Introduction to Data Science (DS1101)

- ***Lecturer: Dr. UA Piumi Ishanka***

LOS

- Explain relevant data science theories and concepts
- Design and implement an experiment incorporating data science principles

Evaluation

- Quizes (04) - 20
- Assignment (01) - 10 -(replaces with)> Mid-Exam - 20
- Final Exam - 70

What is Data Science?

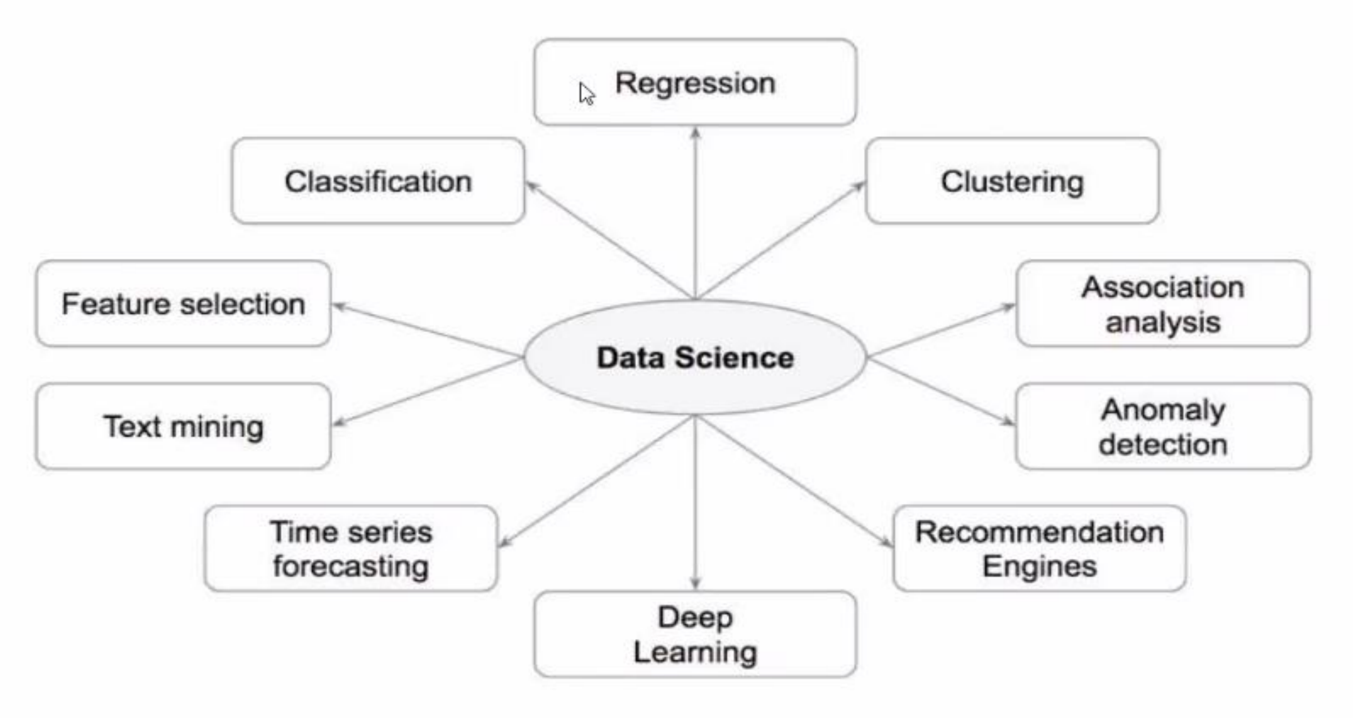
Theories and techniques from many fields and disciplines are used to investigate and analyze a large amount of data to help decision makers in many industries such as science, engineering, economics, politics, finance, and education

- Compute Science
  - Pattern Recognition, visualization, data warehousing, High performance computing, Databases, AI
- Mathematics
  - Mathematical Modeling
- Statistics
  - Statistical and Stochastic modeling, Probability.

Definitions:

- **Data Science** is a set of fundamental principles, processes and techniques that guide the extraction of knowledge from data with the goal of improving decision-making
- It is an interdisciplinary academic field that is bases on:
  - Mathematics
  - Statistics
  - Machine learning and Artificial Intelligence
  - Specialized Programming
- **Data mining** is the extraction of knowledge from data, via phonolites that incorporate data science principles

Types of Data Science



Data-driven decision-making

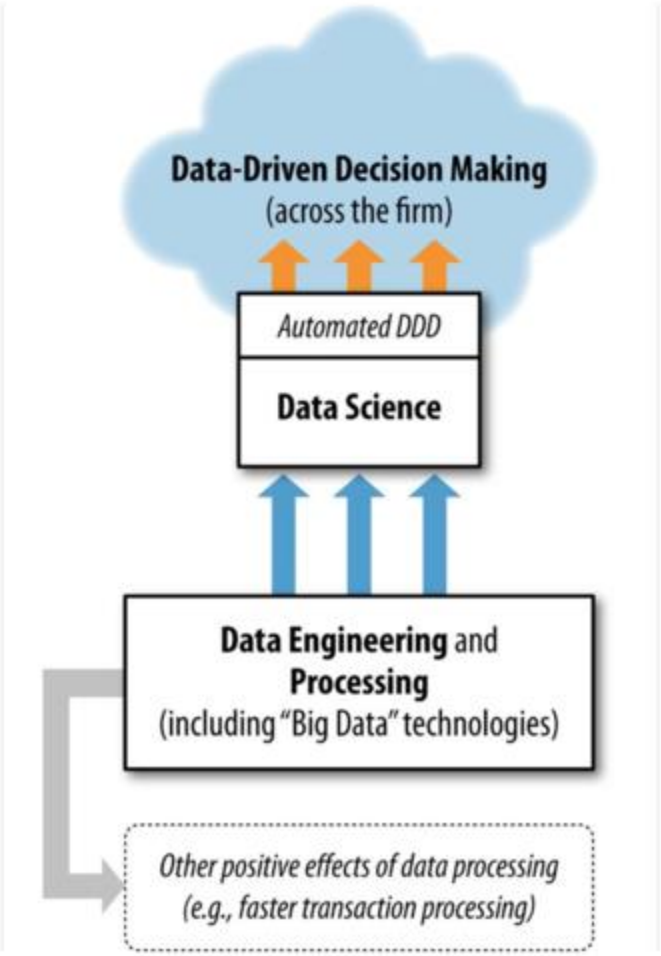
Data-driven decision-making (DDD) refers to the practice of basing decisions on the analysis of data, rather than purely on intuition.

Some decision can be made automatically (finance, recommendations)

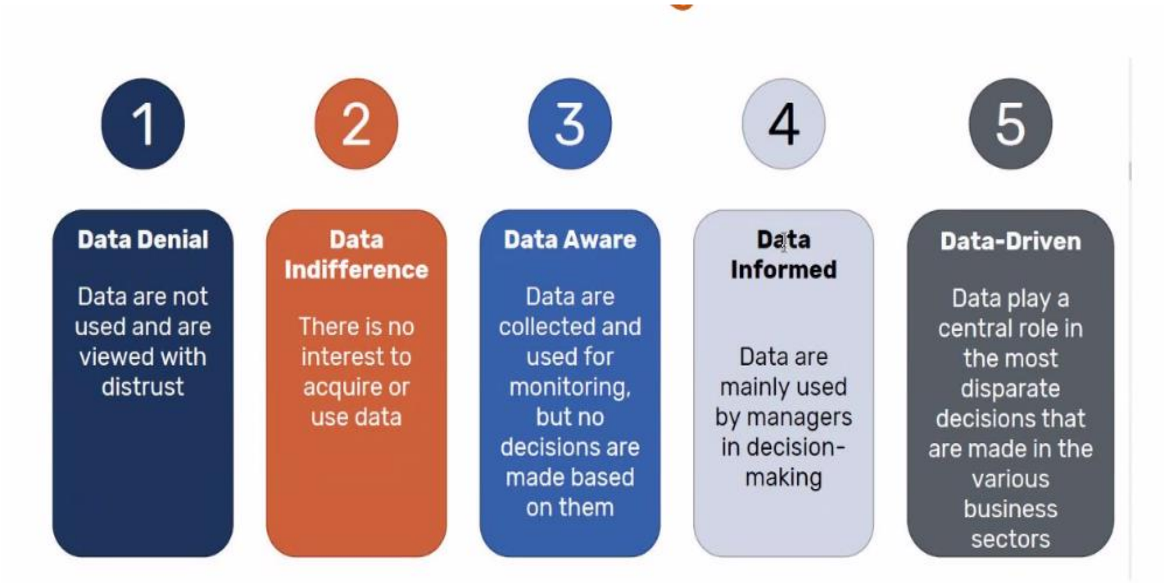
Data engineering and processing support many data oriented business tasks but do not necessarily involve extracting knowledge or data-driven decision making

Data, and the capability to extract useful knowledge from data, should be regarded as key strategic asset

- Need to invest to acquire the right data (even lose money)
- Understand data science, even if you will not do it


Data-Driven Decision Making
(across the firm)
Automated DDD
Data Science
Data Engineering and
Processing
(including "Big Data" technologies)
Other positive effects of data processing
(e.g., faster transaction processing)

The road to becoming data-drive



1

Data Denial

Data are not used and are viewed with distrust

2

Data Indifference

There is no interest to acquire or use data

3

Data Aware

Data are collected and used for monitoring, but no decisions are made based on them

4

Data Informed

Data are mainly used by managers in decision-making

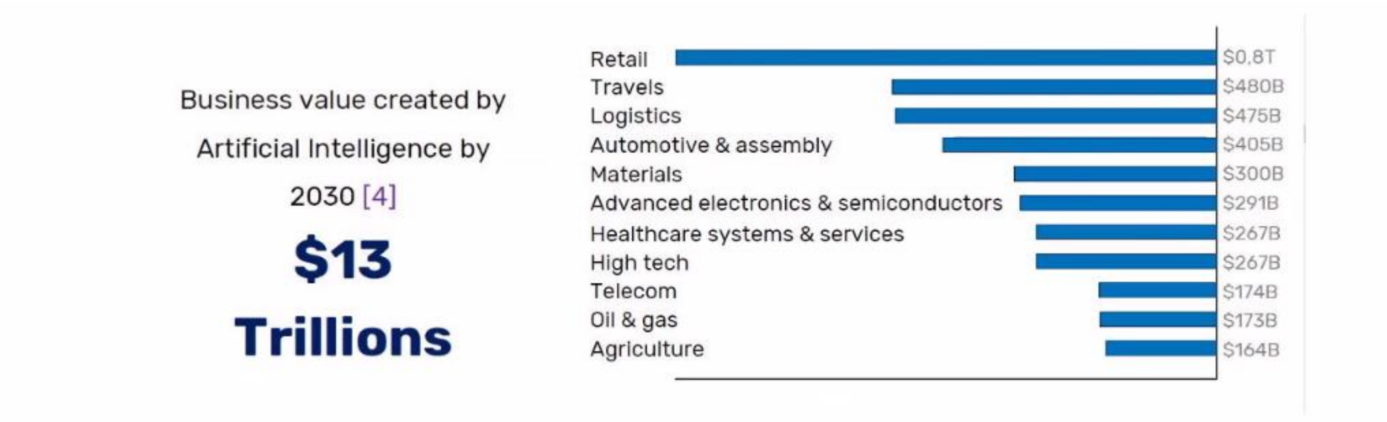
5

Data-Driven

Data play a central role in the most disparate decisions that are made in the various business sectors

1 - DATA DENIAL: Data are not used and are viewed with distrust
2 - DATA INDIFFERENCE - There is no interest to acquire or use data
3 - DATA AWARE- Data are collected and used for monitoring, but no decisions are made based on them
4 - DATA INFORMED - Data are mainlyused by managers in decision-making
5 - DATA DRIVEN - Data play a central role in the most disparate decisions that are madein the various business sectors

Why become data driven?



It is **difficult** to find an industrial sector **that will not benefit** from artificial intelligence in the near future

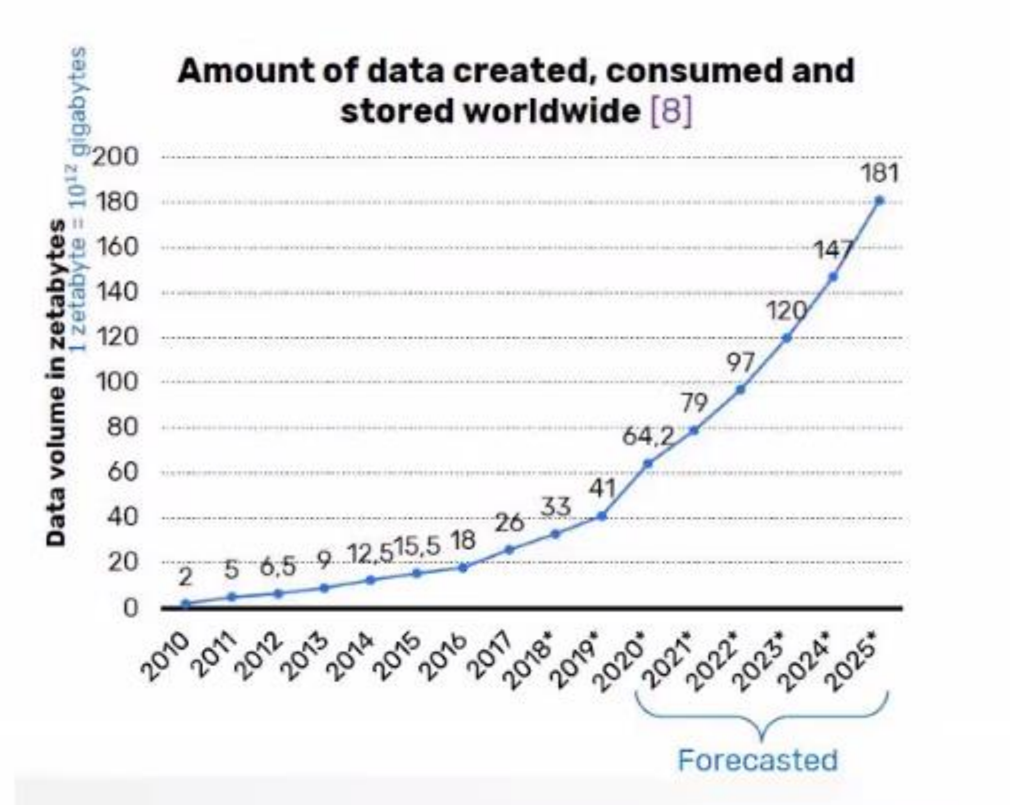
What is data, talk about benefits of analyzing data, (ex was hate speech from social media, covid19 vacciness results)

What are data?

We refer to data as any piece of information that has been collected and stored in a computer.

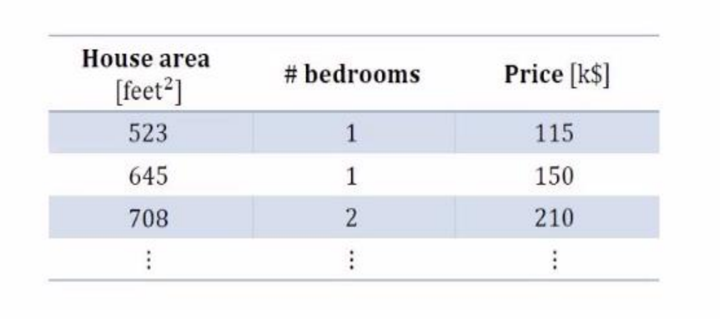
Examples:

- Sensor measurements
- Customer information
- Transaction history
- Social media posts



Types of Data: Structured vs Unstructured

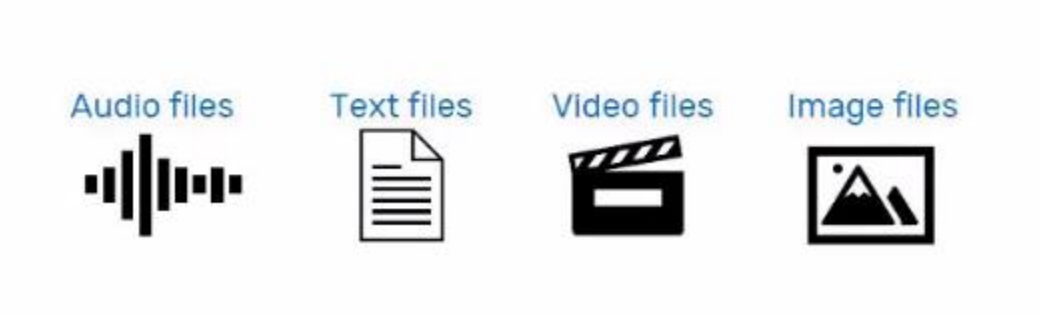
Structured data



House area [feet^2]	# bedrooms	Price [k$]
523	1	115
645	1	150
708	2	210
⋮	⋮	⋮

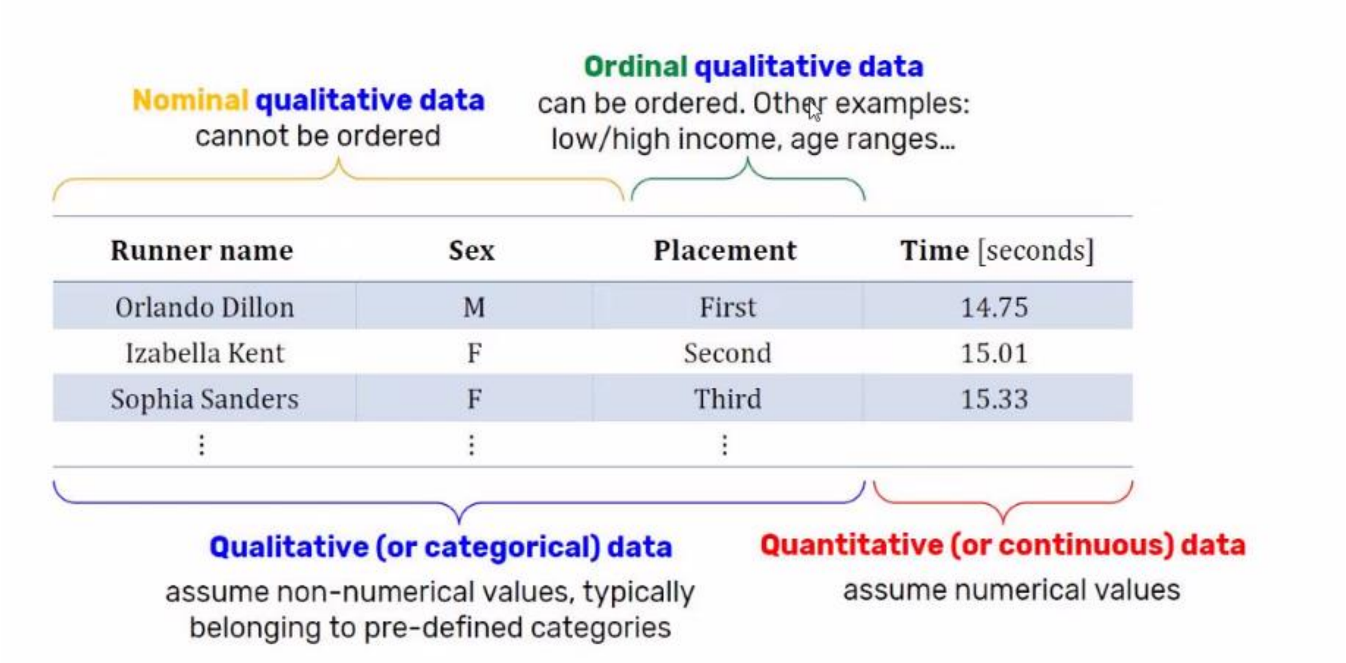
- Data that are organized following a predefined scheme and stored in tabular formats(Excel sheets, SQL databases…)

Unstructured data



- Data that can have an internal structure but do not follow a predefined data model or scheme

Types of Data: quantitative vs qualitative



Nominal qualitative data cannot be ordered

Ordinal qualitative data can be ordered. Other examples: low/high income, age ranges...

Runner name	Sex	Placement	Time [seconds]
Orlando Dillon	M	First	14.75
Izabella Kent	F	Second	15.01
Sophia Sanders	F	Third	15.33
⋮	⋮	⋮	

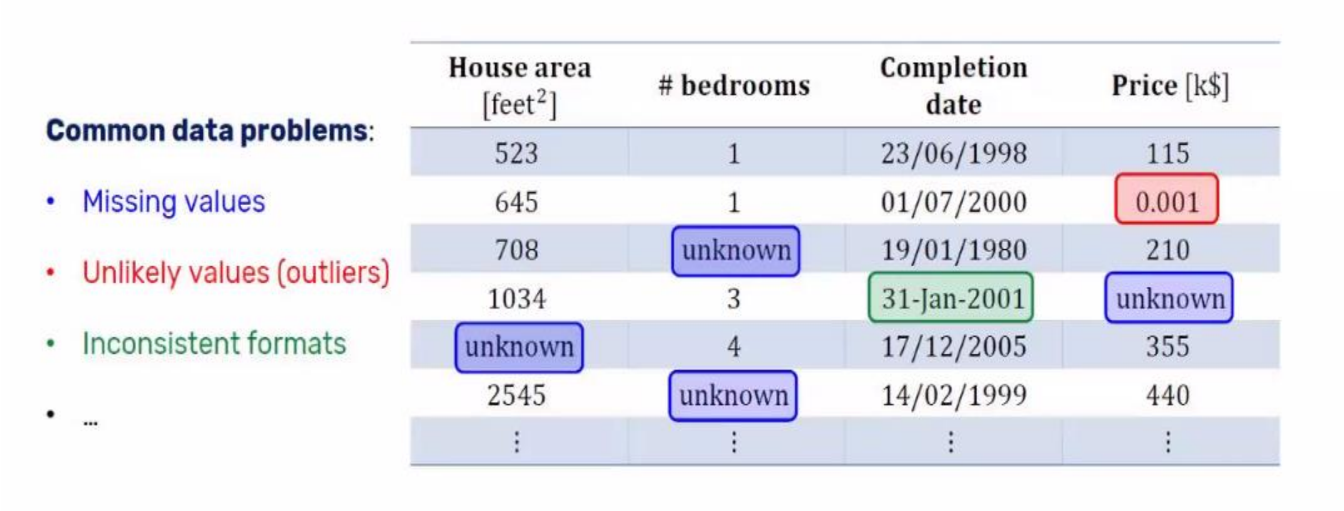
Qualitative (or categorical) data assume non-numerical values, typically belonging to pre-defined categories

Quantitative (or continuous) data assume numerical values

Types of Data

- Relational Data (tables/transaction/legacy data)
- Text data (web)
- Semi-structured data (XML)
- Graph Data
- Social Network, Semantic Web(RDF)
- Streaming Data
- You can afford to scan the data once

Data are dirty



Common data problems:

- Missing values
- Unlikely values (outliers)
- Inconsistent formats
- ...

House area [feet^2]	# bedrooms	Completion date	Price [k$]
523	1	23/06/1998	115
645	1	01/07/2000	0.001
708	unknown	19/01/1980	210
1034	3	31-Jan-2001	unknown
unknown	4	17/12/2005	355
2545	unknown	14/02/1999	440
⋮	⋮	⋮	⋮

Common data problems:

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- Unlikely values (outliers)
- Inconsistent formats

Typically, data must be cleaned before usage (**Data Cleaning**)

References

C. Shah, A Hands-On Introduction to Data Science, 1st edition. 2020 -

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