Basic Data Mining with Python

Webinar

CSC649 (Special Topics in Computer Science)

Presenter

Pradeep Isawasan currently a senior lecturer in College of Computing, Informatics and Media, Universiti Teknologi MARA (UiTM), Perak Branch, Tapah Campus.

- YouTube
- TikTok
- GitHub
- Kaggle
- Google Scholar

What is Data Mining?

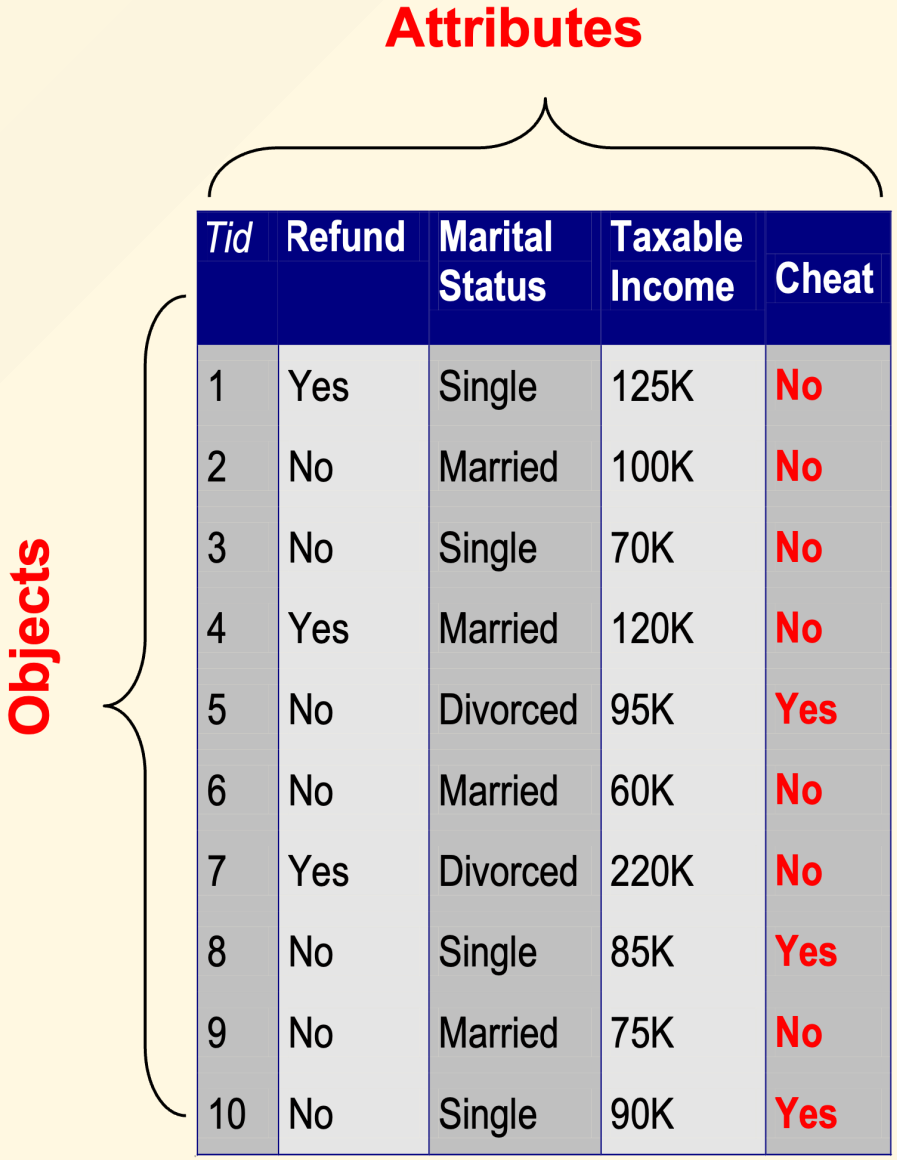
Many Definitions

- 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 Data Mining Process

For today's talk, we make it simple by seperating 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 readibilty.
- Rank = 1* for 2021 *(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.

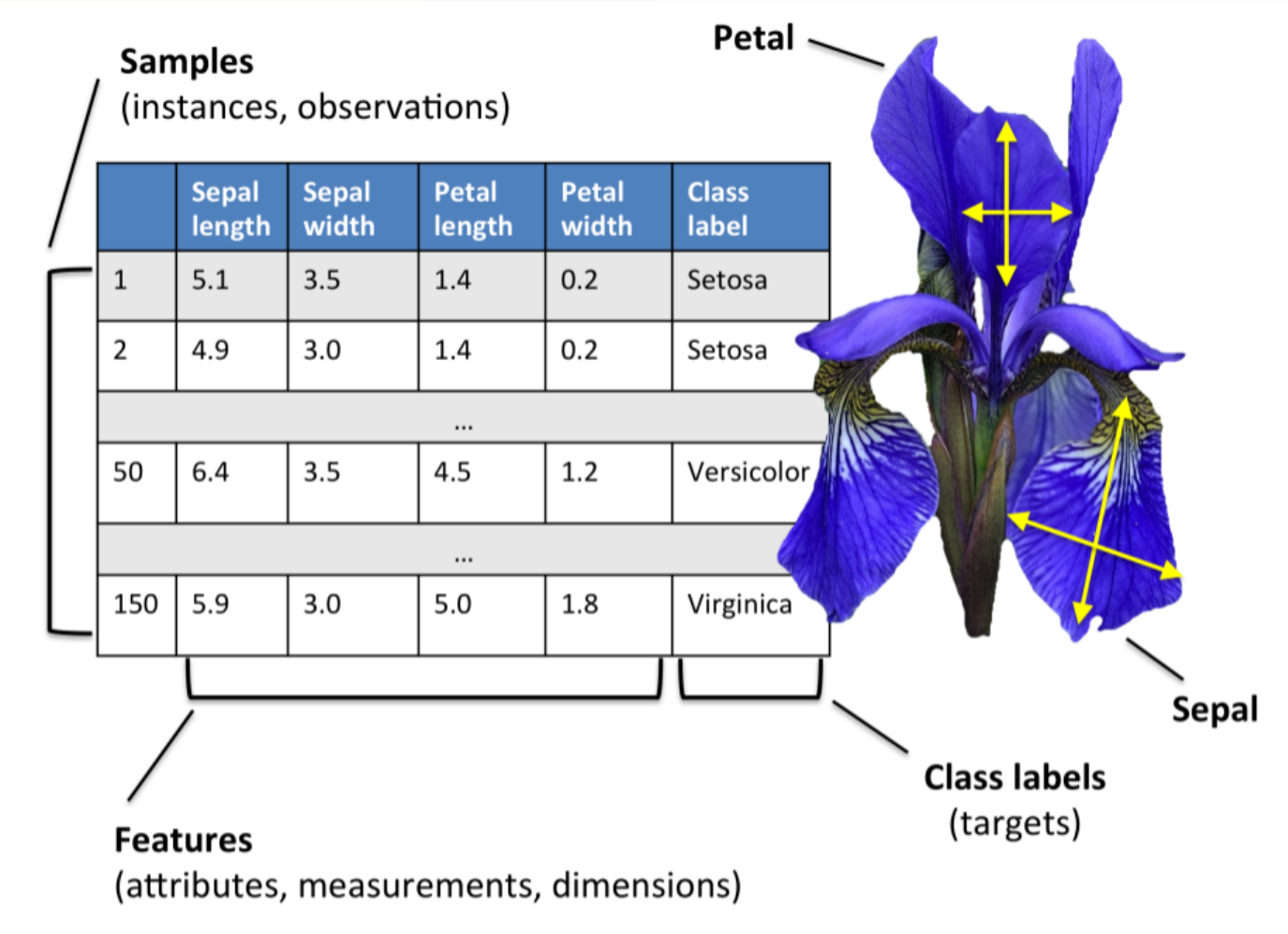
```
# Default sep = ','
df = pd.read_csv("iris_dirty.csv")
```

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.



	Sepal length	Sepal width	Petal length	Petal width	Class label
1	5.1	3.5	1.4	0.2	Setosa
2	4.9	3.0	1.4	0.2	Setosa
...					
50	6.4	3.5	4.5	1.2	Versicolor
...					
150	5.9	3.0	5.0	1.8	Virginica

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.

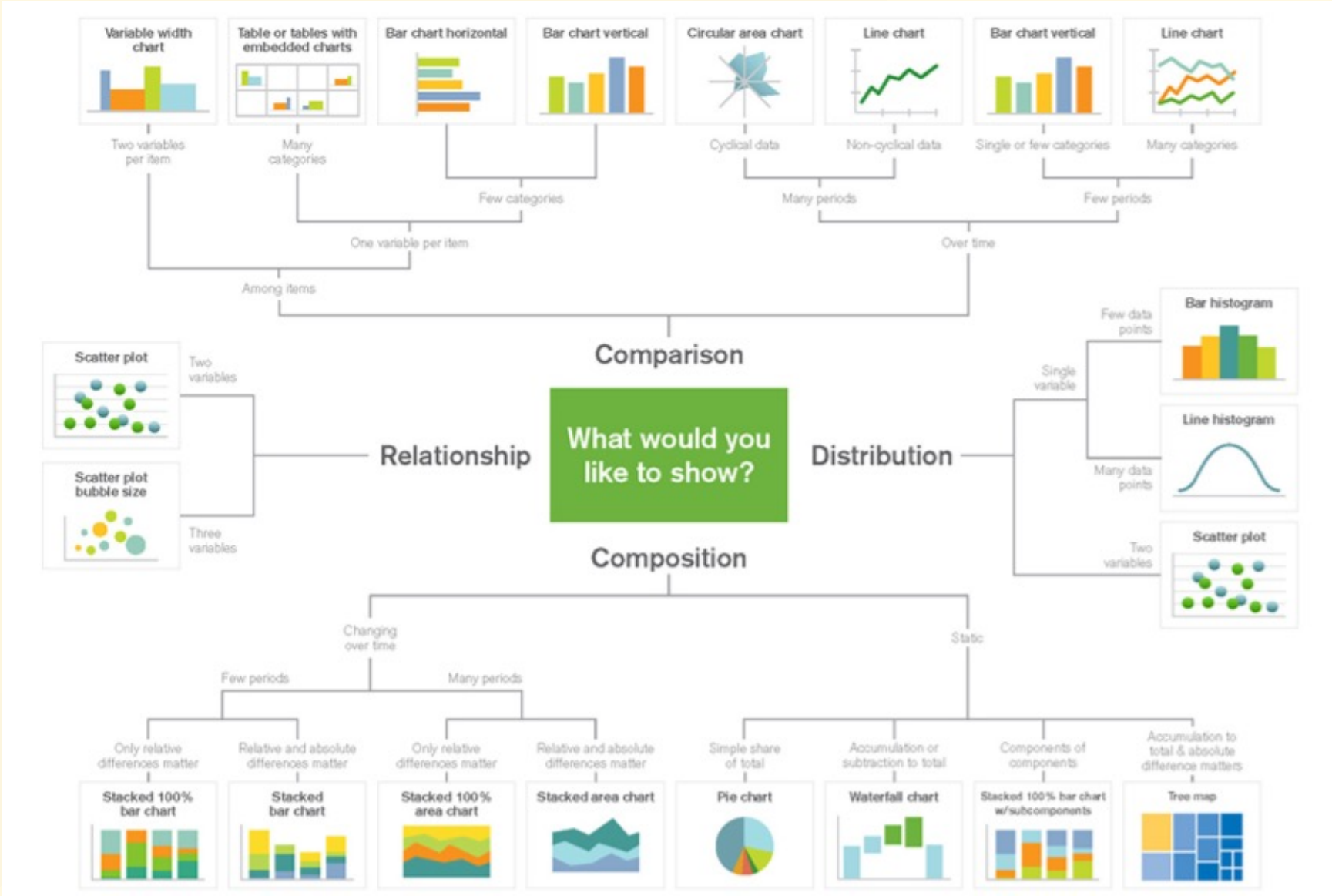
Data Visualization

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


What would you like to show?
Comparison
Relationship
Distribution
Composition
Variable width chart
Table or tables with embedded charts
Bar chart horizontal
Bar chart vertical
Circular area chart
Line chart
Bar chart vertical
Line chart
Two variables per item
Many categories
Few categories
Cyclical data
Non-cyclical data
Single or few categories
Many categories
One variable per item
Many periods
Few periods
Among items
Over time
Scatter plot
Scatter plot bubble size
Two variables
Three variables
Few data points
Many data points
Two variables
Bar histogram
Line histogram
Scatter plot
Changing over time
Static
Few periods
Many periods
Only relative differences matter
Relative and absolute differences matter
Only relative differences matter
Relative and absolute differences matter
Simple share of total
Accumulation or subtraction to total
Components of components
Accumulation to total & absolute difference matters
Stacked 100% bar chart
Stacked bar chart
Stacked 100% area chart
Stacked area chart
Pie chart
Waterfall chart
Stacked 100% bar chart w/subcomponents
Tree map

Data Visualization

Scatter plot

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

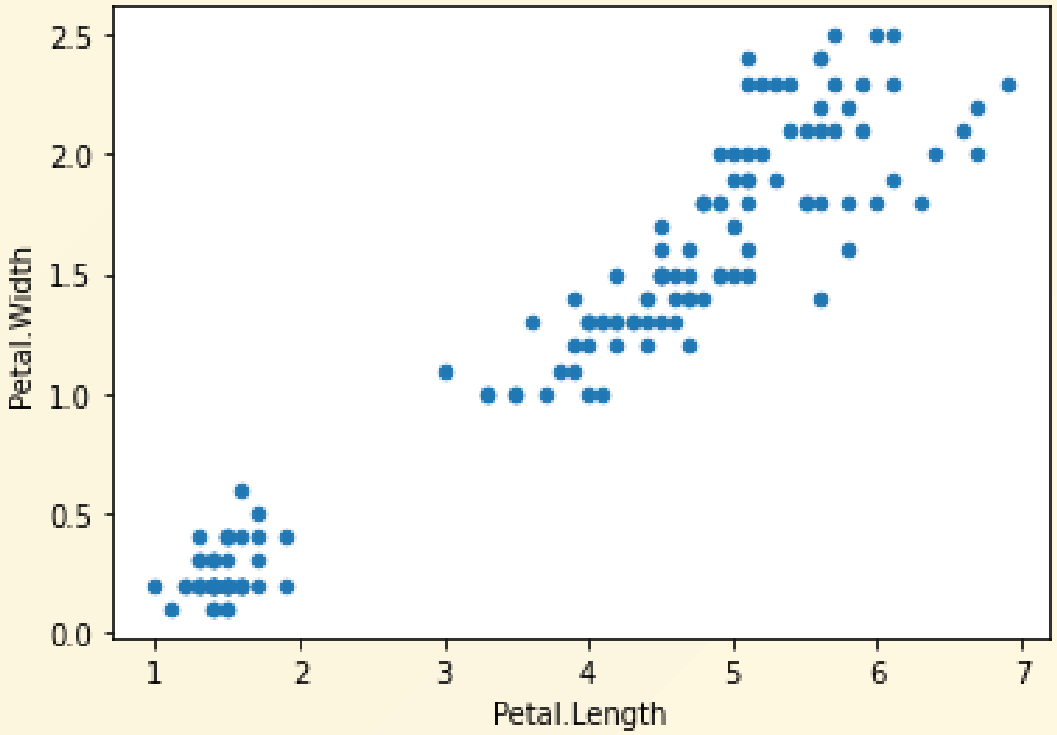
Using colour as third variable

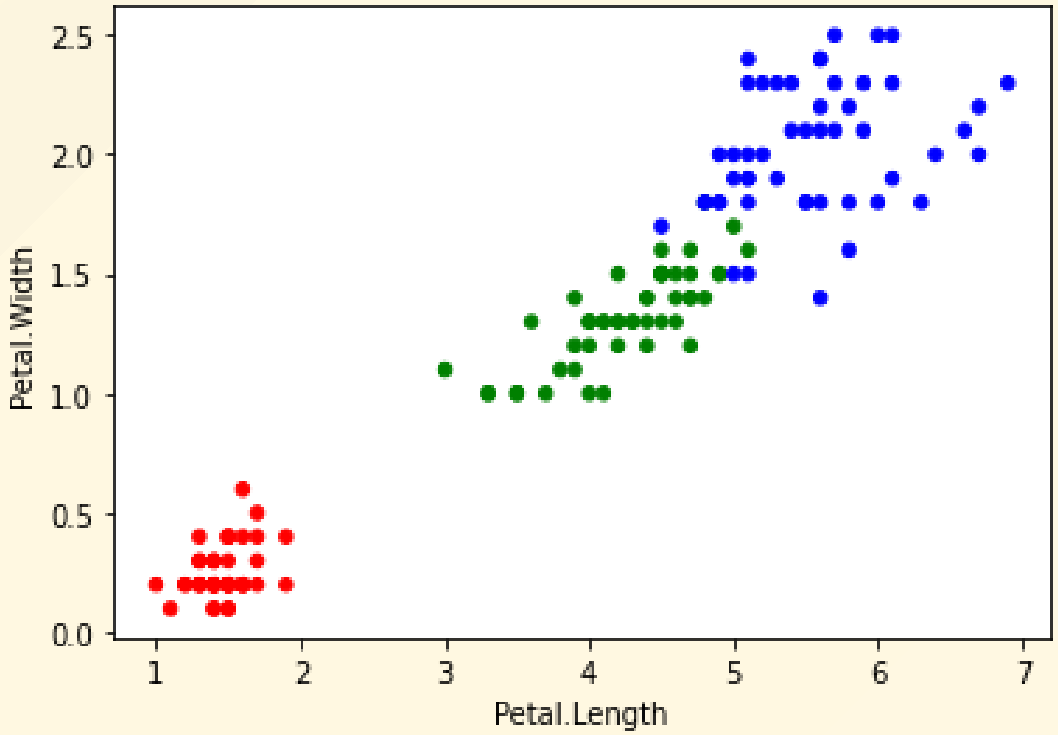
```
# Dictionary mapping colour with categorical values
colors = {'setosa':'red','virginica':'blue','versicolor':'green'}

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)

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