EE2211 Tutorial 2

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Q0

Program for demonstration of one-hot encoding

```python
from numpy import array
from numpy import argmax
from sklearn.preprocessing import LabelEncoder
from sklearn.preprocessing import OneHotEncoder
```

Importing Libraries

```python
# define example
data = ['cold', 'cold', 'warm', 'cold', 'hot', 'hot', 'warm', 'cold', 'warm', 'hot']
values = array(data)
print(values)
```

Define example data

```python
# integer encode
label_encoder = LabelEncoder()
integer_encoded = label_encoder.fit_transform(values)
print(integer_encoded)
```

Integer encode: convert categorical labels into integer labels:

- 'cold' -> 0
- 'warm' -> 2
- 'hot' -> 1

```python
# binary encode
onehot_encoder = OneHotEncoder(sparse_output=False)
integer_encoded = integer_encoded.reshape(len(integer_encoded), 1)
onehot_encoded = onehot_encoder.fit_transform(integer_encoded)
print(onehot_encoded)
```

OneHotEncoder converts the integer-encoded array into a one-hot encoded matrix. Each category is represented by a binary vector:

0 -> [1, 0, 0] (cold)
1 -> [0, 1, 0] (hot)
2 -> [0, 0, 1] (warm)

```python
# invert first example
inverted = label_encoder.inverse_transform([argmax(onehot_encoded[0, :])])
print(inverted)
```

converted back to the original label

Q0

```
['cold' 'cold' 'warm' 'cold' 'hot' 'hot' 'warm' 'cold' 'warm' 'hot']
[0 0 2 0 1 1 2 0 2 1]
[[1. 0. 0.]
 [1. 0. 0.]
 [0. 0. 1.]
 [1. 0. 0.]
 [0. 1. 0.]
 [0. 1. 0.]
 [0. 0. 1.]
 [1. 0. 0.]
 [0. 0. 1.]
 [0. 1. 0.]]
['cold']
```

01

Q1

(Data Reading and Visualization, simple data structure)

A Comma Separated Values (CSV) file is a plain text file that contains a list of data. These files are often used for exchanging data between different applications.

- Download the file “government-expenditure-on-education.csv” from https://data.gov.sg/dataset/government-expenditure-on-education (Please use the file provided in the repository).
- Plot the educational expenditure over the years. (Hint: you might need “import pandas as pd” and “import matplotlib.pyplot as plt”.)

Q1

“government-expenditure-on-education.csv”

year	total_expenditure_on_education
1981	942517
1982	1358430
1983	1611647
1984	1769728
1985	1812376
1986	1641893
1987	1654115
1988	1604473
1989	1765250
1990	2056374
1991	2816371
1992	2597894
1993	2902886
1994	3318956
1995	3443857
1996	3771955
1997	4449754
1998	4853120
1999	4857488
2000	5867507
2001	6239575

Q1

```python
import pandas as pd
import matplotlib.pyplot as plt
import os
```

Importing Libraries

```python
df = pd.read_csv("./GovernmentExpenditureonEducation.csv")
```

Reading the CSV File

```python
expenditureList = df['total_expenditure_on_education'].tolist()
yearList = df['year'].tolist()
```

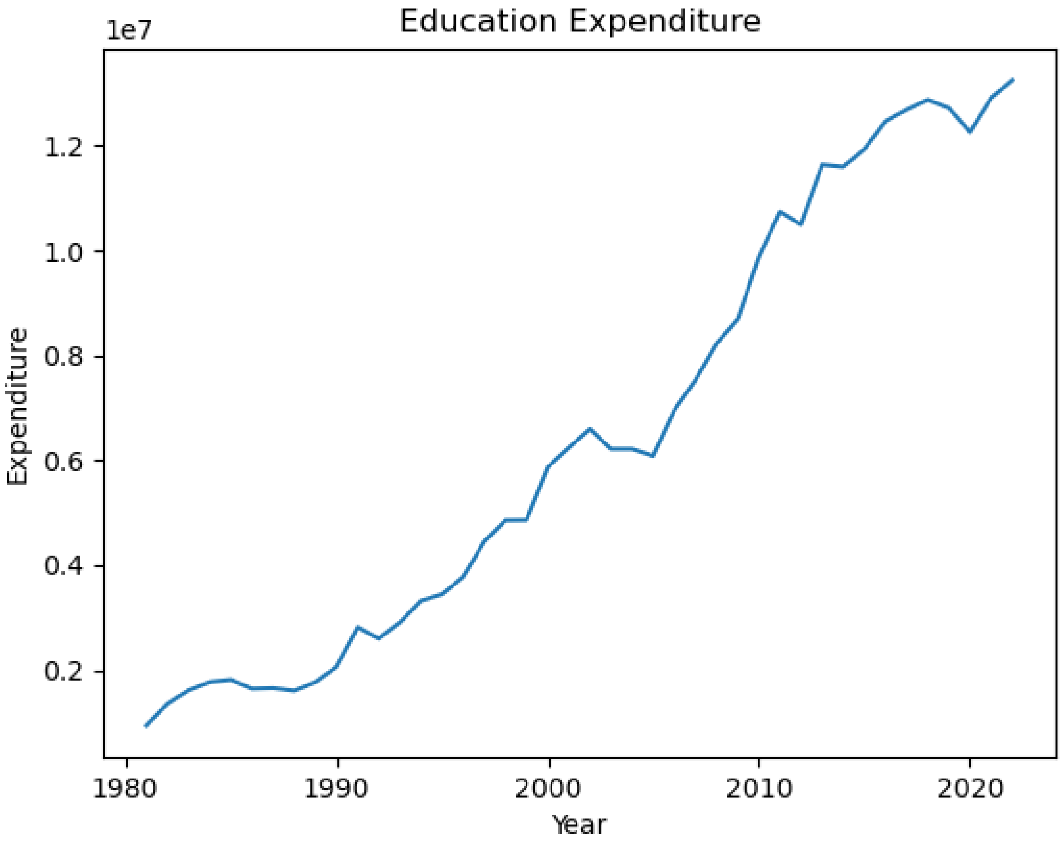
Extract the column from DataFrame and convert it into a list.

```python
plt.plot(yearList, expenditureList, label = 'Expenditure over the years')
plt.xlabel('Year')
plt.ylabel('Expenditure')
plt.title('Education Expenditure')
plt.show()
```

Plotting the Data

01

Q1



Education Expenditure
1e7
1.2
1.0
0.8
0.6
0.4
0.2
Expenditure
1980
1990
2000
2010
2020
Year

02

Q2

(Data Reading and Visualization, slightly more complicated data structure.)

- Download the CSV file from https://data.gov.sg/dataset/annual-motor-vehicle-population-by-vehicle-type.
- Extract and plot the number of Omnibuses, Excursion buses and Private buses over the years as shown below.
- (Hint: you might need “import pandas as pd” and “import matplotlib.pyplot as plt”.)

Q2

	A	B	C	D
1	year	category	type	number
236	2016	Goods and Other Vehic	Very Heavy Good	16407
237	2016	Buses	Omnibuses	5470
238	2016	Buses	School buses (CB	1840
239	2016	Buses	Private buses	2659
240	2016	Buses	Private hire buses	1598
241	2016	Buses	Excursion buses	6771
242	2016	Tax Exempted Vehicles	Cars and Station-	2506
243	2016	Tax Exempted Vehicles	Motorcycles and	613
244	2016	Tax Exempted Vehicles	Buses	466
245	2016	Tax Exempted Vehicles	Goods and Other	19311
246	2017	Cars and Station-wagor	Private cars	502187
247	2017	Cars and Station-wagor	Company cars	24196
248	2017	Cars and Station-wagor	Tuition cars	843
249	2017	Cars and Station-wagor	Private Hire (Self-	21180
250	2017	Cars and Station-wagor	Private Hire (Cha	46903
251	2017	Cars and Station-wagor	Off peak cars	16947
252	2017	Taxis	Taxis	23140
253	2017	Motorcycles and Scoote	Motorcycles and	141304
254	2017	Goods and Other Vehic	Goods-cum-pass	2972
255	2017	Goods and Other Vehic	Light Goods Vehic	94724
256	2017	Goods and Other Vehic	Heavy Goods Veh	28641
257	2017	Goods and Other Vehic	Very Heavy Good	16520
258	2017	Buses	Omnibuses	5665
259	2017	Buses	School buses (CB	1844
260	2017	Buses	Private buses	2533

```python
import pandas as pd
import matplotlib.pyplot as plt
import os
```

Importing Libraries

```python
df = pd.read_csv("AnnualMotorVehiclePopulationbyVehicleType.csv")
```

Loading the Data

```python
year = df['year'].tolist()
category = df['category'].tolist()
vehtype = df['type'].tolist()
number = df['number'].tolist()
```

Convert the columns from the DataFrame into Python List

```python
val1 = df.loc[df['type']=='Omnibuses'].index
val2 = df.loc[df['type']=='Excursion buses'].index
val3 = df.loc[df['type']=='Private buses'].index
print(val1)
```

Filter the DataFrame based on the condition provided inside the loc method. '.index' returns the indices where the condition is true.

```python
List1 = df.loc[val1]; print(List1)
List2 = df.loc[val2]; print(List2)
List3 = df.loc[val3]; print(List3)
```

Create lists contain only the rows corresponding to 'Omnibuses', 'Excursion buses', and 'Private buses' respectively

```python
plt.plot(List1['year'], List1['number'], label = 'Number of Omnibuses')
plt.plot(List2['year'], List2['number'], label = 'Number of Excursion buses')
plt.plot(List3['year'], List3['number'], label = 'Number of Private buses')
plt.xlabel('Year')
plt.ylabel('Number of vehicles')
plt.title('Number of vehicles over the years')
plt.legend()
plt.show()
```

Q2

```
Int64Index([112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 214, 235, 256,
            277, 298, 319],
           dtype='int64')
Int64Index([152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 218, 239, 260,
            281, 302, 323],
           dtype='int64')
Int64Index([132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 216, 237, 258,
            279, 300, 321],
           dtype='int64')
```

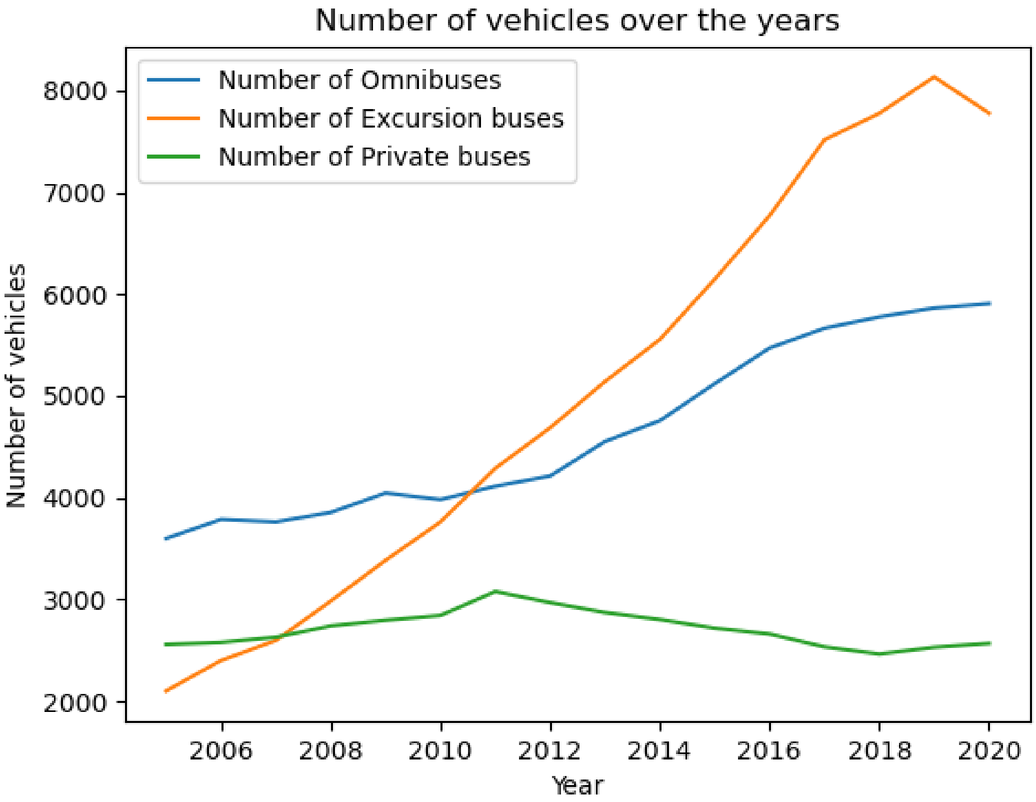
	year	category	type	number
112	2005	Buses	Omnibuses	3599
113	2006	Buses	Omnibuses	3785
114	2007	Buses	Omnibuses	3761
115	2008	Buses	Omnibuses	3854
116	2009	Buses	Omnibuses	4045
117	2010	Buses	Omnibuses	3981
118	2011	Buses	Omnibuses	4112
119	2012	Buses	Omnibuses	4212
120	2013	Buses	Omnibuses	4552
121	2014	Buses	Omnibuses	4756
214	2015	Buses	Omnibuses	5120
235	2016	Buses	Omnibuses	5470
256	2017	Buses	Omnibuses	5665
277	2018	Buses	Omnibuses	5776
298	2019	Buses	Omnibuses	5863
319	2020	Buses	Omnibuses	5906

	year	category	type	number
152	2005	Buses	Excursion buses	2101
153	2006	Buses	Excursion buses	2399
154	2007	Buses	Excursion buses	2596
155	2008	Buses	Excursion buses	2983
156	2009	Buses	Excursion buses	3384
157	2010	Buses	Excursion buses	3761
158	2011	Buses	Excursion buses	4288
159	2012	Buses	Excursion buses	4686
160	2013	Buses	Excursion buses	5141
161	2014	Buses	Excursion buses	5554
218	2015	Buses	Excursion buses	6147
239	2016	Buses	Excursion buses	6771
260	2017	Buses	Excursion buses	7517
281	2018	Buses	Excursion buses	7777
302	2019	Buses	Excursion buses	8135
323	2020	Buses	Excursion buses	7779

	year	category	type	number
132	2005	Buses	Private buses	2557
133	2006	Buses	Private buses	2577
134	2007	Buses	Private buses	2628
135	2008	Buses	Private buses	2739
136	2009	Buses	Private buses	2795
137	2010	Buses	Private buses	2842
138	2011	Buses	Private buses	3076
139	2012	Buses	Private buses	2968
140	2013	Buses	Private buses	2871
141	2014	Buses	Private buses	2802
216	2015	Buses	Private buses	2717
237	2016	Buses	Private buses	2659
258	2017	Buses	Private buses	2533
279	2018	Buses	Private buses	2463
300	2019	Buses	Private buses	2529
321	2020	Buses	Private buses	2567

02

Q2



Number of vehicles over the years
Number of Omnibuses
Number of Excursion buses
Number of Private buses
8000
7000
6000
5000
4000
3000
2000
Number of vehicles
2006
2008
2010
2012
2014
2016
2018
2020
Year

Q2 Method 2

```
import pandas as pd
import colorsys
import matplotlib.pyplot as plt
import seaborn as sns
```

Importing Libraries

```
df = pd.read_csv("AnnualMotorVehiclePopulationbyVehicleType.csv")
```

Load the data

```
sns.set_style("darkgrid")
```

Sets the aesthetic style of the plots to "darkgrid", which includes a dark background with gridlines.

```
df3 = df.loc[df['type'].isin(['Omnibuses', 'Excursion buses', 'Private buses’])]
```

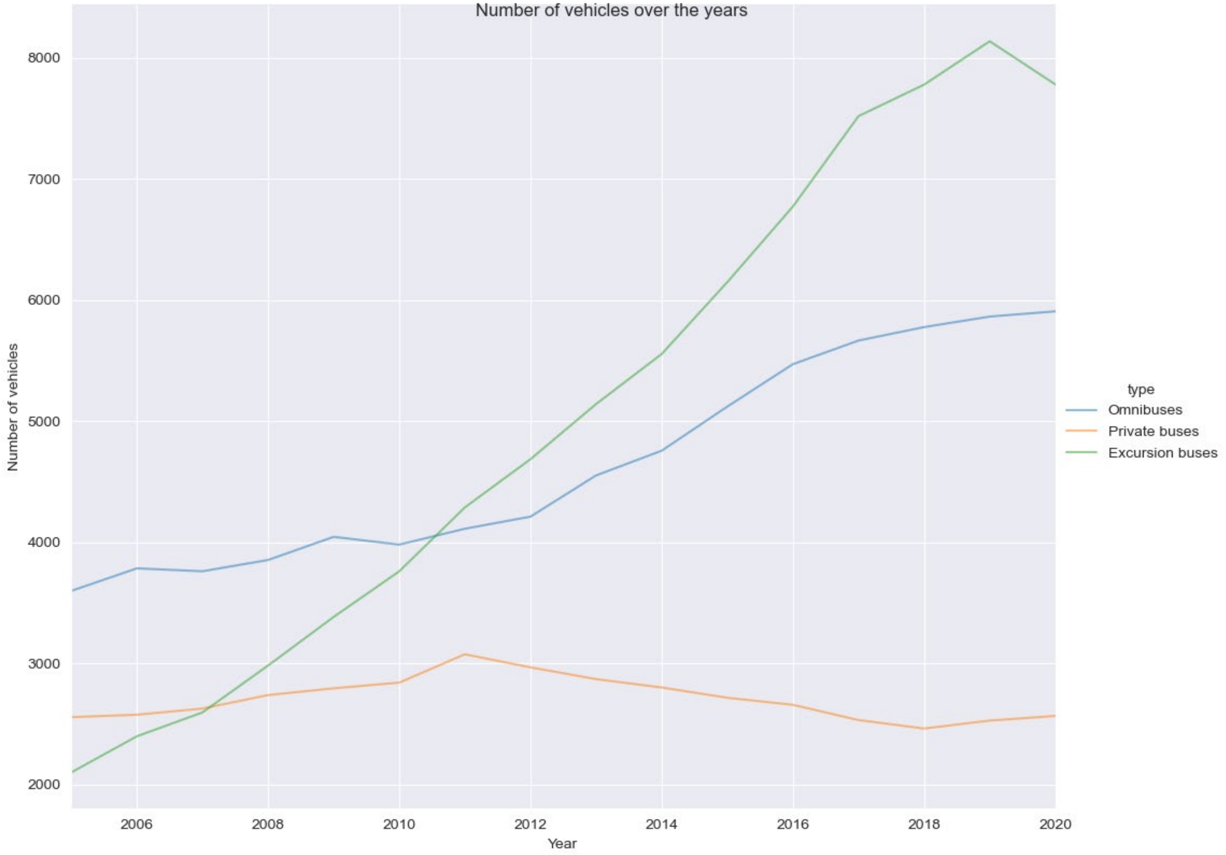
- df.loc[]: This is a label-based indexer for selecting rows and columns from the DataFrame.
- df['type'].isin(): Filters the rows where the specific 'type'

```
g = sns.PairGrid(data=df3, x_vars="year", y_vars="number", hue="type", height=10, aspect=1)
```

A PairGrid object g plots 'year' on the x-axis and 'number' on the y-axis, with different colors for different 'type' values.

```
g = g.map(plt.plot, alpha=0.5)
g = g.set(xlim=(df['year'].min(), df['year'].max()))
g = g.add_legend()
g.fig.suptitle('Number of vehicles over the years')
plt.xlabel('Year')
plt.ylabel('Number of vehicles')
```

Q2 Method 2



Number of vehicles over the years
8000
7000
6000
5000
4000
3000
2000
Number of vehicles
2006
2008
2010
2012
2014
2016
2018
2020
Year
type
Omnibuses
Private buses
Excursion buses

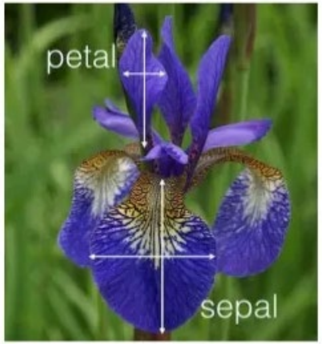
03 Q3

(Data Reading and Visualization, distribution)

The “iris” flower data set consists of measurements such as the length, width of the petals, and the length, width of the sepals, all measured in centimeters, associated with each iris flower.

- Get the data set “from sklearn.datasets import load_iris” and
- Do a scatter plot as shown below. (Hint: you might need “from pandas.plotting import scatter_matrix”)

Iris Versicolor　　Iris Setosa　　Iris Virginica



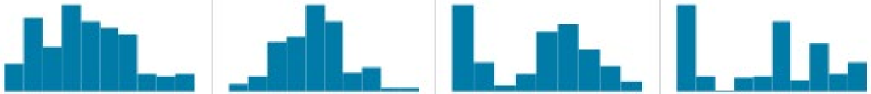
https://analyticsindiamag.com/ai-mysteries/start-building-first-machine-learning-project-famous-dataset/

https://medium.com/analytics-vidhya/exploration-of-iris-dataset-using-scikit-learn-part-1-8ac5604937f8

Q3

About this file

The dataset is a CSV file which contains a set of 150 records under 5 attributes - Petal Length, Petal Width, Sepal Length, Sepal width and Class(Species)



# sepal_length	# sepal_width	# petal_length	# petal_width	species
4.3 7.9	2 4.4	1 6.9	0.1 2.5	3 unique values
5.1	3.5	1.4	0.2	Iris-setosa
4.9	3	1.4	0.2	Iris-setosa
4.7	3.2	1.3	0.2	Iris-setosa
4.6	3.1	1.5	0.2	Iris-setosa
5	3.6	1.4	0.2	Iris-setosa
5.4	3.9	1.7	0.4	Iris-setosa
4.6	3.4	1.4	0.3	Iris-setosa
5	3.4	1.5	0.2	Iris-setosa
4.4	2.9	1.4	0.2	Iris-setosa
4.9	3.1	1.5	0.1	Iris-setosa
5.4	3.7	1.5	0.2	Iris-setosa
4.8	3.4	1.6	0.2	Iris-setosa
4.8	3	1.4	0.1	Iris-setosa

https://www.kaggle.com/datasets/arshid/iris-flower-dataset

Q3 Method 1

```
import pandas as pd; print("pandas version: {}".format(pd.__version__))
import matplotlib.pyplot as plt
import sklearn; print("scikit-learn version: {}".format(sklearn.__version__))
```

Importing Libraries and Printing Versions

```
from sklearn.datasets import load_iris
iris_dataset = load_iris()
from sklearn.model_selection import train_test_split
```

Loading the Iris Dataset

```
X_train, X_test, y_train, y_test = train_test_split( iris_dataset['data'], iris_dataset['target'],
random_state=0)
```

Splitting the dataset into training and testing sets

```
# create dataframe from data in X_train
# label the columns using the strings in iris_dataset.feature_names
iris_dataframe = pd.DataFrame(X_train, columns=iris_dataset.feature_names)
```

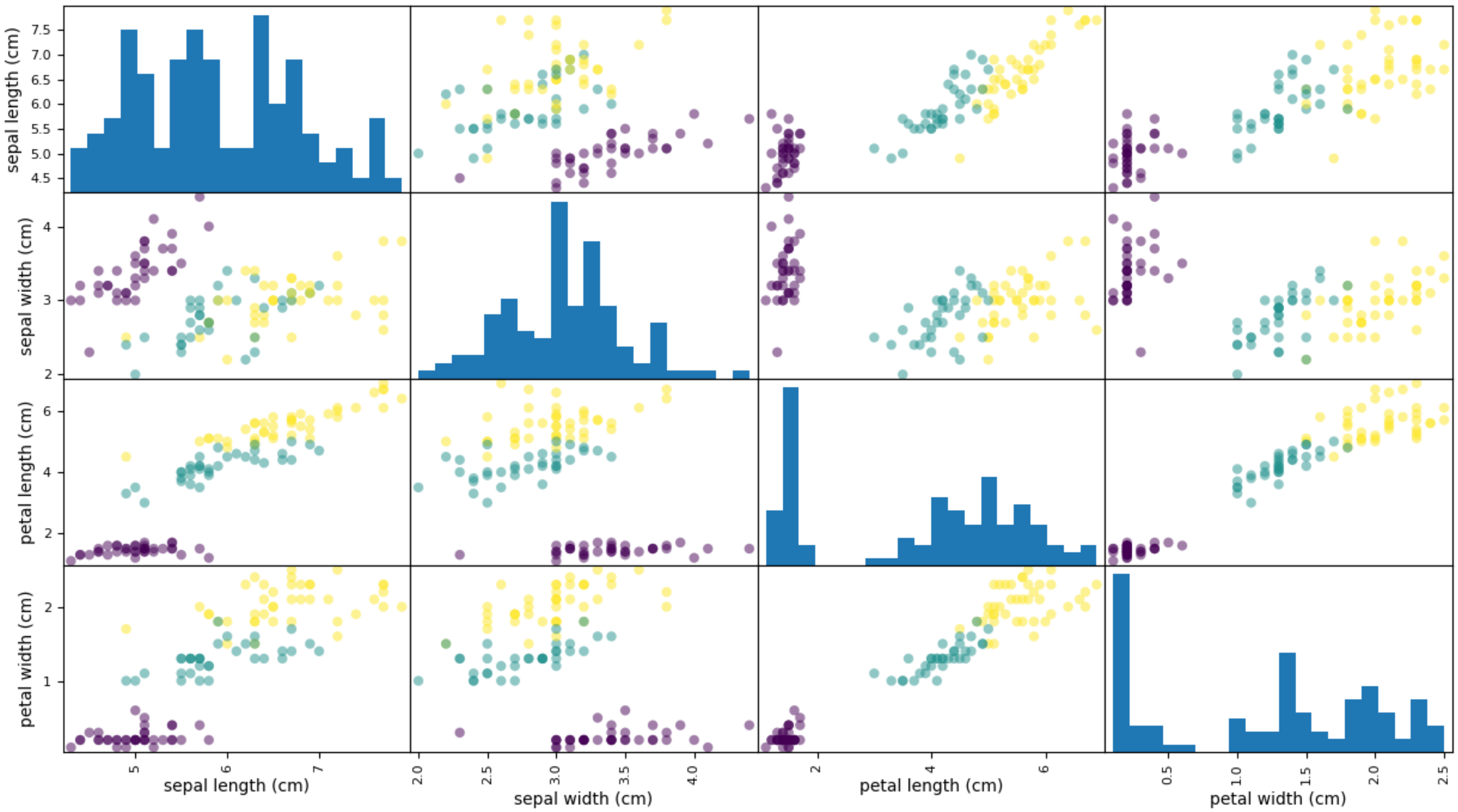
- Create a DataFrame from training data
- Label columns using feature names from iris_dataset (e.g., sepal length, sepal width, petal length, petal width).

```
# create a scatter matrix from the dataframe, color by y_train
from pandas.plotting import scatter_matrix

grr = pd.plotting.scatter_matrix(iris_dataframe, c=y_train, figsize=(15, 15), marker='o',
hist_kwds={'bins': 20})
plt.show()
```

Visualizing data with a scatter matrix

Colors the points according to their class labels



sepal length (cm)
sepal width (cm)
petal length (cm)
petal width (cm)

Q3 Method 2

```python
import pandas as pd
import colorsys
import matplotlib.pyplot as plt
import seaborn as sns
```

Importing Libraries

```python
sns.set()
iris = sns.load_dataset("iris")
```

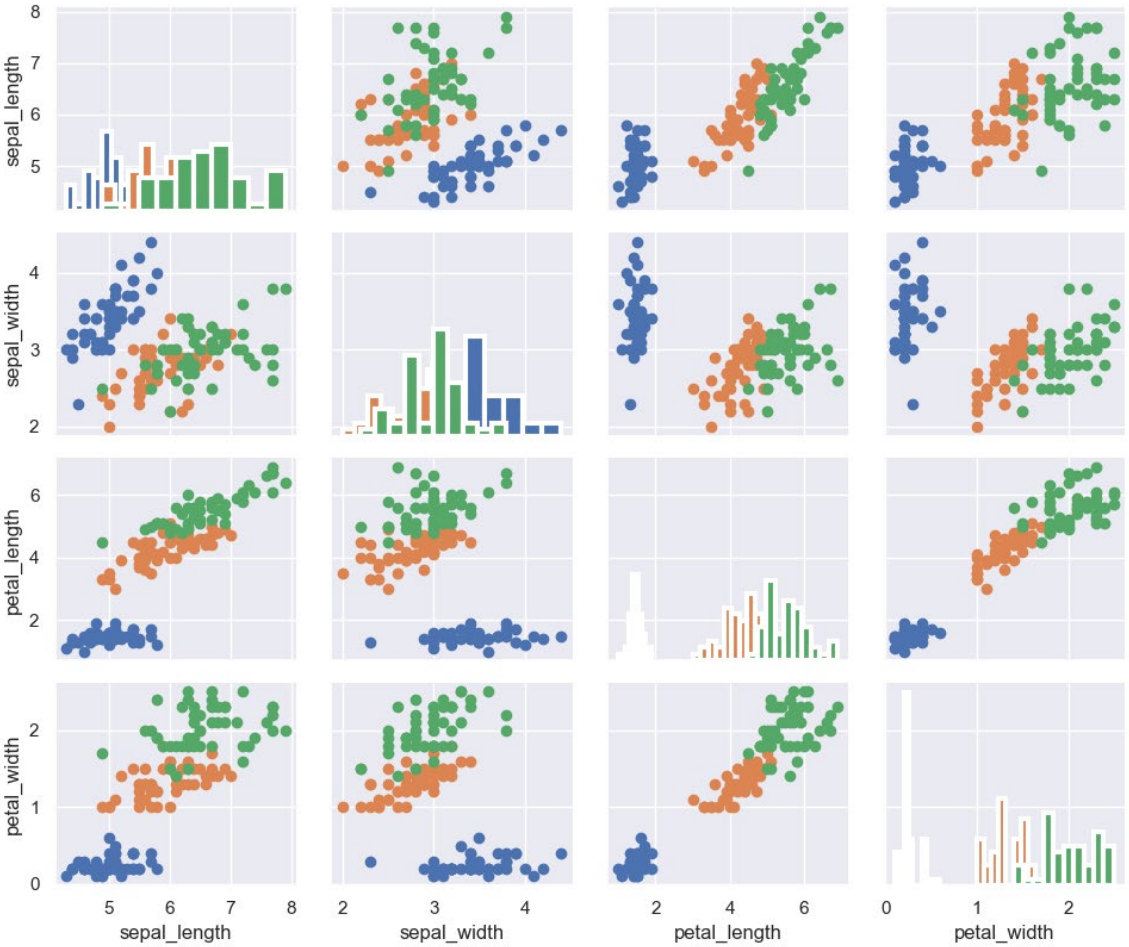
Set Seaborn default style and load the iris dataset

```python
g = sns.PairGrid(iris, hue="species")
```

- A PairGrid to create a matrix of plots to visualize relationships between variables in a dataset
- The hue parameter differentiates the data points by color based on the species of the iris flowers.

```python
g = g.map_diag(plt.hist, linewidth=3)
g = g.map_offdiag(plt.scatter)
plt.show()
```

- Create histograms on diagonal
- Create scatter plots on the off-diagonal


sepal_length
sepal_width
petal_length
petal_width
8
7
6
5
4
3
2
6
4
2
2
1
0
5
6
7
8
2
3
4
2
4
6
0
1
2
sepal_length
sepal_width
petal_length
petal_width

04

Q 4

(Data Wrangling/Normalization)

You are given a set of data for supervised learning. A sample block of data looks like this:

" 1.2234, 0.3302, 123.50, 0.0081, 30033.81, 1
1.3456, 0.3208, 113.24, 0.0067, 29283.18, -1
0.9988, 0.2326, 133.45, 0.0093, 36034.33, 1
1.1858, 0.4301, 128.55, 0.0077, 34037.35, 1
1.1533, 0.3853, 116.70, 0.0066, 22033.58, -1
1.2755, 0.3102, 118.30, 0.0098, 30183.65, 1
1.0045, 0.2901, 123.52, 0.0065, 31093.98, -1
1.1131, 0.3912, 113.15, 0.0088, 29033.23, -1 "

Each row corresponds to a sample data measurement with 5 input features and 1 response.

(a) What kind of undesired effect can you anticipate if this set of raw data is used for learning?

(b) How can the data be preprocessed to handle this issue?

Q4

Ans:

(a) Those features with very large values may overshadow those with very small values.

(b) We can either use min-max or z-score normalization to resolve the problem.

```python
# Tutorial 2 Problem 4
import pandas as pd
import matplotlib.pyplot as plt
import numpy as np
```

Importing Libraries

```python
data = [ [1.2234, 0.3302, 123.50, 0.0081, 30033.81, 1],
[1.3456, 0.3208, 113.24, 0.0067, 29283.18, -1],
[0.9988, 0.2326, 133.45, 0.0093, 36034.33, 1],
[1.1858, 0.4301, 128.55, 0.0077, 34037.35, 1],
[1.1533, 0.3853, 116.70, 0.0066, 22033.58, -1],
[1.2755, 0.3102, 118.30, 0.0098, 30183.65, 1],
[1.0045, 0.2901, 123.52, 0.0065, 31093.98, -1],
[1.1131, 0.3912, 113.15, 0.0088, 29033.23, -1] ]
```

'data' is a list of lists, where each inner list represents a row of data. Each row contains six values.

```python
df = pd.DataFrame(data)
df.head(7)
```

Converts the list of lists into a pandas DataFrame, which is a table-like data structure with rows and columns.

```python
from sklearn import preprocessing

# Z-score scaling
df_scaled = preprocessing.scale(df)
print(df_scaled.mean(axis=0))
print(df_scaled.std(axis=0))
```

Applies Z-score scaling to the DataFrame df. Z-score scaling standardizes the data such that each column will have a mean of 0 and a standard deviation of 1.

```python
# min-max scaling
mix_max_scale = preprocessing.MinMaxScaler()
df_minax = mix_max_scale.fit_transform(df)
```

Min-Max scaling transforms the data so that all features are within a given range, usually [0, 1]

Q4

```
# Z-score scaling
df_scaled = preprocessing.scale(df)
print(df_scaled.mean(axis=0))
print(df_scaled.std(axis=0))
```

```
[-8.32667268e-16 -3.88578059e-16 -1.52655666e-15 -1.80411242e-16
  6.10622664e-16  0.00000000e+00]
[1. 1. 1. 1. 1. 1.]
```

05 Q5 (Missing Data)

The Pima Indians Diabetes Dataset involves predicting the onset of diabetes within 5 years in Pima Indians given medical details. Download the Pima-Indians-Diabetes data from https://raw.githubusercontent.com/jbrownlee/Datasets/master/pima-indians-diabetes.data.csv.

It is a binary (2-class) classification problem. The number of observations for each class is not balanced. There are 768 observations with 8 input variables and 1 output variable. The variable names are as follows:

0. Number of times pregnant.
1. Plasma glucose concentration a 2 hours in an oral glucose tolerance test.
2. Diastolic blood pressure (mm Hg).
3. Triceps skinfold thickness (mm).
4. 2-Hour serum insulin (mu U/ml).
5. Body mass index (weight in kg/(height in m)^2).
6. Diabetes pedigree function.
7. Age (years).
8. Class variable (0 or 1).

(a) Print the summary statistics of this data set.
(b) Count the number of "0" entries in columns [1,2,3,4,5].
(c) Replace these "0" values by "NaN".
(Hint: you might need the ".describe()" and ".replace(0, numpy.NaN)" functions "from pandas import read_csv".)

05 Q5

```
#(a) from pandas import read_csv
import pandas as pd
dataset = pd.read_csv('pima-indians-diabetes.csv', header=None)
print(dataset.describe())
```

Importing the Dataset

```
#(b)
print((dataset[[1,2,3,4,5]] == 0).sum())
```

Counting Zeros in Specific Columns

```
#(c) import numpy
import numpy
# mark zero values as missing or NaN
dataset[[1,2,3,4,5]] = dataset[[1,2,3,4,5]].replace(0, numpy.NaN)
# print the first 20 rows of data
print(dataset.head(20))
print(dataset.isnull().sum())
```

Replacing Zeros with ‘NaN’ and Checking for Missing Values

Q5

```python
#(a) from pandas import read_csv
import pandas as pd
dataset = pd.read_csv('pima-indians-diabetes.csv', header=None)
print(dataset.describe())
```

	0	1	2	3	4	5	6	7	8
count	768.000000	768.000000	768.000000	768.000000	768.000000	768.000000	768.000000	768.000000	768.000000
mean	3.845052	120.894531	69.105469	20.536458	79.799479	31.992578	0.471876	33.240885	0.348958
std	3.369578	31.972618	19.355807	15.952218	115.244002	7.884160	0.331329	11.760232	0.476951
min	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.078000	21.000000	0.000000
25%	1.000000	99.000000	62.000000	0.000000	0.000000	27.300000	0.243750	24.000000	0.000000
50%	3.000000	117.000000	72.000000	23.000000	30.500000	32.000000	0.372500	29.000000	0.000000
75%	6.000000	140.250000	80.000000	32.000000	127.250000	36.600000	0.626250	41.000000	1.000000
max	17.000000	199.000000	122.000000	99.000000	846.000000	67.100000	2.420000	81.000000	1.000000

Q5

```
#(b)
print((dataset[[1,2,3,4,5]] == 0).sum())
```

```
1     5
2    35
3   227
4   374
5    11
```

```python
#(c) import numpy
import numpy
# mark zero values as missing or NaN
dataset[[1,2,3,4,5]] = dataset[[1,2,3,4,5]].replace(0, numpy.NaN)
# print the first 20 rows of data
print(dataset.head(20))
print(dataset.isnull().sum())
```

	0	1	2	3	4	5	6	7	8
0	6	148.0	72.0	35.0	NaN	33.6	0.627	50	1
1	1	85.0	66.0	29.0	NaN	26.6	0.351	31	0
2	8	183.0	64.0	NaN	NaN	23.3	0.672	32	1
3	1	89.0	66.0	23.0	94.0	28.1	0.167	21	0
4	0	137.0	40.0	35.0	168.0	43.1	2.288	33	1
5	5	116.0	74.0	NaN	NaN	25.6	0.201	30	0
6	3	78.0	50.0	32.0	88.0	31.0	0.248	26	1
7	10	115.0	NaN	NaN	NaN	35.3	0.134	29	0
8	2	197.0	70.0	45.0	543.0	30.5	0.158	53	1
9	8	125.0	96.0	NaN	NaN	NaN	0.232	54	1
10	4	110.0	92.0	NaN	NaN	37.6	0.191	30	0
11	10	168.0	74.0	NaN	NaN	38.0	0.537	34	1
12	10	139.0	80.0	NaN	NaN	27.1	1.441	57	0
13	1	189.0	60.0	23.0	846.0	30.1	0.398	59	1
14	5	166.0	72.0	19.0	175.0	25.8	0.587	51	1
15	7	100.0	NaN	NaN	NaN	30.0	0.484	32	1
16	0	118.0	84.0	47.0	230.0	45.8	0.551	31	1
17	7	107.0	74.0	NaN	NaN	29.6	0.254	31	1
18	1	103.0	30.0	38.0	83.0	43.3	0.183	33	0
19	1	115.0	70.0	30.0	96.0	34.6	0.529	32	1

0	0
1	5
2	35
3	227
4	374
5	11
6	0
7	0
8	0

06

Q6

Disease Outbreak Response System Condition (DORSCON) in Singapore is a colour-coded framework that shows the current disease situation. The framework provides us with general guidelines on what needs to be done to prevent and reduce the impact of infections. There are 4 statuses – Green, Yellow, Orange and Red, depending on the severity and spread of the disease. Which type of data does DORSCON belong to ?

(1) Categorical; (2) Ordinal; (3) Continuous; (4) Interval

Q6

Ans:

(1) Categorical; and (2) Ordinal

07

Q7

A boxplot is a standardized way of displaying the dataset based on a five-number summary: the minimum, the maximum, _BLANK1_, and the first and third quartiles, where the number of data points that fall between the first and third quartiles amounts to _BLANK2_ percent of the total number of data on display.

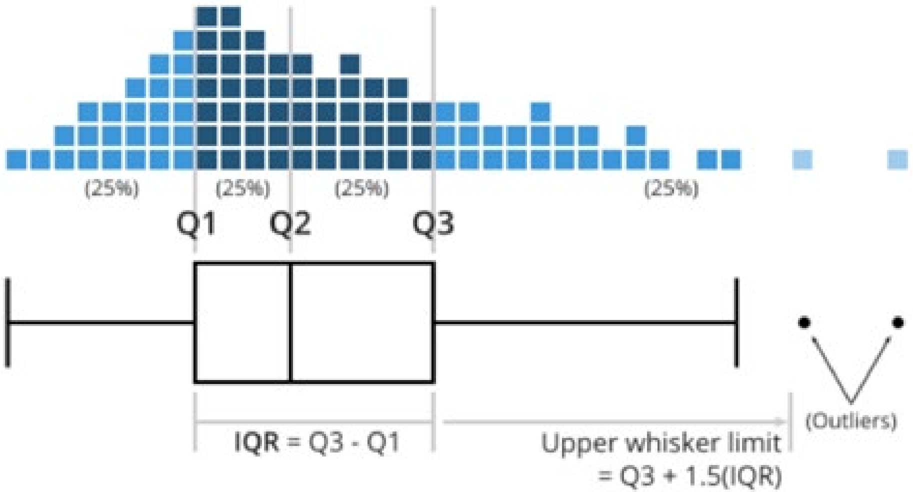
Ans:
BLANK1: ???
BLANK2: ???

Q7

Ans:

BLANK1: Median

BLANK2: 50%



https://www.atlassian.com/data/charts/box-plot-complete-guide

Example of Boxplot

```
# Tutorial 2: Example of Boxplot
import seaborn as sns
import statistics
import matplotlib.pyplot as plt
import numpy as np
import pandas as pd
```

Importing Libraries

```
dataPointsWOoutliers=[55,57,57,58,63,66,66,67,68,69,70,70,70,70,72,73,75,76,76,78,79,81.]
dataPointsWoutliers=[35,57,57,58,63,66,66,67,68,69,70,70,70,70,72,73,75,76,76,78,79,99.]]
df_combined = pd.DataFrame()
df_combined['normal'] = dataPointsWOoutliers
df_combined['outliers'] = dataPointsWoutliers
```

Stores both lists of data points in two columns: normal for data without outliers and outliers for data with outliers

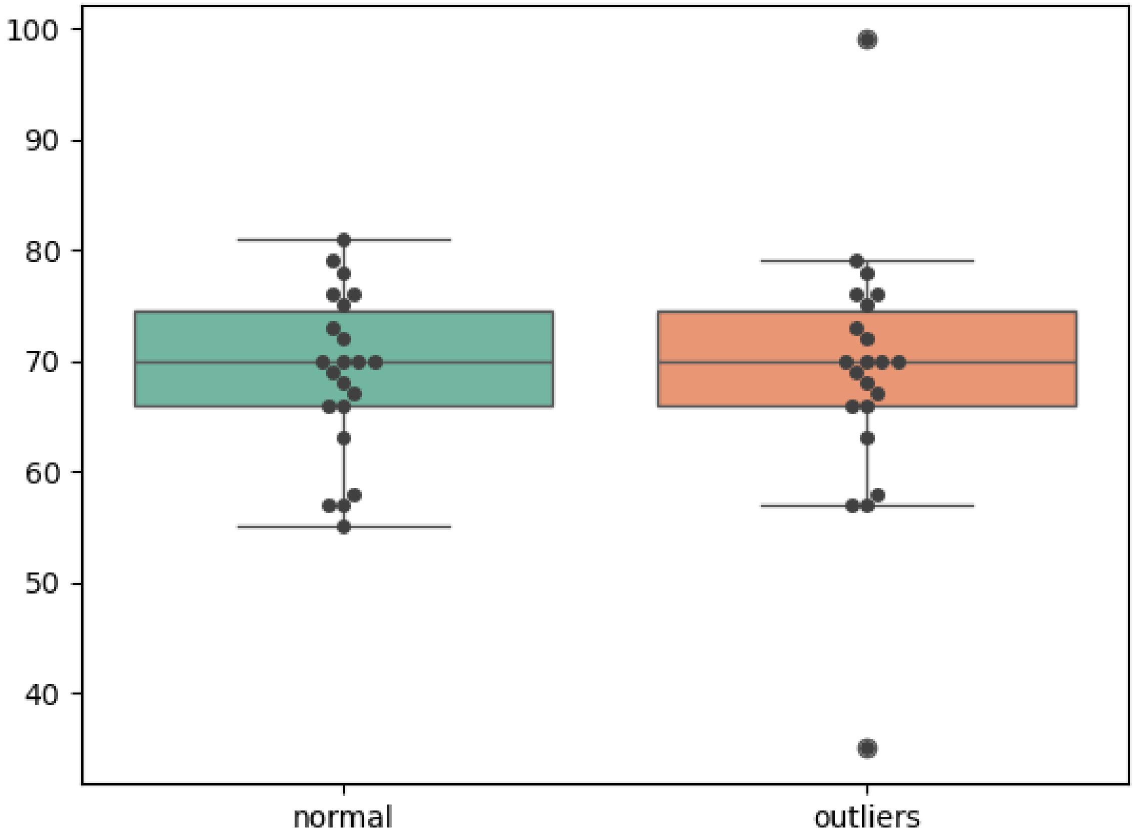
```
ax1 = sns.boxplot(data=df_combined, orient="v", palette="Set2")
```

A boxplot to show the distribution of the data, highlighting the median, quartiles, and any potential outliers.

```
ax1 = sns.swarmplot(data=df_combined, orient="v", color=(".25"))
plt.show()
```

Overlays a swarm plot on top of the boxplot

```
print(statistics.median(dataPointsWOoutliers))
print(statistics.median(dataPointsWoutliers))
```


100
90
80
70
60
50
40
normal
outliers

THANK YOU