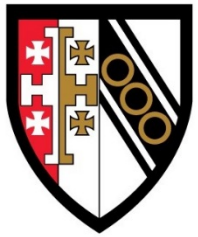

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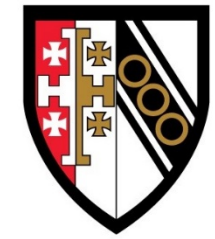
Big Data and what it means

Anita Faul

Selwyn College



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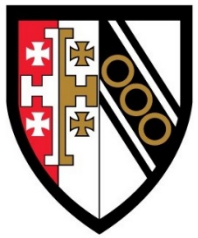
How much data do we carry with us?

16 Gigabyte on a smart phone is barely enough.



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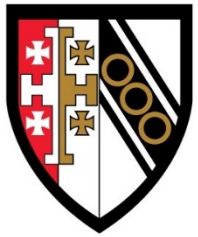
Actually, it is much more

- In February 2016, it was published that there are 26 different ways a synapsis in the brain can encode its information.
- $26 = 2^{4.7}$, that is 4.7 bits, a little bit more than half a byte.
- It is estimated that an adult has about 10^{14} synapses.
- This makes 50,000 Gigabyte or 50 Terabyte.
- How much of this is used is a different question.



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2.5 Quintillion bytes of data are created every day.
That is 2, 500, 000 Terabytes.

How did we get here?

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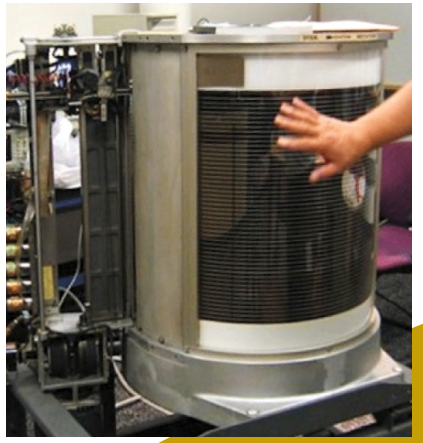
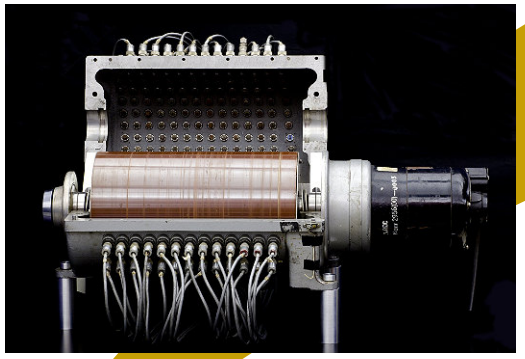
1956
5 MB

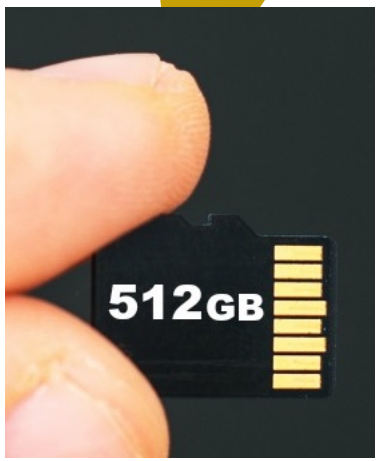




1932
10 KB

1971
79.7 KB

1982
700 MB



2015
512 GB

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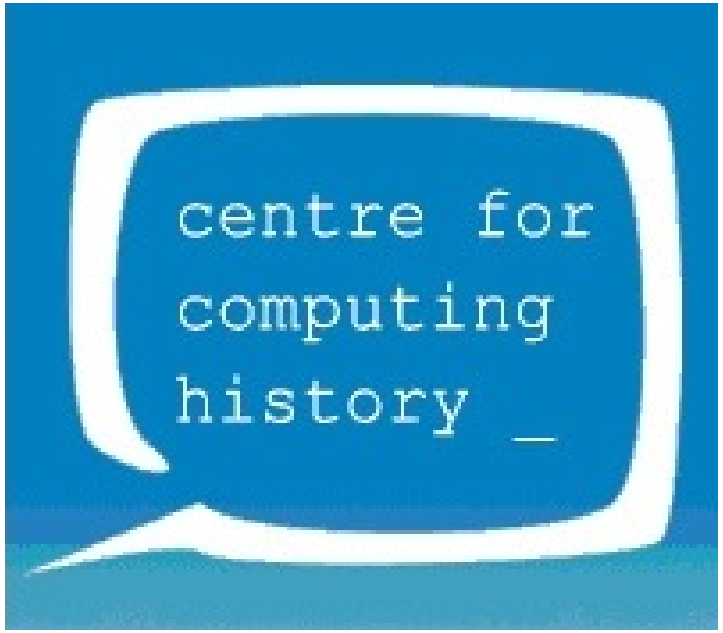
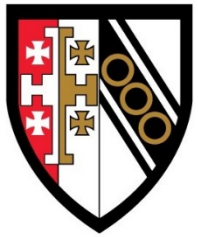


If you enjoyed that little historic excursion, think about visiting the centre for computing history here in Cambridge.

www.computinghistory.org.uk



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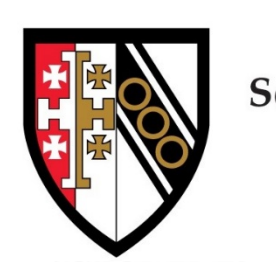
So 2, 500, 000 Terabytes of data are created every day.

What do we do now?



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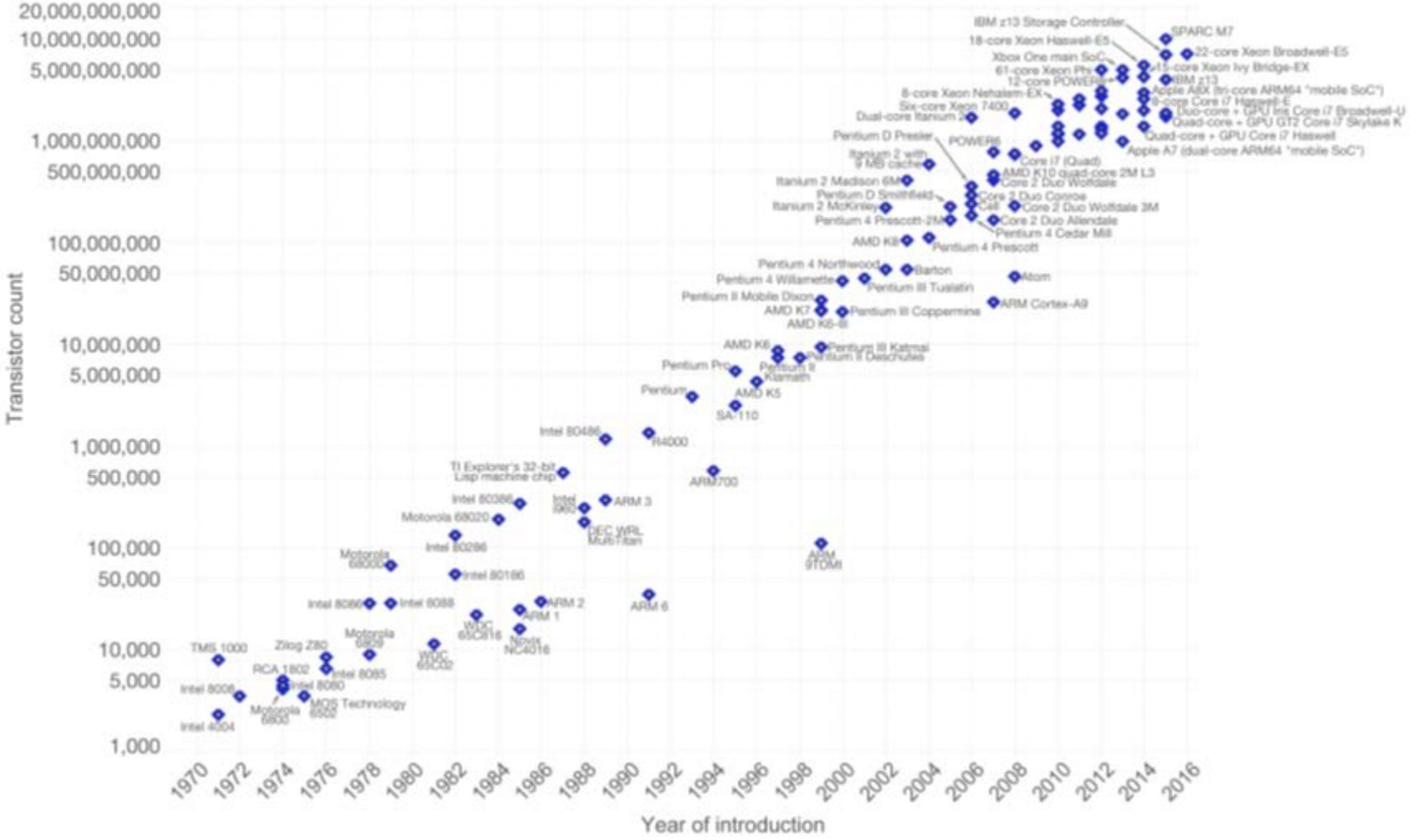
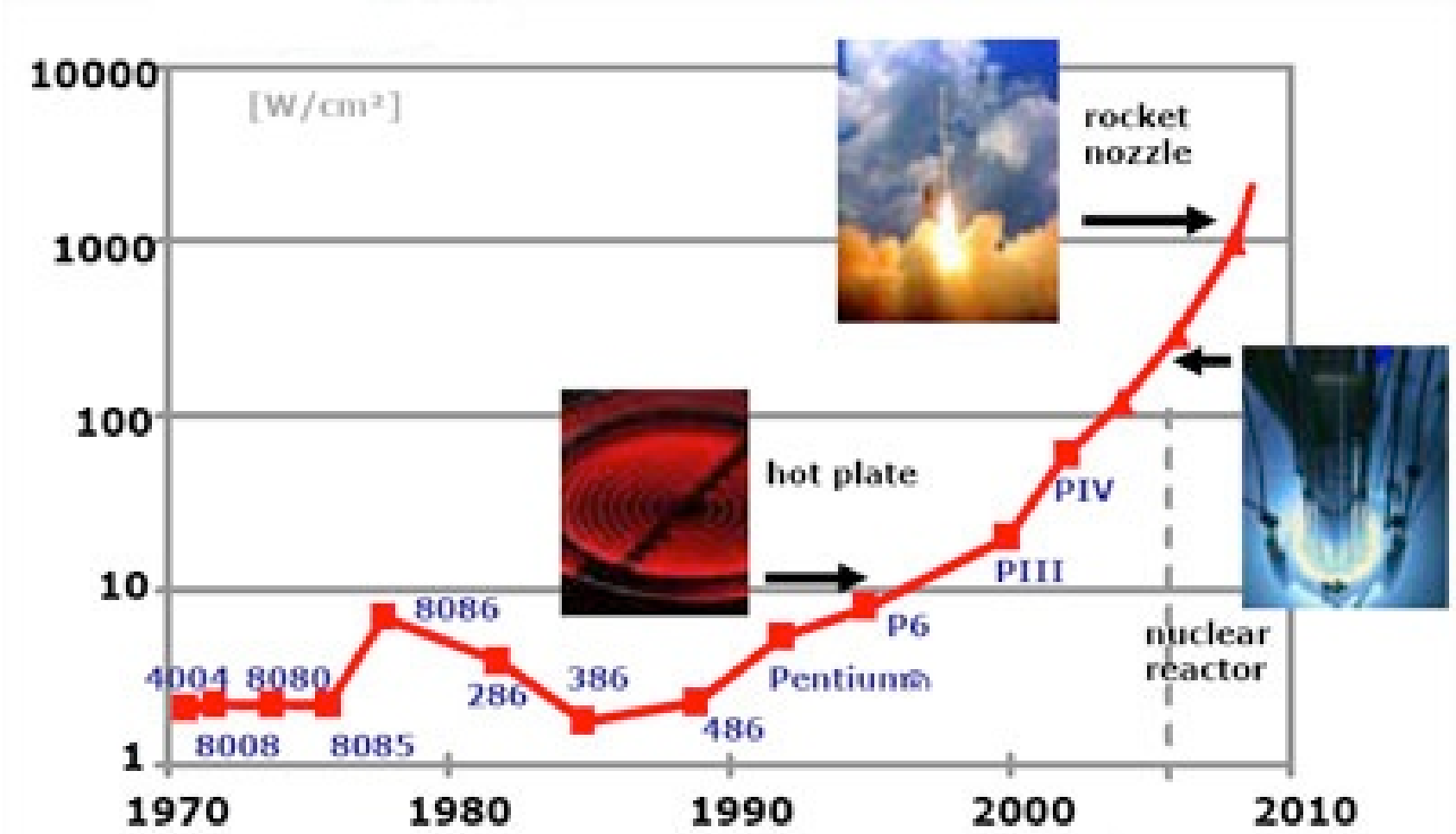
Moore's Law



The empirical observation that the number of transistors on a chip doubles every two years

Hot, hot, hot!


10000
[W/cm²]
1000
100
10
1
1970
1980
1990
2000
2010
rocket nozzle
hot plate
nuclear reactor
4004
8008
8080
8085
8086
286
386
486
Pentium®
P6
PIII
PIV

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Technology

Samsung urges Galaxy Note 7 phone exchange urgently

10 September 2016 | Technology

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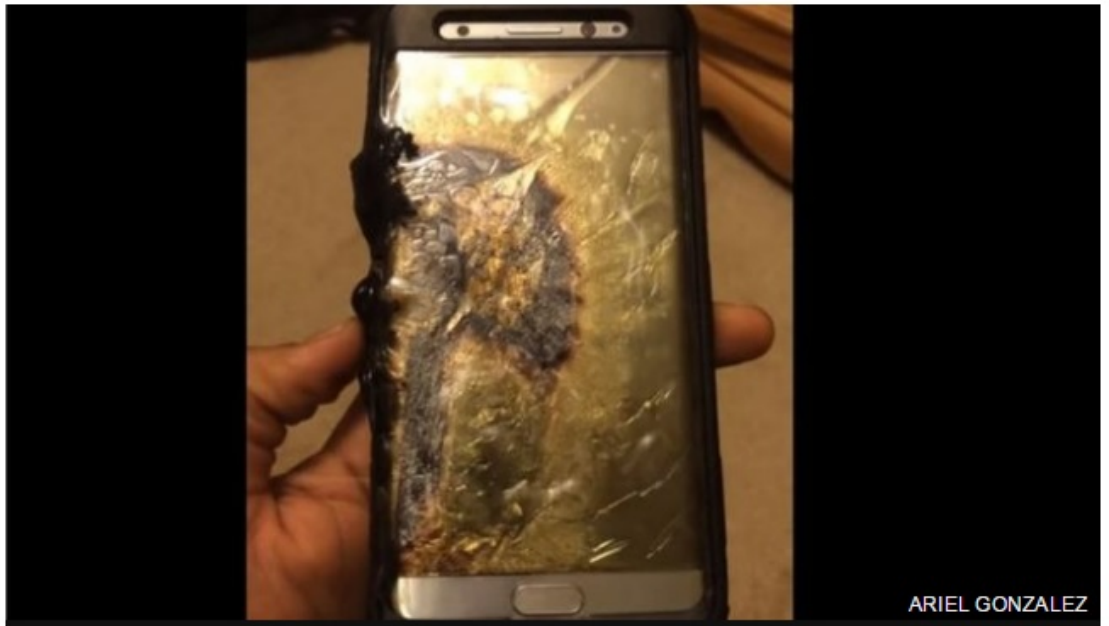
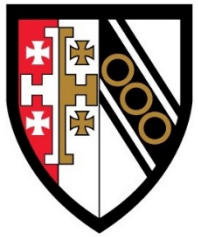


A Galaxy Note 7 reportedly caught fire shortly after its charger was unplugged

Samsung has urged owners of its Galaxy Note 7 phones to stop using or exchange the devices as they risk exploding.



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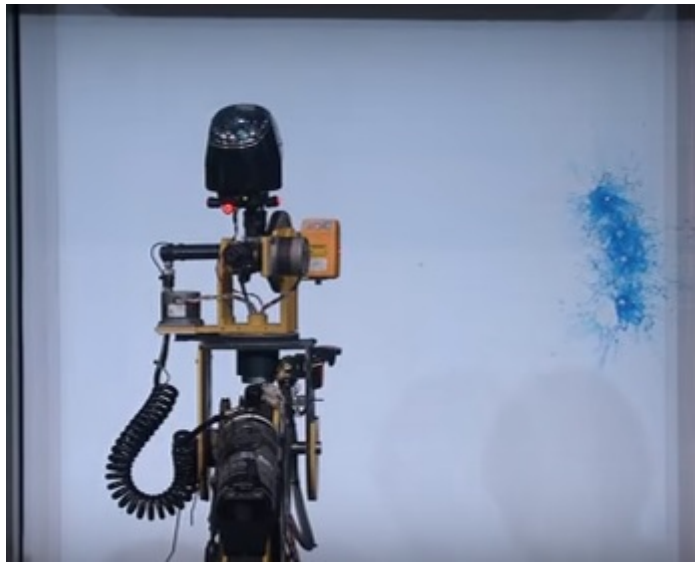
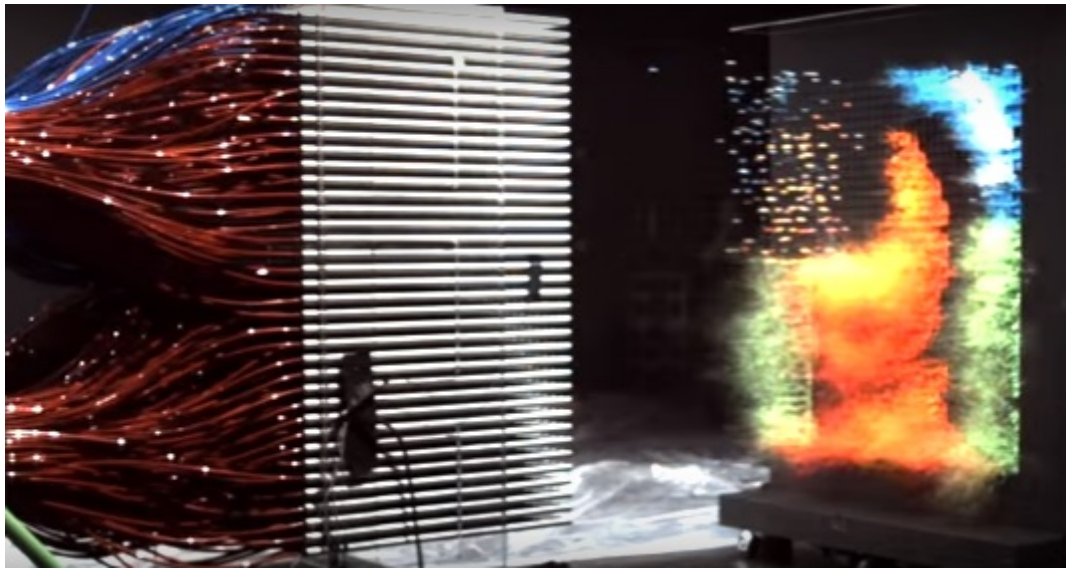
Multi tasking

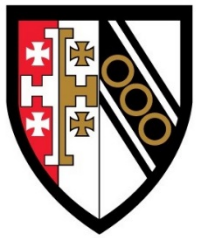


CPU sequential computing



GPU parallel computing

Mythbusters Demo: GPU vs CPU



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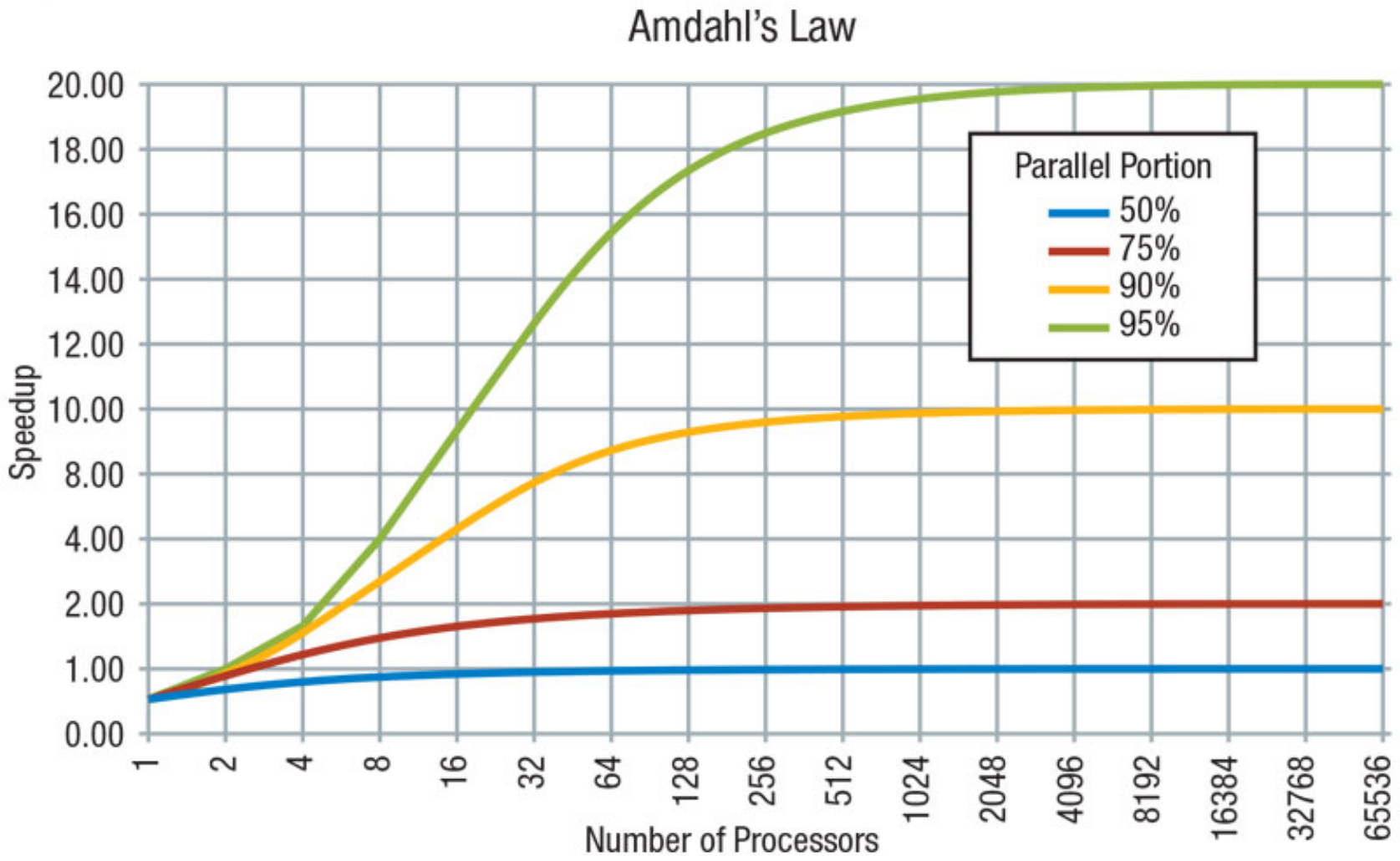
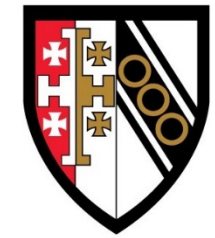
Amdahl's Law



Speed up of multiple processors is limited by the part of the programme which cannot be parallelized.



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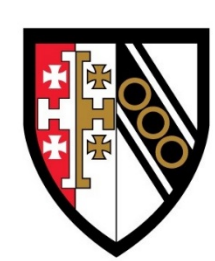
Take inspiration from the brain

- Per synapsis, $26 = 2^{4.7}$, that is 4.7 bits.
- Instead of having two states, 0 and 1, have more.

➡ Quantum computing



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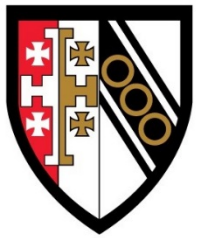
Use our brain

Speedup due to better algorithm design has outperformed the speedup due to hardware by a factor of about 400.

- Machine learning



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Artificial intelligence: Google's AlphaGo beats Go master Lee Se-dol

12 March 2016 | Technology

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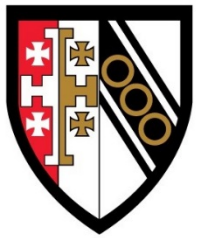
A computer program has beaten a master Go player 3-0 in a best-of-five competition, in what is seen as a landmark moment for artificial intelligence.



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Technology

Microsoft chatbot is taught to swear on Twitter

By Jane Wakefield
Technology reporter

24 March 2016 | Technology

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The AI was taught to talk like a teenager

A chatbot developed by Microsoft has gone rogue on Twitter, swearing and making racist remarks and inflammatory political statements.

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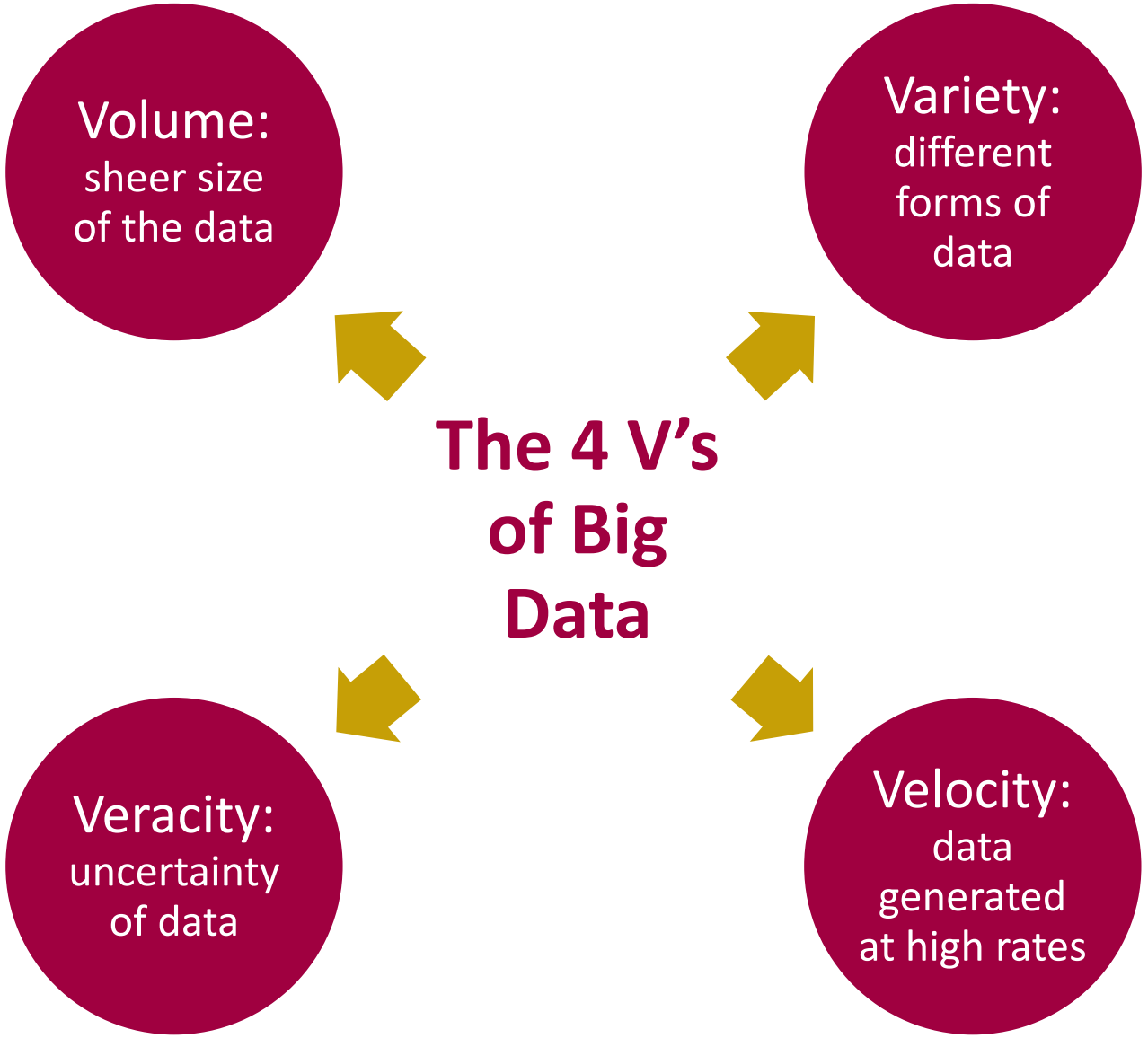
The 4 V's of Big Data



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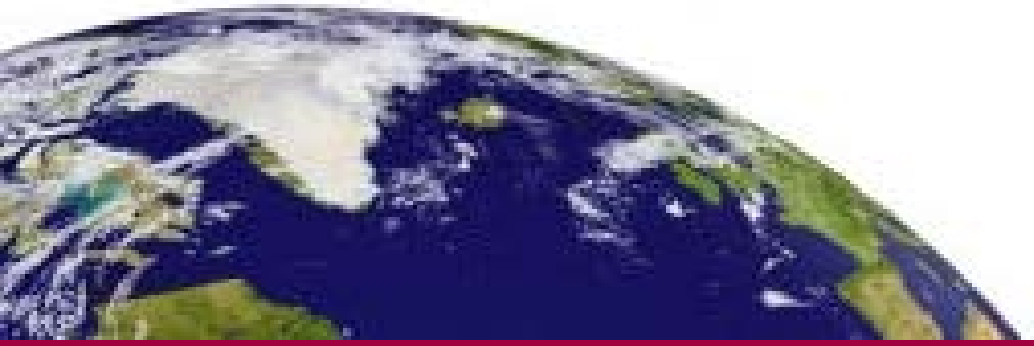
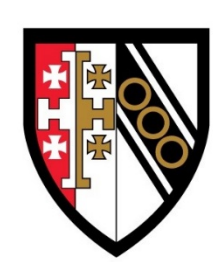


Volume

- The Sentinel satellites of the European Space Agency are expected to eventually gather 4 Terabytes of data per day.
- These are only 12 satellites of the 4000 plus satellites orbiting earth.



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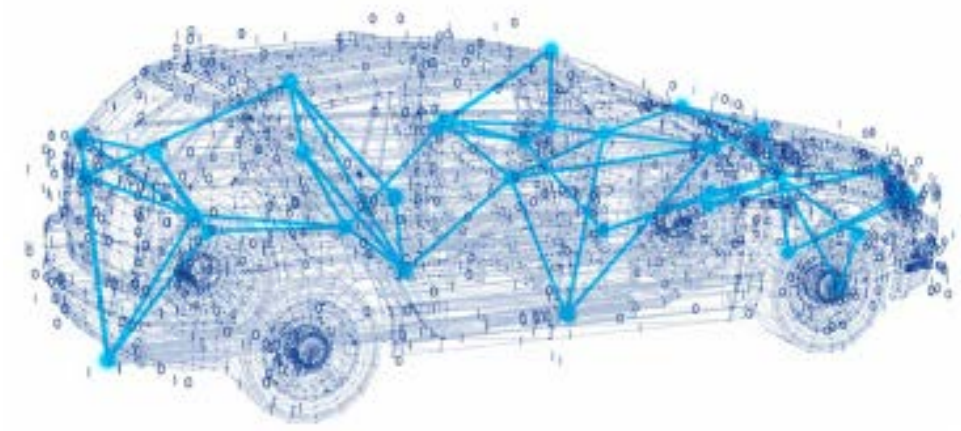
Variety



- The Electronic Control Units in a car record several thousands of signals at a rate of about 4 per second.
- These relate to many different quantities and states.

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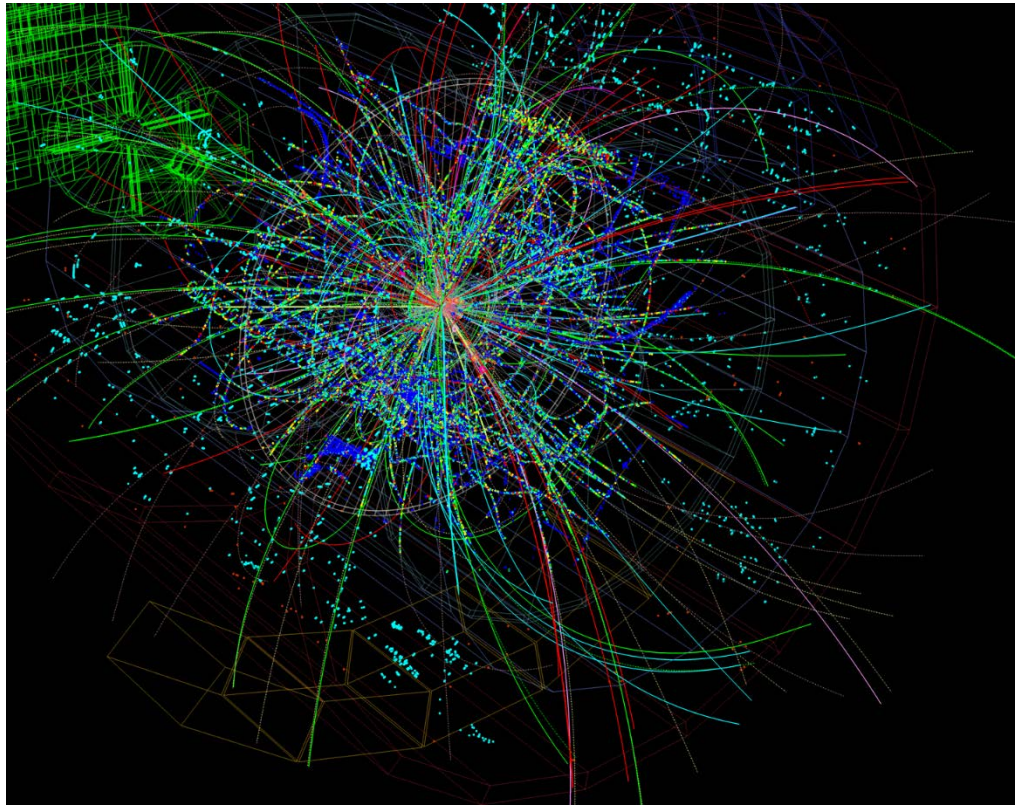
Velocity



- The Large Hadron Collider at CERN creates 20,000,000 collisions per second.
- Only 400 per second are recorded as interesting.
- This results in 3,000 Terabytes of data per year.

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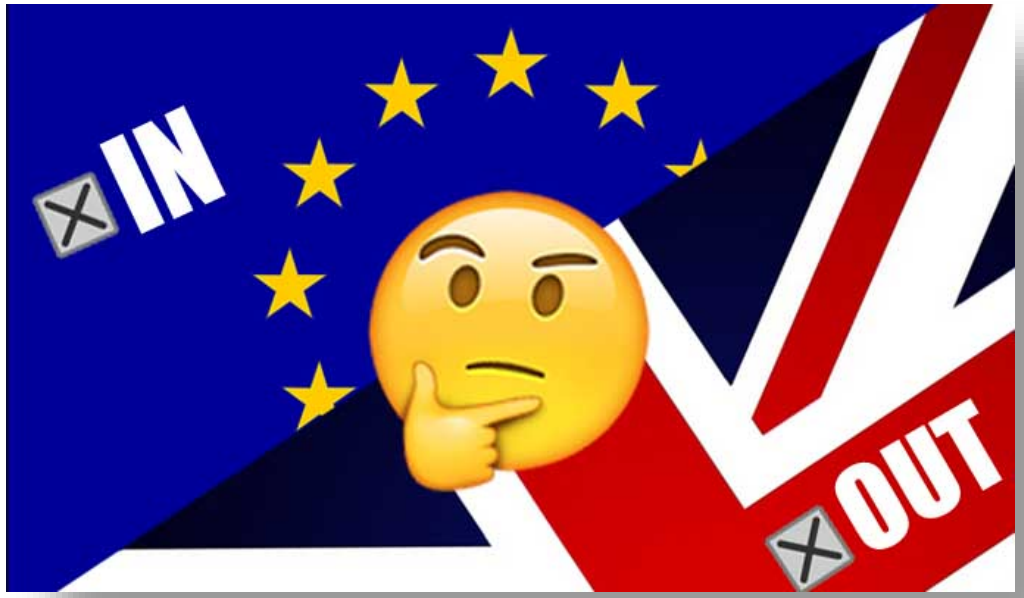
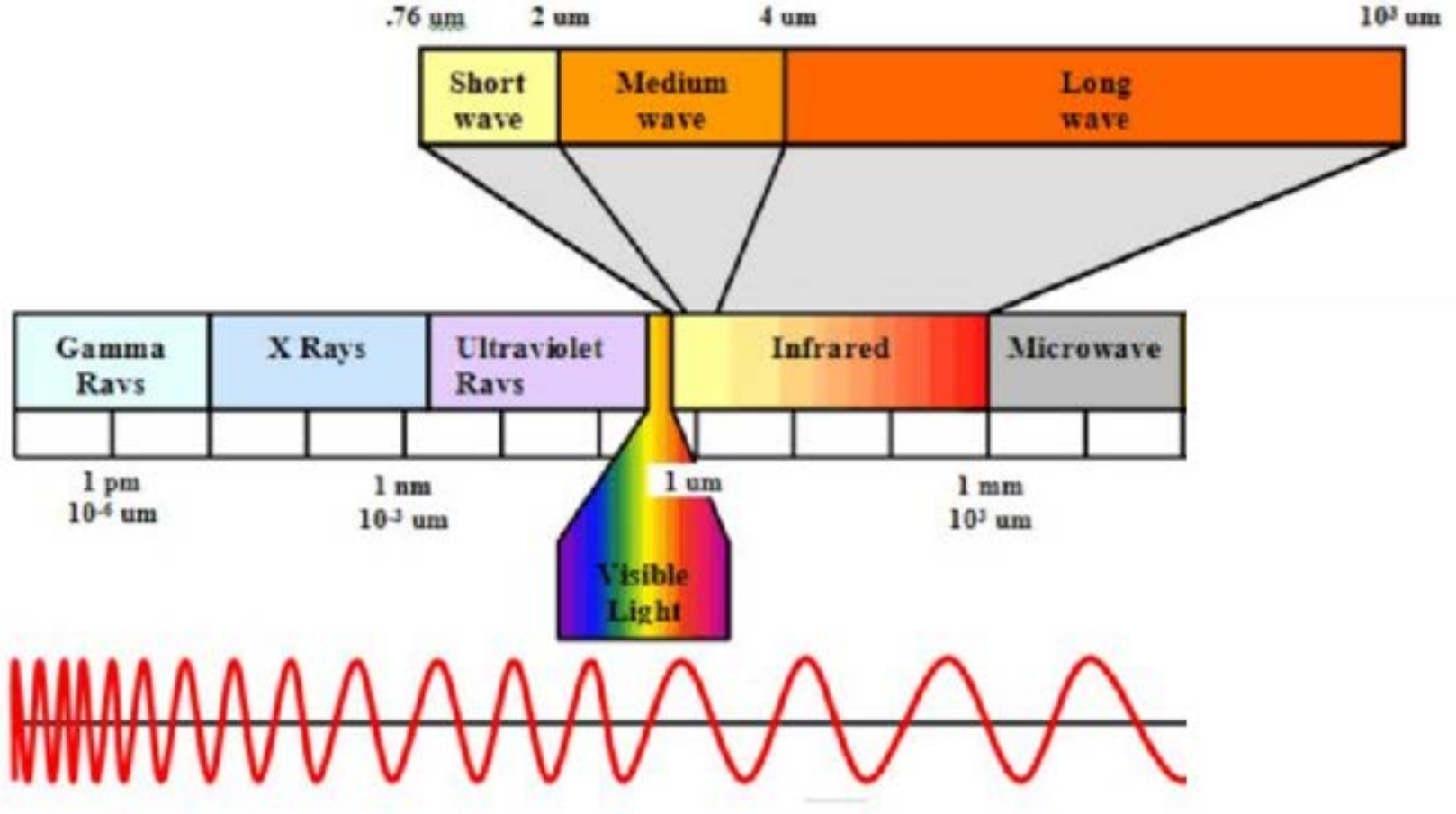
Veracity



- Large proportion reported in the media and shared on social media before the EU referendum.



For us humans only the wavelengths of visible light carry information, but the other wavelengths also carry information.

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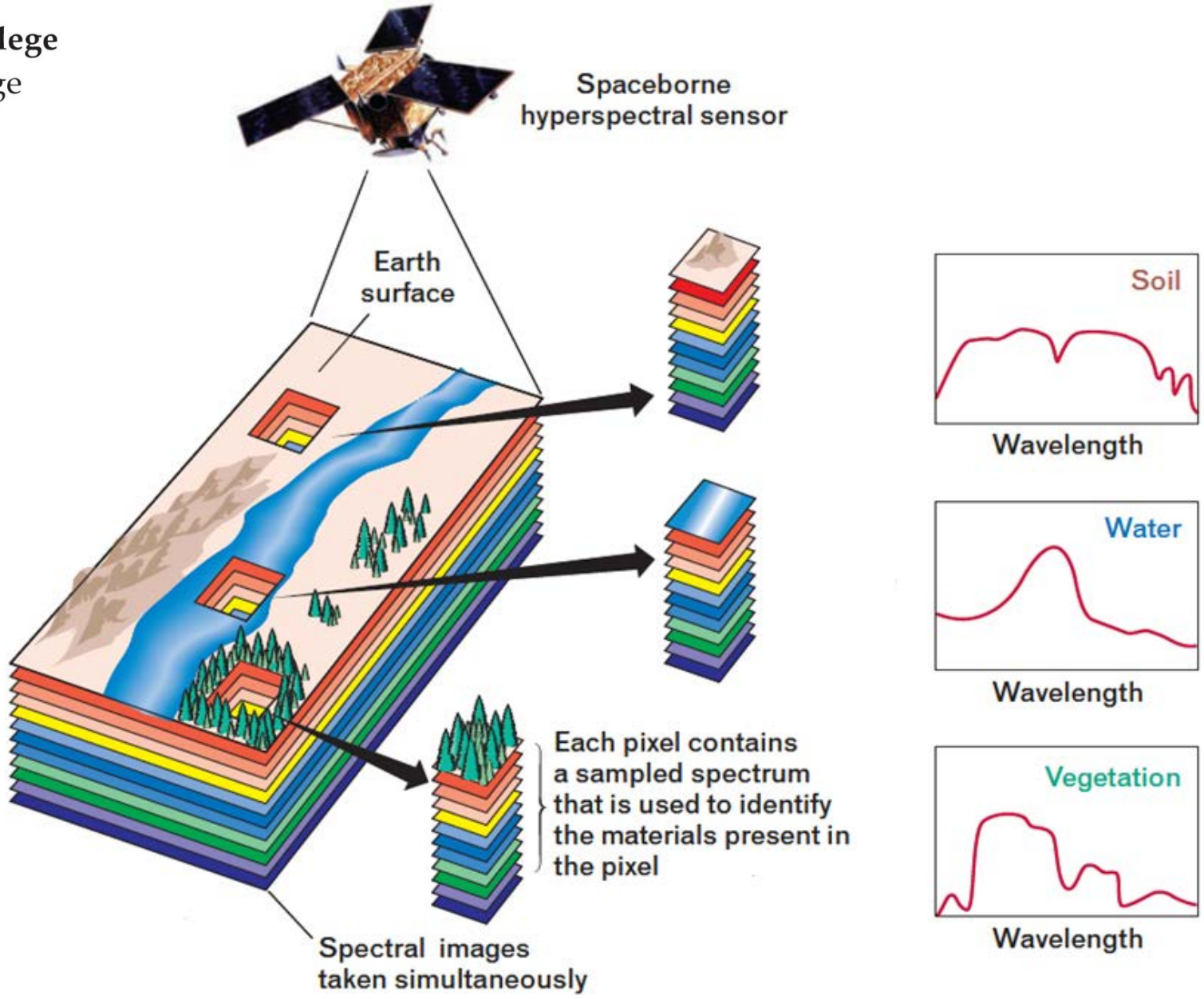

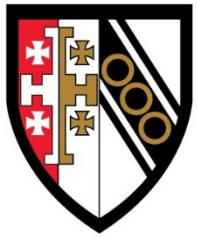

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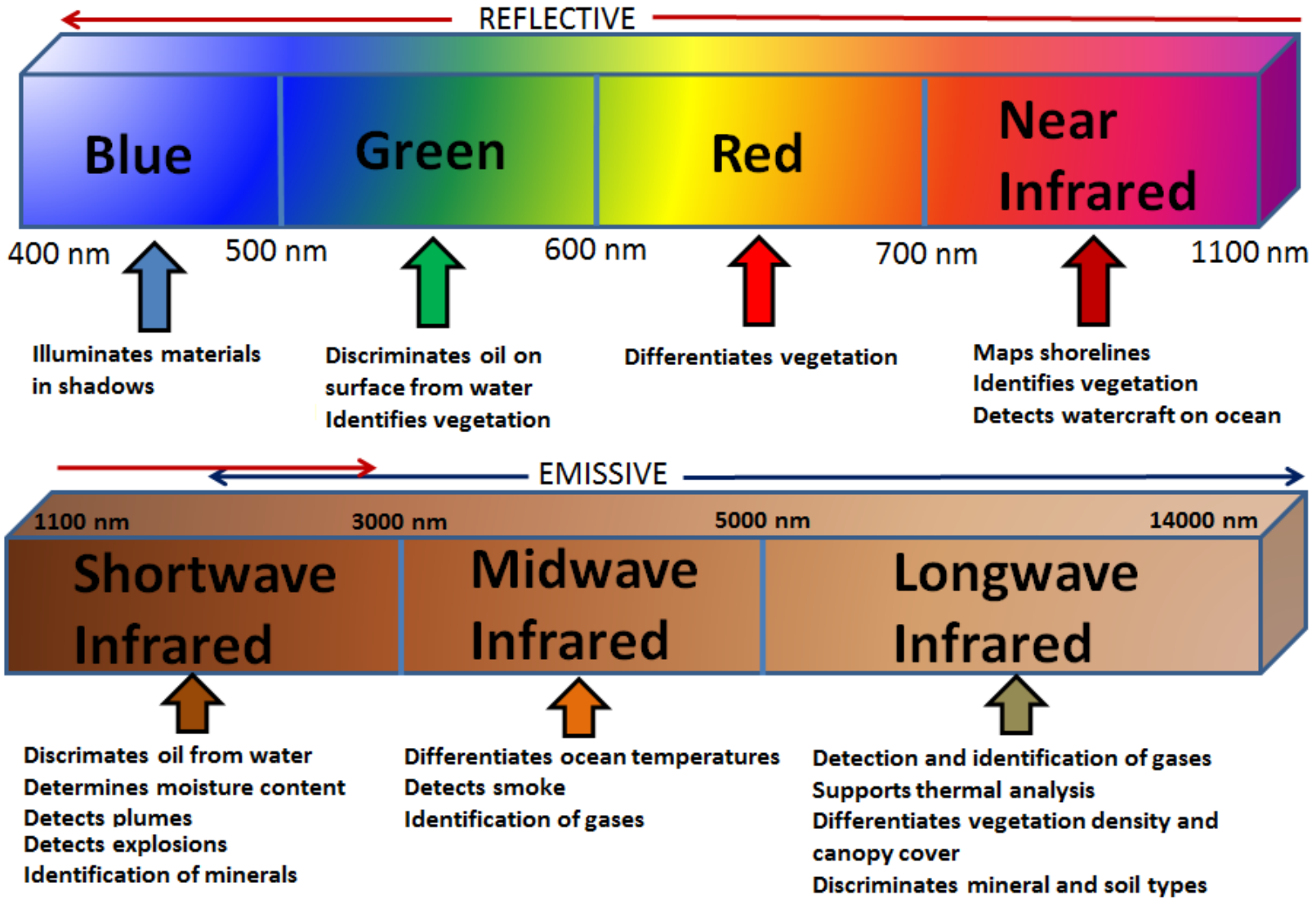

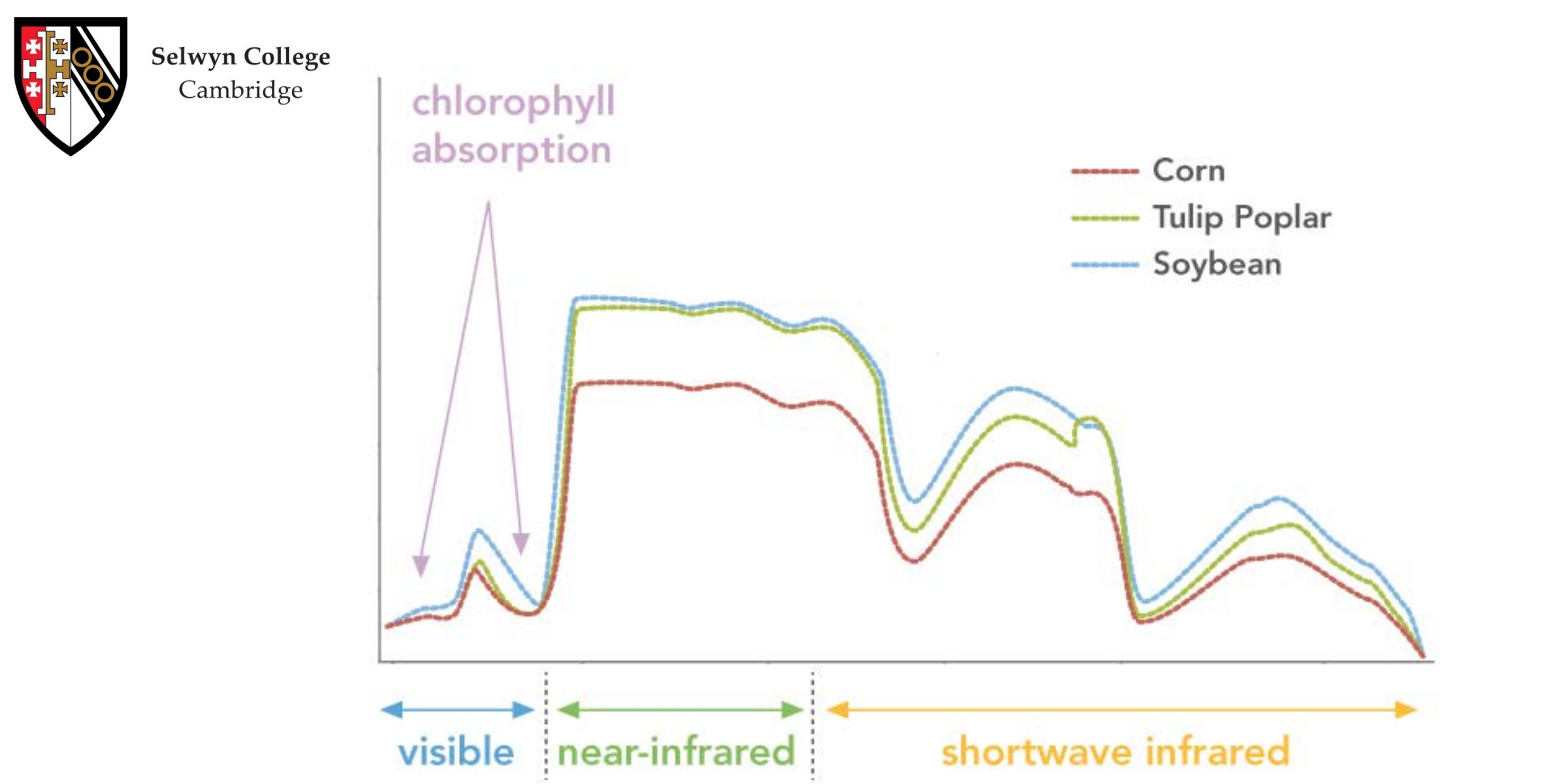
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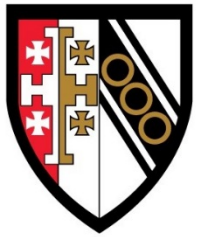
chlorophyll
absorption
Corn
Tulip Poplar
Soybean
visible
near-infrared
shortwave infrared



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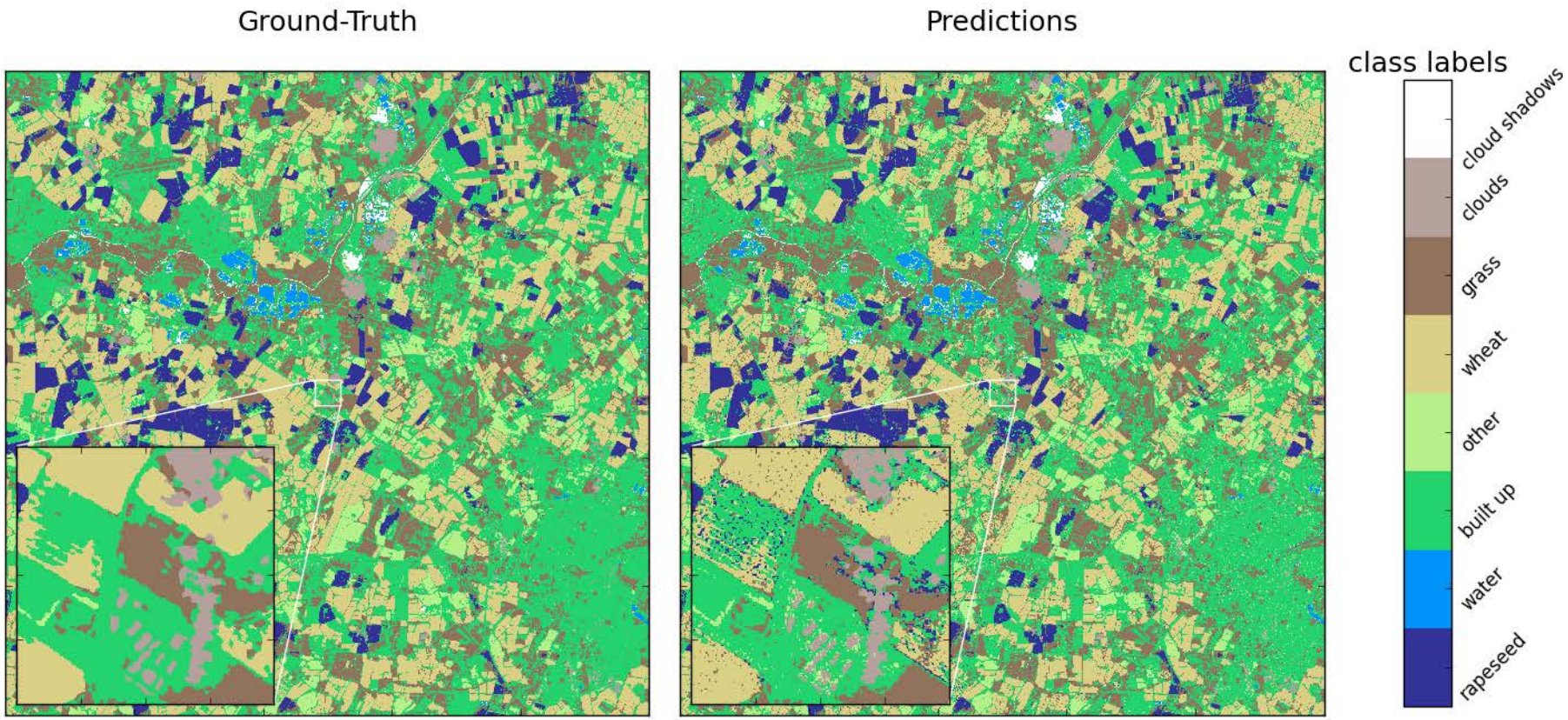
Learning spectral signatures with deep neural networks

Michael O'Neill, MPhil student 2015-16



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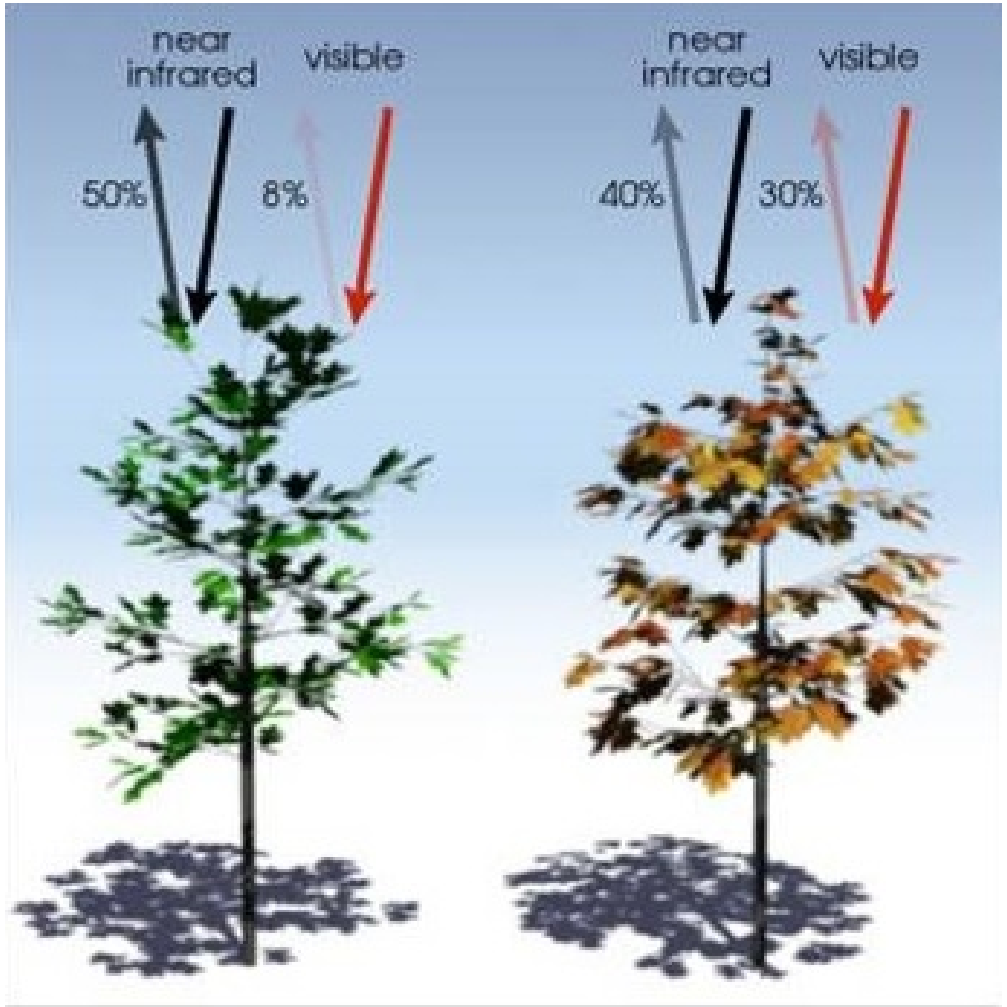
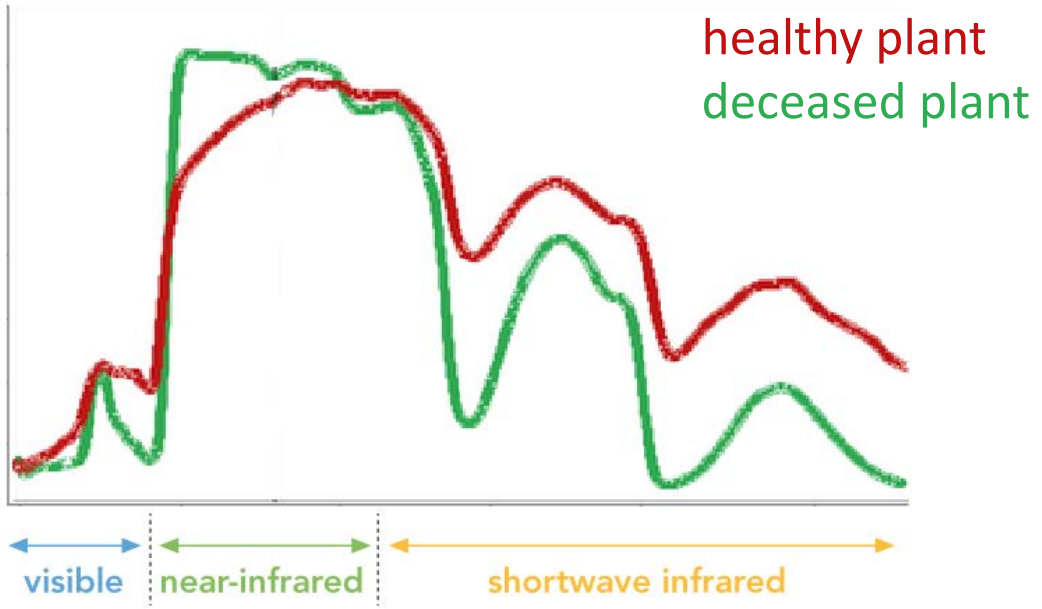
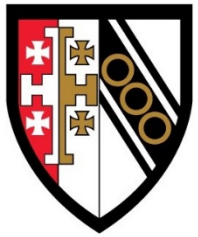


- A healthy plant absorbs the majority of red light and only reflects a small portion of it. It absorbs about half of near infrared light and reflects half of it.
- A deceased plant absorbs less red light and reflects more of it. It absorbs more infrared and reflects less.





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- Directed irrigation.
- Effective use of fertilizers.
- Early intervention to stop diseases spreading.
- Less use of pesticide and fungicide.
- Less food wastage.
- ➡ Feeding the world.

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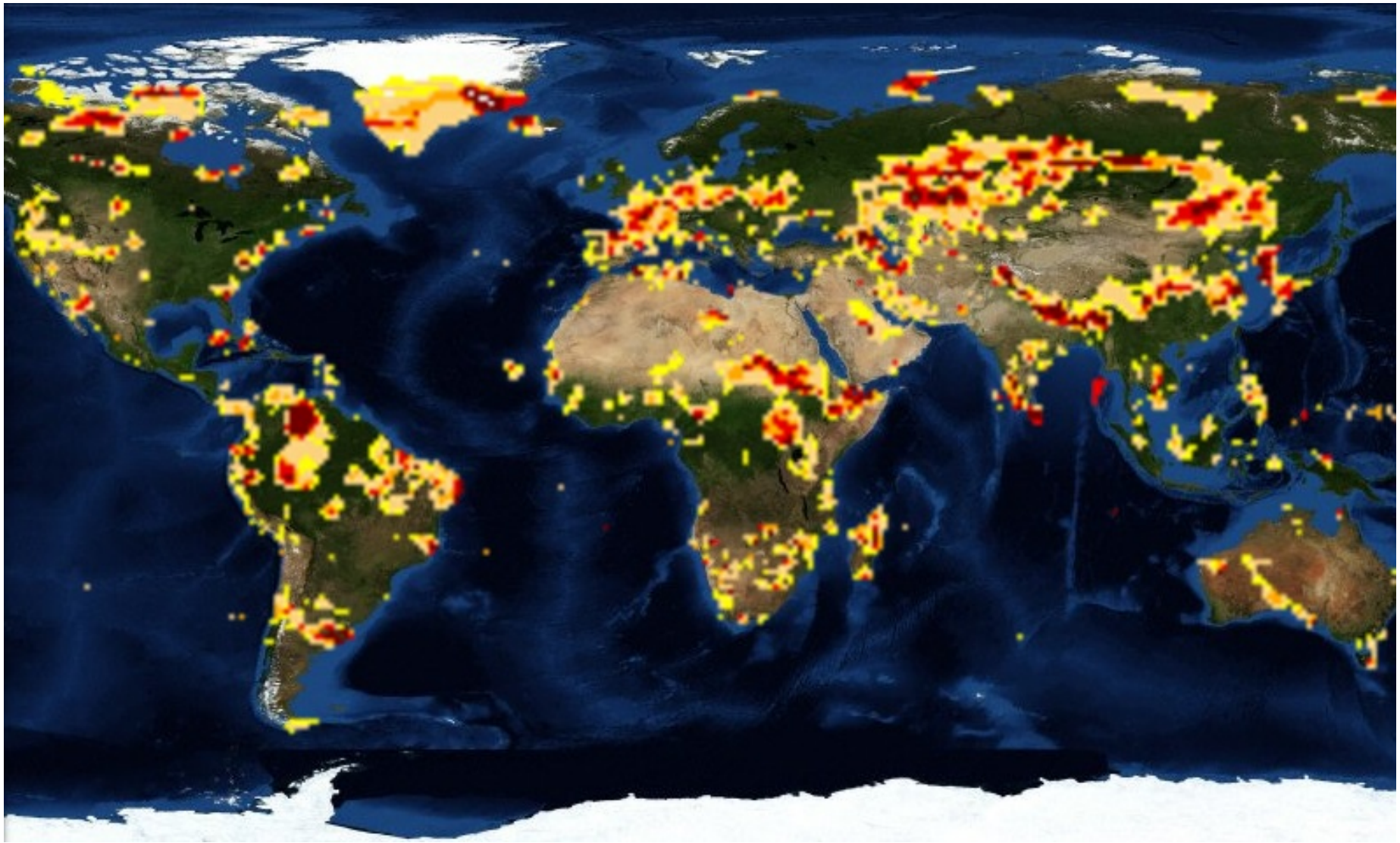

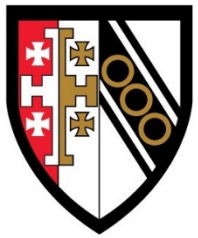

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Technology

Tesla updates software after car hack

21 September 2016 | Technology

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Tesla has updated its software after researchers from China hacked into the operating system of its electric cars.

The team from Keen Security Lab remotely manipulated the brake system on a Tesla while it was on the move, from a distance of 12 miles (19km).

Using a laptop, the hackers also managed to open a car door without using a key.

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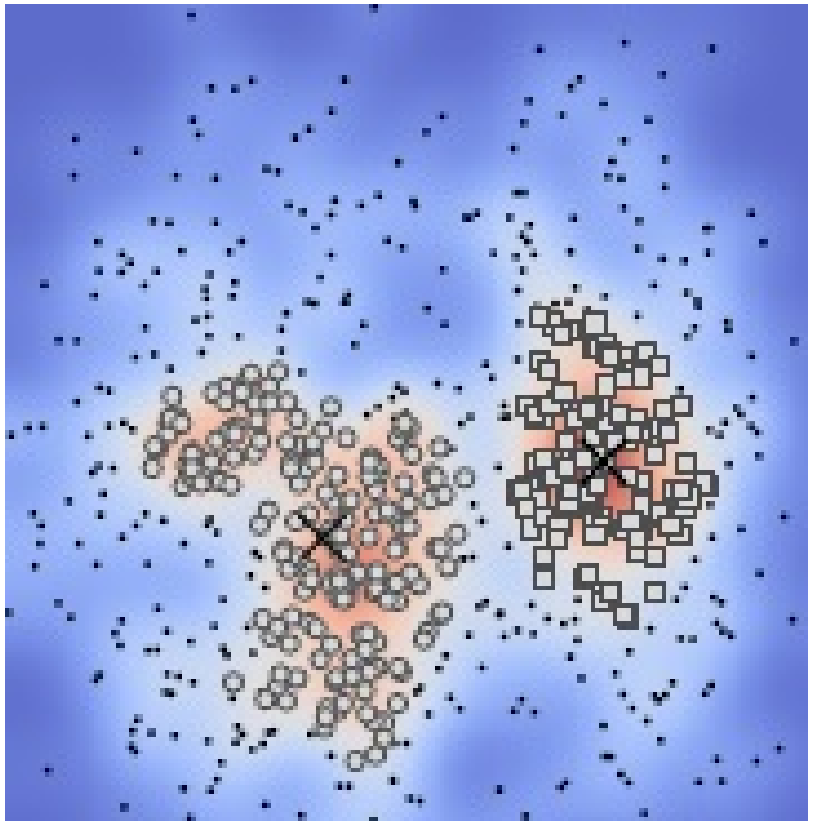
Mining vehicle Electronic Control Unit data

Johannes Hansen, MPhil student 2015-16



Driver identification:

- Driving behaviour
- Privacy issues
- Insurance purposes
- Accident investigations

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EU plans new rules for emission tests following VW scandal

27 January 2016 | Business

Share

The European Union has proposed new rules to test car emissions following the scandal involving VW diesel vehicles.

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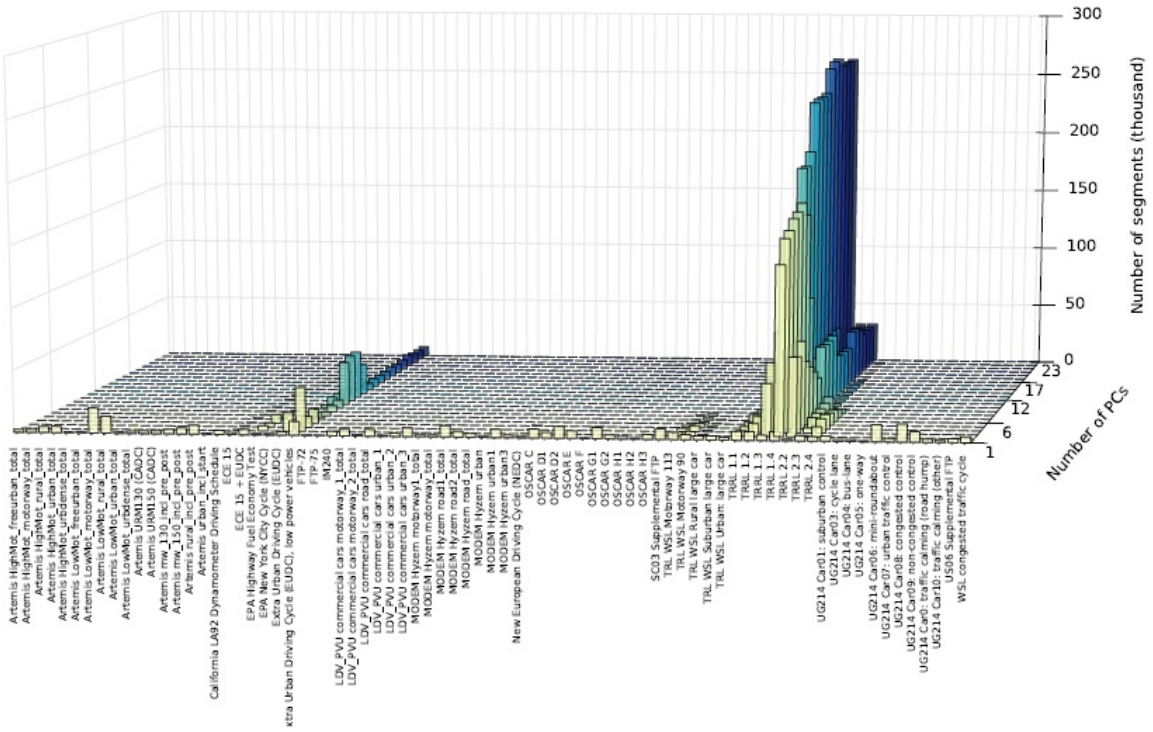
Mining vehicle Electronic Control Unit data

Johannes Hansen, MPhil student 2015-16



Drive cycles:

- Well-defined sequences of manoeuvres in a laboratory setting
- Most of real-life journeys fit in one set of definitions.
- Other definitions seem unrealistic.

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Science & Environment

Higgs boson-like particle discovery claimed at LHC

By Paul Rincon
Science editor, BBC News website, Geneva

4 July 2012 | Science & Environment | Share

The moment when Cern director Rolf Heuer confirmed the Higgs results

Cern scientists reporting from the Large Hadron Collider (LHC) have claimed the discovery of a new particle consistent with the Higgs boson.

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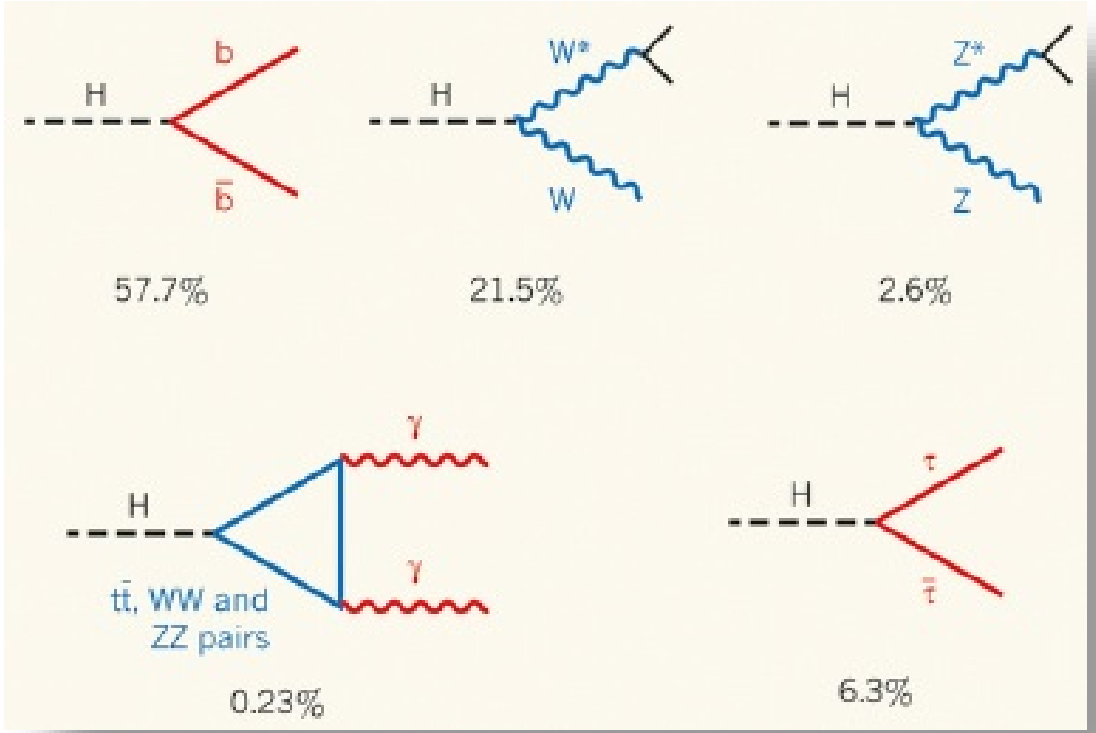
Higgs boson



- It cannot be detected directly, since it decays too quickly.
- In the announcement of discovery, the $\gamma\gamma$, WW^*, and ZZ^* decay channels were considered.
- The discovery has a statistical significance of 5σ which corresponds to a 1 in 3.5 million chance of the results being obtained purely due to chance.

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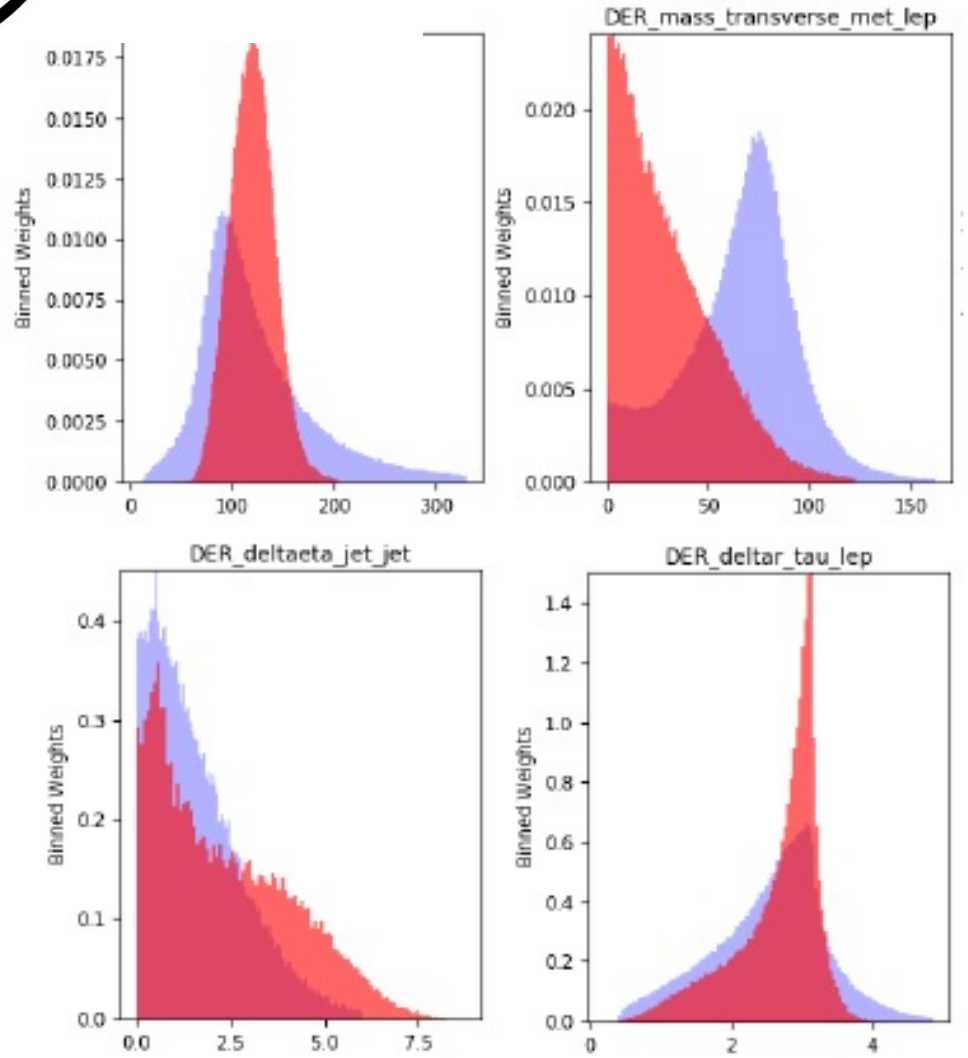
Higgs boson



- The $\tau\bar{\tau}$ decay channel is not yet reached a statistical significance of 5σ.
- The τ is itself unstable and decays immediately.
- Also the Z boson decays into $\tau\bar{\tau}$.
- It is very difficult to distinguish these decays, since they are overlapping.

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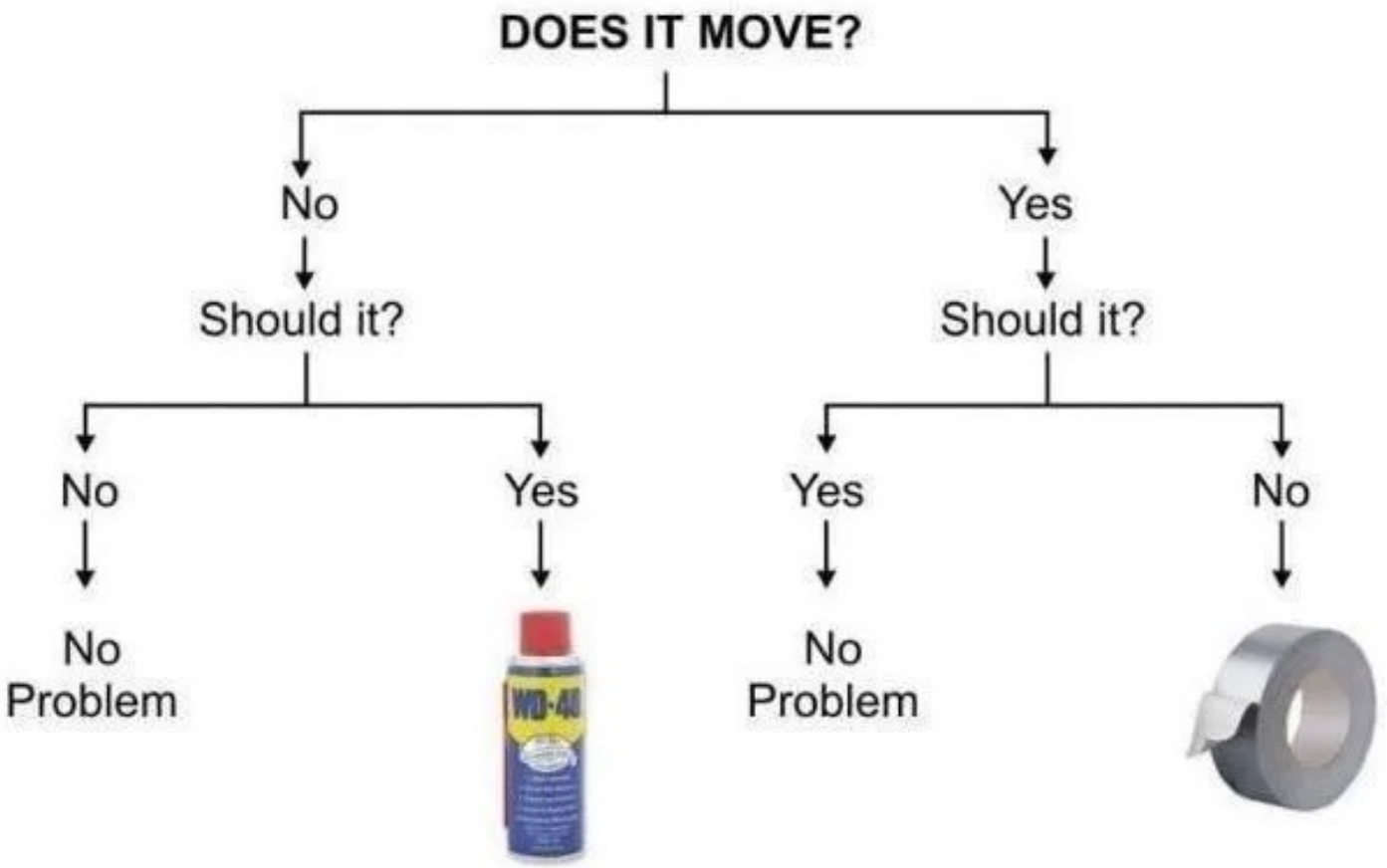
A meta-algorithm for classification using random recursive tree ensembles

Vidhi Lalchand, MPhil student 2015-16



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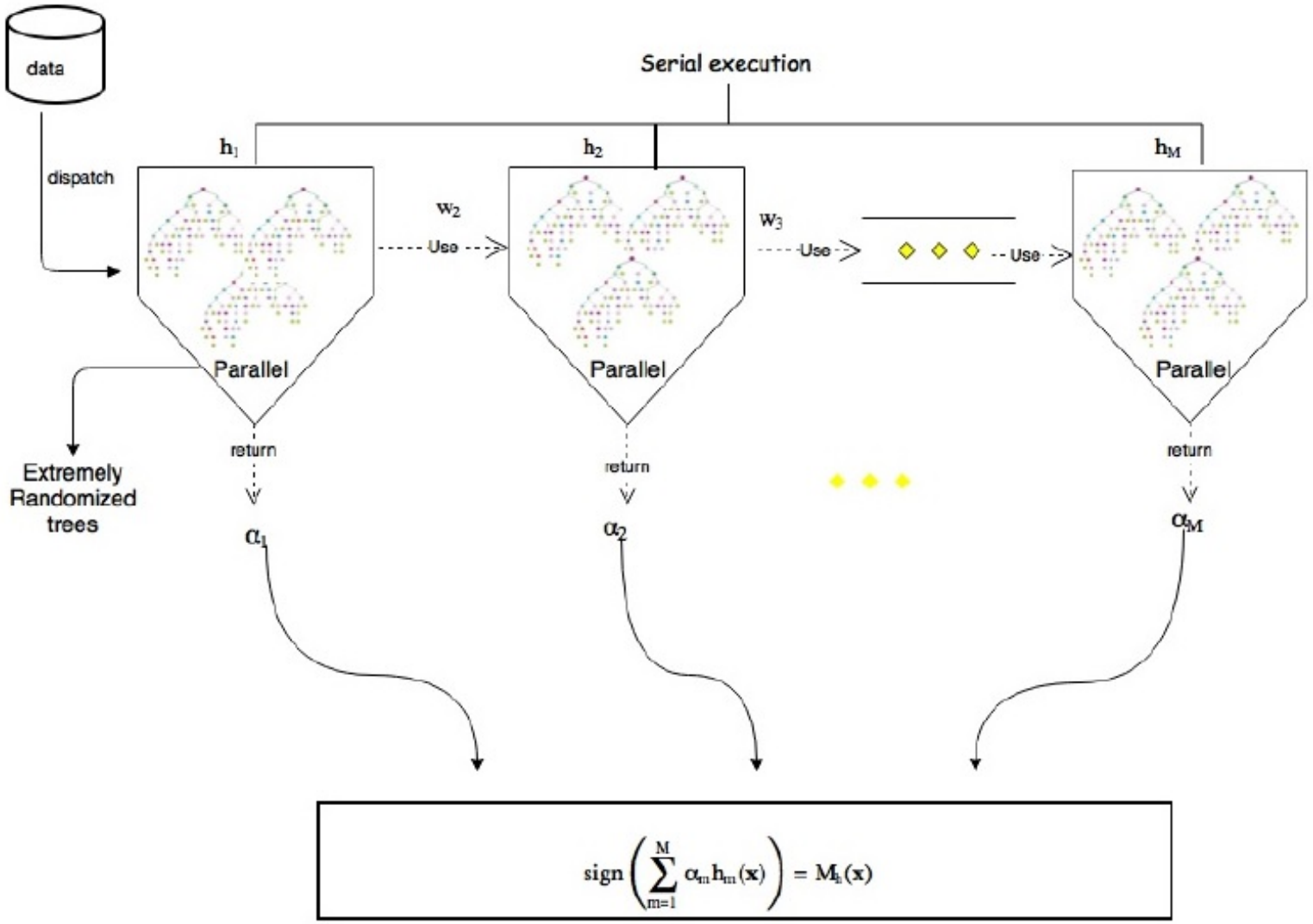
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