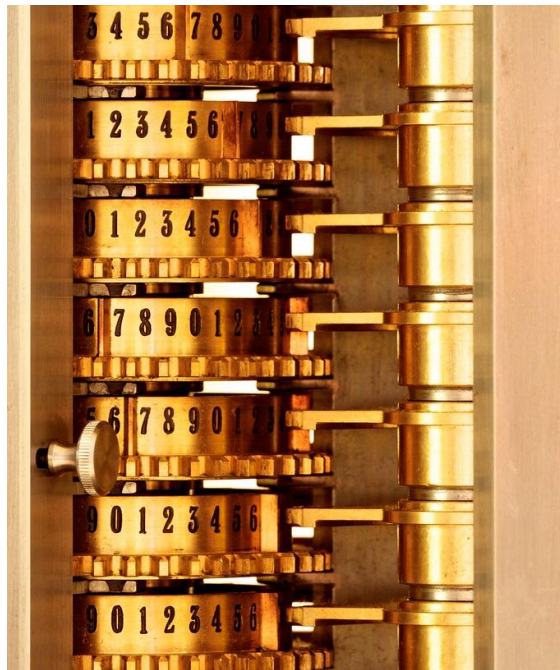
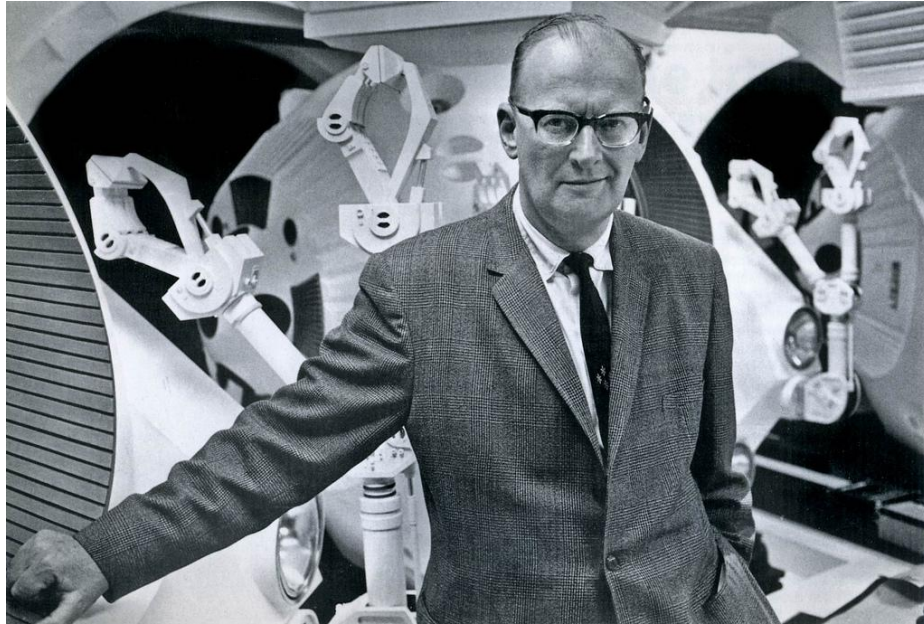


Computers, brains and AI

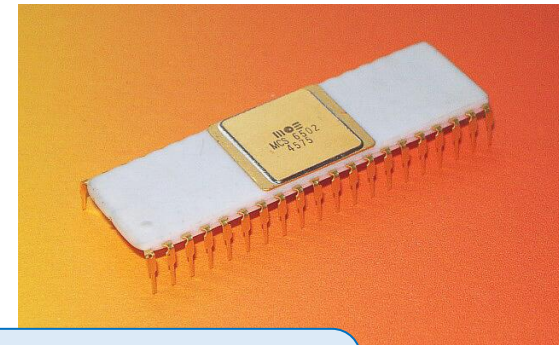
1: Intro



Arthur C. Clarke



“... indistinguishable from magic”



Arthur C. Clarke: “Any sufficiently advanced technology is indistinguishable from magic”.

https://en.wikipedia.org/wiki/Clarke%27s_three_laws.

For example, this 1970s chip would be completely mysterious because it is tiny and inert.



[Chip](#) by Christian Bassow / [CC BY-SA 4.0](#)

[Arthur C. Clarke](#) by ITU Pictures / [CC BY 2.0](#)

[Tractor](#) by Kharkiv Tractor Plant / [CC BY 4.0](#)

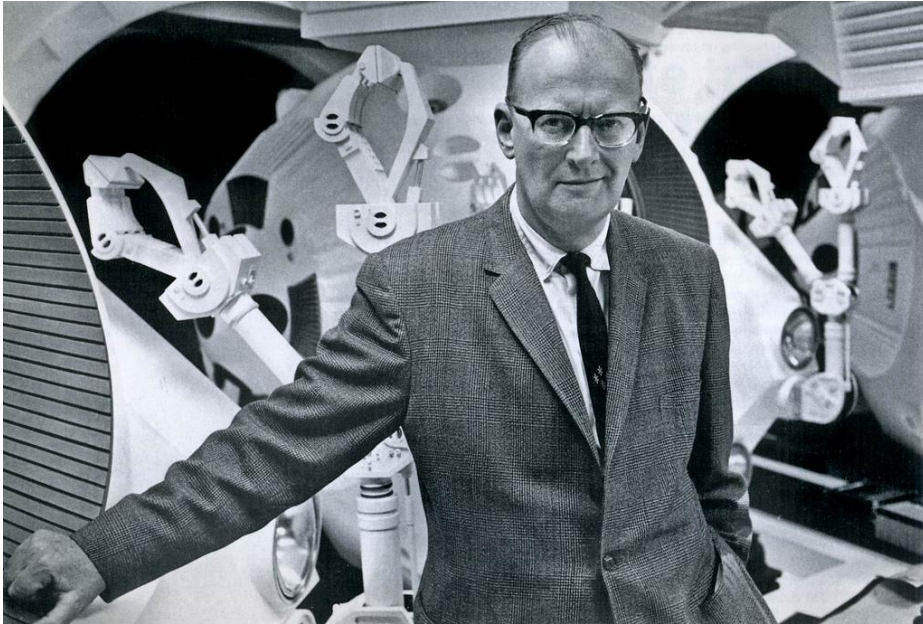


Questions are welcome any time.

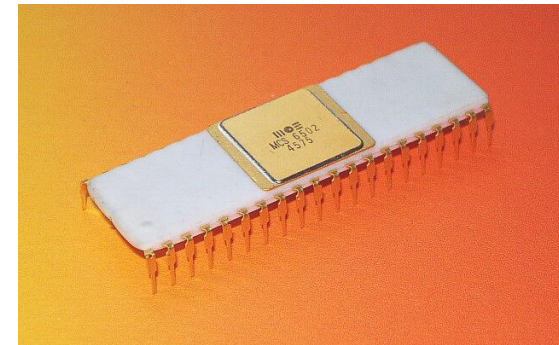
A particularly good time to ask questions
is when these light bulbs appear.



Arthur C. Clarke



“... indistinguishable from magic”



[Chip](#) by Christian Bassow / [CC BY-SA 4.0](#)

[Arthur C. Clarke](#) by ITU Pictures / [CC BY 2.0](#)

[Tractor](#) by Kharkiv Tractor Plant / [CC BY 4.0](#)

Computer, includes tablets and smart phones.

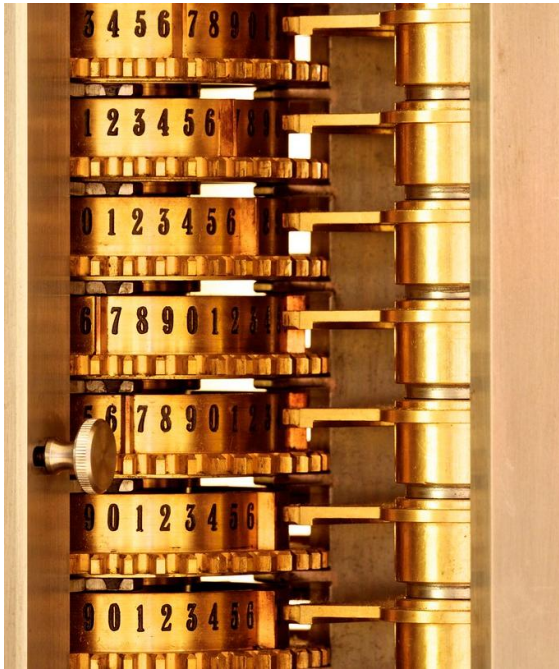
→ Computers, brains and AI ←

1: Intro

Charles
Babbage

Difference
Engine

Analytical
Engine



Ada
Lovelace

*the first
computer
program*

1843



Don't be shy

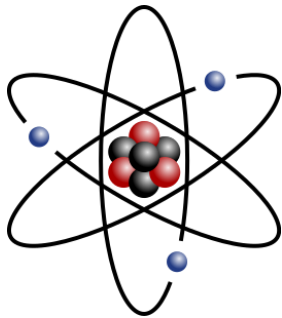
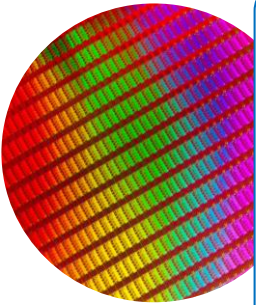


Can you say
that again?

Where we are
going?



hardware



We can think of computer science as a stack with physics and chemistry at the base, and then hardware and various levels of software, and, finally, AI at the top.

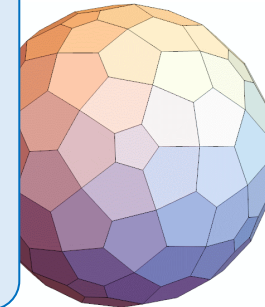
We're not defining AI (except in broad terms as "clever software"), nor are we claiming AI is necessarily a force for good.

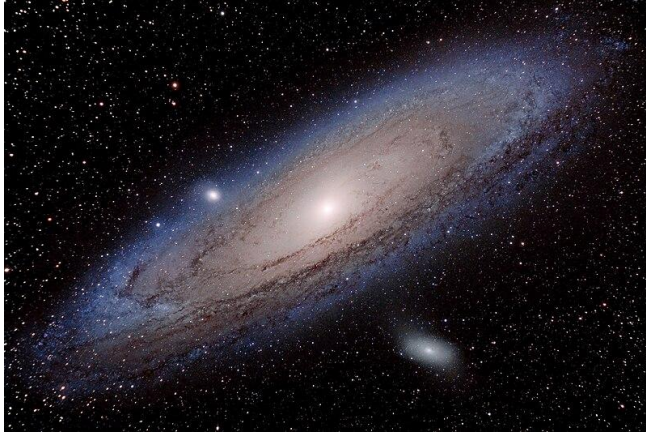
AI



u3ac.org.uk

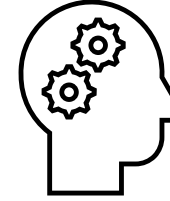
software





maths

AI



I was fascinated by science and maths as far back as I can remember, and especially the mystery of how the brain works.

ChatGPT

When ChatGPT arrived, I started studying AI full time.

November 2022



- 1) Intro
- 2) Foundations
- 3) Logic
- 4) Deep learning
- 5) Deep learning
- 6) ChatGPT
- 7) ChatGPT
- 8) ChatGPT
- 9) The future of AI
- 10) The future of AI

Deep learning is a kind of **machine learning**. The **deep** is a buzzword that means “many layers”. (We will learn about layers later).



brains

Slides



captions

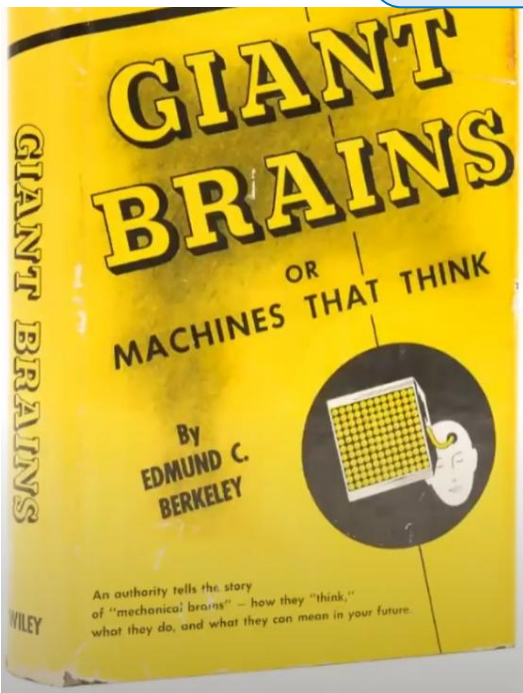
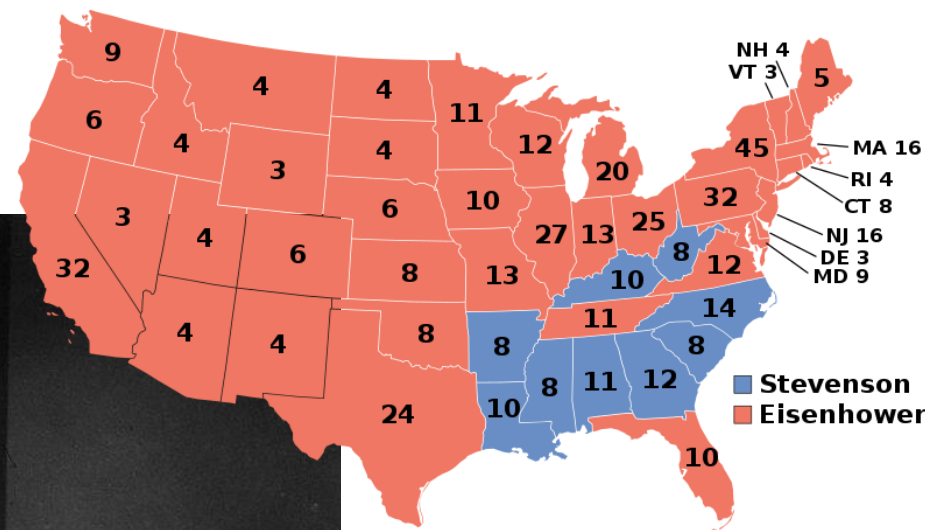


The UNIVAC

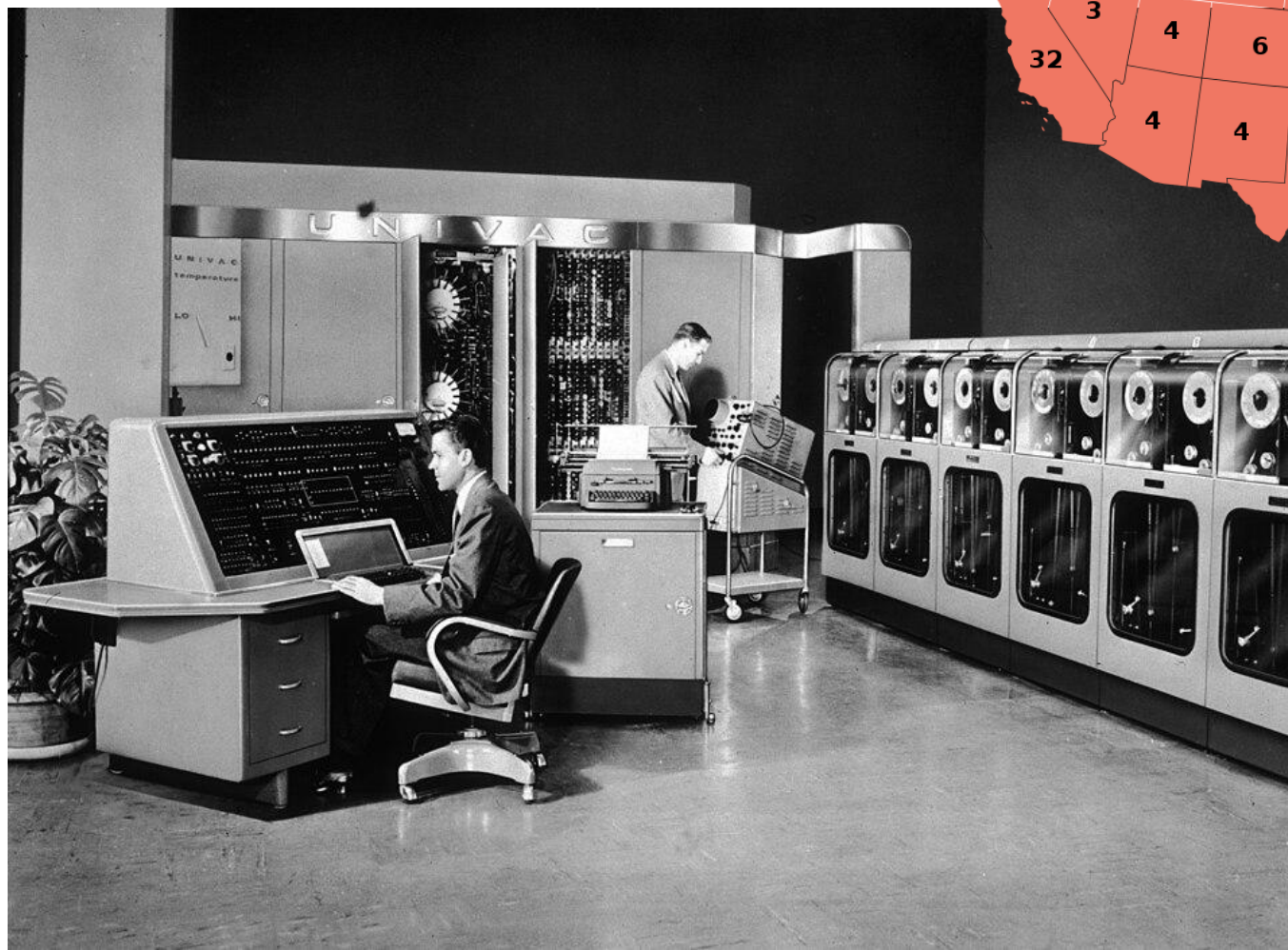
1947

The UNIVAC correctly predicted the outcome of the 1952 presidential election in front of 20 million TV viewers, pushing computers into the spotlight as "electronic brains".

1952



1949



1960



GOFAI

ELIZA
chatbot



All the funding gets pulled.
(The first AI winter).



1980

Good old-fashioned AI

GOFAI is the old approach:
reasoning and logic

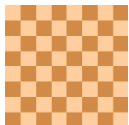
Expert systems

Easy
is hard



2000

Deep Blue beats
Kasparov


Deep Blue



2020

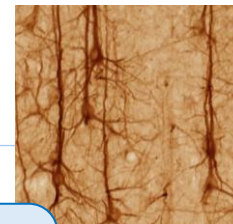


Machine learning

Perceptron

People immediately
start making
artificial neural
networks.

The **Perceptrons** book
by Minsky and Papert kills
off machine learning.



Birds fly

Even simple statements like “birds fly”
turn out to have too many subtleties.



AlexNet

The deep learning “Big Bang”

2012



Chess
Jeopardy
Book / CC0
Swan from pxhere / CC0
Bus by Martin49 / CC BY 2.0
Cat by Von.grzanka / CC BY-SA 3.0
Dog by Kyfishfishfish / CC BY-SA 4.0
The thinker by CrisNYCa / CC BY-SA 4.0
Tractor by Kharkiv Tractor Plant / CC BY 4.0
Penguin by Christopher Michel / CC BY 2.0
Neurons by UC Regents Davis campus / CC BY 3.0
Duckling by Luis Miguel Bugallo Sánchez / CC BY-SA 3.0

Get ready ...



We recognize the rabbit in a split second, which is far too fast for any [saccades](#) or any sequential operations like tracing round the silhouette (especially since our individual neurons are so slow).

How we think

How we think we think

People say they recognize the rabbit because of the long ears, but that can't be the whole story because this picture is still recognizable as a rabbit.

In other words, there's a difference between how we think and how we think we think, a theme we will come back to many times.





?



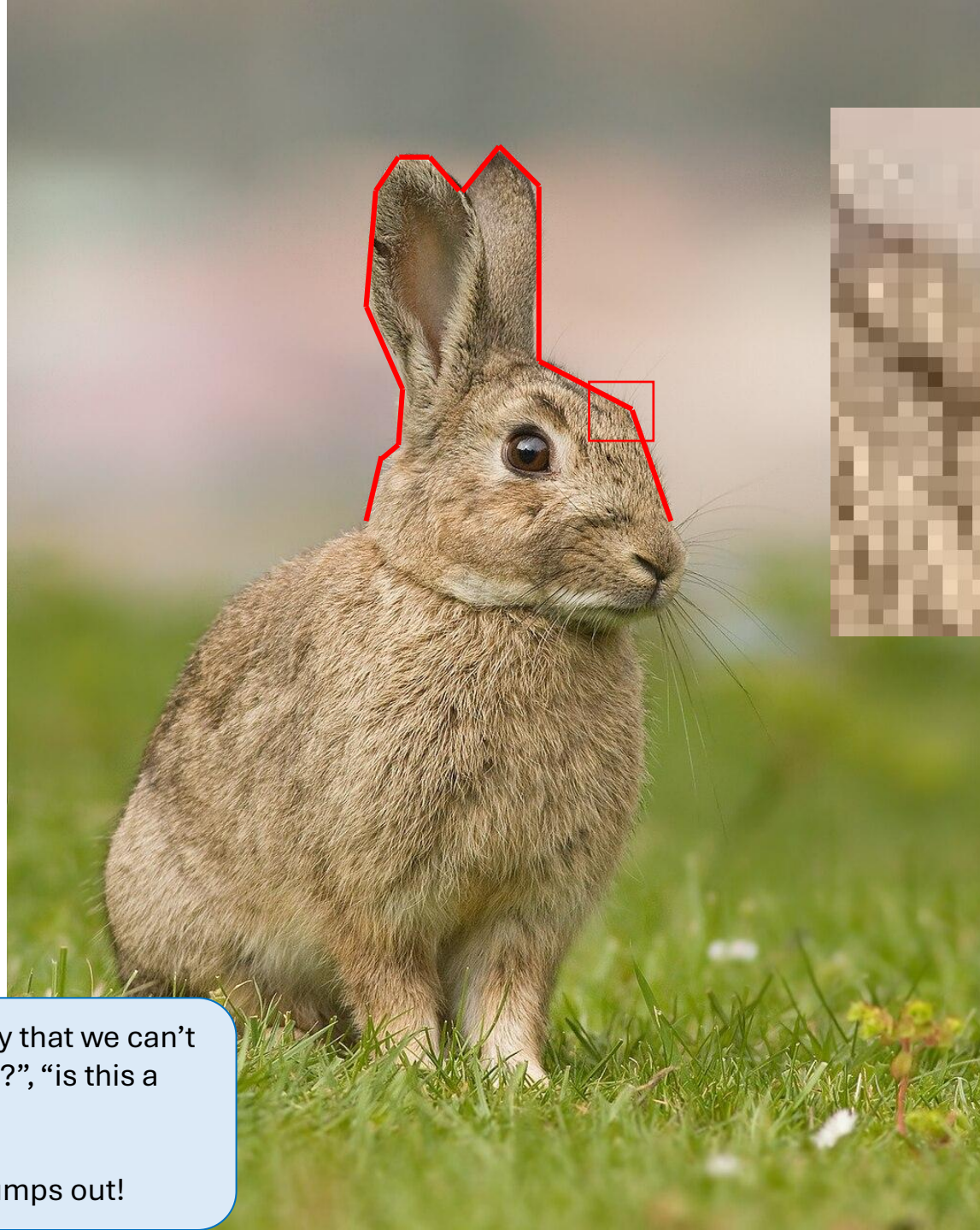
?



?

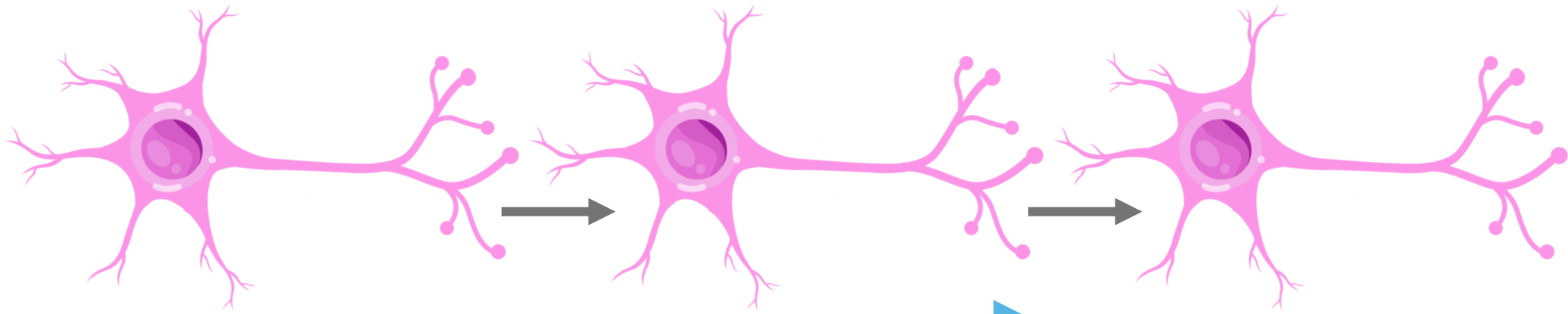
We recognize the rabbit so quickly that we can't possibly be thinking "is this a dog?", "is this a bus?" etc.

Somehow the "rabbiness" just jumps out!



Finding edges isn't straightforward.

As we will see in a later talk, **edge detection** is a part of biological and artificial neural networks. The edges aren't traced sequentially. Instead, the edge detection is done in parallel.



$\frac{1}{100}$ of a second

Signals take a hundredth of a second to traverse a neuron, which is amazingly slow compared to a transistor, which makes it all the more surprising that we can all recognize the rabbit so quickly.

Transistor

$\frac{1}{50,000,000,000}$ of a second



$\frac{1}{4}$ of a second



How do we recognize things?

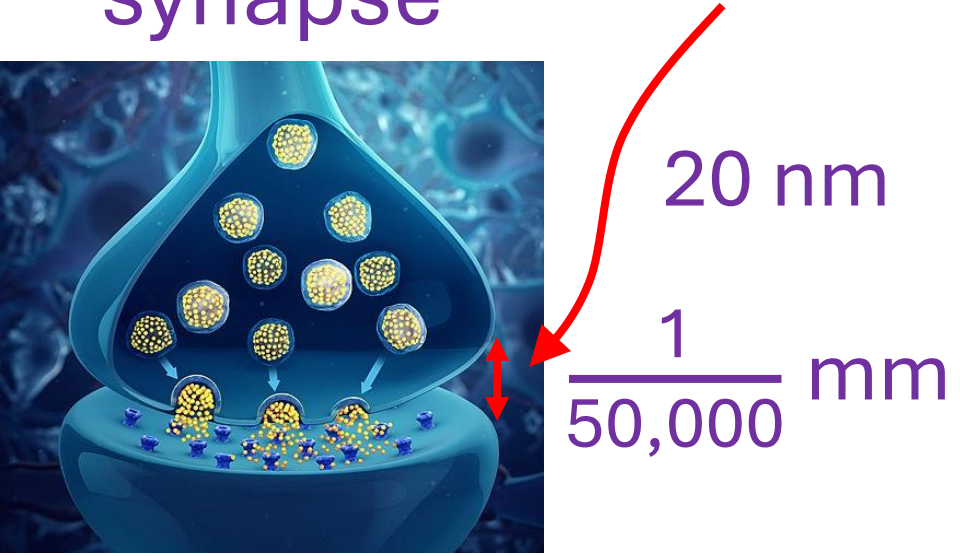
scale

Both biological and artificial neural networks only start doing interesting things when they are huge.

Hence, some of the enormous networks being created by OpenAI and Google etc. To power these projects, some of the companies are even buying nuclear reactors!



synapse



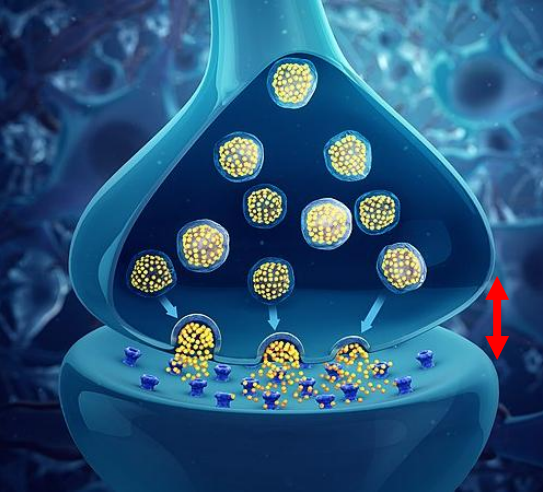
$$\frac{1}{50,000} \text{ mm} : 1 \text{ mm}$$

$$10 \text{ cm} : 5 \text{ km}$$

If a brain were scaled up so that small features like synapses were visible, it would be ridiculously large.



synapse



20 nm

$\frac{1}{50,000}$ mm

$\frac{1}{50,000}$ mm : 1 mm

10 cm : 5 km

The quote from Hamlet:

https://en.wikipedia.org/wiki/What_a_piece_of_work_is_a_man

An introduction to synapses:

<https://dana.org/resources/neurotransmission-the-synapse/>



Hamlet

how infinite in faculty

150,000,000,000,000 synapses

5,000,000 years

Counting to 150,000,000,000,000 (day and night) would take 5,000,000 years.

Emily Dickinson

The brain – is wider than the sky –

Walt Whitman: I am large, I contain multitudes

What did
we learn?

1960

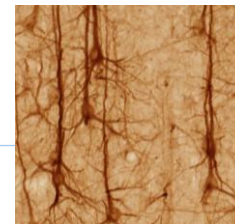


GOF AI

ELIZA



Machine learning



1980

Good old fashioned AI

Easy
is hard



Birds fly



2000



AlexNet



2012



20



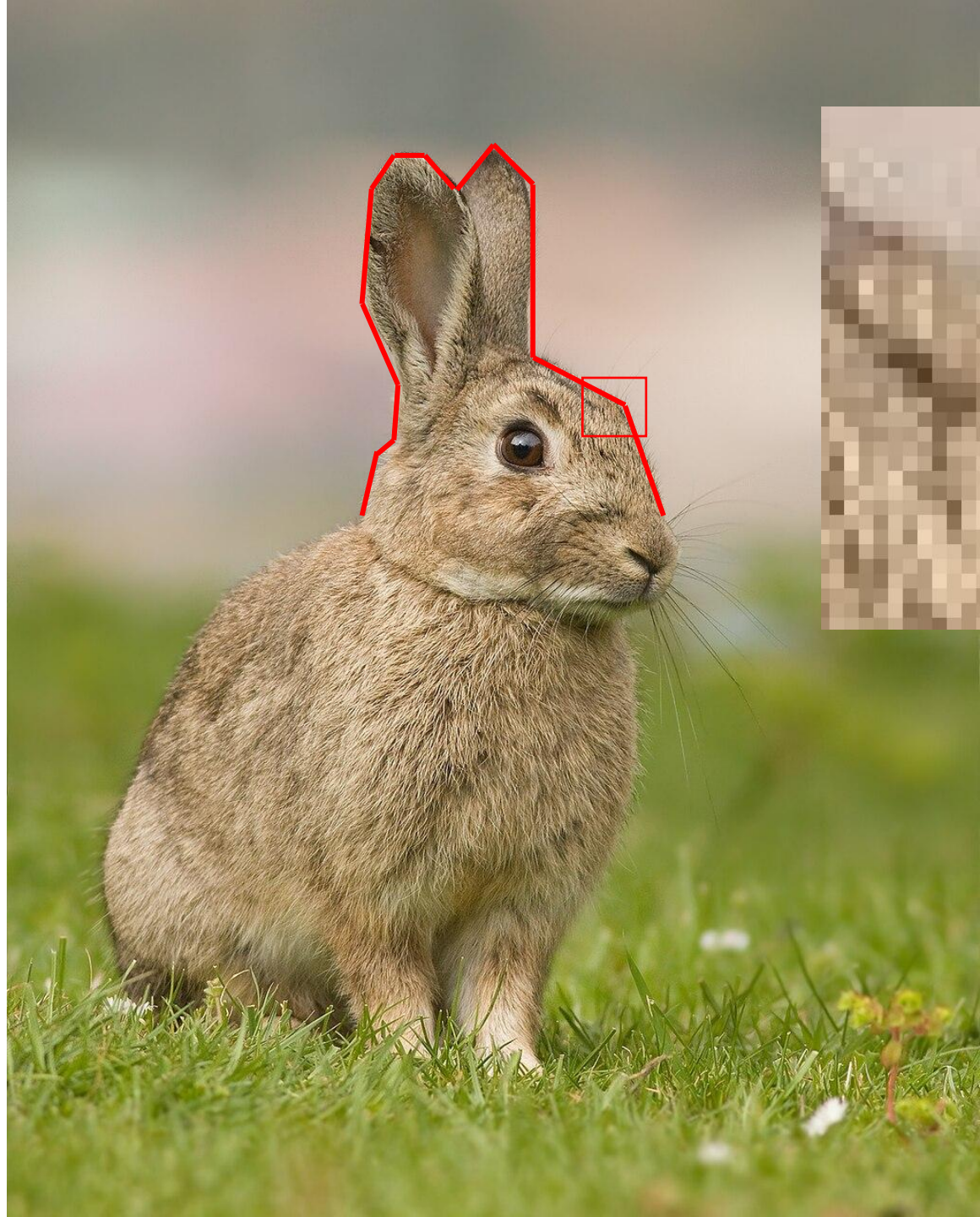
?



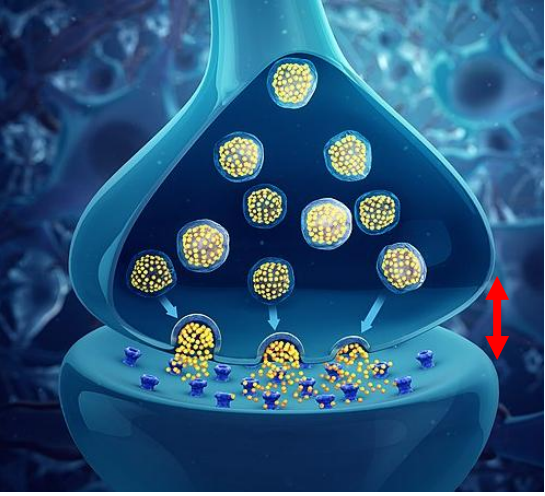
?



?



synapse



20 nm

$\frac{1}{50,000}$ mm

$\frac{1}{50,000}$ mm : 1 mm

10 cm : 5 km

