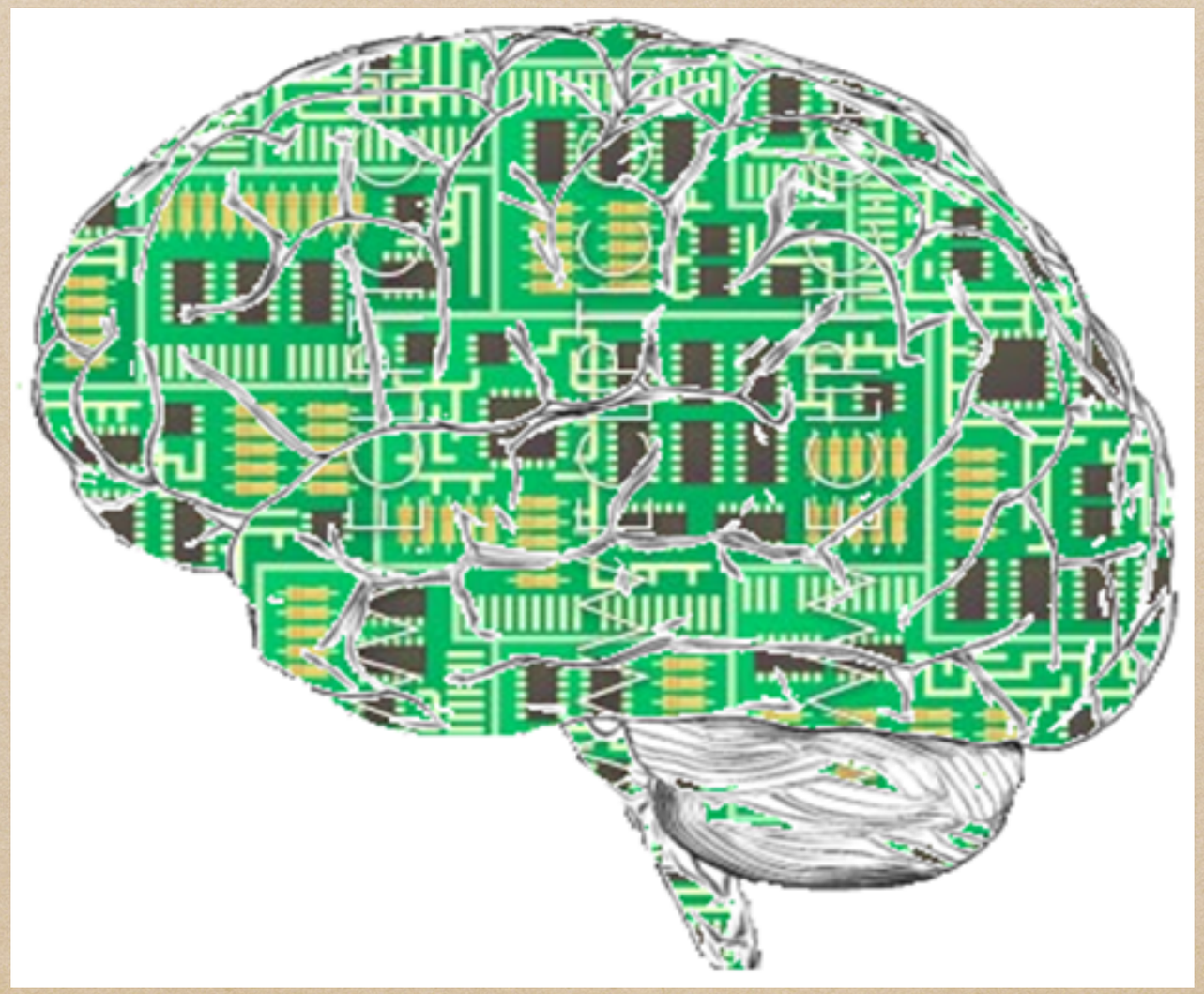
MACHINE LEARNING

and Artificial Intelligence



Big Ideas Forum - 5.30.2019

Talking points

1. What is Machine Learning?
2. What is intelligence?
3. How do we determine if a machine is intelligent?
4. How do machines learn?
5. Where is Machine Learning used now?
6. Will machines ever be like (match) the brain?
7. Machine Learning & The Future

Machine Learning?

1. What is Machine Learning?
2. What exactly is intelligence?
3. How do we determine if a machine is intelligent?
4. How does a machine learn?
5. Where is Machine Learning used now?
6. Will machines ever be like (match) the brain?
7. Machine Learning & The Future

Machine Learning

MI covers the areas of machine learning and artificial intelligence - and the ways they are applied.

Machine Intelligence (MI) refers to the ability of machines to learn without explicit programming.

First hype cycle in the 1950s, but we have now entered a transitional phase in which advanced computational power and neural networks are allowing MI to realize its potential.

Machine Learning

We have three levels of AI/MI:

1. Artificial Intelligence
2. Artificial General Intelligence
3. Artificial Super Intelligence

Machine Learning

1. What is Machine Learning?
2. What exactly is intelligence?
3. How do we determine if a machine is intelligent?
4. How do machines learn?
5. Where is Machine Learning used now?
6. Will machines ever be like (match) the brain?
7. Machine Learning & The Future

What is Intelligence?

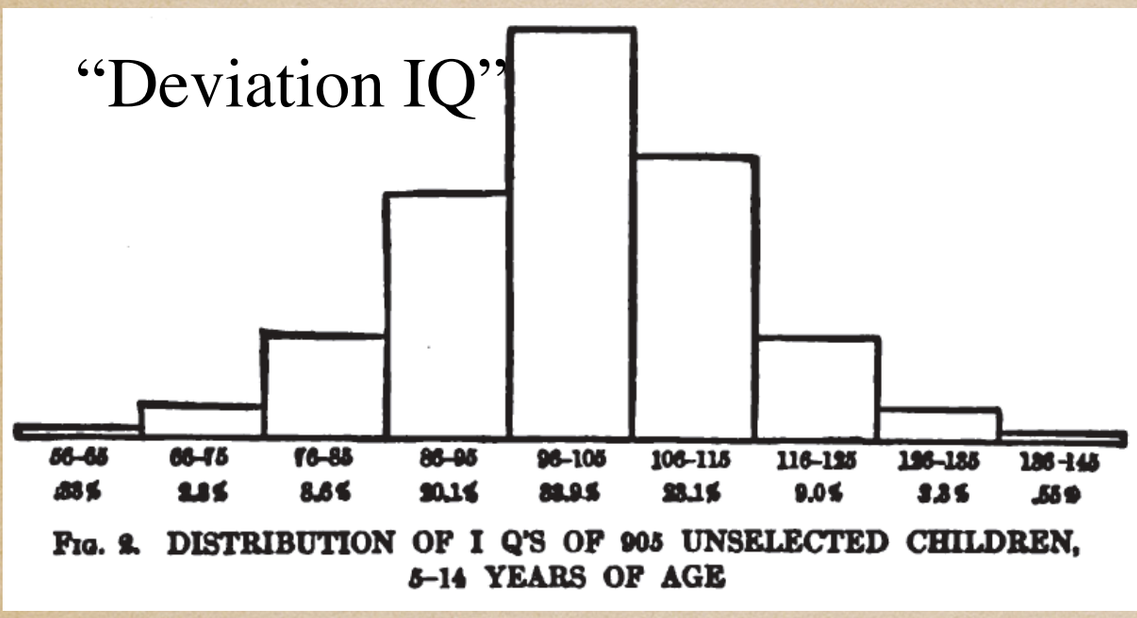


FIG. 2. DISTRIBUTION OF I Q'S OF 905 UNSELECTED CHILDREN, 5–14 YEARS OF AGE

Wechsler Intelligence Scale for Children–Fifth Edition (WISC-V) IQ classification

IQ Range ("deviation IQ")	IQ Classification[34]
130 and above	Extremely High
120–129	Very High
110–119	High Average
90–109	Average
80–89	Low Average
70–79	Very Low
69 and below	Extremely Low

The current scoring method for all IQ tests is the "deviation IQ". In this method, an IQ score of 100 means that the test-taker's performance on the test is at the median level of performance in the sample of test-takers of about the same age used to norm the test.

IQ of 115 is one standard deviation *above* the median performance; likewise, 85 is one standard deviation below the median.

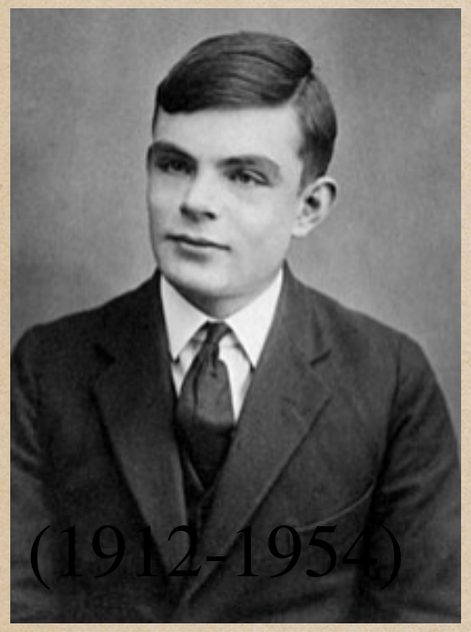
85-115 accounts for 2/3 of all individuals

https://listovative.com/top-12-people-highest-iq-world/

Machine Learning

1. What is Machine Learning?
2. What is intelligence?
3. How do we determine if a machine is intelligent?
4. How do machines learn?
5. Where is Machine Learning used now?
6. Will machines ever be like (match) the brain?
7. Machine Learning & The Future

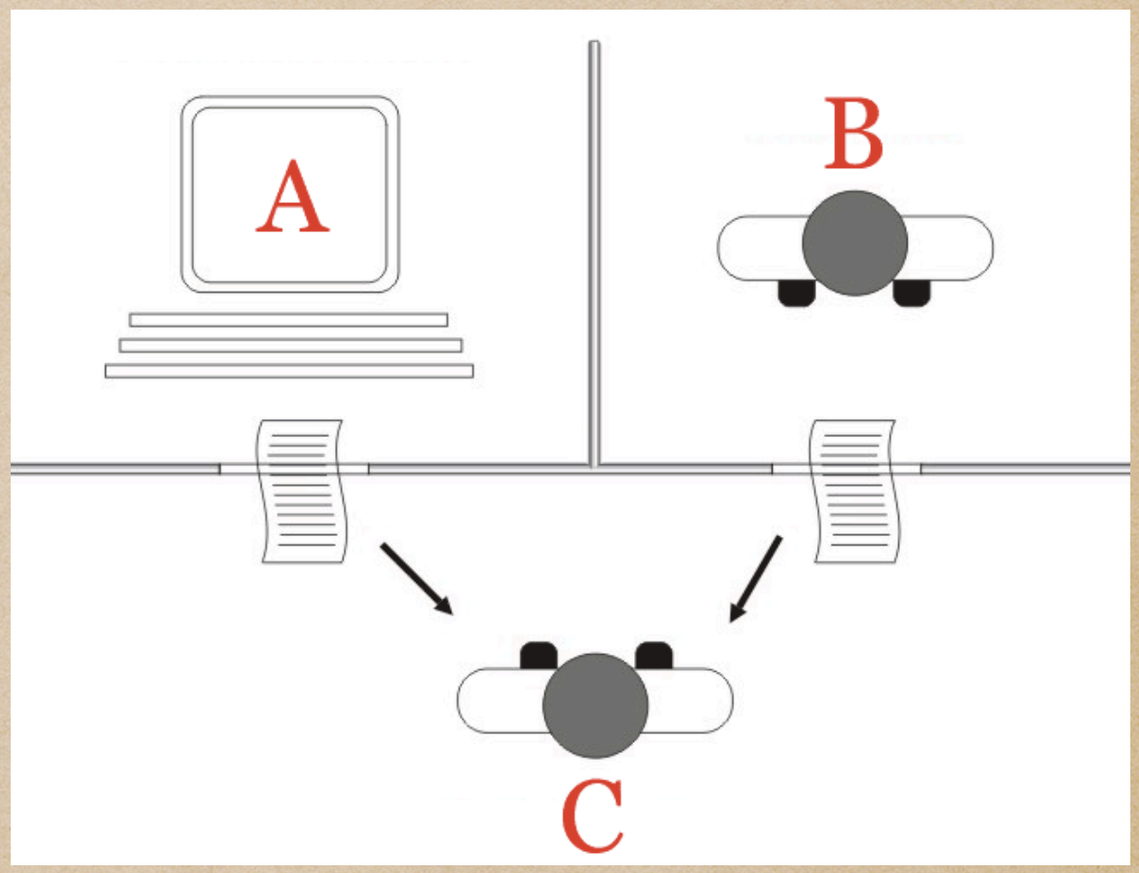
3. How do we determine if a machine is intelligent?



Alan Turing
1912-1954
(1912-1954)

Turing Test:

"A computer would deserve to be called intelligent if it could decide a human into believing it was a human."



Movie: Ex Machina

Machine Learning

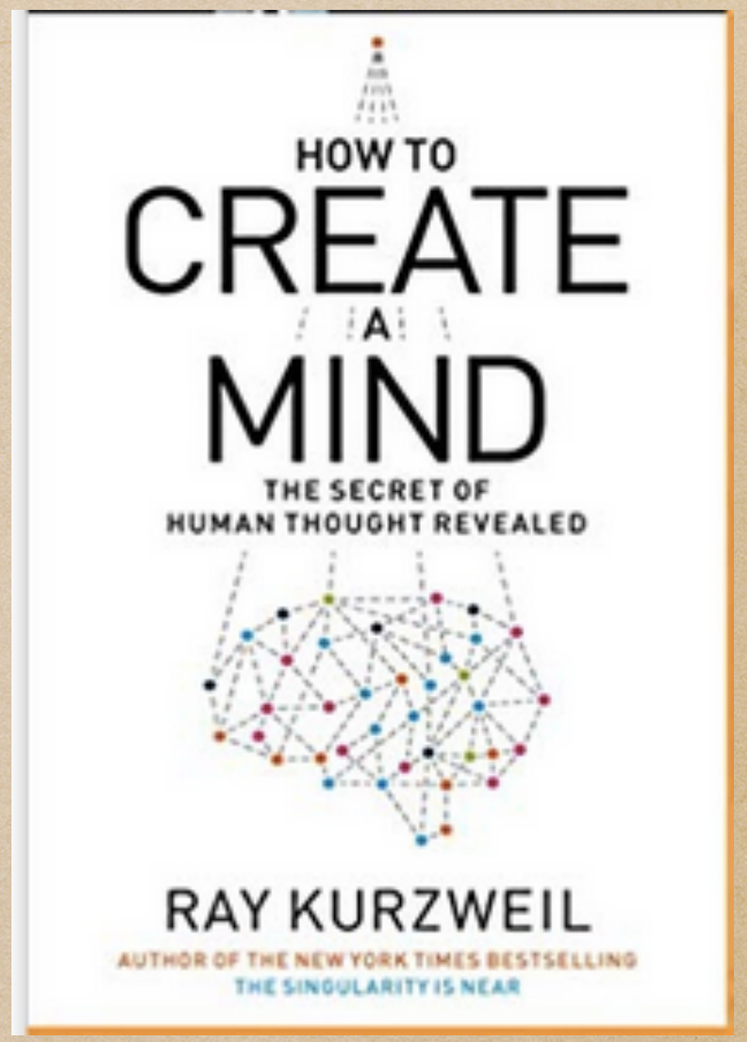
1. What is Machine Learning?
2. What exactly is intelligence?
3. How do we determine if a machine is intelligent?
4. How do machines learn?
5. Where is Machine Learning used now?
6. Will machines ever be like (match) the brain?
7. Machine Learning & The Future

4. How do machines learn?

Ray Kurzweil:

The cutting edge of the project to understand, model, and simulate the human brain is to reverse-engineer the cerebral neocortex, where we do our recursive hierarchical thinking.

The cerebral cortex, which accounts for 80 percent of the human brain, is composed of a highly repetitive structure, allowing humans to create arbitrarily complex[…]”



4. How do machines learn?

Southeast to north-central connection:

Horizontal crossbar:

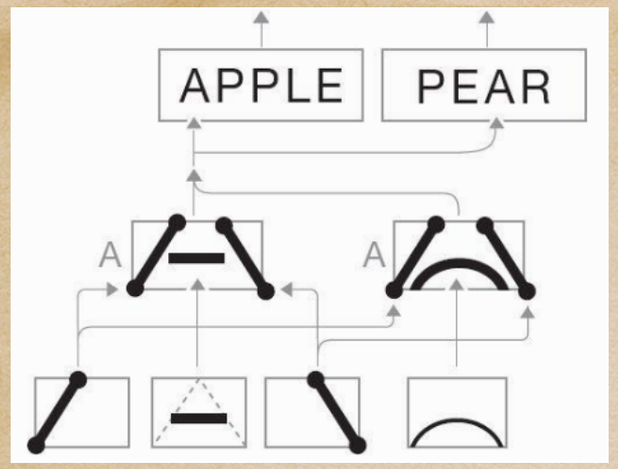
Leftmost vertical line:

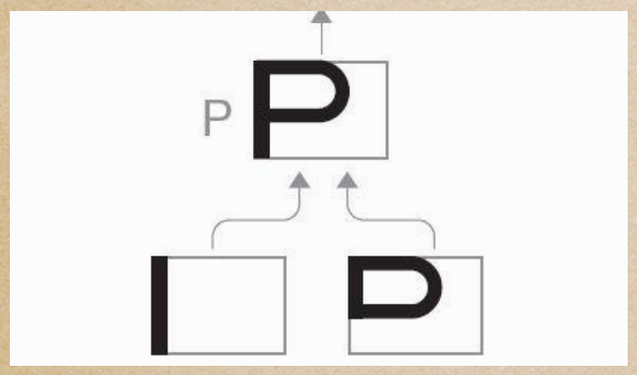
Concave region facing south:

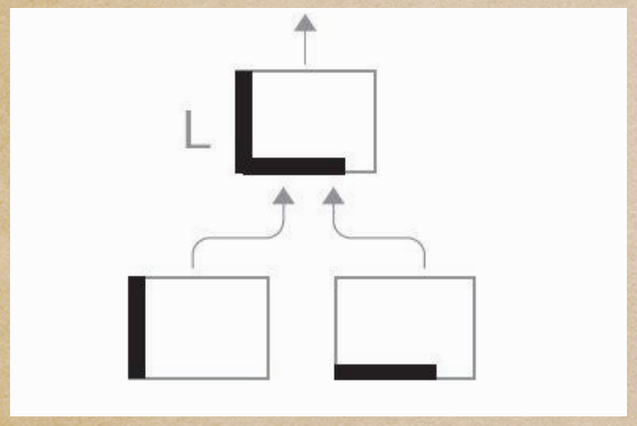
Bottom horizontal line:

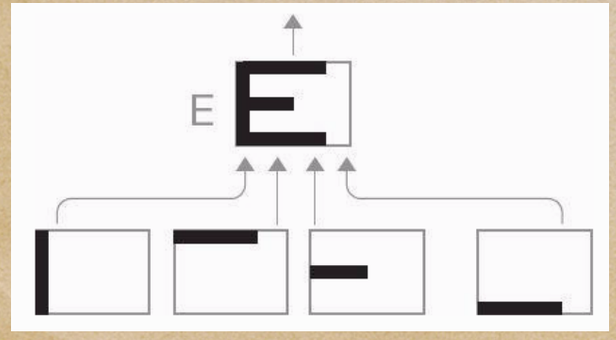
Top horizontal line:

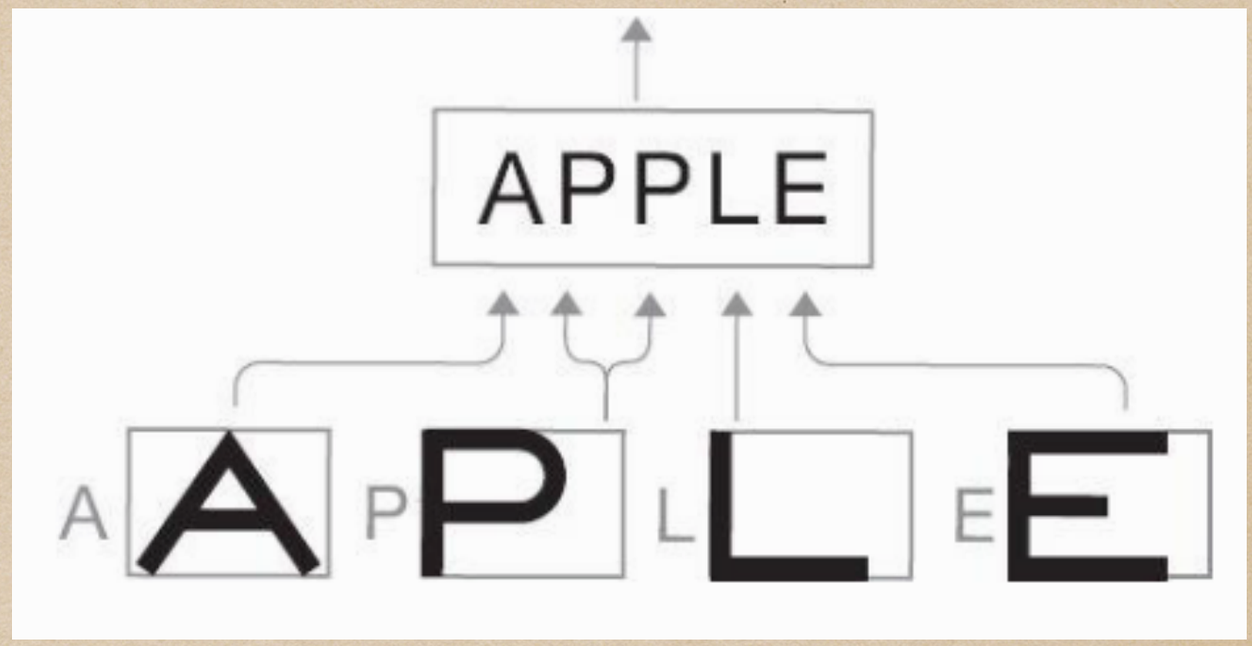
Middle horizontal line:


APPLE
PEAR
A
A

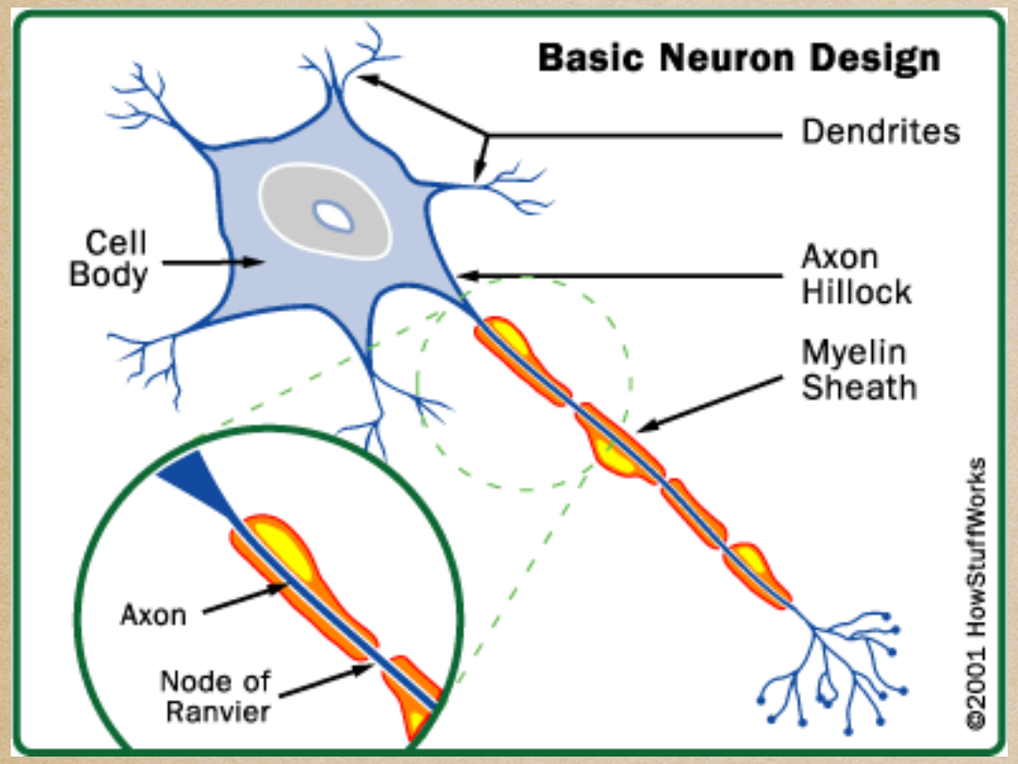

P
P


L
L


E
E


APPLE
A
A
P
P
L
L
E
E

4. How do machines learn?



4. How do machines learn?

ALSO . . .

In order to understand how the brain's (and then a computer's) amazing ability to create hugely complex systems based on relatively small input, we need to look at its design principles

Cellular Automaton . . .

- a computational mechanism that (*for example*) dictates how each cell in a grid changes color grid *based on the color of adjacent or nearby cells* according to a specified rule.

For example:

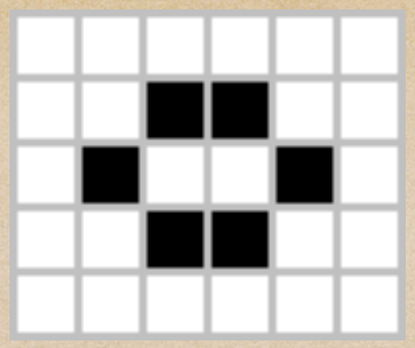
L with 1L neighbors →D

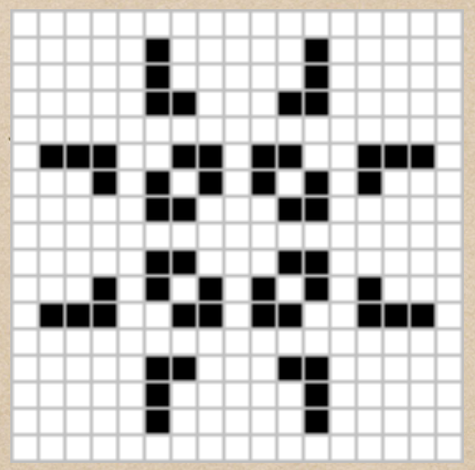
L with 2 or 3 L neighbors →L

L with 4-8 L neighbors →D

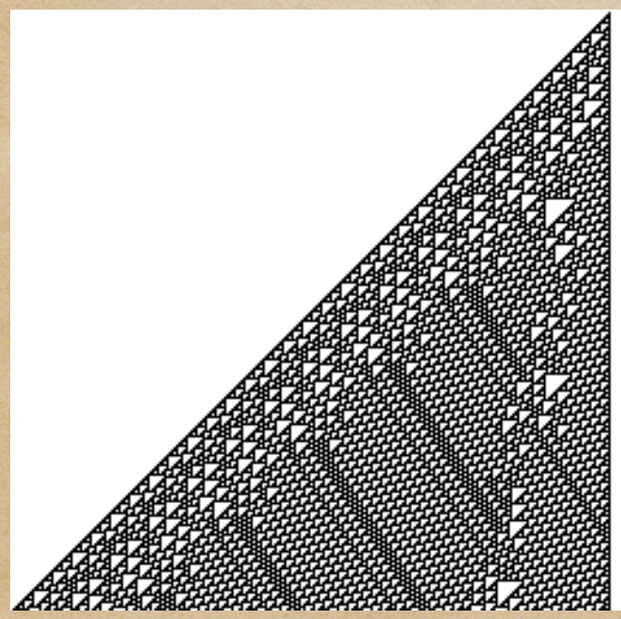
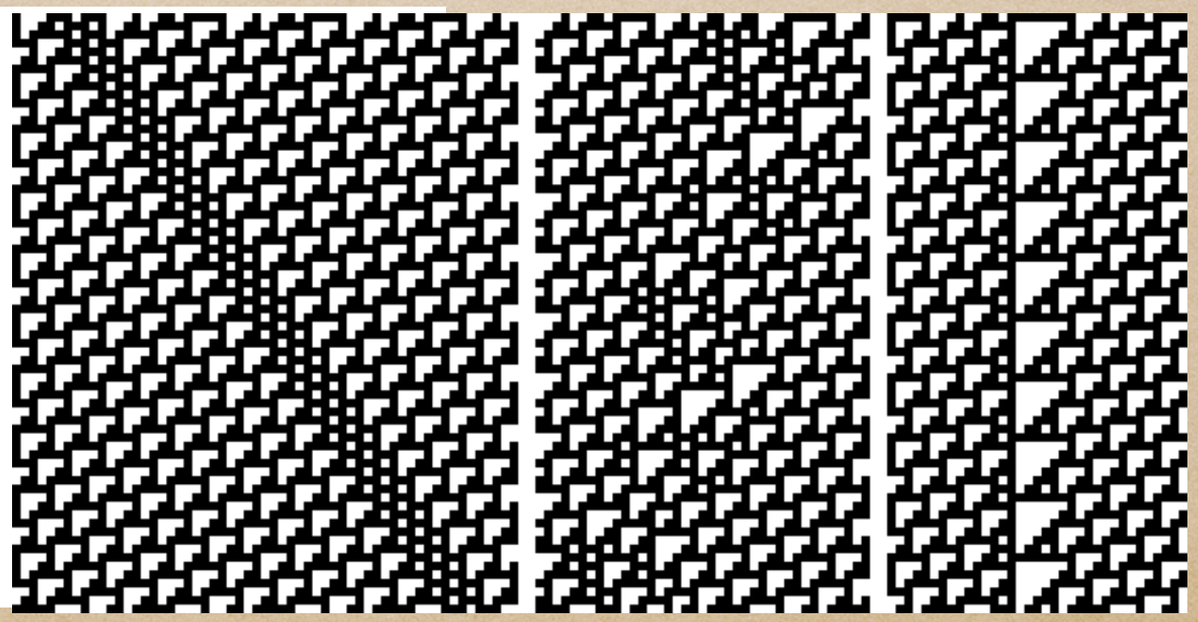
D with 3L neighbors →L





Video clip
& See appendix

THE CONWAY'S GAME OF LIFE IS A FAMOUS CELLULAR AUTOMATA

Machine Learning

"Watson understands nothing. It's a bigger steamroller."

—Noam Chomsky

Does it actually matter if a machine UNDERSTANDS anything or indeed IS INTELLIGENT??

Machine Learning

Why is that interesting?

. . . a very simple set of rules can generate
complex random patterns (chaos and order in the same system)

. . . in case of the brain:
A small amount of specification in the genome ends up with a complexity that is a billion times greater


Still awake?
Awesome!

Machine Learning

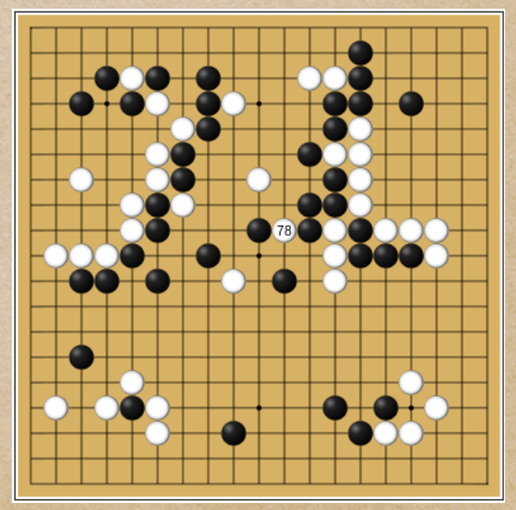
1. What is Machine Learning?
2. What is intelligence?
3. How do we determine if a machine is intelligent?
4. How does a machine learn?
5. Where is Machine Learning used now?
6. Will machines ever be like (match) the brain?
7. Machine Learning & The Future

4. How do machines learn?

First, IBM Watson beat the Jeopardy masters hands-down (2011)

Then, Google's DeepMind (2014) beat chess world champion Garry Kasparov in a set of chess games

And Google's AlphaGo (2016) defeated Lee Sedol, one of the world's best players of Go, a board game so complex that computers had not been expected to master it until 2025



Machine Learning Usages

"Deep learning" allows systems to learn and improve by crunching lots of examples rather than being explicitly programmed ("instead of people writing software, we have data writing software").

USAGES:

- to power internet search engines
- block spam e-mails
- suggest e-mail replies
- translate web pages
- recognize voice commands
- detect credit-card fraud
- steer self-driving cars

Ex.: Image recognition:

2010: 72% correct labeling of images (humans, the average is 95%).

2012: 85% accuracy (by deep learning).

2015 (ImageNet): 96% accuracy (surpassing humans for the first time)

Machine Learning Usages

Natural Language Processing

- Speech technologies
  - Automatic speech recognition (ASR)
  - Text-to-speech synthesis (TTS)
  - Dialog systems
- Language Processing Technologies
  - Machine Translation
  - Information Extraction
  - Information Retrieval
  - Text classification, Spam filtering.

Machine Learning Usages

Others..

- Computer Vision:
  - Object and Character Recognition
  - Image Classification
  - Scenario Reconstruction etc.
- Game-Playing
  - Strategy/FPS games, Deep Blue etc.
- Logic-based programs
  - Proving theorems
  - Reasoning etc.


This is your pilot speaking.
I'm working from home today

Machine Learning?

1. What is Machine Learning?
2. What is intelligence?
3. How do we determine if a machine is intelligent?
4. How does a machine learn?
5. Where is Machine Learning used now?
6. Will machines ever be like (match) the brain?
7. Machine Learning & The Future

Machines vs. Brains

It's a matter of

SPEED

The brain processes approx. 10^{14} IPS (100 trillion)

Fastest PC has approx. 10^{11} IPS

Needs to increase 1,000X

MEMORY

The brain has approx. 10^{17} b memory

Biggest PC has approx. 10^{13} B (100 TB)

Needs to increase 10,000X

Increase from 2000-2019: 1 million times

Machine Learning?

1. What is Machine Learning?
2. What is intelligence?
3. How do we determine if a machine is intelligent?
4. How does a machine learn?
5. Where is Machine Learning used now?
6. Will machines ever be like (match) the brain?
7. Machine Learning & The Future

Machine Learning & The Future

The confluence/synergy of all these NT* areas:

3 levels of AI
Robotics
Synthetic biology/genome
Computational science
Cloud/Big Data Analytics
Augmented Reality
Nanotechnology
IoT
Tele-presence/holographic communication
Collective Intelligence
Blockchains
3D/4D printing
Drones, Driverless cars
Conscious technology
The Semantic Web

The future is just around the corner!

* NT: New Technologies

Machine Learning & The Future

Moore's Law and Nielsen's Law

+

AI morphing into AGI

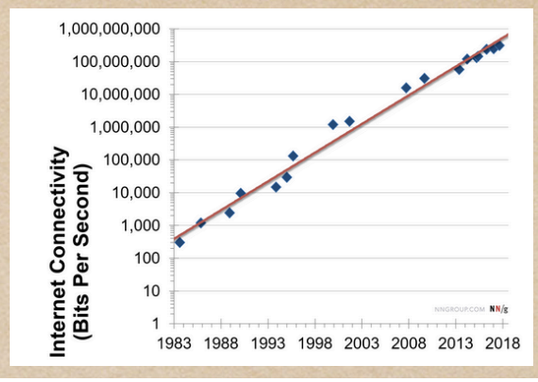
+

Computational science

+

Synergy with the NT areas

. . . will change what we think is possible



		Annualized Growth Rate	Compound Growth Over 10 Years
Nielsen's law	Internet bandwidth	**50%**	57×
Moore's law	Computer power	**60%**	100×

https://youtu.be/ZrGPuUQsDjo

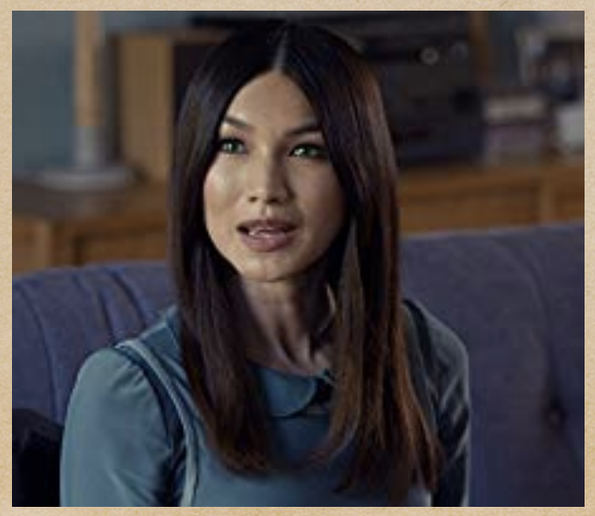
Human Augmentation: AI-Brain Interface

(Elon Musk: The Neural Lace)

Where are we headed?

The moral issue:

Will all the good things said, there's fear that AI poses an existential threat to humanity, because superintelligent computers might not share mankind's goals and could turn on their creators, violating Asimov's 3 laws.



Asimov's Laws (1942)

1920-1992

First Law
A robot may not injure a human being or, through inaction, allow a human being to come to harm.

Second Law
A robot must obey the orders given it by human beings except where such orders would conflict with the First Law.

Third Law
A robot must protect its own existence as long as such protection does not conflict with the First or Second Laws.

Interesting sources:

* How AI can enhance our memory, work and social lives w/Tom Grube (GOOGLE expert): https://youtu.be/DJMhz7JlPvA (10 min)

* Interview with Elon Musk (5 min) on AI: https://www.youtube.com/watch?v=ZrGPuUQsDjo&feature=youtu.be

* Machine Intelligence: https://app.getpocket.com/read/2508335825

* Game of life https://www.youtube.com/watch?v=XcuBvj0pw-E&NR=1&feature=fvwp

¨and https://www.youtube.com/watch?feature=fvwp&v=C2vgICfQawE&NR=1

¨3D: https://www.youtube.com/watch?feature=endscreen&NR=1&v=wNypW-aSCmE

Making photos move and talk: https://techcrunch.com/2019/05/22/mona-lisa-frown-machine-learning-brings-old-paintings-and-photos-to-life/?utm_source=pocket&utm_medium=email&utm_campaign=pockethits

Thank You!

Big Ideas Forum - 5.30.2019