Demystifying Machine Learning

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0. Talk outline

1. Explain the reasoning behind my talk
2. Defining AI, ML and any other buzzwords you might want clarified
3. Exploring some examples of Machine Learning
4. Dive down the rabbit hole of Machine Learning using Neural Networks
5. ~~Train and test a Neural Network LIVE!~~ (we can do this after if we have time ☺)
6. Take a look at what a Neural Network looks like in Python
7. Explain why ML has become so popular in recent years
8. Explain what issues ML and increased AI involvement brings to our every day lives
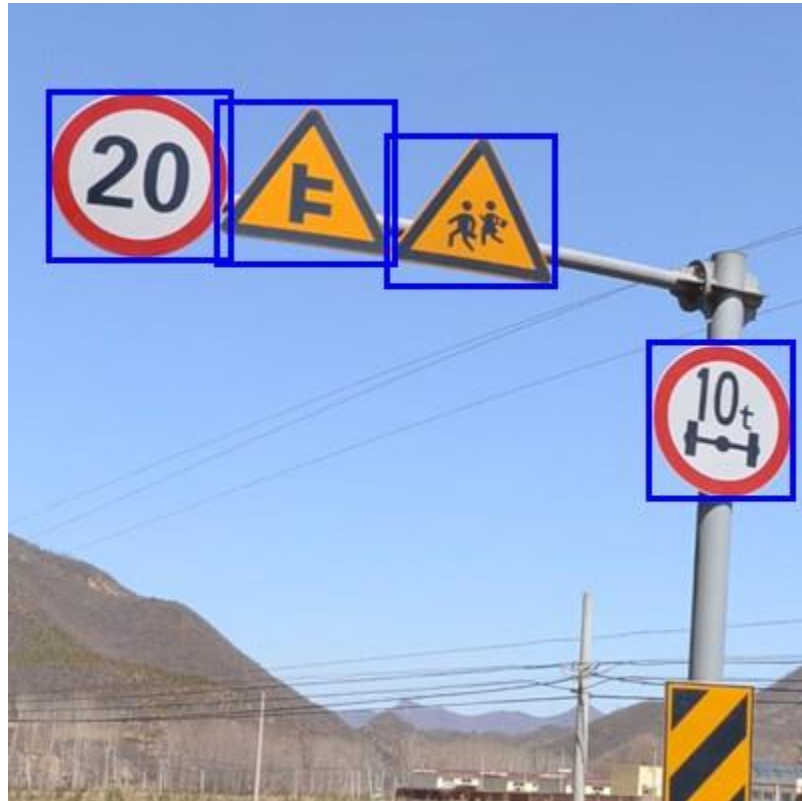9. Concluding thoughts

1. Reasoning

- It is out there, whether you like it or not

- You are affected by it, whether you like it or not

- You should be informed, so you can avoid:
  - Propagating false information
  - Getting worried and scared when you don't need to
  - Believing the robot uprising is imminent

- Understanding the simplicity behind something that seems like magic
  - Software is magic, until you learn what it really is
  - AI is magic to people in software, until they learn what it really is

2. AI vs ML vs Blockchain vs (insert buzzword)

- AI: Artificial Intelligence
  - Weak vs Strong
  - Three aims
- ML: Machine Learning
  - Learning system
    - Supervised
    - Unsupervised
    - Reinforcement
- Blockchain
  - Nothing at all to do with AI or ML
  - No you do not need one
- Other buzzwords
  - Raise your hand if you want any of them explained
  - I'll do my best to answer
  - If not now, find me later and we'll discuss it further

3. Machine Learning Examples

• Detecting and Recognising Traffic Signs

TO COMPLETE YOUR REGISTRATION, PLEASE TELL US WHETHER OR NOT THIS IMAGE CONTAINS A STOP SIGN:

NO   YES

ANSWER QUICKLY—OUR SELF-DRIVING CAR IS ALMOST AT THE INTERSECTION.

SO MUCH OF "AI" IS JUST FIGURING OUT WAYS TO OFFLOAD WORK ONTO RANDOM STRANGERS.

3. Machine Learning Examples

- Defeating the best human Chess and Go players

3. Machine Learning Examples

- Efficiently inpainting faces and scenes
- https://www.youtube.com/watch?v=gg0F5JjKmhA

4. Diving into the rabbit hole

- How does a machine learn?
  - Depends on the machine…
- One method is using Artificial Neural Networks
- So are we making artificial brains??

4. Diving into the rabbit hole

- Biological Neuron
  - Input into Synapses
  - Neuron internal structure decides whether it fires based on inputs
  - Neuron fires (or does not fire) out the Axon
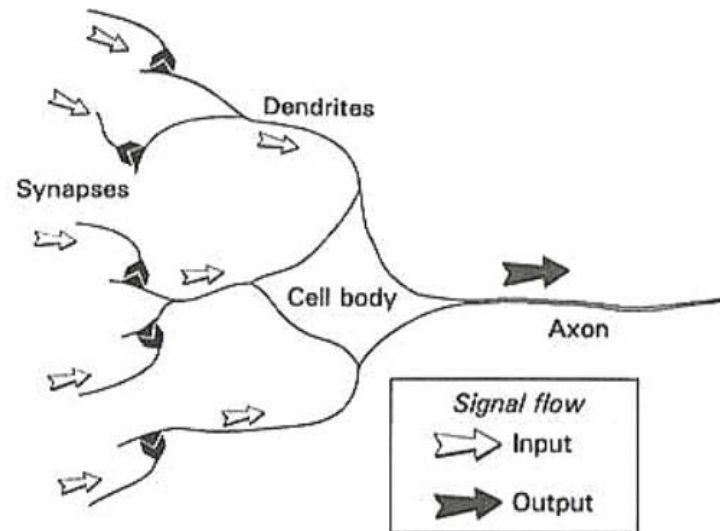
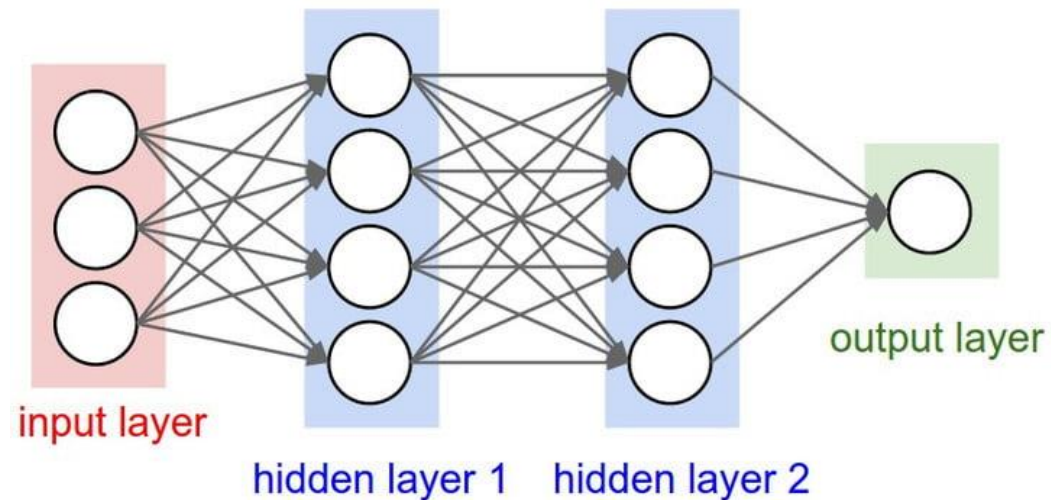# 4. Diving into the rabbit hole

- Biological Neural Network
  - Several Neurons connected together
  - Axon output acts as input to other Synapses
  - Human brains have around 80 billion neurons

4. Diving into the rabbit hole

- Artificial Neuron
  - Inspired by Biological Neurons
    - Not necessarily a simulation of one
  - Input is a NUMBER
    - Integer (such as 1, 0, 5, -3, etc)
    - Decimal (such as -0.344, 0.55, 1.420, etc)
  - Neuron decides whether to fire depending on its internal structure
    - Net function (how it interprets inputs)
    - Activation function (what the output will be depending on the net value)
  - Neuron outputs the result of the activation function

4. Diving into the rabbit hole

- Artificial Neural Network
  - Several Artificial Neurons "connected" together
    - Since they're just running instructions, they're not actually physically connected
  - Activation value of one neuron acts as input value of next
  - ANNs typically have tens to thousands of neurons

input layer

hidden layer 1   hidden layer 2

output layer

4. Diving into the rabbit hole

- Artificial Neural Network Uses
  - Prediction
    - What is the temperature given arbitrary inputs?
  - Classification
    - Which kind of road traffic sign is this?

5. ~~Lets train a Neural Network live!~~

- ~~I need a volunteer~~
    - ~~You only need 5 fingers~~
- ~~We will train a neural network to recognise how many fingers you are holding up~~
- ~~If you're interested in how I did it:~~
    - https://github.com/purrcat259/how-many-fingers
- Maybe we'll do this one after if there is time ☺

6. Sample Neural Network in Python

- I found an example which uses Keras and I will use Tensorflow as a backend
- Say what??
- Tensorflow
  - The library which handles the creation and operation of the network
- Keras
  - A library which makes definition of a neural network much simpler
  - It interfaces with a backend to do the actual computation of the network
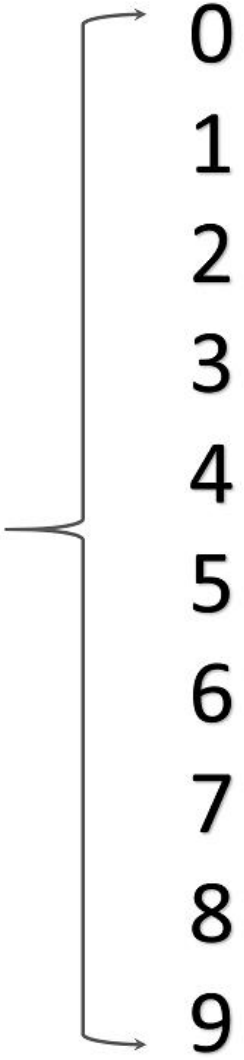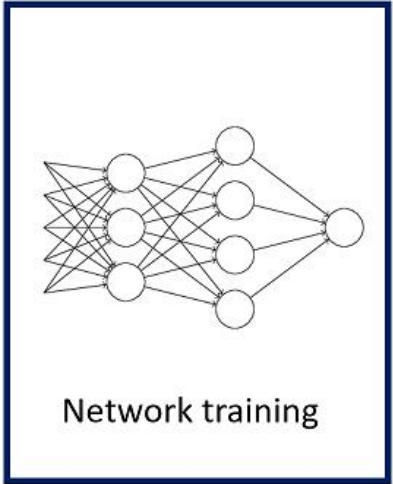 - It can use a variety of backends
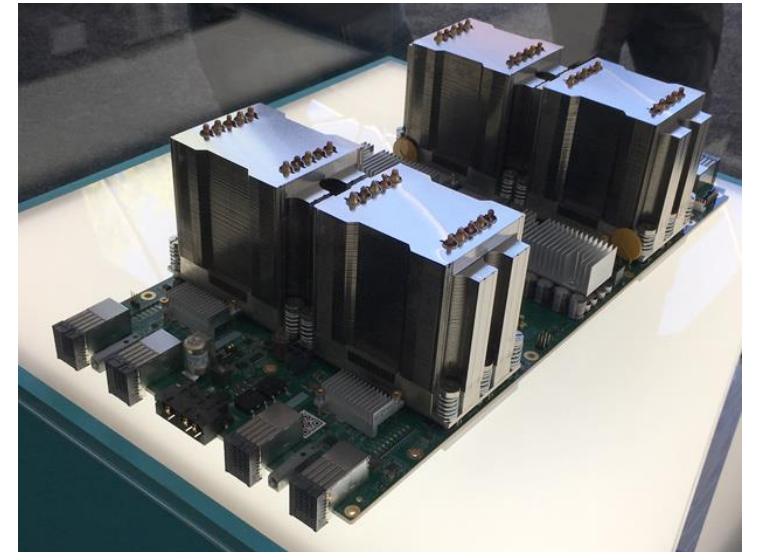   - One of which is Tensorflow

MNIST

MNIST

Data & Labels
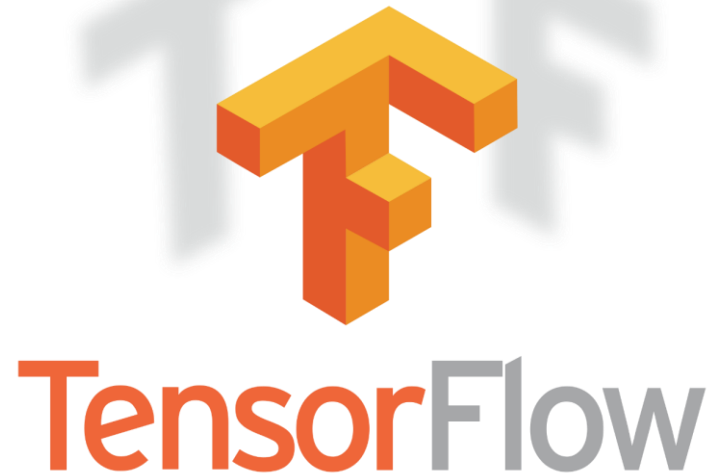
Network training

0
1
2
3
4
5
6
7
8
9
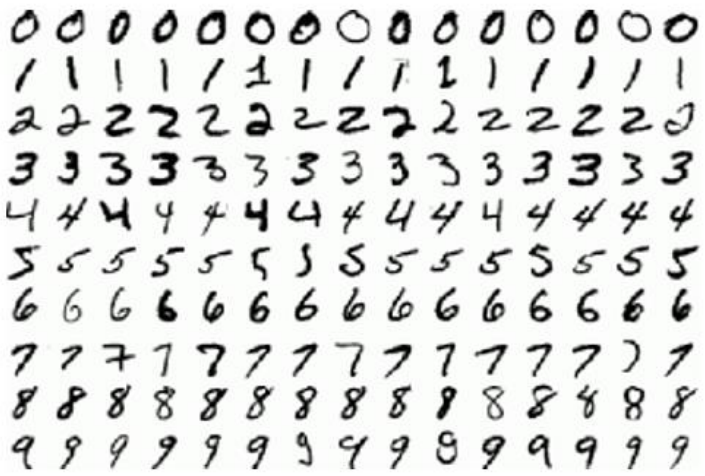
7. Popularity explosion of Machine Learning

- Main factor 1 of 3
  - Hardware
    - CPU < GPU < TPU
    - ~1 TFLOP (Intel i9-7980XE) < 11.3 TFLOPS (1080 GTX Ti) < 180 TFLOPS (Gen 2)

7. Popularity explosion of Machine Learning

- Main factor 2 of 3
  - Framework support
    - Less time making a network, more time making a better one
    - Hardware support

# 7. Popularity explosion of Machine Learning

- Main factor 3 of 3
  - Big data
    - Data, Data, Data, Data, Data, Data, Data, Data, Data, Data, Data
  - Thanks to
    - IOT
    - Smartphones with a bajillion sensors
    - More in depth online tracking

8. The bad news of AI and ML

- Bias amplification
  - Man is to worker that woman is to _____
    - If we train our systems on biased data, they will also be biased
- Overfitting
  - If we can only recognise traffic signs in clear conditions…
    - What happens when it is foggy?
- Loss of accountability
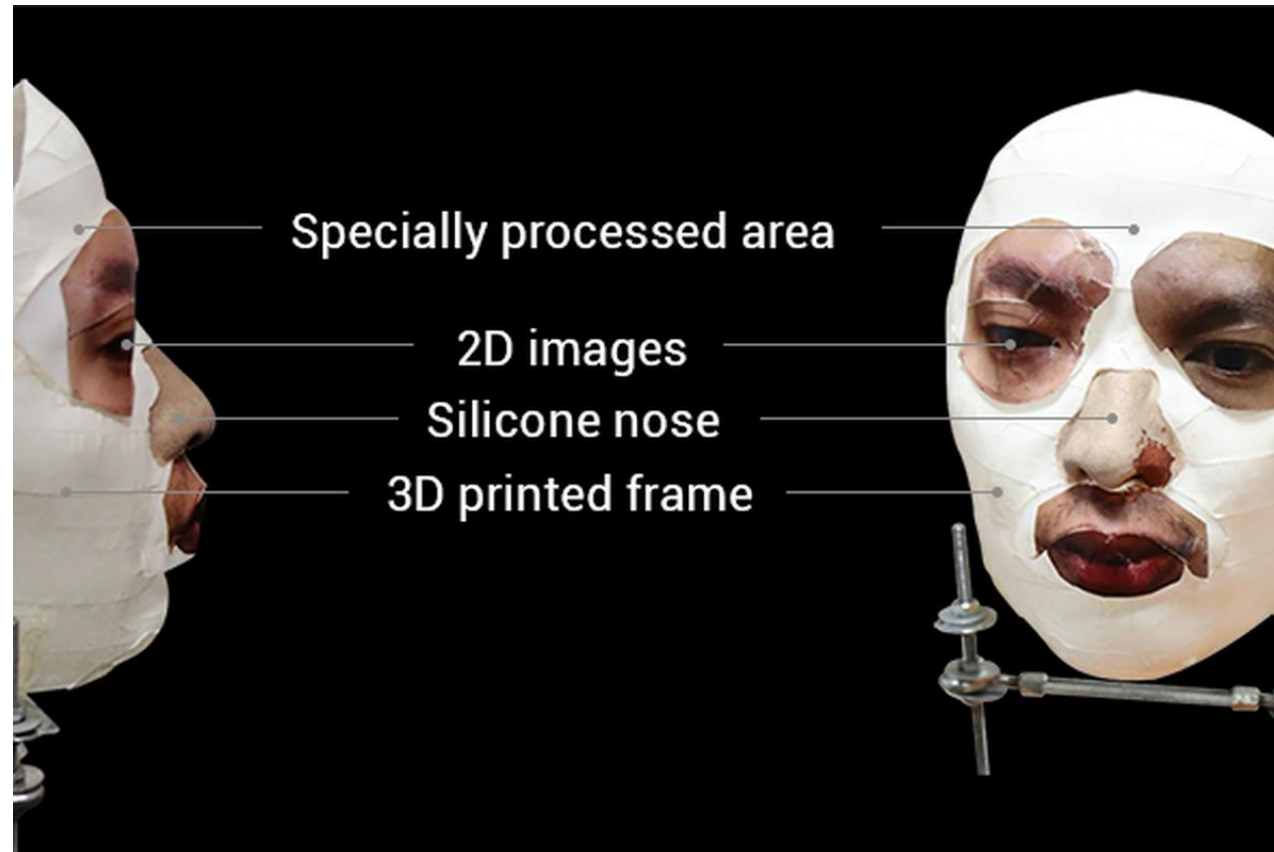 - If an AI controlled car runs someone over
    - Who is responsible?

8. Recent AI disasters / AI growing pains

- Google Photos image tagging dark skinned people as gorillas
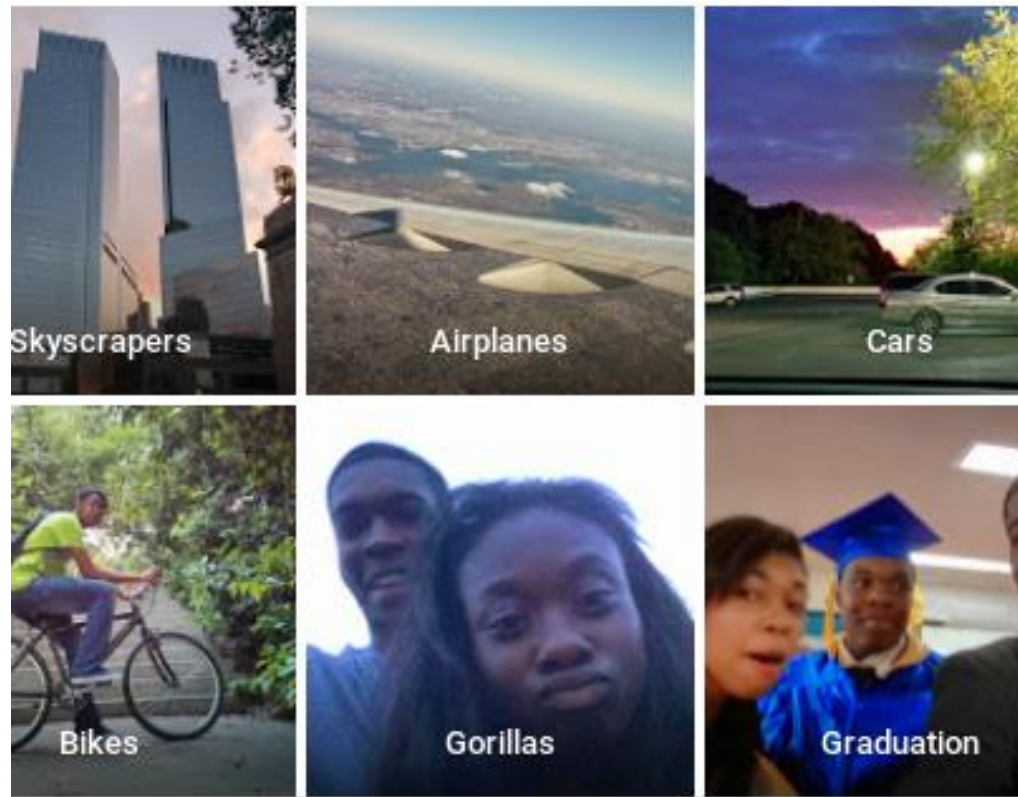
8. Recent AI disasters / AI growing pains

- Face ID defeated by a 3D printed mask

Specially processed area

2D images

Silicone nose

3D printed frame

8. Recent AI disasters / AI growing pains

- Innocent looking graffiti

- Capable of completely misclassifying signs on purpose
  - Rogue signs: Deceiving Traffic Sign Recognition with Malicious Ads and Logos
  - Success rates in excess of 95% in both physical and virtual settings
  - https://arxiv.org/pdf/1801.02780.pdf

8. Recent AI disasters / AI growing pains

- Uber autonomous taxi mis-classifies woman walking her bicycle across the road, running her over

9. Concluding Thoughts

- AI and ML are yet another tool
- Enable great progress
- Over-reliance can cause unnecessary loss of life, value and/or property

9. Concluding Thoughts

- Any questions?
- Further thoughts?
  - Lets talk later, I'll do my best to explain
  - simon@agius-muscat.net
  - @purrcat259 on Twitter
- Thanks for listening ☺