

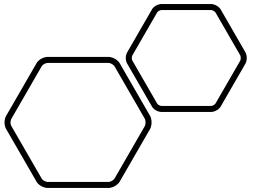


42028: Deep Learning and Convolutional Neural Network

Week 1

Introduction to Machine Learning
and Deep Learning





Outline

- Introduction to AI, ML, CV, & DL
- Popular use cases
- Deep Learning Evolution
- AI, ML, DL Relationship
- Features in machine - example
- ML/DL Pipeline
- Deep Learning and CNN @ UTS

What is Artificial Intelligence?

Human Intelligence exhibited by machine!



What is Artificial Intelligence?

- A generic term for getting **computers** to perform **human tasks**, and the scope is always changing overtime.
- We don't have a generic AI system which does multiple human tasks!
- The systems available today are able to perform one or few well defined tasks, which are at par with the human performance or sometimes better!

Popular Use Cases

- Image Classification
 - Object Detection and Recognition
 - Image Captioning
 - Face Detection and Recognition
 - Biometrics (Fingerprint, Retina, Hand Geometry, etc.)
 - Speech Recognition
 - Natural Language Processing (NLP)
 - Language Translations
 - Creative (learn to draw an image in the style of an artist!)
- :

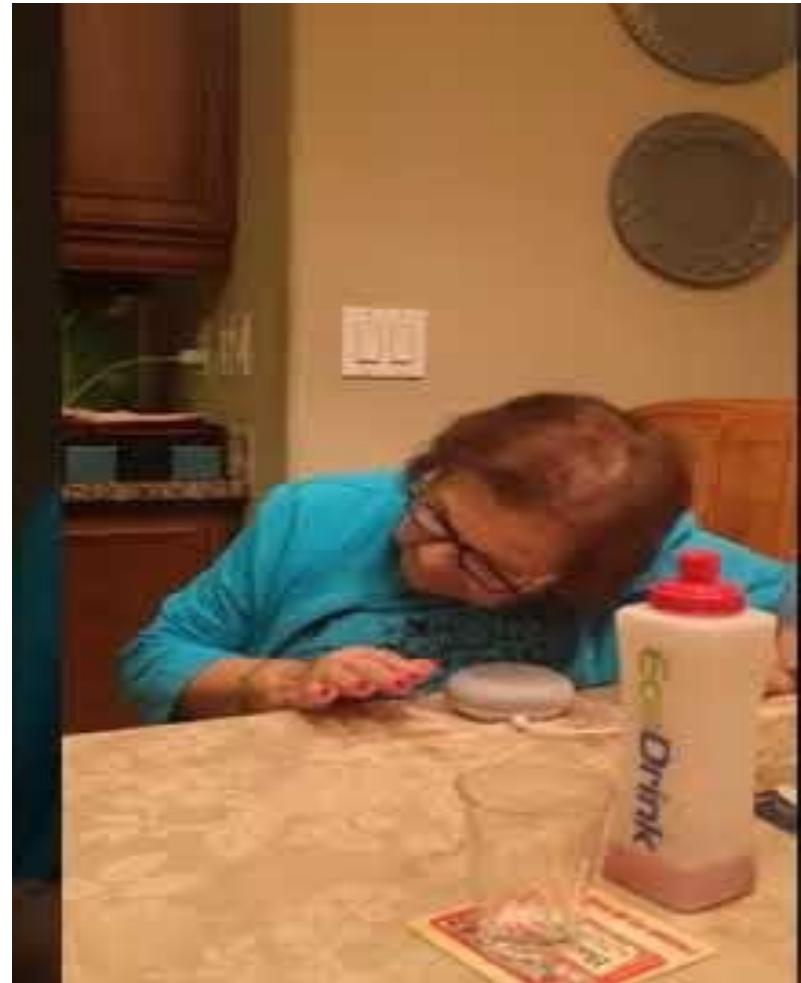
Popular Use Cases - Examples

- Speech Recognition



Popular Use Cases - Examples

- Speech Recognition - Technology Challenges!



Popular Uses Cases - Examples

- Natural Language Processing

"Beware though, bots have the illusion of simplicity on the front end but there are many hurdles to overcome to create a great experience. So much work to be done. Analytics, flow optimization, keeping up with ever changing platforms that have no standard. For deeper integrations and real commerce like Assist powers, you have error checking, integrations to APIs, routing and escalation to live human support, understanding NLP, no back buttons, no home button, etc etc. We have to unlearn everything we learned the past 20 years to create an amazing experience in this new browser." — [Shane Mac, CEO of Assist](#)



Popular Uses Cases - Examples

- ChatGPT3!

The screenshot shows the ChatGPT interface on a web browser. On the left, there's a sidebar with options like '+ New chat', 'Assistance Request: Summar...', 'Help Request Received', and 'Add Two Numbers Python'. Below these are buttons for 'Clear conversations', 'Upgrade to Plus' (with a 'NEW' badge), 'Dark mode', 'Improve ChatGPT', 'Updates & FAQ', and 'Log out'.

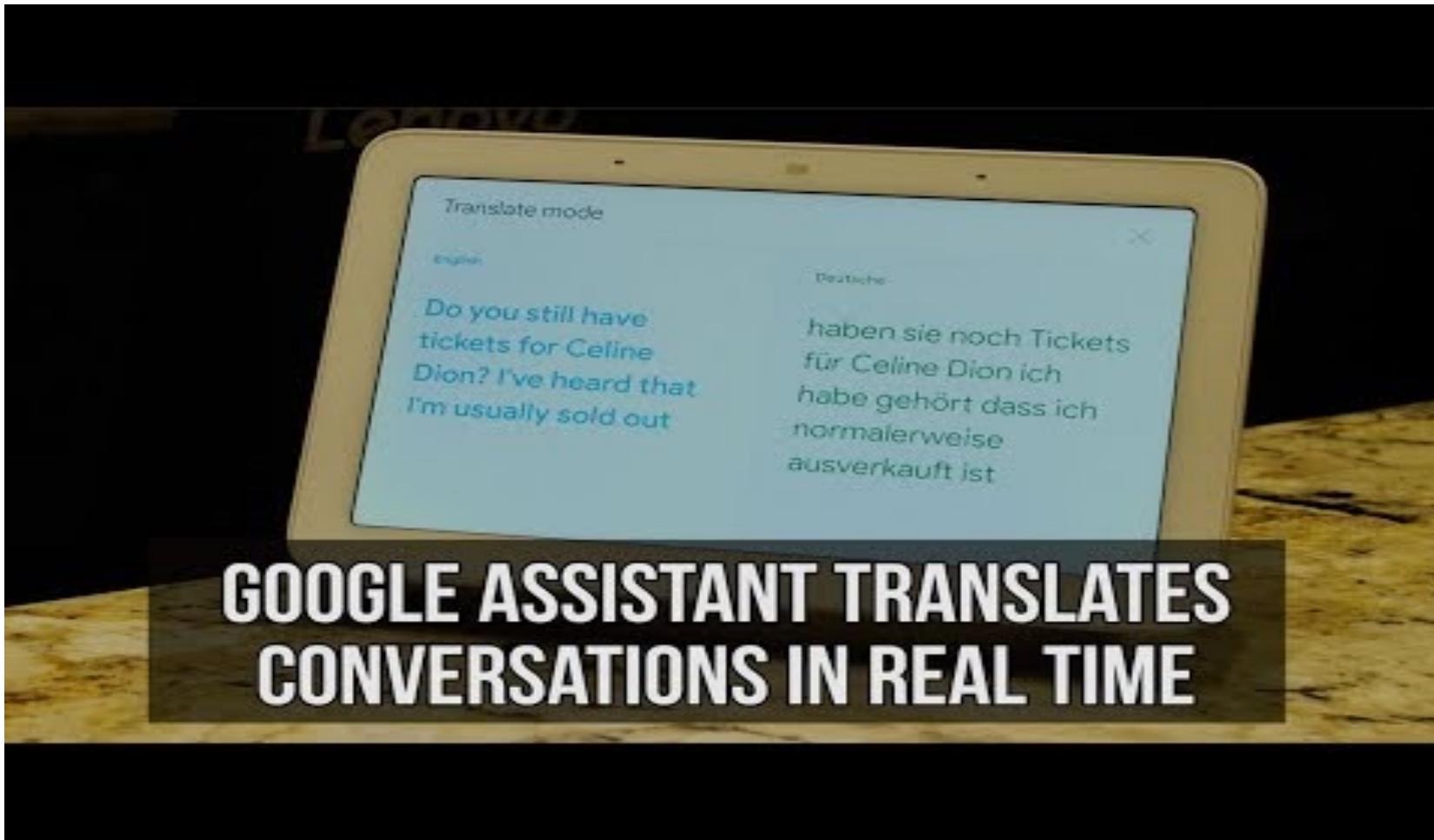
The main area has a title 'ChatGPT' with a cursor icon. Below it are three sections: 'Examples' (with a sun icon), 'Capabilities' (with a lightning bolt icon), and 'Limitations' (with a warning sign icon).

Examples	Capabilities	Limitations
"Explain quantum computing in simple terms" →	Remembers what user said earlier in the conversation	May occasionally generate incorrect information
"Got any creative ideas for a 10 year old's birthday?" →	Allows user to provide follow-up corrections	May occasionally produce harmful instructions or biased content
"How do I make an HTTP request in Javascript?" →	Trained to decline inappropriate requests	Limited knowledge of world and events after 2021

At the bottom, there's a footer note: 'ChatGPT Feb 13 Version. Free Research Preview. Our goal is to make AI systems more natural and safe to interact with. Your feedback will help us improve.'

Popular Uses Cases - Examples

- Language translations



What is Machine Learning?

“Machine Learning is the field of study that gives computer ability to learn without being explicitly programmed”

– Arthur Samuel, 1958

¹Machine Learning is a Science (and art) of programming computers so that they can learn from Data!

Why and When to use Machine Learning?

- Problems for which existing solutions require a lot of hand-tuning or a long list of rules
- Complex Problems for which there is no good solution at all using traditional approach
- Fluctuating environments: Machine Learning systems can adapt on new data
- Getting insight about complex problems and a large amount of data

Challenges of Machine Learning?

- Insufficient amount of training **data**
- Non-representative training **data**
- Poor Quality **data**
- Irrelevant Features!: Garbage in → Garbage Out!
- Overfitting the training **data**
- Under fitting the training **data**

Challenges of Machine Learning?

- More of the challenges are around **Data**!
- **Data** or **Algorithm**, which is more important?
- Check:
 - ¹ Unreasonable Effectiveness of data
 - ²Revisiting the Unreasonable Effectiveness of Data

Reference: ¹<https://static.googleusercontent.com/media/research.google.com/en//pubs/archive/35179.pdf>

²<https://ai.googleblog.com/2017/07/revisiting-unreasonable-effectiveness.html>

Challenges of Machine Learning?

- Overfitting example

concerned parent: if all your friends jumped off a bridge would you follow them?
machine learning algorithm: yes.

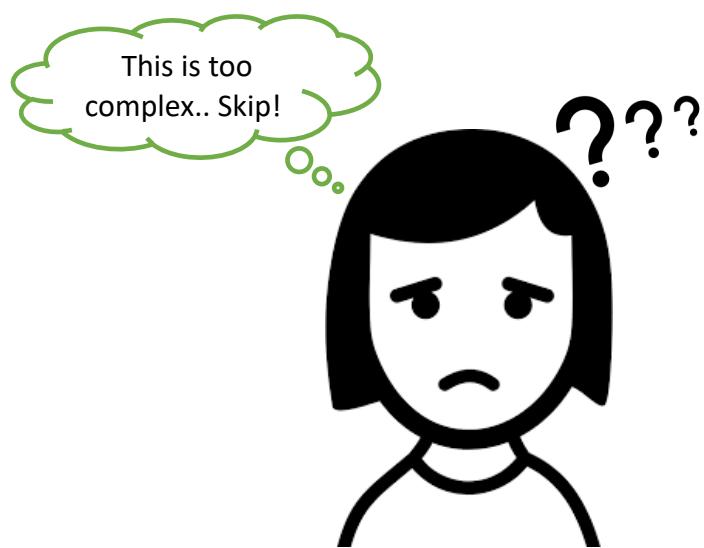
12:20 PM - 15 Mar 2018

7,194 Retweets 14,643 Likes

78 7.2K 15K

Challenges of Machine Learning?

- Overfitting and Underfitting



Not Interested in learning

Open Book Exam: 45%
Closed Book Exam: 35%

Underfitting/not learning



Memorizing everything

Open Book Exam: 98%
Closed Book Exam: 55%

Overfitting



Learning concept well with examples

Open Book Exam: 93%
Closed Book Exam: 85%

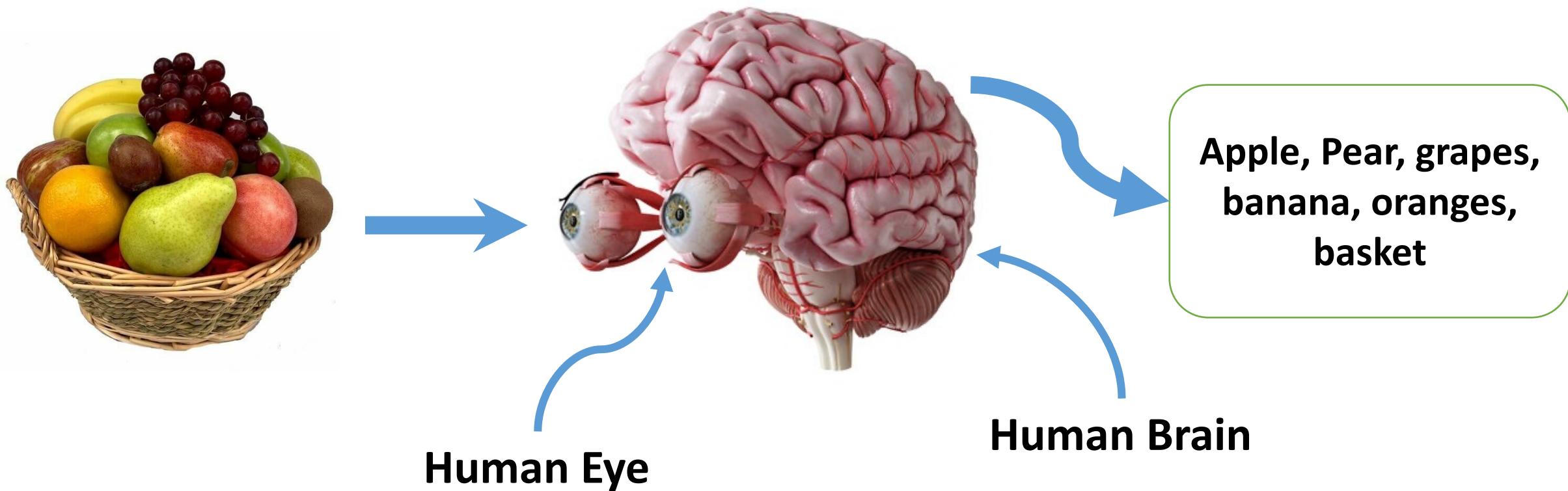
Best-Fit

Computer Vision

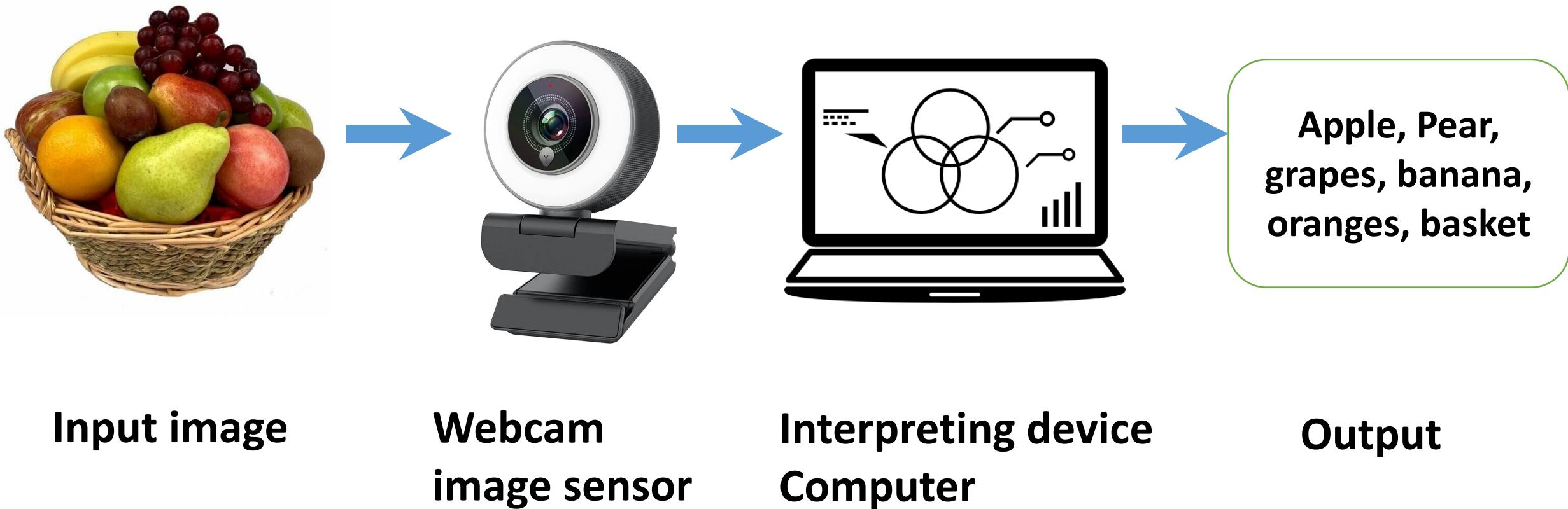
How computers see and understand
digital images and videos.



Human Vision Vs Computer Vision



Human Vision Vs Computer Vision



Computer Vision

Computer vision includes all tasks performed by the biological vision system:

- Eye/Retina → Camera/Webcam
- Extracting information → Image Processing
- understanding what is seen → Image Analysis and Understanding/ML

Applications

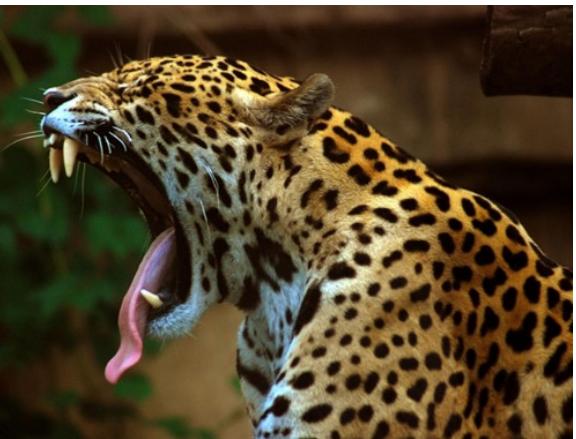


Image search engines



Assistance to differently
abled humans (bionic eye)



Unmanned Surveillance
using Drone



Autonomous driving



Human machine interaction/ Robotics

Computer Vision: Popular tasks

Image Classification



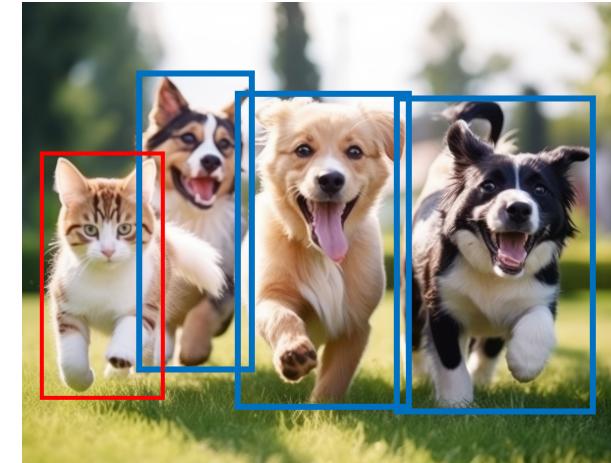
DOG

Image Classification
+ Localization



DOG

Object Detection



CAT

DOG

Instance Segmentation



CAT

DOG

Single Object

Multiple Object

Computer Vision: Popular Uses Cases

- Image Captioning
(Computer Vision + NLP)

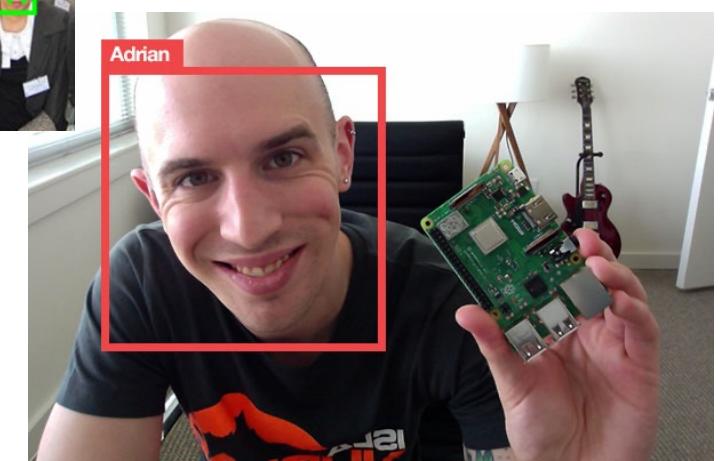


A woman is throwing a frisbee in a park.



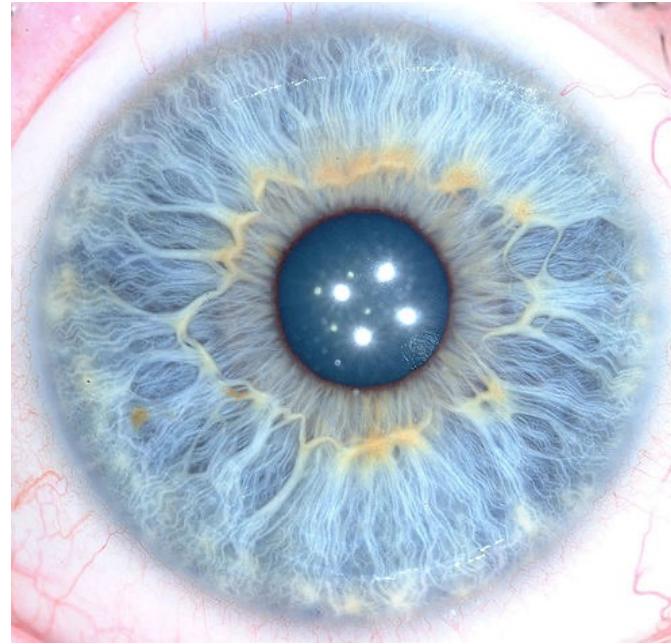
A little girl sitting on a bed with a teddy bear.

- Face Detection and Recognition



Computer Vision: Popular Uses Cases

- Biometrics (Fingerprint, Retina, Hand Geometry, etc.) (Computer Vision)



Computer Vision: Popular Uses Cases

- Creative

This are fake images! →
Generated using GAN

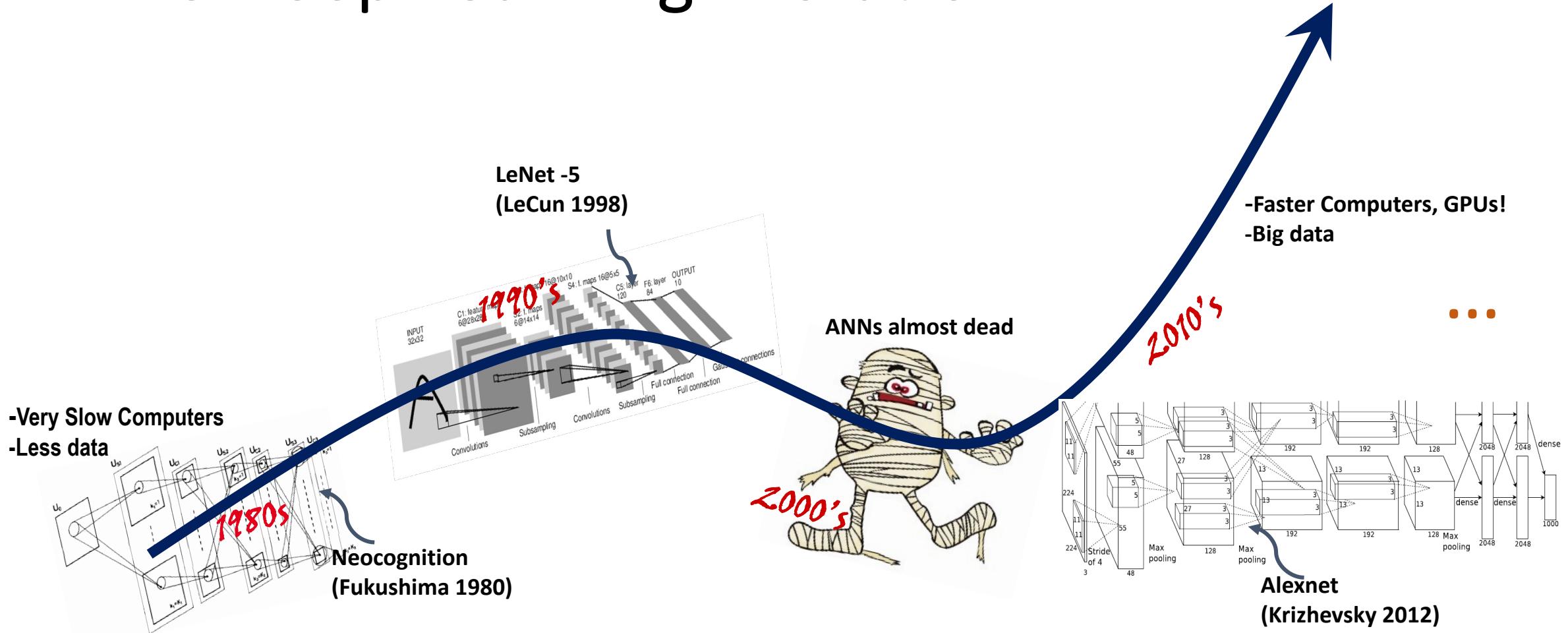


Deep Learning

Definition:

- It is a class of machine learning algorithms that uses multiple layers to progressively extract higher level of features from the raw input.
- The word “*Deep*” in deep learning refers to the number of layers through which data is transformed.

The Deep Learning Evolution



Deep Learning is a technique for implementing Machine Learning!
also known as Deep Neural Networks (DNNs)

Deep Learning Evolution

So What Changed Overtime?

- Availability of faster computers!
cheap and fast GPUs
- Very large datasets!



Deep Learning Frameworks & Libraries

Caffe

theano

DL4J
DEELEARNING4J



Microsoft
CNTK

K
Keras

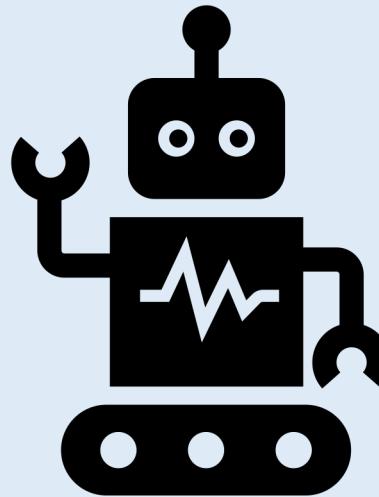
The TensorFlow logo features a stylized orange 'F' shape composed of small squares, with the word "TensorFlow" in a grey sans-serif font below it.

MatConvNet

mxnet

AI, ML and DL relationship!

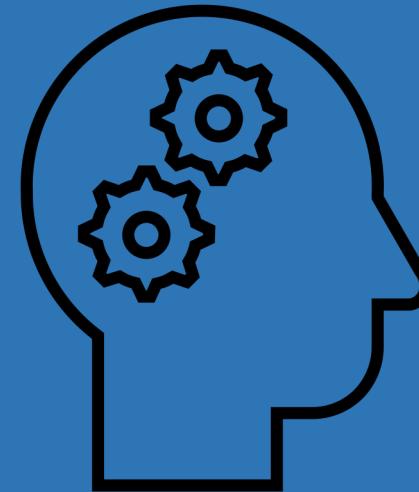
Making machine & programs intelligent



Artificial Intelligence

1950s

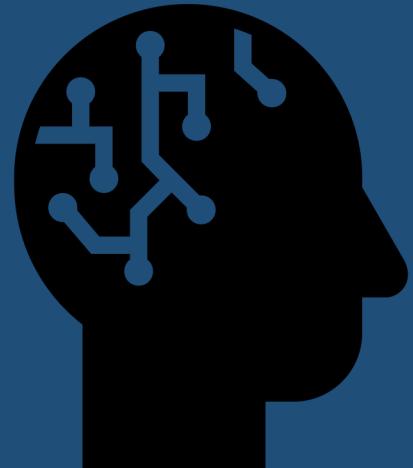
Learn without any explicit programming



Machine Learning

1980s

Learn using Deep Neural Networks



Deep Learning

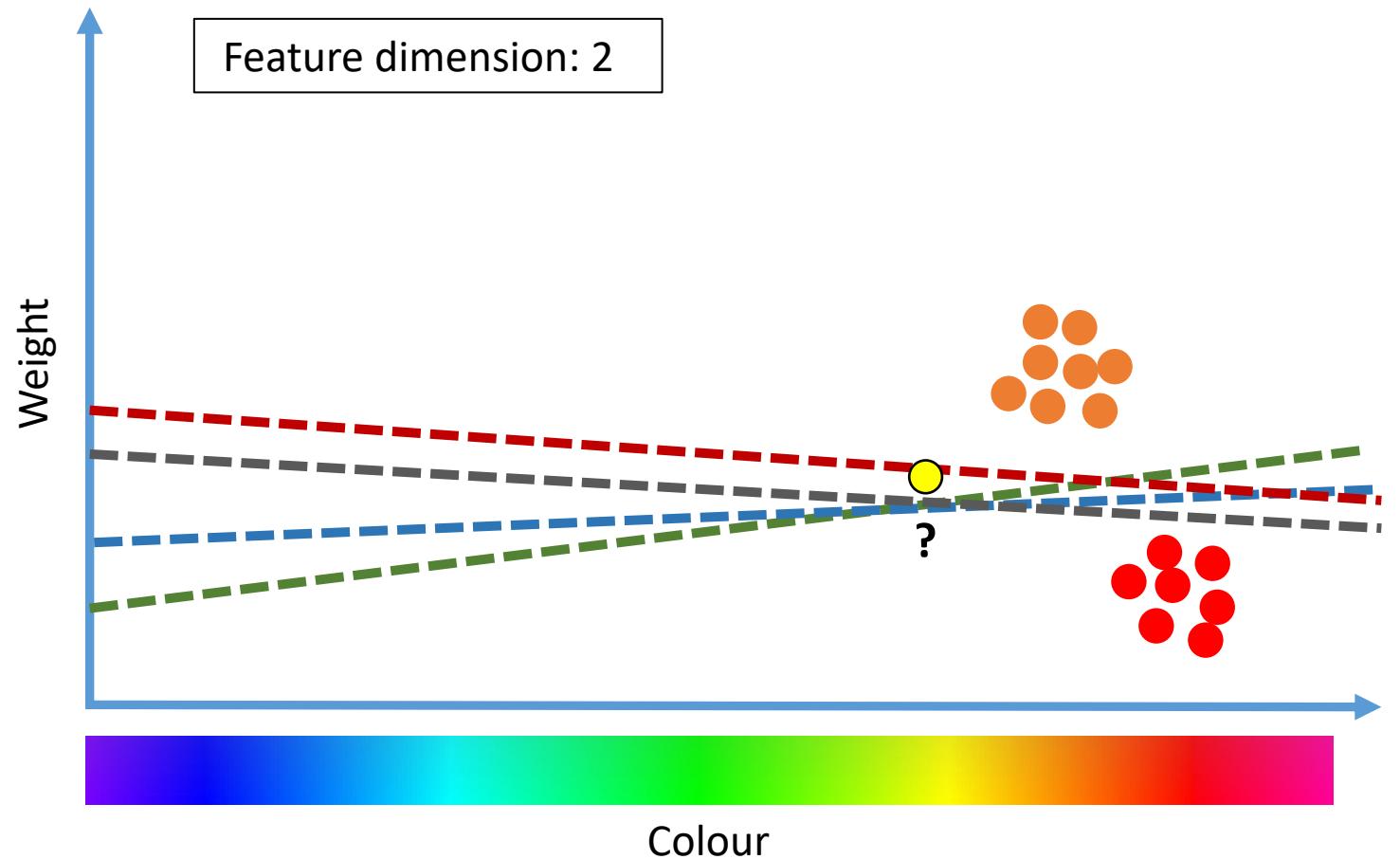
Features in Machine Learning



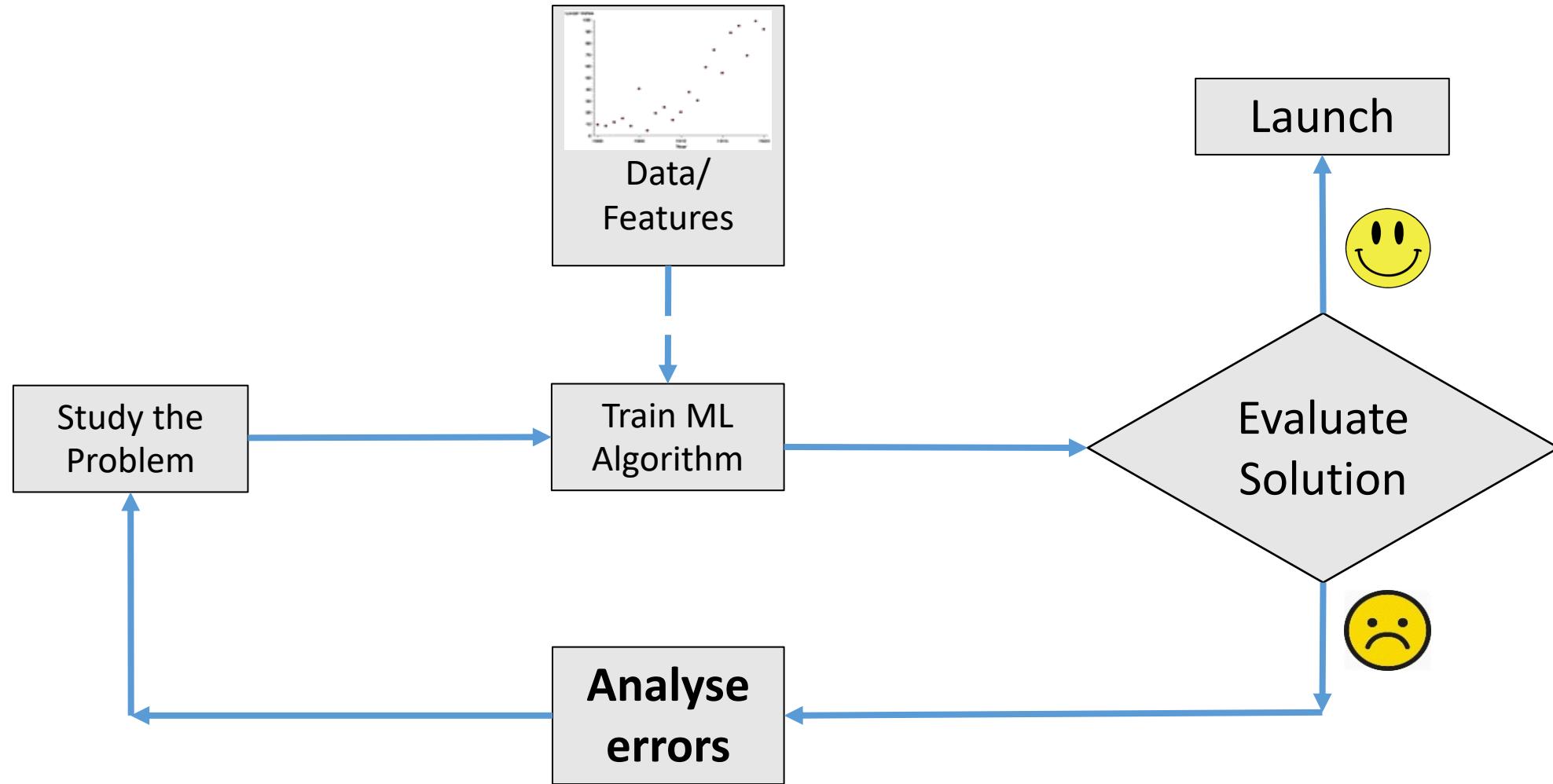
Features in Machine Learning

- Orange
- Apple

Choosing appropriate and useful features can have a significant impact on the performance of a Machine Learning system!

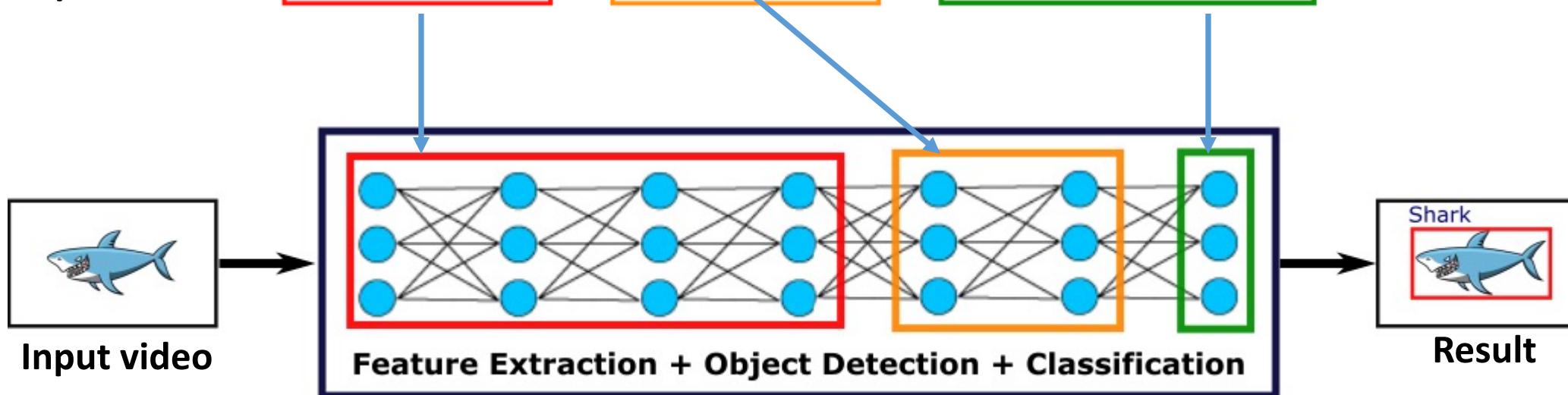
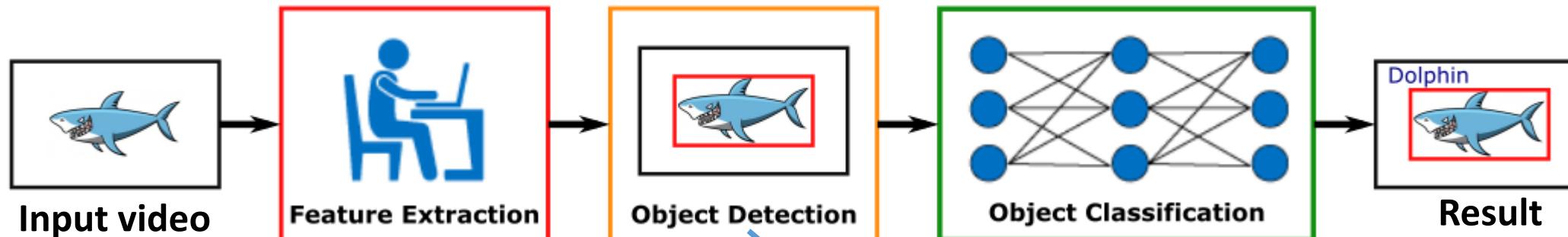


Typical Machine Learning Pipeline



Traditional ML Vs DL Pipeline

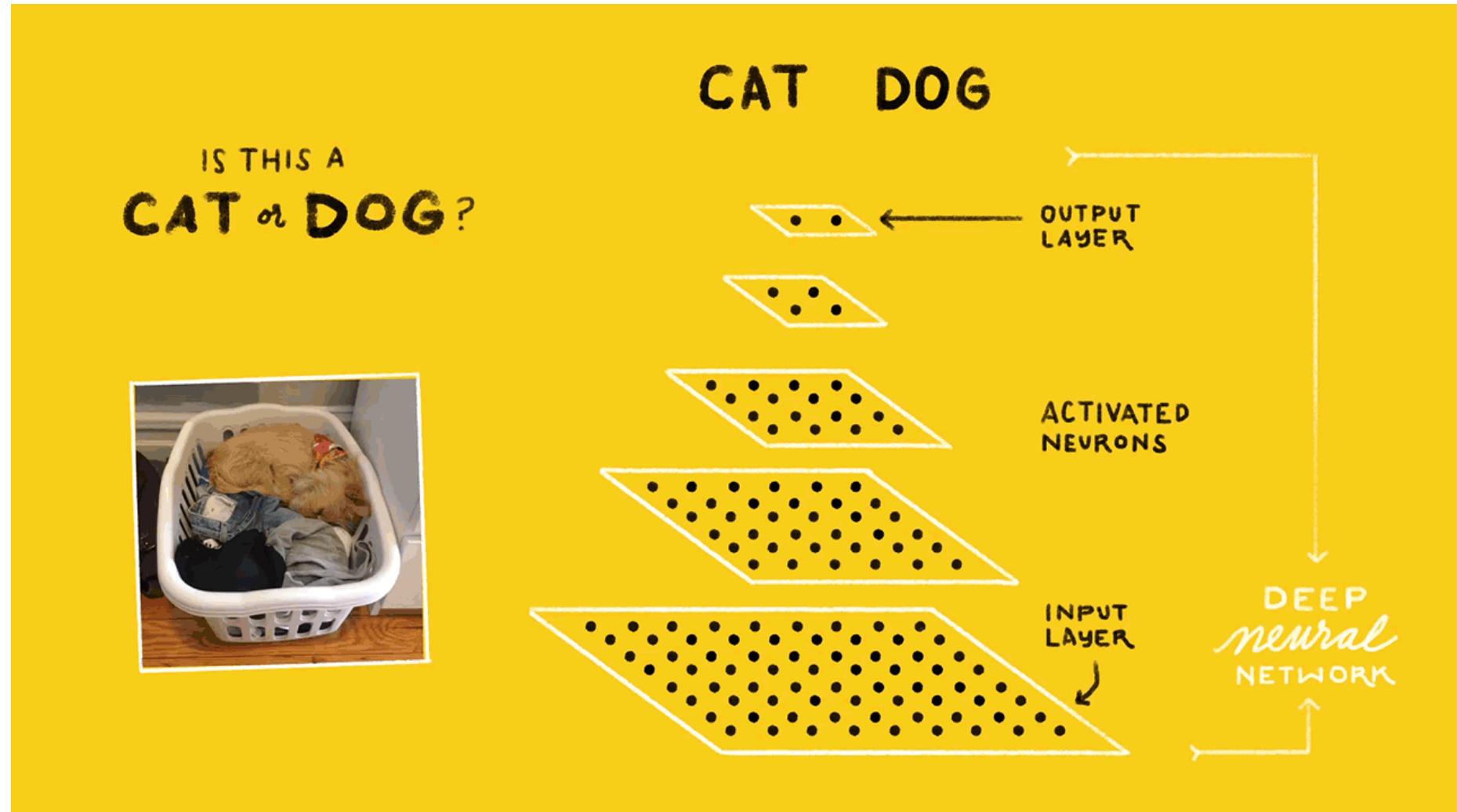
Traditional Machine Learning (ML) pipeline for object detection and classification



End-to-End Deep Learning (DL) technique for Object Detection and Classification

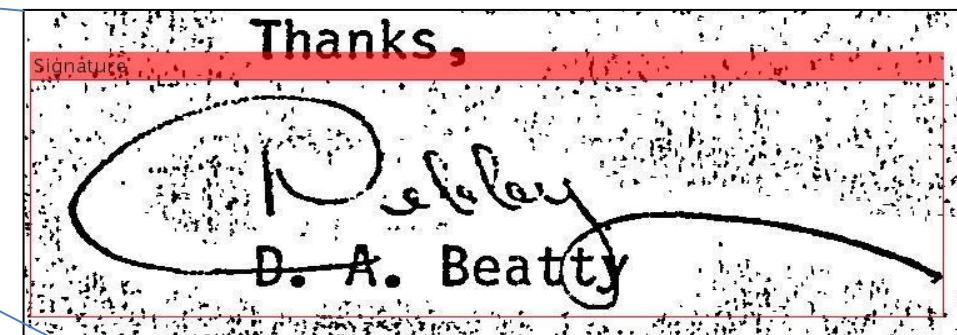
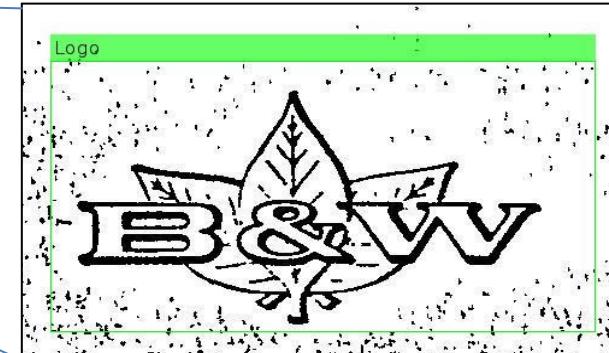
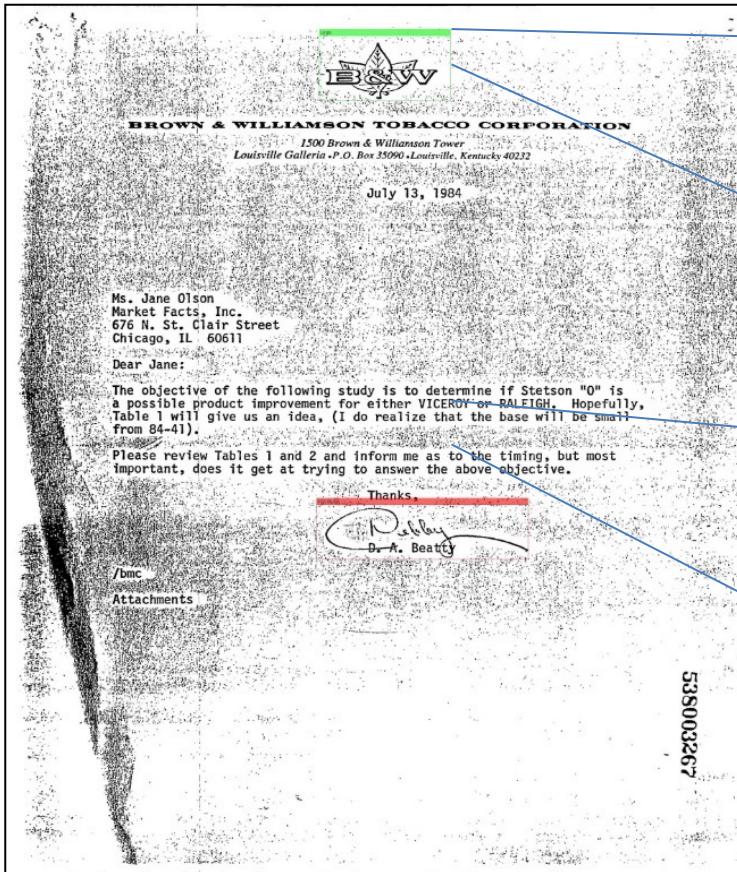
Deep Learning Pipeline example

- More layers that loosely mimic human brain
- No explicit feature engineering



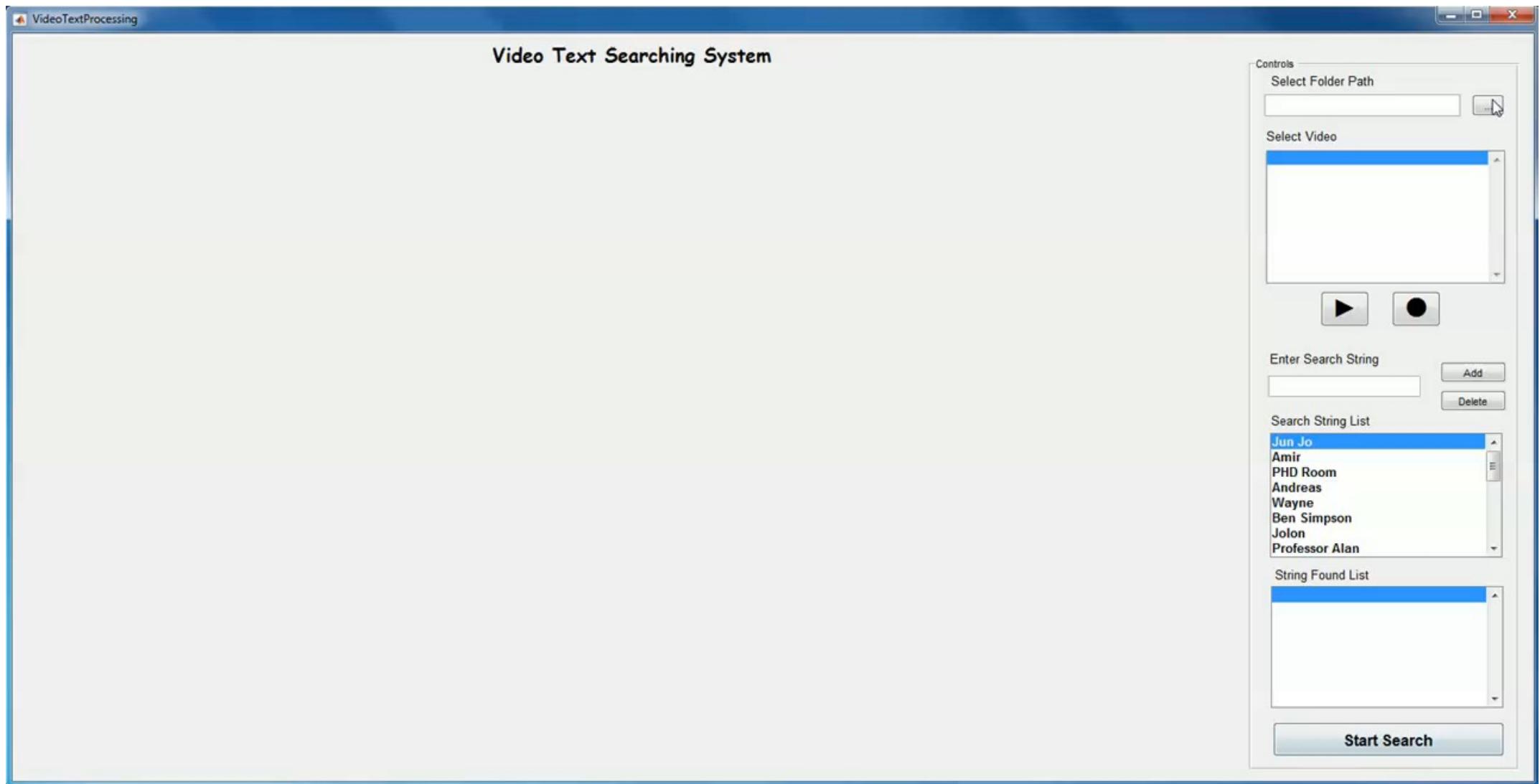
Deep Learning @UTS!

Signature and Logo detection



Logo and Signature
detection result

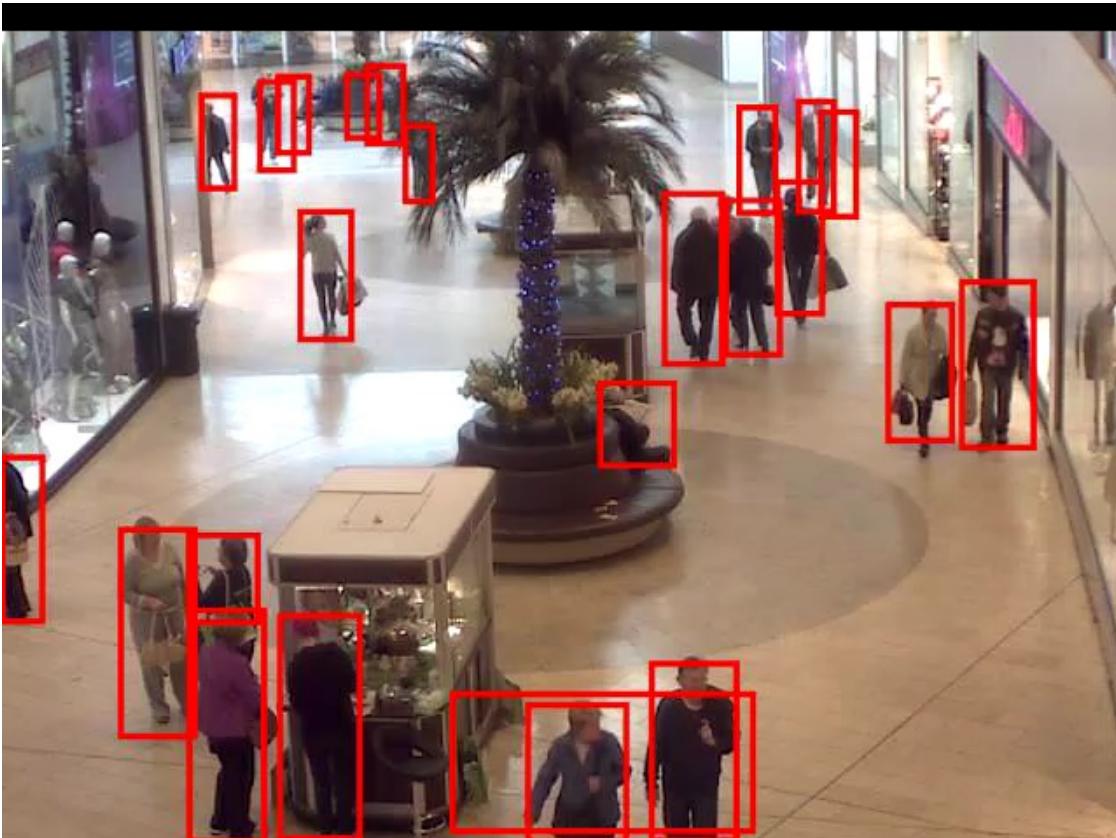
Real-time Text searching in Videos



Drone detection for Security and Surveillance

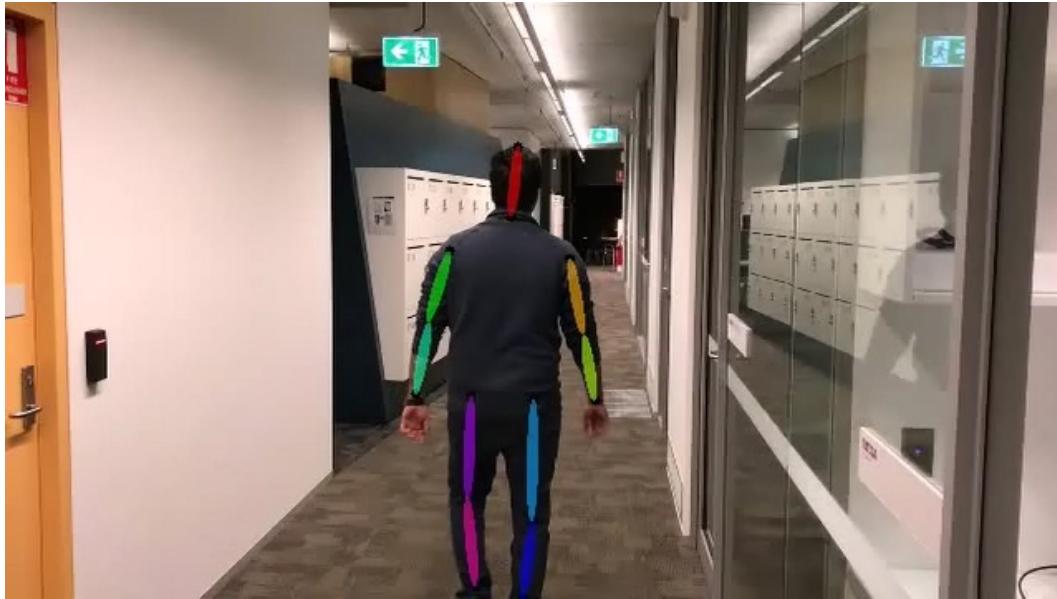


Crowding Behaviour Analysis & Density Estimation



Human Action/Gesture Recognition

Pose Machines Demo



The Award winning  **SHARKspotter**[®]

