

# **Data Mining with Python**

Foreign Expert Seminar,  
School of Computer Science Engineering and Information Systems,  
Vellore Institute of Technology (VIT), India

# Presenter

**Ts. Dr. Pradeep Isawasan**

Senior Lecturer,

*College of Computing, Informatics and Mathematics,  
Universiti Teknologi MARA (UiTM), Perak Branch, Malaysia.*

--> [YouTube](#), [TikTok](#), [GitHub](#), [Kaggle](#), [Google Scholar](#)

# What is Data Mining?

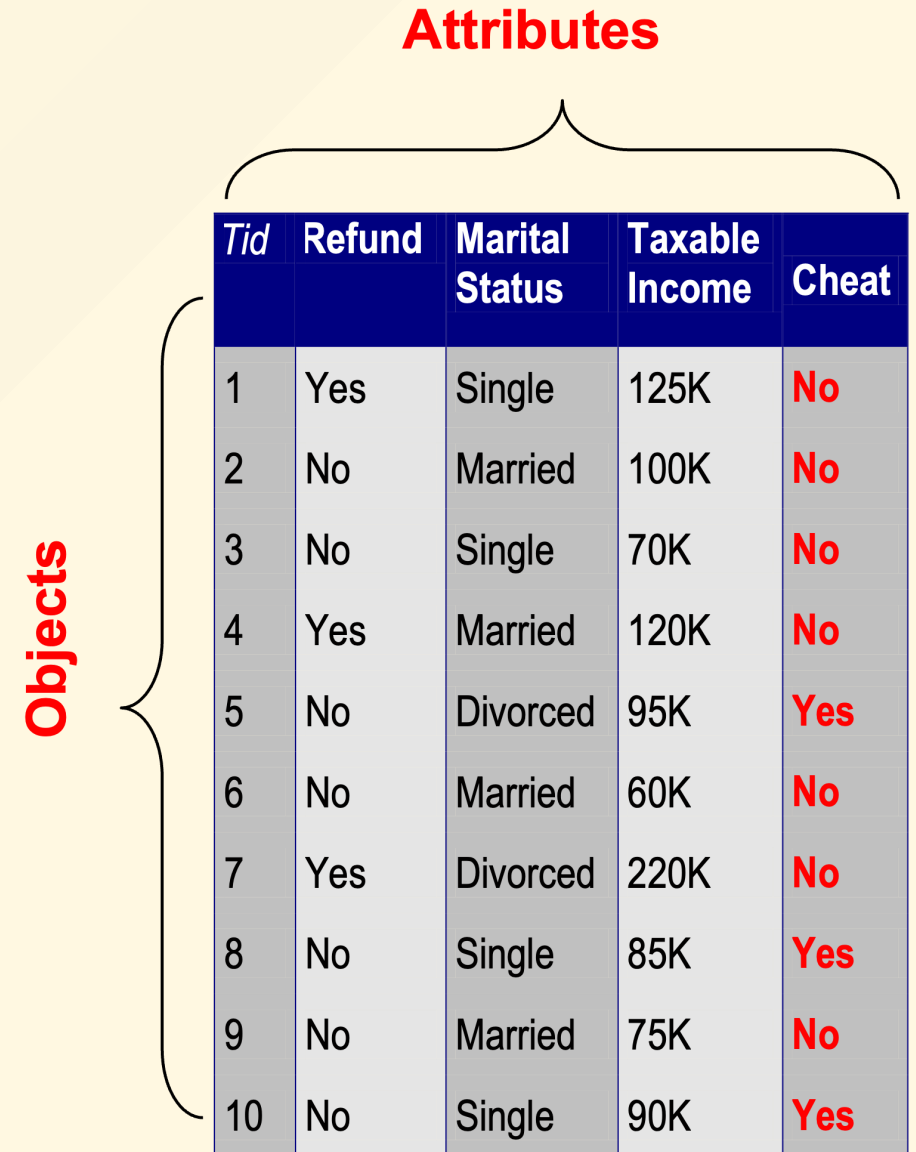
## Many Definitions

- Non-trivial extraction of implicit, previously unknown and potentially useful information from data
- Exploration & analysis, by automatic or semi-automatic means, of large quantities of data in order to discover meaningful patterns

*Data Mining is a process of extracting insights from data.*

# What is Data?

- Collection of data objects and attributes
- An attribute is a property or characteristics of an object
- A collection of attributes describe an object



The diagram illustrates the relationship between data objects and attributes. A table is shown with five columns: *Tid*, Refund, Marital Status, Taxable Income, and Cheat. The columns are grouped under the label 'Attributes' with a bracket. The rows are grouped under the label 'Objects' with a bracket. The 'Cheat' column contains values in red text.

Attributes				
<i>Tid</i>	Refund	Marital Status	Taxable Income	Cheat
1	Yes	Single	125K	No
2	No	Married	100K	No
3	No	Single	70K	No
4	Yes	Married	120K	No
5	No	Divorced	95K	Yes
6	No	Married	60K	No
7	Yes	Divorced	220K	No
8	No	Single	85K	Yes
9	No	Married	75K	No
10	No	Single	90K	Yes

# The Data Mining Process

For today's talk, we make it simple by separating the process into

## **Part 1: Data Preprocessing**

- Cleaning, transforming, visualizing

## **Part 2: Machine Learning**

- Create model, train, test, evaluate, use

# Technology/Tools

## **Programming Language**

*Python, R*

## **Software**

*Weka, RapidMiner, Excel*

## **Cloud**

*R Studio Cloud, Power BI, Tableau, Google Collab*

# Programming Language

## What is Python?

- High-Level Programming Language.
- Emphasizes on code readability.
- Rank = 1\* for 2023 \*[\(IEEE Spectrum\)](#).
- Consist of fantastic libraries!

# Part I: Preprocessing



# Python Library

## Pandas for Data Analysis and Manipulation

A Python library is a collection of related modules. It makes Python programming simpler and convenient for the programmer.

```
# importing Pandas library  
import pandas as pd
```

Pandas is the backbone of most python data mining projects.

# Reading Data

Usually we can use pandas library. Pandas store the imported data as DataFrame.

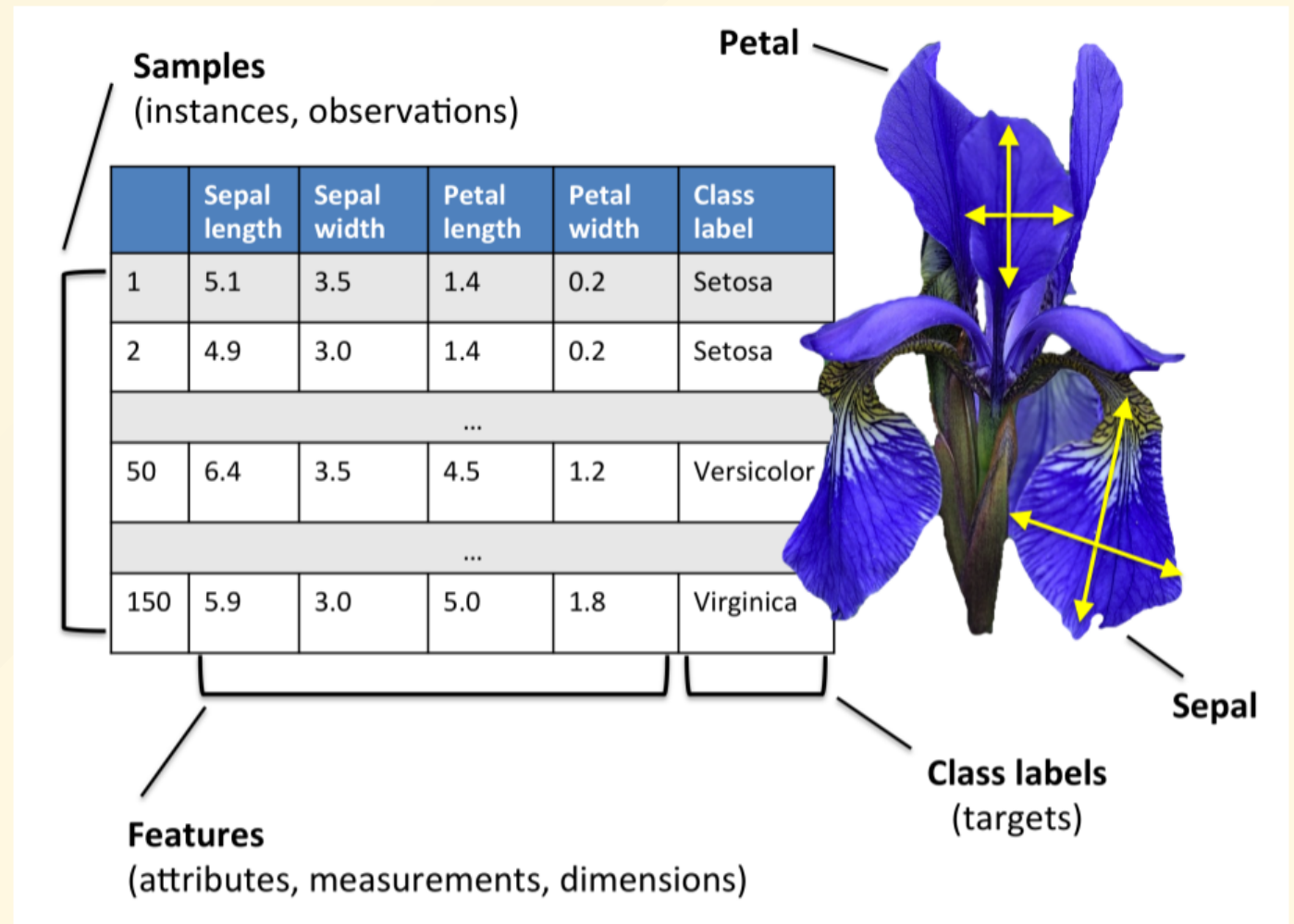
```
# Default sep = ','  
df = pd.read_csv("iris_dirty.csv")
```

or if you want to use another separator, simply add sep='\t'

```
df = pd.read_csv("file_name.csv", sep = '\t')
```

# Iris Flower Dataset

- Also known as Fisher's Iris dataset
- Introduced by Ronald Fisher in his 1936 paper.



# View Data

You can have a look at the first five rows with `.head()`:

```
# by default is 5 rows  
df.head()  
# you can also customize the #-rows  
df.head(10)
```

or the last five rows with `.tail()`:

```
df.tail()
```

# Data Info

The shape property returns the dimensionality of the DataFrame.

```
df.shape
```

The info() method prints information about the DataFrame.

```
df.info
```

# Statistical Description

All standard statistical operations are present in Pandas:

```
# Show the statistical summary on the numerical columns  
df.describe()  
# or individually  
df.mean()
```

```
# Show the statistical summary on the categorical columns  
df.describe(include = 'object')
```

# Data Cleaning

## Finding Missing Values

It is common to have not-a-number (NaN) values in your data set.

```
# Will give the total number of NaN in each column  
df.isna().sum()
```

# Data Cleaning

## Handling Missing Values

```
# Remove the rows with NaN, not recommended  
df.dropna()
```

```
# fill NaN with 0, also not recommended  
df.fillna(0)
```

```
# fill NaN with mean, better  
df1 = df.fillna(df.mean(numeric_only=True))
```



# Data Cleaning

## Problematic Values

Typo can be considered problematic.

```
# Count unique categorical values  
df1.Species.unique()  
df1['Species'].value_counts()  
  
# View problematic values  
df1.iloc[[7]]
```

# Data Cleaning

## Handling Problematic Values

We can replace with the correct value using `replace()`

```
df2 = df1.replace(['SETSA'], 'setosa')
```

Cleaning done!

Check out my [Kaggle post](#) for more data cleaning example.

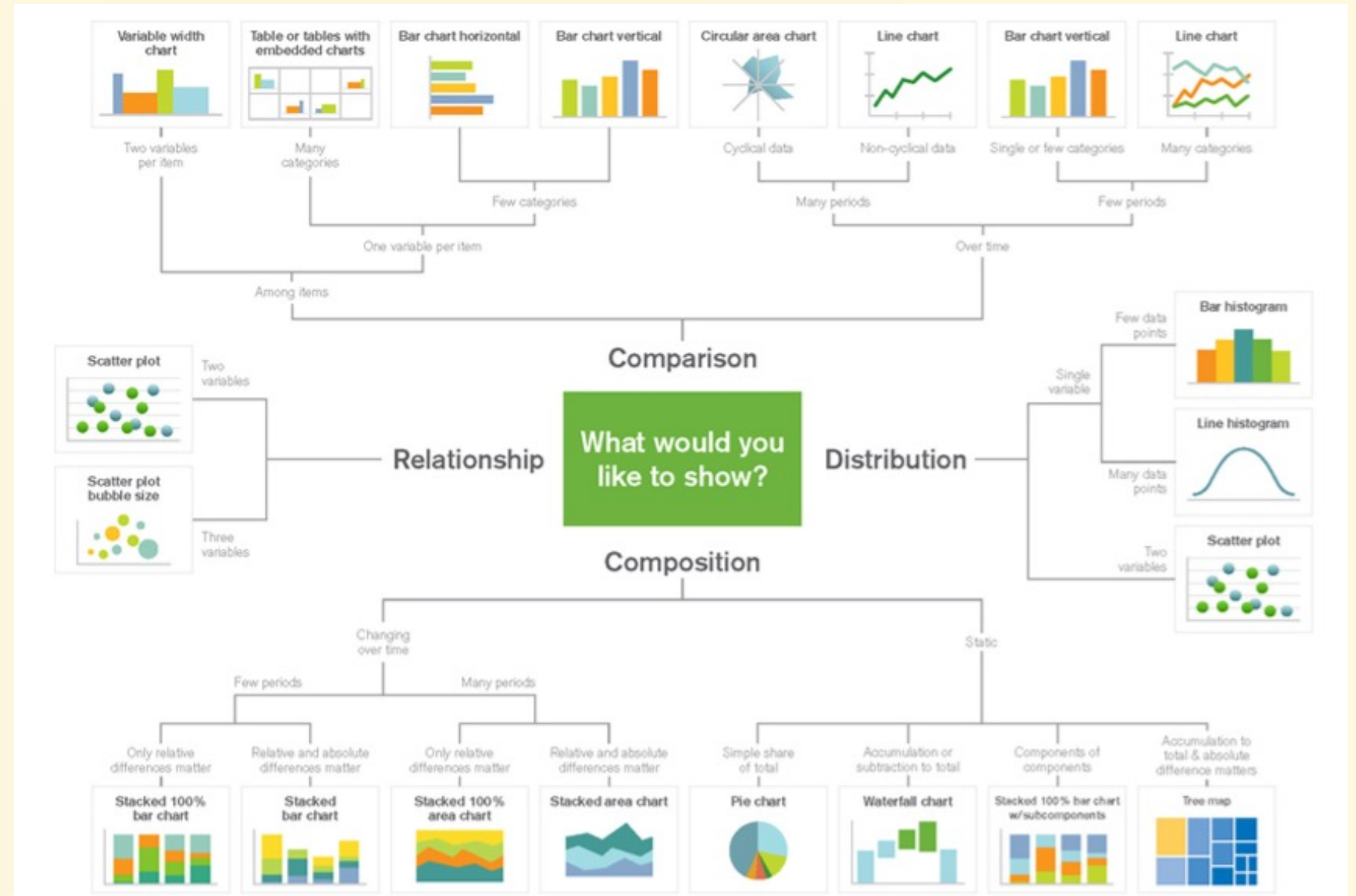
# Data Visualization

Why?

- Visualizing data prior to analysis is a good practice.
- Statistical description do not fully depict the data set in its entirety.

Check out my video [HERE](#) explaining the importance of visualizing data when analyzing it.

# Cheat Sheet



# Data Visualization

## Scatter plot

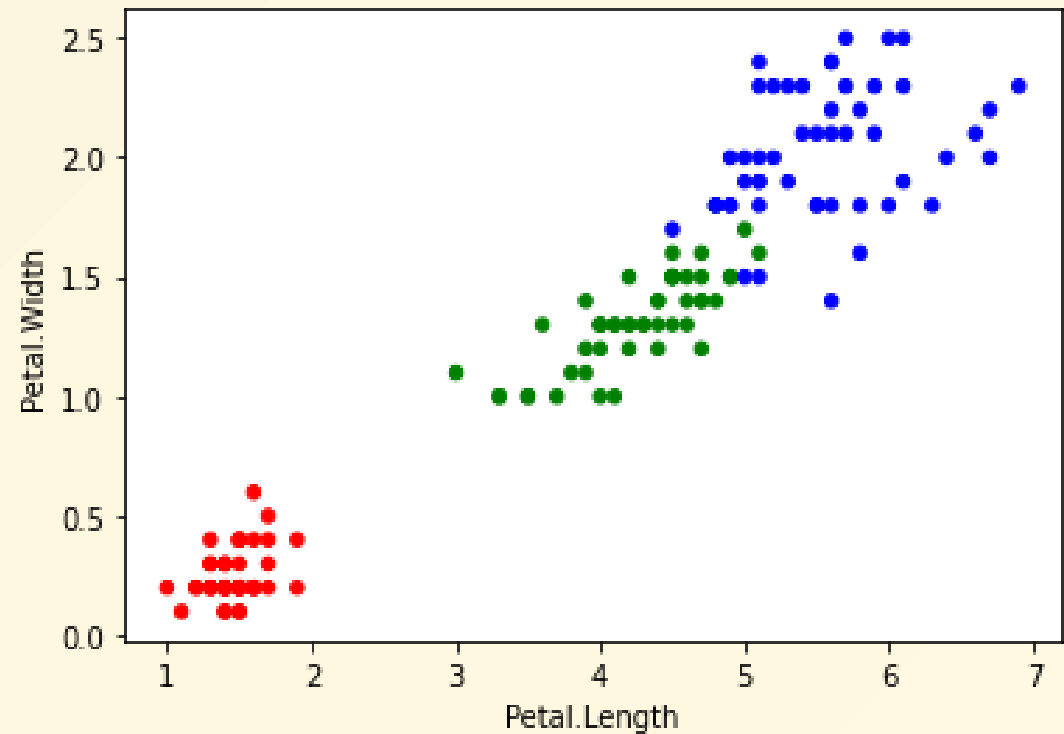
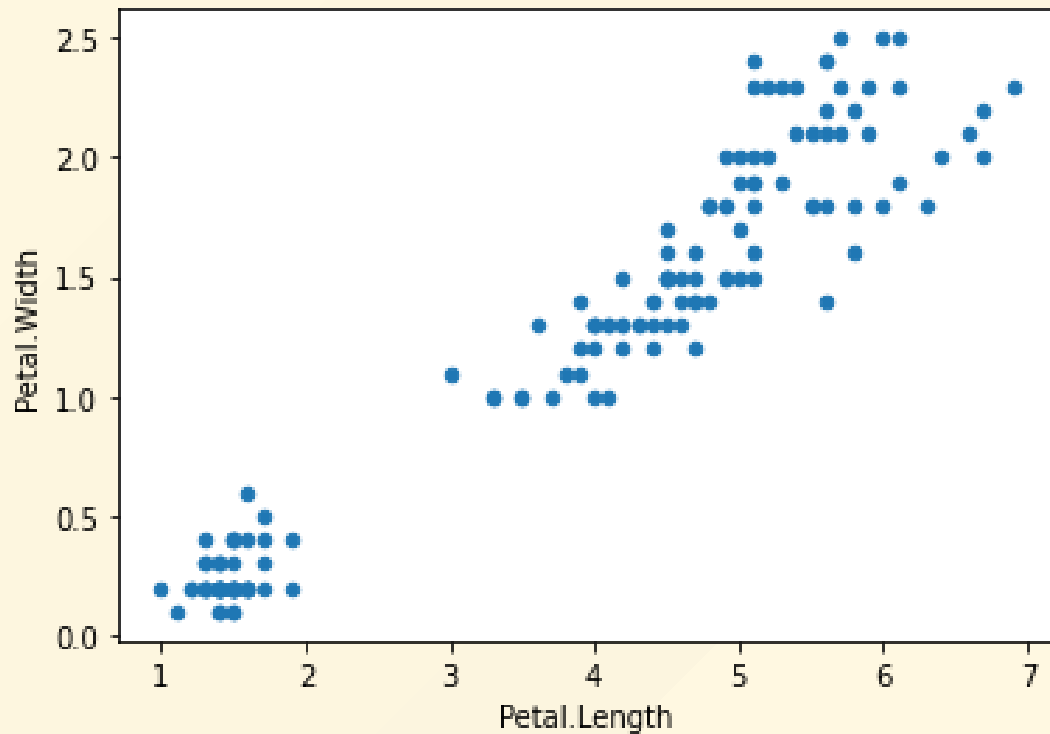
```
df2.plot.scatter(x = 'Petal.Length', y = 'Petal.Width')
```

## Using colour as third variable

```
# Dictionary mapping colour with categorical values  
colors = {'setosa': 'red', 'virginica': 'blue', 'versicolor': 'green'}  
  
df2.plot.scatter(x = 'Petal.Length', y = 'Petal.Width', c = df2['Species'].map(colors))
```

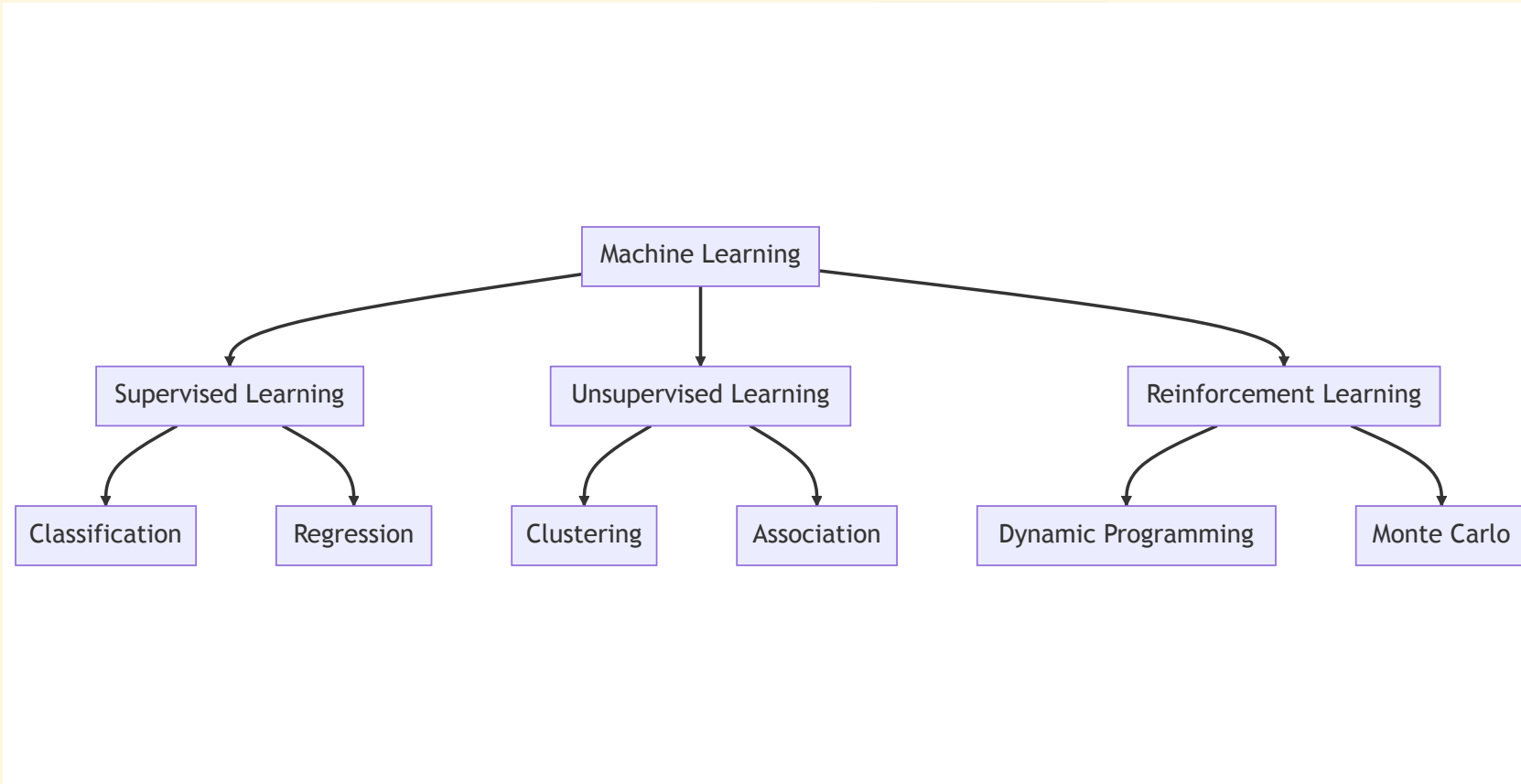
# Data Visualization

What do you see?



# **Part II: Machine Learning (ML)**

# Machine Learning





# Performing Classification

When you look at the petal measurements of the three species , what do you see?

- *It's pretty obvious to us humans that virginica has larger petals than versicolor and setosa. But machine cannot understand like we do. It needs some algorithm to do so.*

For that, we need to implement an algorithm that is able to classify the iris flowers into their corresponding classes.

# Python Library

## scikit-learn for Machine Learning

Scikit-learn provides various tools for model fitting, model selection, model evaluation, and many other utilities.

```
# import built-in machine learning algorithms, for example Logistic Regression  
from sklearn.linear_model import LogisticRegression
```

# Holdout Method

Randomly split the dataset into two sets; Training set and Test set

```
from sklearn.model_selection import train_test_split

# Separate/Assign the attributes into (X) and target (y)
X = df2.iloc[:, :-1]
y = df2.iloc[:, -1]

#split 80% training and 20 test
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2)
```

# Algorithm

**Logistic Regression** is used to predict a categorical target , given a set of independent variables.

```
# import Linear Regression  
from sklearn.linear_model import LogisticRegression  
  
# create model  
model = LogisticRegression(max_iter=150)  
  
# train model  
model.fit(X_train, y_train)
```

# Evaluation

Model evaluation is the process of using different evaluation metrics to understand a machine learning model's performance.

```
from sklearn import metrics  
# Find accuracy  
metrics.accuracy_score(y_test, y_pred)
```

```
#Find confusion matrix  
metrics.confusion_matrix(y_test, y_pred)
```

Check out my video \*[HERE](#) on how to calculate confusion matrix.

# Finally!

Our model ready to be used.

```
# Lets create a new data  
data = {'Sepal.Length': [4.7], 'Sepal.Width': [3.1], 'Petal.Length': [1.7], 'Petal.Width': [0.3]}  
  
newdf = pd.DataFrame(data)
```

```
# Now we can predict using our model  
ynew = model.predict(newdf)
```

# Next?

## Can we have a better classifier performance?

- Normalizing, scaling, feature selection, cross-validation, etc.

## Which algorithm is better?

- [Neural Network?](#), Check out my video on perceptron

## How to apply?

- create a "*machine learning*" capable web/mobile-based system

# Learning Materials

## Textbook

- [Introduction to Data Mining](#)

## Practical Books

- [Python for Data Analysis](#)
- [Machine Learning with Python Cookbook](#)



# Exercise

## Instructions

1. Download the dirty Iris dataset [HERE](#)
2. Perform data preprocessing such as handling missing values, handling problematic values, etc.
3. Split the dataset into training and test set
4. Perform classification using Logistic Regression
5. Evaluate the model