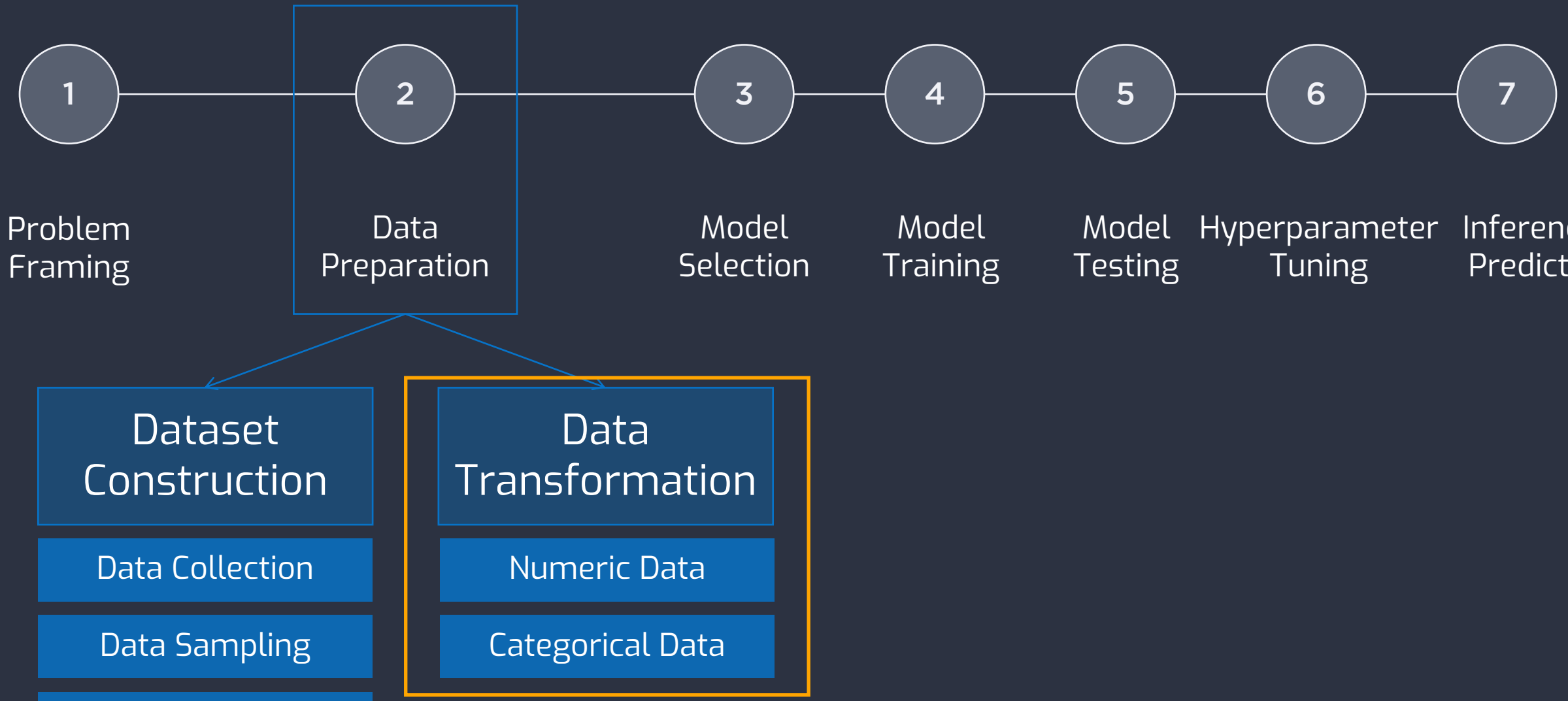
COMP2261 ARTIFICIAL INTELLIGENCE / MACHINE LEARNING

Data Transformation

Dr SHI Lei

Durham University

learning lab

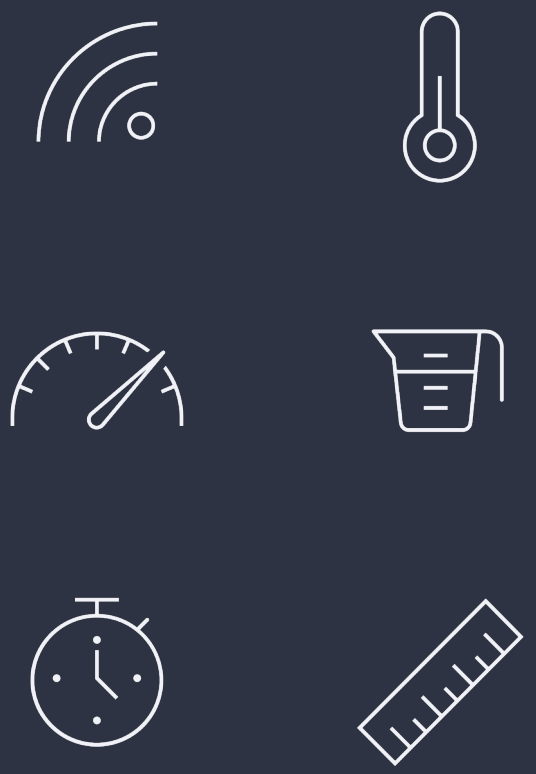

1
2
3
4
5
6
7
Problem Framing
Data Preparation
Model Selection
Model Training
Model Testing
Hyperparameter Tuning
Inference / Prediction
Dataset Construction
Data Collection
Data Sampling
Data Splitting
Data Transformation
Numeric Data
Categorical Data

Learning Objectives

- Understand what is Data Transformation
- Understand why we need Data Transformation

In Machine Learning projects, we need Data to train models.

Data in real world doesn't come in a nice format that can be directly used.



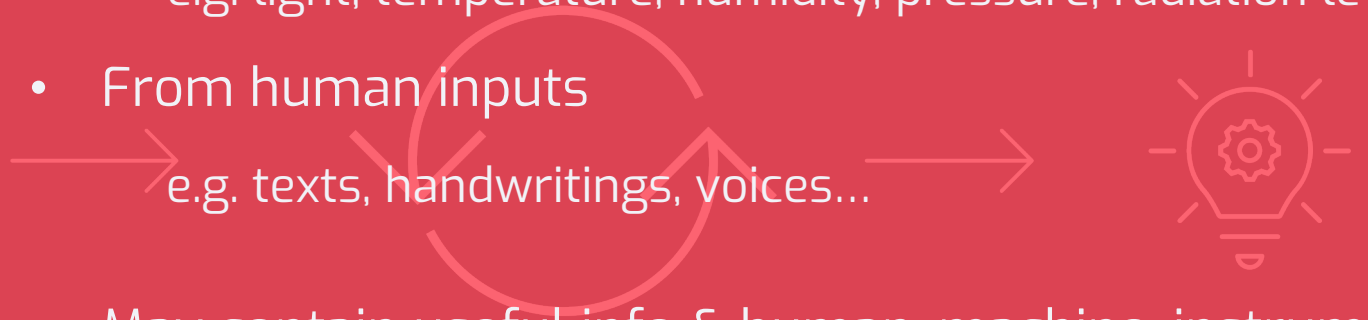
Raw / source data (directly collected from a source)

- From an electronic sensor which measures physical input

  e.g. light, temperature, humidity, pressure, radiation level…

- From human inputs

  e.g. texts, handwritings, voices…



- May contain useful info & human, machine, instrument errors.
- May be in different colloquial formats, unformatted, uncoded or suspected such as outliers.
- May be in XML, JSON, relational database records, etc.

We need to put those heterogeneous data sources together and create Feature vectors from it for learning algorithms.

Feature Engineering

The process of selecting and extracting features from raw data.

art

?

science / engineering

Machine learning engineers often spend 70%~80% of their time in data preparation phase before modelling.

Data Transformation

Data Transformation

EXAMPLE. transforming raw data to feature vector

Raw Data (in JSON)

```
0: {
  student_info: {
    first_name: Bruce,
    last_name: Lee,
    age: 18,
    sex: male,
    height: 1.72,
    num_module: -1
    …
  }
}
```

Feature Engineering

Feature Vector

```
[
  32.0,
  96.0,
  18.0,
  0.0,
  1.72,
  -1.0,
  0.0,
  3.142,
  …
]
```

Feature engineering: the process of selecting and extracting features from raw data.

Data Transformation

Feature

A specific representation on top of raw data.

It is an individual, measurable attribute shared by all of the independent observations on which analysis or prediction is to be done.

An attribute could only be a feature if it is useful to the model; and in another word, a feature being a feature other than being an attribute is because it is in the context of a specific problem and can contribute to solving the problem.

Main reasons to transform features

Mandatory transformations	For data compatibility e.g., we convert non-numeric features into numeric, so that we can do matrix multiplication; we resize the inputs to a fixed size, because linear models have a fixed number of inputs.
Optional quality transformations	For better model performance e.g., tokenisation of text features; or normalise numeric features.

Before feature transformation

Need to explore and clean up data.

e.g., explore several rows of data and check basic statistics or fix missing entries.

Data can look on way in basic statistics and another when in graph

Visualise data in graphs and charts such as scatter plots, lines and histograms.

Takeaway Points

- Data may come from various sources e.g. sensors, human, etc.
- Data may be in various formats, unformatted, uncoded, etc.
- Data may contain useful info and human, machine errors.
- Need to put heterogeneous data sources together and create feature vectors from it for learning algorithms
- Transforming raw data to feature vector - feature engineering.
- Need to explore and clean up data before data transformation.