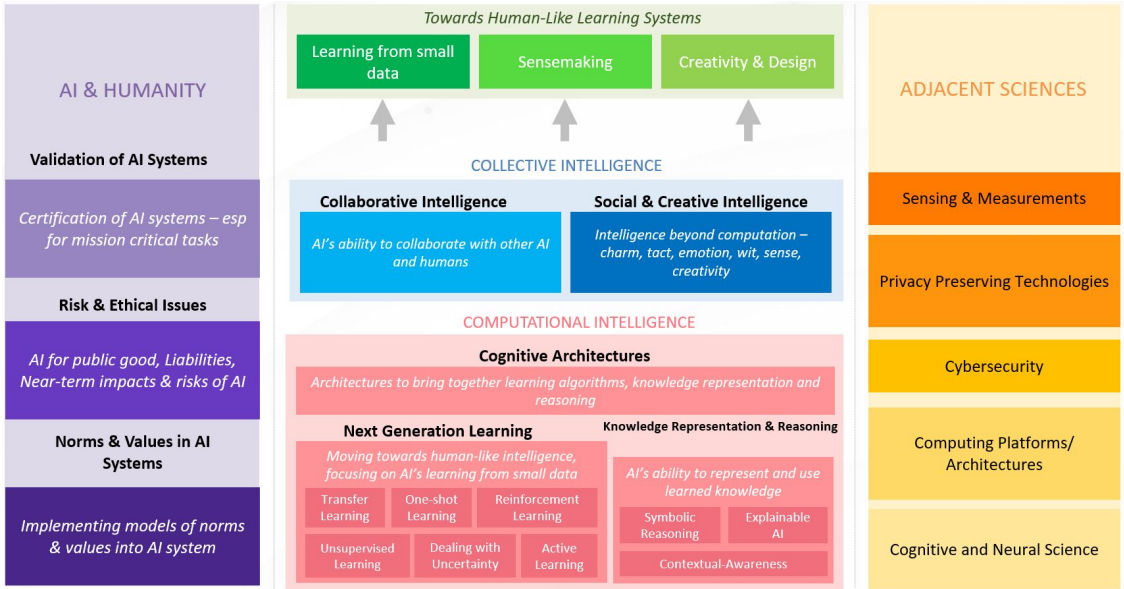
Introduction to Neural Networks

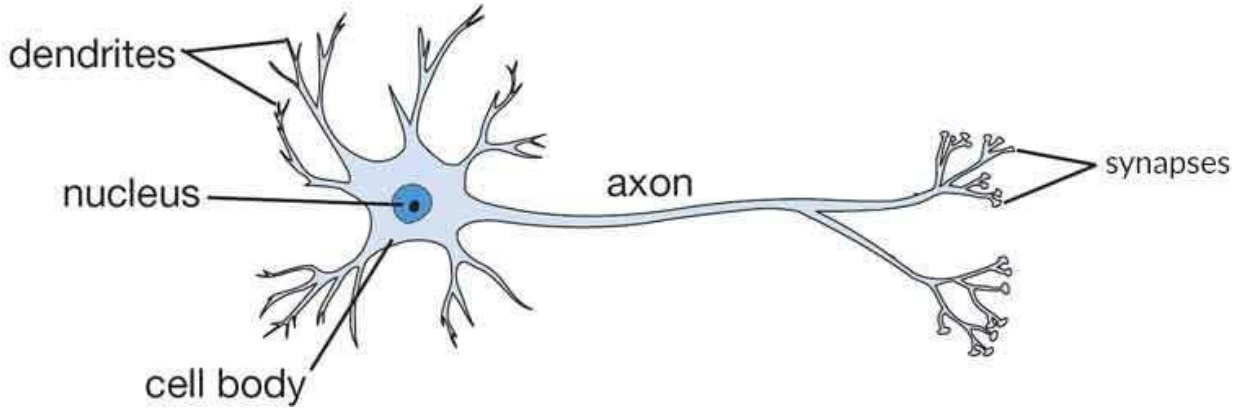
NUS CBE
2018.08.24

Why neural networks?



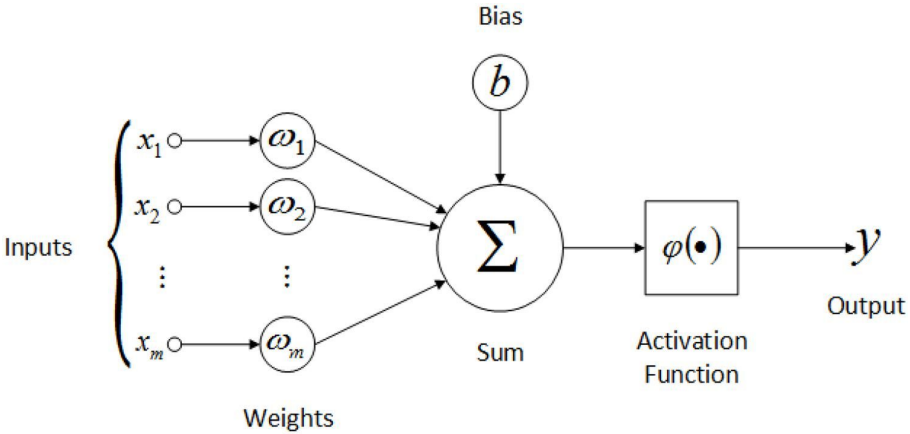
- AI.SG
- Neural networks are the foundation for these topics

Inspired from neuroscience - biological neuron



xenonstack.com/blog/data-science/artificial-neural-networks-applications-algorithms

Artificial neuron

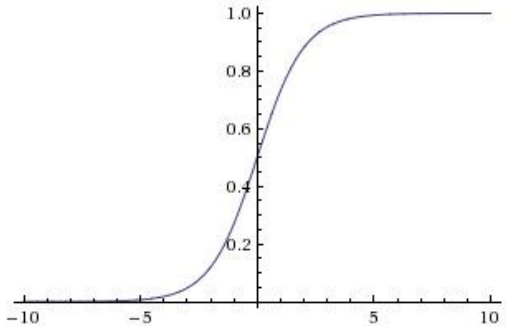


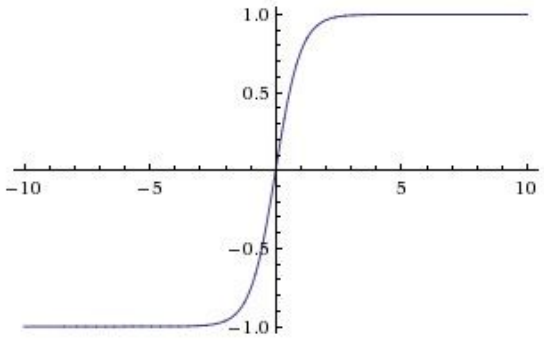
$$y = \varphi(x\omega + b)$$

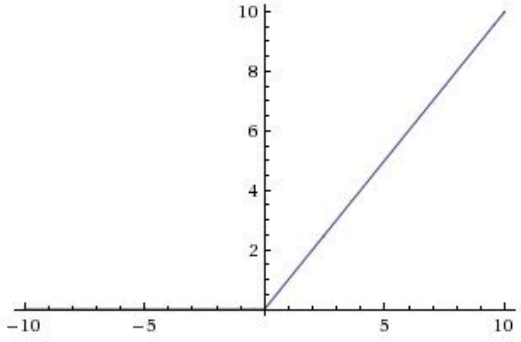
- If no activation function φ, becomes linear regression
- We estimate **ω and b**
- Activation function makes this non linear

Activation functions

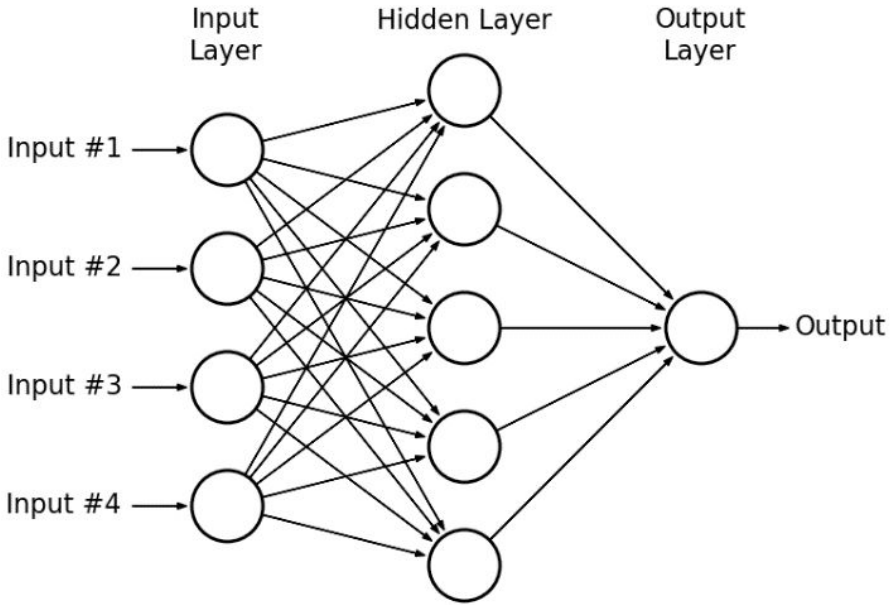
sigmoid: $f(x) = 1/(1+e^{-x})$ tanh: $f(x) = (e^{x} - e^{-x})/(e^{x} + e^{-x})$ relu: $f(x) = \max(0,x)$







More layers = more representational power



Mapping

- mapping vector **y** to vector **x**; **y** = f(**x**)
- images --> categories
- features of a house --> price
- states of environment --> actions (reinforcement learning)
- Mathematically just a sequence of tensor operations

Implementation

- Refer to colab notebook
  - https://colab.research.google.com/drive/1hm0l3JAeAo1yQH36GzuxfCreZmDYRxvB

Human brain and AI

- Q: Why should we look at the brain when developing AI systems?

  Geoff Hinton: The main reason is that it's the thing that works. It's the only thing we know that's really smart and has general purpose intelligence.

https://www.oreilly.com/ideas/adapting-ideas-from-neuroscience-for-ai

- DeepMind: “...creating a virtuous circle whereby AI researchers use ideas from neuroscience to build new technology, and neuroscientists learn from the behaviour of artificial agents to better interpret biological brains..”

https://deepmind.com/blog/ai-and-neuroscience-virtuous-circle/

Interesting papers:

- Anthony et al. Thinking Fast and Slow with Deep Learning and Tree Search. 2017
  - Inspired by Kahneman's theory, utilized in AlphaGo Zero
- Lanctot et al. A Unified Game-Theoretic Approach to Multiagent Reinforcement Learning. 2017
  - Extend Cognitive Hierarchy of Camerer, Ho & Chong with deep reinforcement learning

More resources:

- http://cs231n.github.io/
- http://course.fast.ai/