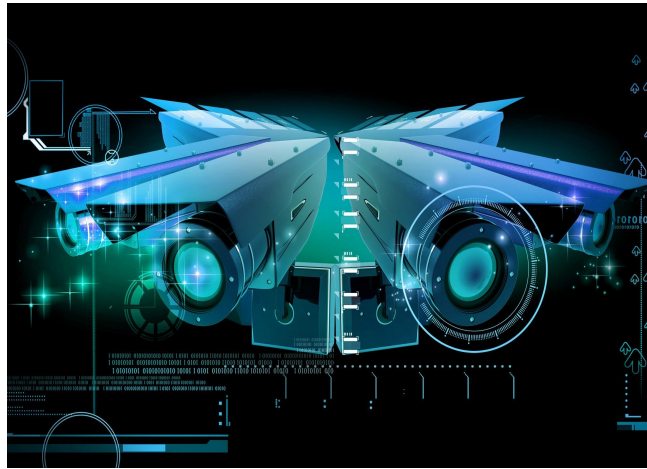
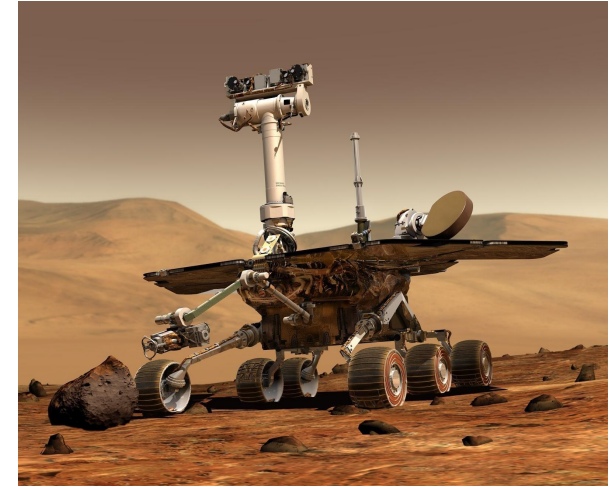
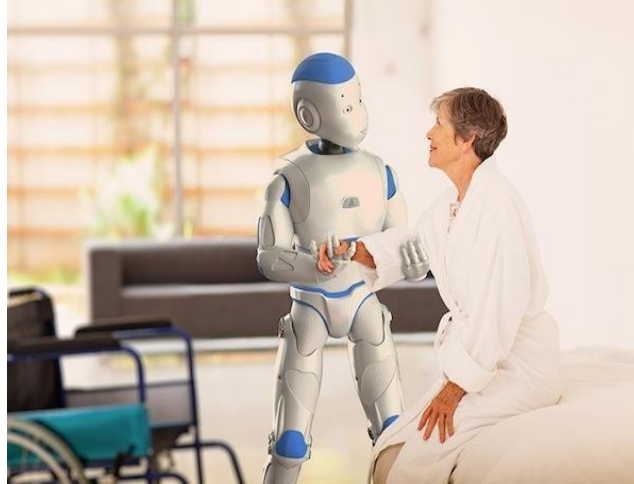


Automation is future



Outsider's point of view

Stephen Hawking: “AI will be 'either best or worst thing' for humanity.”

Bill gates: “I am in the camp that is concerned about super intelligence. First the machines will do a lot of jobs for us and not be super intelligent. That should be positive if we manage it well. A few decades after that though the intelligence is strong enough to be a concern.”



Elon Musk: “I’m increasingly inclined to think that there should be some regulatory oversight, maybe at the national and international level, just to make sure that we don’t do something very foolish.”

What researchers think?

Yann LeCun: “Some people have asked what would prevent a hypothetical super-intelligent autonomous benevolent A.I. to “reprogram” itself and remove its built-in safeguards against getting rid of humans. Most of these people are not themselves A.I. researchers, or even computer scientists.”



Director - Facebook AI Research

Yoshua Bengio: “There is no truth to that perspective if we consider the current A.I. research. Most people do not realize how primitive the systems we build are, and unfortunately, many journalists (and some scientists) propagate a fear of A.I. which is completely out of proportion with reality. We would be baffled if we could build machines that would have the intelligence of a mouse in the near future, but we are far even from that.”



Head - Montreal Institute for Learning Algorithms ([MILA](https://mila.queensu.ca/))

What I think is that they both are right :)

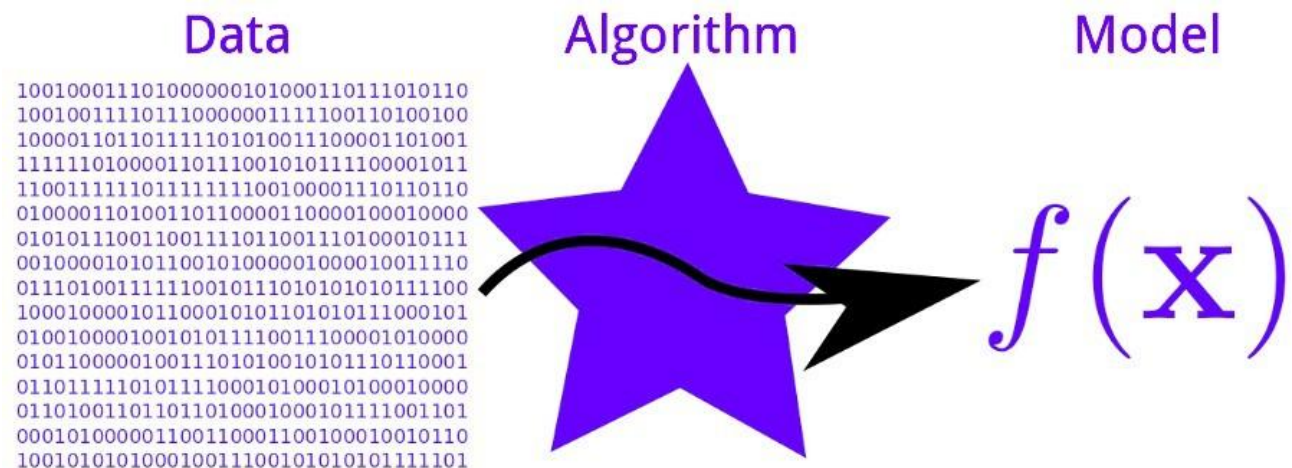
What is learning?

Learning is the act of acquiring new or modifying and reinforcing existing knowledge, behaviors, skills, values, or preferences which may lead to a potential change in synthesizing information, depth of the knowledge, attitude or behavior relative to the type and range of experience

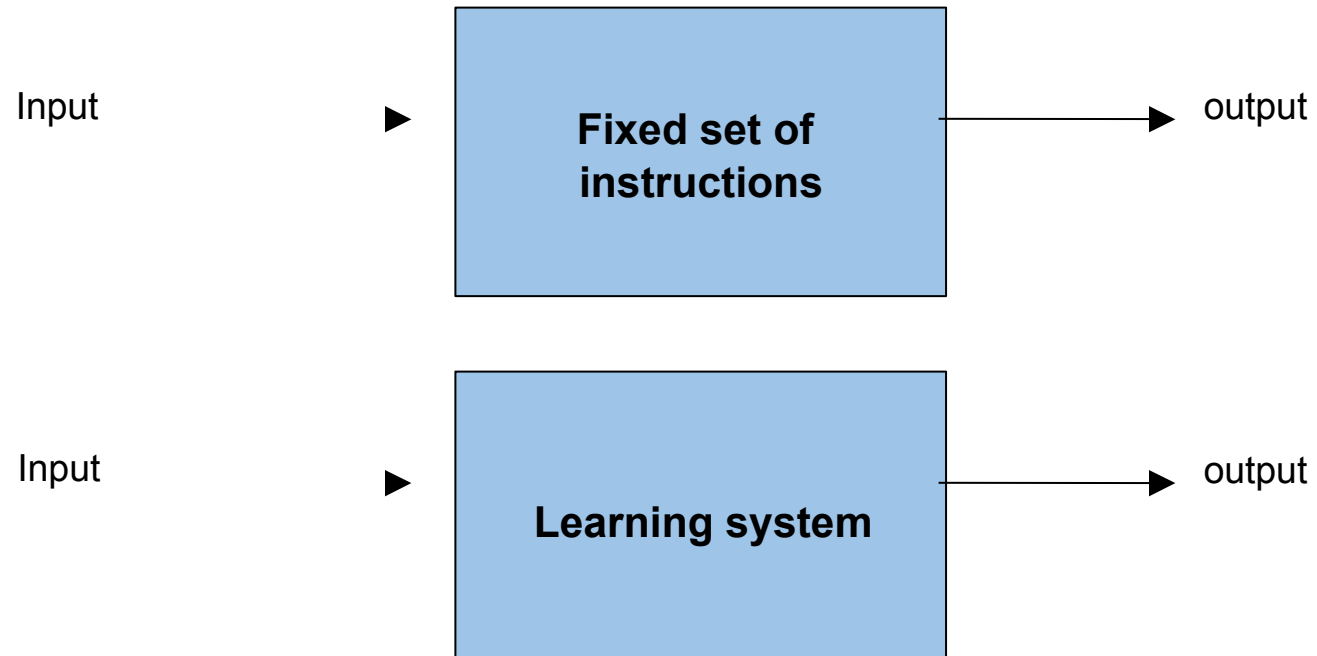
-- Wikipedia.org

Machine Learning

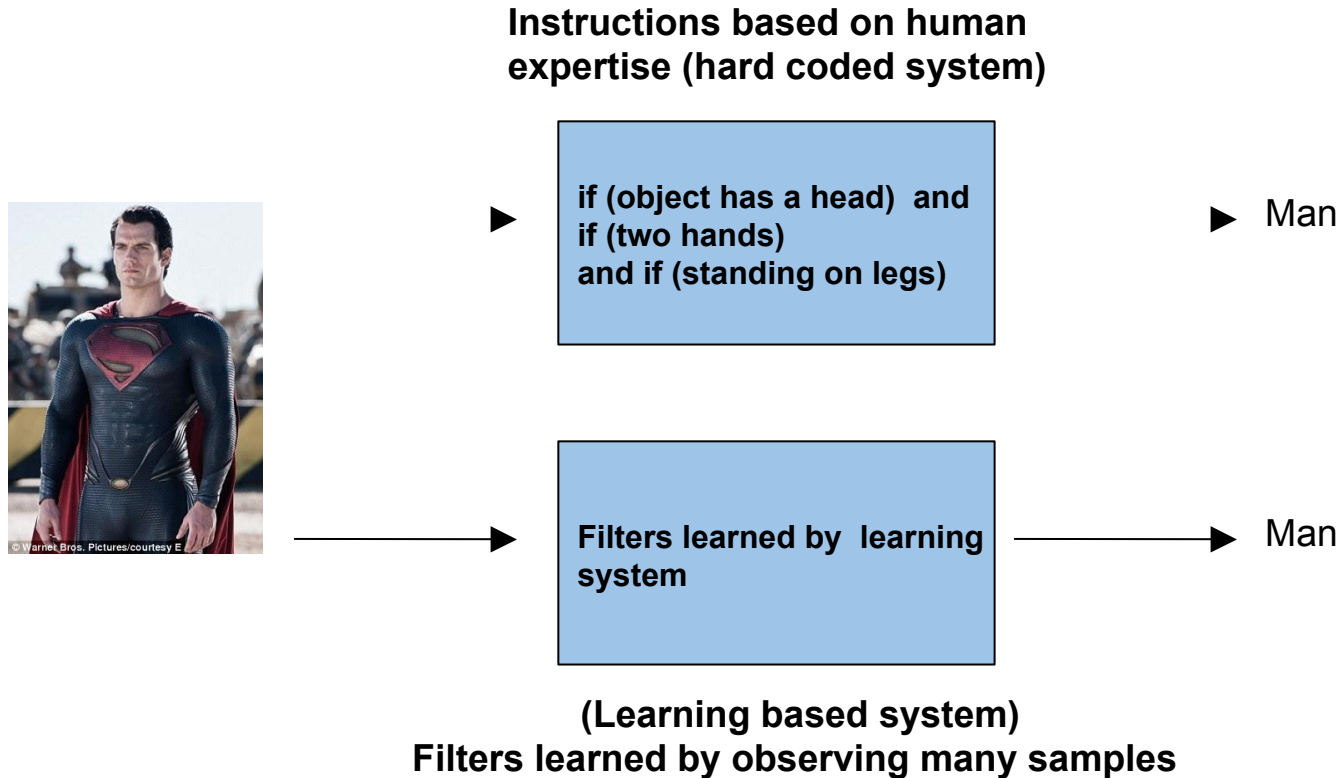
How can we build computer programs that automatically improve their performance through experience?



Two primary ways of doing a task?



Two primary ways of doing a task?



Machine Learning

Approaches:

- Artificial neural networks
- Bayesian networks
- Clustering
- Representation learning
- Reinforcement learning
- Support Vector Machines
- Logistic and Linear regression
- ...



Applications:

- Structured data problems
- Computer vision
- Natural language processing
- information retrieval
- Robotics
- ...

In Machine Learning, what did you learn so far?

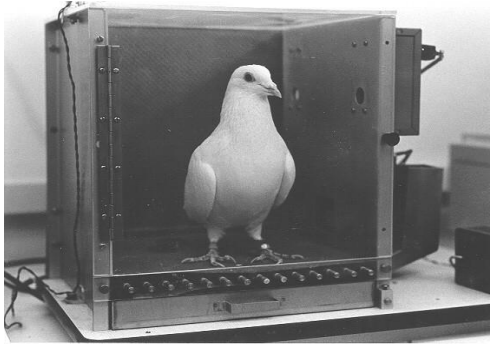
Best learning system known to us?

Best learning system known to us?



Biological neural system

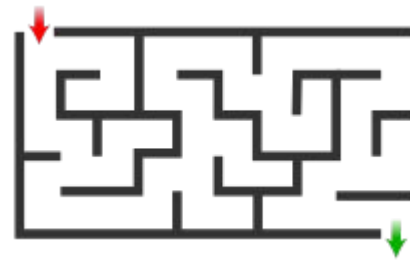
Thinking is possible even with a “small” brain



Pigeons as art experts – 85% (Watanabe *et al.* 1995)

Source: https://en.wikipedia.org/wiki/Marc_Chagall

https://en.wikipedia.org/wiki/Vincent_van_Gogh

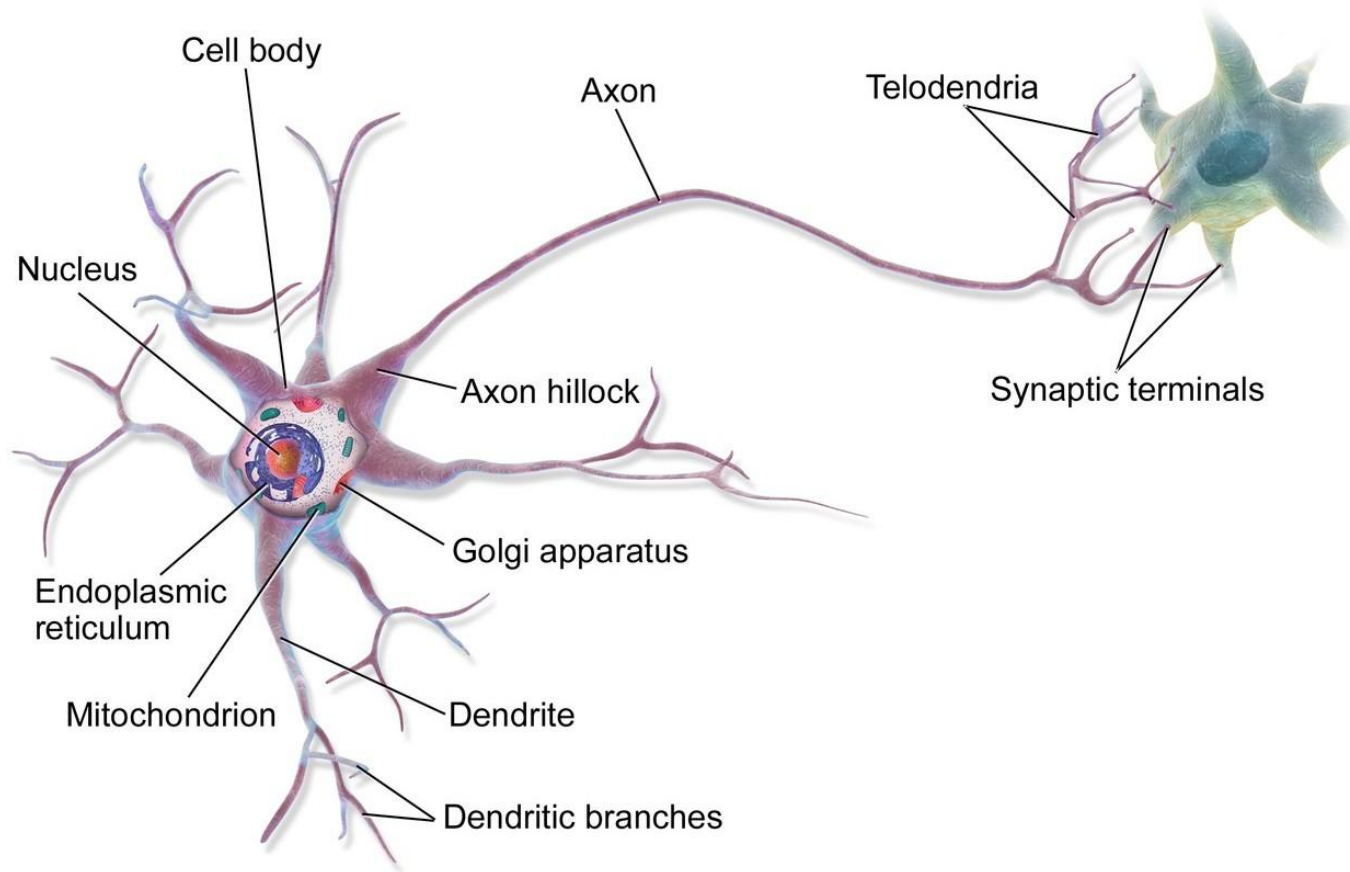


Mice trained to run mazes[1], detect drugs[1][2]

The results

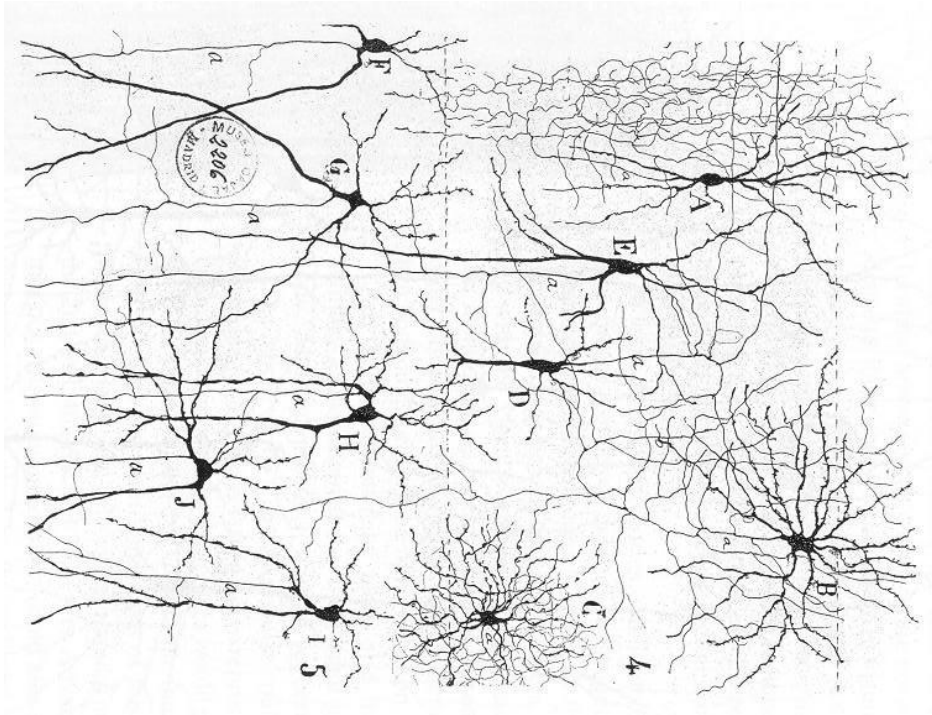
- Pigeons were able to discriminate between Van Gogh and Chagall with 95% accuracy (when presented with pictures they had been trained on)
- Discrimination still 85% successful for previously unseen paintings of the artists
- Mice can memorize mazes, odors of contraband (drugs / chemicals / explosives)

So, how does the brain work?



Direction of signal is along the Axon from Nucleus to synapse

Biological neural networks



- ☐ Fundamental units are termed neurons.
- ☐ Connections between neurons are synapses. 10000 trillion neurons
- ☐ Equivalent to computer with one trillion bit per second processor.

Biological Neural Networks

Neurons Example species

302	Nematode worm
10^3	Snail
10^4	Ant
10^5	Fly (Compound eyes, nerves in the legs, vibrissae)
$0.8 * 10^6$ to 10^6	Honeybee
$4 * 10^6$	Mouse
$1.5 * 10^7$	Frog (Continuous targeting, catching while in 3D motion)
$5 * 10^7$	Bat
$1.6 * 10^8$	Dog Cat Chimp Human
$3 * 10^8$	Whales, Elephants, Dolphins
$6 * 10^9$	
10^{11}	
$>10^{11}$	

Simulating worm brain in software:

<http://tinyurl.com/mx7bdd4>

Artificial Neural Networks



L'Avion III de Clément Ader, 1897 (Musée du CNAM, Paris)

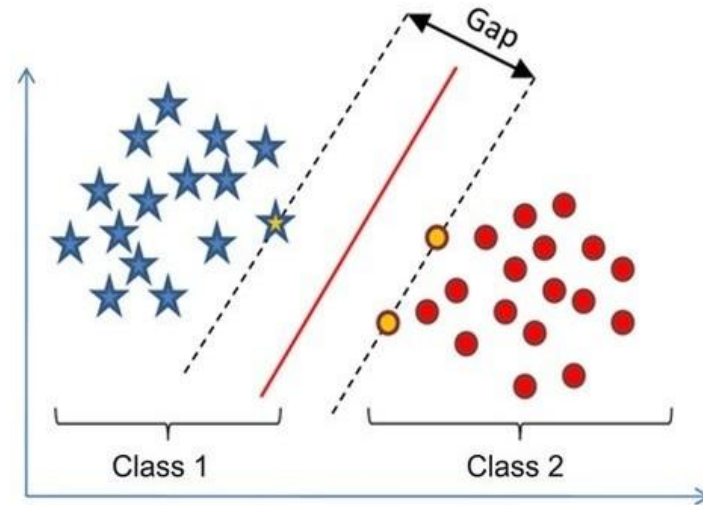
Let us draw some inspiration from the best learning system

Warning! Do not copy it exactly!

One needs to understand what needs to be borrowed.

Artificial Neural Networks

**Simple regression
/classification tasks on both
structured and unstructured
data**



Advanced AI applications:

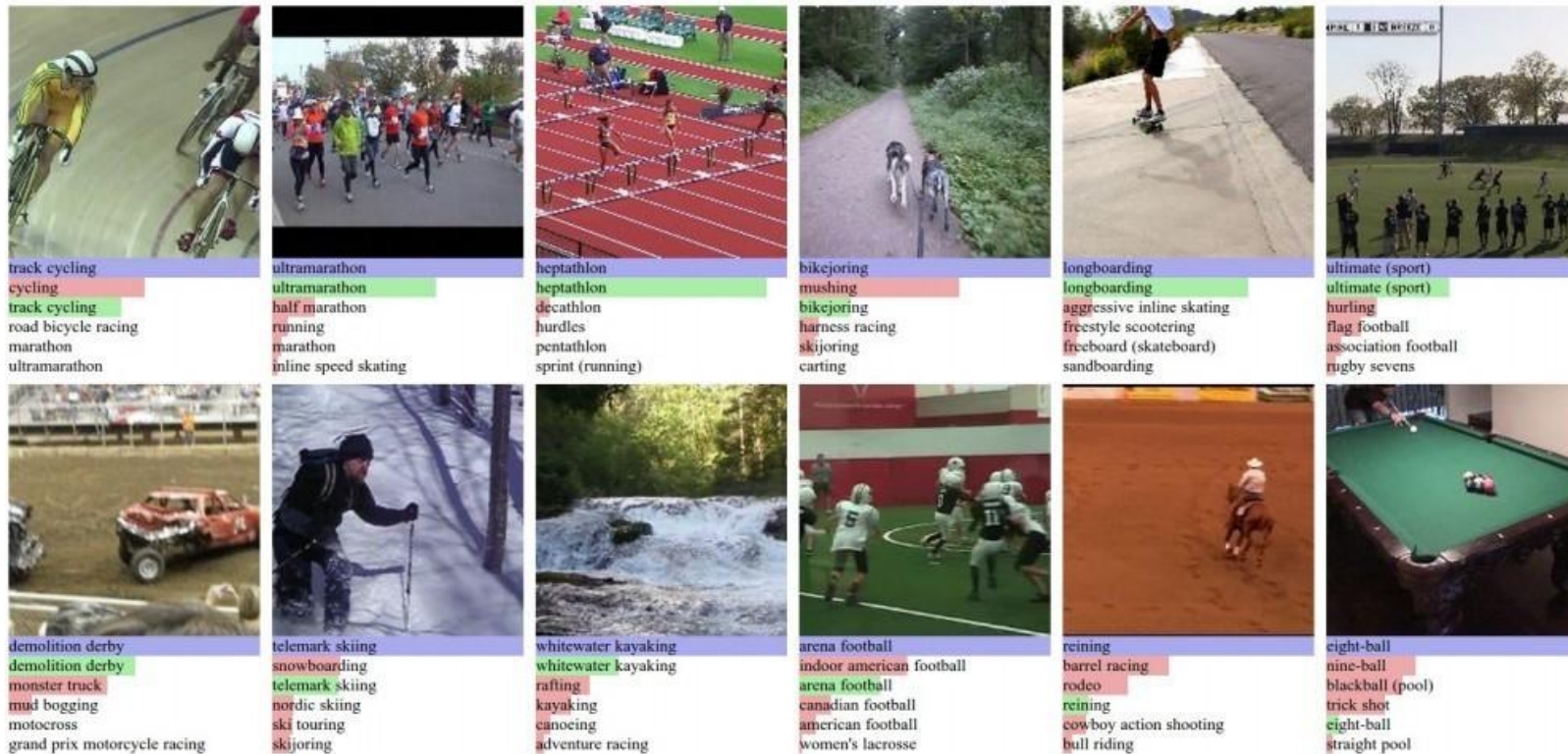
- Autonomous driving
- Translation engines
- Speech recognition

...

Lets play with some toy datasets to test the limitations of perceptron and how to overcome them with MLP.

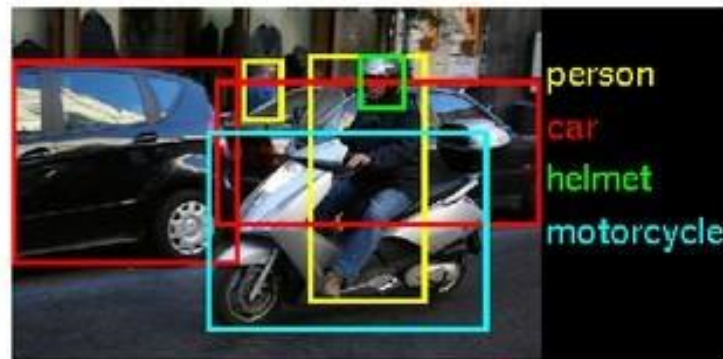
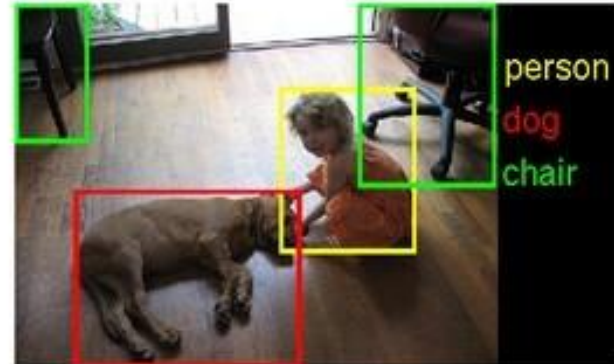
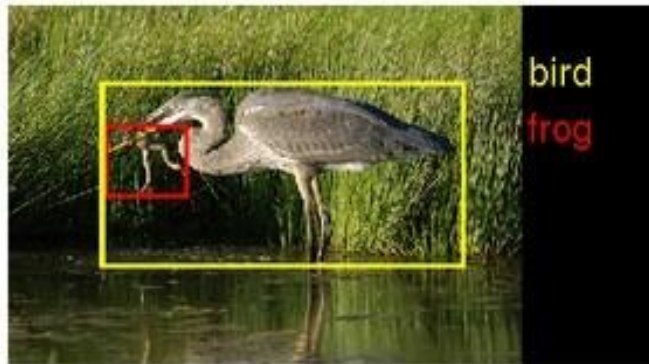
<http://playground.tensorflow.org>

Applications of Artificial Neural Nets: Visual image recognition



ImageNet challenge: 1000 classes, 1 million training images.
[Krizhevsky.2012]

Applications of Artificial Neural Nets: Image Segmentation



Applications of Artificial Neural Nets: Video classification



*Large-scale Video Classification
with Convolutional Neural
Networks,*
--Andrej Karpathy
(Google/Stanford)

Applications of Artificial Neural Nets: Natural language processing (NLP)



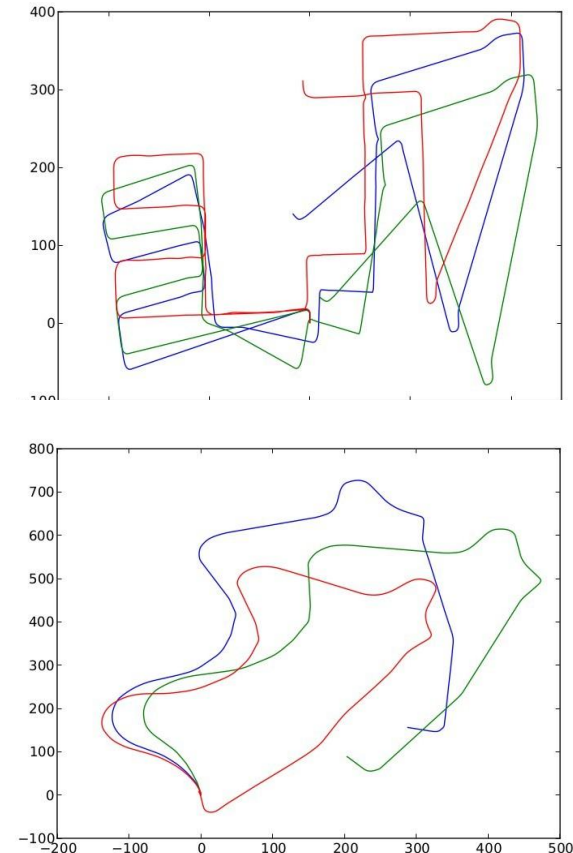
- semantic parsing
- search query retrieval
- sentence modeling
- classification
- prediction

Applications of Artificial Neural Nets: Art



A Neural Algorithm of Artistic Style, Leon A. Gatys

Applications of Artificial Neural Nets: Visual odometry



Konda, Kishore, and Roland Memisevic. "*Learning visual odometry with a convolutional network*"

Applications of Artificial Neural Nets: Atari games



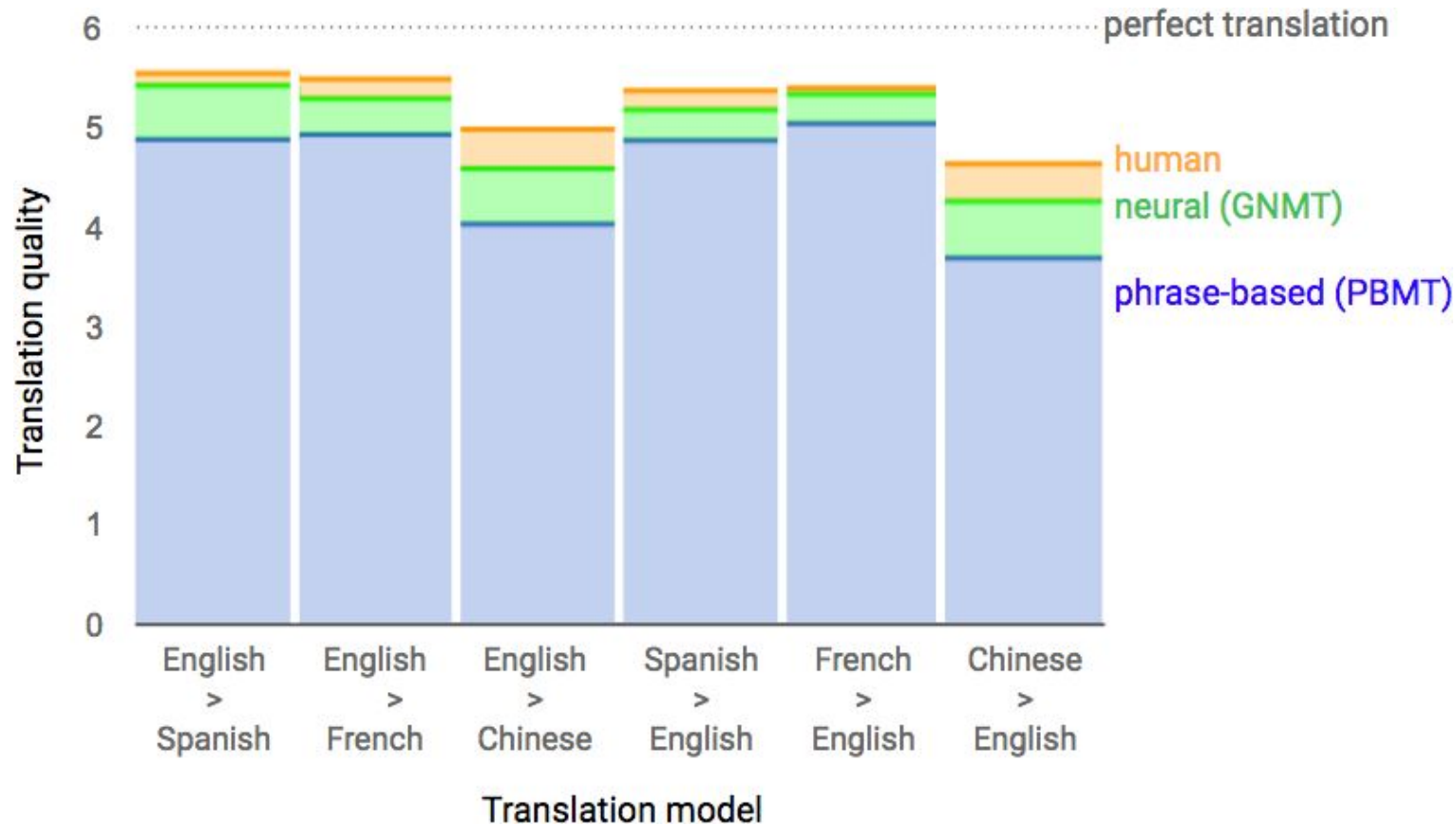
Human-level control through deep reinforcement learning, Google DeepMind

Applications of Artificial Neural Nets: “Go” game



The first computer program to ever beat a professional player at the game of “Go” and now a world champion

Applications of Artificial Neural Nets: Google Translate Neural Machine Translation (NMT)



Applications of Artificial Neural Nets: Autonomous driving

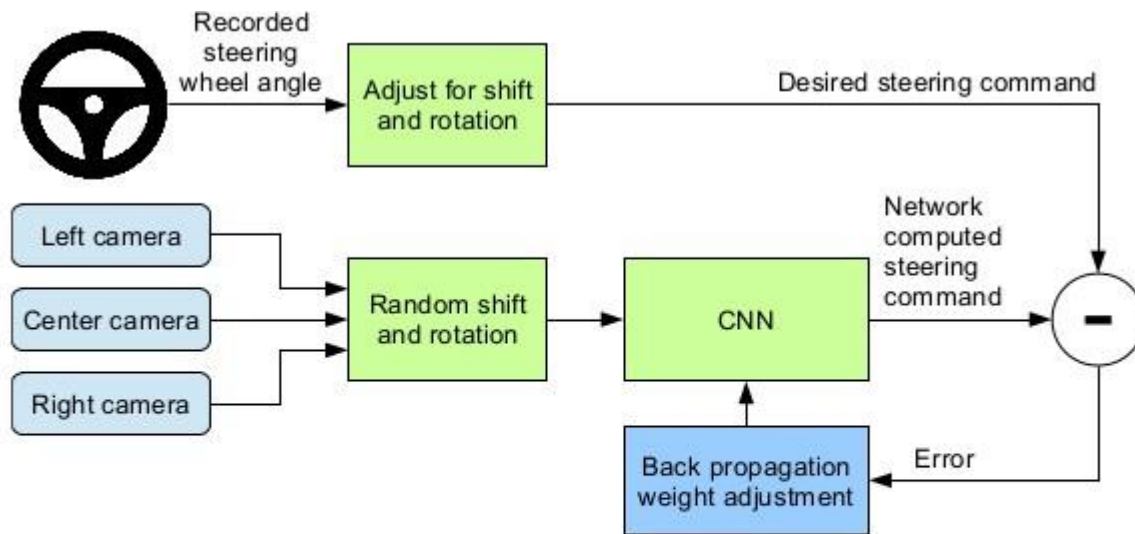


Figure 2: Training the neural network.

Once trained, the network can generate steering from the video images of a single center camera. This configuration is shown in Figure 3.

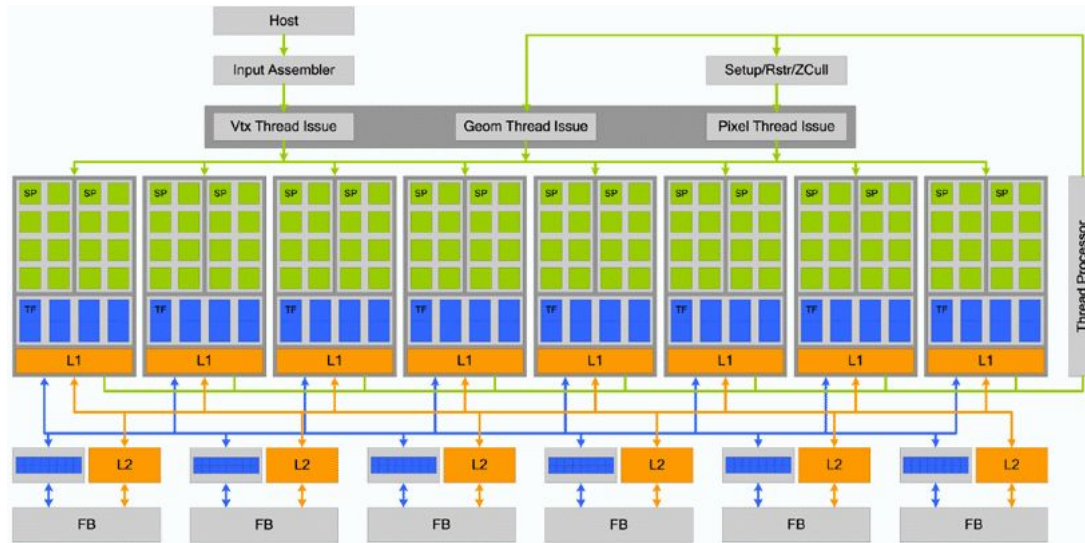


[NVIDIA Corporation]

History of Artificial Neural Networks

- ☐ A computational model for biological neural networks was created in 1943 by Warren McCulloch and Walter Pitts.
 - ☐ One of the key breakthroughs was the backpropagation algorithm by Werbos in 1975.
 - ☐ Parallel distributed computing, introduced by David E. Rumelhart and James McClelland.
 - ☐ The neocognitron is a hierarchical, multilayered artificial neural network proposed by Kunihiro Fukushima in the 1980. (Basis of CNNs)
 - ☐ Neural networks were overshadowed by the popularity of other ML methods in the 1990s.
 - ☐ Some people like Yann LeCun, Geoffrey Hinton, Yoshua Bengio and others continued believing in artificial neural networks.
-

Hardware: Modern GPUs

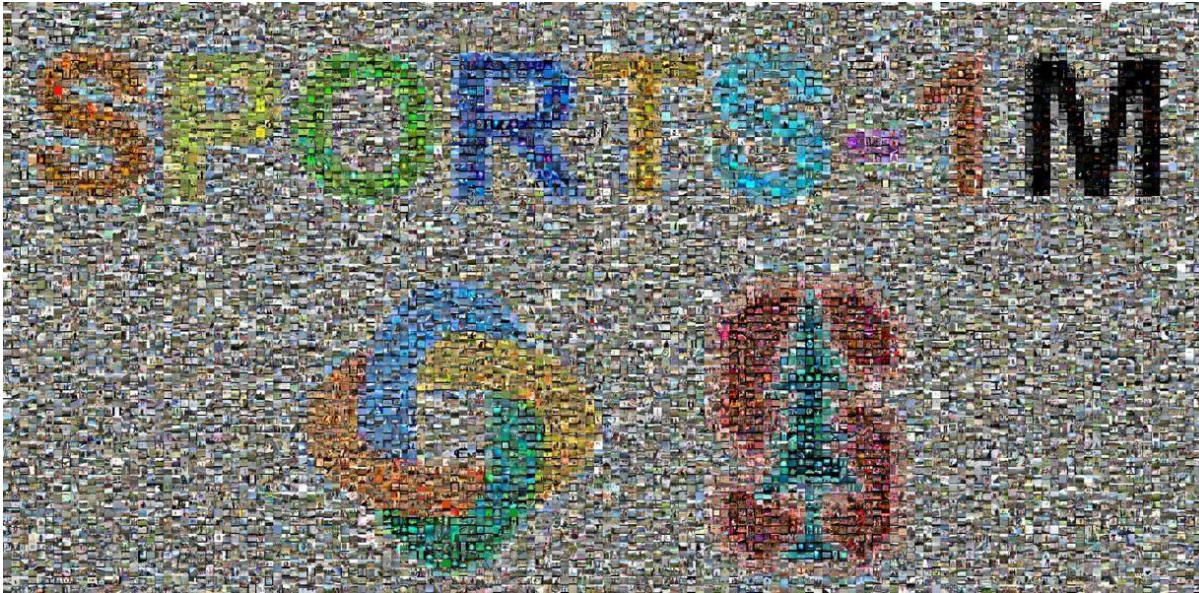


GPU computing is very efficient for matrix algebra:
Most mathematical computations in Artificial Neural Networks are matrix algebra.

Big data and internet



1 million labeled images



The Sports-1M dataset

Machine Intelligence LANDSCAPE

CORE TECHNOLOGIES

ARTIFICIAL INTELLIGENCE	DEEP LEARNING	MACHINE LEARNING	NLP PLATFORMS	PREDICTIVE APIS	IMAGE RECOGNITION	SPEECH RECOGNITION
IBM WATSON MetaMind Numenta ai-one Cycorp Research Reactor SCALED INTELLIGENCE	vicarious facebook Google SKYMINI Baidu IDL ersatz SignalSense	rapidminer context Oxdata H2O DATA RPM LiftNite Azure ML Yhat Wise Sense CrashLab Alpine	cortical.io idibon LUMINOSO wit.ai Maluba	AlchemyAPI MINDOPS Google bigm indico ALGORITHMIA PredictionIO Expect Labs	clarifai MADBITS DNNresearch DEXTRO VISENZE lookflow	GRIDSPACE popUP archive NUANCE

RETHINKING ENTERPRISE

SALES	SECURITY / AUTHENTICATION	FRAUD DETECTION	HR / RECRUITING	MARKETING	PERSONAL ASSISTANT	INTELLIGENCE TOOLS
Preact RelateIQ CLARABRIDGE infer AVISO NGDATA FRAMED ATTENTIVITY causata	CROSSMATCH EYEVERIFY CYLANCE conjur BITSIGHT biorym	sift science ThreatMetrix Brighterion SOCURE feedzai Verapin	TalentBin entelo predikt Connectifier gild hiQ	brightfunnel CommandIQ RADIUS Telkpart bloomreach AIRPR people pattern Freemium	Siri Cortana tempo KASISTO VIV Google now cleversense Rebinlabs fuse machines CLARA LABS	ADATAD Palantir Quid Digital Reasoning FirstRain

RETHINKING INDUSTRIES

ADTECH	AGRICULTURE	EDUCATION	FINANCE	LEGAL	MANUFACTURING	MEDICAL
METAMARKETS dstillery rocketfuel YieldMo ADBRAIN	BLUE RIVER TerraVision cerosmaging THE CLIMATE CORPORATION tule	Declara Coursera KNEWTON kidaptive	Bloomberg alphasense Dataminr FinGenius KENSHC minnetabrook BINATIX	Lex Machina brightleaf COUNSELYTICS JUDICATA Diligence Engine RAVEL Brevia	SIGHT MACHINE MICROSCAN IVISYS BOULDER TRACKING	Parzival Genoscient grand round table transcriptic ZEPHYR REALITY bina TUTE ECONOMICS
OIL AND GAS	MEDIA / CONTENT	CONSUMER FINANCE	PHILANTHROPIES	AUTOMOTIVE	DIAGNOSTICS	RETAIL
kaggle AYASDI TACHYUS biota Flutura	Outbrain newsle ARRIA SAILTHRU wovii NarrativeScience YSCOP Summy Prismatic	Affirm iVenture news finance BILL GUARD LendUp LendingClub Kabbage	DataKind thorn DATA GUILD	Google Continental CRUISE Mobileye	enlitic lumiat 3SCAN ENTOP	BAY SENSORS PRISM SKYLABS celect euclid

RETHINKING HUMANS / HCI

AUGMENTED REALITY	GESTURAL COMPUTING	ROBOTICS	EMOTIONAL RECOGNITION
Sungate Intelligence APX blippar META layar	THALMIC LABS omek LEAP eyeSight 3Gear GestureTek	Intel LIQUID ROBOTICS iRobot jibo anxi	affectiva BEYOND VERBAL EMOTION cogito

SUPPORTING TECHNOLOGIES

HARDWARE	DATA PREP	DATA COLLECTION
NVIDIA XILINX QUALCOMM rigit	TRIFACTA tamr Paxata Alation	diffbot kimono CrowdFlower Cnnotate WorkFusion import

How can you contribute to the society?

- ✓ Bio-informatics
- ✓ Brain- machine interfaces
- ✓ Chemo-informatics
- ✓ Classifying DNA sequences
- ✓ Detecting credit card fraud
- ✓ Medical diagnosis
- ✓ Structural health
- ✓ monitoring Security and
- ✓ surveillance Weather
- ✓ prediction Agricultural
productivity analysis



ML expert