

AI UX & Data Visualisation Design Principles (CA6002)

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Chapter 1.1 – Introduction

Contents

- What is Data Visualisation?
- Importance of Data Visualisation
- What will You Learn in this Course



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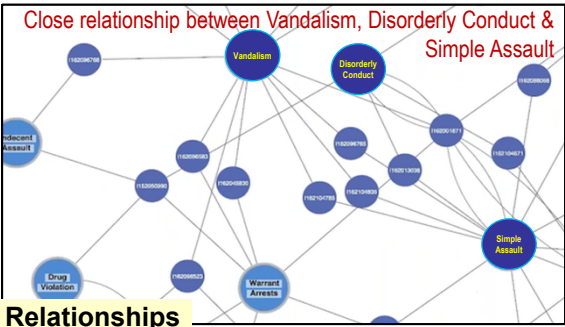
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Introduction

What is Data Visualisation?

- Data visualisation is the **representation** of **data** or **information** in a graph, chart, map or other **visual format**.
- **Visual elements** are used to provide an accessible way to **see** and **understand** trends, outliers, patterns and relationships in the data.



Crime Visualisation from Cambridge Intelligence.com

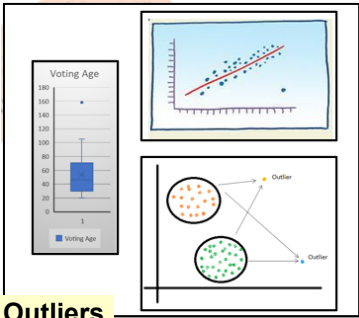


Image from Analyticsvidhya.com

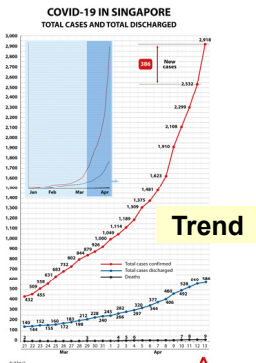


Image from CNA (13 Apr 2020)

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Importance of Data Visualisation

The visual creature

- About half the human brain is directly or indirectly devoted to **visual processing**.
- Humans are much better at remembering **pictures** than words^[1]. Students given **visuals** to go along with lectures have also been shown to have **better retention** than students listening to lectures without visual aids^[2].
- The McGurk effect seems to also suggest that the **visual** sensory modality can **dominate** the auditory modality.

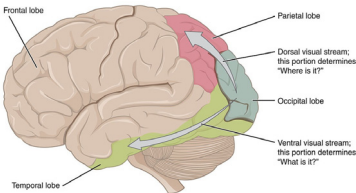


Image from Wikimedia



BBC video on McGurk Effect - <https://youtu.be/G-IN8vWm3m0>



[1] Neural correlates of the episodic encoding of pictures & words - <https://www.pnas.org/content/95/5/2703.full> [2] Bui, D.C. & McDaniel, M.A. (2012) – Enhancing learning during lecture ... <https://www.sciencedirect.com/science/article/abs/pii/S2211368115000200>

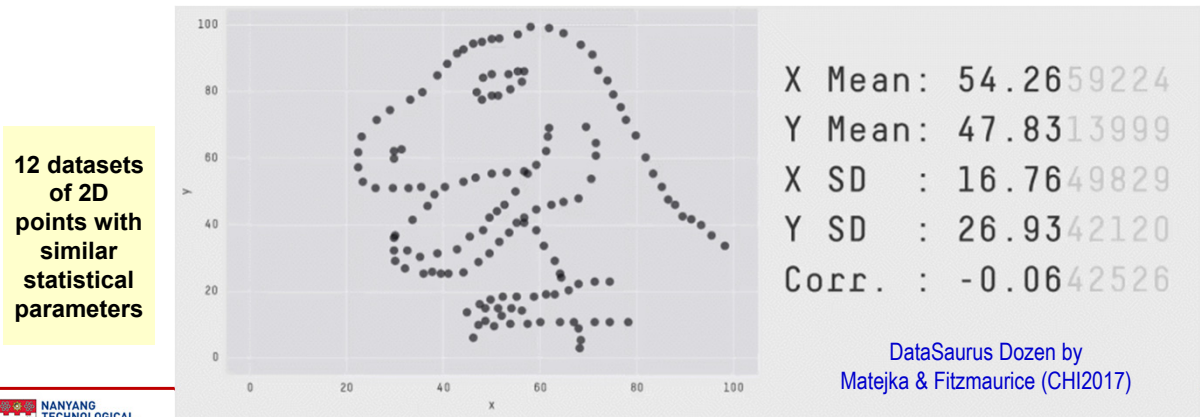
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Importance of Data Visualisation

Blinded by statistics

- Basic statistical analysis alone may not provide useful insights into how datasets can have **differing characteristics** despite having **similar statistical** parameters.



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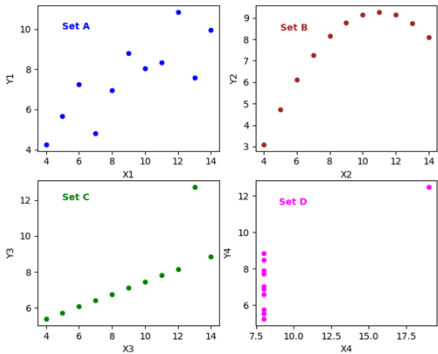
Importance of Data Visualisation

Blinded by statistics

- Basic statistical analysis alone may not provide useful insights into how datasets can have **differing characteristics** despite having **similar statistical** parameters.
- Statistician Francis Anscombe^[3] used the **Anscombe's Quartet**^[3] of four datasets to show why **visualisation** is a **crucial part of data analysis**.

| | Set A | | Set B | | Set C | | Set D | |
|-------------------------|-------|-------|-------|------|-------|-------|-------|------|
| | X1 | Y1 | X2 | Y2 | X3 | Y3 | X4 | Y4 |
| | 10 | 8.04 | 10 | 9.14 | 10 | 7.46 | 8 | 6.58 |
| | 8 | 6.95 | 8 | 8.14 | 8 | 6.77 | 8 | 5.76 |
| | 13 | 7.58 | 13 | 8.74 | 13 | 12.74 | 8 | 7.71 |
| | 9 | 8.81 | 9 | 8.77 | 9 | 7.11 | 8 | 8.84 |
| | 11 | 8.33 | 11 | 9.26 | 11 | 7.81 | 8 | 8.47 |
| | 14 | 9.96 | 14 | 8.1 | 14 | 8.84 | 8 | 7.04 |
| | 6 | 7.24 | 6 | 6.13 | 6 | 6.08 | 8 | 5.25 |
| | 4 | 4.26 | 4 | 3.1 | 4 | 5.39 | 19 | 12.5 |
| | 12 | 10.84 | 12 | 9.13 | 12 | 8.15 | 8 | 5.56 |
| | 7 | 4.82 | 7 | 7.26 | 7 | 6.42 | 8 | 7.91 |
| | 5 | 5.68 | 5 | 4.74 | 5 | 5.73 | 8 | 6.89 |
| Mean | 9.00 | 7.50 | 9.00 | 7.50 | 9.00 | 7.50 | 9.00 | 7.50 |
| Correlation Coefficient | 0.82 | | 0.82 | | 0.82 | | 0.82 | |
| Std Dev | 3.16 | 1.94 | 3.16 | 1.94 | 3.16 | 1.94 | 3.16 | 1.94 |

Anscombe's Quartet



[3] Anscombe, F. J. (1973). "Graphs in Statistical Analysis". American Statistician. 27 (1): 17–21

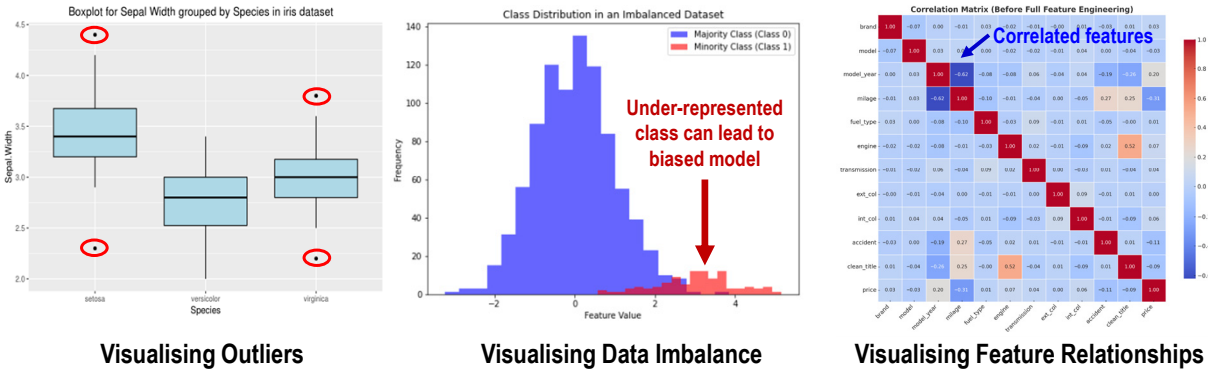
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Importance of Data Visualisation

Visualise Attributes of Machine Learning Datasets

- Visualisation of datasets used in machine learning algorithms can help identify **anomalies** (e.g. outliers), **imbalance** in the dataset and uncover **hidden patterns** that can help in the selection of appropriate features for the ML algorithm training.

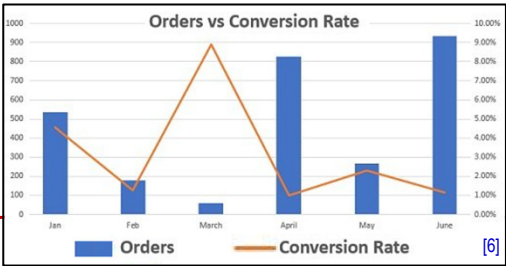


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Visualising Datasets

Is There An Ideal Way?

- There are many ways to visualise a dataset.
- Choosing the best way to visualise the dataset will depend on:
 - The data **types** (e.g. its scale of measure, spatial (geodata), temporal, etc)
 - The **context** and **relationship** within the data (e.g. highest value, part of a whole)
 - The **purpose** of the visualisation (e.g. identify trends, compare values, show composition, communicate a specific message)



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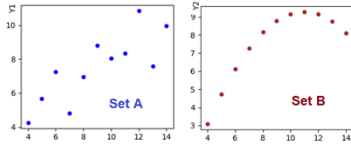
Visualising Datasets

What Is Considered A Good Visualisation?

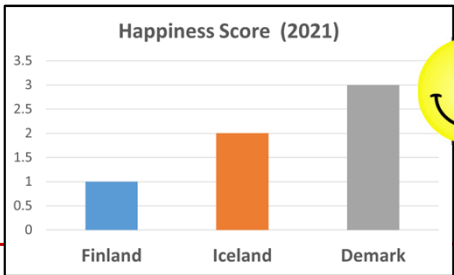
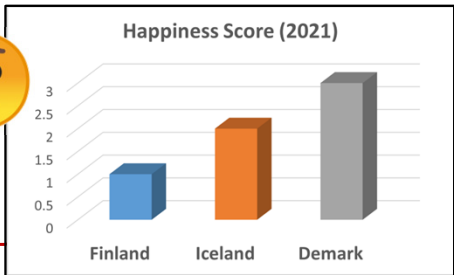
- A good visualisation shows **connections** within the data that are too complex to explain with words or is **hidden** from non-visual analysis.
- A good visualisation makes it **easier** to quickly understand the information presented and grasps meaningful **insights** embedded within the data.

| | Set A | | Set B | |
|-------------------------|-------|------|-------|------|
| | X1 | Y1 | X2 | Y2 |
| Mean | 9.00 | 7.50 | 9.00 | 7.50 |
| Correlation Coefficient | 0.82 | | 0.82 | |
| Std Dev | 3.16 | 1.94 | 3.16 | 1.94 |

From Anscombe's Quartet



Poor Visual Perception



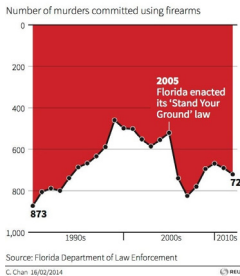
Good Visual Clarity



Ethical Visualisation Staying True

- Ethics are the set of **moral principles** that guides a person's **decision** and **actions**.
- In data visualisation, there are many opportunities to **manipulate** and **distort** the message a person perceives using misleading or untruthful data representation.
- Ethical conduct** is an important part of **your responsibility** when you design and present visual information.
- Your **professional integrity** requires you to be mindful of how your audience will interpret the information you present in your visualisation.
- So, communicate **clearly & truthfully**.

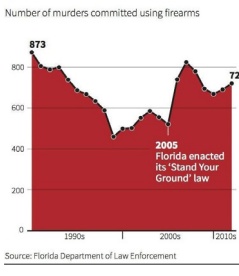
Gun deaths in Florida



Source: Florida Department of Law Enforcement
C. Chan 18/02/2014

Reuters Original Version [7]

Gun deaths in Florida



Source: Florida Department of Law Enforcement

P.A. Fedewa's Ethical Version [7]



[7] BusinessInsider.com, This Chart Shows An Alarming Rise In Florida Gun Deaths After 'Stand Your Ground' Was Enacted - <https://www.businessinsider.com/gun-deaths-in-florida-increased-with-stand-your-ground-2014-2>

Welcome to Data Visualisation for AI (Part 1)

What will you be learning in this course?



The Person – the theory of human visual perception and its implications in designing effective data visualisation.



The Process – from preparing the data to choosing and implementing the right visualisation solution for displaying and exploring various types of data.



The Practice – solve data visualisation problems through thoughtful visual design, prompt engineering and code verification/modification.



The Purpose – learn to design visualisation to assist in the exploration of AI datasets and create narratives that are effective in communicate your intended message.



Summary

Introduction

- Data visualisation is the transformation of data into a **visual form** so that **meaningful information** embedded within it can be made **more accessible**.
- Data visualisation is important to any disciplines or individual who **deals with data** and the need to **extract** or **share insights** from these data.
- Effective data visualisation serves two main purposes. It allows us to **explore** the dataset to gain useful insights and it allows us to **communicate** effectively what the data is telling us.



References for Introduction

[1] Neural correlates of the episodic encoding of pictures & words - <https://www.pnas.org/content/95/5/2703.full>

[2] Bui, D.C. & McDaniel, M.A. (2012) – Enhancing learning during lecture... <https://www.sciencedirect.com/science/article/abs/pii/S2211368115000200>

[3] Anscombe, F. J. (1973). "Graphs in Statistical Analysis". American Statistician. 27 (1): 17–21

[4] Big Data Visualization. Value it brings & techniques in requires - <https://www.scnsoft.com/blog/big-data-visualization-techniques>

[5] C.N. Knafllic, Storytelling with data, Wiley (2015)

[6] Chart from: <https://www.optimizesmart.com/what-type-of-chart-to-use-to-compare-data-in-excel/>

[7] BusinessInsider.com, This Chart Shows An Alarming Rise In Florida Gun Deaths After 'Stand Your Ground' Was Enacted - <https://www.businessinsider.com/gun-deaths-in-florida-increased-with-stand-your-ground-2014-2>