

16 January 2023

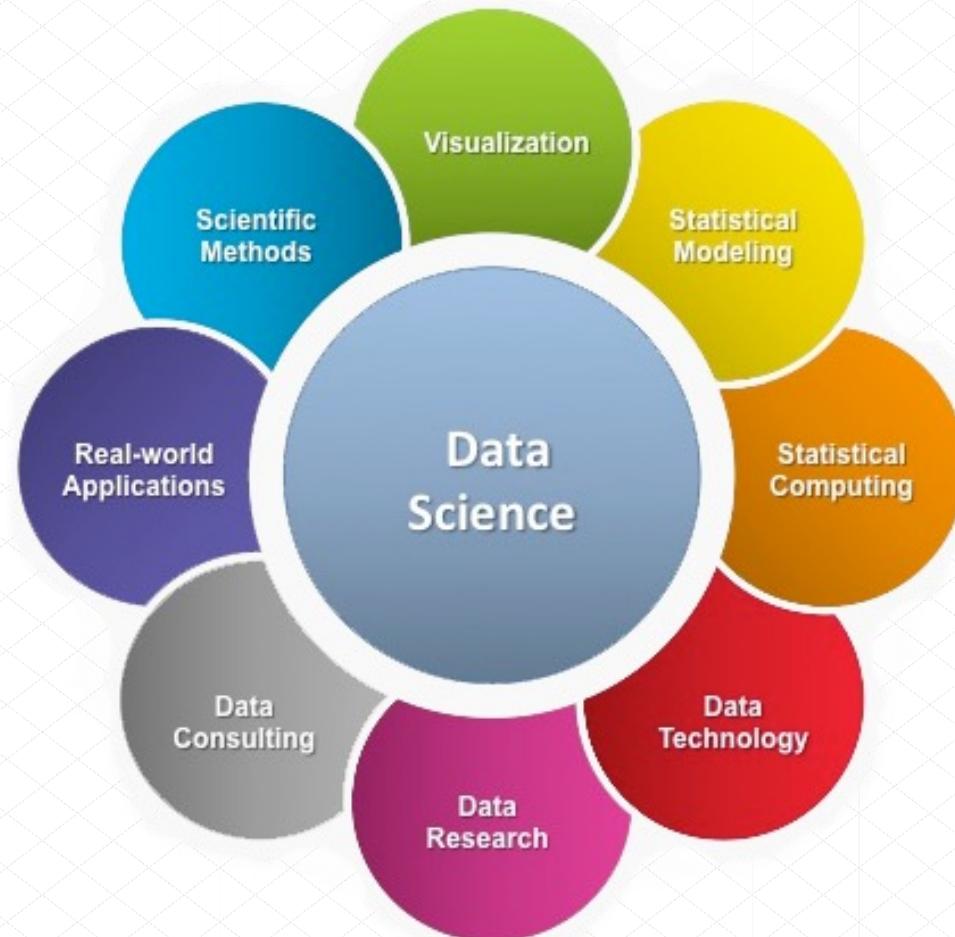


**CT4031**  
**Maths for Data Science**

**Week 2 – Applications of Data Science**



# Applications of data science



Source: <https://bit.ly/3yNxbLY>



# Applications of data science

## Task

- Search for a real-world dataset on <https://www.kaggle.com/>
- And answer these questions:
  - How can this dataset be used?
  - What areas can be benefited with Data Science in this dataset?



# Applications of data science: Finance

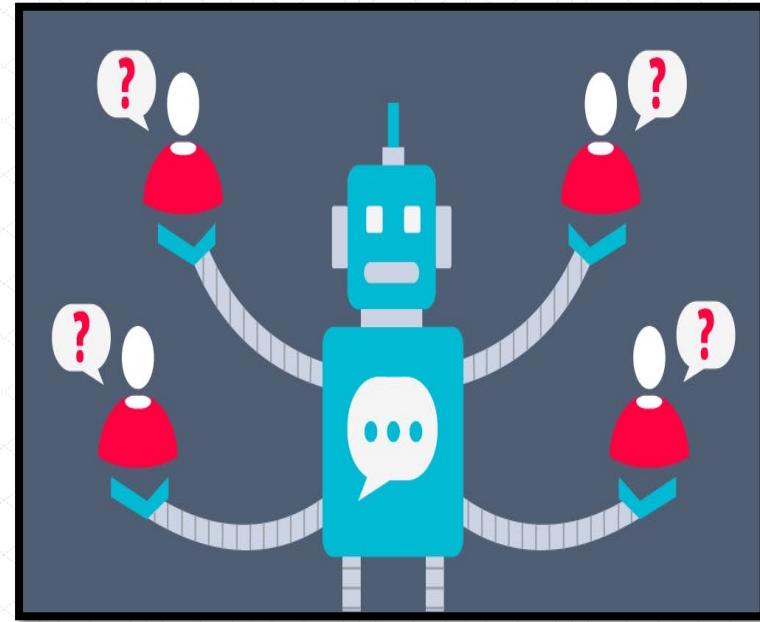
- ❑ Fraud and Risk Detection
  - ❑ credit card fraud, inflated insurance claims, and organized crime
  - ❑ Customer profiling, past expenditures, and other essential variables to analyze the probabilities of risk and default.
- ❑ Price Optimization
- ❑ Location of New Stores
- ❑ Automated risk management
  - ❑ credit risk (e.g. 'is this customer going to default on their card payments?')
  - ❑ market risk (e.g. 'is the housing bubble going to burst?').
  - ❑ inflation risk, legal risk, and so on.





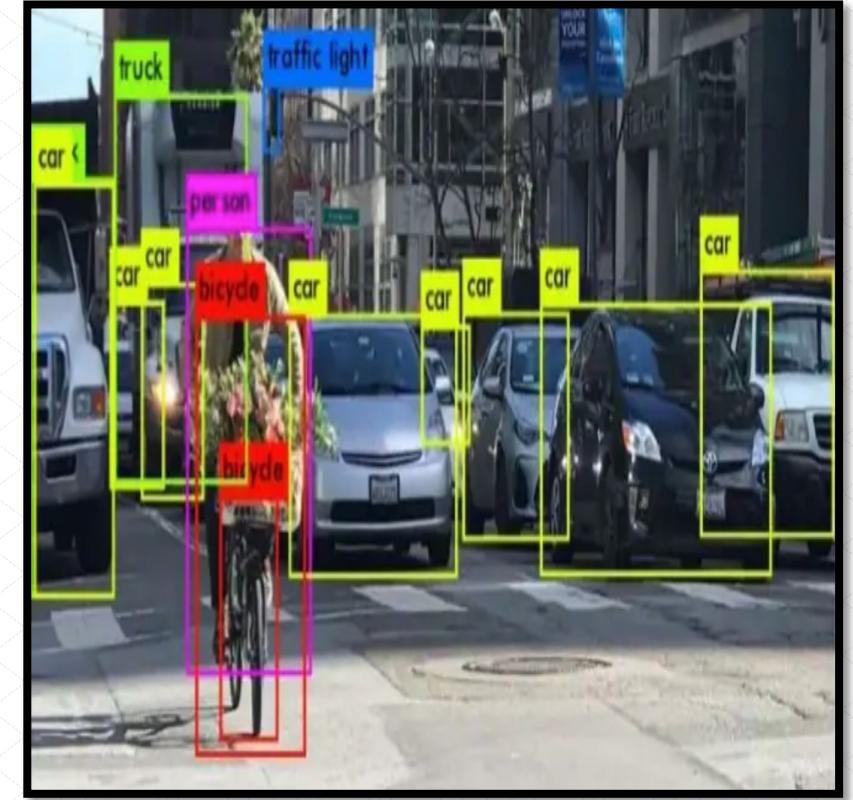
# Applications of data science: Advertisement

- ❑ **Targeted Advertising:** – the entire digital marketing spectrum. Starting from the display banners on various websites to the digital billboards at the airports – almost all of them are decided by using data science algorithms.
- ❑ Website Recommendations according to customer's interest and relevance of information.
- ❑ Internet giants like Amazon, Twitter, Google Play, Netflix, LinkedIn, IMDb, and much more use this system to improve the user experience.
- ❑ The recommendations are made based on previous search results for a user.



# Applications of data science: Image Processing

- ❑ Image processing is one of the fields of artificial intelligence, which involves converting images into digital form to allow computers to process them through an algorithm.
- ❑ machines can identify and extract information from objects in a specific image or video file.
- ❑ However, to correctly recognise objects in pictures, they need a vast database and a model to replicate the way humans perceive this world.
- ❑ Digital image processing uses machine learning models such as deep neural networks to allow more various actions, such as adding filters to an image or enhancing some aspects to improve its quality.



# Applications of data science: Image Processing

- ❑ Object classification – allows you to identify what is contained in an image;
- ❑ Object localisation – determines the location of a single object in an image;
- ❑ Object detection – specifies the location of multiple objects in an image;
- ❑ Object tracking – identifies objects in the video;
- ❑ Optical character recognition – allows a computer to read physical documents, such as scanned papers;

**Classification**



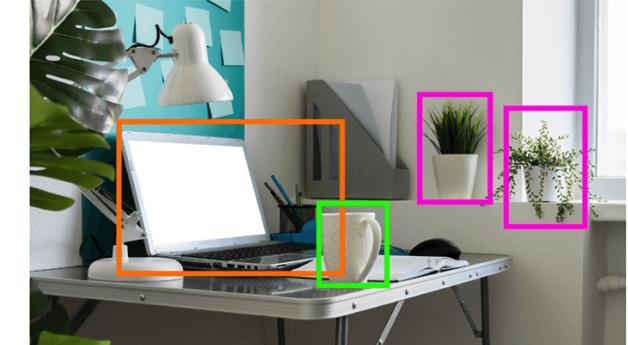
plant

**Classification + Localisation**



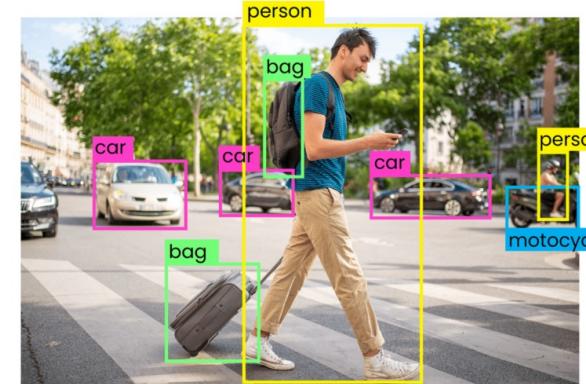
plant

**Object detection**



plant, cup, computer

**Object tracking**



WESENSA

# Applications of data science: Security

- ❑ Thanks to facial recognition technology, security systems can recognise and remember household members and then take appropriate action (such as calling a security company) when intruders are detected.
- ❑ Moreover, facial recognition is also used by services such as security and the police. For example, the British police use this technology to scan the public during major events. The AI-based system helps officers detect suspicious people. If it finds someone at least 59% similar to the wanted criminals, a match is sent to the officer to double-check.
- ❑ According to UK authorities, the implementation of this system has increased the efficiency of policing.
- ❑ **Cyber Threats**
  - ❑ Firewalls, antivirus, and other protection programs can learn the patterns of the attacker through data science and alert the network or system administrator of potential security breaches.





# Applications of data science: Security: Healthcare

## 1. Medical Image Analysis

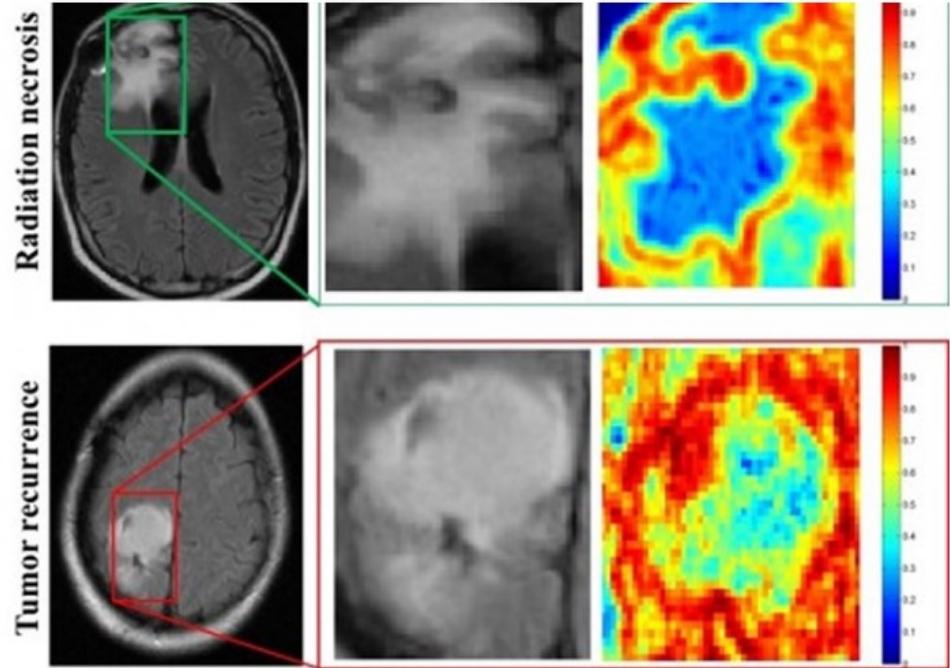
- detecting tumors, artery stenosis, organ delineation, cancer diagnosing
- Machine learning algorithms and datasets

## 2. Genetics & Genomics

- Use of data science for the integration of different kinds of data with genomic data in the disease research, which provides a deeper understanding of genetic issues in reactions to particular drugs and diseases.

## 3. Drug Development

- drug discovery process is highly complicated and involves many disciplines.
- billions of testing, huge financial and time expenditure. On average, it takes twelve years to make an official submission.
- Data science applications and machine learning algorithms simplify and shorten this process.





# Applications of data science: Security: Healthcare

## 1. Virtual assistance for patients and customer support

- ❑ Optimization of the clinical process builds upon the concept that for many cases it is not actually necessary for patients to visit doctors in person. A mobile application can give a more effective solution by bringing the doctor to the patient instead.
- ❑ Predictive Modeling for Diagnosis
  - ❑ predict the outcome of disease given the historical data of the patients.
  - ❑ Cancer ,





# Applications of data science: Search Engines

- Google
- Yahoo
- Safari
- Firefox





# Applications of data science

## Task

- How do you think Data Science impacts society?
- List 2 areas where Data Science has/is made/making a great impact in our society and provide examples.



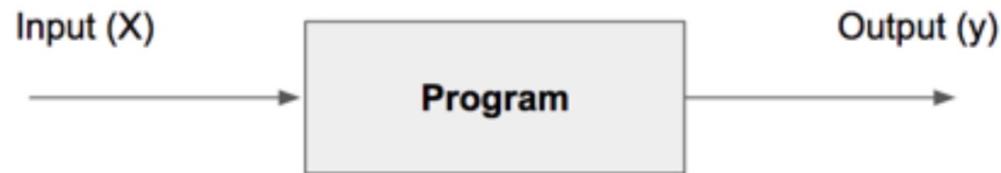
# Data science, Math and Computing

- Calculus and functions
- Probability
- Statistics
- Graph theory
- Mathematical proof



# Data science, Math and Computing

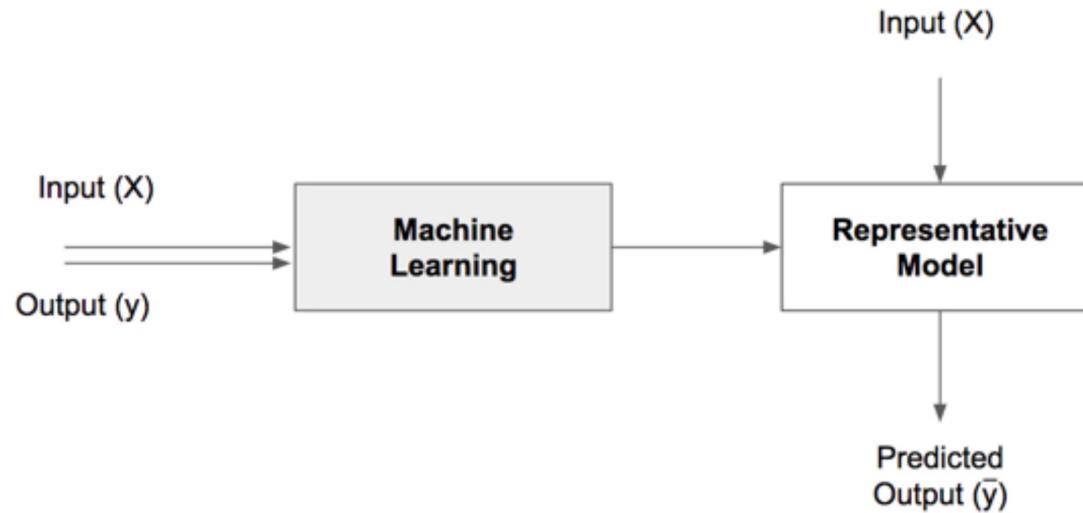
## Functions and basic coding





# Data science, Math and Computing

## Functions and machine learning

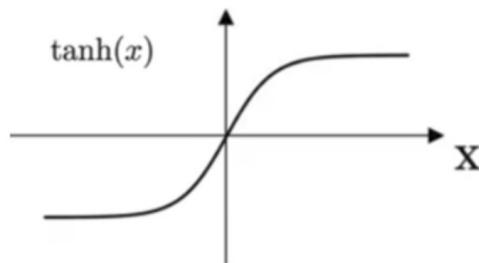




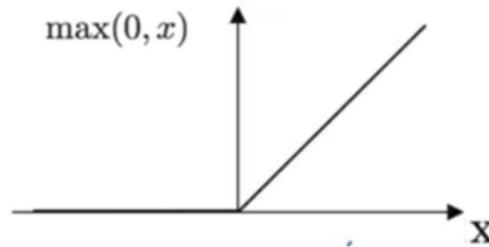
# Data science, Math and Computing

## Activation functions and machine learning

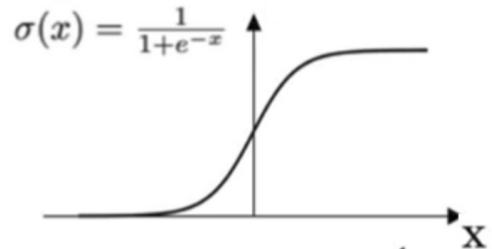
**Hyper Tangent Function**



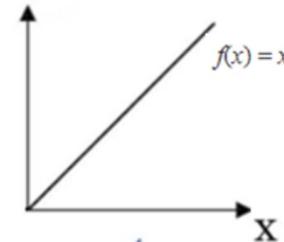
**ReLU Function**



**Sigmoid Function**



**Identity Function**





# Data science, Math and Computing

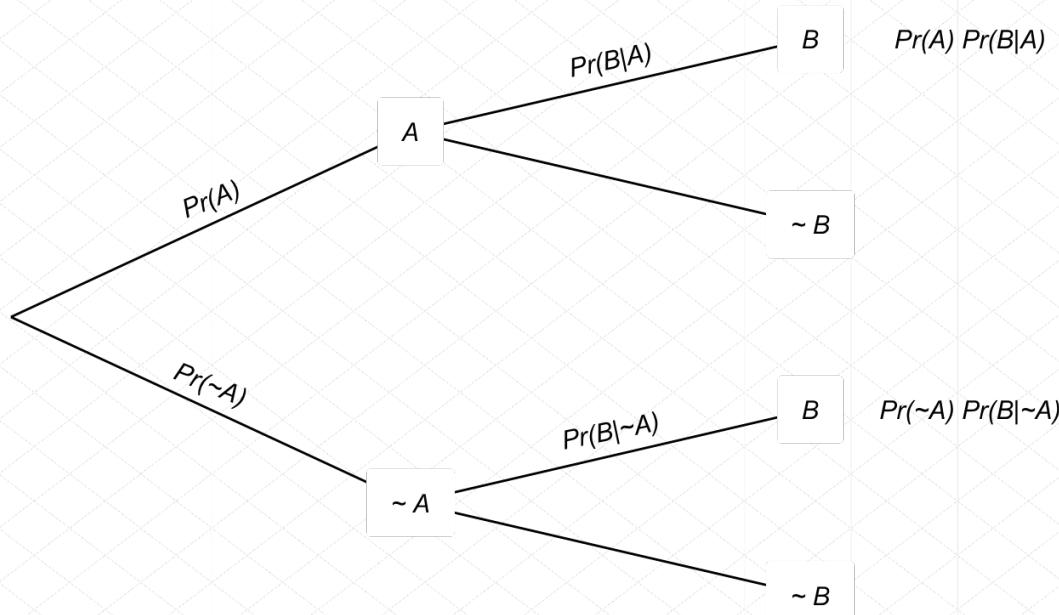
## Probability and Bayes rule

$$P(A|B) = \frac{P(B|A)P(A)}{P(B)}$$



# Data science, Math and Computing

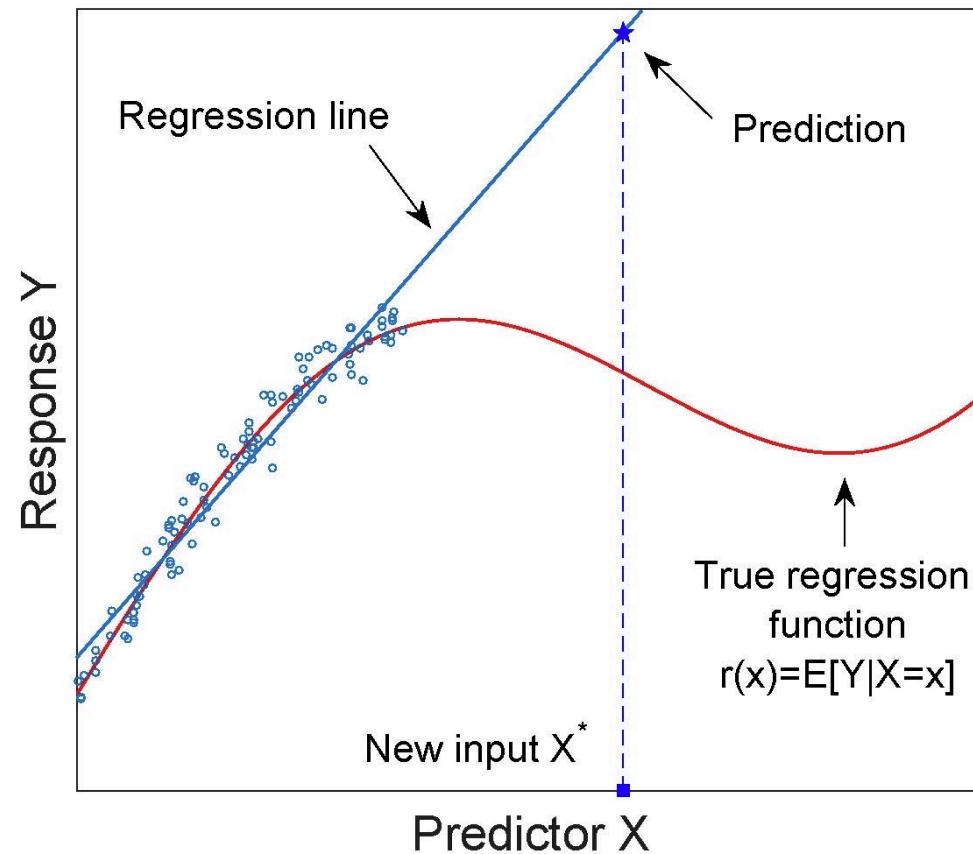
## Probability and Bayes rule





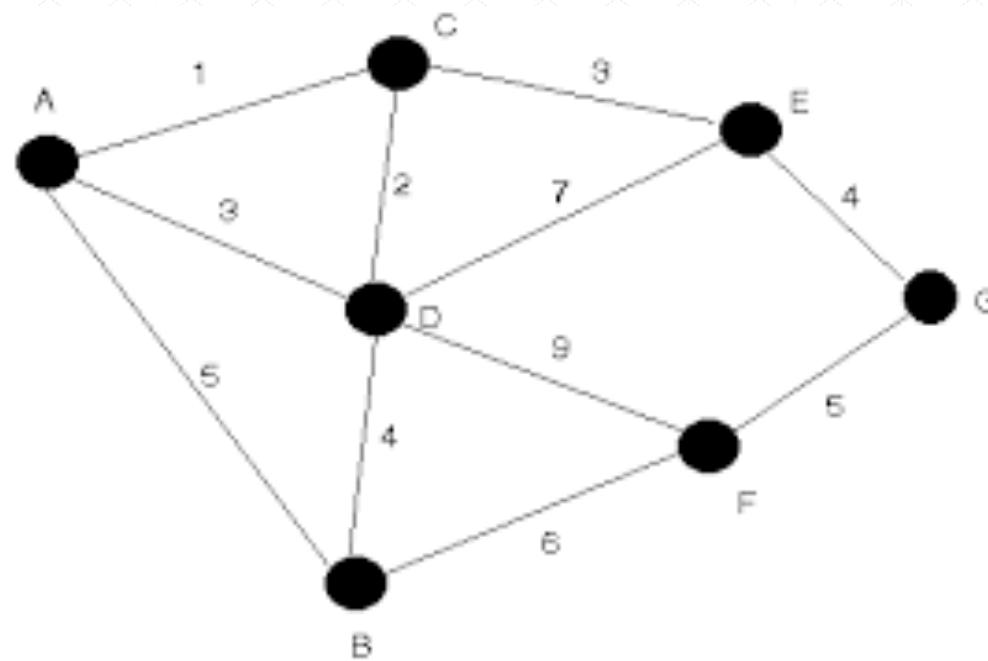
# Data science, Math and Computing

## Statistics



# Data science, Math and Computing

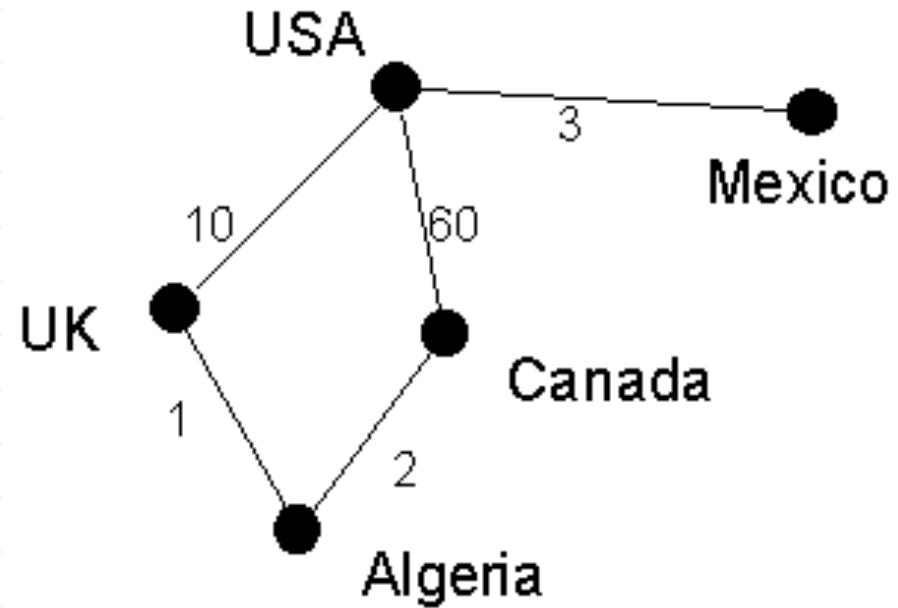
## Graph theory





# Data science, Math and Computing

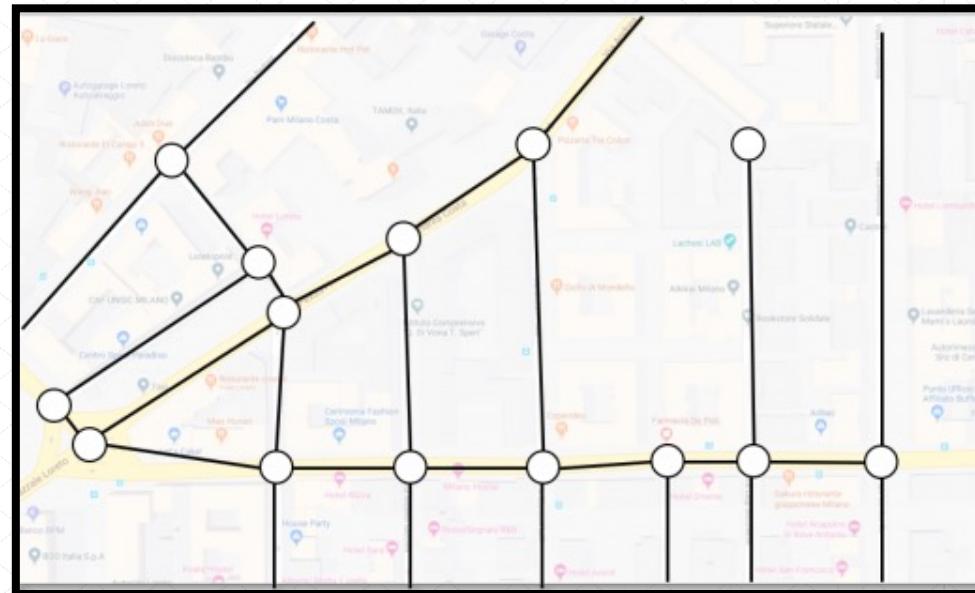
## Graph theory





# Data science, Math and Computing

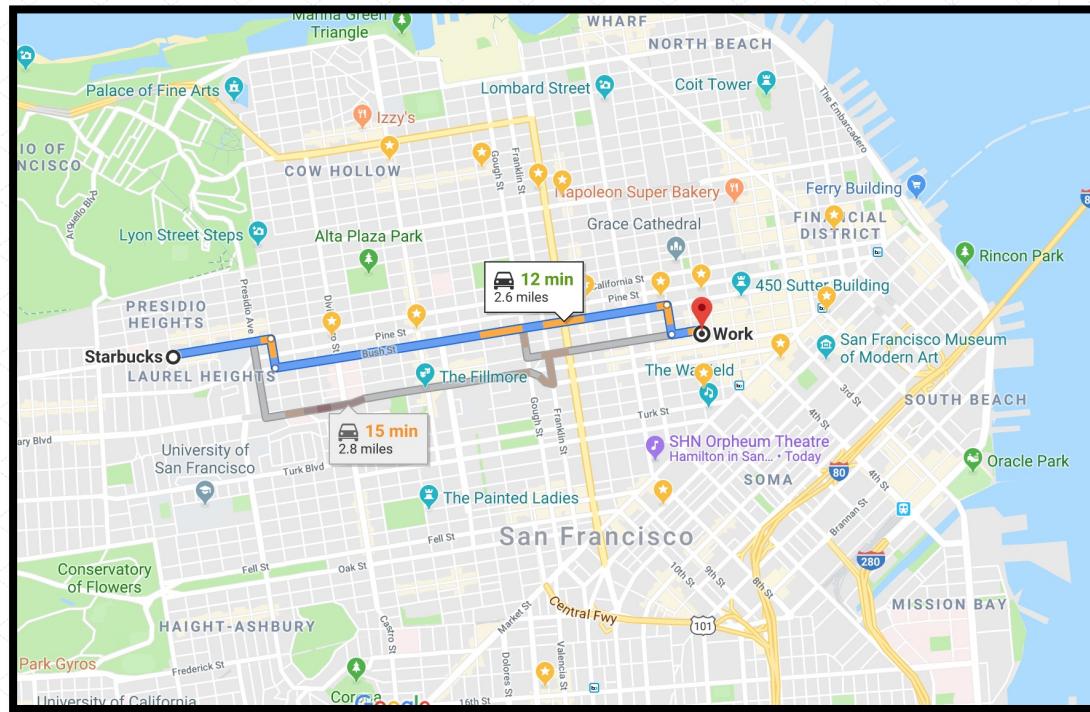
## Graph theory





# Data science, Math and Computing

## Graph theory





# Data science, Math and Computing

## Mathematical proof

### *A One-Line Proof that there are Infinitely Many Prime Numbers*

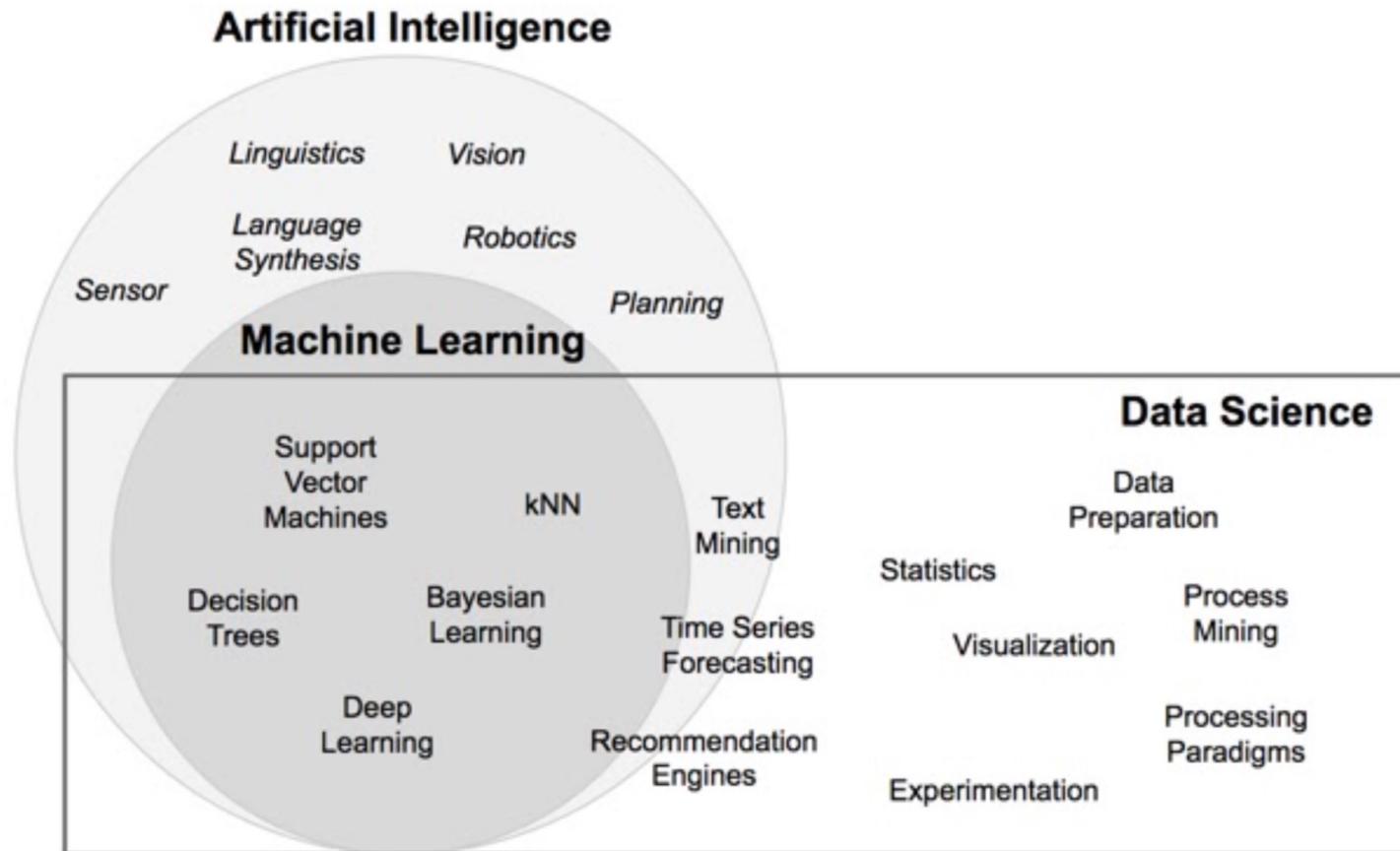
If the set of primes is finite, then

$$0 < \prod_p \sin\left(\frac{\pi}{p}\right) = \prod_p \sin\left(\frac{\pi \cdot (1 + 2 \prod_{p'} p')}{p}\right) = 0.$$

Source: <https://bit.ly/2T6QWyt>

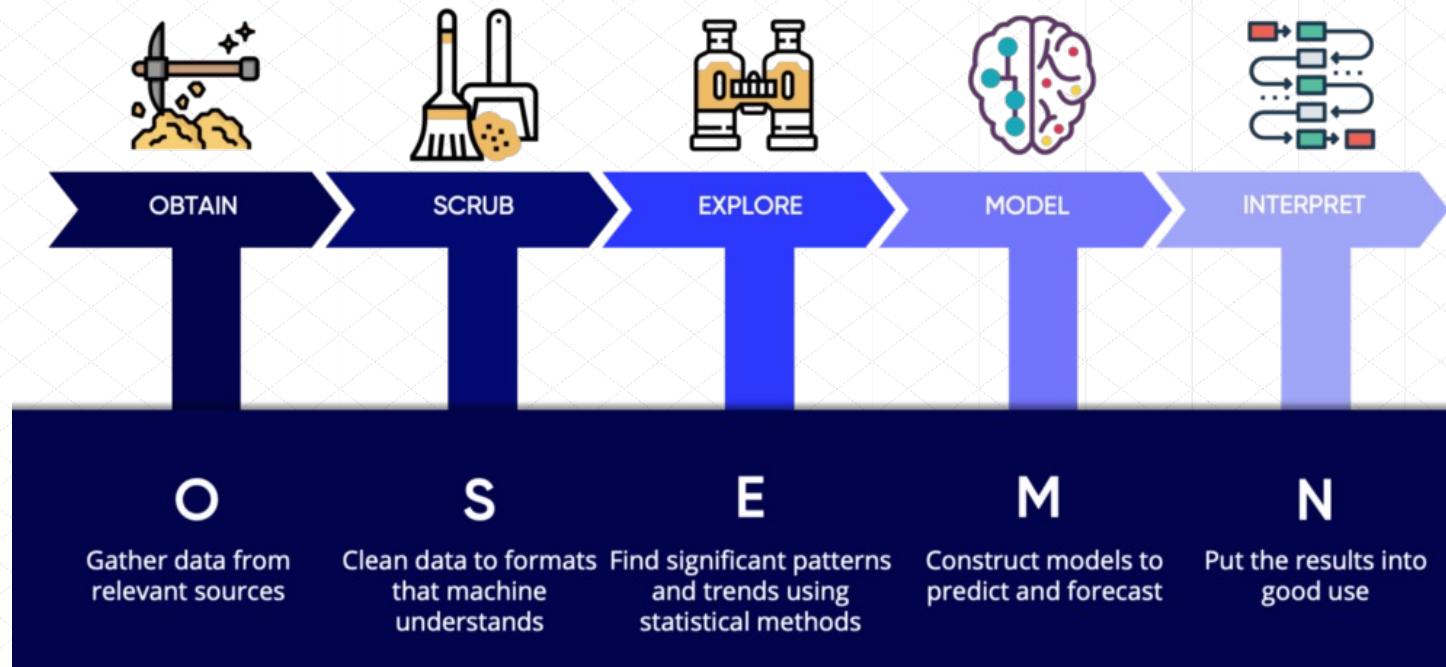


# AI, Machine Learning and Data Science





# Data science process



Source: <https://bit.ly/3rlxxqV>



# Post-Sessional Work

Coding recap and SPOJ - (<https://www.spoj.com/>)

ICPC - <https://icpc.global/>



# References

Laguna State Polytechnic University, 'Introduction to Data Science', 22:07:27 UTC. Accessed: Jul. 13, 2021. [Online]. Available:

<https://www.slideshare.net/fvsandoval/introduction-to-data-science-164979975>

Introduction to Data Science,

[https://docs.google.com/presentation/d/16EeFHg8Dkcy4ttxoPa6yap1Pn4xsJwuwW7flmqmcJjA/edit?usp=drive\\_web&usp=embed\\_facebook](https://docs.google.com/presentation/d/16EeFHg8Dkcy4ttxoPa6yap1Pn4xsJwuwW7flmqmcJjA/edit?usp=drive_web&usp=embed_facebook) (accessed Jul. 13, 2021).

<https://www.mygreatlearning.com/blog/data-science-applications/>



# Next Session!

- Data cleaning



