

Take Home Lessons from Today 10-3-24

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**':

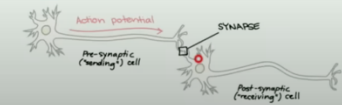
1. Store gigantic amount of information in a computer.
2. Look up the relevant information when someone asks.



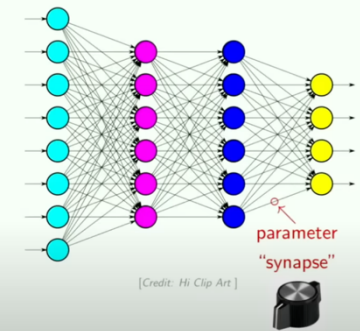
Learning Brute-force approach to Artificial Intelligence



The learning algorithm is built in:



The Neural Network

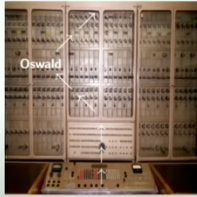




How information is stored

Expert System

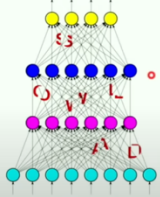
Oswald



Who killed Kennedy?

Neural Network

Oswald

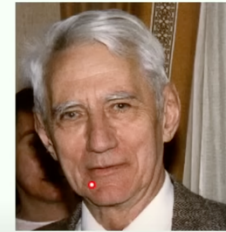


Who killed Kennedy?



Discriminative versus Generative

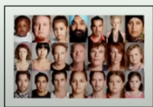
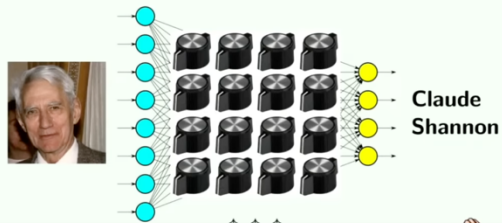
Create a face



Claude Shannon



Lucky Break #2: Over-Parametrization



[Credit: WA Museum]



training data



[Credit: Numpy]

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.



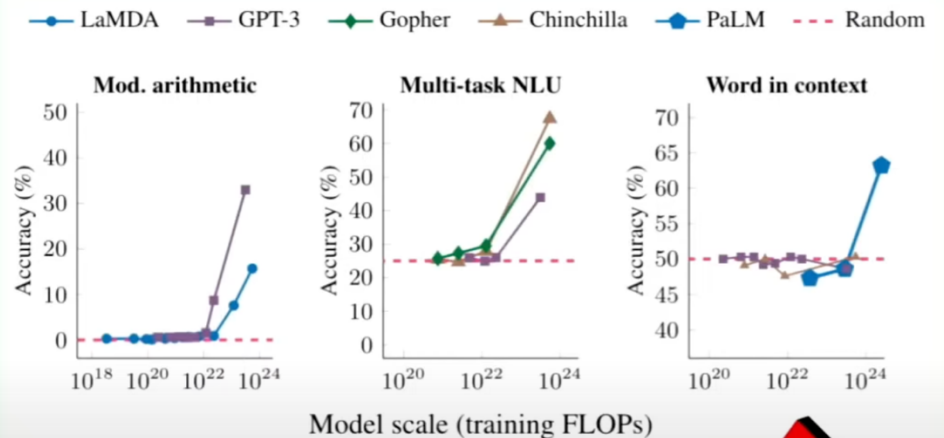
The human brain in numbers: a linearly scaled-up primate brain

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More Luck: Emergent Abilities



[J. Wei & Y. Tay, Google (2022)]



Can You Cross The Bridge?
Can You Play Bridge?

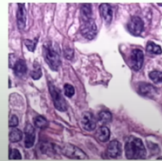


Two things AI offers

1. Doing what we already do.



2. Doing what we cannot do.



The key difference

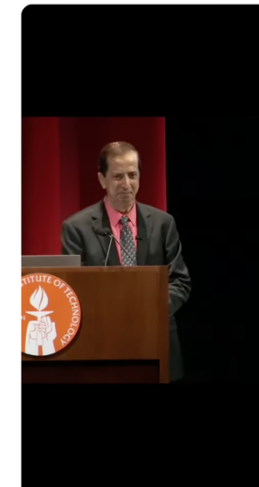
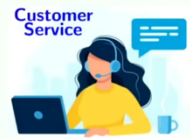
The pace

- The Industrial Revolution took hold in approximately 80 years
1760 - \approx 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



I did not use AI
to generate this lecture.



Caltech

Thank
You!

The Watson
Lectures

Your Poem about happiness from ChatGPT

Here is mine, written by ChaptGTP 3.0 on Sept. 25, 2023

In the heart's gentle glow, happiness resides, A radiant beacon, where joy abides. It dances like sunlight on a tranquil sea, A melody of laughter, wild and free.

Happiness is a whisper in the morning air, A feeling so precious, so incredibly rare. It's the warmth of a hug, a smile that gleams, A symphony of hopes, fulfilling dreams.

It's the laughter of children at play in the park, The embrace of a loved one when the world turns dark. It's the beauty of nature, in each bloom and tree, A reminder that life's greatest gift is to be free.

Happiness is found in the simplest of things, In the love that a family, together, brings. It's the taste of sweet moments, the touch of a hand, A connection that weaves us in life's grand strand.

It's the thrill of adventure, the thrill of the chase, The wonder of exploring new realms of space. It's the kindness of strangers, a comforting embrace, A world filled with love, a better place.

Happiness is not a destination to find, But a journey of moments, a state of the mind. It's gratitude, love, and a heart that's pure, A treasure we cherish, forever endure.

So seek not in distant lands or skies, For happiness dwells where your spirit lies. Embrace each day with a grateful heart, And happiness will be your lifelong art.

Your very hard technical question to ChatGPT:

Here is mine, written by ChaptGTP 3.0 on Sept. 25, 2023

Question: Do the different enantiomers of chiral drugs react differently in the body. Give two examples.

Yes, the different enantiomers (mirror-image isomers) of chiral drugs can often react differently in the body, even though they have the same chemical formula and structure. This phenomenon is known as enantiomer-specific pharmacology and is due to the fact that biological systems, such as enzymes and receptors, are often chiral and can interact differently with enantiomers. Here are two examples:

1. **Thalidomide:** Thalidomide is a classic example of the importance of enantiomer-specific pharmacology. It was originally marketed as a racemic mixture (containing both the R- and S-enantiomers) to treat morning sickness in pregnant women. However, it was later discovered that while one enantiomer (S-thalidomide) had the desired sedative effects, the other enantiomer (R-thalidomide) was responsible for severe teratogenic effects, leading to limb malformations in babies born to mothers who had taken the drug. This stark difference in biological activity between the two enantiomers highlights the importance of testing and regulating chiral drugs for safety.
2. **Albuterol:** Albuterol is a bronchodilator commonly used to treat asthma and other respiratory conditions. It exists as a racemic mixture of R- and S-enantiomers, with the R-enantiomer being the active form. While both enantiomers have similar chemical structures, the R-enantiomer is more effective in dilating bronchial airways, leading to improved breathing. The S-enantiomer, on the other hand, has a weaker bronchodilatory effect and can potentially cause side effects. Pharmaceutical formulations have been developed to deliver primarily the active R-enantiomer to maximize therapeutic benefit.

In both of these examples, the differences in biological activity between enantiomers can have significant clinical implications. It's essential for pharmaceutical companies to carefully study and control the enantiomeric composition of chiral drugs to ensure their safety and effectiveness in clinical use. This field of study is known as chiral pharmacology, and it plays a crucial role in modern drug development and regulation.