

Short Course on Deep Learning and Convolutional Neural Network

Day 1: Introduction to Machine Learning
and Deep Learning

What is Artificial Intelligence?

- “Human Intelligence exhibited by machine!”
- 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 Uses 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 Uses Cases - Examples

- Image Classification, Object Detection and Recognition (Computer Vision)

Classification



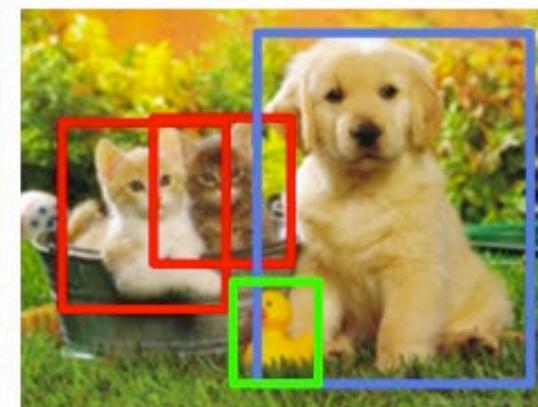
CAT

Classification + Localization



CAT

Object Detection



CAT, DOG, DUCK

Instance Segmentation



CAT, DOG, DUCK

Popular Uses Cases - Examples

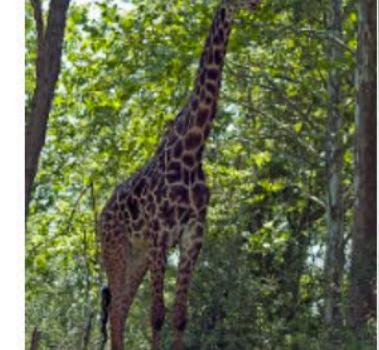
- Image Captioning (Computer Vision + NLP)



A woman is throwing a frisbee in a park.

A dog is standing on a hardwood floor.

A stop sign is on a road with a mountain in the background.



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

A group of people sitting on a boat in the water.

A giraffe standing in a forest with trees in the background.

Popular Uses Cases - Examples

- Face Detection and Recognition (Computer Vision)



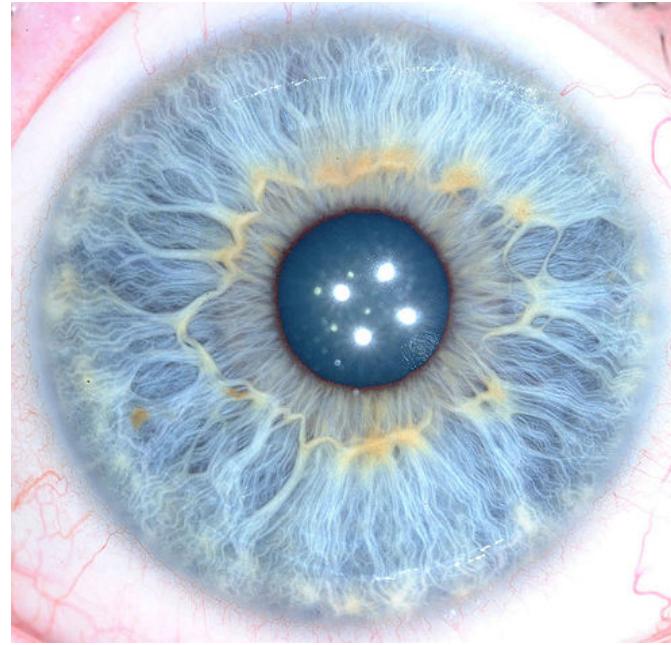
Image source: https://github.com/kpzhang93/MTCNN_face_detection_alignment



Image Source: <https://www.pyimagesearch.com/2018/06/25/raspberry-pi-face-recognition/>

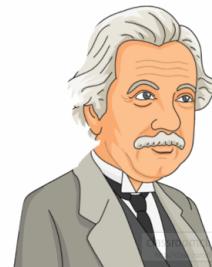
Popular Uses Cases - Examples

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



Popular Uses Cases - Examples

- Speech Recognition



Hey **Google...**
What's the weather today? ...



The temperature at VIT Chennai
is very high today!

Deep Learning classes have started! ☺

Popular Uses Cases - Examples

- Speech Recognition - Technology Challenges!



Popular Uses Cases - Examples

- Creative

This are fake images! →
Generated using GAN



Popular Uses Cases - Examples

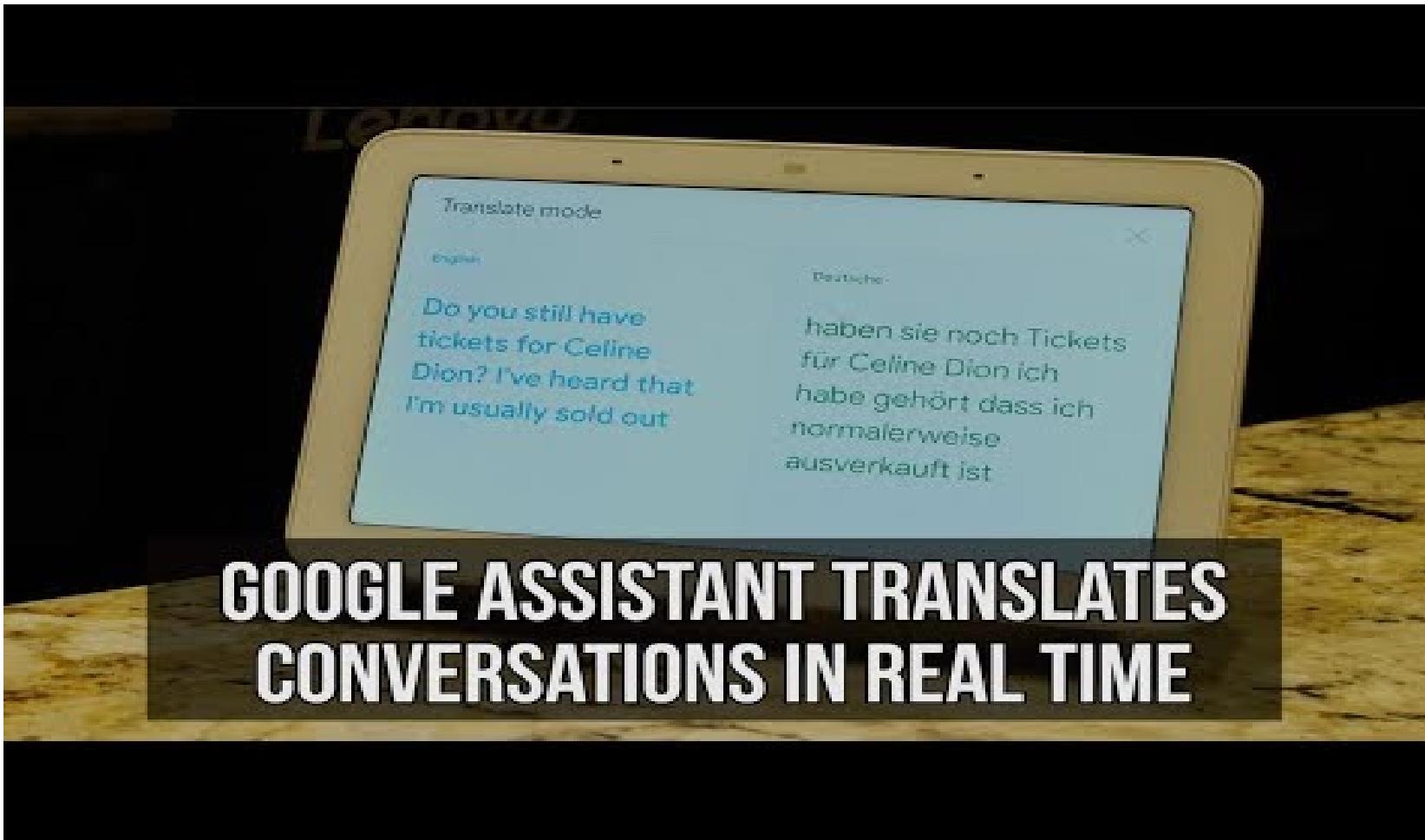
- Natural Language Processing

"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

- Language translations



What is Machine Learning?

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

More General Definition:

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

– Arthur Samuel, 1958

¹Hands-On Machine Learning with Scikit-Learn and TensorFlow

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?

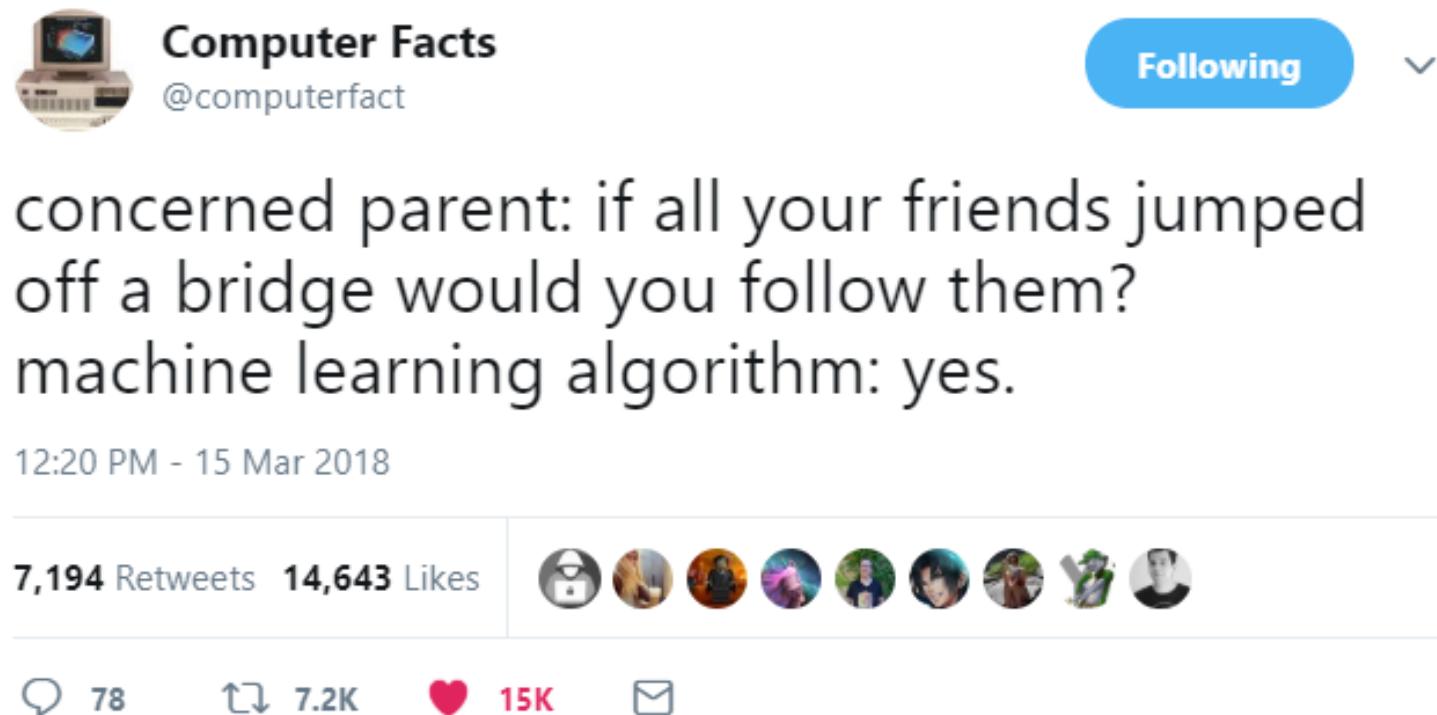
- More of the challenges are around **Data**!
- **Data** or **Algorithm**, which is more important?
- Check:
 - ¹ Unreasonable Effectiveness of data
 - ²Revisiting the Unreasonable Effectiveness of Data

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



Computer Facts
@computerfact

Following

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

12:20 PM - 15 Mar 2018

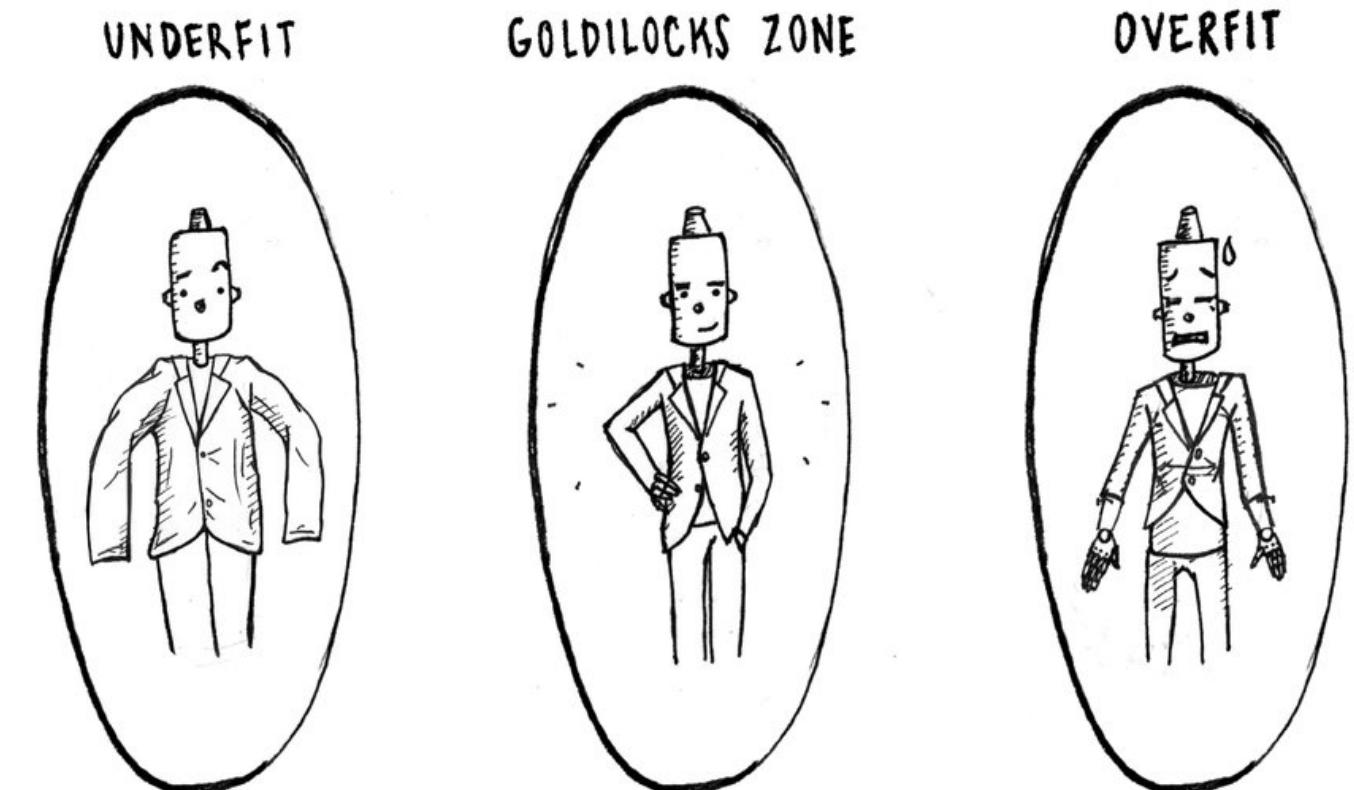
7,194 Retweets 14,643 Likes

78 7.2K 15K

Challenges of Machine Learning?

- Under fitting example

MACHINE LEARNING GENERALIZATION
FINDING THE PERFECT FIT



Computer Vision

- Definition:

It is a field of study surrounding how computers see and understand digital images and videos.

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

- seeing/sensing visual stimulus (Eye/Retina), → Image Acquisition (Cameras)
- 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

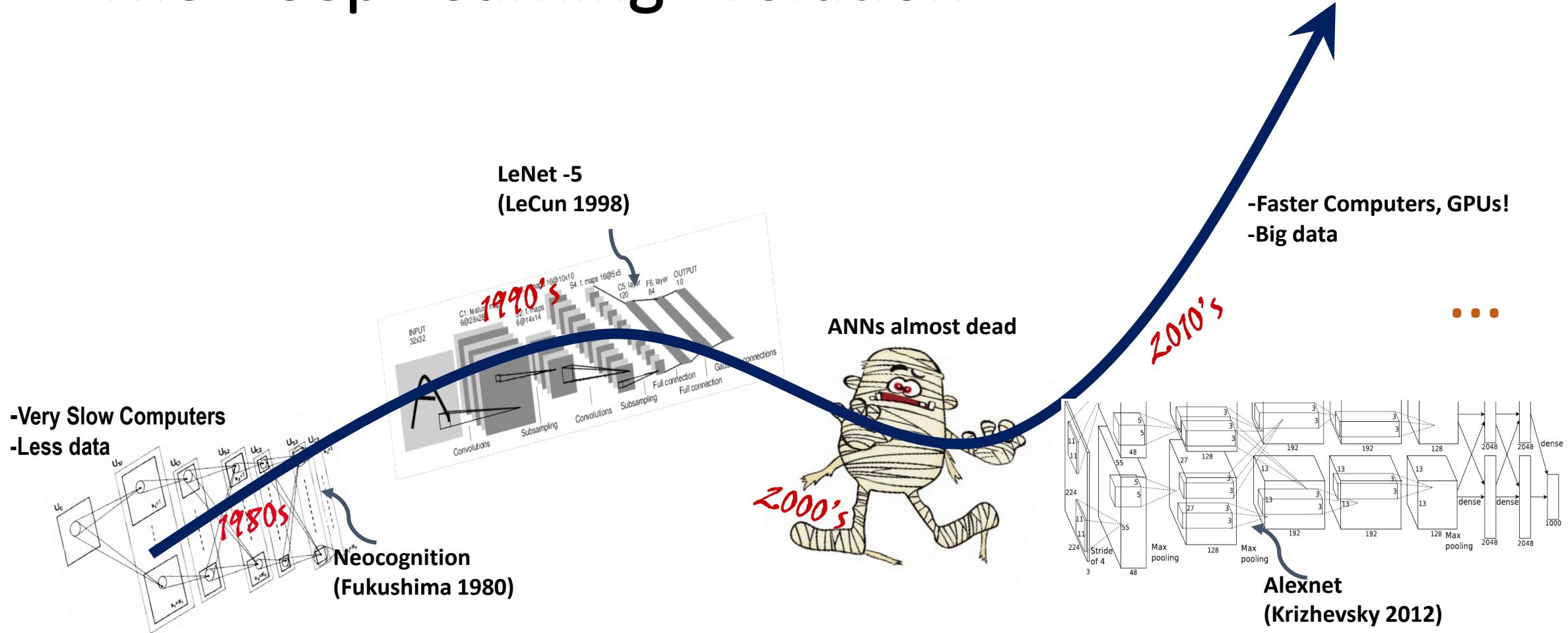


Autonomous driving



Human machine interaction/ Robotics

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

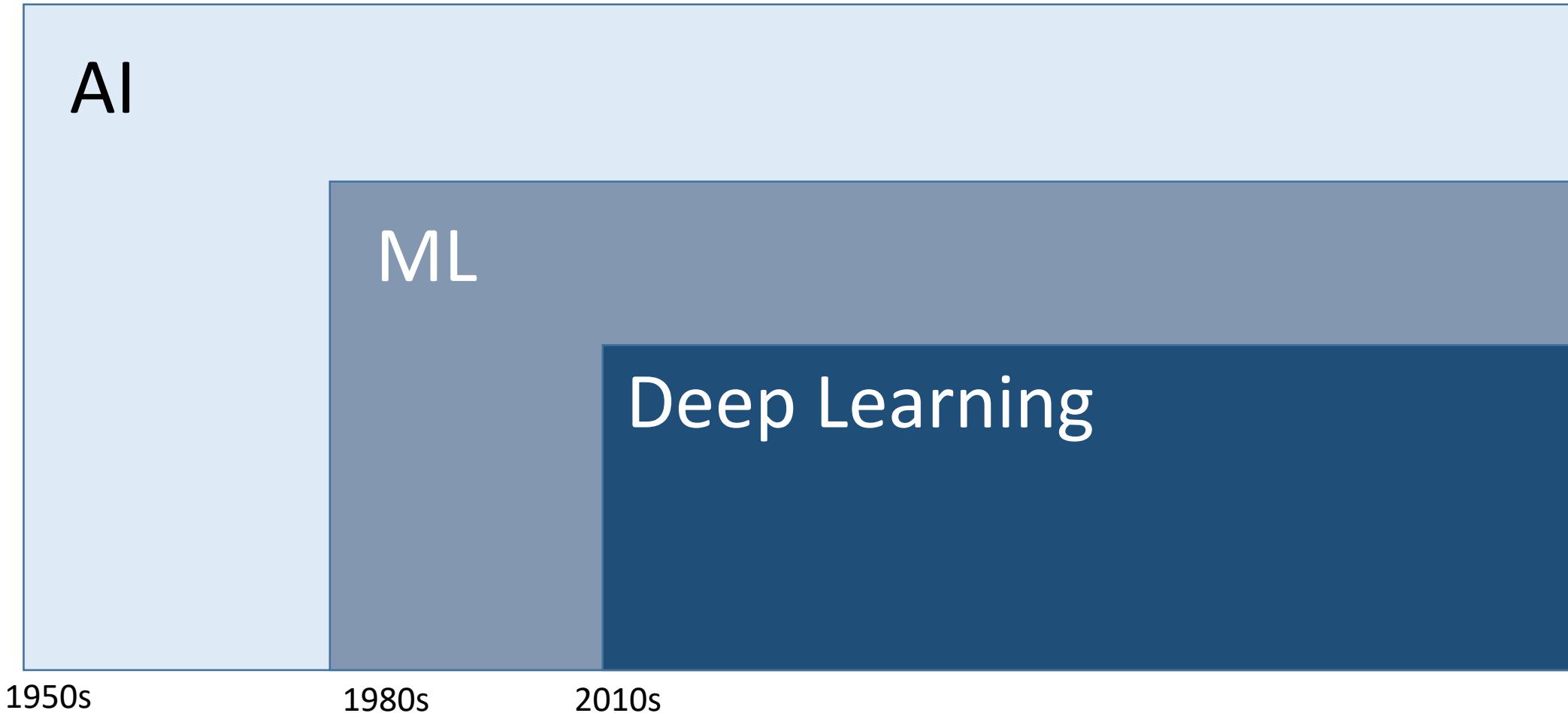
DL4J
DEELEARNING4J



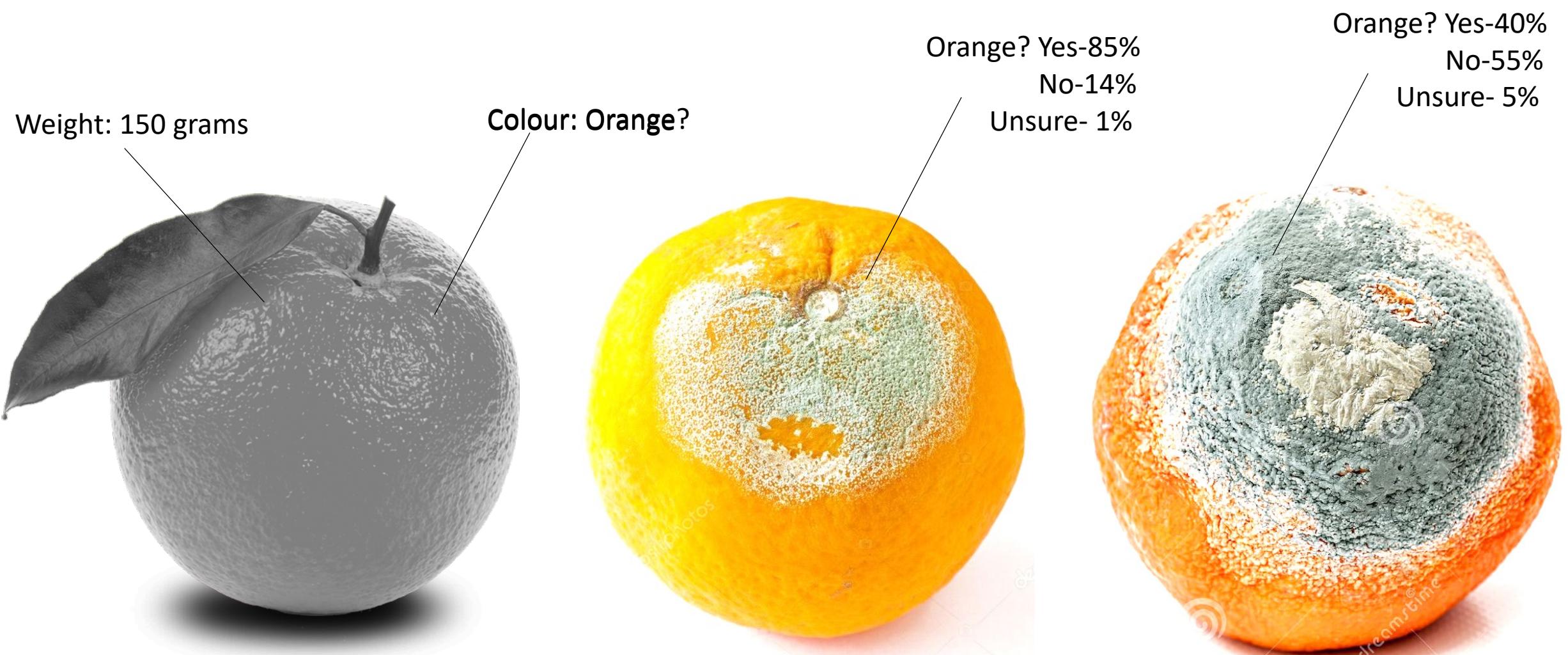
MatConvNet

mxnet

AI, ML and DL relationship!



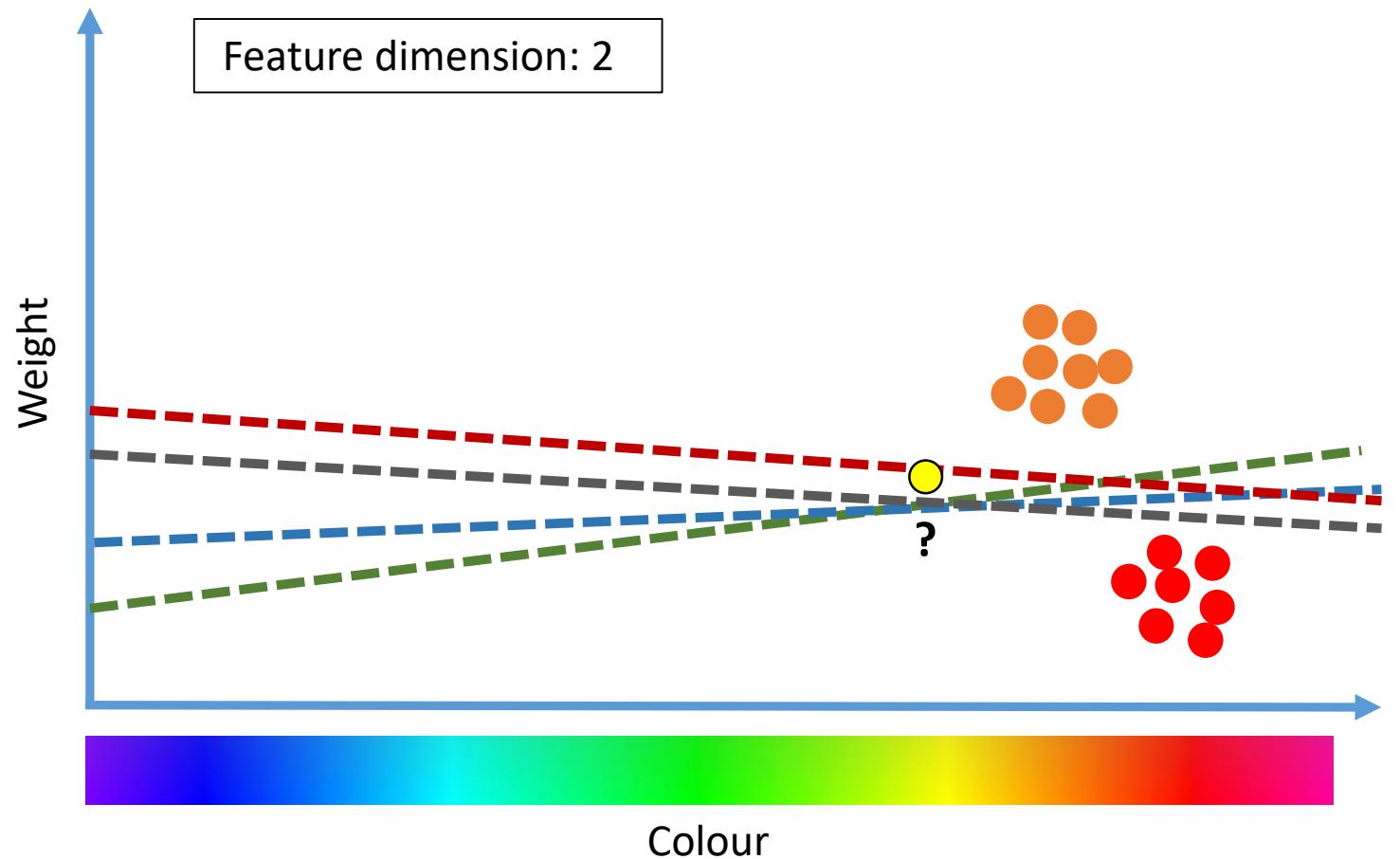
Features in Machine Learning



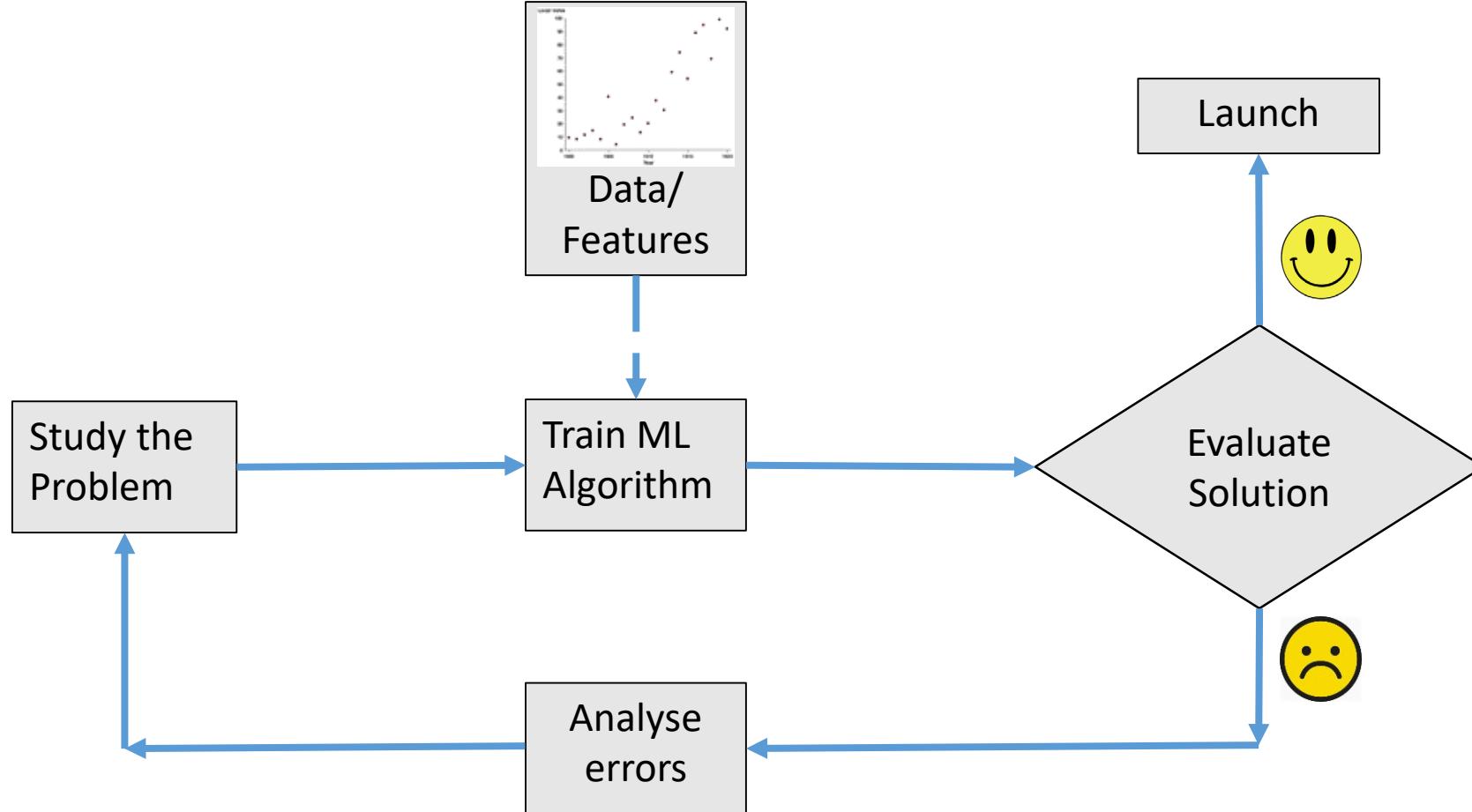
Features in Machine Learning

- Orange
- Apple

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

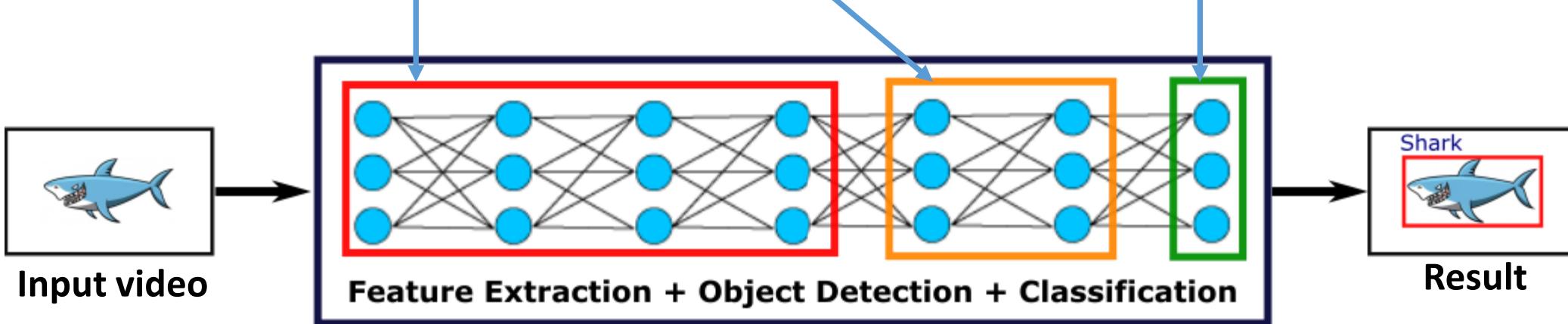
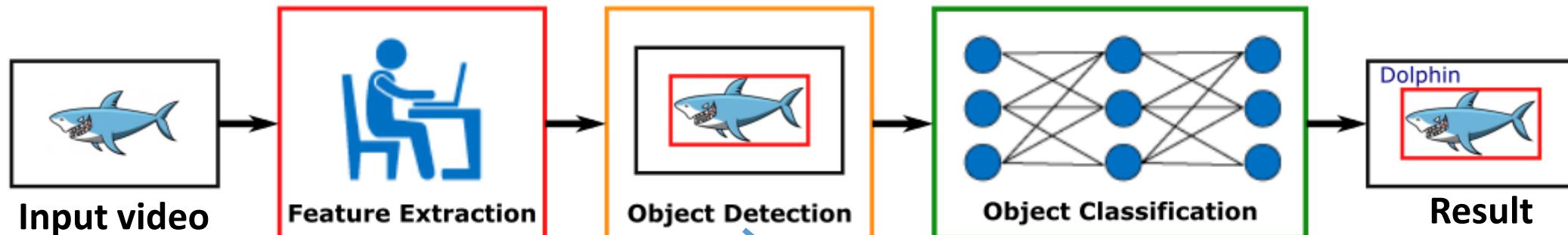


Typical Machine Learning Pipeline



Traditional Machine Learning Vs DL

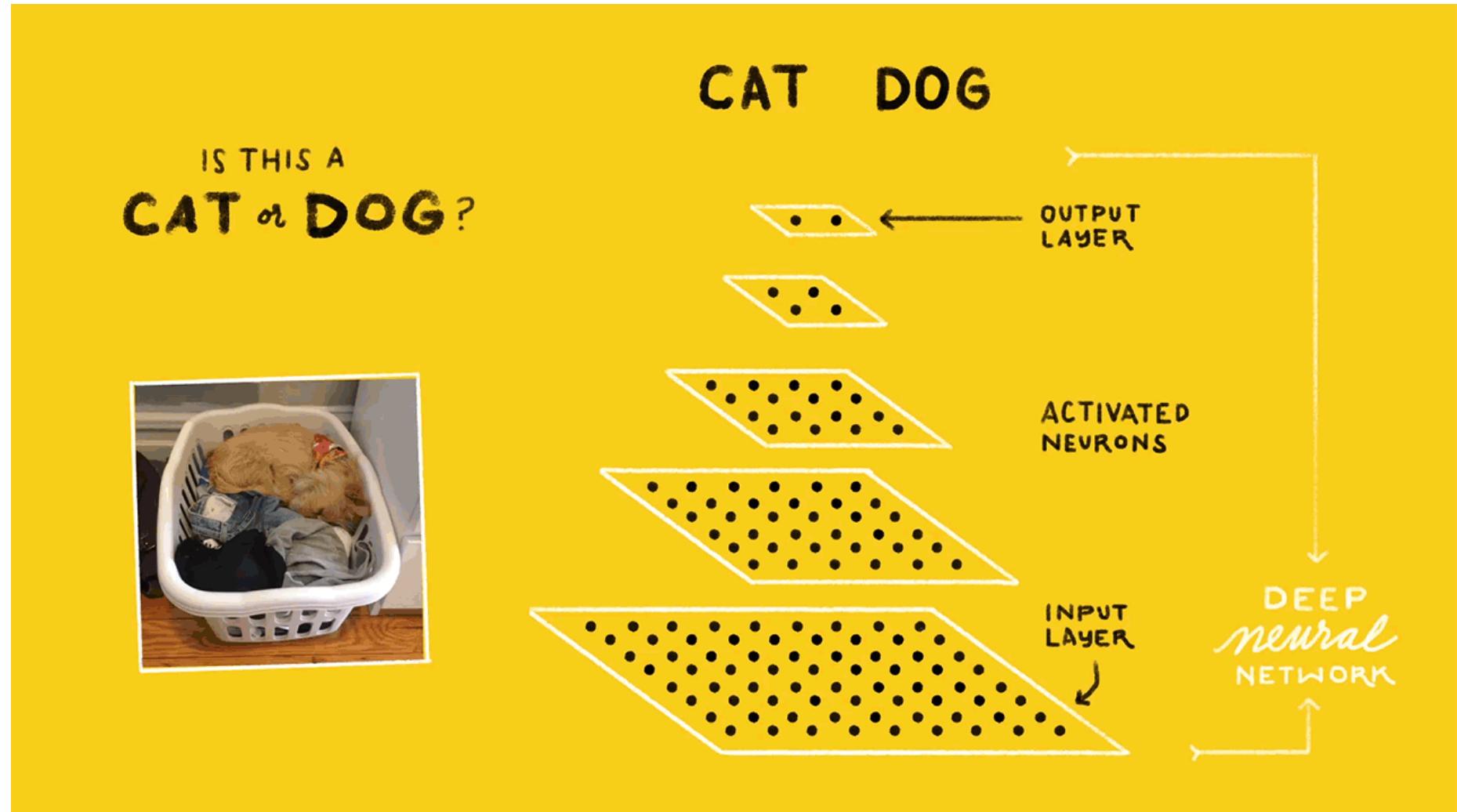
Traditional Machine Learning pipeline for object detection and classification



End-to-End Deep Learning technique for Object Detection and Classification

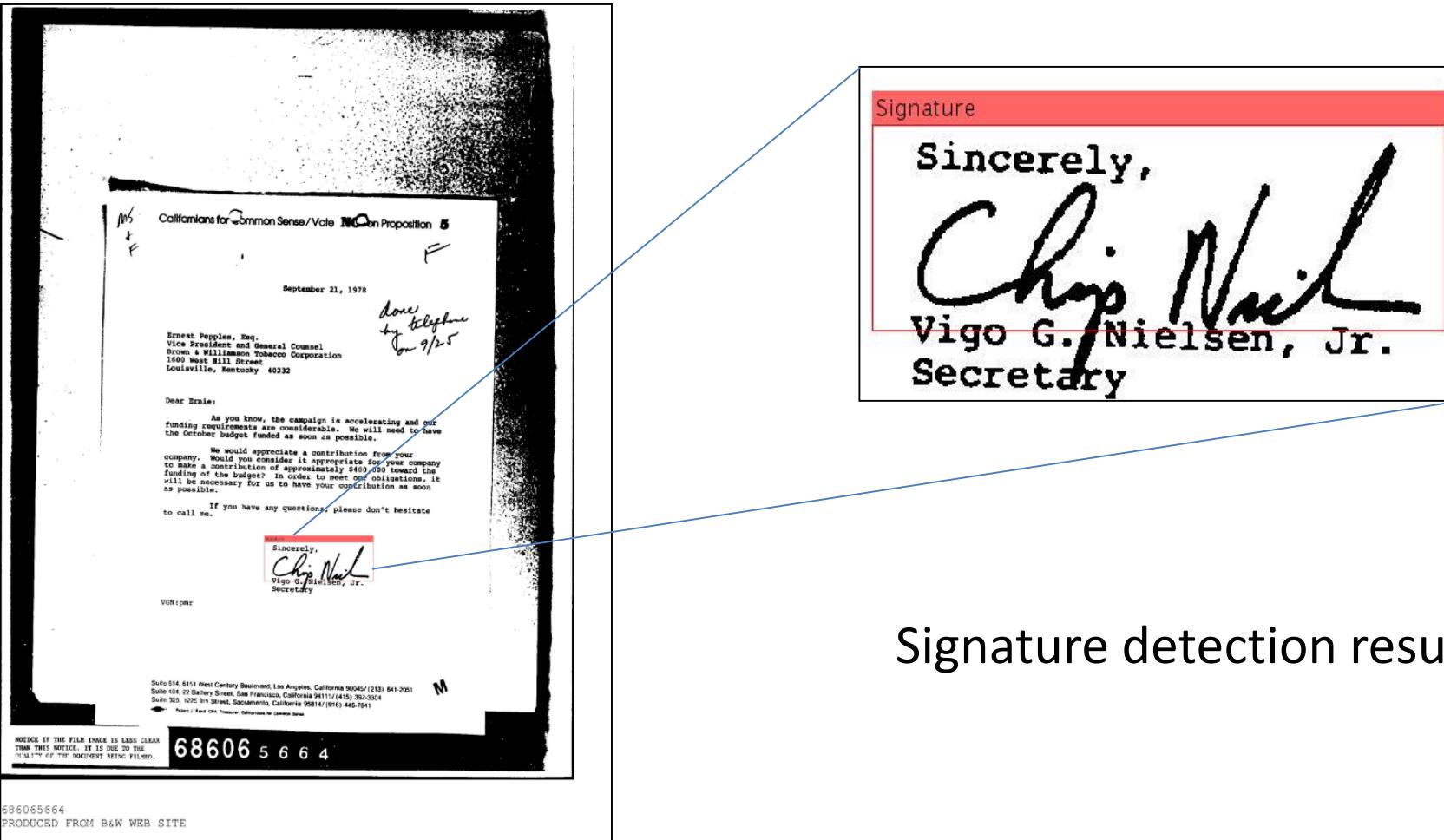
Deep Learning Pipeline example

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



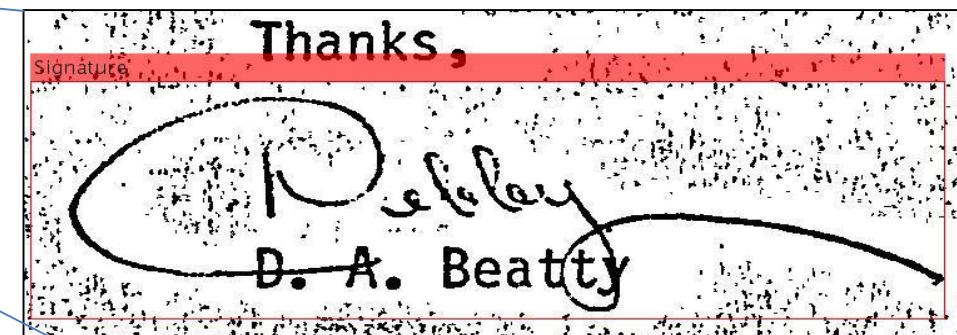
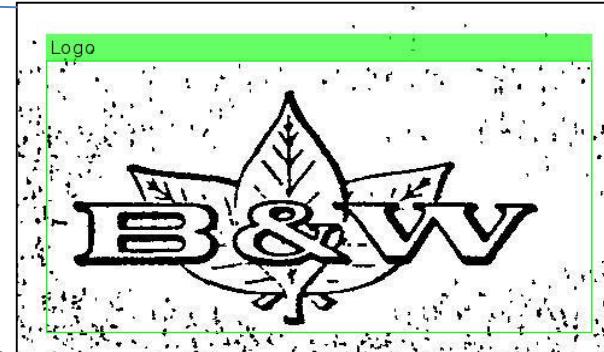
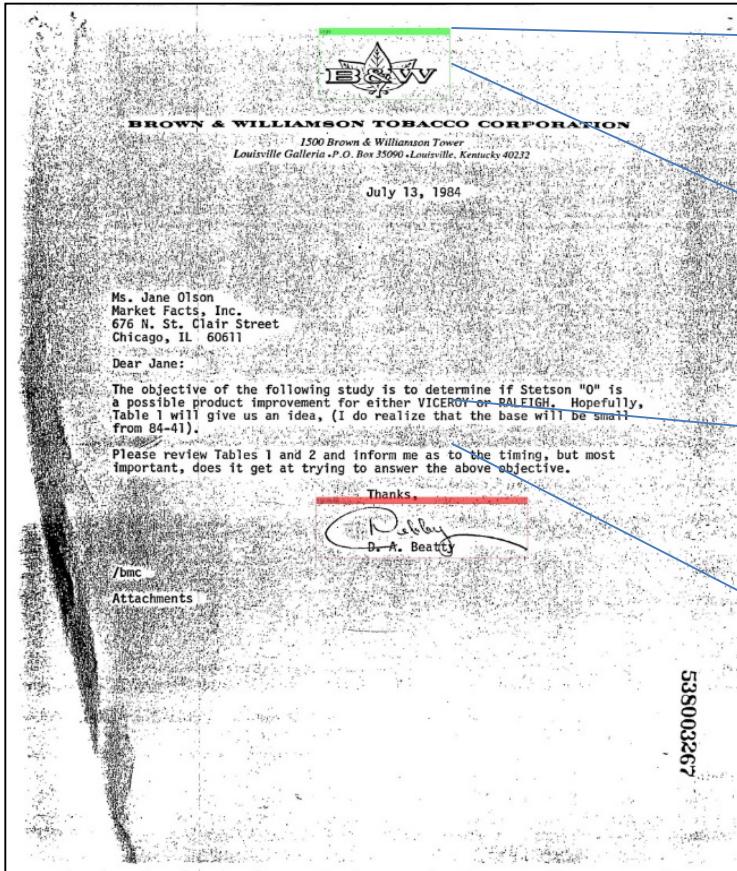
Deep Learning @UTS!

Signature and Logo detection



Signature detection result

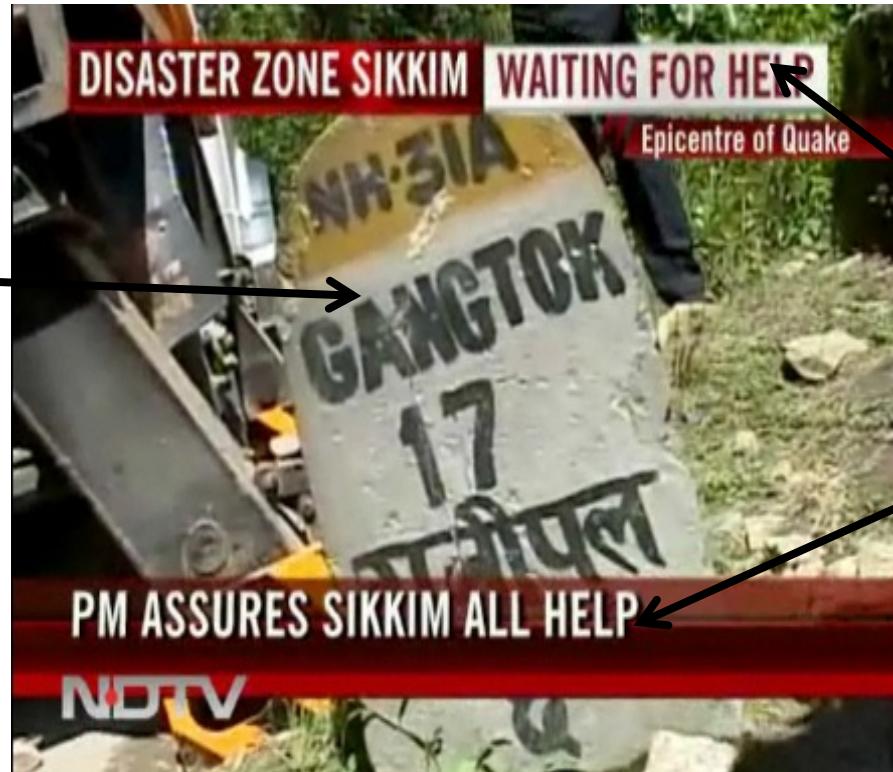
Signature and Logo detection



Logo and Signature
detection result

Text Information extraction in video

Scene Text
(natural)



Graphics Text
(overlaid)

Text information classification based on its origin

Text Detection Complexity



Vertical Text



Horizontal Text

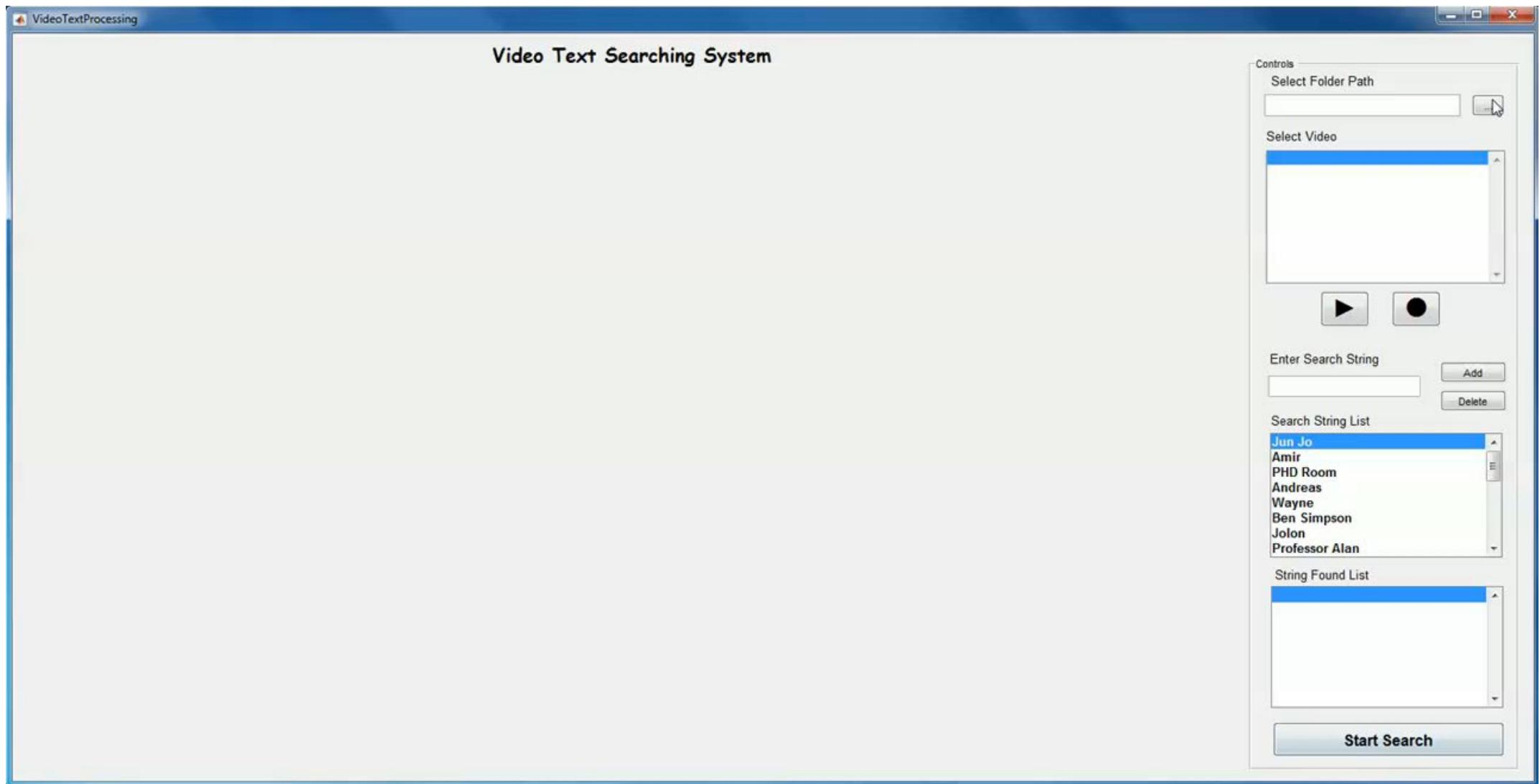


Non-Horizontal Text



Arbitrary / Curved Oriented Text

Real-time Text searching in Videos



Crowding Behaviour Analysis & Density Estimation



Human Action/Gesture Recognition

Pose Machines Demo



The Award winning  **SHARKspotter[®]**



CrocSpotter®



Drones for Security

