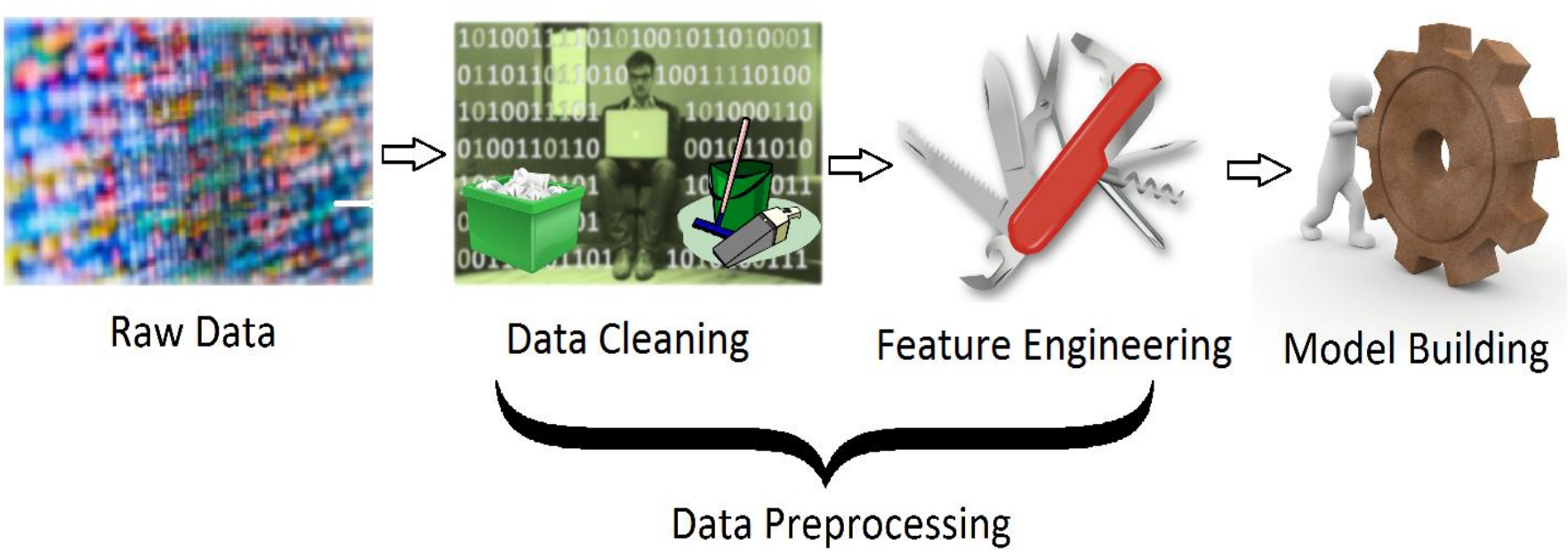
INT354
Machine Learning Foundations

Lecture #4.0

Data Pre-processing

Data

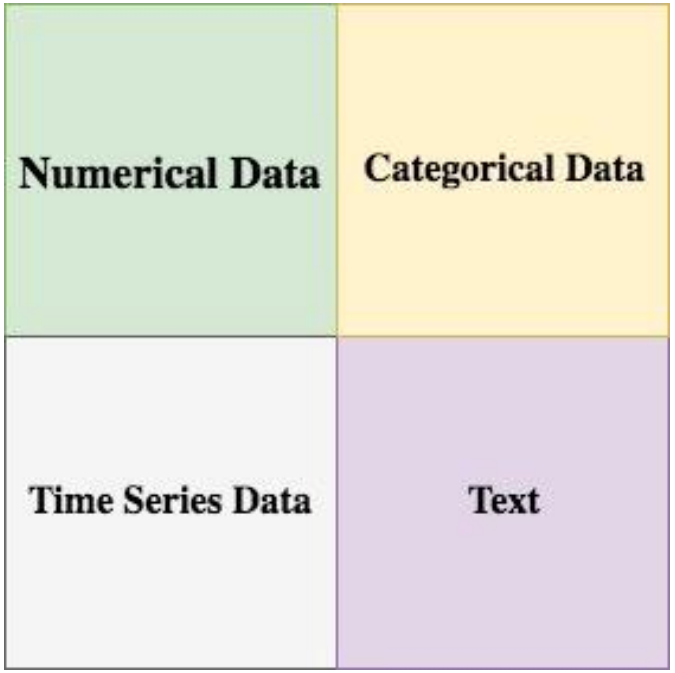
- **Machine learning depends largely on test data.**
- **A large amount of data is required for ML.**



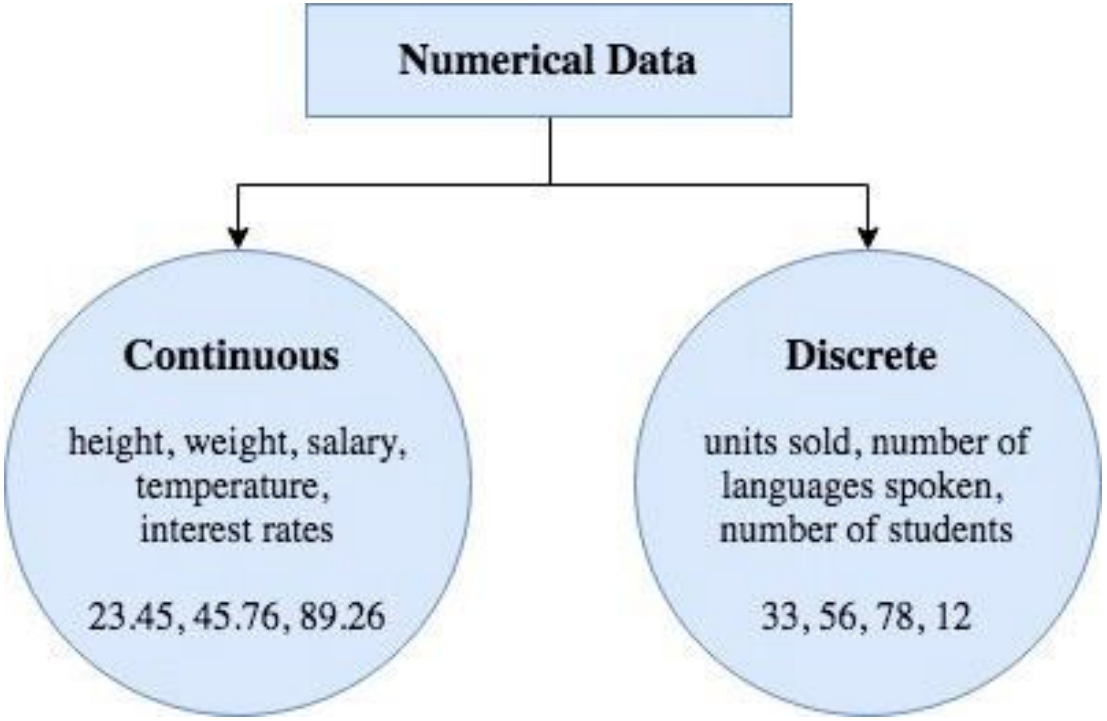
Different types of data in ML

Data can be categorized into 4 basic types:

- **Numerical Data**
- **Categorical Data**
- **Time Series Data**
- **Text**



Numerical Data



Categorical Data

Population Bins

0 – 10 million, 10 – 100 million, 100 – 500 million, > 500 million

Ordinal Data

Time-Series Data

Text Data


DETECTION
BIG DATA
COMPUTING
INFORMATION TECHNOLOGY
SOCIAL MEDIA
PROMOTION
MODELS
E-MARKETING
COMMUNICATION
SERVICES
CONTENT
PROCESSING
BRANDING
COMPUTER
MULTIMEDIA
NETWORK
PROJECTS
CONSUMER
CONSUMER DEMAND
MARKETS
PREDICTIVE
ORGANIZATION
SOFTWARE
WEB MARKETING
PLANNING
CODING
PROGRAM
ANALYTICS
EVENTS
PROGRAMMING
DATA MINING
DATA SCIENCE
INFORMATION
MACHINE LEARNING
VISION
ENGINEERING
RESEARCH
PROBABILITY
WEB SERVICES
BIG
WEB DEV
KDD
COMPUTING
MATHS PATTERN
DATA
STRATEGY
WORLDWIDE
VISUALIZATION
BIG DATA
ENGINEERING
SERVICE
PROJECTS
SOLUTIONS
PLANNING
MEDIA
MOBILE
PRO
PRICING
SOCIAL NETWORK
SEGMENTATION
STATISTICS
INFORMATION
CODING
SOCIAL NETWORKS
TARGET
DIGITAL

Data Preparation Process

- **The process of data preparation comprises the following:**
  - **Data Selection**
  - **Data Pre-processing**
  - **Data Transformation**

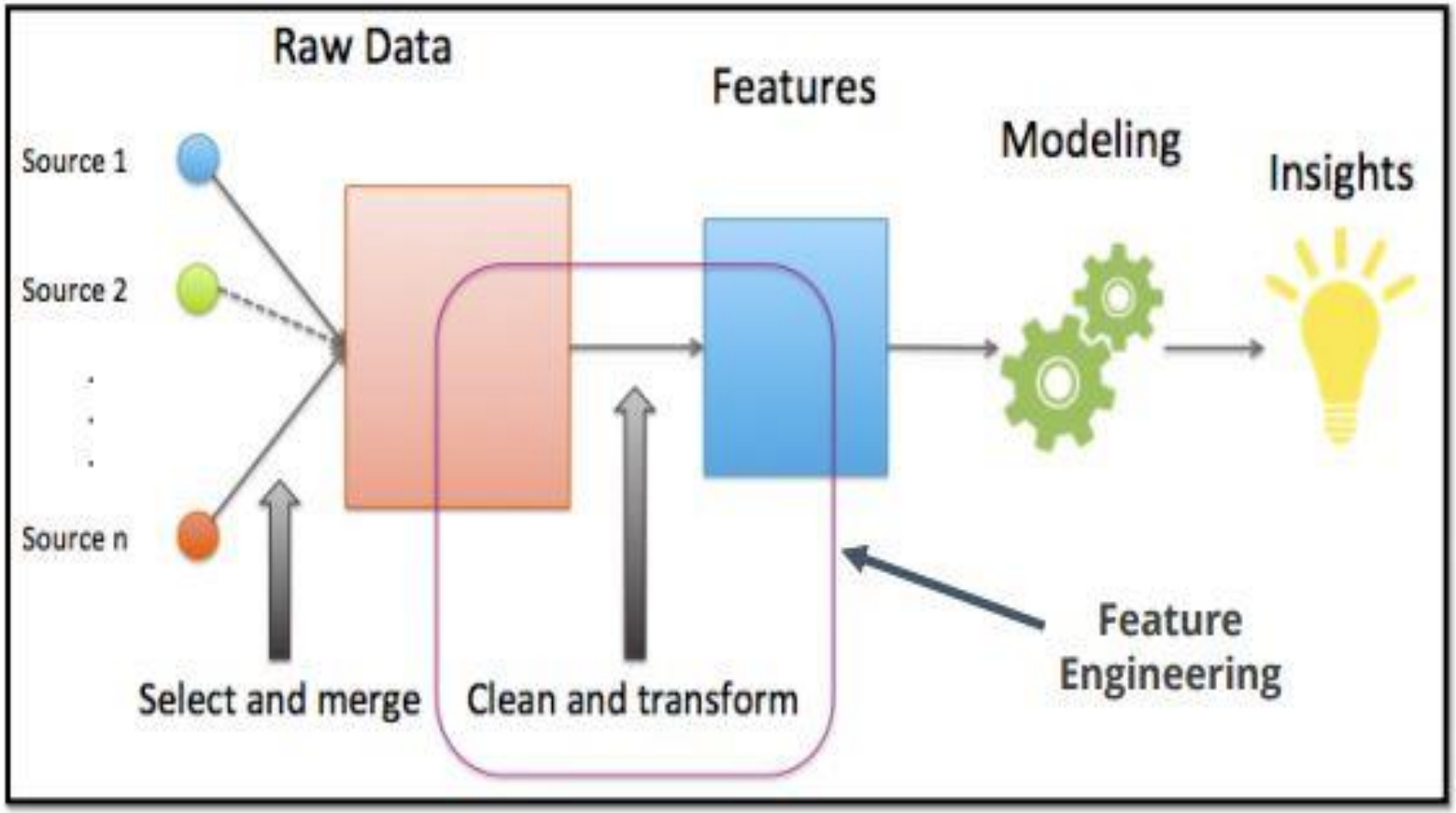
Data Selection

Steps involved in Data Selection involves:

- **Selecting only a subset of available data.**
- **The selected sample must be an accurate representation of the entire population.**
- **Some data can be derived or simulated from the available data if required.**
- **Data not relevant to the problem at hand can be excluded.**

Feature Engineering

- **Transforming raw data into features that better represent the underlying problem to the predictive models, resulting in improved model accuracy on unseen data.**



Framework of Feature Engineering

- **Frame your problem:**
  - **Can you frame your problem in a way that machine learning could be useful. Eg: prediction.**
- **Understand your data:**
  - **What data will be most helpful to understand and generate a better understanding of the problem.**
- **Frame your feature goals:**
  - **What are you optimizing for?**
    - **Iteration speed**
    - **Model performance**
- **Test, Iterate, Test Again:**
  - **Check your choices for robustness.**
  - **Validate**

Aspects of Feature Engineering

- **Feature Selection**
- **Feature Extraction**
- **Feature Addition**
- **Feature Filtering**

Example: flight date time vs status

- **Status of flight depends on the hour of the day, not on the date-time.**

	Date_Time_Combined	Status
0	2018-02-14 20:40	Delayed
1	2018-02-15 10:30	On Time
2	2018-02-14 07:40	On Time
3	2018-02-15 18:10	Delayed
4	2018-02-14 10:20	On Time

	Hour_Of_Day	Status
0	20	Delayed
1	10	On Time
2	7	On Time
3	18	Delayed
4	10	On Time

Creating new feature "Hour_of_Day" is the feature engineering.

Feature Selection vs Feature Extraction vs Feature Engineering

- ***Feature selection* is essential for creating the dataset.**
- ***Feature extraction* applies automatic methods like PCA for constructing new features.**
- ***Feature engineering* deals with the manual construction of features from raw data.**


COMING UP