Deep Learning and Convolutional Neural Network (42028)

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!)

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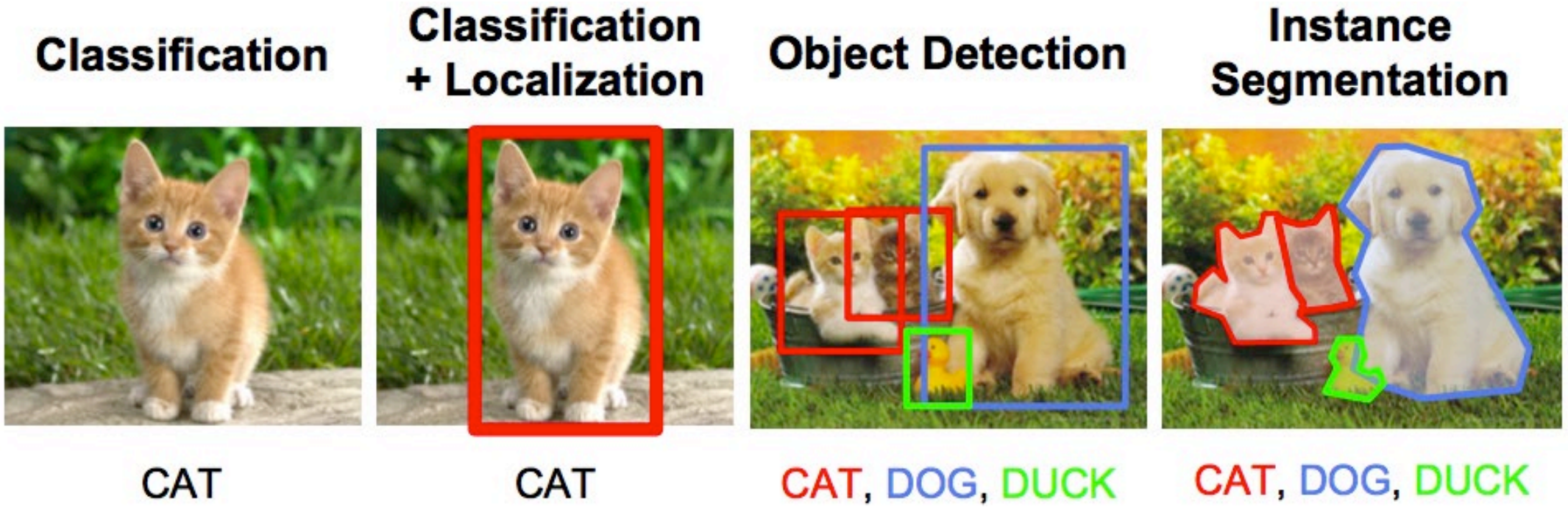
Popular Uses Cases - Examples

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



Images source: cs224d course

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

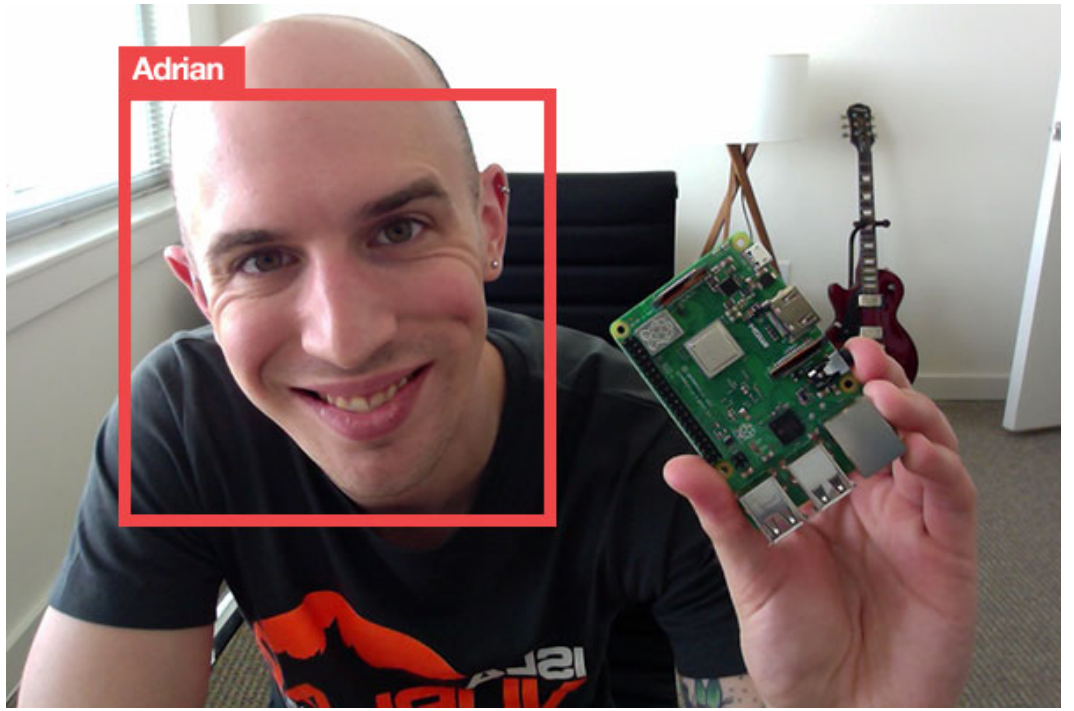
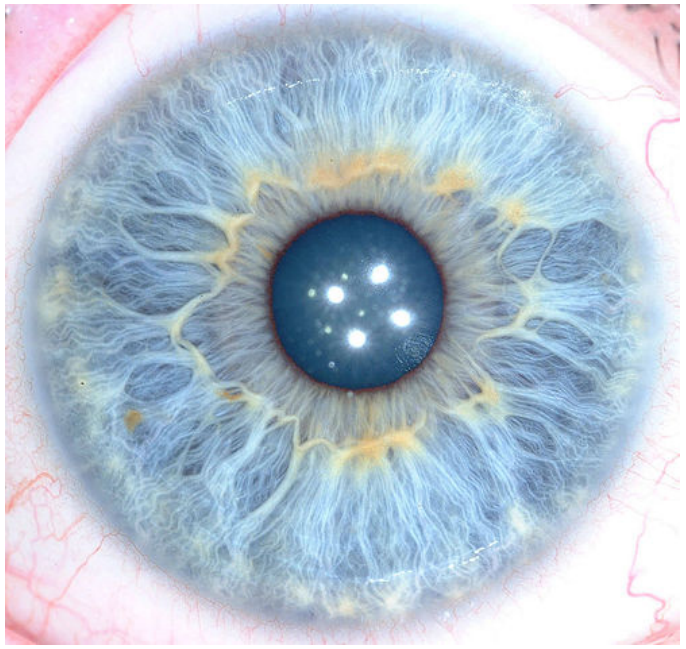


Image Source: https://www.pyimagesearch.com/2018/06/25/raspberry-pi-face-recognition/

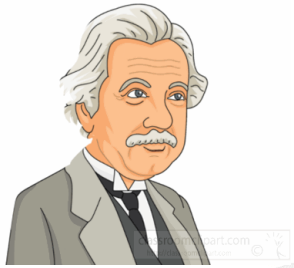
Popular Uses Cases - Examples

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



Popular Uses Cases - Examples

- Speech Recognition



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

Image Source: https://medium.com/@joelgarciajr84/creating-an-application-that-uses-speech-recognition-76117a396b7d

Popular Uses Cases - Examples

- Speech Recognition - Technology Challenges!

Popular Uses Cases - Examples

- Creative

This are fake images! → Generated using GAN

Image source: https://research.nvidia.com/publication/2017-10_Progressive-Growing-of

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?

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

More General Definition:

"*Machine Leaning is the field of study that gives computer ability to learn without being explicitly programmed*"

– Arthur Samuel, 1958

[1]Hands-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

Reference: Hands-On Machine Learning with Scikit-Learn and TensorFlow

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

Reference: Hands-On Machine Learning with Scikit-Learn and TensorFlow

Challenges of Machine Learning?

- More of the challenges are around Data!

- Data or Algorithm, which is more important?

- Check:

  [1] Unreasonable Effectiveness of data

  [2]Revisiting 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

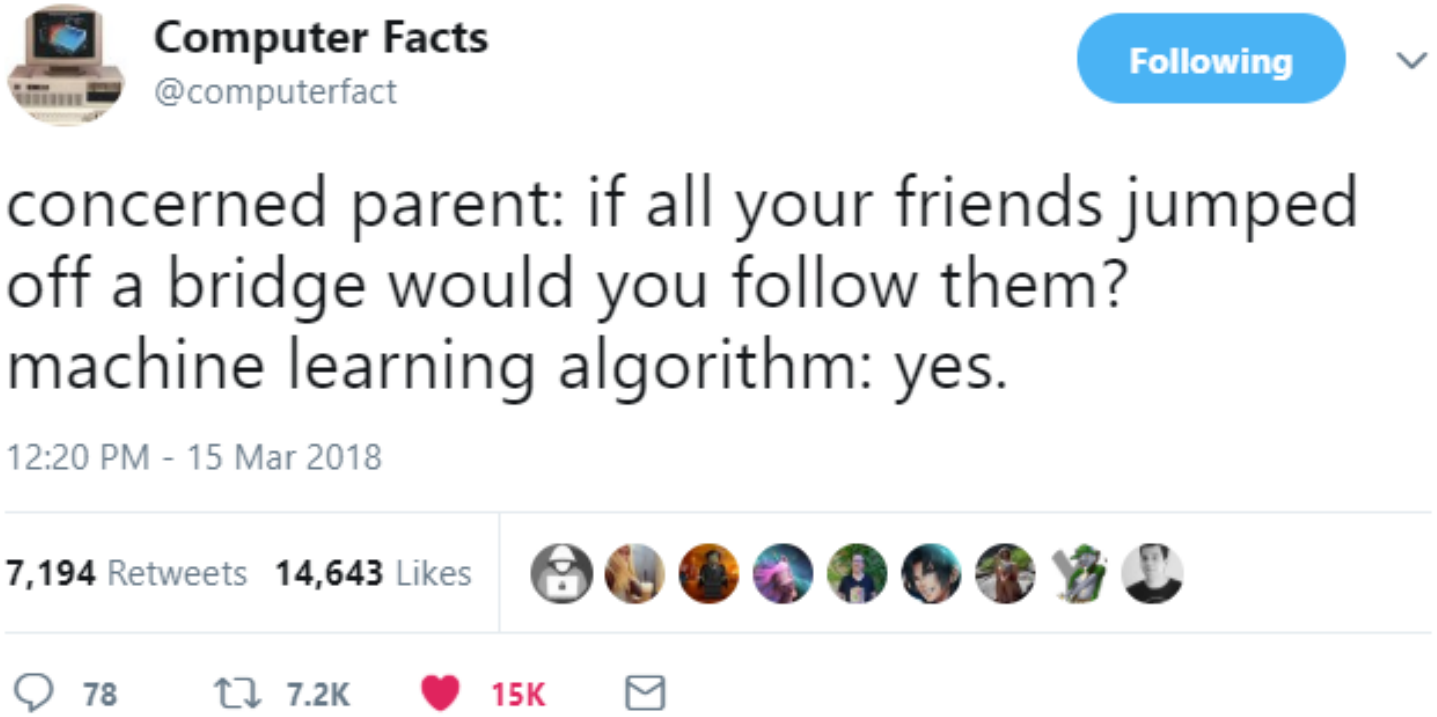


Image source: https://www.reddit.com/r/ProgrammerHumor/comments/8p96r8/yes/

Challenges of Machine Learning?

- Under fitting example

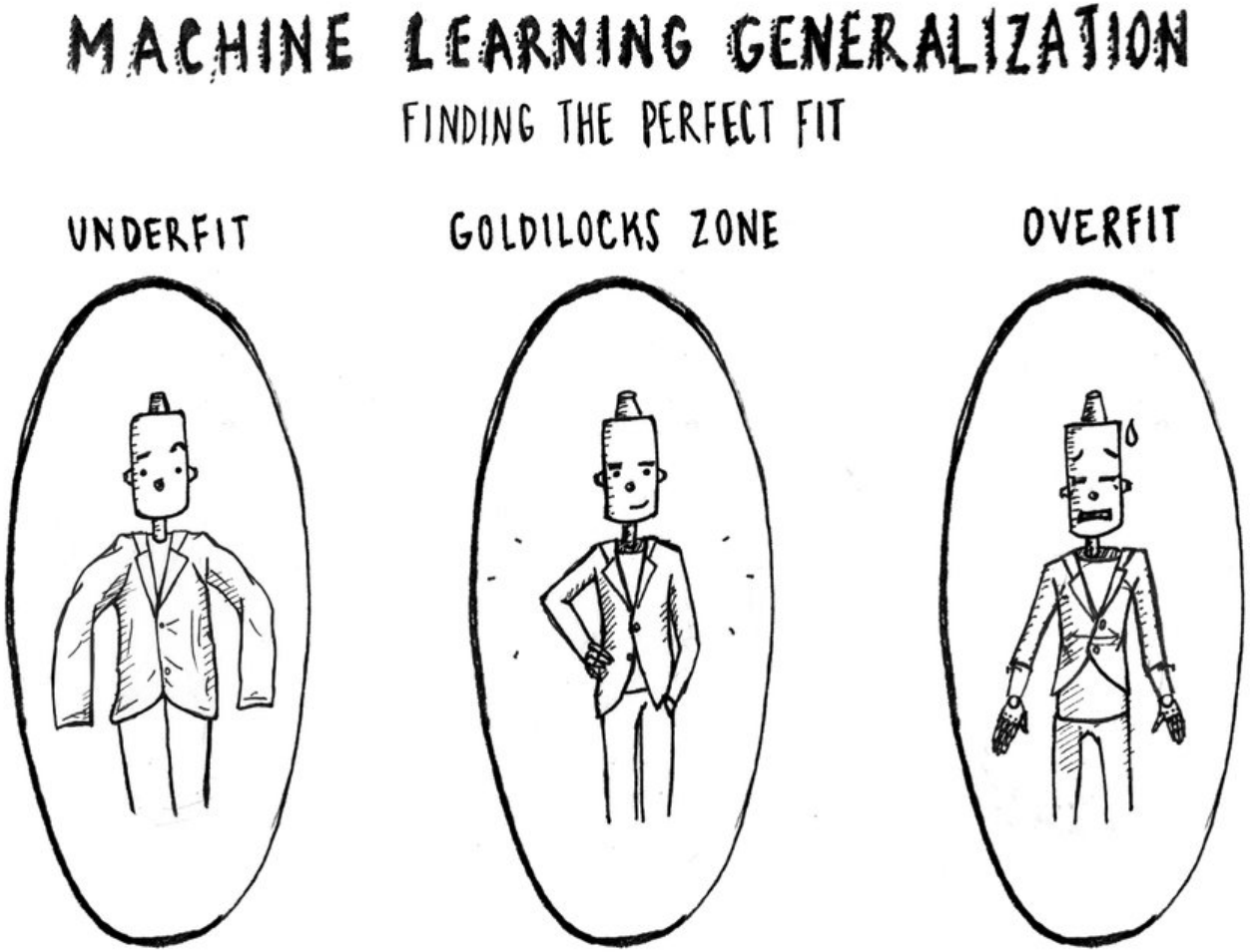


Image source: https://www.euclidean.com/overfitting-underfitting-models

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

Reference: https://deepai.org/machine-learning-glossary-and-terms/computer-vision

Applications

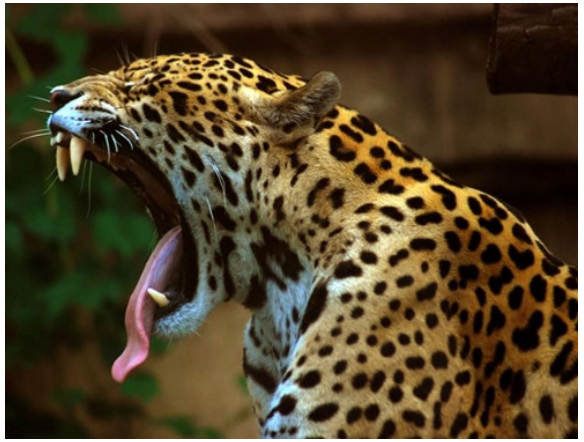


Image search engines

Assistance to differently abled humans (bionic eye)

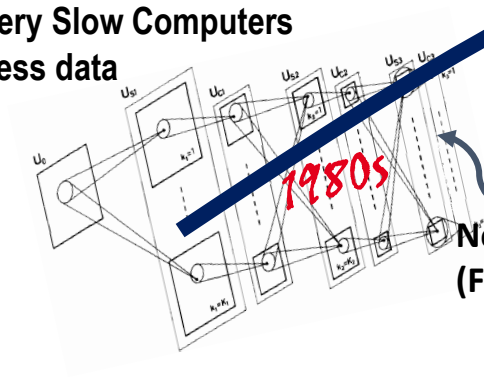
Unmanned Surveillance using Drone

Autonomous driving

Human machine interaction/ Robotics

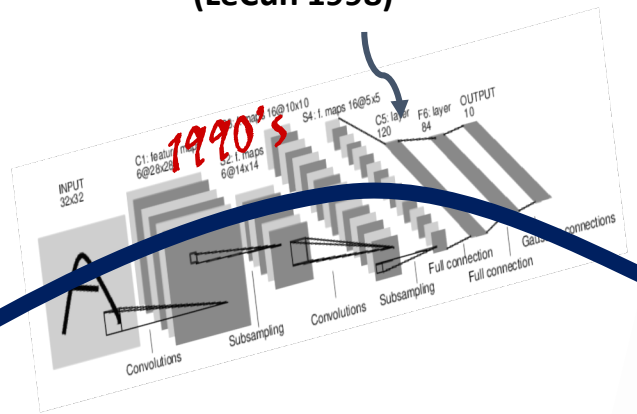
The Deep Learning Evolution

-Very Slow Computers
-Less data

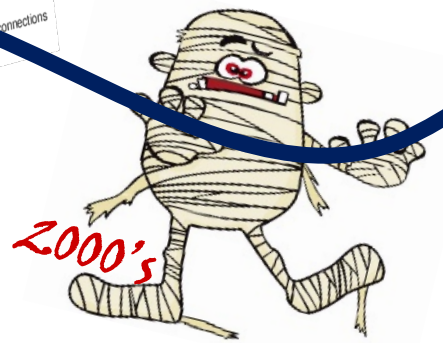


Neocognition
(Fukushima 1980)

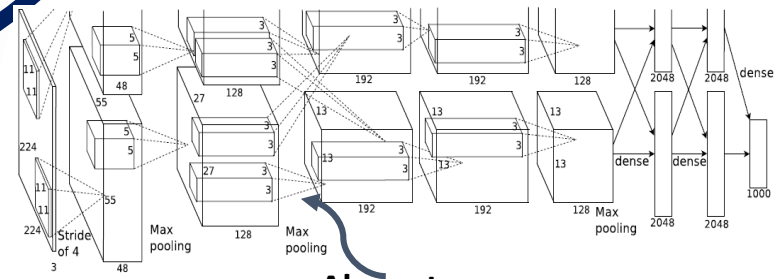
LeNet -5
(LeCun 1998)



ANNs almost dead



-Faster Computers, GPUs!
-Big data



Alexnet
(Krizhevsky 2012)

...

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

Deep Learning Evolution

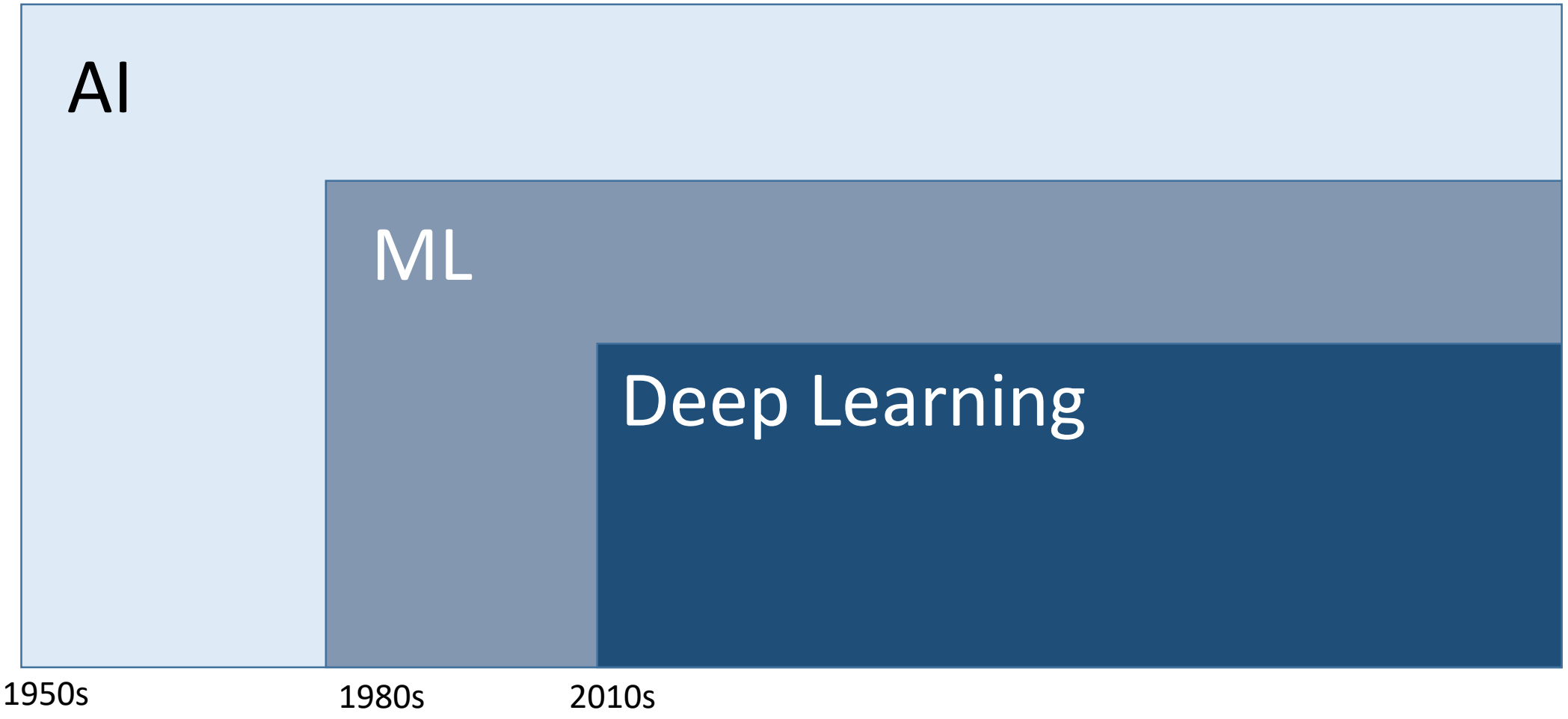
So What Changed Overtime?

- Availability of faster computers!
  cheap and fast GPUs

- Very large datasets!

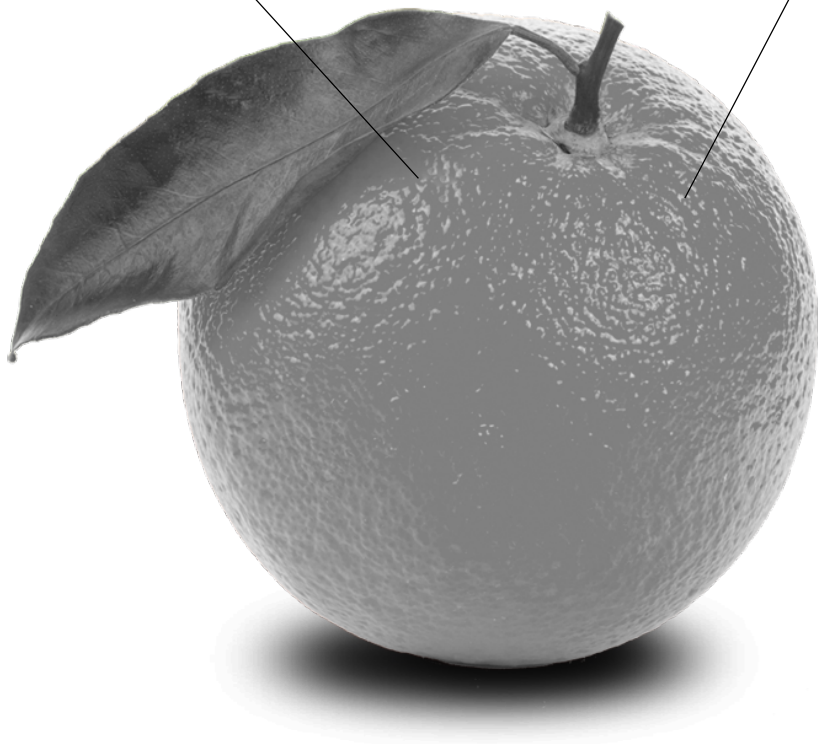
Deep Learning Frameworks & Libraries

AI, ML and DL relationship!



Features in Machine Learning

Weight: 150 grams



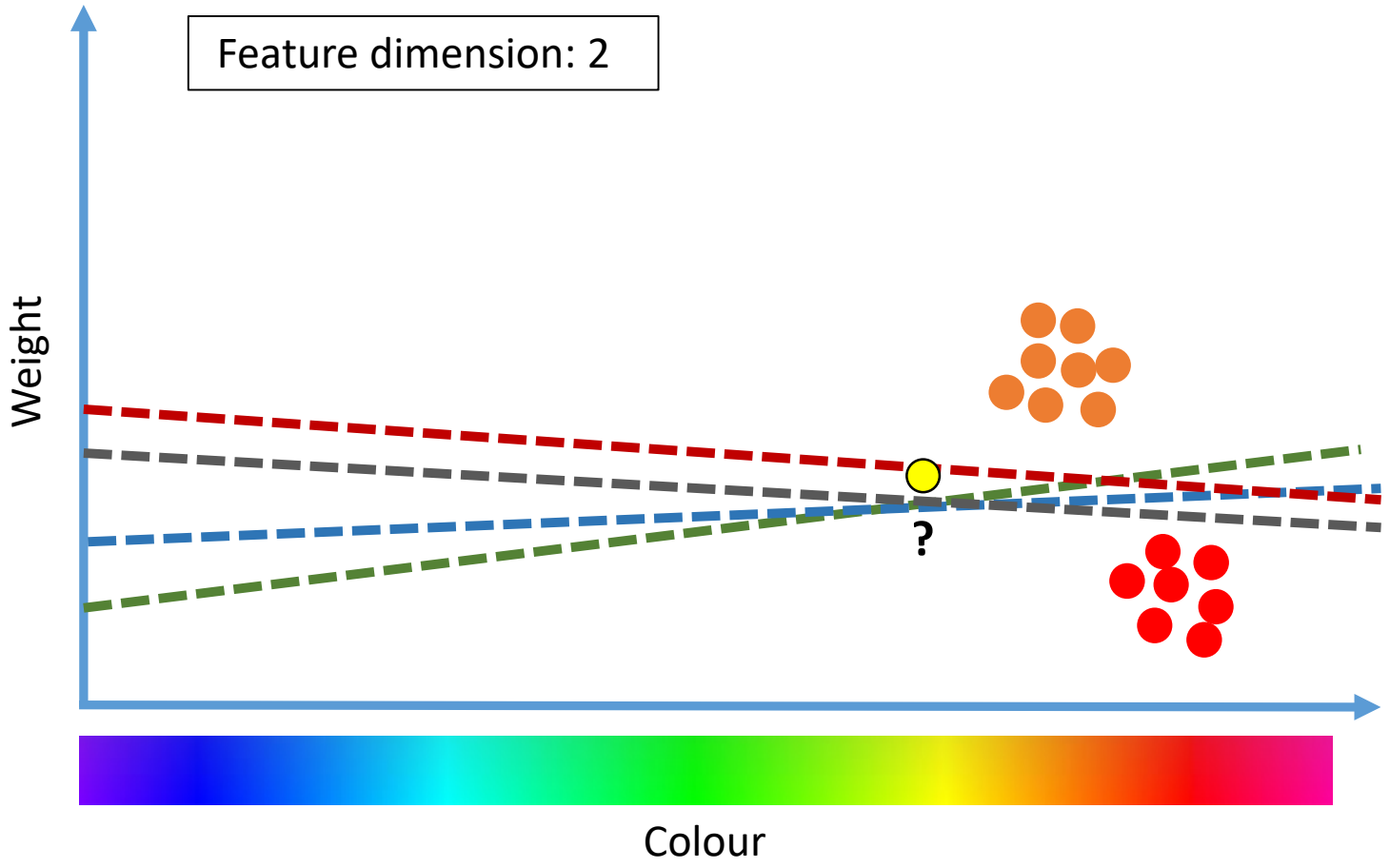
Colour: Orange?

Orange? Yes-85%
No-14%
Unsure- 1%

Orange? Yes-40%
No-55%
Unsure- 5%

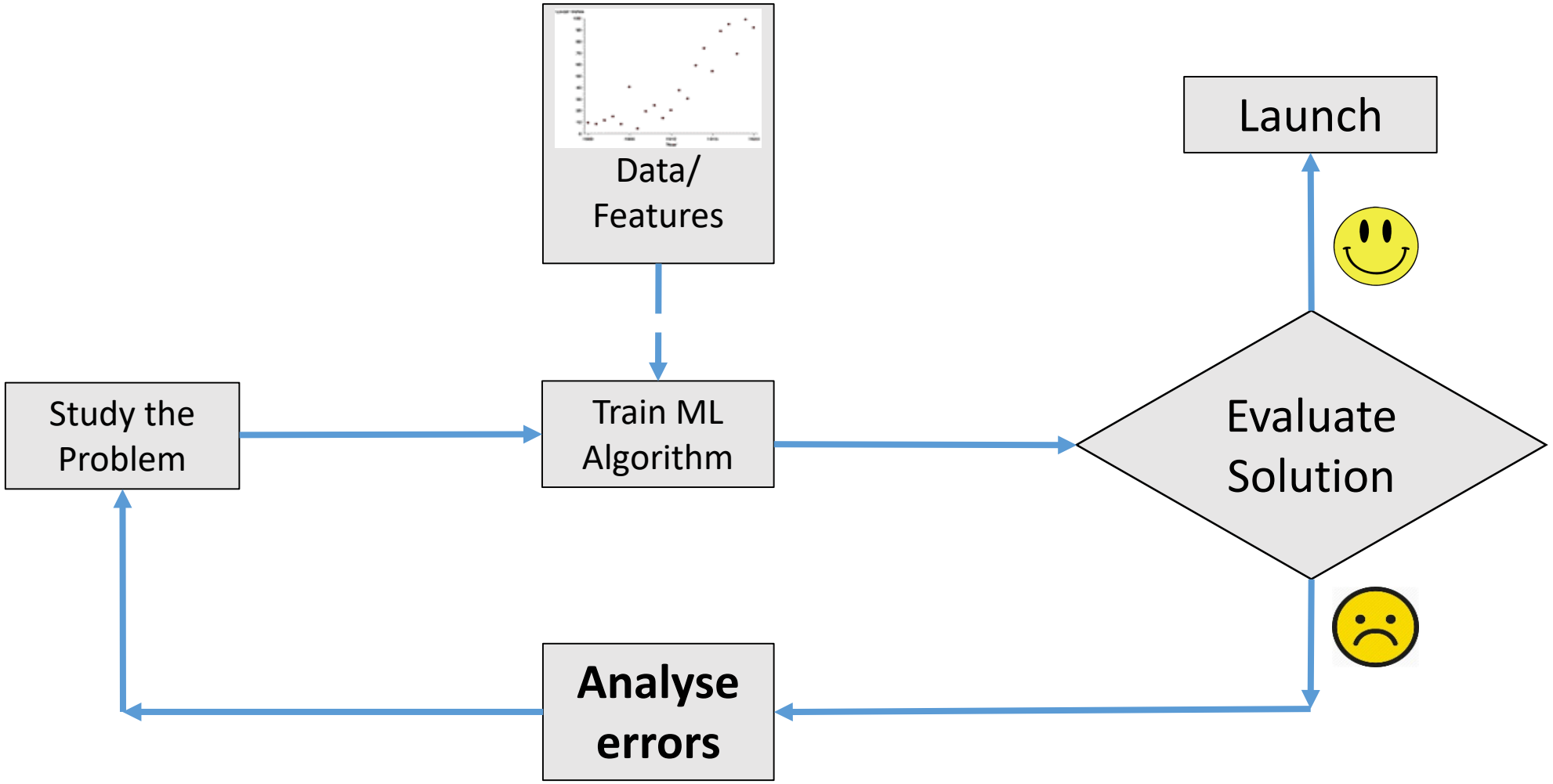
Features in Machine Learning

- Orange
- Apple



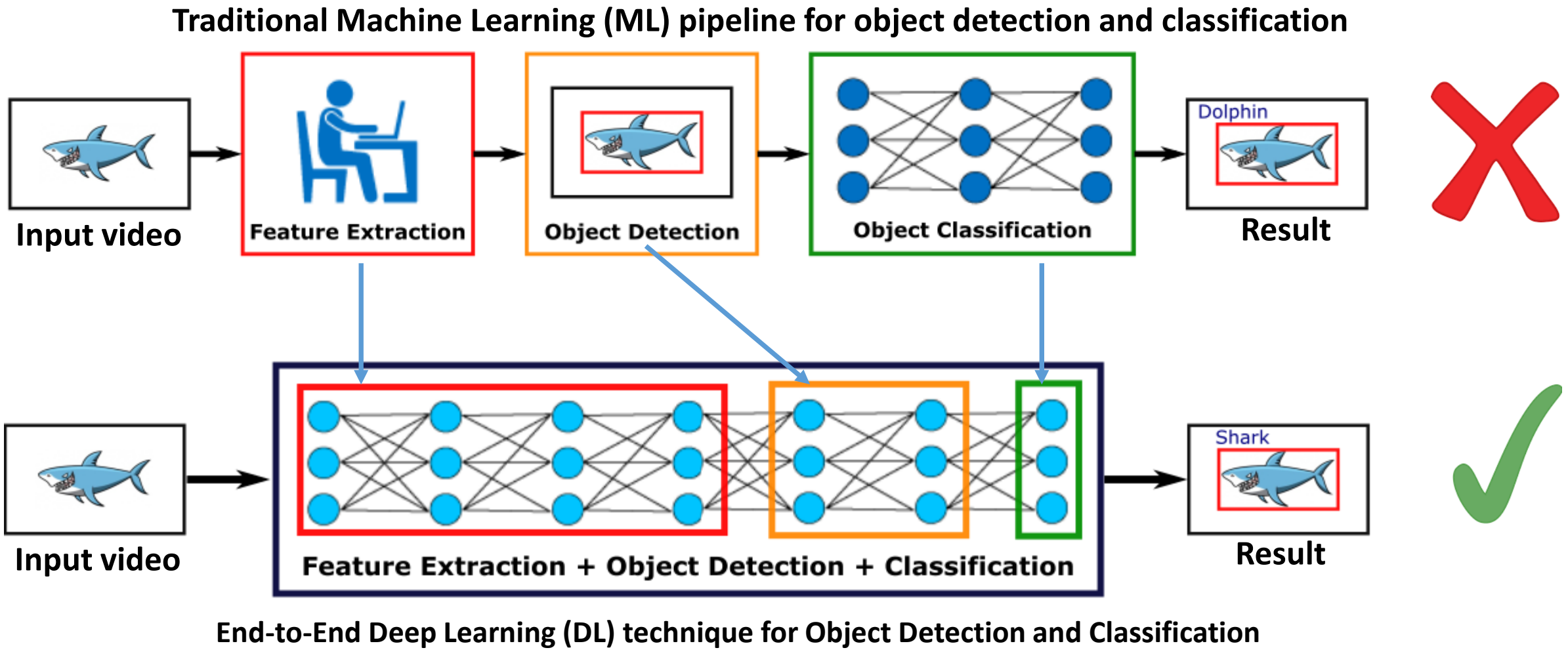
Choosing appropriate and useful features can have a significant impact on the performance of a Machine Learning system!

Typical Machine Learning Pipeline



Reference: Hands-On Machine Learning with Scikit-Learn and TensorFlow

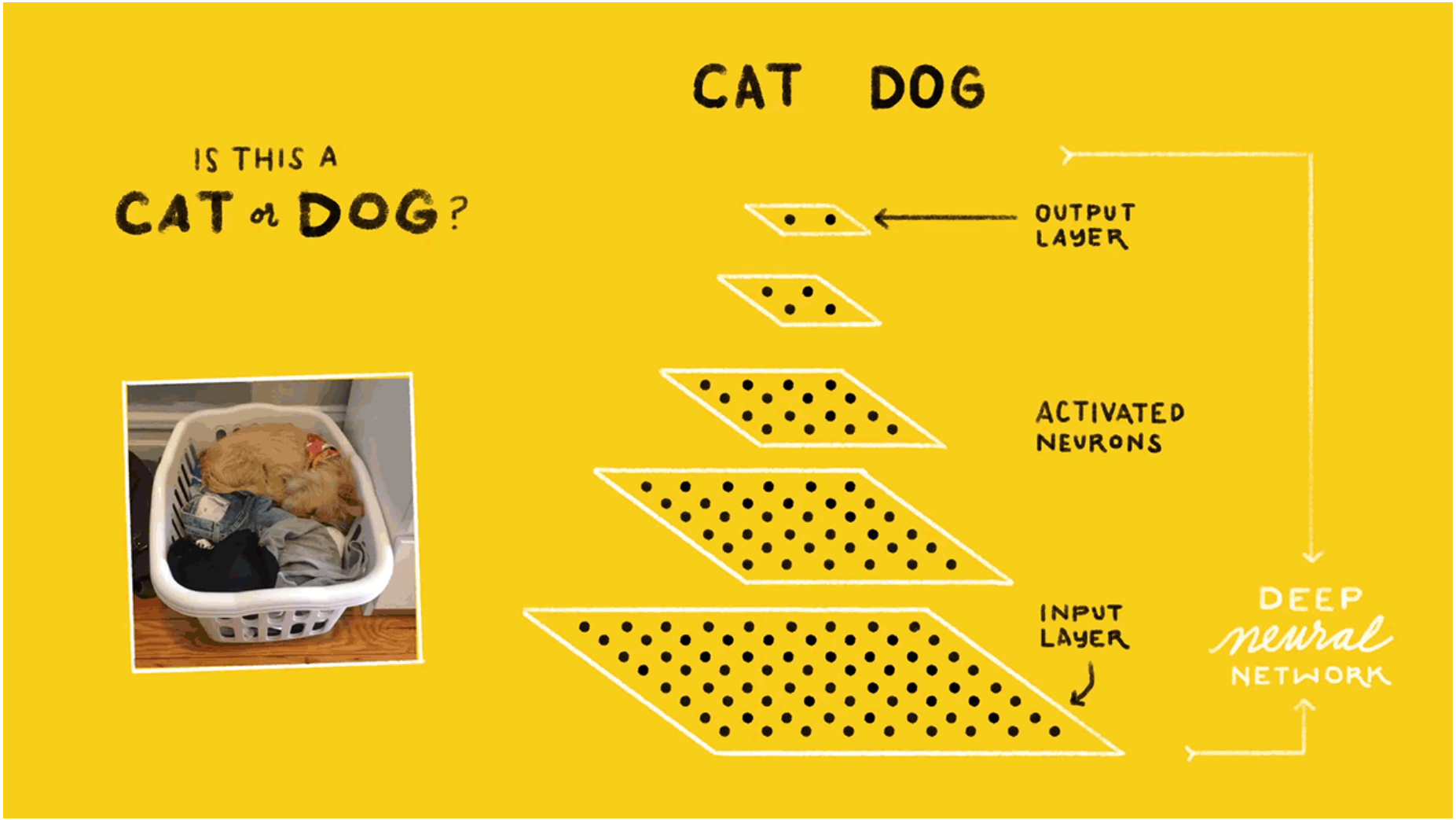
Traditional ML Vs DL Pipeline



Deep Learning Pipeline example

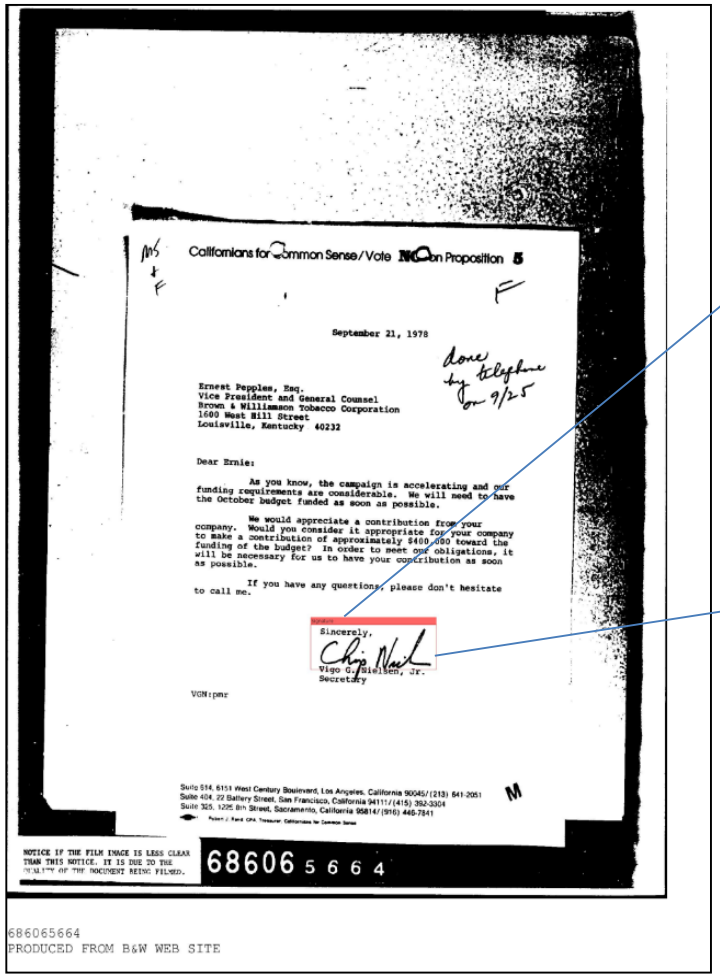
- More layers that loosely mimic human brain

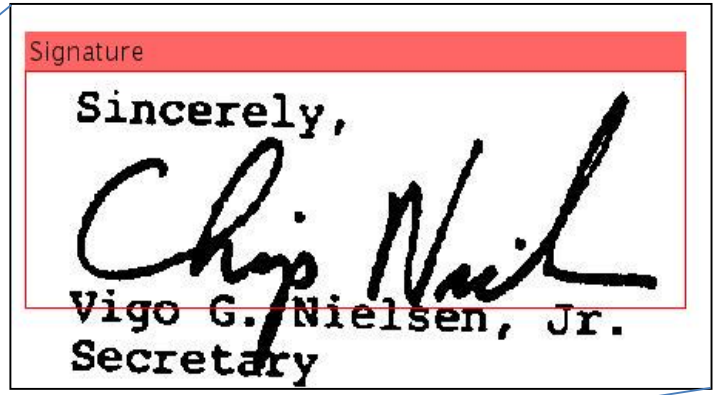
- No explicit feature engineering



Deep Learning @UTS!

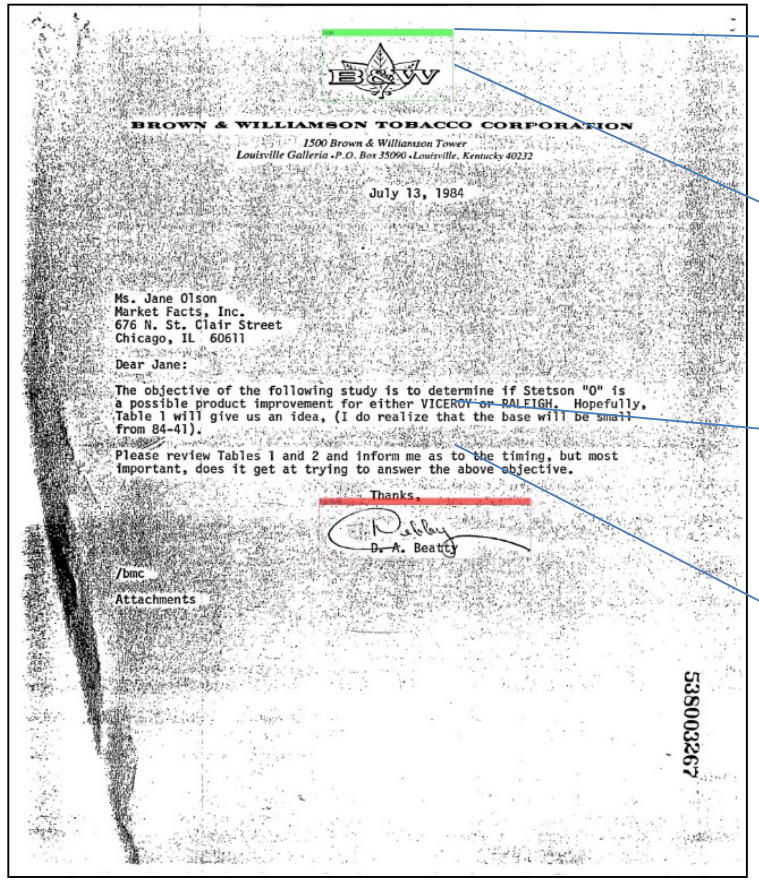
Signature and Logo detection





Signature detection result

Signature and Logo detection



BROWN & WILLIAMSON TOBACCO CORPORATION

1500 Brown & Williamson Tower
Louisville Galleria • P.O. Box 35090 • Louisville, Kentucky 40232

July 13, 1984

Ms. Jane Olson
Market Facts, Inc.
676 N. St. Clair Street
Chicago, IL 60611

Dear Jane:

The objective of the following study is to determine if Stetson "O" is a possible product improvement for either VICEROY or RALEIGH. Hopefully, Table 1 will give us an idea, (I do realize that the base will be small from 84-41).

Please review Tables 1 and 2 and inform me as to the timing, but most important, does it get at trying to answer the above objective.

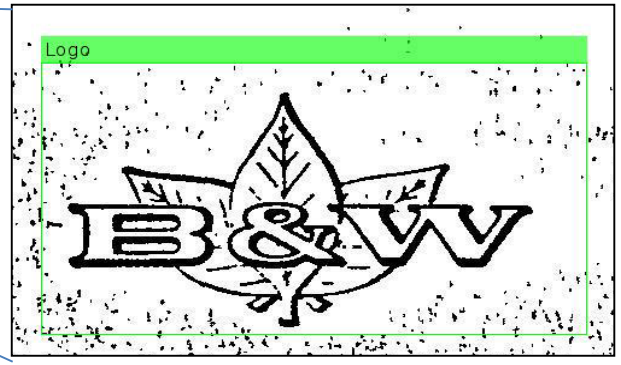
Thanks,

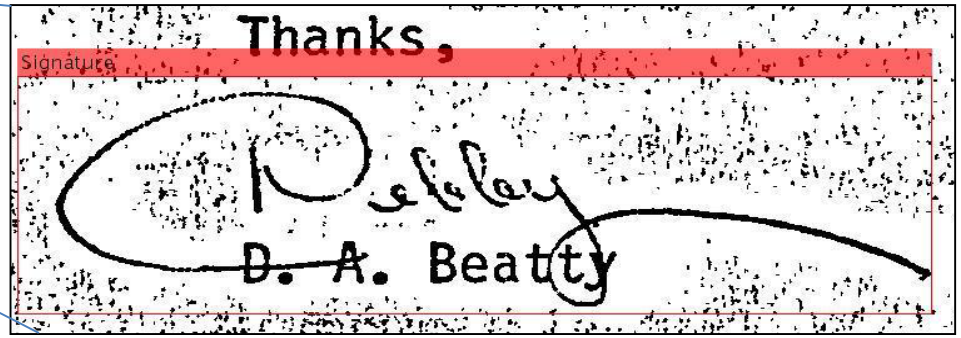
D. A. Beatty

/bmc

Attachments

538003267

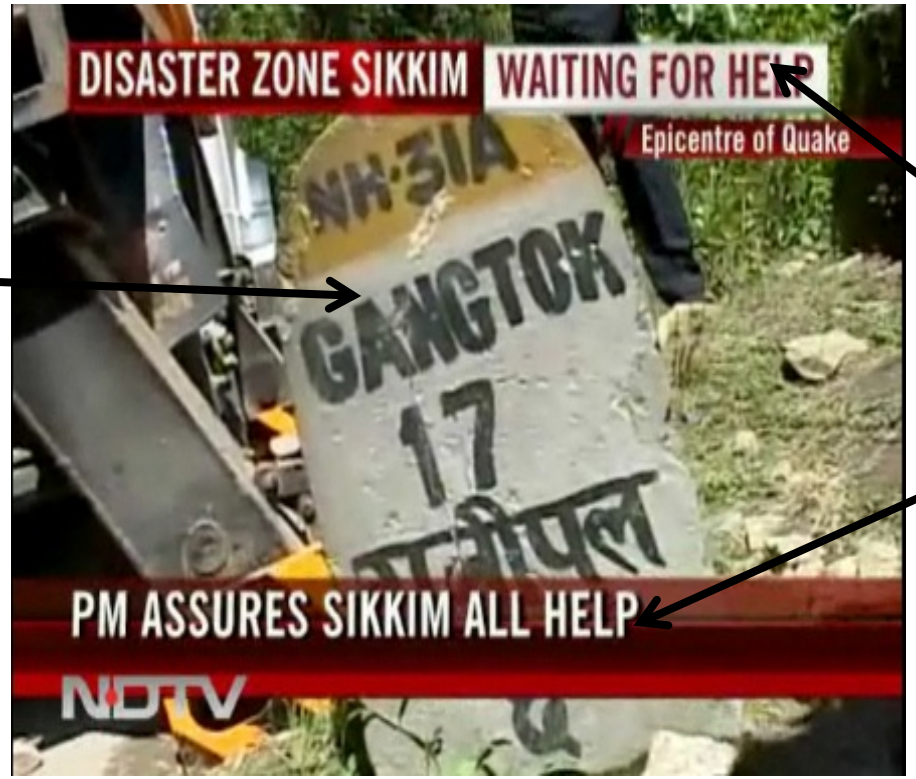




Logo and Signature detection result

Text Information extraction in video

Scene Text
(natural)



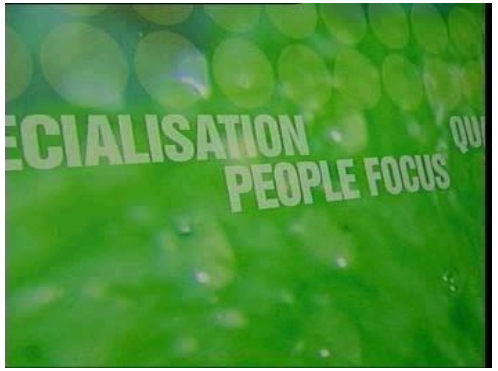
Graphics Text
(overlaid)

Text information classification based on its origin

Text Detection Complexity

Vertical Text

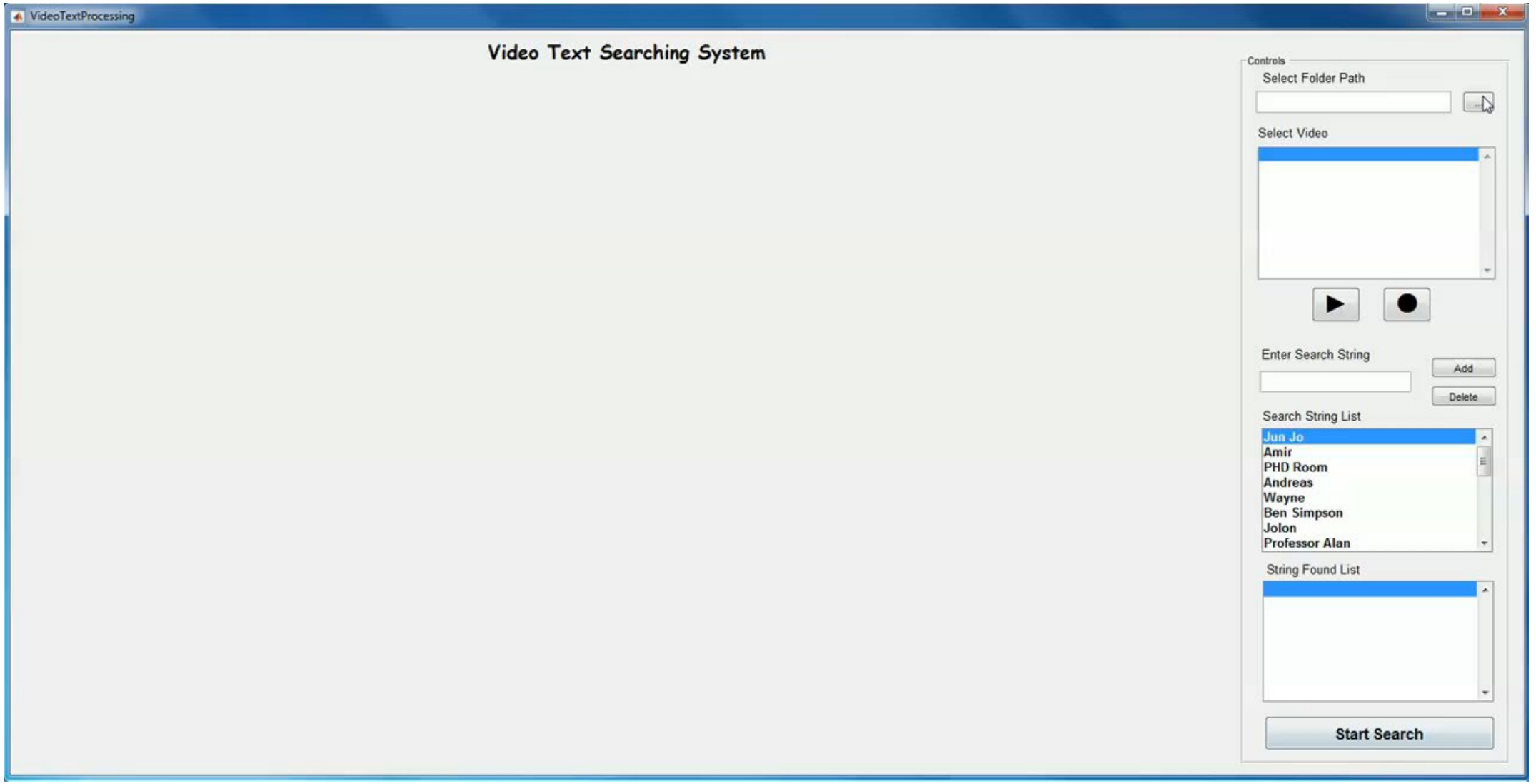
Horizontal Text



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©