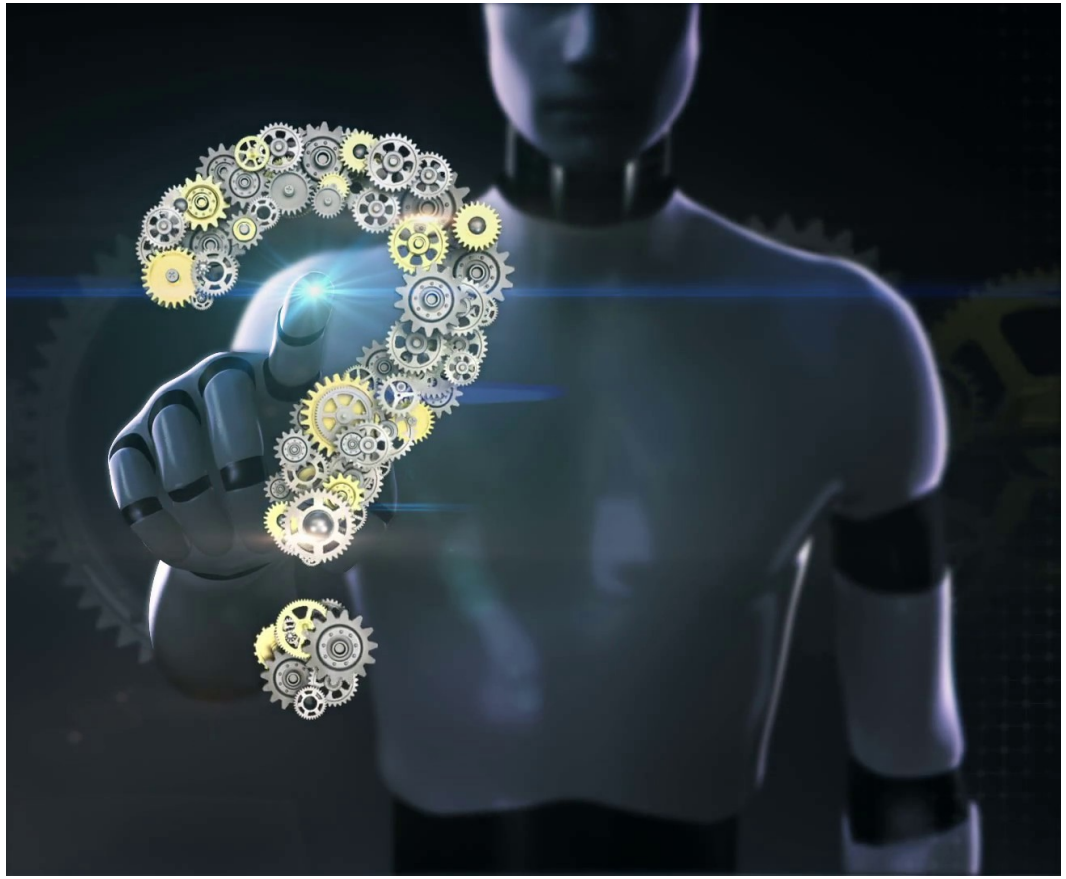
INTRODUCTION TO ARTIFICIAL INTELLIGENCE & MACHINE LEARNING

Outline

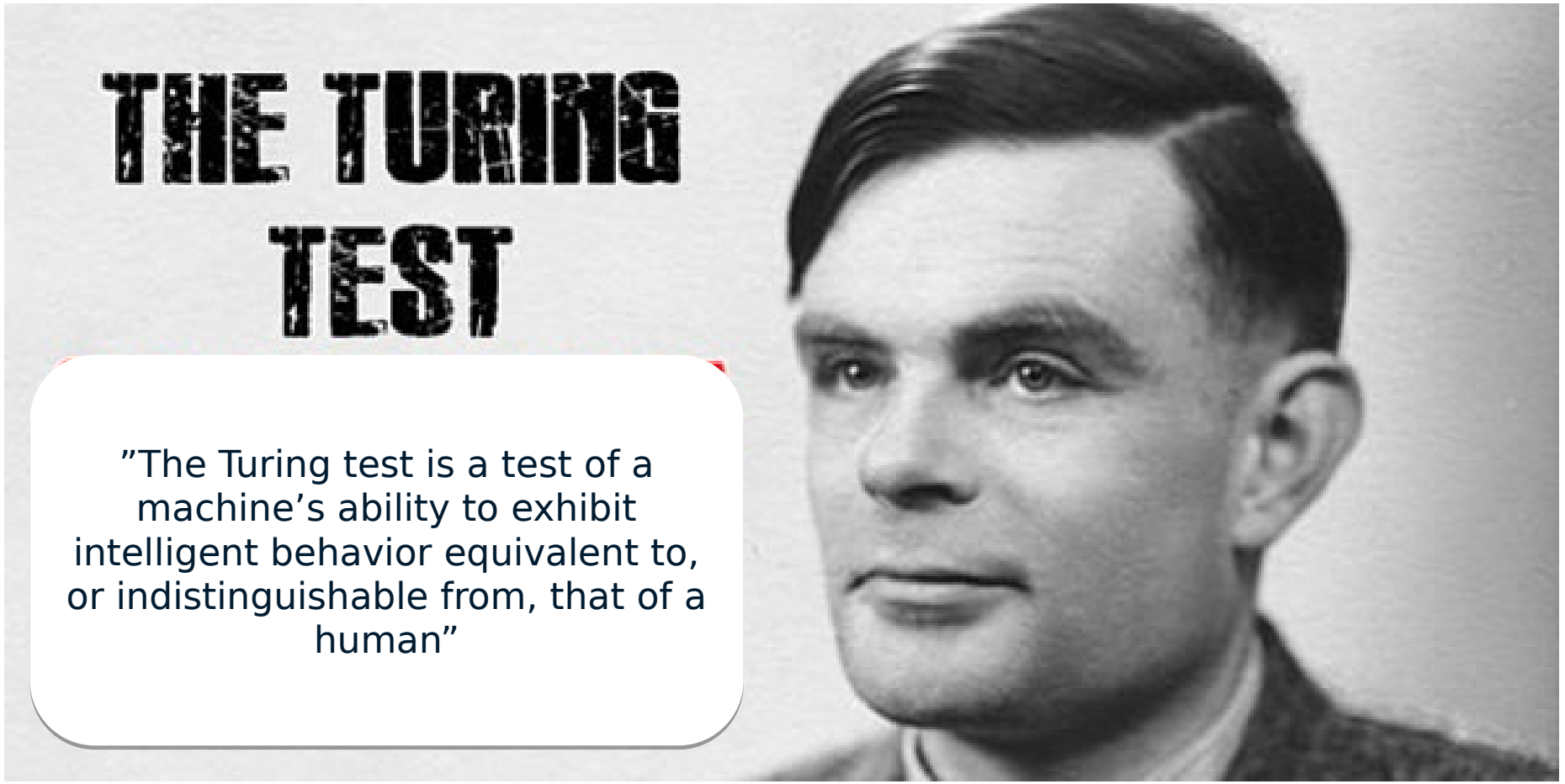
- What is Artificial Intelligence
- What is Machine Learning
- Play Pictionary!
- Machine Learning Walkthrough
- Risks associated with AI

ARTIFICIAL INTELLIGENCE

- How Would You Define Artificial Intelligence?



Can machines think?



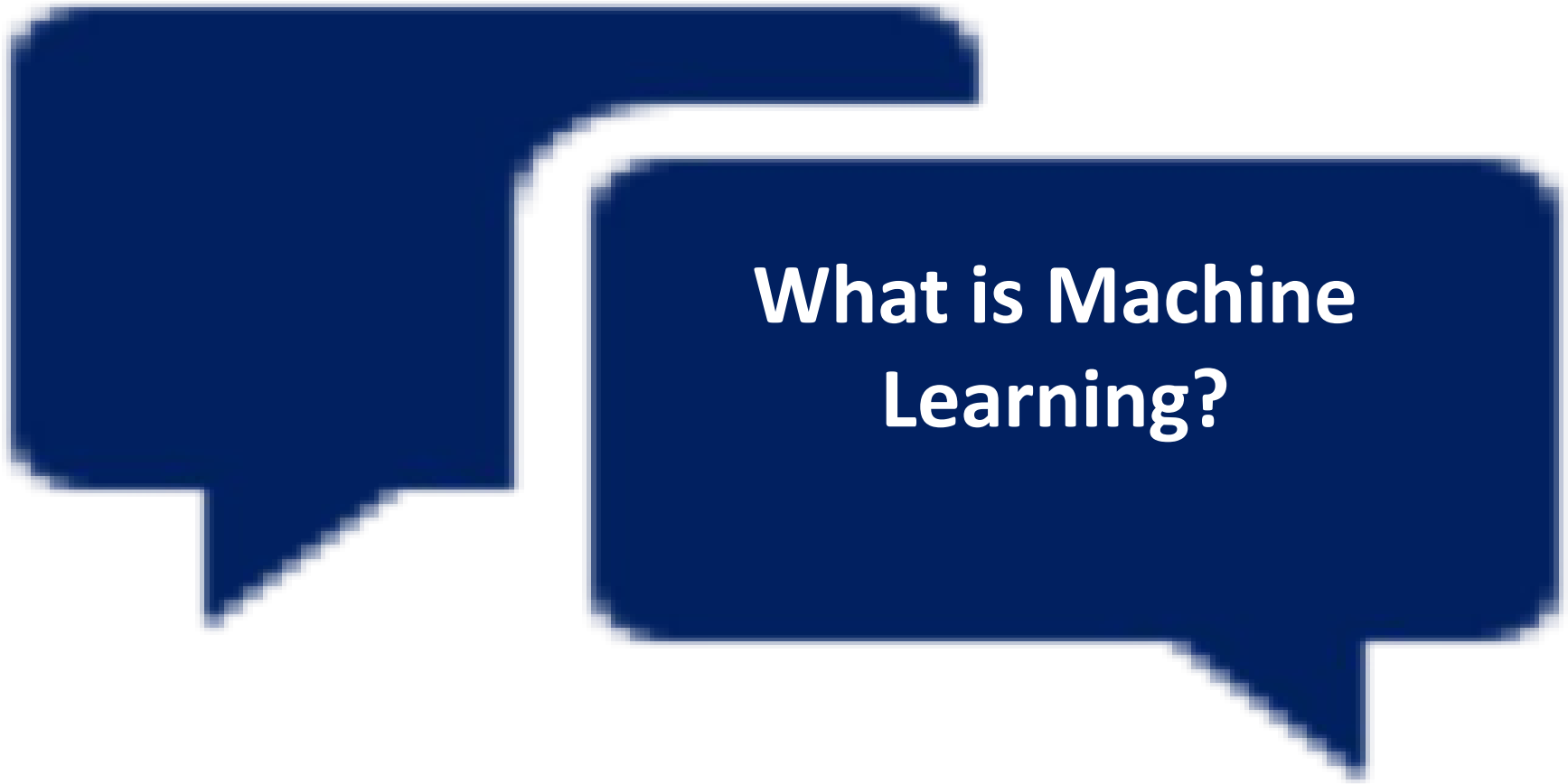
Categories of AI

- **Strong AI**
  - Essentially a machine thinking just like a human
  - Nowhere near this now!

- **Applied AI**
  - Advanced information processing
  - Expert systems
  - This is where we are now!
  - Facial recognition, medical diagnoses, stock trading, chat bots etc.

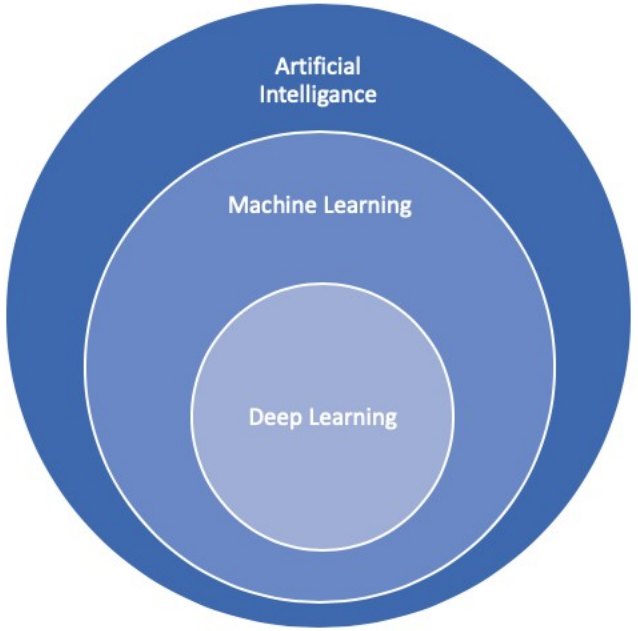
AI In Action
Booking an Appointment

Machine Learning


What is Machine Learning?

What is Machine Learning?

- Machine learning is the ability for a machine to learn something from data
- A machine could learn to
  - Play Chess or Go
  - Recognise faces and other images
  - Recognise damage to a vehicle
  - Identify fraudulent behaviour patterns
  - Spot medical conditions from an X-Ray

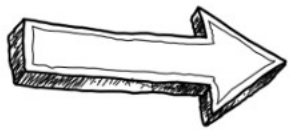


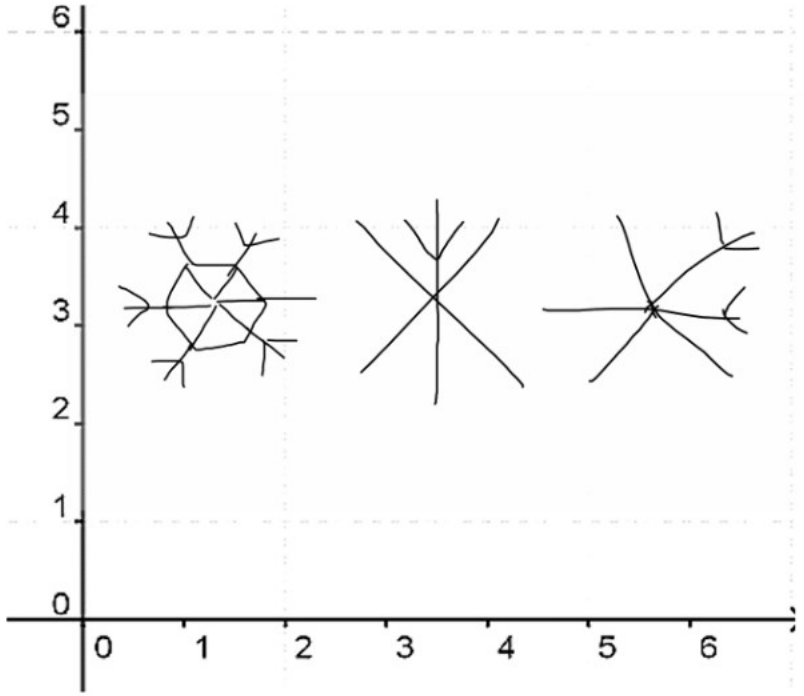
Let’s Play Pictionary

https://quickdraw.withgoogle.com/

The Data that Google Draw is using

```
[
  [  // First stroke
    [x0, x1, x2, x3, ...],
    [y0, y1, y2, y3, ...],
    [t0, t1, t2, t3, ...]
  ],
  [  // Second stroke
    [x0, x1, x2, x3, ...],
    [y0, y1, y2, y3, ...],
    [t0, t1, t2, t3, ...]
  ],
  ... // Additional strokes
]
```





Formal Definition – Machine Learning

"Machine Learning is said to

- *learn from experience E*
- *with respect to some class of task T*
- *and a performance measure P*

- *if its performance at the task measured by the performance measure improves with experience"*

Tom Mitchell 1997

Formal Definition – Facial Recognition

- *“Facial Recognition”*
  - *learn from looking at lots of images of faces*
  - *with respect to learning to recognize people*
  - *and measure how many are identified correctly*
  - *if recognizing people improves with experience”*

What is machine learning?

Machine learning algorithms find natural patterns in data that generate insight and help you make better decisions and predictions

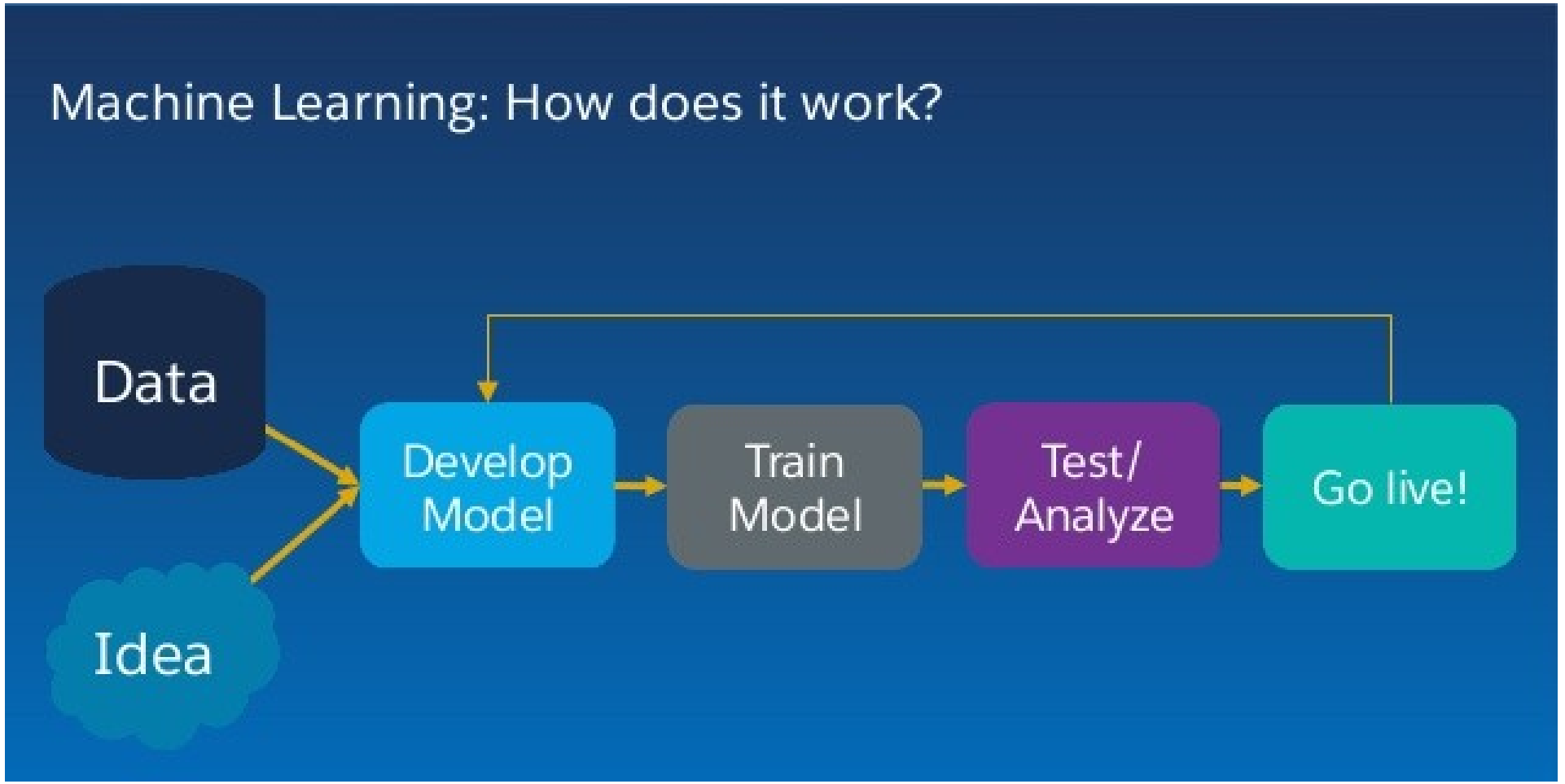
Use computational methods to “learn” or create “knowledge” directly from data

Where is ML usec

- HEALTHCARE: Patient Diagnosis
- FINANCE: Fraud Detection
- MANUFACTURING: Anomaly Detection
- RETAIL: Inventory Optimization
- GOVERNMENT: Smarter Services
- TRANSPORTATION: Demand Forecasting
- NETWORKS: Hacker Detection
- E-COMMERCE: Recommendation
- MEDIA: User Interaction

https://www.youtube.com/watch?v=zwm2C3V35Fw

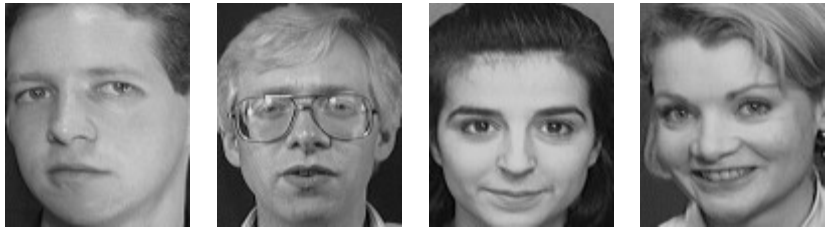
How Machine Learning Works

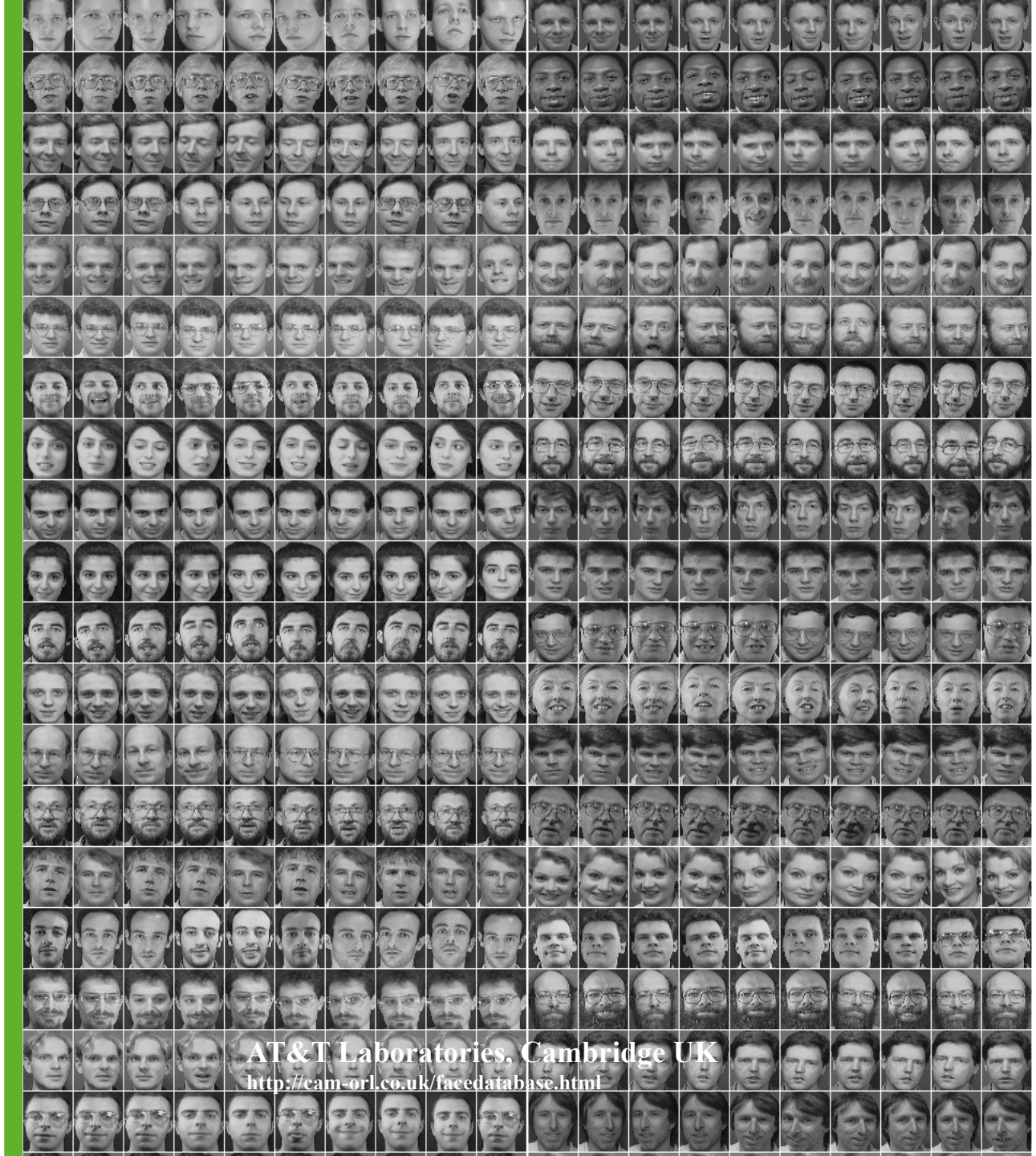


Face Recognition

Training examples of a person

Test images

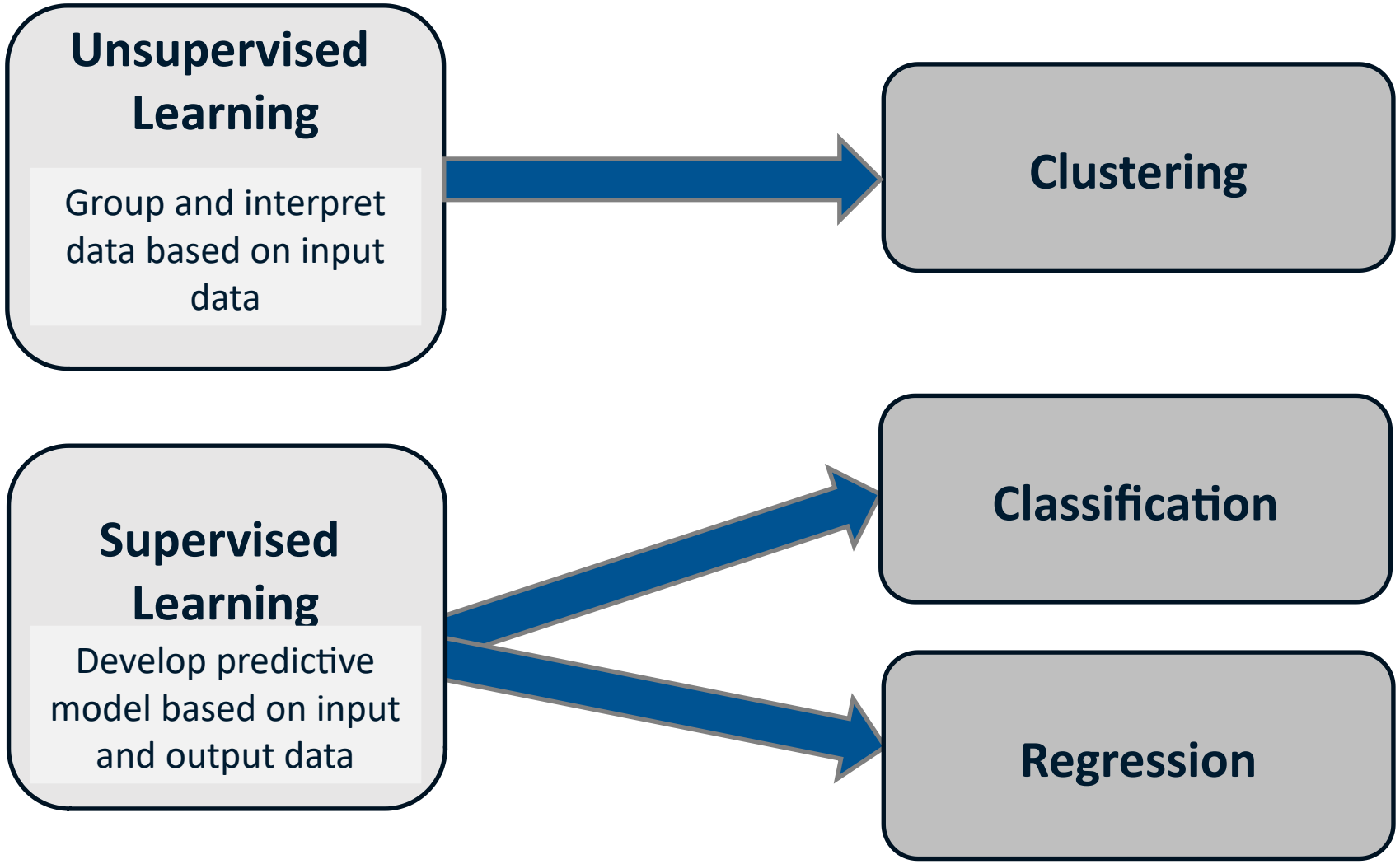




Types of Learning

Supervised learning	• Training data includes desired outputs
Unsupervised learning	• Training data does not include desired outputs
Semi-supervised learning	• Training data includes a few desired outputs
Reinforcement learning	• Rewards from sequence of actions

Machine Learning Techniques



Machine Learning Algorithms

Classification:

Support Vector Machines
Discriminant Analysis
Naïve Bayes
Nearest Neighbour

Regression:

Linear Regression
SVR/GPR
Ensemble Methods
Decision Trees
Neural Networks

Clustering:

Fuzzy Hiearchial
Gaussian Mixture
Neural Networks
Hidden Markov Model

Machine Learning Scenarios

Scenario	Technique
Record and analyze customer conversations to gauge their feeling on the outcome.	**Natural Language Processing**: a suite of techniques that analyze written or spoken languages, and produces text from speech, or speech from text, or translations.
Allow clients to access their private data using a selfie	**Clustering:** an approach to machine learning that groups data based on other data around it. Data that is most similar will be grouped together. Data that is least similar will be in different groups. Good at finding patterns in data.
Deploy a chatbot to help clients with their most frequent queries	**Regression:** a technique which works with labelled data and its properties, and find patterns. For example, looking at the properties of houses, and the prices that they sold for. Used to make predictions
Analyze trades to identify the most profitable	**Sentiment analysis:** using natural language processing to analyze how happy a person is in a situation (e.g. a text, a comment, a tweet or a conversation).
Predict the price of a complex security based on previous transactions	**Image recognition:** a series of techniques that train deep learning models on images, so that they can recognize future images. Among other uses, this can be used for facial recognition.

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A Typical Project

Resources and Timelines

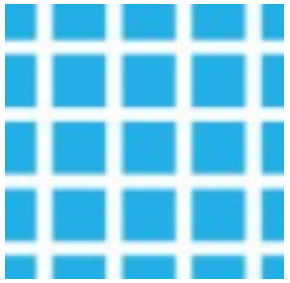
The Process Flow

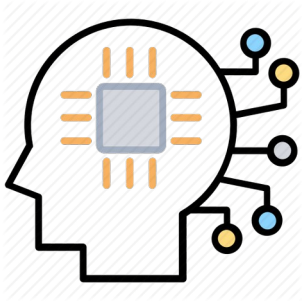
Unstructured Data Generated and Stored

Data cleansed and organised ready for learning

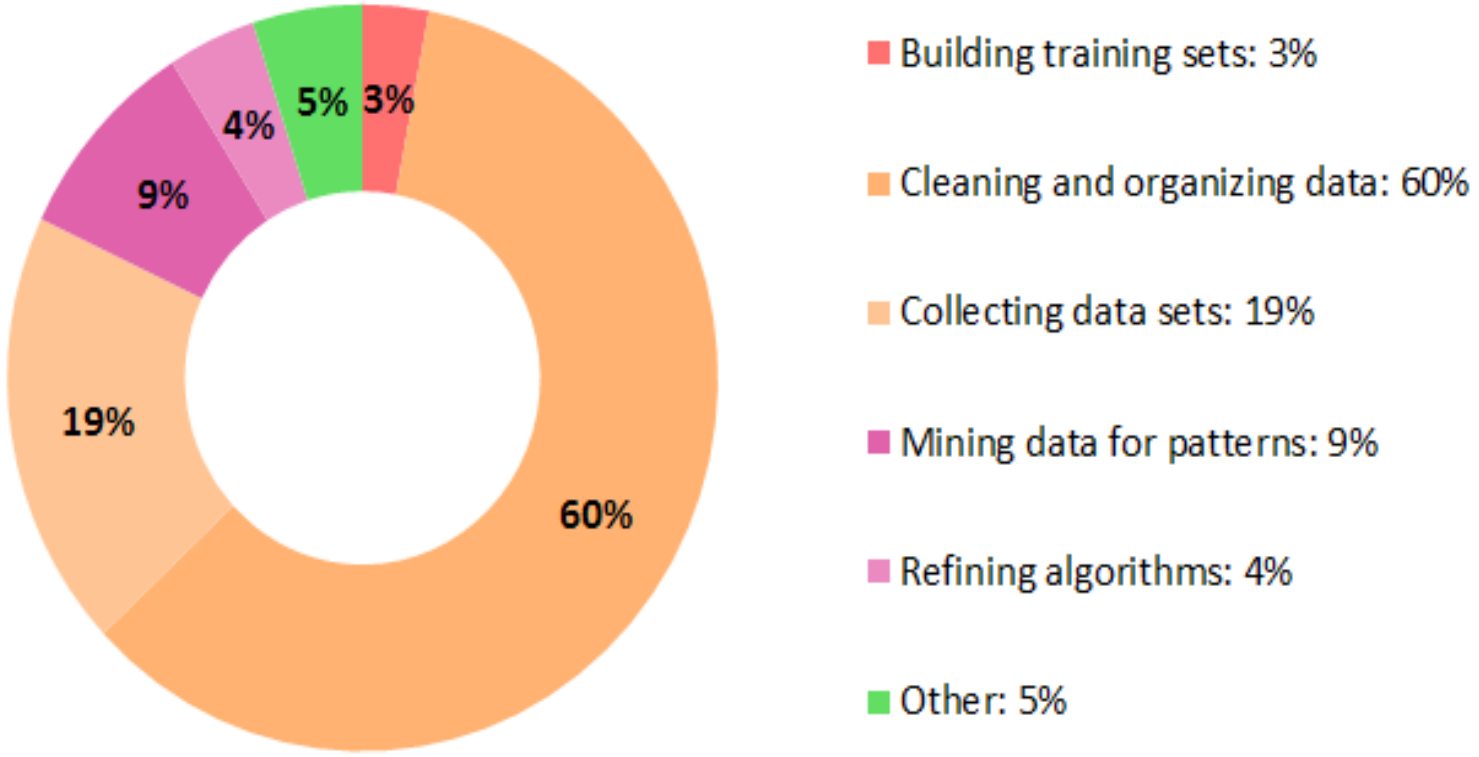
Algorithms applied to teach the machine using the data

Learning can then be applied to solve real problems





How AI-ML Professionals spend their time



The Data

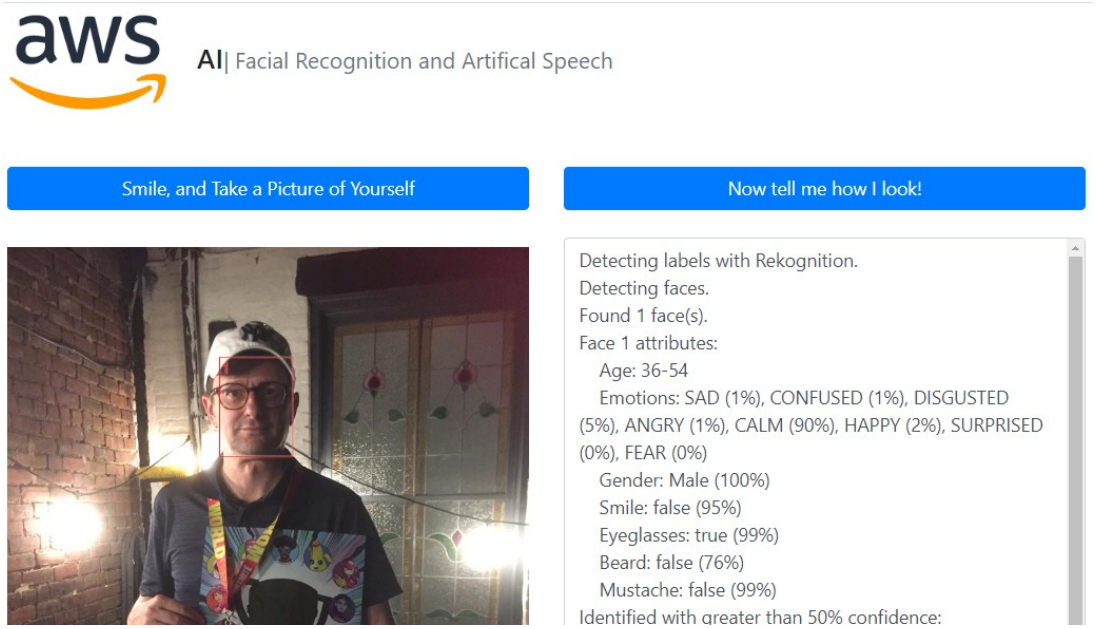
- Data is absolutely critical for ML
  - Without data you have nothing to learn from
- That data needs to be
  - Available
  - Cleansed and structured in a way that can be accessed by the ML logic (although some ML algorithms can handle unstructured data)
  - Secured

Where to use AI and ML

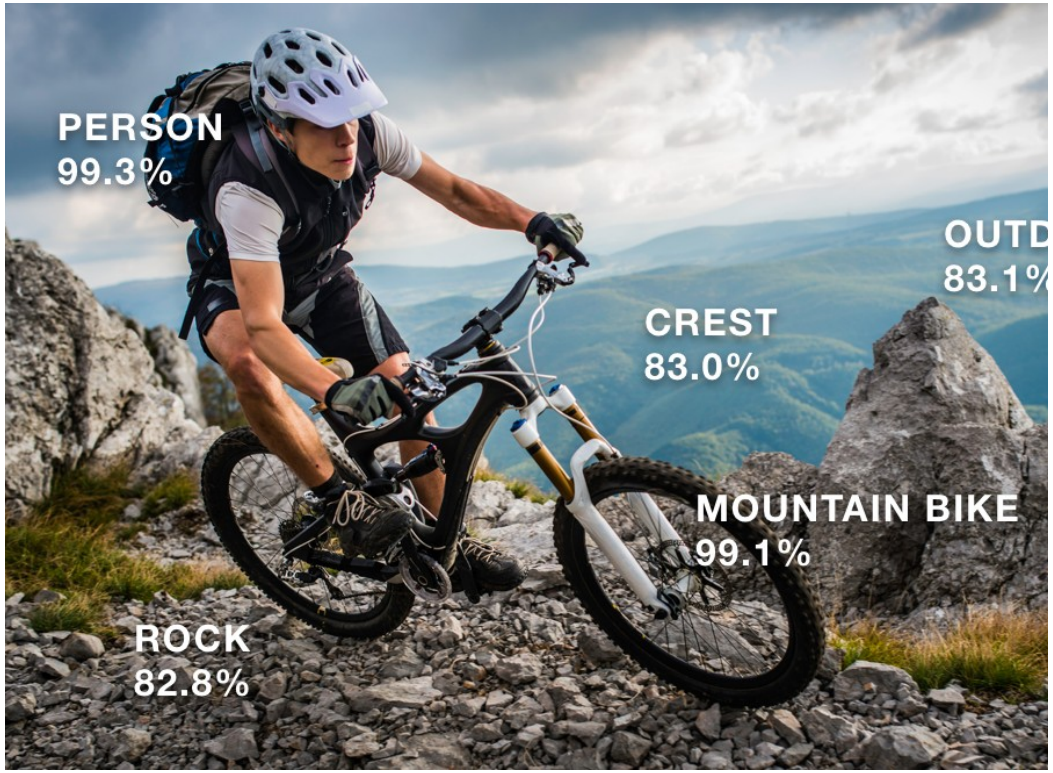
- Where the rules and equations are complex
  - face/handwriting/speech recognition
  - driving a car
- Where humans are not good at the task
  - industrial/manufacturing control
  - mass spectrometer analysis, drug design, astronomic discovery
- Where the rules are rapidly changing
  - fraud detection
  - credit scoring
- With the need for customization/personalization
  - movie/book recommendation
  - personalized news reader

Image Recognition Hands On

- Now you can try some image recognition
- Using your phone, visit
  - http://neueda.conygre.com/recognition/index.html



Rekognition



- AWS have already done all the machine learning, so you can focus on the artificial intelligence
- The Amazon service is called Rekognition
  - https://aws.amazon.com/rekognition/
- Not only can it do faces, but it can do
  - Scene detection
  - Image appropriateness detection
  - Path detection
  - Text detection

What can go wrong with Artifical Intelligence?

Amazon Rekognition FALSE MATCHES

28 current members of Congress

Summary

- Play Pictionary!
- What is Machine Learning
- What is Artificial Intelligence
- Demonstration of Artificial Intelligence
- Machine Learning Walkthrough
- Risks associated with AI

MACHINE LEARNING ALGORITHMS

OBJECTIVES

- Supervised Learning
  - Categories - Regression and Classification
  - Linear Regression
  - Logistic Regression
- Unsupervised Learning
  - Categories - Association and Clustering
  - Apriori
  - K Means
- Ensembles
  - Random Forest

TYPES OF ML ALGORITHM

- Supervised Learning
- Unsupervised Learning
- Reinforcement Learning

- We will focus on supervised and unsupervised learning

SUPERVISED LEARNING

- Supervised learning is the most straightforward
  - You already know X, and you want to know Y
- You identify a formula using training data to work out what the relationship is between x and y

$$y = f(x)$$

TWO TYPES OF SUPERVISED LEARNING

- Supervised learning is often either
  - **Classification**
    - Is there a pedestrian – yes or no
    - Is this person sick – yes or no
  - **Regression**
    - Give me a height for this baby when they are grown up
    - How much snow will we get this year in Chicago?

CLASSIFICATION EXAMPLE

- Self driving cars learning to recognise pedestrians
  - Algorithms are trained using lots of images with pedestrians in

where is the pedestrian? = **f(**somePicture**)**

REGRESSION EXAMPLE

- An example of regression supervised learning might be how tall a person might end up
  - You provide lots of data about existing people and their biological parents heights and see if you can come up with a prediction
- Apparently it is 79% down to genes!

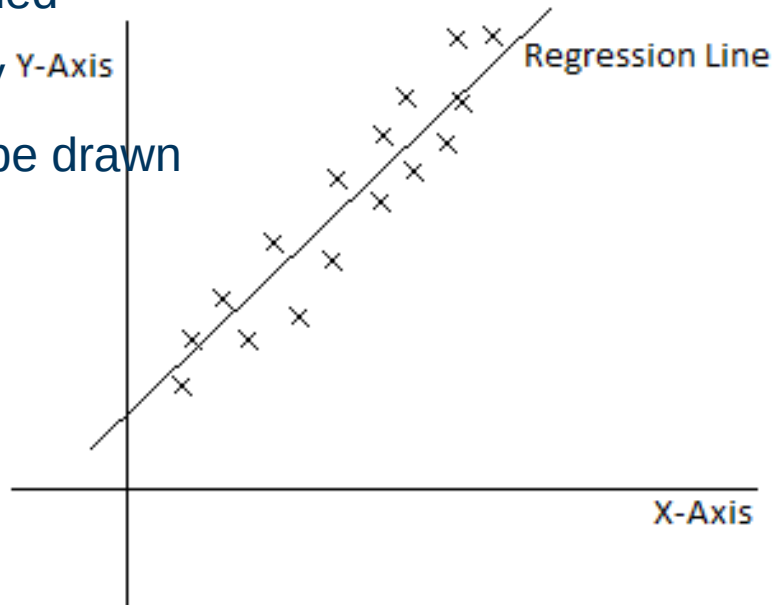
SUPERVISED LEARNING ALGORITHMS

- Generally considered the simplest algorithm, it's sensible to start with Linear Regression

- Many Others are also available, including
  - Logistic Regression
  - Naïve-Bayes
  - K-Nearest neighbors (KNN)

LINEAR REGRESSION

- Linear regression is a bit like your science experiments at school
- X and Y axes on a graph
  - X is pH and Y is how much acid you added
  - X is distance moved and Y is how heavy
- Once you have all the crosses, a line can be drawn
- Linear regression is ideal for supervised learning with regression eg. how tall?



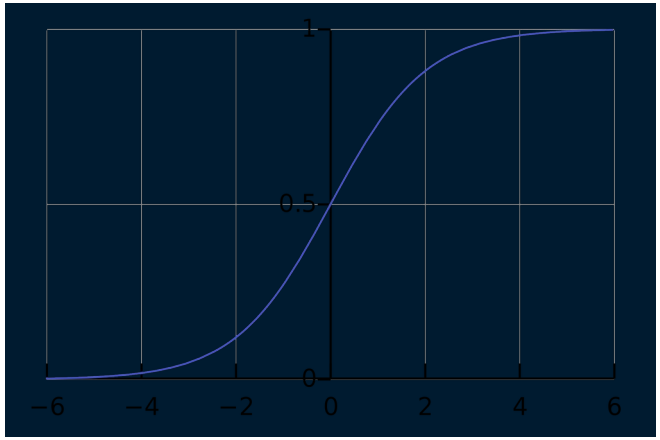
LOGISTIC REGRESSION – A CLASSIFICATION ALGORITHM

- Logistic regression is more useful when you want a specific answer – yes or no
  - Is there a person in the image?
  - In simple terms, a logical regression algorithm returns a value between 0 and 1
    - **1** is very probable (eg. there is a person)
    - **0** is not probable (eg. there is not a person)
  - You then determine a **threshold** for what is decided to be a positive match
    - Anything above 0.75 for example is treated as 1 and anything below is treated as 0

LOGISTIC REGRESSION – THE MATH

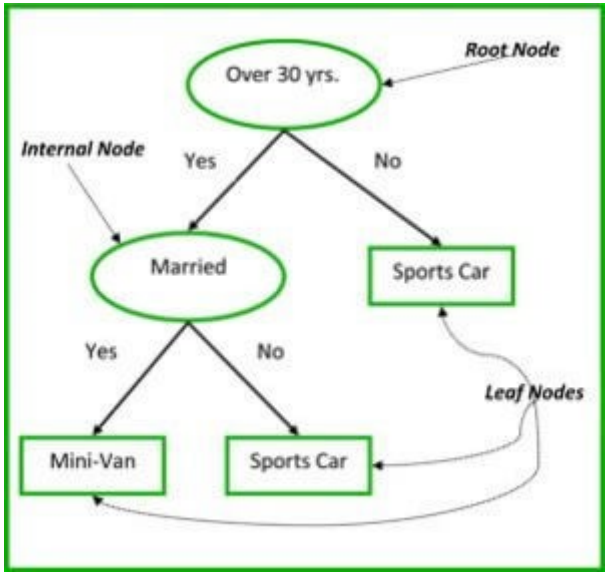
- The Math is a bit more complex than the math for a linear regression
  - The Math for this involves a formula that provides an S curve

$$h(x)= 1/ (1 + ex)$$



OTHER SUPERVISED LEARNING ALGORITHMS

- **CART – Classification and Regression Trees**
- This algorithm involves lots of decision making in a tree like structure
  - It looks at various attribute to come up with a prediction

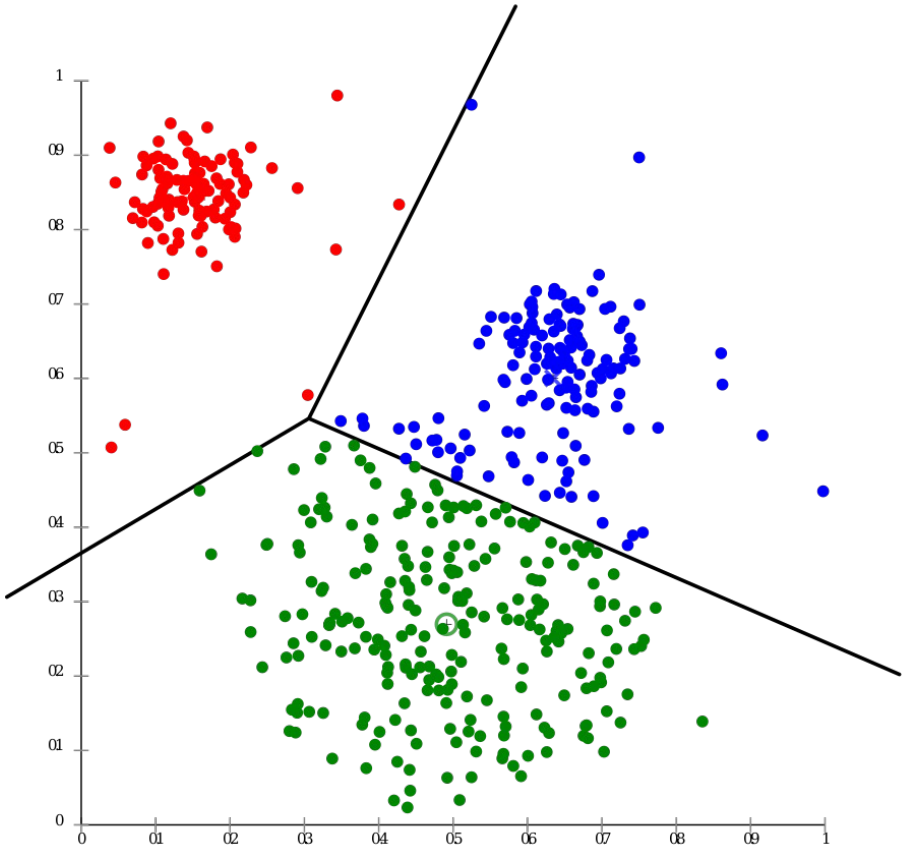


UNSUPERVISED LEARNING

- Unsupervised learning is where we have the input but no output
  - We have no training data, so unsupervised
- Types of unsupervised learning include
  - Clustering
  - Association

CLUSTERING USING K-MEANS

- The **K-Means** algorithm is used to identify clusters of data



ASSOCIATION - APRIORI

- Used for shopping basket analysis
  - “They have added a TV to the basket, so they might want a stand to put it on”
- A commonly used algorithm is called **Apriori**

- Apriori involves searching data for common combinations of items

ENSEMBLES - RANDOM FOREST

- Some algorithms can run multiple times concurrently to get more accurate results
  - Take our classification tree algorithm CART
- You could run this multiple times over and over at the same time with different combinations
  - Not a single tree, but a ***forest*** of trees
  - Not using defined combinations, but ***randomised*** combinations
- We will come back to this one later..

SUMMARY

- Supervised Learning
  - Categories - Regression and Classification
  - Linear Regression
  - Logistic Regression
- Unsupervised Learning
  - Categories - Association and Clustering
  - Apriori
  - K Means
- Ensembles
  - Random Forest

Appendix: Code Examples

- The code examples are written in Python and use the Jupyter Notebooks format
- Download the full zip to a machine that has Jupyter Notebooks installed
  - https://github.com/fcallaly/ml-training-notebooks/