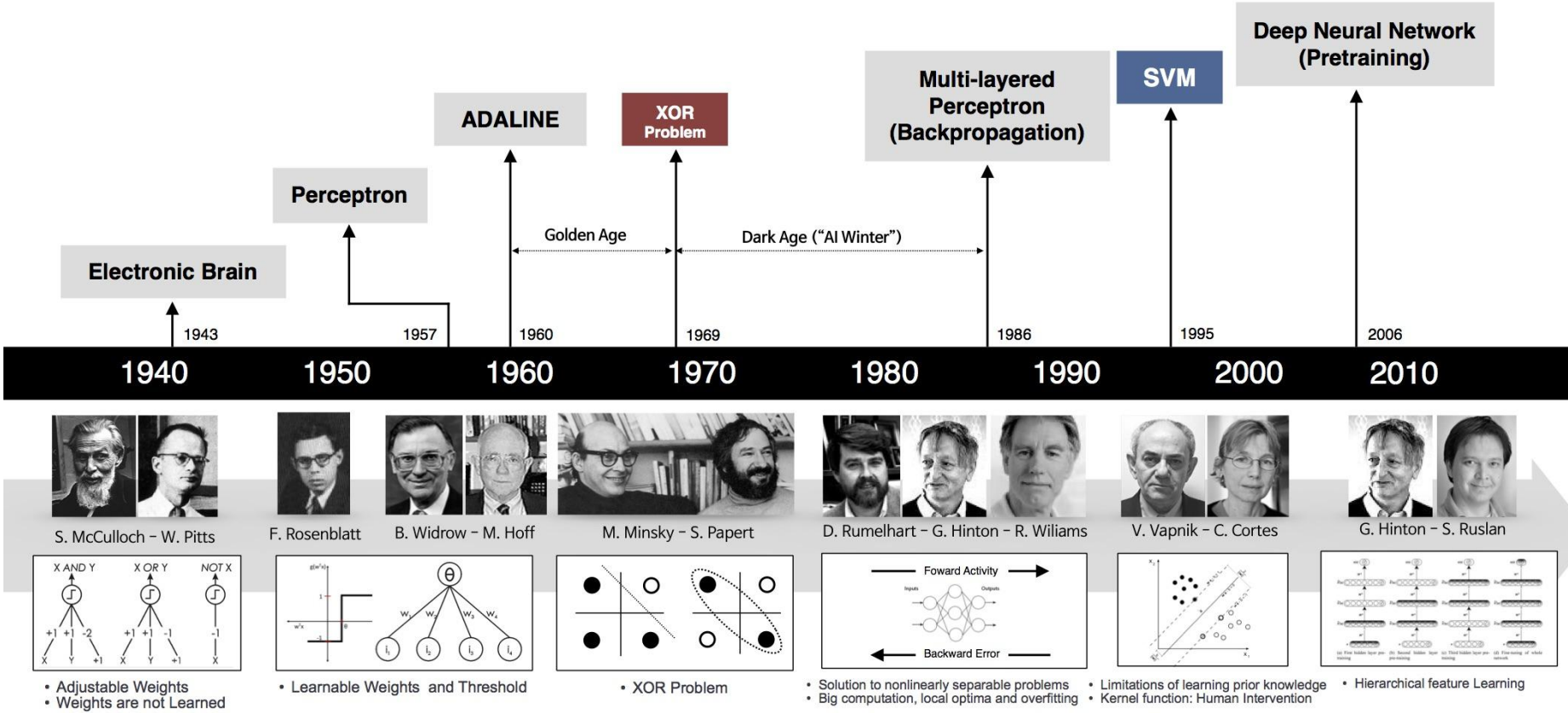
Deep Learning History



Beginnings

Alan Turing - Computing Machinery and Intelligence (1950)

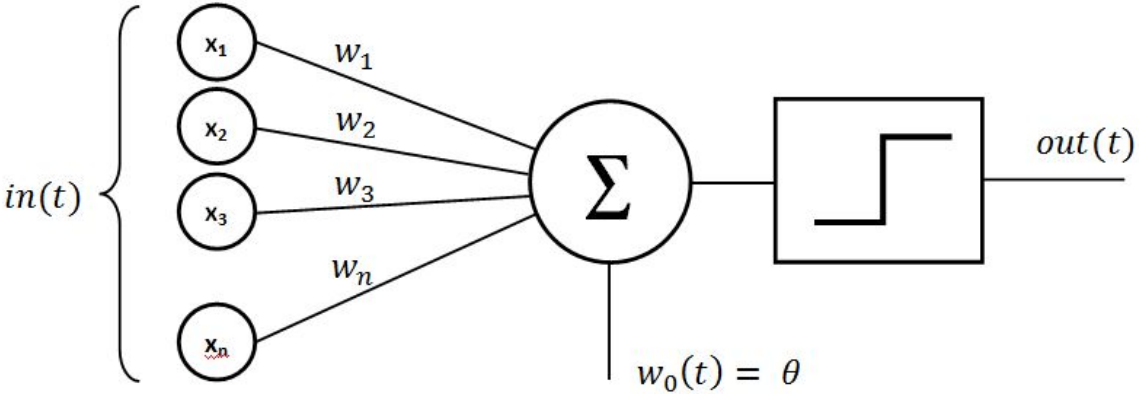
https://www.csee.umbc.edu/courses/471/papers/turing.pdf

This paper introduce the concept of what is now known as the “Turing Test”

The state of the art at the time was the Threshold Logic Unit - mostly based on current knowledge of how neurons were thought to work.

Perceptron

The perceptron algorithm was invented in 1957 at the Cornell Aeronautical Laboratory by Frank Rosenblatt,funded by the United States Office of Naval Research The perceptron was intended to be a machine, rather than a program, and while its first implementation was in software for the IBM 704, it was subsequently implemented in custom-built hardware as the "Mark 1 perceptron". This machine was designed for image recognition: it had an array of 400 photocells, randomly connected to the "neurons". Weights were encoded in potentiometers, and weight updates during learning were performed by electric motors



Perceptron

Frank Rosenblatt and the Perceptron

AI Winter (1969)

Cause of AI Winter

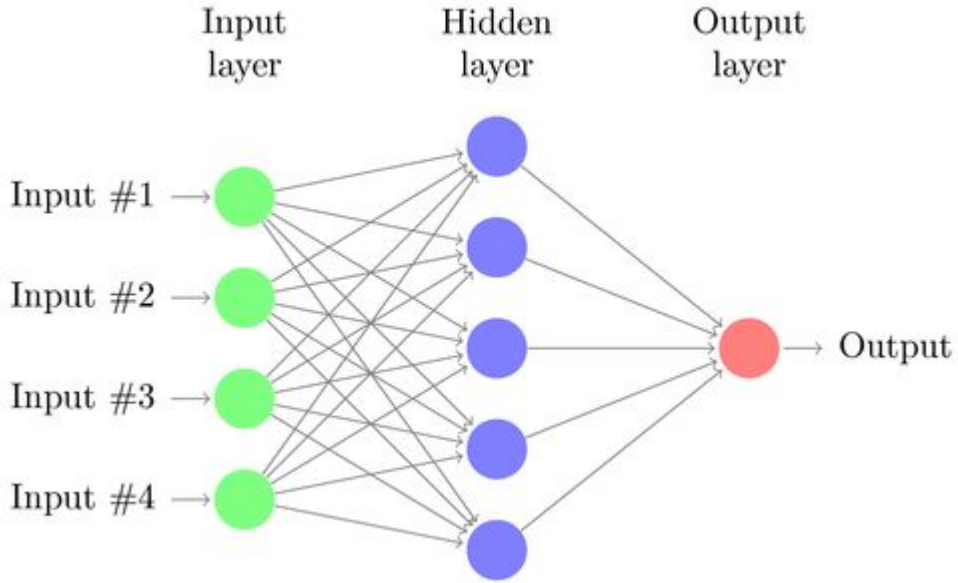
Perceptrons: an introduction to computational geometry is a book written by Marvin Minsky and Seymour Papert and published in 1969.

It offered a mathematical proof that the perceptron could not approximate an XOR function given an infinite training set.

I never liked XOR anyway.

Multilayer Perceptrons

By stacking several layers of perceptrons, researchers were able to overcome the XOR problem.



Backpropagation (1986)

Geoff Hinton, along with David Rumelhart and Ronald Williams, published a paper entitled “Learning representations by back-propagating errors”

https://www.iro.umontreal.ca/~vincentp/ift3395/lectures/backprop_old.pdf

This provided a mechanism for training multilayer perceptron networks.

Also about this time, the **universal approximation theorem** states that a feed-forward network with a single hidden layer containing a finite number of neurons (i.e., a multilayer perceptron), can approximate continuous functions on compact subsets of $\mathbf{R}^n$, under mild assumptions on the activation function.

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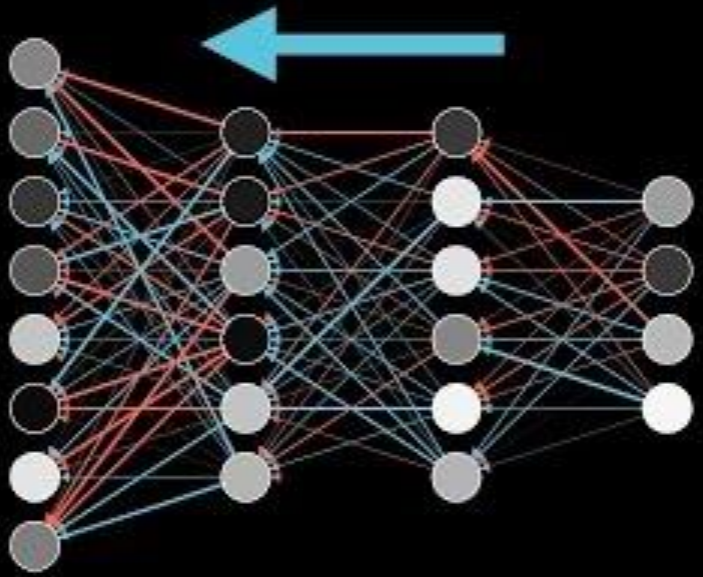
Backpropagation



Learning before "Deep"

Gradient based learning (1998) - Yann Lecun - http://yann.lecun.com/exdb/publis/pdf/lecun-01a.pdf

CNN from Yann Lecun (AT&T Bell Labs) could recognize handwritten digits.

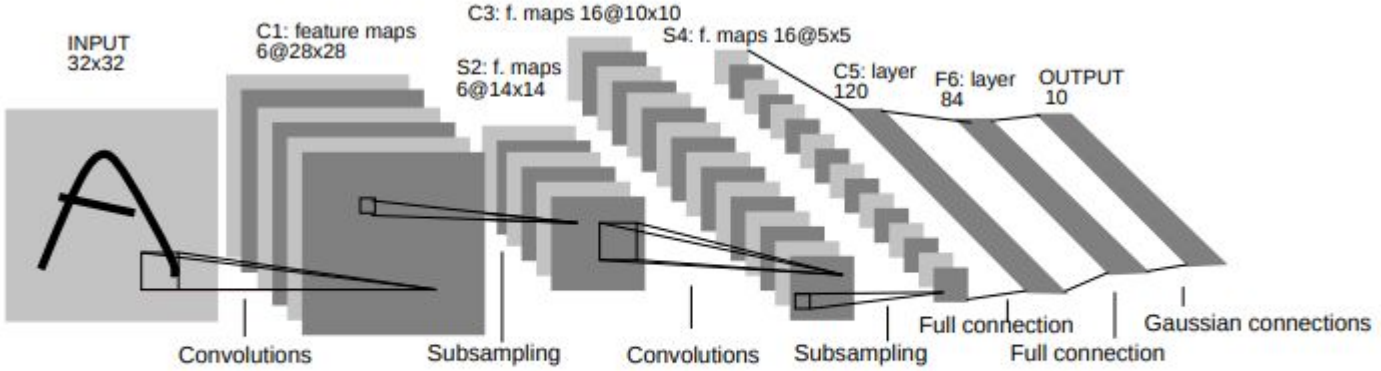


Fig. 2. Architecture of LeNet-5, a Convolutional Neural Network, here for digits recognition. Each plane is a feature map, i.e. a set of units whose weights are constrained to be identical.

Rolling in the Deep

Deep Learning (2006) - Again with Geoff HInton. The idea was to train a simple 2-layer unsupervised model like a restricted boltzman machine, freeze all the parameters, stick on a new layer on top and train just the parameters for the new layer.

Using this strategy, people were able to train networks that were deeper than previous attempts, prompting a rebranding of ‘neural networks’ to ‘deep learning’.

Filling the void with Hardware and Data

Imagenet (2009) - millions of labeled images created and published by

Fei-Fei Li at Stanford

MNIST - Handwritten digits

Google House Numbers from street view

Flickr 30k Image dataset

GPU - used for multi-core floating point calculation

Custom chipsets from Intel (Nervana) https://ai.intel.com/ and NVIDIA

Exponential Improvements

Alexnet (2012) - Won the Large Scale Visual Recognition Challenge(LSVRC) with an error rate 10% lower than the previous year. Used dropout to reduce overfitting and a rectified linear activation unit (ReLU)

Generative Adversarial Networks (2014) - Ian Goodfellow

Gated Recurrent Unit (2014) - Kyunghyun Cho et al

Speech recognition:

https://venturebeat.com/2017/05/17/googles-speech-recognition-technology-now-has-a-4-9-word-error-rate/

https://techcrunch.com/2017/08/20/microsofts-speech-recognition-system-hits-a-new-accuracy-milestone/

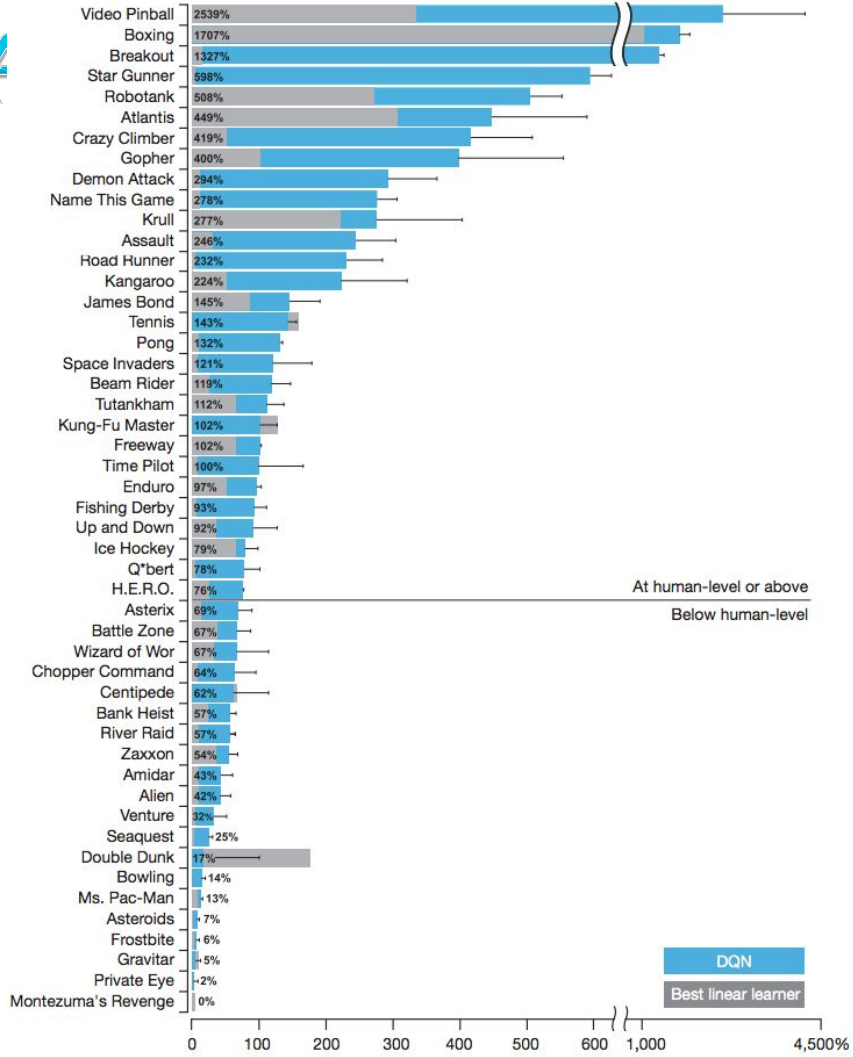
https://hacks.mozilla.org/2017/11/a-journey-to-10-word-error-rate/

Future History

Open source libraries are allowing new products to be developed very quickly.

For instance:
https://towardsdatascience.com/hey-google-where-is-my-pet-tensorflow-object-detection-contribution-9c1d1fdd0443

Google's TensorFlow
Microsoft's CNTK
Amazon's DSSTNE
Theano
Torch
Caffe
Deeplearning4J


Video Pinball 2539%
Boxing 1707%
Breakout 1327%
Star Gunner 598%
Robotank 508%
Atlantis 449%
Crazy Climber 419%
Gopher 400%
Demon Attack 294%
Name This Game 278%
Krull 277%
Assault 246%
Road Runner 232%
Kangaroo 224%
James Bond 145%
Tennis 143%
Pong 132%
Space Invaders 121%
Beam Rider 119%
Tutankham 112%
Kung-Fu Master 102%
Freeway 102%
Time Pilot 100%
Enduro 97%
Fishing Derby 93%
Up and Down 92%
Ice Hockey 79%
Q*bert 78%
H.E.R.O. 76%
Asterix 69%
Battle Zone 67%
Wizard of Wor 67%
Chopper Command 64%
Centipede 62%
Bank Heist 57%
River Raid 57%
Zaxxon 54%
Amidar 43%
Alien 42%
Venture 32%
Seaquest 25%
Double Dunk 17%
Bowling 14%
Ms. Pac-Man 13%
Asteroids 7%
Frostbite 6%
Gravitar 5%
Private Eye 2%
Montezuma's Revenge 0%
At human-level or above
Below human-level
DQN
Best linear learner
0
100
200
300
400
500
600
1,000
4,500%

Other Cool Stuff!

Check out page 60 of the 2018 AI Index Report for more.
http://cdn.aiindex.org/2018/AI%20Index%202018%20Annual%20Report.pdf

Robot learning to run:
https://twitter.com/eron_gj/status/967672260147470336

Other Cool Stuff!