Lección 21 | 06.05.2019

Robert Ajemian - Guest Lecture

> Is backpropagation (Neural Networks) biologically plausible? <

- Invented in 1974 (for an economics thesis in Harvard) (Fun fact)

Major features (Good things about it)

1) graceful decay (no catastrophic failure if one or two nodes die)
2) noise tolerance
3) generalization - perform well on unseen data

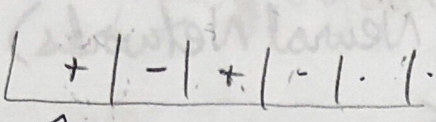
Major differences (comparison)

	Brain (neuron)	Computers (chips)
processing speed	10^3 (spikes/sec)	10^9 Hz (refresh rate)
Signal transmission speed	10^2	10^8 m/s (speed of light)
Signal/Noise	~ 1 (order of magnitude)	10^6 (barely any noise)

Memory or Information

Computer

- address register



each bin has an address

- Contents of the bin can be accessed by direct addressing

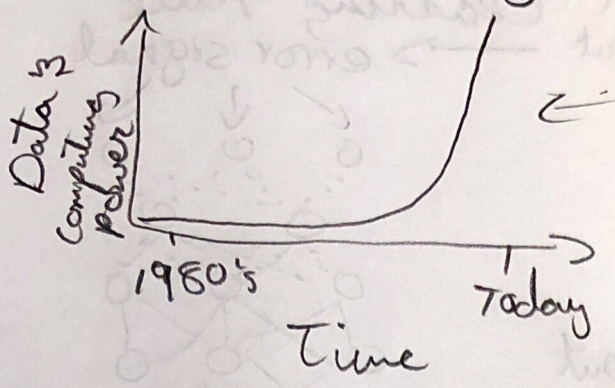
Brain

	Computer	Brain
representation	segmented, not distributed	distributed
	address - addressable	content - addressable

Computer components are mostly parallel to brain components (processing speed, noise, etc...) However, computers have <u>better</u> stats, so why couldn't they be brain-like?

- Neural nets were invented in the 1980's
- Nothing that has been invented in machine learning was not already known in the 1980's

- So what changed?



Moore's law & Big data *

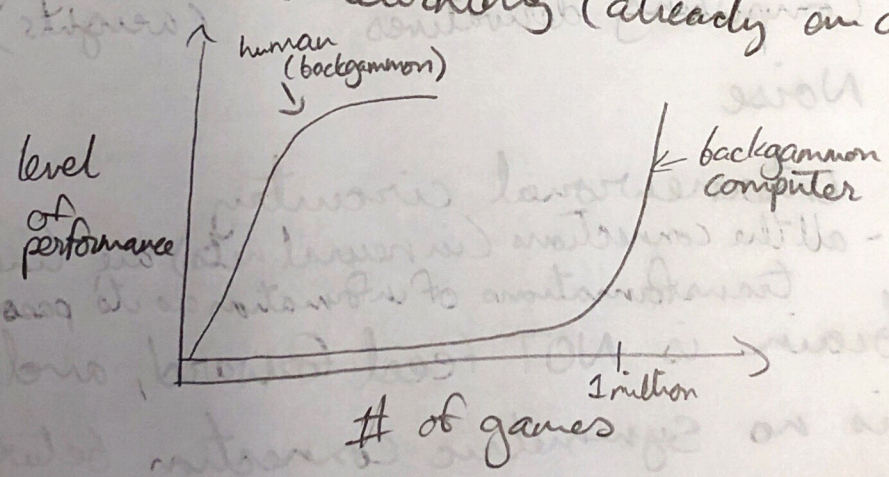
the large increases in computing power & data enabled ALL of Machine Learning

→ The brain doesn't operate this way *

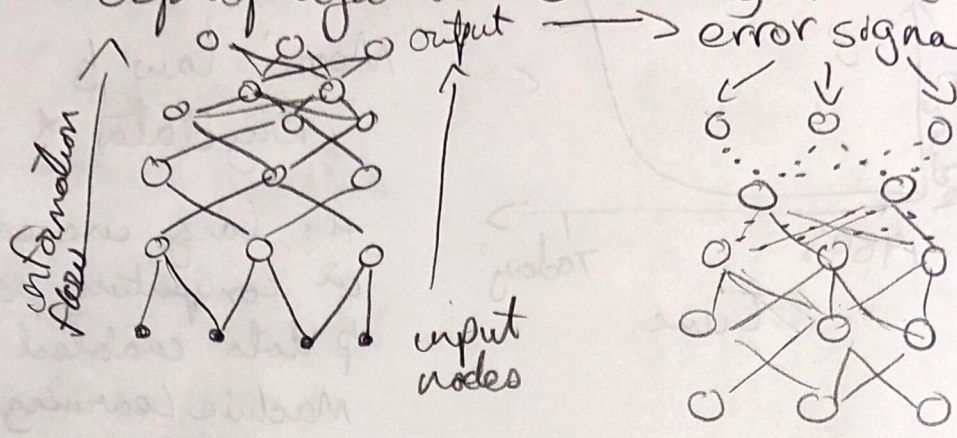
Learning:

TD Backgammon & AlphaGo

- Essence: Self-Play
  - reinforcement learning (already an old idea)

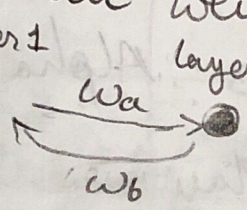


Backpropagation Learning Rule



→ this requires:

1) [a clock to sync fowar-prop.
   [a clock to sync back-prop.
2) symmetric weights



for learning in backprop.
$w_a = w_b$
(weights)

3) computing derivatives
4) Noise
5) interneuronal circuitry
   - all the connections (in neural nets) are linear transformations of information as it's passed forward

★ The brain is NOT feed forward, and there is no symmetric connection between neurons

Brain is:
- ✓ redundant (not feed-forward)
- ✓ highly locally interconnected
- ✓ most connections are regulatory (not learning)

✓ Hebian learning (correlation-learning; pattern-based learning)