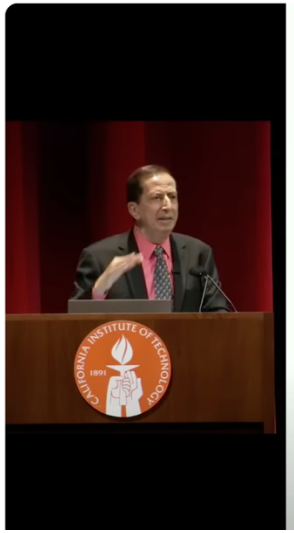
Take Home Lessons from Today

1. Artificial intelligence is not new in the computer world, it used to be accomplished by “brute force”; archiving vast amounts of information in an orderly manner then looking it up when needed. What is new is that modern artificial intelligence is driven by algorithms that actively learn information and store it in diffuse ways.
2. The most recent artificial intelligence is modeled after neurons, functioning through connections (synapses) that propagate a signal when stimulated appropriately by other neurons. These systems are often referred to as computational neural networks. Early work in the neural network field was based on faith that the intelligence and learning ability of human brains could ever be achieved in this way.
3. In neural networks, individual computation nodes are connected to each other with specific parameters that determine whether they will activate other connected nodes. You can think of these parameters as being analogous to how individual neurons will create an action potential only after they are stimulated in the right way through their dendrites. And just like neurons, connections that are used remain, and ones that are not used never form. This process can be thought of as learning, analogous to getting knobs set at just the right place between all the different nodes so that signals pass among them in organized ways (have information).
4. In neural networks, information is learned and stored throughout the system by the specific parameters (knobs), creating pathways that will reconnect when the information is sought.
5. There are two kinds of artificial intelligence using neural networks, discriminatory (who is in the picture?) and generative (draw a picture or write a poem or article).
6. Not much happens with neural networks until VERY large neural networks are created and taught (150 billion connections currently). After a threshold* level of many, many connections is reached, systems like ChatGPT 3.0 “wake up” and provide very appropriate answers to complex language or image requests provided that EXTENSIVE learning has been accomplished prior to asking the question. The difference between the neural networks and the old “brute force” information storage is that neural networks can combine learned information in entirely new ways. ***This minimum number of neuron threshold idea for consciousness was also mentioned by Dr. Herculano-Houzel when comparing human brains to those of other animals.**
7. The pace of the revolution caused by AI will be much faster than the industrial revolution, automating tasks that require routine (repetitive) intelligence (driving, customer service, healthcare, marketing), while allowing us to do things we cannot already do.

Brute-force approach to Artificial Intelligence

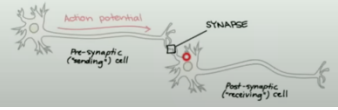
The '**Lookup Table**':

1. Store gigantic amount of information in a computer.
2. Look up the relevant information when someone asks.

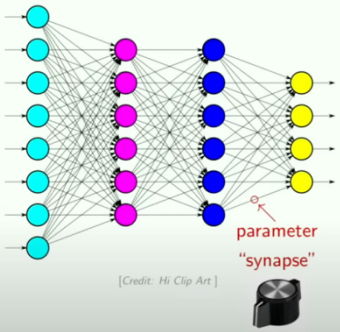


Learning Brute-force approach to Artificial Intelligence

The learning algorithm is built in:



The Neural Network



[Credit: Hi Clip Art]

How information is stored

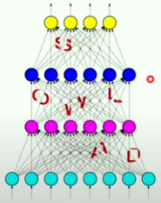
Expert System

Oswald

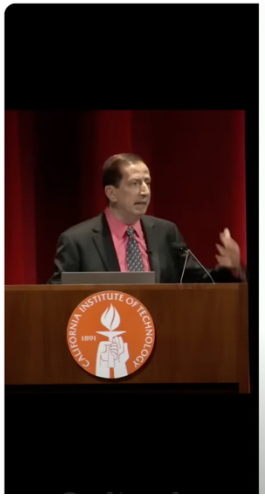
Who killed Kennedy?

Neural Network

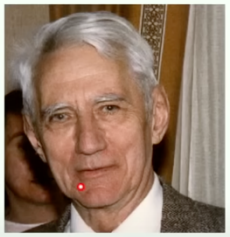
Oswald



Who killed Kennedy?

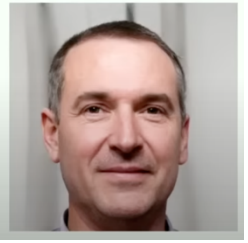


Discriminative versus Generative

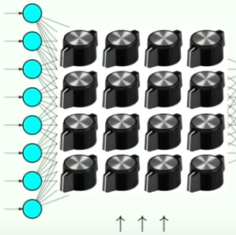


Claude Shannon

Create a face



Lucky Break #2: Over-Parametrization



Claude
Shannon

[Credit: WA Museum]

training data

[Credit: Nicepng]

Since neurons interact combinatorially through the synapses they establish with one another, and further so as they interact in networks, the increase in cognitive abilities afforded by increasing the number of neurons in the brain can be expected to increase exponentially with absolute number of neurons, and might even be subject to a thresholding effect once critical points of information processing are reached. In this way, the effects of a three-fold increase in numbers of neurons may be much more remarkable when comparing already large brains, such as those of humans and gorillas, than when comparing small brains, such as those of squirrel monkeys and galagos.

frontiers in
HUMAN NEUROSCIENCE

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The human brain in numbers: a linearly scaled-up primate brain

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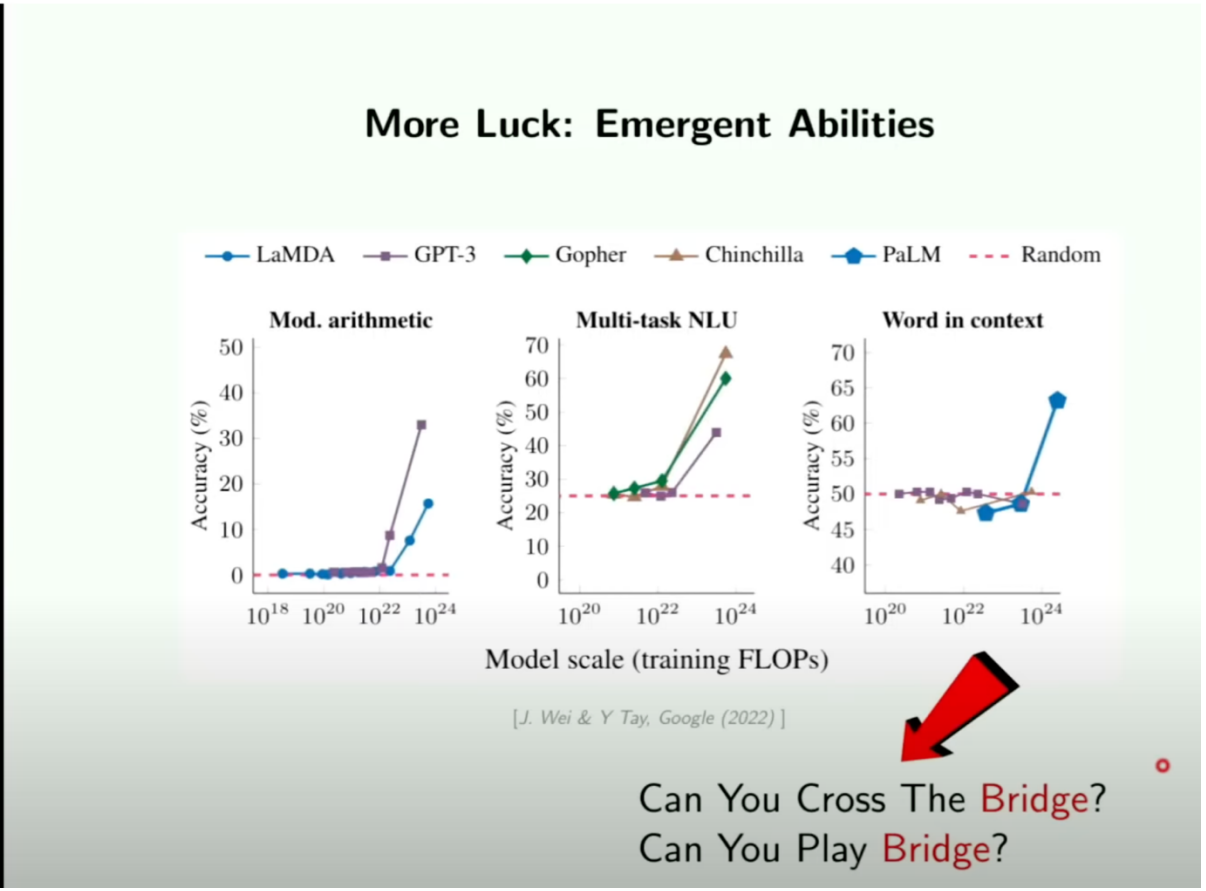
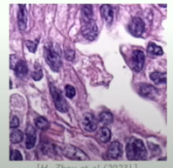


Two things AI offers

1. Doing what we already do.

[Credit: hearstapps]

2. Doing what we cannot do.



[H. Zhou et al (2023)]

The key difference

The pace

- The Industrial Revolution took hold in approximately **80 years**

  1760 - ≈1840

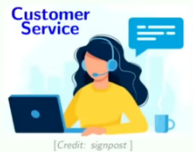
- A.I. Revolution will have taken taken hold in less than **20 years**

  2012 - 2030?

By the year 2030

AI can automate any task that requires routine intelligence

[Credit: Vox]



[Credit: signpost]

I did not use AI
to generate this lecture.

Caltech

Thank You!

The Watson Lectures

Your Poem about an activity that makes me happy from ChatGPT

Here is mine, written by ChaptGTP 5.0 on October 2, 2025

Beneath the Blue

The ocean greets with open arms,
A world of quiet, endless charms.
Bubbles rise like silver song,
As weightless drift carries me along.

Sunlight dances in shifting streams,
Painting corals with liquid dreams.
Fish in colors, bright and free,
Weave their secrets around me.

Joy is breathing calm and slow,
In the gentle sway, the ebb, the flow.
The heart forgets its heavy load,
As wonder opens every road.

Here, beneath the water's skin,
A deeper happiness begins.
For in the ocean's vast embrace,
I find my soul, my truest place.