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ANNA UNIVERSITY



DEPARTMENT OF INFORMATION TECHNOLOGY
IT5612- DATA ANALYTICS AND CLOUD COMPUTING
LABORATORY

RECORD

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BONAFIDE CERTIFICATE

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EXP NO :1.a
DATE: 25-01-23

STUDY ON NUMPY, SCIPY, STATSMODELS AND PANDAS PACKAGES

Aim:

To study about the Python packages required to work with data analytics.

Theory:

a. Pandas

Pandas is an open-source library that is made mainly for working with relational and labelled data. It provides various data structures and operations for manipulating data.

Functions in Pandas

S. No	Description	Example
1.	<code>read_csv()</code> : This helps to read a csv [comma-separated-values] file into a pandas dataframe. It can also read files separated by delimiter	<code>df = pd.read_csv('data.csv')</code>
2.	<code>head()</code> : The <code>head(n)</code> is used to return the first n rows of a dataset. By default, the function returns 5 rows of the dataframe	<code>df.head(10)</code>
3.	<code>describe()</code> : It is used to generate descriptive statistics of data in a pandas data frame or services	<code>df.describe()</code>
4.	<code>memory_usage()</code> : It returns a pandas series having the memory usage of each column in a dataframe	<code>df.memory_usage(deep == true)</code>
5.	<code>loc[]</code> : It helps to access a group of rows and columns in a dataset	<code>df.loc[0:4, ['Name', 'Age']]</code>

b. Numpy

Numpy is a Python library used for working with arrays. It also has functions for working in domain of linear algebra, Fourier transformation and matrices.

Functions in Numpy

S. No	Description	Example
1.	numpy.concatenate() : This function is used to join two arrays of same size, either in a row-wise or column-wise way	res = np.concatenate((arr1, arr2), axis =1)
2.	numpy.char.add() : It concatenates the data value of two arrays, merge them and represent a new array as a result	res = numpy.char.add(['python'], ['java'])
3.	numpy.median() : It calculates the median of an ordered array	med = np.median(a1)
4.	numpy.average() : It returns the average of all data values of the passed array	avg = np.average(a1)
5.	numpy reshape : This function allows us to change the dimension of the array without hampering the data value	res = a1.reshape(3, 2)

c. Scipy

Scipy contains a variety of sub packages which help to solve the most common issue related to scientific computation. It is built on top of the numpy library.

Functions in Scipy

S. No	Description	Example
1.	linalg.solve() : This gives the solutions of linear equations inn the matrix form	res = linalg.solve(a,b)
2.	linalg.inv() : This returns the inverse of the given matrix.	res = linalg.inv(a)
3.	linalg.det() : This returns the determinant of the given matrix.	res = linalg.det(ar)
4.	linalg.eig() : This returns the eigen values and eigen vectors of the given matrix.	eval, evec = linalg.eig(ar)
5.	special.logsumexp(x) : This computes the log of sum of exponential input element	np.log(np.sum (np.exp(a)))

d. Stats Model

It provides classes and functions for the estimation of many different statistical models for conducting statistical test and statistical data exploration

Functions in Stats Model:

S. No	Description	Example
1.	get_rdataset : It is used to download any dataset we want	data = sm.datasets. get_rdataset("Tom", "Chris").data
2.	add_constant(X) : It is used to add a constant column to input dataset	res = sm.addconstant(res)
3.	OLS(y, x).fit() : It is a type of linear square method for estimating unknown parameters in linear regression	res = sm.OLS(y, x).fit()
4.	linear_rainbow() : The null hypothesis is the fit of the model using full sample. It is the same as using a central subset. Rainbow test has power against many different forms of non-linearity	print(sm.stats.linear_rainbow.— doc--)

Result:

Thus, a study on the Python packages used to work with data analysis has been made.

EXP NO :1.b
DATE: 01-02-23

READ DATA/DATASET

Aim:

To write python programs to read and display content from text file, csv file and web.

a. Reading from Text File

CODE:

```
file1 = open("file.txt","r")  
file1.read()
```

OUTPUT:

```
'Welcome to Data Analytics Laboratory'
```

b. Reading from CSV File

CODE:

```
import csv
with open("sample.csv", 'r') as file:
    reader=csv.reader(file)
    for i in reader:
        print(i)
```

OUTPUT:

```
[ 'Number', 'Square' ]
[ '1', '1' ]
[ '2', '4' ]
[ '3', '9' ]
[ '4', '16' ]
[ '5', '25' ]
```


c. Reading from Web:

CODE:

```
import requests
from bs4 import BeautifulSoup
r = requests.get("https://www.mitindia.edu/en/")
soup = BeautifulSoup(r.content, 'html.parser')
lines = soup.find_all('p')
for line in lines:
    print(line.text)
```

OUTPUT:

In 1949, Shri.C.Rajam, gave the newly independent India-Madras Institute of Technology, so that MIT could establish the strong technical base it needed to take its place in the world. It was the rare genius and daring of its founder that made MIT offer courses like Aeronautical Engineering, Automobile Engineering, Electronics Engineering and Instrument Technology for the first time in our country. Now it also provides technical education in other engineering fields such as Rubber and Plastic Technology & Production Technology. It was merged with Anna University in the year 1978. Sixty years hence, while it continues to be a pioneer in courses that it gave birth to, it is already renowned for producing the crème de la crème of the scientific community in more nascent courses such as Computer Science and Information Technology MIT has produced great scientist like Dr.A.P.J.Abdul Kalam, versatile genius like Sujatha and many more. The broad-based education, coupled with practice-oriented training in their speciality, has enabled the students of MIT to handle with skill and success a wide variety of technical problems. The Madras Institute of Technology has developed into an important centre of engineering education and earned an excellent reputation both in India and abroad. MIT had received many awards which includes an award for the Best Overall Performance, awarded by Indian Society of Technical Education (ISTE) during the year 1999.

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RESULT:

Thus, the Python programs to read and display content from text file, CSV file, and web have been written and verified.

EXP NO : 2.a
DATE: 01-02-23

DESCRIPTIVE ANALYSIS

Aim:

To explore the various commands for performing descriptive data analysis on the Iris Dataset.

Codes and Output:

- i. Import the necessary packages and dataset

```
import pandas as pd;  
df=pd.read_csv("archive/city_hour.csv");  
df=df[["PM2.5","PM10","NO2","SO2","O3","AQI_Bucket"]]
```

- ii. Head

```
df.head()
```

	PM2.5	PM10	NO2	SO2	O3	AQI_Bucket
0	NaN	NaN	40.01	122.07	NaN	NaN
1	NaN	NaN	27.75	85.90	NaN	NaN
2	NaN	NaN	19.32	52.83	NaN	NaN
3	NaN	NaN	16.45	39.53	153.58	NaN
4	NaN	NaN	14.90	32.63	NaN	NaN

iii. Getting Information about the dataset

Shape parameter

```
df.shape
```

```
(707875, 6)
```

Info method

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 707875 entries, 0 to 707874
Data columns (total 6 columns):
#   Column          Non-Null Count  Dtype  
---  -
0   PM2.5           562787 non-null float64
1   PM10            411138 non-null float64
2   NO2             590753 non-null float64
3   SO2             577502 non-null float64
4   O3              578667 non-null float64
5   AQI_Bucket      578795 non-null object
dtypes: float64(5), object(1)
memory usage: 32.4+ MB
```

Describe method

```
df.describe()
```

	PM2.5	PM10	NO2	SO2	O3
count	562787.000000	411138.000000	590753.000000	577502.000000	578667.000000
mean	67.622994	119.075804	28.885157	14.038307	34.798979
std	74.730496	104.224752	29.162194	19.305540	29.806379
min	0.010000	0.010000	0.010000	0.010000	0.010000
25%	26.200000	52.380000	10.810000	4.880000	13.420000
50%	46.420000	91.500000	20.320000	8.370000	26.240000
75%	79.490000	147.520000	36.350000	14.780000	47.620000
max	999.990000	1000.000000	499.510000	199.960000	497.620000

iv. Checking Missing Values

isnull() method

```
df.isnull().sum()
```

```
PM2.5      145088
PM10       296737
NO2        117122
SO2        130373
O3         129208
AQI_Bucket 129080
dtype: int64
```

v. Checking Duplicates

drop_duplicates()

```
dup=df.drop_duplicates()
```

```
dup
```

	PM2.5	PM10	NO2	SO2	O3	AQI_Bucket
38289	25.91	84.90	58.41	140.10	47.69	Poor
38290	27.27	98.29	71.93	144.20	71.96	Poor
38291	27.27	102.68	66.79	124.37	88.85	Poor
38292	27.30	102.68	60.64	170.01	97.76	Poor
38294	23.84	121.94	70.40	31.13	94.66	Poor
...
707869	8.25	33.25	24.05	1.85	41.38	Satisfactory
707871	17.25	49.25	33.20	2.02	25.58	Satisfactory
707872	36.00	71.00	30.80	1.77	26.15	Good
707873	15.75	63.00	28.90	0.75	15.82	Good
707874	15.00	66.00	26.85	2.10	17.05	Good

347512 rows × 6 columns

Series.value_counts()

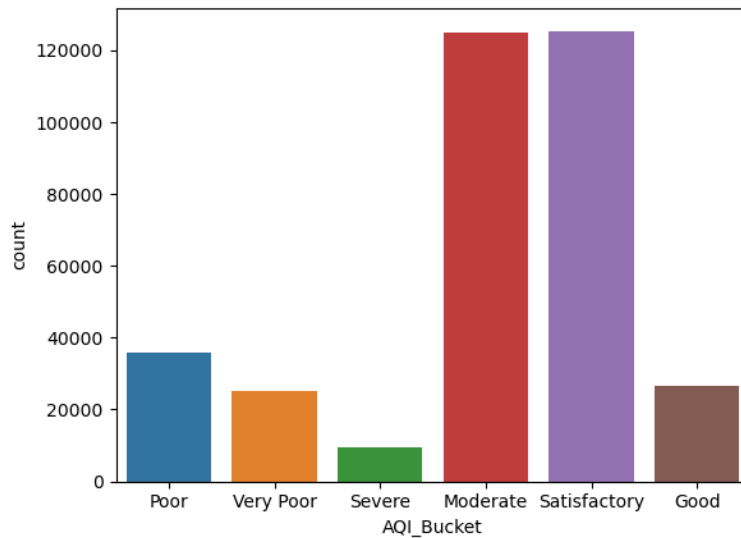
```
df.value_counts("AQI_Bucket")
```

```
AQI_Bucket
Satisfactory    125448
Moderate        124879
Poor            35861
Good            26480
Very Poor       25241
Severe           9648
dtype: int64
```

vi. Data Visualization

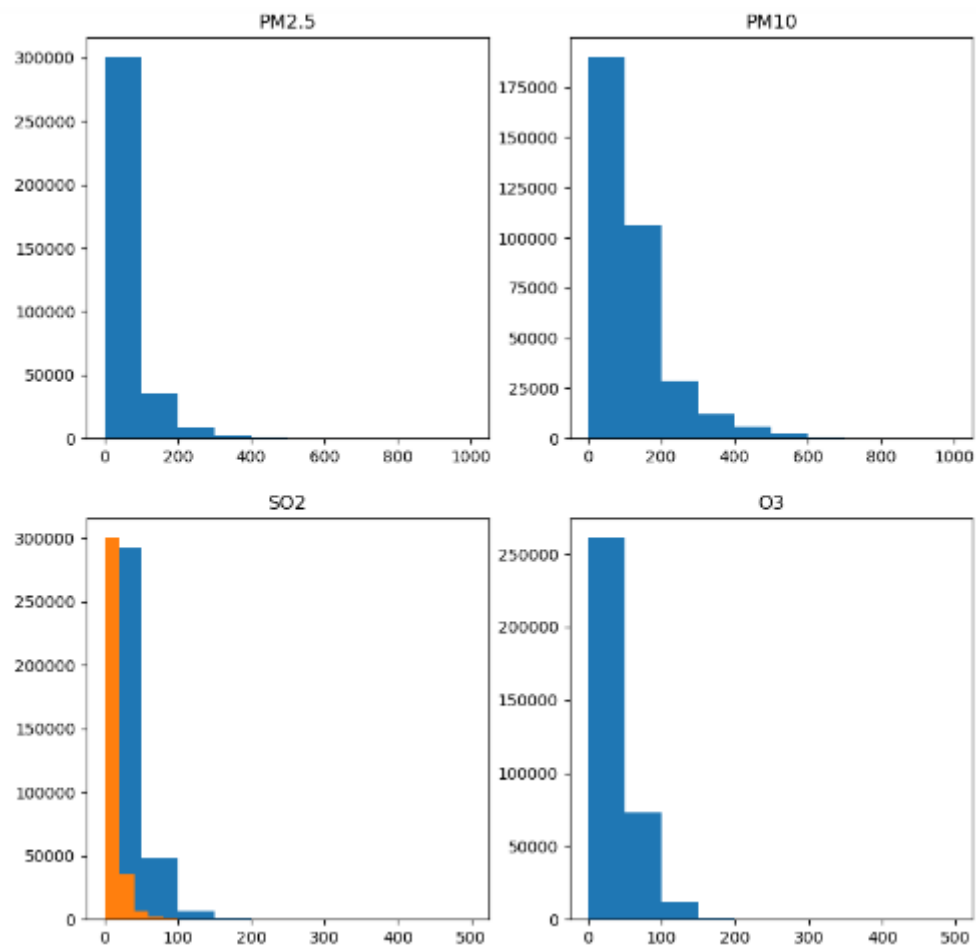
Data Visualization using countplot

```
import seaborn as sns
import matplotlib.pyplot as plt
sns.countplot(x='AQI_Bucket', data=df, )
plt.show()
```



Data Visualization using histogram

```
fig, axes = plt.subplots(2, 2, figsize=(10,10))
axes[0,0].set_title("PM2.5")
axes[0,0].hist(df['PM2.5'], bins=10)
axes[0,1].set_title("PM10")
axes[0,1].hist(df['PM10'], bins=10);
axes[1,0].set_title("NO2")
axes[1,0].hist(df['NO2'], bins=10);
axes[1,0].set_title("SO2")
axes[1,0].hist(df['SO2'], bins=10);
axes[1,1].set_title("O3")
axes[1,1].hist(df['O3'], bins=10);
```

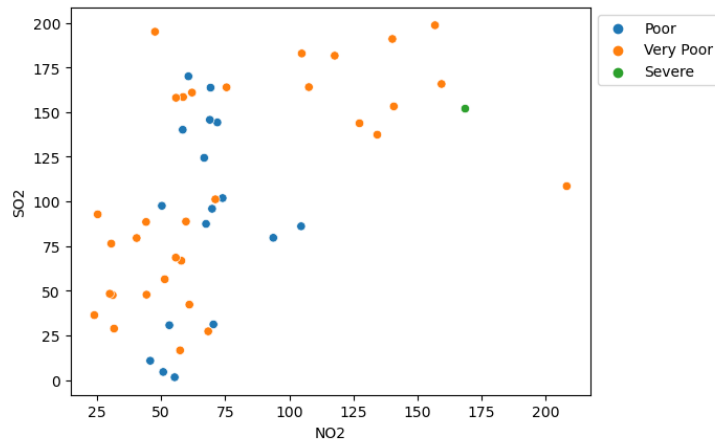


Data Visualization using scatterplot

```
sns.scatterplot(x='NO2', y='SO2', hue='AQI_Bucket',
data=df.head(50), )
plt.legend(bbox_to_anchor=(1, 1), loc=2)
plt.show()
```


EXP NO : 2.b
DATE: 08-02-23

UNIVARIATE ANALYSIS



Result:

Thus, the various commands for performing descriptive data analysis on the Iris Dataset have been executed and verified.

Aim:

To perform univariate analysis on the Air Quality dataset.

i. Frequency

```
import pandas as pd  
df=pd.read_csv("archive/city_hour.csv")  
df['AQI'].value_counts()
```

```
68.0      3389  
102.0     3389  
64.0      3275  
72.0      3183  
66.0      3172  
...  
740.0        1  
661.0        1  
1157.0        1  
767.0        1  
8.0          1  
Name: AQI, Length: 884, dtype: int64
```

ii. Mean

```
df['O3'].mean()
```

```
36.05122673403284
```

iii. Median

```
df['O3'].mean()
```

```
27.96
```

iv. Mode

```
df['O3'].mode()
```

```
0      22.14  
Name: O3, dtype: float64
```

v. Variance

```
df['O3'].var()
```

```
848.4269834914085
```

vi. Standard Deviation

```
df['O3'].std()
```

```
29.127769971135937
```

vii. Skewness

```
from scipy.stats import skew
import numpy as np
import pylab as p
y1 = df['AQI']
print("Skewness = ", skew(y1))
```

```
Skewness = 2.958968947212698
```

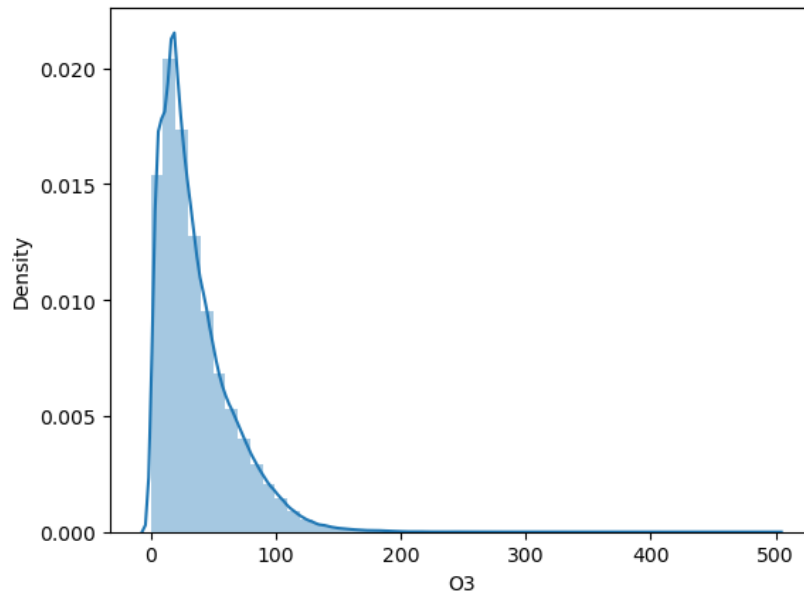
viii. Kurtosis

```
import seaborn as sns
sns.distplot(df['O3'], hist=True, kde=True)
df['O3'].kurt()
```

EXP NO : 2.c
DATE: 08-02-23

UNIVARIATE TIME SERIES ANALYSIS

4.72922057433085



Result:

Thus, univariate analysis on the Air Quality dataset has been performed and verified.

Aim:

To perform univariate time series analysis on the Air Quality dataset.

i. Import Packages and Dataset

```
import pandas as pd  
import numpy as np  
df1=pd.read_csv("archive/time_series_dataset.csv",parse_dates=["Date"],  
index_col=["Date"])  
df1
```

ii. TIME SERIES FEATURES

a. Mean in the period of 3 months

```
df1.resample('3M').mean()
```

Temperature	
Date	
2023-01-31	23.000000
2023-04-30	24.666667
2023-07-31	24.000000
2023-10-31	27.000000

b. Feature Importance

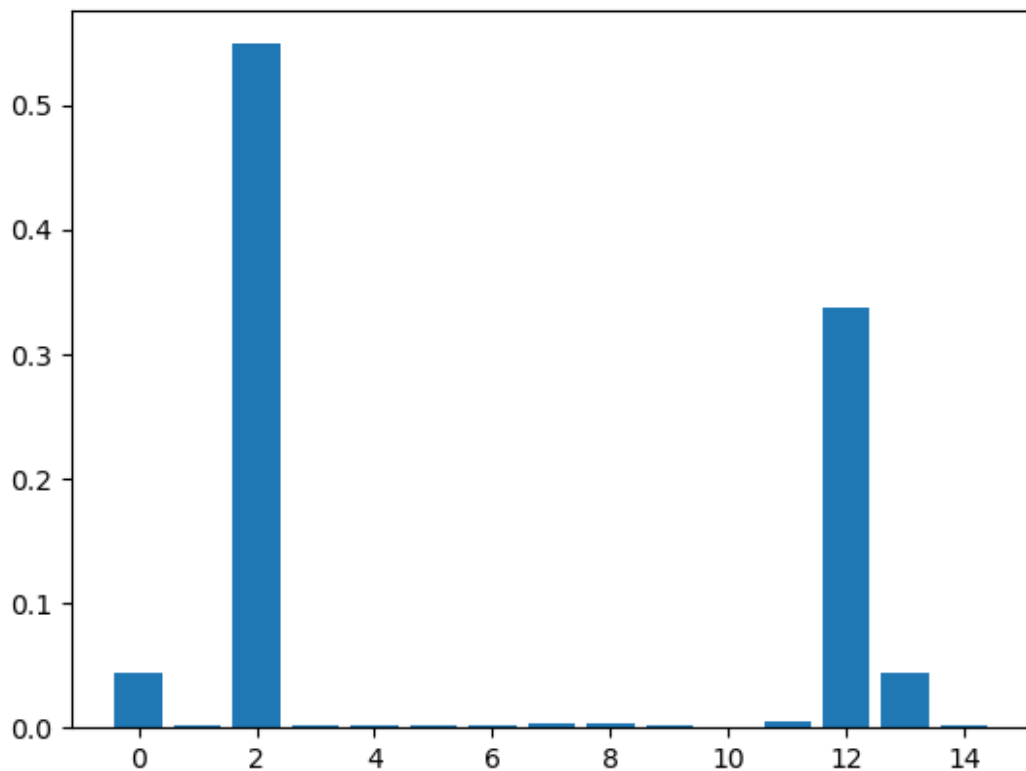
```
from sklearn.datasets import make_regression
from sklearn.tree import DecisionTreeRegressor
import matplotlib.pyplot as plt

X, y = make_regression(n_samples=1000, n_features=15,
n_informative=5,
random_state=1)

model = DecisionTreeRegressor()
model.fit(X, y)

importance = model.feature_importances_

plt.bar([x for x in range(len(importance))], importance)
plt.show()
```



c. Forecast and Evaluate Data

```
pred = model.predict(X)
errors = abs(pred - y)
print('Mean Absolute Error:', round(np.mean(errors), 2), 'degrees.')
```

```
Mean Absolute Error: 0.0 degrees.
```

```
mape = 100 * (errors / y)
accuracy = 100 - np.mean(mape)
print('Accuracy:', round(accuracy, 2), '%.')
```

```
Accuracy: 100.0 %.
```

Result:

Thus, univariate time series analysis has been performed on the Air Quality dataset and has been verified.

EXP NO : 2.d
DATE: 15-02-23

BIVARIATE ANALYSIS

Aim:

To perform bivariate analysis on the given dataset.

i. Import necessary packages and dataset

```
import pandas as pd
import numpy as np;
from scipy.stats import pearsonr
df=pd.read_csv("archive/city_hour.csv")
df=df[["AQI_Bucket"]]
encD=pd.get_dummies(df,columns=['AQI_Bucket'])
```

ii. Pearson Correlation Coefficients and Interpretation

```
encD.corr()
```

	AQI_Bucket_Good	AQI_Bucket_Moderate	AQI_Bucket_Poor	AQI_Bucket_Satisfactory	AQI_Bucket_Severe	AQI_Bucket_Very Poor
AQI_Bucket_Good	1.000000	-0.238048	-0.103960	-0.197548	-0.045576	-0.084458
AQI_Bucket_Moderate	-0.238048	1.000000	-0.287591	-0.546489	-0.126078	-0.233641
AQI_Bucket_Poor	-0.103960	-0.287591	1.000000	-0.238662	-0.055061	-0.102035
AQI_Bucket_Satisfactory	-0.197548	-0.546489	-0.238662	1.000000	-0.104629	-0.193891
AQI_Bucket_Severe	-0.045576	-0.126078	-0.055061	-0.104629	1.000000	-0.044732
AQI_Bucket_Very Poor	-0.084458	-0.233641	-0.102035	-0.193891	-0.044732	1.000000

iii. Simple Linear Regression

```
import matplotlib.pyplot as plt

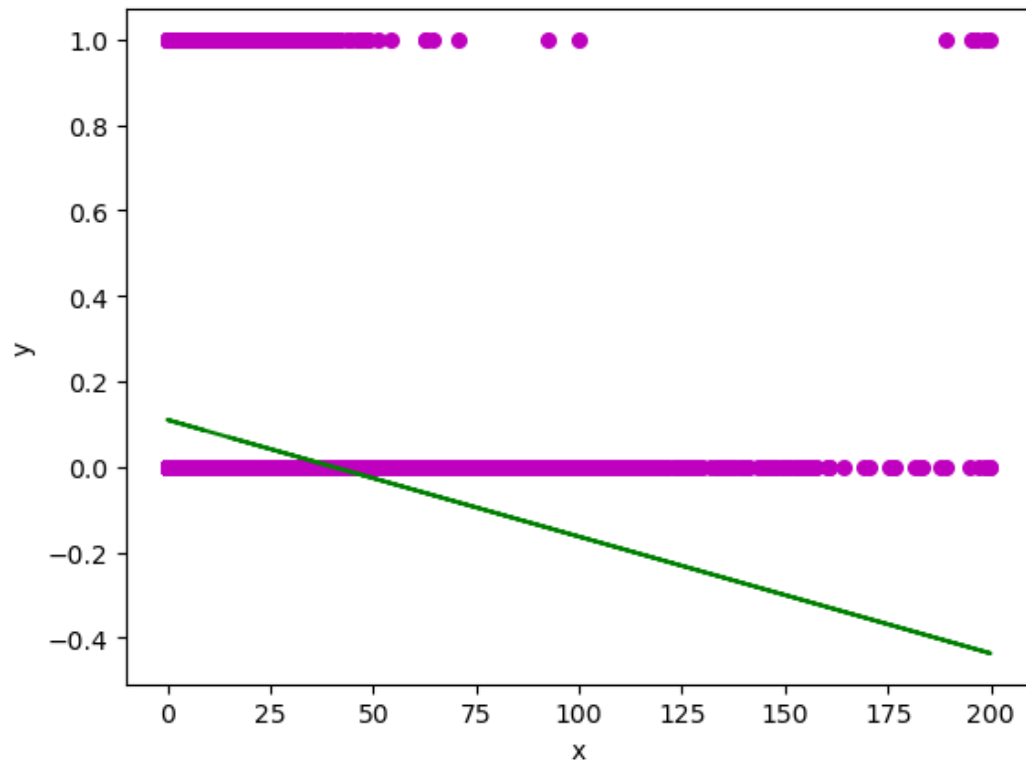
def estimate_coef(x, y):
    n = np.size(x)
    m_x = np.mean(x)
    m_y = np.mean(y)
    SS_xy = np.sum(y*x) - n*m_y*m_x
    SS_xx = np.sum(x*x) - n*m_x*m_x
    b_1 = SS_xy / SS_xx
    b_0 = m_y - b_1*m_x
    return (b_0, b_1)

def plot_regression_line(x, y, b):
    plt.scatter(x, y, color = "m",
                marker = "o", s = 30)
    # predicted response vector
    y_pred = b[0] + b[1]*x
    plt.plot(x, y_pred, color = "g")
    plt.xlabel('x')
    plt.ylabel('y')
    plt.show()

def main():
    x = encD["SO2"]
    y = encD["AQI_Bucket_Good"]
    b = estimate_coef(x, y)
    print("Estimated coefficients:\nb_0 = {} \nb_1 = {}".format(b[0], b[1]))
    plot_regression_line(x, y, b)

if __name__ == "__main__":
    main()
```

```
Estimated coefficients:  
b_0 = 0.1100817841186347  
b_1 = -0.002734473404634446
```



iv. Chi-Squared Test

```
from scipy.stats import chi2_contingency  
stat, p, dof, expected = chi2_contingency(encD["AQI"])  
alpha = 0.05  
print("p value is " + str(p))  
if p <= alpha:  
    print('Dependent (reject H0)')  
else:  
    print('Independent (H0 holds true)')
```

```
p value is 1.0  
Independent (H0 holds true)
```

v. T-Test

```
from scipy.stats import ttest_ind  
param1 = encD["O3"]  
param2 = encD["AQI_Bucket_Good"]  
stat, p = ttest_ind(param1, param2)  
print("Statistics: %.3f, p = %.3f" % (stat,p))
```

```
Statistics: 471.017, p = 0.000
```

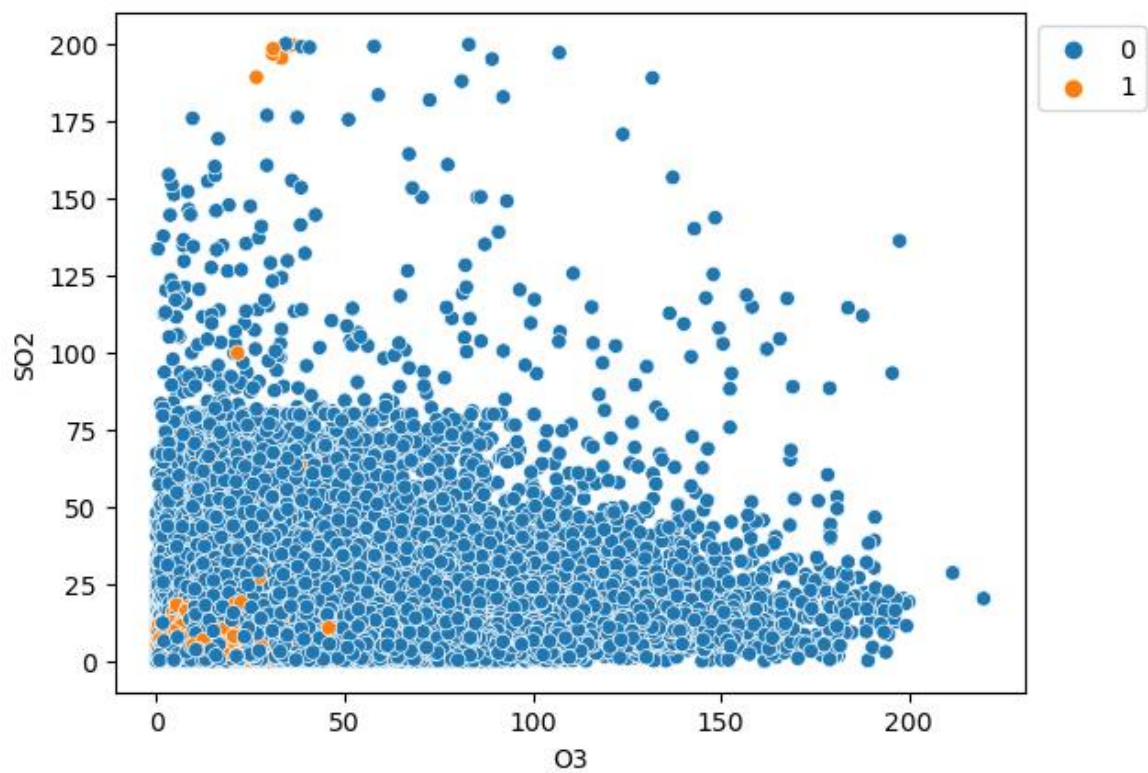
vi. Analysis of Variance

```
import scipy.stats as stats  
fvalue, pvalue = stats.f_oneway(encD["O3"],  
encD["AQI_Bucket_Good"],encD["AQI_Bucket_Moderate"],encD["AQI_Bucket  
_Poor"],encD["AQI_Bucket_Satisfactory"],encD["AQI_Bucket_Severe"],encD["A  
QI_Bucket_Very Poor"] )  
print("fvalue: ", fvalue, ", pvalue: ", pvalue)
```

```
fvalue: 220625.20408816423 , pvalue: 0.0
```

vii. Scatterplots

```
import seaborn as sns
sns.scatterplot(x = "O3", y = "SO2", hue= "AQI_Bucket_Good", data = encD)
plt.legend(bbox_to_anchor = (1,1), loc = 2)
plt.show( )
```



Result:

Thus, bivariate analysis has been successfully carried out on the Air Quality dataset.

EXP NO : 2.e
DATE: 15-02-23

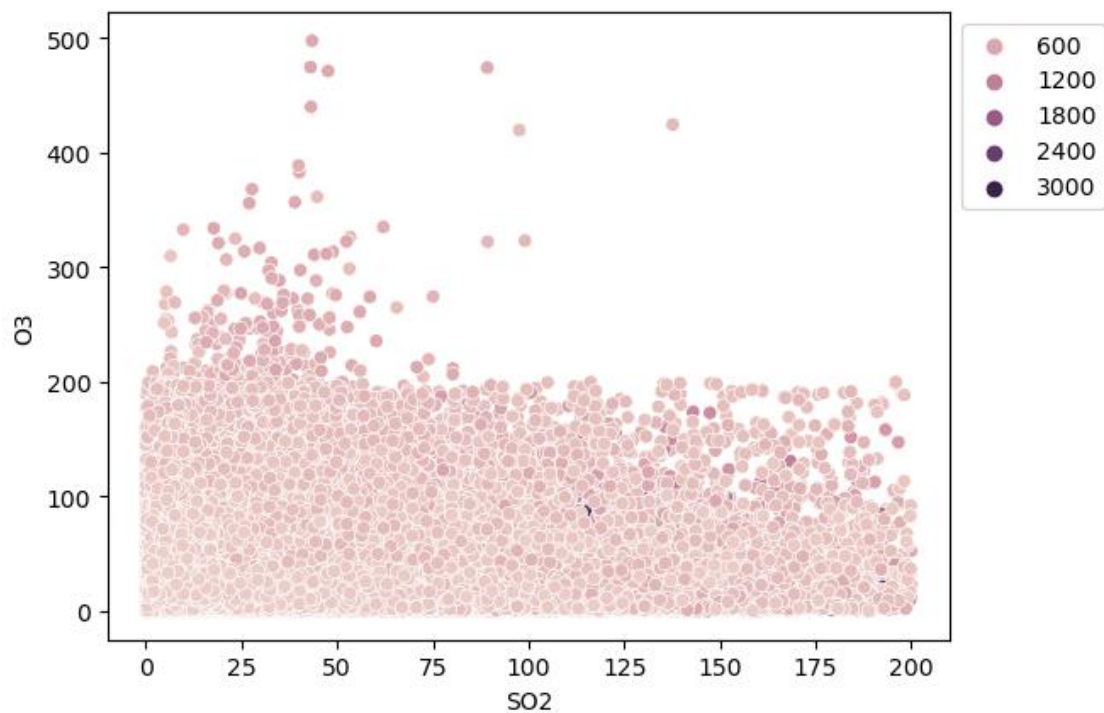
MULTIVARIATE ANALYSIS

Aim:

To perform bivariate analysis on the given dataset.

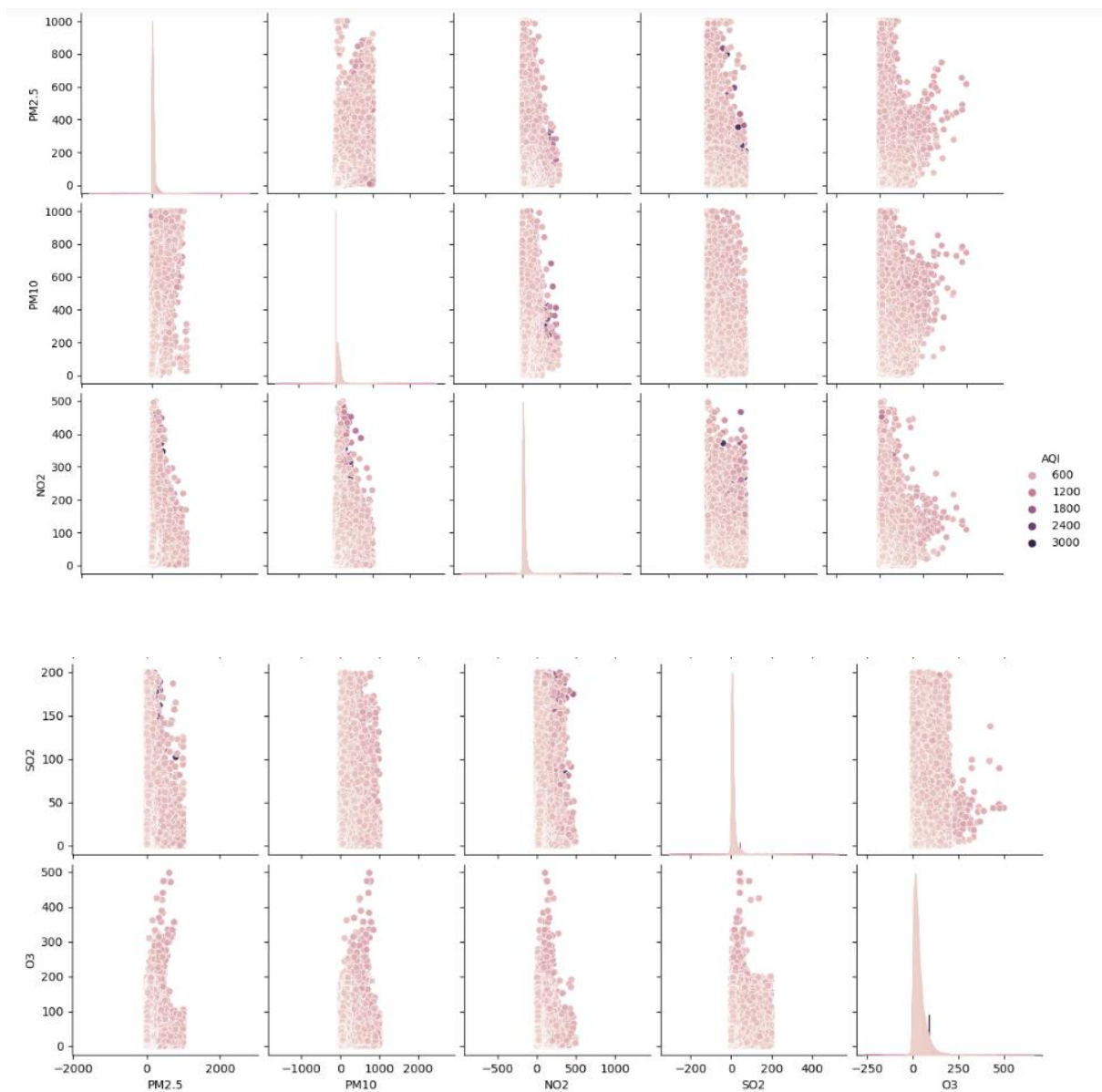
i. Scatterplot

```
sns.scatterplot(x='SO2',y='O3',hue='AQI',data=df,)\nplt.legend(bbox_to_anchor=(1,1),loc=2)\nplt.show()
```



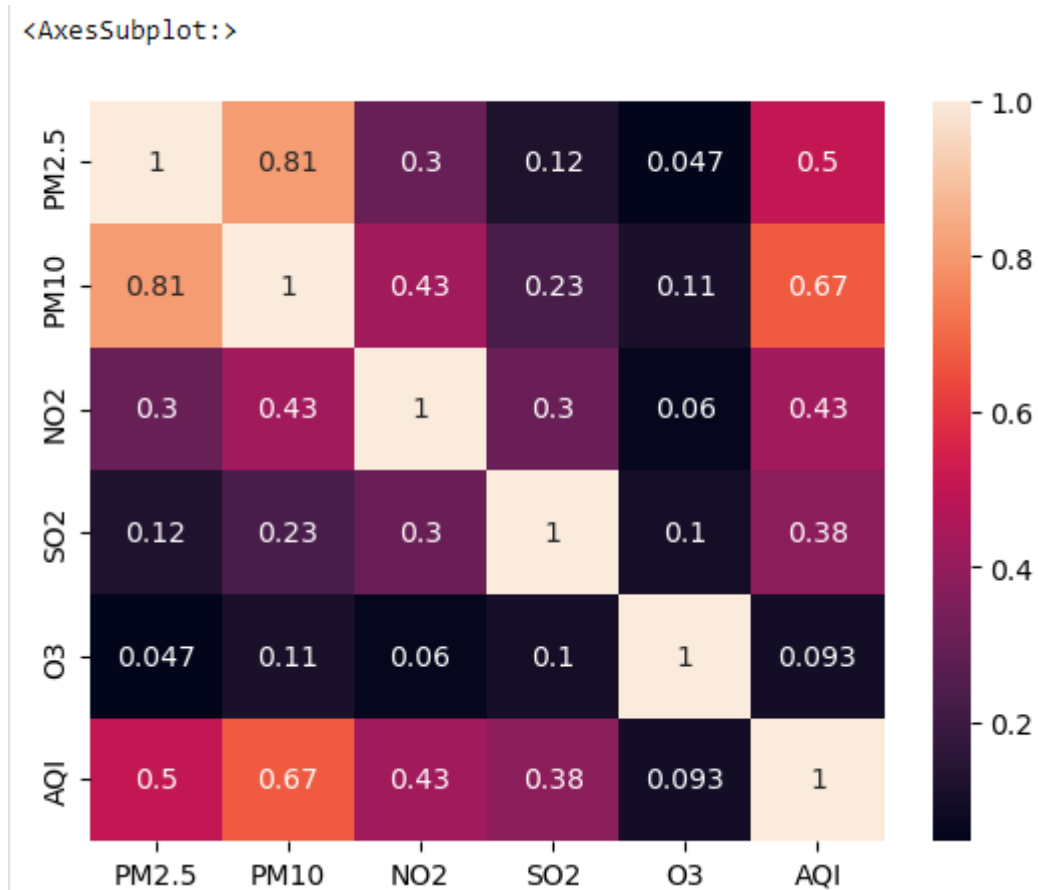
ii. Pair Plots

```
sns.pairplot(df,hue='AQI')
```



iii. Heat Map

```
sns.heatmap(df.corr(method="pearson"),annot=True)
```



Result:

EXP NO : 3
DATE: 22-02-23

CLASSIFICATION OF NAÏVE BAYES

Thus, multivariate analysis has been successfully carried out on the Air Quality dataset.

Aim:

To build models to perform Gaussian and Multinomial Naïve Bayes classification for the given dataset.

GAUSSIAN NAIVE BAYES

i. Import necessary packages and dataset

```
import pandas as pd
import numpy as np
df=pd.read_csv("dataset.csv")
df.head()
```

	PM2.5	PM10	NO2	SO2	O3	AQI
0	104.00	148.50	23.00	15.30	117.62	3.0
1	94.50	142.00	16.25	17.00	136.23	3.0
2	82.75	126.50	14.83	15.40	149.92	3.0
3	68.50	117.00	13.60	21.80	161.70	3.0
4	69.25	112.25	11.80	21.38	161.68	3.0

ii. Exploratory Data Analysis

a. Shape

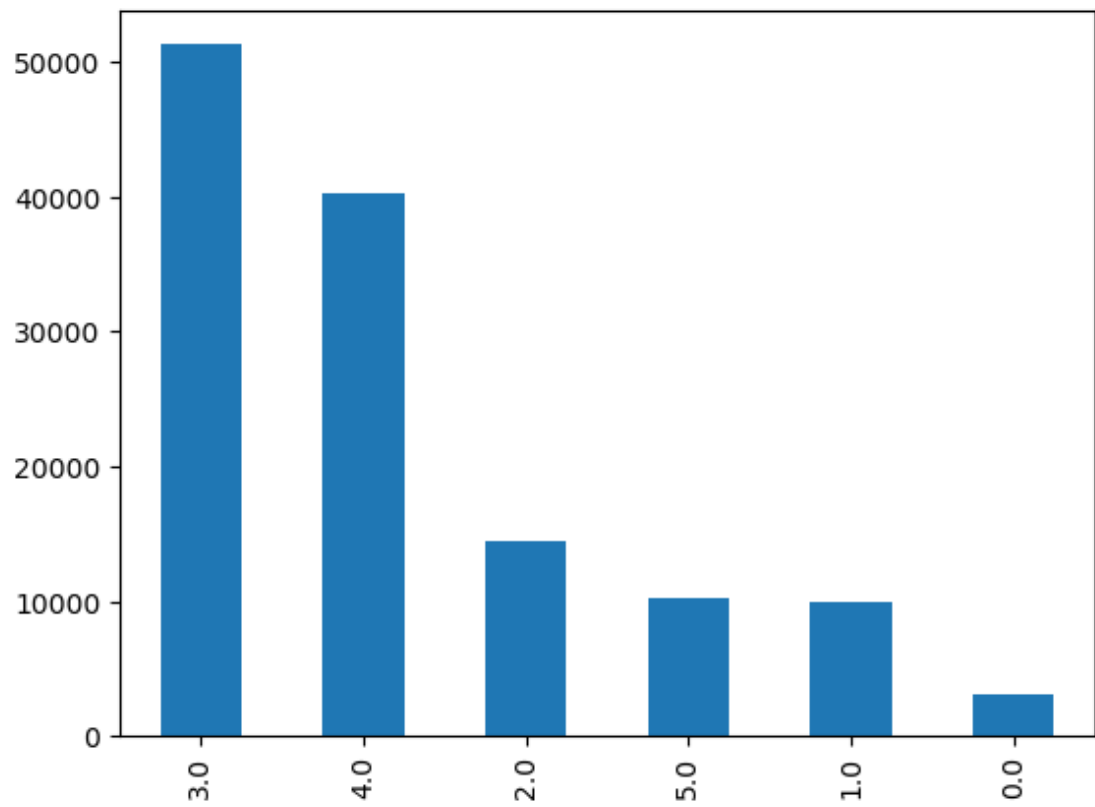

```
df.shape
```

```
(129277, 6)
```

b. Bar plot

```
import seaborn as sns  
import matplotlib.pyplot as plt  
df['AQI'].value_counts().plot.bar()
```

<AxesSubplot:>



iii. Identify Numerical and Categorical Data

```
import numpy as np
numeric_data = df.select_dtypes(include=[np.number])
categorical_data = df.select_dtypes(exclude=[np.number])
print("Number of numerical variables: ", numeric_data.shape[1])
print("Numerical attributes: ", numeric_data.columns)

print("Number of categorical variables: ", categorical_data.shape[1])
print("Categorical attributes: ", categorical_data.columns)
```

```
Number of numerical variables: 6
Numerical attributes: Index(['PM2.5', 'PM10', 'NO2', 'SO2', 'O3', 'AQI'], dtype='object')
Number of categorical variables: 0
Categorical attributes: Index([], dtype='object')
```

iv. Identify the Missing Values

```
df.isnull().sum()
```

```
PM2.5    0
PM10     0
NO2      0
SO2      0
O3       0
AQI      0
dtype: int64
```

v. Data preprocessing

```
from sklearn import preprocessing
#Feature scaling - min max scaling
from sklearn.preprocessing import MinMaxScaler
scaler = MinMaxScaler()
scaled = scaler.fit_transform(df)
encD=df
encD.head()
```

	PM2.5	PM10	NO2	SO2	O3	AQI
0	104.00	148.50	23.00	15.30	117.62	3.0
1	94.50	142.00	16.25	17.00	136.23	3.0
2	82.75	126.50	14.83	15.40	149.92	3.0
3	68.50	117.00	13.60	21.80	161.70	3.0
4	69.25	112.25	11.80	21.38	161.68	3.0

vi. Split dataset into train and test set

```
cols=['PM2.5',"PM10","NO2","SO2","O3"]
X=encD[cols]
y=encD['AQI']
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.4)
```

vii. Train the model

```
from sklearn.naive_bayes import GaussianNB  
gNBmodel = GaussianNB()  
gNBmodel.fit(X_train,y_train)
```

```
GaussianNB()
```

viii. Test model and display result

```
y_pred = gNBmodel.predict(X_test)  
y_pred
```

```
array([3., 3., 4., ..., 5., 3., 5.])
```

ix. Accuracy Score

```
print('Accuracy of Gaussian Naive Bayes on test set: {:.2f}'.format  
(gNBmodel.score(X_test, y_test)))
```

```
Accuracy of Gaussian Naive Bayes on test set: 0.61
```

x. Check for overfitting and underfitting

```

from sklearn.metrics import mean_absolute_error
y_train_pred = gNBmodel.predict(X_train)
mae_train = mean_absolute_error(y_train, y_train_pred)
mae_test = mean_absolute_error(y_test, y_pred)
print(mae_train)
print(mae_test)
if mae_train < mae_test:
    print("Overfitting is present")
else:
    print("Underfitting is present")

```

```

0.4338498826805559
0.42874823538512113

```

```

Underfitting is present

```

xi. Confusion matrix

```

from sklearn.metrics import confusion_matrix
confusion_matrix(y_test, y_pred)

```

```

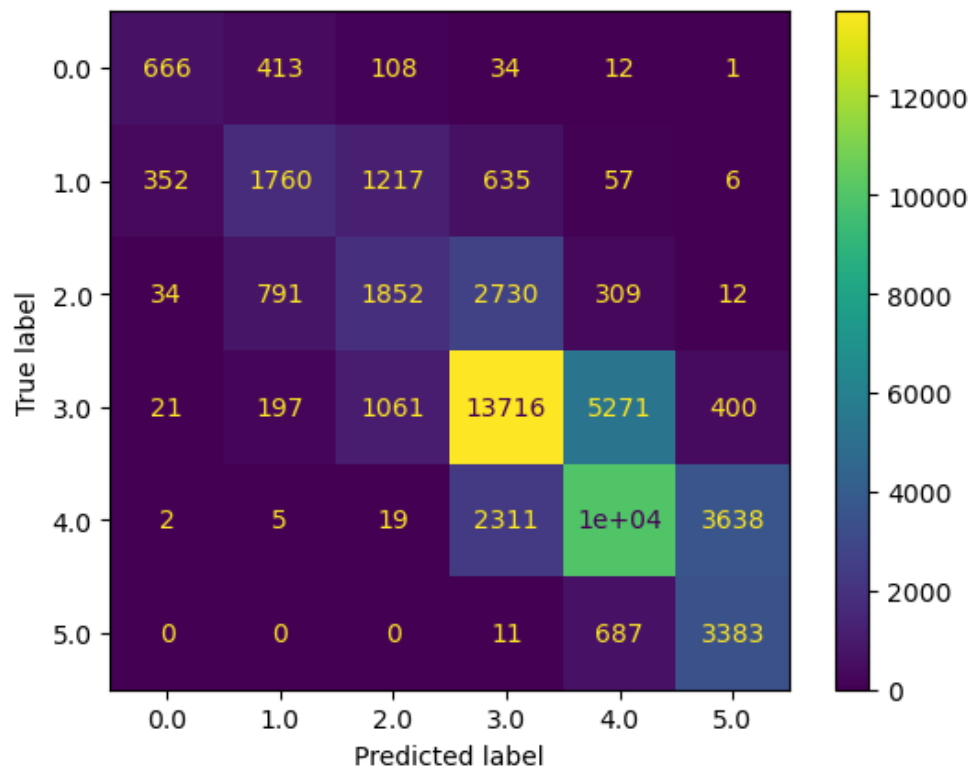
array([[ 666,   413,   108,    34,    12,     1],
       [ 352, 1760, 1217,   635,    57,     6],
       [   34,   791, 1852, 2730,   309,    12],
       [   21,   197, 1061, 13716, 5271,   400],
       [    2,     5,    19, 2311, 10000, 3638],
       [    0,     0,     0,    11,   687, 3383]], dtype=int64)

```

xii. Analyse model performance visually

```
from sklearn.metrics import ConfusionMatrixDisplay
cm = confusion_matrix(y_test, y_pred, labels=gNBmodel.classes_)
disp = ConfusionMatrixDisplay(confusion_matrix=cm,
display_labels=gNBmodel.classes_)
disp.plot()
```

<sklearn.metrics._plot.confusion_matrix.ConfusionMatrixDisplay at 0x2124a9cbeb0>



xiii. Classification report

```
from sklearn.metrics import classification_report  
print(classification_report(y_test, y_pred))
```

	precision	recall	f1-score	support
0.0	0.62	0.54	0.58	1234
1.0	0.56	0.44	0.49	4027
2.0	0.44	0.32	0.37	5728
3.0	0.71	0.66	0.68	20666
4.0	0.61	0.63	0.62	15975
5.0	0.45	0.83	0.59	4081
accuracy			0.61	51711
macro avg	0.56	0.57	0.55	51711
weighted avg	0.61	0.61	0.60	51711

MULTINOMIAL NAÏVE BAYES

i. Train the model

```
from sklearn.naive_bayes import MultinomialNB  
mNBmodel = MultinomialNB()  
mNBmodel.fit(X_train,y_train)
```

```
MultinomialNB()
```


ii. Test model and display result

```
y_pred = mNBmodel.predict(X_test)
y_pred
```

```
array([3., 4., 4., ..., 2., 2., 3.])
```

iii. Accuracy Score

```
print('Accuracy of Multinomial Naive Bayes on test
set:{:.2f}'.format(mNBmodel.score(X_test, y_test)))
```

```
Accuracy of Multinomial Naive Bayes on test set:0.31
```

iv. Checking for Overfitting and Underfitting

```
from sklearn.metrics import mean_absolute_error
y_train_pred = mNBmodel.predict(X_train)
mae_train = mean_absolute_error(y_train, y_train_pred)
mae_test = mean_absolute_error(y_test, y_pred)
print(mae_train)
print(mae_test)
if mae_train < mae_test:
    print("Overfitting is present")
else:
    print("Underfitting is present")
```

```
0.9832787561560478
0.9877008760225097
```

Overfitting is present

v. Confusion Matrix

```
from sklearn.metrics import confusion_matrix  
confusion_matrix(y_test, y_pred)
```

```
array([[ 687,  246,  210,   67,    8,    5],  
       [1438, 1124,  695,  561,  128,   48],  
       [ 708, 1696, 1084, 1189,  615,  428],  
       [ 628, 2617, 3531, 5921, 4117, 3616],  
       [ 135,  951, 1275, 4402, 4877, 4590],  
       [   1,   34,   52,  503, 1393, 2131]], dtype=int64)
```

vi. Classification Report

```
from sklearn.metrics import  
classification_report  
print(classification_report(y_test,  
y_pred))
```

	precision	recall	f1-score	support
0.0	0.19	0.56	0.29	1234
1.0	0.17	0.28	0.21	4027
2.0	0.16	0.19	0.17	5728
3.0	0.47	0.28	0.35	20666
4.0	0.43	0.30	0.36	15975
5.0	0.20	0.52	0.29	4081
accuracy			0.31	51711
macro avg	0.27	0.36	0.28	51711
weighted avg	0.37	0.31	0.32	51711

Result:

EXP NO : 4
DATE: 22-02-23

SVM CLASSIFICATION

Thus, the models to perform Gaussian and Multinomial Naïve Bayes classification for the given dataset have been built successfully.

Aim:

To build models to perform classification using SVM classifier for the given dataset.

Codes and Output:

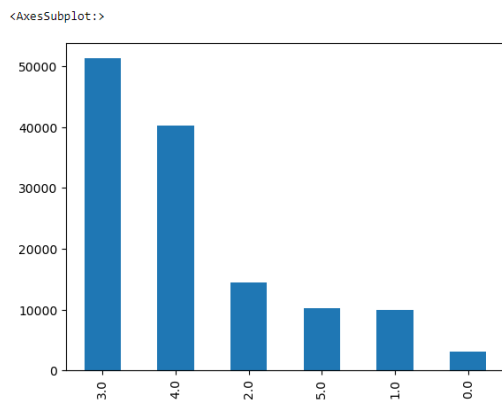
```
import pandas as pd
import numpy as np
df=pd.read_csv("dataset.csv")
```

i. Exploratory Data Analysis

```
df.shape
```

```
(707875, 6)
```

```
import seaborn as sns
import matplotlib.pyplot as plt
df['AQI'].value_counts().plot.bar()
```



ii. Explore Missing Values in Variables

```
df.isnull().sum()
```

```
PM2.5    0  
PM10     0  
NO2       0  
SO2       0  
O3        0  
AQI       0  
dtype: int64
```

iii. Split data into separate training and test set

```
from sklearn.model_selection import train_test_split  
cols=['PM2.5','PM10',"NO2","SO2","O3"]  
X=df[cols]  
y=df['AQI']  
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,  
random_state=40)
```

iv. Run SVM with default Hyperparameter

```
from sklearn.svm import SVC
from sklearn.metrics import accuracy_score
svc=SVC()
svc.fit(X_train,y_train)
y_pred=svc.predict(X_test)
print('Model accuracy score with default hyperparameters: {0:0.4f}'.
format(accuracy_score(y_test, y_pred)))
```

Model accuracy score with default hyperparameters: 0.6655

v. Compare the Train-Set and Test-Set Accuracy

```
from sklearn.svm import SVC
from sklearn.metrics import accuracy_score
svc=SVC()
svc.fit(X_train,y_train)
y_pred=svc.predict(X_test)
print('Model accuracy score with default hyperparameters: {0:0.4f}'.
format(accuracy_score(y_test, y_pred)))
```

Model accuracy score with default hyperparameters: 0.6655

vi. Check for Overfitting and Underfitting

```
from sklearn.metrics import mean_absolute_error
y_train_pred = svc.predict(X_train)
mae_train = mean_absolute_error(y_train, y_train_pred)
mae_test = mean_absolute_error(y_test, y_pred)
print(mae_train)
print(mae_test)
if mae_train < mae_test:
    print("Overfitting is present")
else:
    print("Underfitting is present")
```

vii. Confusion Matrix

```
from sklearn.metrics import confusion_matrix
confusion_matrix(y_test, y_pred)
```

viii. Classification report

EXP NO : 5
DATE: 01-03-23

LOGISTIC REGRESSION

```
from sklearn.metrics import classification_report  
print(classification_report(y_test, y_pred))
```

	precision	recall	f1-score	support
0.0	0.81	0.49	0.61	615
1.0	0.65	0.56	0.60	1988
2.0	0.54	0.35	0.42	2942
3.0	0.69	0.78	0.73	10093
4.0	0.67	0.73	0.70	8158
5.0	0.66	0.46	0.54	2060
accuracy			0.67	25856
macro avg	0.67	0.56	0.60	25856
weighted avg	0.66	0.67	0.66	25856

Result:

Thus, the models to perform classification using SVM classifier for the Air Quality dataset have been built successfully.

Aim:

To perform logistic regression on the Air Quality dataset.

Codes and Output:

- i. Import necessary packages and dataset

```
import pandas as pd  
import numpy as np  
df=pd.read_csv("dataset.csv")
```

ii. Split data into separate training and test set

```
from sklearn.model_selection import train_test_split  
cols=['PM2.5','PM10',"NO2","SO2","O3"]  
X=df[cols]  
y=df['AQI']  
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,  
random_state=40)
```

iii. Train the model

```
from sklearn.linear_model import LogisticRegression  
lr_model = LogisticRegression()  
lr_model.fit(X_train, y_train)  
y_pred = lr_model.predict(X_test)
```

iv. Accuracy Score

```
from sklearn.metrics import accuracy_score  
accuracy = accuracy_score(y_test, y_pred)  
print("Accuracy:", accuracy)
```

Accuracy: 0.4583462252475248

v. Confusion Matrix

```
from sklearn.metrics import confusion_matrix  
confusion_matrix(y_test, y_pred)
```

```
array([[ 51,  374,   8,  187,   1,   0],  
       [ 122,  837,  94,  981,   1,   0],  
       [  31,  570,  89, 2181,  42,   0],  
       [  32,  528, 177, 8694, 832,   0],  
       [   5,  113,  73, 5614, 2178,   5],  
       [   0,   2,   4,  657, 1371,   2]], dtype=int64)
```

vi. Classification report

```
from sklearn.metrics import classification_report  
print(classification_report(y_test, y_pred))
```

	precision	recall	f1-score	support
0.0	0.21	0.08	0.12	621
1.0	0.35	0.41	0.38	2035
2.0	0.20	0.03	0.05	2913
3.0	0.47	0.85	0.61	10263
4.0	0.49	0.27	0.35	7988
5.0	0.29	0.00	0.00	2036
accuracy			0.46	25856
macro avg	0.33	0.27	0.25	25856
weighted avg	0.42	0.46	0.39	25856

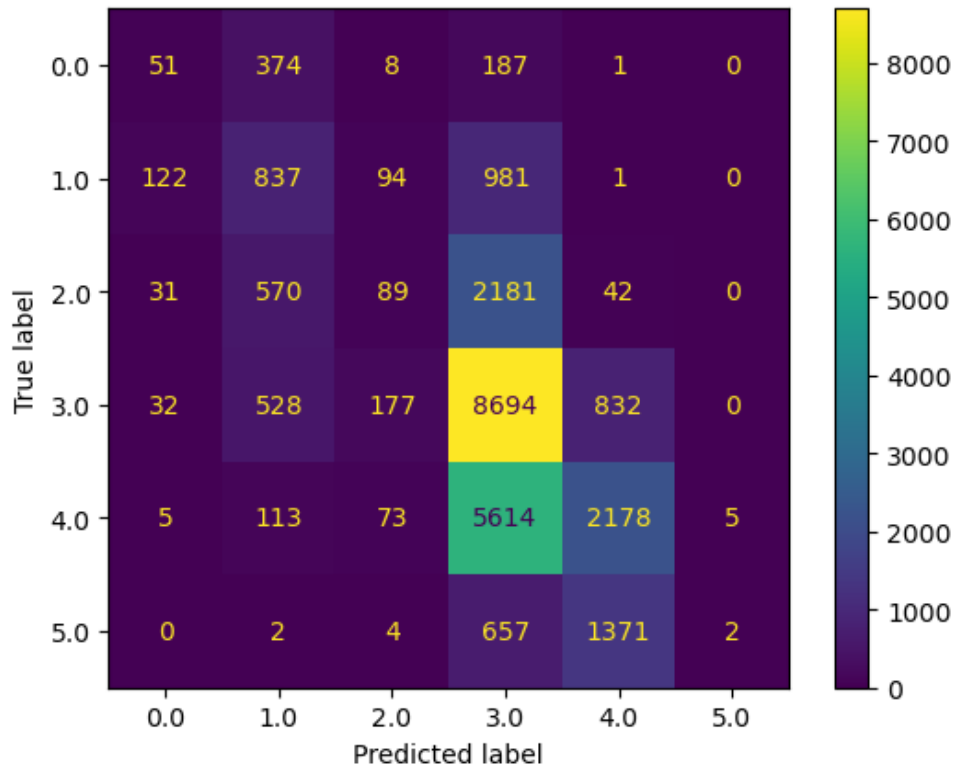
vii. Analyse model performance visually

```
from sklearn.metrics import ConfusionMatrixDisplay  
  
cm = confusion_matrix(y_test, y_pred,  
                      labels=lr_model.classes_)  
  
disp = ConfusionMatrixDisplay(confusion_matrix=cm,  
                              display_labels=lr_model.classes_)  
  
disp.plot()
```

EXP NO : 6
DATE: 01-03-23

MULTIPLE REGRESSION

<sklearn.metrics._plot.confusion_matrix.ConfusionMatrixDisplay at 0x14519a28940>



Result:

Thus, logical regression has been carried out on the Air Quality dataset successfully.

Aim:

To build a multiple regression model on the Air Quality dataset.

- i. **Import necessary packages and dataset**

```
import pandas as pd
import numpy as np
df=pd.read_csv("dataset.csv")
```

ii. **Data preprocessing**

```
from sklearn import preprocessing
from sklearn.preprocessing import MinMaxScaler
scaler = MinMaxScaler()
scaled = scaler.fit_transform(df)
encD=df
encD.head()
```

	PM2.5	PM10	NO2	SO2	O3	AQI
0	104.00	148.50	23.00	15.30	117.62	3.0
1	94.50	142.00	16.25	17.00	136.23	3.0
2	82.75	126.50	14.83	15.40	149.92	3.0
3	68.50	117.00	13.60	21.80	161.70	3.0
4	69.25	112.25	11.80	21.38	161.68	3.0

iii. **Split dataset into train and test set**

```
cols=['PM2.5','PM10','NO2','SO2','O3']
X=encD[cols]
y=encD['AQI']
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.4)
```

iv. **Train the model**

```
from sklearn.linear_model import LinearRegression
linear_regression = LinearRegression()
linear_regression.fit(X_train, y_train)
```

```
LinearRegression()
```

v. **Test model and display result**

```
y_pred=linear_regression.predict(X_test)
y_pred
```

```
array([[3.81702004],
       [2.80993375],
       [2.87657045],
       ...,
       [3.17608338],
       [2.21710344],
       [2.44041965]])
```

Result:

Thus, multiple regression has been carried out on the Air Quality dataset successfully.

Aim:

To understand OpenStack deployment, its implementation and its applications.

Theory:

OpenStack is a cloud operating system that controls large pools of compute, storage and networking resources throughout a data-centre, all managed and provisioned through APIs with common authentication mechanisms.

A dashboard is also available, giving administrators control while empowering their users to provide resources through a web interface. It began in 2010 as a joint project of Rackspace hosting and NASA. It was managed by the OpenStack Foundation, a non-profit entity.

Working of OpenStack

It is essentially a series of commands known as scripts. These scripts are bundled into packages called projects that relay tasks that create cloud environments. To create these environments, OpenStack relies on

- Virtualization that creates a layer of virtual resources abstracted from hardware
- A base as that carries out commands given by OpenStack scripts

OpenStack uses virtualized resources to build clouds. It doesn't execute commands, rather delegates them to base OS.

Components of OpenStack

OpenStack's architecture is made up of numerous open source projects. These are used to set up OpenStack's undercloud and overcloud. Overcloud is used by cloud users and undercloud is used by system admins. Underclouds contain the core components system admins need to set up and manage end user's environments called overclouds.

There are 6 stable, core services that handle computing, networking, storage, identity and images. These make up the infrastructure of OpenStack that allows the rest of the projects to handle dashboarding, orchestration, etc. The 6 components are:

Nova: It is a full management tool that helps compute resource-handling, scheduling, creation, deletion, etc.

Neutron: It connects the networks across other services

Swift: It is a highly fault-tolerant object storage service that stores and retrieves unstructured data objects

Cinder: Provides persistent block storage

Keystone: Authenticates and authorises all services

Glance: Stores and retrieves VM disc images from various locations

Deployment of OpenStack

It is mostly deployed as infrastructure-as-a-Service (IaaS) in both public and private clouds where virtual servers and other resources are made available to users. The software platform consists of interrelated components control diverse, multivendor hardware. Lifecycle management tools and packaging are used to help instances maintain the lifecycle of deployments. Frameworks for the above are Tripleo, OpenStack-helm, kolla-ansible, kayole, etc.

Challenges in Implementation

- Installation challenges
- Documentation
- Upgrading OpenStack
- Long Term Support

Applications of OpenStack

- Private clouds and Public clouds
- Network function virtualization
- Containers

Result:

EXP NO : 7.b DATE: 08-03-23	<u>OPENSTACK INSTALLATION</u>
--	--------------------------------------

EXP NO : 7.b DATE: 08-03-23	<u>OPENSTACK INSTALLATION</u>
--	--------------------------------------

Thus, OpenStack deployment, its implementation and its applications have been studied.

Aim:

To install OpenStack and implement Infrastructure-as-a-service using it.

Installation of OpenStack in Ubuntu

1. Login to sudo ("superuser do") user
2. Open Terminal
3. In terminal, type:

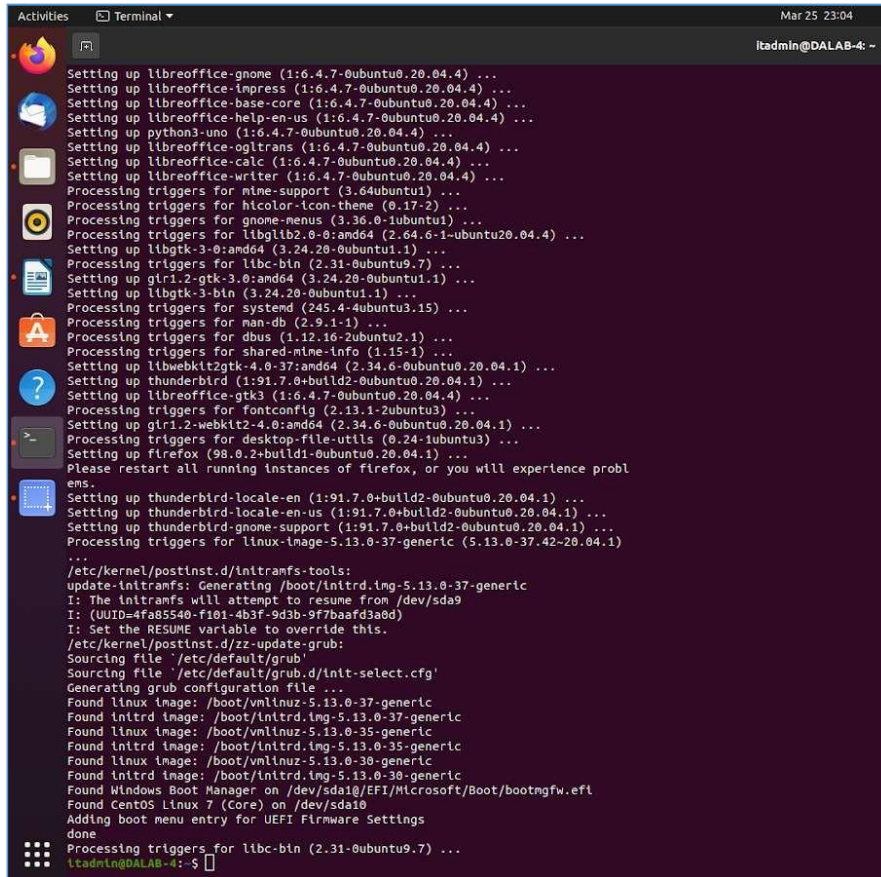
```
sudo apt update
```

This downloads package information from all configured sources.

```
Activities Terminal Mar 25 22:45 itadmin@DALAB-4: ~  
itadmin@DALAB-4:~$ sudo apt update  
Get:1 http://security.ubuntu.com/ubuntu focal-security InRelease [114 kB]  
Hit:2 http://ln.archive.ubuntu.com/ubuntu focal InRelease  
Get:3 http://ln.archive.ubuntu.com/ubuntu focal-updates InRelease [114 kB]  
Get:4 http://ln.archive.ubuntu.com/ubuntu focal-backports InRelease [108 kB]  
Get:5 http://ln.archive.ubuntu.com/ubuntu focal-updates/main amd64 Packages [1,674 kB]  
Get:6 http://ln.archive.ubuntu.com/ubuntu focal-updates/main 1386 Packages [621 kB]  
Get:7 http://security.ubuntu.com/ubuntu focal-security/main amd64 Packages [1,347 kB]  
Get:8 http://ln.archive.ubuntu.com/ubuntu focal-updates/main Translation-en [316 kB]  
Get:9 http://ln.archive.ubuntu.com/ubuntu focal-updates/main amd64 DEP-11 Metadata [278 kB]  
Get:10 http://ln.archive.ubuntu.com/ubuntu focal-updates/main DEP-11 48x48 Icons [60.8 kB]  
Get:11 http://ln.archive.ubuntu.com/ubuntu focal-updates/main DEP-11 64x64 Icons [98.3 kB]  
Get:12 http://ln.archive.ubuntu.com/ubuntu focal-updates/main amd64 c-n-f Metadata [14.8 kB]  
Get:13 http://ln.archive.ubuntu.com/ubuntu focal-updates/restricted 1386 Packages [24.3 kB]  
Get:14 http://ln.archive.ubuntu.com/ubuntu focal-updates/restricted amd64 Packages [887 kB]  
Get:15 http://ln.archive.ubuntu.com/ubuntu focal-updates/restricted Translation-en [127 kB]  
Get:16 http://ln.archive.ubuntu.com/ubuntu focal-updates/restricted amd64 c-n-f Metadata [528 B]  
Get:17 http://ln.archive.ubuntu.com/ubuntu focal-updates/universe 1386 Packages [674 kB]  
Get:18 http://ln.archive.ubuntu.com/ubuntu focal-updates/universe amd64 Packages [913 kB]  
Get:19 http://ln.archive.ubuntu.com/ubuntu focal-updates/universe Translation-en [203 kB]  
Get:20 http://ln.archive.ubuntu.com/ubuntu focal-updates/universe amd64 DEP-11 Metadata [390 kB]  
Get:21 http://ln.archive.ubuntu.com/ubuntu focal-updates/universe DEP-11 48x48 Icons [257 kB]  
Get:22 http://ln.archive.ubuntu.com/ubuntu focal-updates/universe DEP-11 64x64 Icons [458 kB]  
Get:23 http://ln.archive.ubuntu.com/ubuntu focal-updates/universe amd64 c-n-f Metadata [20.3 kB]  
Get:24 http://ln.archive.ubuntu.com/ubuntu focal-updates/multiverse amd64 Packages [24.4 kB]  
Get:25 http://ln.archive.ubuntu.com/ubuntu focal-updates/multiverse 1386 Packages [8,432 B]  
Get:26 http://ln.archive.ubuntu.com/ubuntu focal-updates/multiverse Translation-en [336 B]  
Get:27 http://ln.archive.ubuntu.com/ubuntu focal-updates/multiverse amd64 DEP-11 Metadata [544 B]  
Get:28 http://ln.archive.ubuntu.com/ubuntu focal-updates/multiverse amd64 c-n-f Metadata [592 B]  
Get:29 http://ln.archive.ubuntu.com/ubuntu focal-backports/main amd64 DEP-11 Metadata [7,984 B]  
Get:30 http://ln.archive.ubuntu.com/ubuntu focal-backports/universe amd64 DEP-11 Metadata [30.8 kB]  
Get:31 http://security.ubuntu.com/ubuntu focal-security/main 1386 Packages [407 kB]  
Get:32 http://security.ubuntu.com/ubuntu focal-security/main Translation-en [234 kB]  
Get:33 http://security.ubuntu.com/ubuntu focal-security/main amd64 DEP-11 Metadata [40.8 kB]  
Get:34 http://security.ubuntu.com/ubuntu focal-security/main DEP-11 48x48 Icons [18.3 kB]  
Get:35 http://security.ubuntu.com/ubuntu focal-security/main DEP-11 64x64 Icons [35.5 kB]  
Get:36 http://security.ubuntu.com/ubuntu focal-security/main amd64 c-n-f Metadata [9,800 B]  
Get:37 http://security.ubuntu.com/ubuntu focal-security/restricted amd64 Packages [831 kB]  
Get:38 http://security.ubuntu.com/ubuntu focal-security/restricted 1386 Packages [21.9 kB]  
Get:39 http://security.ubuntu.com/ubuntu focal-security/restricted Translation-en [118 kB]  
Get:40 http://security.ubuntu.com/ubuntu focal-security/restricted amd64 c-n-f Metadata [532 B]  
Get:41 http://security.ubuntu.com/ubuntu focal-security/universe amd64 Packages [695 kB]  
Get:42 http://security.ubuntu.com/ubuntu focal-security/universe 1386 Packages [547 kB]  
Get:43 http://security.ubuntu.com/ubuntu focal-security/universe Translation-en [122 kB]  
Get:44 http://security.ubuntu.com/ubuntu focal-security/universe amd64 DEP-11 Metadata [66.3 kB]  
Get:45 http://security.ubuntu.com/ubuntu focal-security/universe DEP-11 48x48 Icons [33.1 kB]  
Get:46 http://security.ubuntu.com/ubuntu focal-security/universe DEP-11 64x64 Icons [71.6 kB]  
Get:47 http://security.ubuntu.com/ubuntu focal-security/universe amd64 c-n-f Metadata [14.1 kB]  
Get:48 http://security.ubuntu.com/ubuntu focal-security/multiverse amd64 DEP-11 Metadata [2,463 B]  
Fetched 12.0 MB in 5s (2,573 kB/s)  
Reading package lists... Done  
Building dependency tree  
Reading state information... Done  
99 packages can be upgraded. Run 'apt list --upgradable' to see them.
```


4. Upgrade everything in the system, all the packages, and the kernel to the latest versions assupported by the repositories:

```
sudo apt -y upgrade
```

A terminal window titled 'Terminal' with a dark background and light text. The window shows the output of the command 'sudo apt -y upgrade'. The output lists various packages being upgraded, including libreoffice-gnome, libreoffice-impress, libreoffice-base-core, libreoffice-help-en-us, python3-uno, libreoffice-ogltrans, libreoffice-calc, libreoffice-writer, mtime-support, hicolor-icon-theme, gnome-menus, libglib2.0-0:amd64, libgtk-3-0:amd64, libcbt-2.31-0ubuntu9.7, gir1.2-gtk-3.0:amd64, libgtk-3-bin, systemd, man-db, dbus, shared-mime-info, thunderbird, libreoffice-gtk3, fontconfig, gir1.2-webkit2-4.0:amd64, desktop-file-utils, and firefox. It also shows the installation of thunderbird-locale-en, thunderbird-locale-en-us, thunderbird-gnome-support, and linux-image-5.13.0-37-generic. The terminal shows the process of updating the initramfs and the GRUB boot menu. The prompt at the bottom is 'ltadmin@DALAB-4: ~\$'.

5. Upgrade existing packages, installs new dependencies that are not in the system, and deletesthose that are not needed:

```
sudo apt -y dist-upgrade
```



```

itadmin@DALAB-4:~$ sudo apt -y dist-upgrade
[sudo] password for itadmin:
Reading package lists... Done
Building dependency tree
Reading state information... Done
Calculating upgrade... Done
The following packages were automatically installed and are no longer required:
  libfwupdplugin1 linux-headers-5.13.0-30-generic
  linux-hwe-5.13-headers-5.13.0-30 linux-image-5.13.0-30-generic
  linux-modules-5.13.0-30-generic linux-modules-extra-5.13.0-30-generic
Use 'sudo apt autoremove' to remove them.
0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.
itadmin@DALAB-4:~$

```

6. Add user called stack to run DevStack. It should be run as non-root user with sudo enabled:

```
sudo useradd -s /bin/bash -d /opt/stack -m stack
```

```

(base) student@DALAB-4:~/Desktop$ sudo useradd -s /bin/bash -d /opt/stack -m stack
[sudo] password for student:
student is not in the sudoers file. This incident will be reported.
(base) student@DALAB-4:~/Desktop$ su - itadmin
password:
itadmin@DALAB-4:~$ sudo useradd -s /bin/bash -d /opt/stack -m stack
[sudo] password for itadmin:
itadmin@DALAB-4:~$

```

7. User should have sudo privileges to make changes to the system:

```
echo "stack ALL=(ALL) NOPASSWD: ALL" | sudo tee /etc/sudoers.d/stack
```

```

itadmin@DALAB-4:~$ echo "stack ALL=(ALL) NOPASSWD: ALL" | sudo tee /etc/sudoers.d/stack
stack ALL=(ALL) NOPASSWD: ALL
itadmin@DALAB-4:~$

```

8. Log in to the stack once user is created:

```
sudo su - stack
```

```

itadmin@DALAB-4:~$ sudo su - stack
stack@DALAB-4:~$ sudo su -

```

9. Install git:

```
sudo apt -y install git
```

```
stack@DALAB-4:~$ sudo apt -y install git
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following packages were automatically installed and are no longer required:
  libfwupdplugin1 linux-headers-5.13.0-30-generic
  linux-hwe-5.13-headers-5.13.0-30 linux-image-5.13.0-30-generic
  linux-modules-5.13.0-30-generic linux-modules-extra-5.13.0-30-generic
Use 'sudo apt autoremove' to remove them.
The following additional packages will be installed:
  git-man liberror-perl
Suggested packages:
  git-daemon-run | git-daemon-sysvinit git-doc git-el git-email git-gui gitch
  gitweb git-cvs git-mediawiki git-svn
The following NEW packages will be installed:
  git git-man liberror-perl
0 upgraded, 3 newly installed, 0 to remove and 0 not upgraded.
Need to get 5,465 kB of archives.
After this operation, 38.4 MB of additional disk space will be used.
Get:1 http://in.archive.ubuntu.com/ubuntu focal/main amd64 liberror-perl all 0.17029-1 [26.5 kB]
Get:2 http://in.archive.ubuntu.com/ubuntu focal-updates/main amd64 git-man all 1:2.25.1-1ubuntu3.2 [884 kB]
9% [2 git-man 114 kB/884 kB 13%]
pdates/main amd64 git amd64 1:2.25.1-1ubuntu3.2 [4,554 kB]
Fetched 5,465 kB in 4min 3s (22.5 kB/s)
Selecting previously unselected package liberror-perl.
(Reading database ... 213052 files and directories currently installed.)
Preparing to unpack .../liberror-perl_0.17029-1_all.deb ...
Unpacking liberror-perl (0.17029-1) ...
Selecting previously unselected package git-man.
Preparing to unpack .../git-man_1%3a2.25.1-1ubuntu3.2_all.deb ...
Unpacking git-man (1:2.25.1-1ubuntu3.2) ...
Selecting previously unselected package git.
Preparing to unpack .../git_1%3a2.25.1-1ubuntu3.2_amd64.deb ...
Unpacking git (1:2.25.1-1ubuntu3.2) ...
Setting up liberror-perl (0.17029-1) ...
Setting up git-man (1:2.25.1-1ubuntu3.2) ...
Setting up git (1:2.25.1-1ubuntu3.2) ...
Processing triggers for man-db (2.9.1-1) ...
```

10. Download devstack from its repository into system:

```
git clone https://git.openstack.org/openstack-dev/devstack
```

```
stack@DALAB-4:~$ git clone https://github.com/openstack-dev/devstack.git
Cloning into 'devstack'...
remote: Enumerating objects: 48499, done.
remote: Counting objects: 100% (1725/1725), done.
remote: Compressing objects: 100% (686/686), done.
remote: Total 48499 (delta 1177), reused 1444 (delta 1033), pack-reused 46774
Receiving objects: 100% (48499/48499), 15.48 MiB | 4.31 MiB/s, done.
Resolving deltas: 100% (33808/33808), done.
```

11. Download devstack setup configurations files for it. Need to navigate devstack folder by running:

```
cd devstack
nano local.conf
vi local.conf
```

```
stack@DALAB-4:~$ cd devstack
stack@DALAB-4:~/devstack$ nano local.conf
stack@DALAB-4:~/devstack$ vi local.conf
```

12. Add following inside local.conf:

```
[[local|localrc]]
# Password for KeyStone, Database, RabbitMQ and
Service
ADMIN_PASSWORD=StrongAdminSecret
DATABASE_PASSWORD=$ADMIN_PASSWORD
RABBIT_PASSWORD=$ADMIN_PASSWORD
SERVICE_PASSWORD=$ADMIN_PASSWORD
```

After setting above, in local.conf, press Esc key and type :wq to write/save and quit

13.Run following to setup Openstack on system:

```
./stack.sh
```

[illegible]

After installation, terminal:

```

=====
DevStack Component Timing
(times are in seconds)
=====
wait_for_service      18
pip_install           280
apt-get               942
run_process           68
dbsync                66
git_timed             1034
apt-get-update         1
test_with_retry        51
async_wait            1564
osc                   283
=====
Unaccounted time      816
=====
Total runtime         5123
=====

Async summary
=====
Time spent in the background minus waits: 2015 sec
Elapsed time: 5123 sec
Time if we did everything serially: 7138 sec
Speedup: 1.39332

This is your host IP address: 192.168.112.197
This is your host IPv6 address: ::1
Horizon is now available at http://192.168.112.197/dashboard
Keystone is serving at http://192.168.112.197/identity/
The default users are: admin and demo
The password: StrongAdminSecret

Services are running under systemd unit files.
For more information see:
https://docs.openstack.org/devstack/latest/systemd.html

DevStack Version: zed
Change: 0ed70e3f7687ffa62a8a4a38cdad14abdc8c7fa7 Merge "Update DEVSTACK_SERIES to zed" 2022-03-28 13:02:03 +0000
OS Version: Ubuntu 20.04 focal
2022-03-29 15:26:41.917 | stack.sh completed in 5123 seconds.

```

14. Browse URL on browser:
<http://localhost/dashboard>

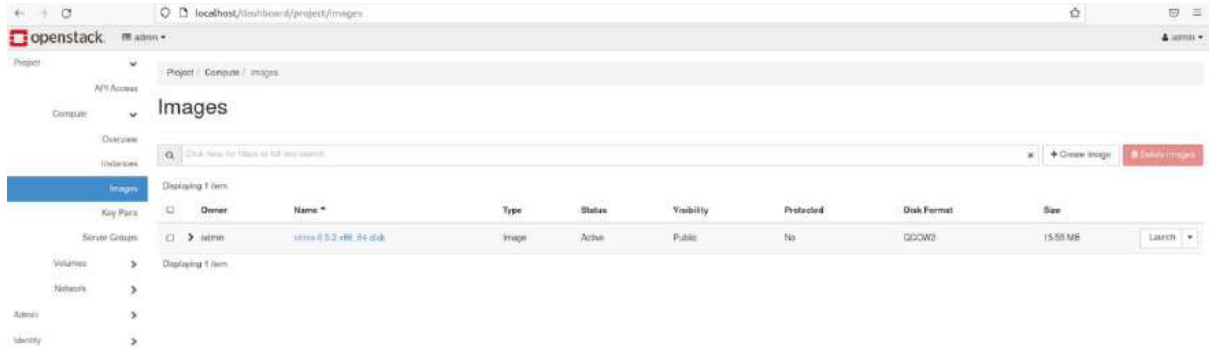


The image shows the OpenStack login interface. At the top is the OpenStack logo, which consists of a red square with a white 'O' inside, followed by the word 'openstack.' in a sans-serif font. Below the logo is a 'Log in' section. It contains two input fields: 'User Name' and 'Password'. The 'User Name' field is a simple text box. The 'Password' field is a text box with a small eye icon on the right side to toggle visibility. At the bottom right of the login section is a blue button with the text 'Sign In'.

EXP NO : 8
DATE: 15-03-23

CREATION OF VM INSTANCES IN AWS

15. Enter credentials. Log in as admin using username 'admin' and password as given in local.conf file:



Result:

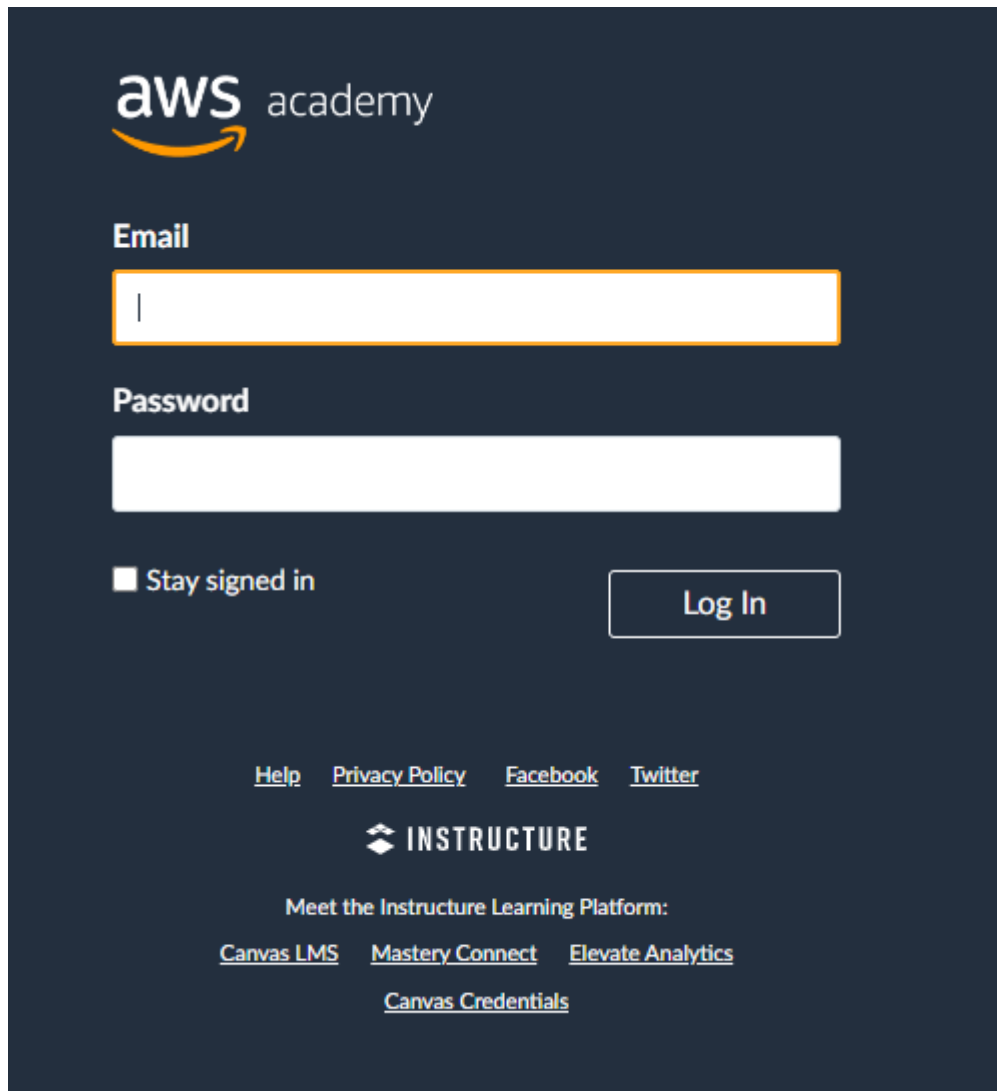
Thus, OpenStack has been successfully installed.

Aim:

To deploy a VM in AWS and execute a simple application on it.

DEPLOYING VM IN AWS:

1. Login to aws academy using credentials.



The image shows the AWS Academy login interface. At the top left is the AWS Academy logo. Below it are two input fields: 'Email' and 'Password'. The 'Email' field contains a single vertical bar character. Below the password field is a checkbox labeled 'Stay signed in'. To the right of the checkbox is a 'Log In' button. At the bottom of the page, there are links for 'Help', 'Privacy Policy', 'Facebook', and 'Twitter'. Below these links is the 'INSTRUCTURE' logo, followed by the text 'Meet the Instructure Learning Platform:'. Underneath this text are four links: 'Canvas LMS', 'Mastery Connect', 'Elevate Analytics', and 'Canvas Credentials'.

aws academy

Email

Password

☐ Stay signed in

Log In

[Help](#) [Privacy Policy](#) [Facebook](#) [Twitter](#)

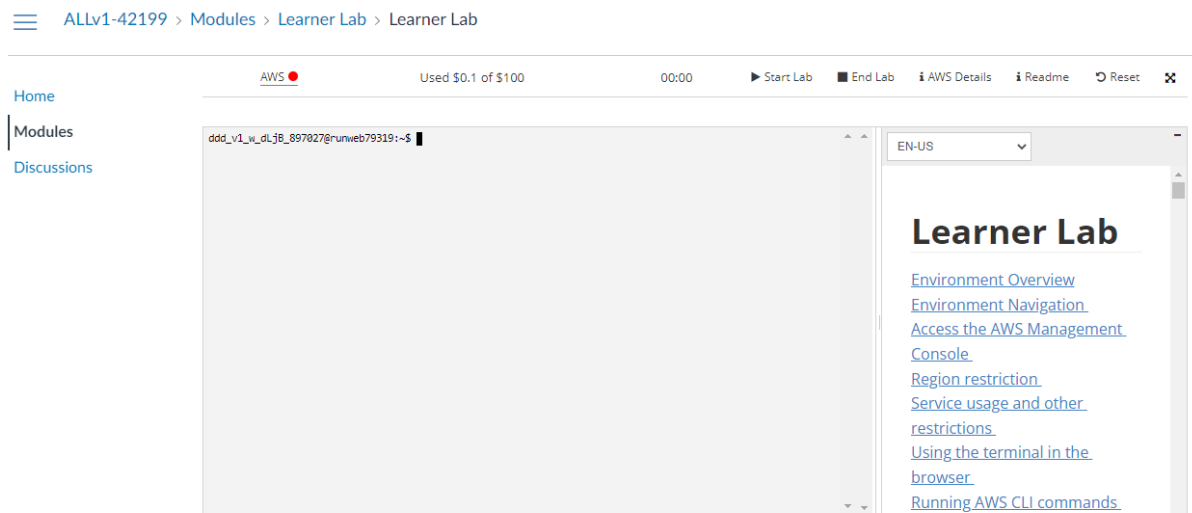
INSTRUCTURE

Meet the Instructure Learning Platform:

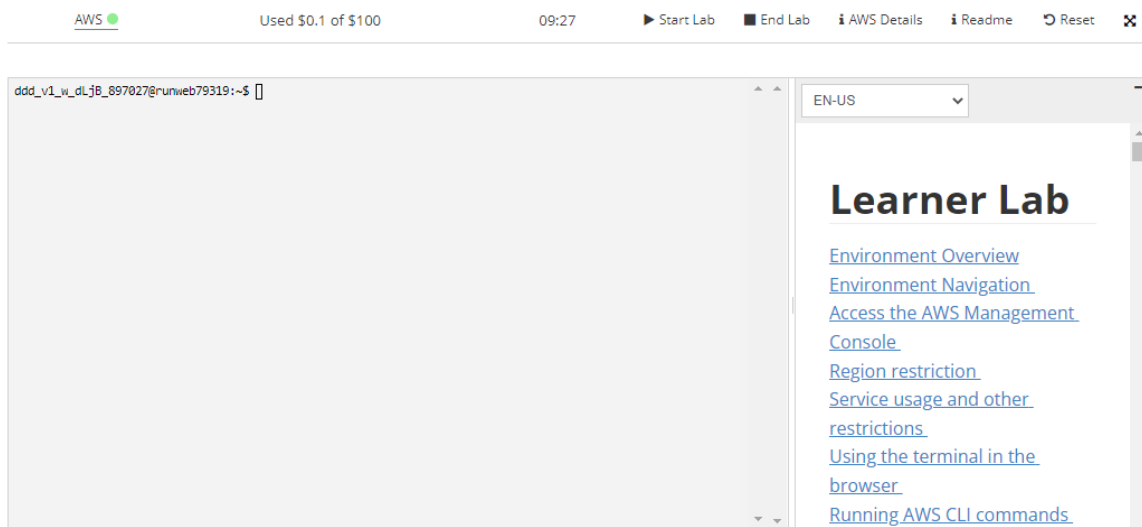
[Canvas LMS](#) [Mastery Connect](#) [Elevate Analytics](#)

[Canvas Credentials](#)

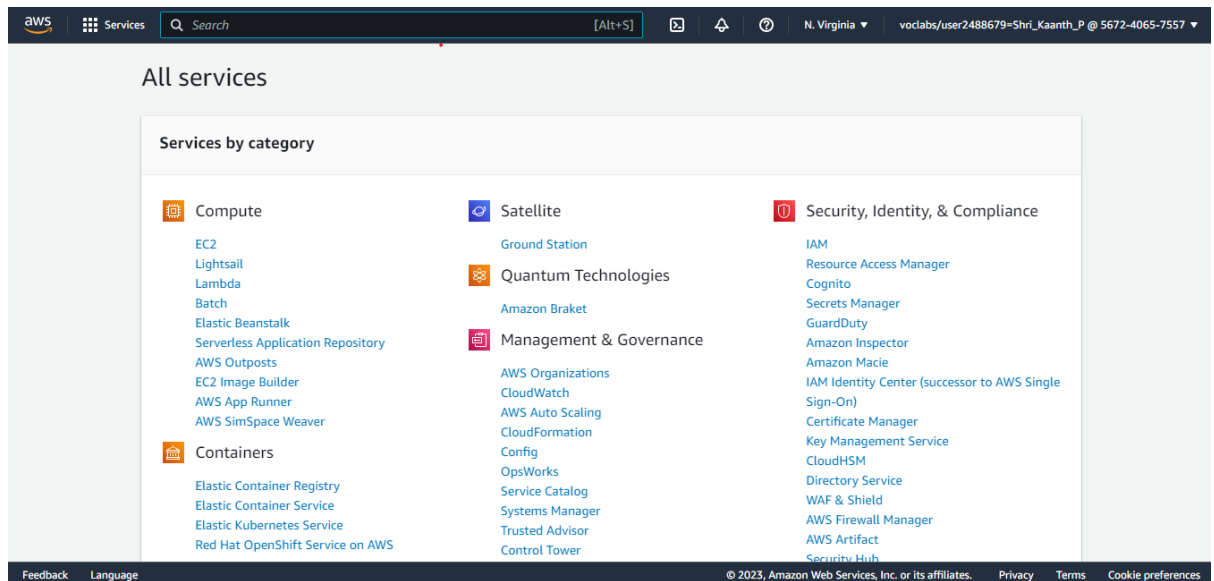
2. In the dashboard, select Modules → Learner Lab. The Learner lab will be opened.



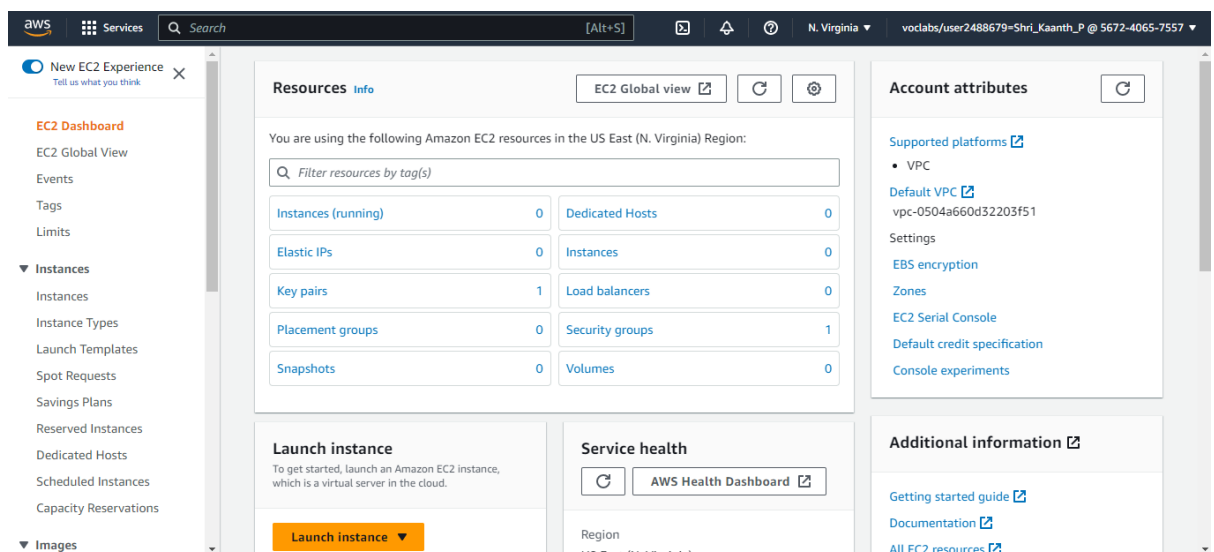
3. The red signal indicates that the lab has not started yet. To start the learner lab, click **Start Lab**. Wait for some time until the lab starts. The yellow signal indicates that the lab is being started. After the lab starts, the red signal changes to green, indicating the lab has started.



4. Click on **AWS to open** AWS Management Console. In the following page, click on **EC2**.



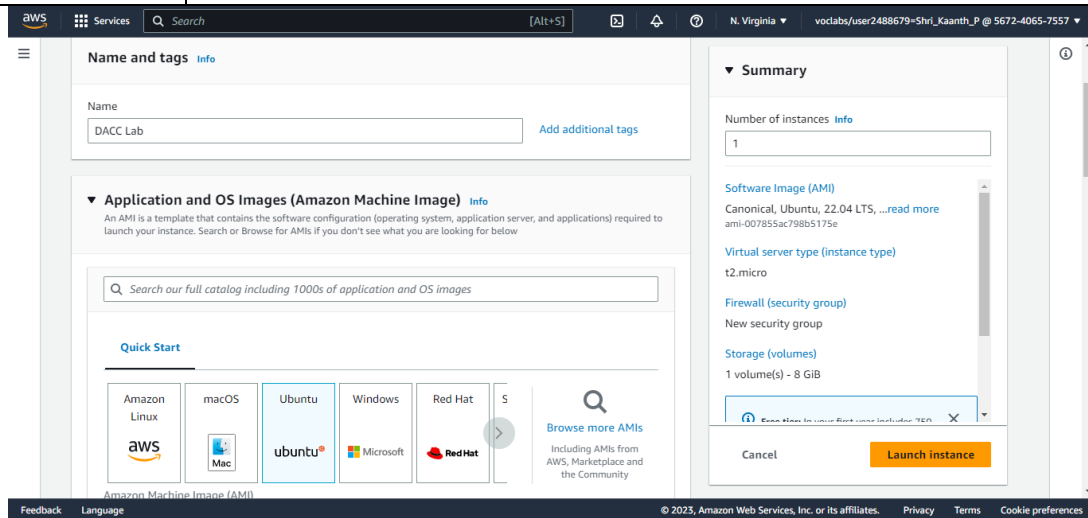
5. Click on **Instances** to view the EC2 instances created. To create a new instance, click **Launch Instance**



6. Select name, Application and OS image, appropriate network settings and VM storage.

EXP NO : 09
DATE: 15-03-23

MONGODB BASICS



For key-pair attribute, click on **Create new key pair** . Enter the name of the key pair and select .pem for using in OpenSSH and click **Create key pair**. A .pem file will be downloaded.

Create key pair

Key pairs allow you to connect to your instance securely.

Enter the name of the key pair below. When prompted, store the private key in a secure and accessible location on your computer. **You will need it later to connect to your instance.** [Learn more](#)

Key pair name

Enter key pair name

The name can include upto 255 ASCII characters. It can't include leading or trailing spaces.

Key pair type

☒ RSA
RSA encrypted private and public key pair

☐ ED25519
ED25519 encrypted private and public key pair (Not supported for Windows instances)

Private key file format

☒ .pem
For use with OpenSSH

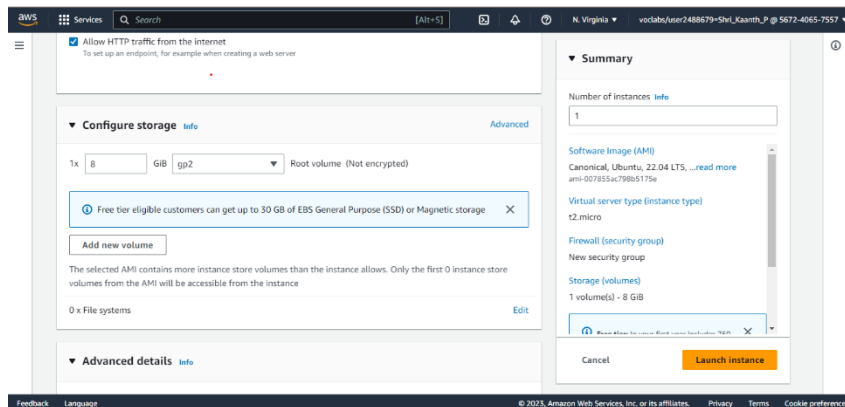
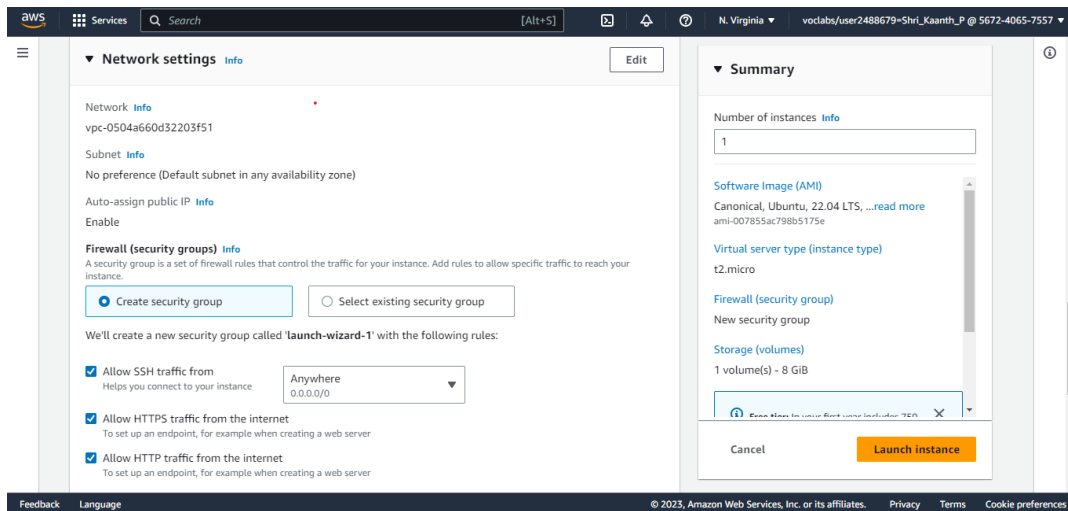
☐ .ppk
For use with PuTTY

Cancel

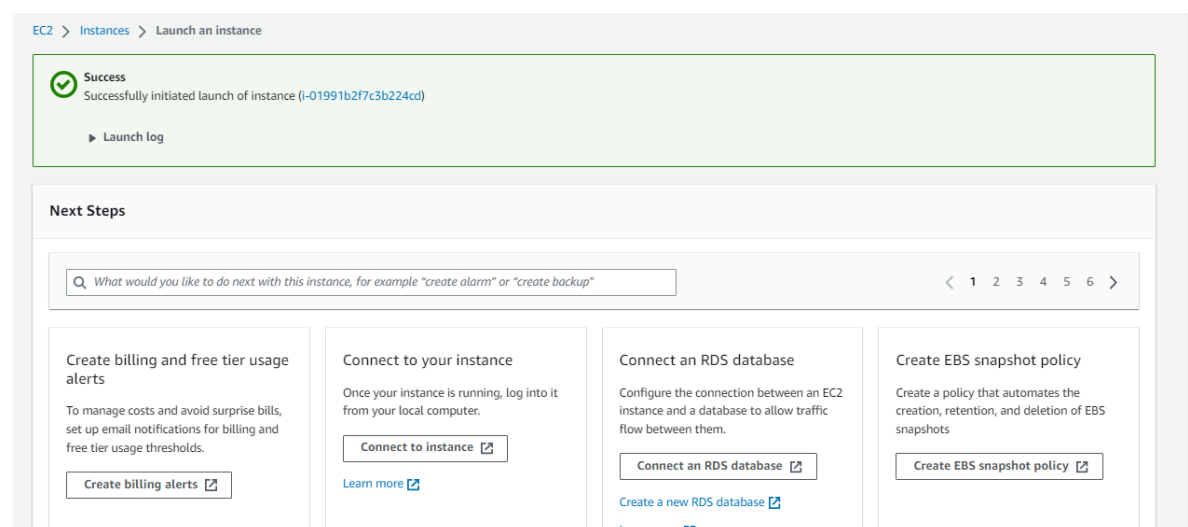
Create key pair

2020506087

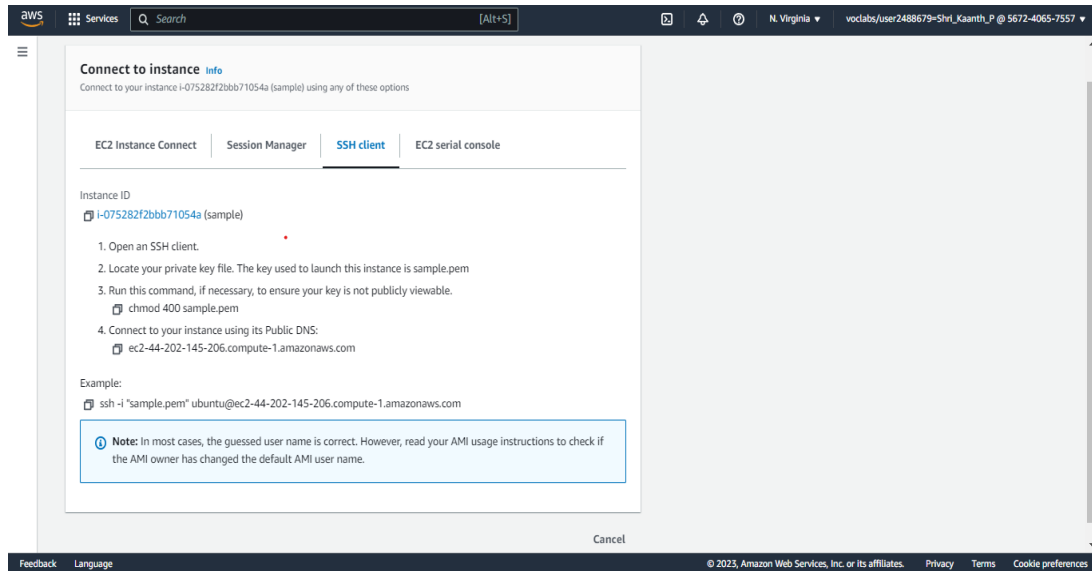
6
5



7. Click **Launch instance** to create the new instance. Your EC2 instance is created. After creating EC2 instance, click **Connect to instance**.



8. Go to **SSH client** section and copy the example given.



9. Now, open command prompt using start menu. Then go to the directory where the .pem file is saved. By default, it is saved in **Downloads** folder.

```
Microsoft Windows [Version 10.0.22621.1413]
(c) Microsoft Corporation. All rights reserved.

C:\Users\shrik>cd Downloads

C:\Users\shrik\Downloads>|
```

10. Paste the command that is copied from the SSH client section after creating the instance and press Enter.

```
ssh -i "dacc lab keypair.pem" ubuntu@ec2-54-147-58-180.compute-1.amazonaws.com
```

You've logged in to your virtual machine.

```
C:\Users\shrik\Downloads>ssh -i "sample.pem" ubuntu@ec2-44-202-145-206.compute-1.amazonaws.com
Welcome to Ubuntu 22.04.2 LTS (GNU/Linux 5.15.0-1031-aws x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:    https://landscape.canonical.com
 * Support:       https://ubuntu.com/advantage

System information as of Wed Mar 29 04:23:27 UTC 2023

System load:  0.0               Processes:            97
Usage of /:   20.4% of 7.57GB   Users logged in:     1
Memory usage: 22%              IPv4 address for eth0: 172.31.95.203
Swap usage:   0%

 * Introducing Expanded Security Maintenance for Applications.
   Receive updates to over 25,000 software packages with your
   Ubuntu Pro subscription. Free for personal use.

   https://ubuntu.com/aws/pro

Expanded Security Maintenance for Applications is not enabled.

0 updates can be applied immediately.

Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status

Last login: Wed Mar 29 03:22:19 2023 from 106.203.91.247
To run a command as administrator (user "root"), use "sudo <command>".
See "man sudo_root" for details.

ubuntu@ip-172-31-95-203:~$ |
```

11. Enter the command below to create and edit a new file. Enter the file content and press Ctrl+c.

```
cat > sample.txt
```

```
ubuntu@ip-172-31-31-114:~$ cat > dacc.txt
Welcome to DACC Laboratory
^C
ubuntu@ip-172-31-31-114:~$ |
```

12. Enter the command below to display the file content.

```
cat dacc.txt
```

```
ubuntu@ip-172-31-31-114:~$ cat dacc.txt
Welcome to DACC Laboratory
```

Result:

Thus, VM has been deployed in OpenStack and a simple application has been executed.

1. Study on MongoDB

Aim:

To study about the basics of MongoDB and its operations.

Theory:

MongoDB is a general-purpose document database designed for modern application development and for the cloud. Its scale-out architecture allows you to meet the increasing demand for your system by adding more nodes to share the load.

MongoDB is a cross-platform, document-oriented database that provides, high performance, high availability, and easy scalability. MongoDB works on concept of collection and document.

Document

MongoDB stores data as JSON documents. The document data model maps naturally to objects in application code, making it simple for developers to learn and use. A document is a set of key-value pairs. Documents have dynamic schema. Dynamic schema means that documents in the same collection do not need to have the same set of fields or structure, and common fields in a collection's documents may hold different types of data. Documents can be nested to express hierarchical relationships and to store structures such as arrays.

Collection

Collection is a group of MongoDB documents. It is the equivalent of an RDBMS table. A collection exists within a single database. Collections do not enforce a schema. Documents within a collection can have different fields. Typically, all documents in a collection are of similar or related purpose.

id is a 12 bytes hexadecimal number which assures the uniqueness of every document. The first 4 bytes for the current timestamp, next 3 bytes for machine id, next 2 bytes for process id of MongoDB server and remaining 3 bytes are simple incremental VALUE.

Sample document

```
{
  _id: ObjectId("6418761848304d22ba39626b"),
  emp_name: 'Ram',
  emp_id: 1001,
  age: 25,
  dept: 'Sales'
}
```

Operations

1. Use

To create and use a database. If the database exists, it returns existing database

```
use employee
```

```
local> use employee
switched to db employee
```

2. Create

To create/insert a new document to a collection

insertOne()

```
db.data.insertOne({emp_name:"Ram",emp_id:1001,age:25,dept:"Sales"})
```

```
employee> db.data.insertOne({emp_name:"Ram",emp_id:1001,age:25,dept:"Sales"})
{
  acknowledged: true,
  insertedId: ObjectId("6418761848304d22ba39626b")
}
```

insertMany()

```
db.data.insertMany([ {emp_name:"Sam",emp_id:1002,age:30,dept:"Accounts"},
,{emp_name:"Raju",emp_id:1003,age:35,dept:"Management"}, {emp_name:"Balu",emp_id:1004,age:40,dept:"Production"}])
```

```
employee> db.data.insertMany([ {emp_name:"Sam",emp_id:1002,age:30,dept:"Accounts"}, {emp_name:"Raju",emp_id:1003,dept:"Management",age:35}, {emp_id:1004,emp_name:"Balu",age:40,dept:"Production"}])
{
  acknowledged: true,
  insertedIds: {
    '0': ObjectId("641876be48304d22ba39626c"),
    '1': ObjectId("641876be48304d22ba39626d"),
    '2': ObjectId("641876be48304d22ba39626e")
  }
}
```


3. Read

To retrieve documents from a collection

```
db.data.find()
```

```
employee> db.data.find()  
[  
  {  
    _id: ObjectId("6418761848304d22ba39626b"),  
    emp_name: 'Ram',  
    emp_id: 1001,  
    age: 25,  
    dept: 'Sales'  
  },  
  {  
    _id: ObjectId("641876be48304d22ba39626c"),  
    emp_name: 'Sam',  
    emp_id: 1002,  
    age: 30,  
    dept: 'Accounts'  
  },  
  {  
    _id: ObjectId("641876be48304d22ba39626d"),  
    emp_name: 'Raju',  
    emp_id: 1003,  
    dept: 'Management',  
    age: 35  
  },  
  {  
    _id: ObjectId("641876be48304d22ba39626e"),  
    emp_id: 1004,  
    emp_name: 'Balu',  
    age: 40,  
    dept: 'Production'  
  }  
]
```

4. Update

To modify existing documents in a collection

```
db.data.updateOne({emp_id:1003},{ $set:{age:50}})
```

```
employee> db.data.updateOne({emp_id:1003},{ $set:{age:50}})
{
  acknowledged: true,
  insertedId: null,
  matchedCount: 1,
  modifiedCount: 1,
  upsertedCount: 0
}
employee> db.data.find({emp_id:1003})
[
  {
    _id: ObjectId("641876be48304d22ba39626d"),
    emp_name: 'Raju',
    emp_id: 1003,
    dept: 'Management',
    age: 50
  }
]
```

5. Delete

To remove documents from a collection

```
db.data.deleteMany({age:{ $lt:38}})
```

```
employee> db.data.updateOne({emp_id:1003},{ $set:{age:50}})
{
  acknowledged: true,
  insertedId: null,
  matchedCount: 1,
  modifiedCount: 1,
  upsertedCount: 0
}
employee> db.data.find({emp_id:1003})
[
  {
    _id: ObjectId("641876be48304d22ba39626d"),
    emp_name: 'Raju',
    emp_id: 1003,
    dept: 'Management',
    age: 50
  }
]
```

Result:

EXP NO : 10
DATE: 12-04-23

HADOOP INSTALLATION

A student management system has been designed using MongoDB and CRUD operations have been performed on it successfully.

Aim:

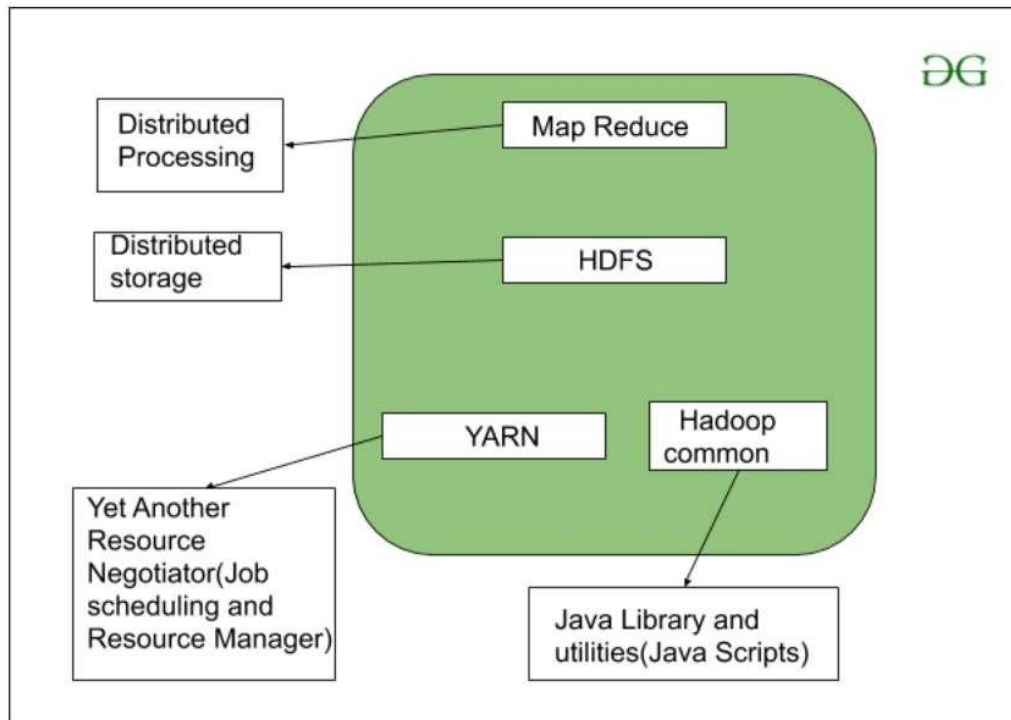
To study about the architecture of Hadoop and its components.

Theory:

Hadoop is a framework written in Java that utilizes a large cluster of commodity hardware to maintain and store big size data. Hadoop works on MapReduce Programming Algorithm that was introduced by Google.

The Hadoop Architecture Mainly consists of 4 components:

- MapReduce
- HDFS(Hadoop distributed File System)
- YARN(Yet Another Resource Framework)
- Common Utilities or Hadoop Common



Components of Hadoop Architecture

1. MapReduce

MapReduce is an Algorithm or a data structure that is based on the YARN framework. The major feature of MapReduce is to perform the distributed processing in parallel in a Hadoop cluster which Makes Hadoop fast. MapReduce has 2 main tasks which are divided phase-wise. In first phase, Map is utilized and in next phase Reduce is utilized.

The Input is provided to the Map() function and then its output is used as an input to the Reduce() function to receive the final output. The Input is a set of Data. The Map() function breaks data blocks into tuples that are key-value pairs. These key-value pairs are now sent as input to the Reduce(). The Reduce() function then combines the broken key-value pairs based on its key value and form set of tuples. Some operation like sorting, summation, etc. is performed which is then sent to the final Output Node which generates the final output.

2. HDFS

The Hadoop Distributed File System (HDFS) is a distributed file system for Hadoop. It contains a master/slave architecture. This architecture consist of a single NameNode performs the role of master, and multiple DataNodes performs the role of a slave. Both NameNode and DataNode are capable enough to run on commodity machines. The Java language is used to develop HDFS. So any machine that supports Java language can easily run the NameNode and DataNode software.

The NameNode manages the file system namespace by executing an operation like the opening, renaming and closing the files. The HDFS cluster contains several DataNodes each of which contains multiple data blocks that store data. The DataNodes read and write requests from the file system's clients.

3. YARN

YARN is a Framework on which MapReduce works. YARN performs 2 operations that are Job scheduling and Resource Management. The Purpose of Job scheduler is to divide a big task into small jobs so that each job can be assigned to various slaves in a Hadoop cluster and processing can be maximized. Job Scheduler also keeps track of which job is important, which job has more priority, dependencies between the jobs and all the other information like job timing, etc. And the use of resource manager is to manage all the resources that are made available for running a Hadoop cluster.

4. Hadoop Common

Hadoop common or Common utilities are nothing but Java library and Java files or the java scripts that are needed for all the other components present in a Hadoop cluster. These utilities are used by HDFS, YARN, and MapReduce for running the cluster. Hadoop Common

INSTALL AND CONFIGURE HADOOP IN ITS TWO OPERATING MODES:

HADOOP SINGLE-NODE CLUSTER INSTALLATION

1. Download the Java 8 Package. Save this file in your home directory.
2. Extract the Java Tar File.

```
tar -xvf jdk-8u101-linux-i586.tar.gz
```

3. Download the Hadoop 2.7.3 Package.

```
https://archive.apache.org/dist/hadoop/core/hadoop-2.7.3/hadoop-2.7.3.tar.gz
```

4. Extract the Hadoop tar File.

```
tar -xvf hadoop-2.7.3.tar.gz
```

5. Add the Hadoop and Java paths in the bash file (.bashrc).

Open. bashrc file. Now, add Hadoop and Java Path as shown below.

```
vi .bashrc
```

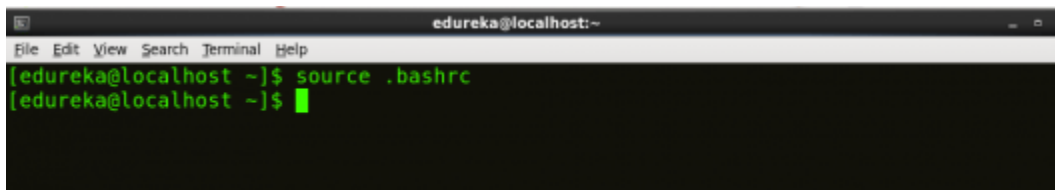
```
# User specific aliases and functions

export HADOOP_HOME=$HOME/hadoop-2.7.3
export HADOOP_CONF_DIR=$HOME/hadoop-2.7.3/etc/hadoop
export HADOOP_MAPRED_HOME=$HOME/hadoop-2.7.3
export HADOOP_COMMON_HOME=$HOME/hadoop-2.7.3
export HADOOP_HDFS_HOME=$HOME/hadoop-2.7.3
export YARN_HOME=$HOME/hadoop-2.7.3
export PATH=$PATH:$HOME/hadoop-2.7.3/bin

# Set JAVA_HOME
export JAVA_HOME=/home/edureka/jdk1.8.0_101
export PATH=/home/edureka/jdk1.8.0_101/bin:$PATH
```

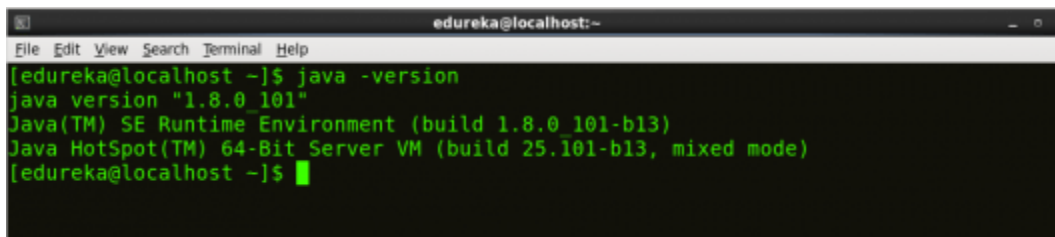
Then, save the bash file and close it. For applying all these changes to the current Terminal, execute the source command.

```
source .bashrc
```

A terminal window titled 'edureka@localhost:~' with a menu bar (File, Edit, View, Search, Terminal, Help). The prompt is '[edureka@localhost ~]\$'. The command 'source .bashrc' has been entered and executed, resulting in a new prompt '[edureka@localhost ~]\$' with a green cursor.

To make sure that Java and Hadoop have been properly installed on your system and can be accessed through the Terminal, execute the java -version and hadoop version commands.

```
java -version
```

A terminal window titled 'edureka@localhost:~' with a menu bar (File, Edit, View, Search, Terminal, Help). The prompt is '[edureka@localhost ~]\$'. The command 'java -version' has been entered and executed, resulting in the following output: 'java version "1.8.0_101"', 'Java(TM) SE Runtime Environment (build 1.8.0_101-b13)', and 'Java HotSpot(TM) 64-Bit Server VM (build 25.101-b13, mixed mode)'. The prompt is now '[edureka@localhost ~]\$' with a green cursor.

```
hadoop version
```

```
edureka@localhost:~$ hadoop version
Hadoop 2.7.3
Subversion https://git-wip-us.apache.org/repos/asf/hadoop.git -r baa91f7c6bc9cb92be5982de4719c1c8af91ccff
Compiled by root on 2016-08-18T01:41Z
Compiled with protoc 2.5.0
From source with checksum 2e4ce5f957ea4db193bce3734ff29ff4
This command was run using /home/edureka/hadoop-2.7.3/share/hadoop/common/hadoop-common-2.7.3.jar
[edureka@localhost ~]$
```

6. Edit the Hadoop Configuration files.

```
cd hadoop-2.7.3/etc/hadoop/
ls
```

```
edureka@localhost:~/hadoop-2.7.3/etc/hadoop$ ls
capacity-scheduler.xml  httpfs-env.sh          mapred-env.sh
configuration.xml       httpfs-log4j.properties mapred-queues.xml.template
container-executor.cfg  httpfs-signature.secret mapred-site.xml.template
core-site.xml           httpfs-site.xml        slaves
hadoop-env.cmd          kms-acls.xml           ssl-client.xml.example
hadoop-env.sh           kms-env.sh             ssl-server.xml.example
hadoop-metrics2.properties kms-log4j.properties  yarn-env.cmd
hadoop-metrics.properties kms-site.xml           yarn-env.sh
hadoop-policy.xml       log4j.properties      yarn-site.xml
hdfs-site.xml           mapred-env.cmd
```

7. Open core-site.xml and edit the property mentioned below inside configuration tag:

```
vi core-site.xml
```

```
<?xml version="1.0" encoding="UTF-8"?>
<?xml-stylesheet type="text/xsl" href="configuration.xsl"?>
<configuration>
  <property>
    <name>fs.default.name</name>
    <value>hdfs://localhost:9000</value>
  </property>
</configuration>
```

8. Open hdfs-site.xml and edit the property mentioned below inside configuration tag:


```
vi hdfs-site.xml
```

```
<?xml version="1.0" encoding="UTF-8"?>
<?xml-stylesheet type="text/xsl" href="configuration.xsl"?>
<configuration>
  <property>
    <name>dfs.replication</name>
    <value>1</value>
  </property>
  <property>
    <name>dfs.permission</name>
    <value>>false</value>
  </property>
</configuration>
```

9. Open mapred-site.xml and edit the property mentioned below inside configuration tag:

```
vi mapred-site.xml
```

```
<?xml version="1.0" encoding="UTF-8"?>
<?xml-stylesheet type="text/xsl" href="configuration.xsl"?>
<configuration>
  <property>
    <name>mapreduce.framework.name</name>
    <value>yarn</value>
  </property>
</configuration>
```

10. Open yarn-site.xml and edit the property mentioned below inside configuration tag:

```
vi yarn-site.xml
```

```
<?xml version="1.0">
<configuration>
  <property>
    <name>yarn.nodemanager.aux-services</name>
    <value>mapreduce_shuffle</value>
  </property>
  <property>
    <name>yarn.nodemanager.auxservices.mapreduce.shuffle.class</name>
    <value>org.apache.hadoop.mapred.ShuffleHandler</value>
  </property>
</configuration>
```

11. Edit `hadoop-env.sh` and add the Java Path as mentioned below:

```
vi hadoop-env.sh
```

```
# The java implementation to use.  
export JAVA_HOME=/home/edureka/jdk1.8.0_101
```

12. Go to Hadoop home directory and format the NameNode.

```
cd  
cd Hadoop-2.7.3  
bin/Hadoop namenode -format
```

13. Once the NameNode is formatted, go to `hadoop-2.7.3/sbin` directory and start all the daemons.

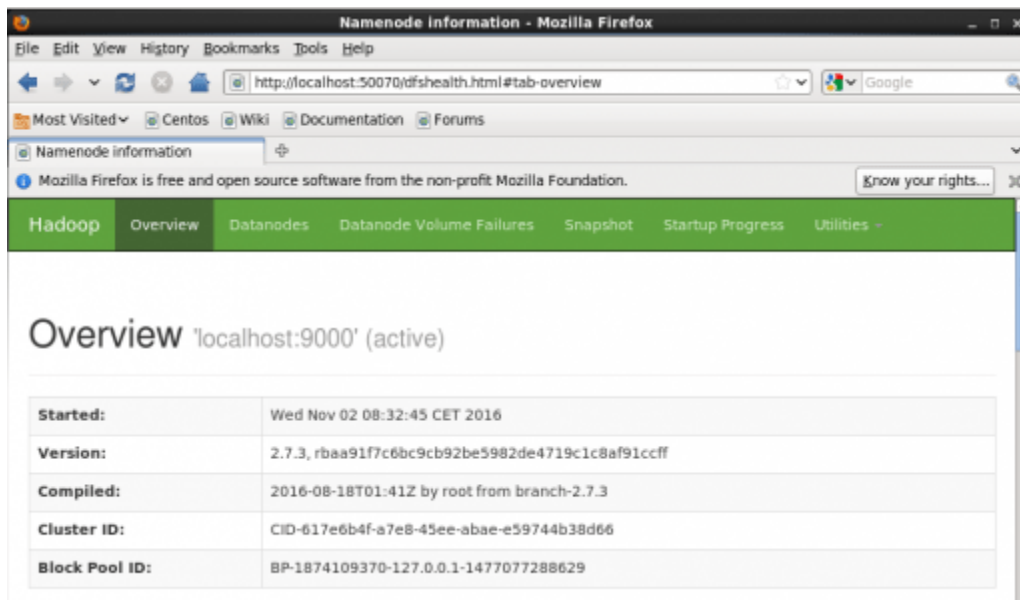
```
cd hadoop-2.7.3/sbin  
./start-all.sh
```

14. To check that all the Hadoop services are up and running, run the below command.

```
jps
```

```
edureka@localhost:~/hadoop-2.7.3/sbin
File Edit View Search Terminal Help
[edureka@localhost sbin]$ ./mr-jobhistory-daemon.sh start historyserver
starting historyserver, logging to /home/edureka/hadoop-2.7.3/logs/mapred-edureka-h
istoryserver-localhost.localdomain.out
[edureka@localhost sbin]$ jps
22113 NameNode
22310 ResourceManager
22694 JobHistoryServer
22727 Jps
22206 DataNode
22559 NodeManager
[edureka@localhost sbin]$
```

15. Now open the Mozilla browser and go to localhost:50070/dfshealth.html to check the NameNode interface.



Thus, Single-node Hadoop cluster is installed.

HADOOP MULTI -NODE CLUSTER INSTALLATION

1. Check the IP address of all machines.

```
ip addr show
```

```
edureka@master:~/hadoop-2.7.3
File Edit View Search Terminal Help
[edureka@master hadoop-2.7.3]$ ip addr show
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 16436 qdisc noqueue state UNKNOWN
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
    inet6 ::1/128 scope host
        valid_lft forever preferred_lft forever
2: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP qlen 1000
    link/ether 08:00:27:70:7b:0d brd ff:ff:ff:ff:ff:ff
    inet6 fe80::a00:27ff:fe70:7b0d/64 scope link
        valid_lft forever preferred_lft forever
3: eth1: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP qlen 1000
    link/ether 08:00:27:99:c4:ff brd ff:ff:ff:ff:ff:ff
    inet 192.168.56.102/24 brd 192.168.56.255 scope global eth1
    inet6 fe80::a00:27ff:fe99:c4ff/64 scope link
        valid_lft forever preferred_lft forever
[edureka@master hadoop-2.7.3]$

edureka@slave:~
File Edit View Search Terminal Help
[edureka@slave ~]$ ip addr show
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 16436 qdisc noqueue state UNKNOWN
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
    inet6 ::1/128 scope host
        valid_lft forever preferred_lft forever
2: eth2: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP qlen 1000
    link/ether 08:00:27:97:9a:f4 brd ff:ff:ff:ff:ff:ff
    inet 10.0.2.15/24 brd 10.0.2.255 scope global eth2
    inet6 fe80::a00:27ff:fe97:9af4/64 scope link
        valid_lft forever preferred_lft forever
3: eth3: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP qlen 1000
    link/ether 08:00:27:59:dd:cb brd ff:ff:ff:ff:ff:ff
    inet 192.168.56.103/24 brd 192.168.56.255 scope global eth3
    inet6 fe80::a00:27ff:fe59:ddcb/64 scope link
        valid_lft forever preferred_lft forever
[edureka@slave ~]$
```

2. Disable the firewall restrictions.

```
service iptables stop
sudo chkconfig iptables off
```

```
edureka@slave:~
File Edit View Search Terminal Help
[edureka@slave ~]$ service iptables stop
[edureka@slave ~]$ sudo chkconfig iptables off
[sudo] password for edureka:
[edureka@slave ~]$
```

3. Open hosts file to add master and data node with their respective IP addresses.

```
sudo nano /etc/hosts
```

```
edureka@master:~/hadoop-2.7.3
File Edit View Search Terminal Help
GNU nano 2.0.9 File: /etc/hosts
127.0.0.1 localhost localhost.localdomain localhost4 localhost4.localdomain4
192.168.56.102 master
192.168.56.103 slave
```

- Restart the sshd service.

```
service sshd restart
```

- Create the SSH Key in the master node. (Press enter button when it asks you to enter a filename to save the key).

```
ssh-keygen -t rsa -P ""
```

```
edureka@localhost:~
File Edit View Search Terminal Help
[edureka@master ~]$ ssh-keygen -t rsa -P ""
Generating public/private rsa key pair.
Enter file in which to save the key (/home/edureka/.ssh/id_rsa):
Your identification has been saved in /home/edureka/.ssh/id_rsa.
Your public key has been saved in /home/edureka/.ssh/id_rsa.pub.
The key fingerprint is:
d9:95:df:04:b3:d8:36:7a:ef:dc:20:c2:1f:33:44 edureka@master
The key's randomart image is:
+--[ RSA 2048 ]-----+
|      o               |
|    + +              |
|  E B .              |
| o o = =             |
| S . o o .           |
| . . . .             |
| o = . .             |
| o = + .             |
| . +                 |
+-----+
[edureka@master ~]$
```

- Copy the generated ssh key to master node's authorized keys.

```
cat $HOME/.ssh/id_rsa.pub >> HOME/.ssh/authorized_keys
```

7. Copy the master node's ssh key to slave's authorized keys.

```
ssh-copy-id -i $HOME/.ssh/id_rsa.pub edureka@slave
```

8. Download the Java 8 Package. Save this file in your home directory.

9. Extract the Java Tar File.

```
tar -xvf jdk-8u101-linux-i586.tar.gz
```

10. Download the Hadoop 2.7.3 Package.

```
https://archive.apache.org/dist/hadoop/core/hadoop-2.7.3/hadoop-2.7.3.tar.gz
```

11. Extract the Hadoop tar File.

```
tar -xvf hadoop-2.7.3.tar.gz
```

12. Add the Hadoop and Java paths in the bash file (.bashrc).

Open. bashrc file. Now, add Hadoop and Java Path as shown below.

```
vi .bashrc
```

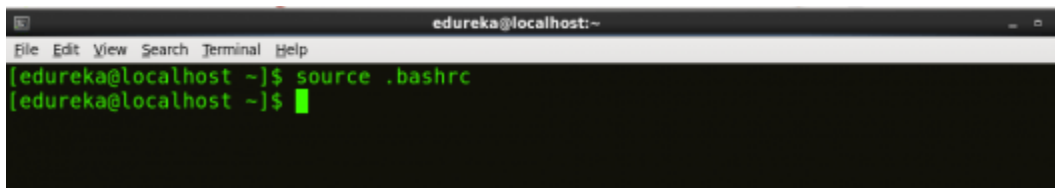
```
# User specific aliases and functions

export HADOOP_HOME=$HOME/hadoop-2.7.3
export HADOOP_CONF_DIR=$HOME/hadoop-2.7.3/etc/hadoop
export HADOOP_MAPRED_HOME=$HOME/hadoop-2.7.3
export HADOOP_COMMON_HOME=$HOME/hadoop-2.7.3
export HADOOP_HDFS_HOME=$HOME/hadoop-2.7.3
export YARN_HOME=$HOME/hadoop-2.7.3
export PATH=$PATH:$HOME/hadoop-2.7.3/bin

# Set JAVA_HOME
export JAVA_HOME=/home/edureka/jdk1.8.0_101
export PATH=/home/edureka/jdk1.8.0_101/bin:$PATH
```

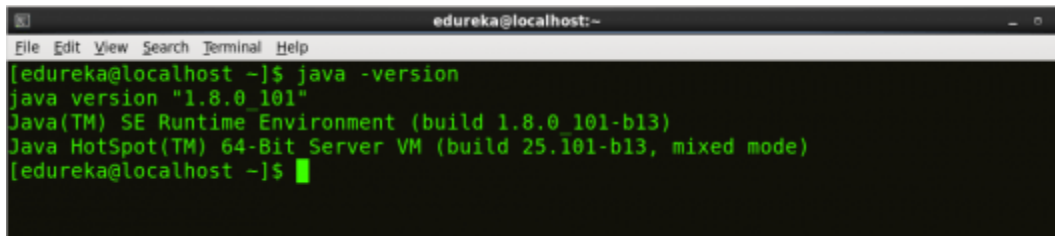
Then, save the bash file and close it. For applying all these changes to the current Terminal, execute the source command.

```
source .bashrc
```

A screenshot of a terminal window titled 'edureka@localhost:~'. The terminal shows the command '[edureka@localhost ~]\$ source .bashrc' being entered and executed, followed by a new prompt '[edureka@localhost ~]\$' with a green cursor. The terminal has a menu bar with 'File', 'Edit', 'View', 'Search', 'Terminal', and 'Help'.

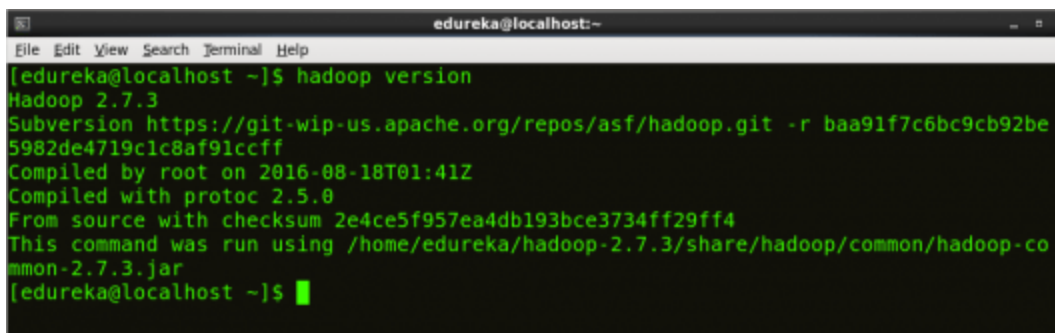
To make sure that Java and Hadoop have been properly installed on your system and can be accessed through the Terminal, execute the java -version and hadoop version commands.

```
java -version
```



```
edureka@localhost:~  
File Edit View Search Terminal Help  
[edureka@localhost ~]$ java -version  
java version "1.8.0_101"  
Java(TM) SE Runtime Environment (build 1.8.0_101-b13)  
Java HotSpot(TM) 64-Bit Server VM (build 25.101-b13, mixed mode)  
[edureka@localhost ~]$
```

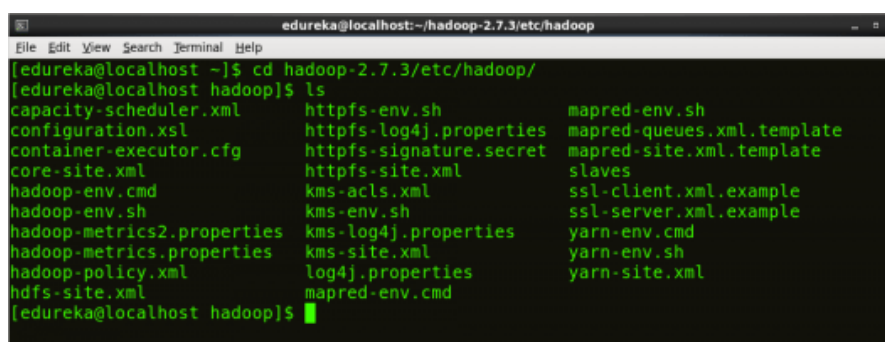
```
hadoop version
```



```
edureka@localhost:~  
File Edit View Search Terminal Help  
[edureka@localhost ~]$ hadoop version  
Hadoop 2.7.3  
Subversion https://git-wip-us.apache.org/repos/asf/hadoop.git -r baa91f7c6bc9cb92be5982de4719c1c8af91ccff  
Compiled by root on 2016-08-18T01:41Z  
Compiled with protoc 2.5.0  
From source with checksum 2e4ce5f957ea4db193bce3734ff29ff4  
This command was run using /home/edureka/hadoop-2.7.3/share/hadoop/common/hadoop-common-2.7.3.jar  
[edureka@localhost ~]$
```

Edit the Hadoop Configuration files.

```
cd hadoop-2.7.3/etc/hadoop/  
ls
```



```
edureka@localhost:~/hadoop-2.7.3/etc/hadoop  
File Edit View Search Terminal Help  
[edureka@localhost ~]$ cd hadoop-2.7.3/etc/hadoop/  
[edureka@localhost hadoop]$ ls  
capacity-scheduler.xml    httpfs-env.sh            mapred-env.sh  
configuration.xml         httpfs-log4j.properties  mapred-queues.xml.template  
container-executor.cfg    httpfs-signature.secret  mapred-site.xml.template  
core-site.xml             httpfs-site.xml          slaves  
hadoop-env.cmd            kms-acls.xml             ssl-client.xml.example  
hadoop-env.sh             kms-env.sh               ssl-server.xml.example  
hadoop-metrics2.properties kms-log4j.properties    yarn-env.cmd  
hadoop-metrics.properties kms-site.xml             yarn-env.sh  
hadoop-policy.xml         log4j.properties        yarn-site.xml  
hdfs-site.xml             mapred-env.cmd  
[edureka@localhost hadoop]$
```

13. Create masters file and edit as follows in both master and slave machines as

```
sudo gedit masters
```

below:

14. Edit slaves file in master machine as follows:

```
sudo gedit /home/edureka/hadoop-2.7.3/etc/hadoop/slaves
```

15. Edit slaves file in slave machine as follows:

```
sudo gedit /home/edureka/hadoop-2.7.3/etc/hadoop/slaves
```

16. Edit core-site.xml on both master and slave machines as follows:

```
sudo gedit /home/edureka/hadoop-2.7.3/etc/hadoop/core-site.xml
```

17. Edit hdfs-site.xml on master machine as follows:

```
sudo gedit /home/edureka/hadoop-2.7.3/etc/hadoop/hdfs-site.xml
```

18. Edit core-site.xml on slave machine as follows:

```
sudo gedit /home/edureka/hadoop-2.7.3/etc/hadoop/core-site.xml
```

19. Copy mapred-site from the template in configuration folder and the edit mapred-site.xml on both master and slave machines as follows:

```
cp mapred-site.xml.template mapred-site.xml  
sudo gedit /home/edureka/hadoop-2.7.3/etc/hadoop/mapred-site.xml
```

20. Edit yarn-site.xml on both master and slave machines as follows:

```
sudo gedit /home/edureka/hadoop-2.7.3/etc/hadoop/yarn-site.xml
```

21.Format the namenode (Only on master machine).

```
hadoop namenode -format
```

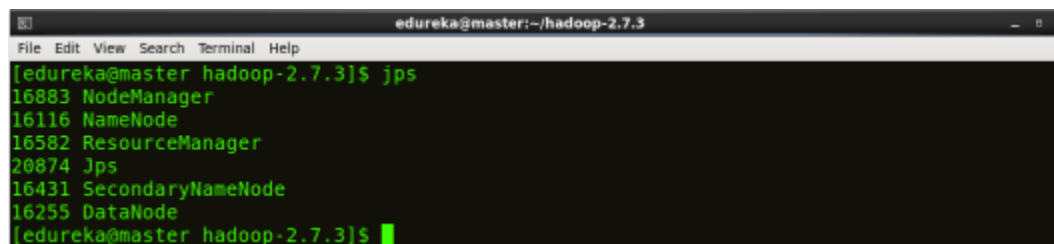
22.Start all daemons (Only on master machine).

```
./sbin/start-all.sh
```

23.Check all the daemons running on both master and slave machines.

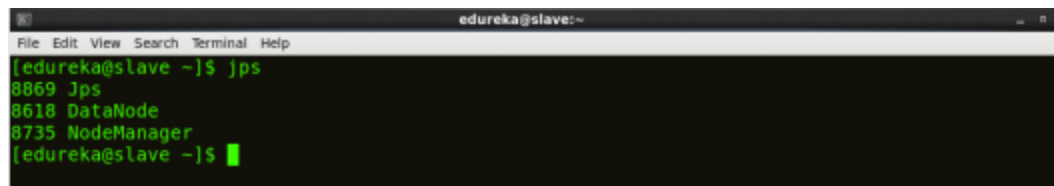
```
jps
```

On master:

A terminal window titled 'edureka@master:~/hadoop-2.7.3' showing the output of the 'jps' command. The output lists several Hadoop daemons with their respective PIDs: 16883 NodeManager, 16116 NameNode, 16582 ResourceManager, 20874 Jps, 16431 SecondaryNameNode, and 16255 DataNode.

```
edureka@master:~/hadoop-2.7.3
File Edit View Search Terminal Help
[edureka@master hadoop-2.7.3]$ jps
16883 NodeManager
16116 NameNode
16582 ResourceManager
20874 Jps
16431 SecondaryNameNode
16255 DataNode
[edureka@master hadoop-2.7.3]$
```

On slave:

A terminal window titled 'edureka@slave:~' showing the output of the 'jps' command. The output lists three Hadoop daemons with their respective PIDs: 8869 Jps, 8618 DataNode, and 8735 NodeManager.

```
edureka@slave:~
File Edit View Search Terminal Help
[edureka@slave ~]$ jps
8869 Jps
8618 DataNode
8735 NodeManager
[edureka@slave ~]$
```

24. Open the browser and go to master:50070/dfshealth.html on your master machine, this will give you the NameNode interface.

Configured Capacity:	34.47 GB
DFS Used:	48 KB (0%)
Non DFS Used:	17.15 GB
DFS Remaining:	17.32 GB (50.25%)
Block Pool Used:	48 KB (0%)
DataNodes usages% (Min/Median/Max/stdDev):	0.00% / 0.00% / 0.00% / 0.00%
Live Nodes	2 (Decommissioned: 0)
Dead Nodes	0 (Decommissioned: 0)
Decommissioning Nodes	0
Total Datanode Volume Failures	0 (0 B)
Number of Under-Replicated Blocks	0
Number of Blocks Pending Deletion	0

Thus, Multi-node Hadoop cluster is installed.

RESULT:

Thus, Hadoop has been successfully installed.

EXP NO : 11
DATE: 19-04-23

VISUALIZATION TOOLS IN PYTHON

Aim:

To study about the visualization tools in python that are used for data analytics.

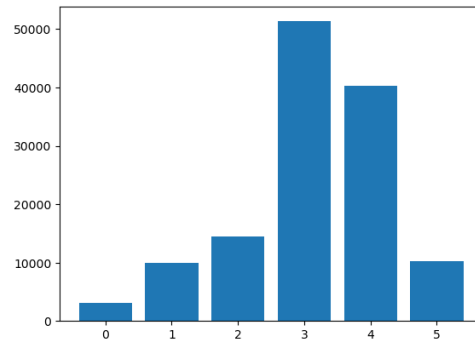
IMPORTING PACKAGES AND DATASET

```
import pandas as pd
import numpy as np
df = pd.read_csv("dataset.csv")
df.head()
```

	PM2.5	PM10	NO2	SO2	O3	AQI
0	104.00	148.50	23.00	15.30	117.62	3.0
1	94.50	142.00	16.25	17.00	136.23	3.0
2	82.75	126.50	14.83	15.40	149.92	3.0
3	68.50	117.00	13.60	21.80	161.70	3.0
4	69.25	112.25	11.80	21.38	161.68	3.0

1. BARPLOT

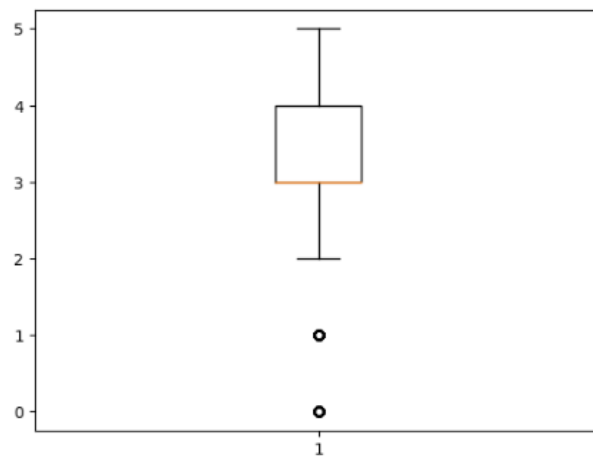
```
import matplotlib.pyplot as plt
plot = df['AQI'].value_counts()
plt.bar(plot.index,plot.values)
```



2. BOXPLOT

```
plt.boxplot(df['AQI'])
```

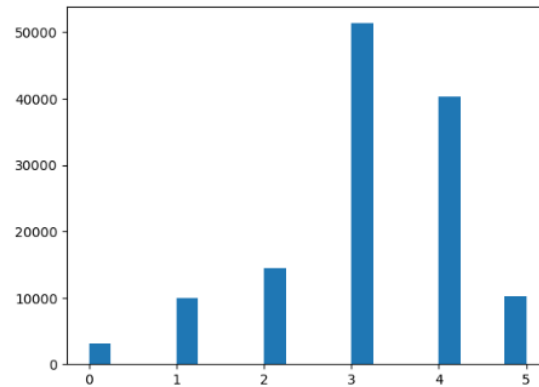
```
{'whiskers': [<matplotlib.lines.Line2D at 0x2193de25e20>,
<matplotlib.lines.Line2D at 0x2193de39160>],
'caps': [<matplotlib.lines.Line2D at 0x2193de39430>,
<matplotlib.lines.Line2D at 0x2193de39700>],
'boxes': [<matplotlib.lines.Line2D at 0x2193de25b50>],
'medians': [<matplotlib.lines.Line2D at 0x2193de399d0>],
'fliers': [<matplotlib.lines.Line2D at 0x2193de39ca0>],
'means': []}
```



3. HISTOGRAM

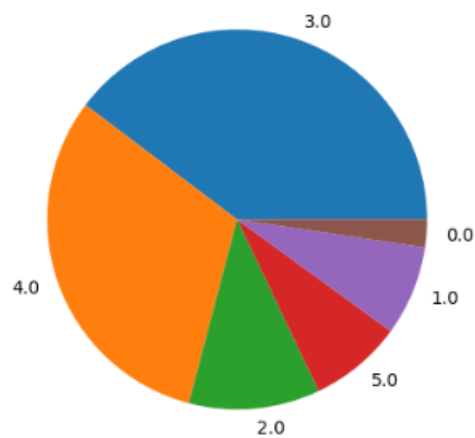
```
plt.hist(df['AQI'],bins=20)
```

```
(array([ 3047.,    0.,    0.,    0., 9896.,    0.,    0.,    0.,
       14425.,    0.,    0.,    0., 51330.,    0.,    0.,    0.,
        40336.,    0.,    0., 10243.]),
 array([0., 0.25, 0.5, 0.75, 1., 1.25, 1.5, 1.75, 2., 2.25, 2.5,
        2.75, 3., 3.25, 3.5, 3.75, 4., 4.25, 4.5, 4.75, 5. ]),
 <BarContainer object of 20 artists>)
```



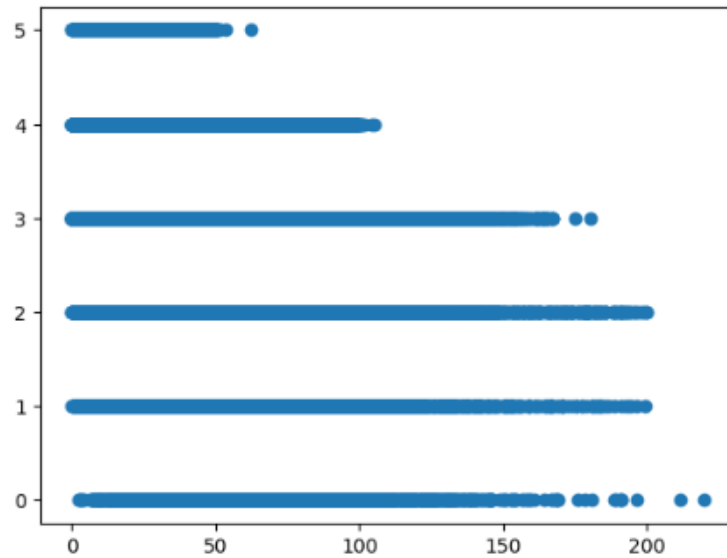
4. PIECHART

```
plt.pie(df['AQI'].value_counts(),labels=df['AQI'].value_counts().index)
```



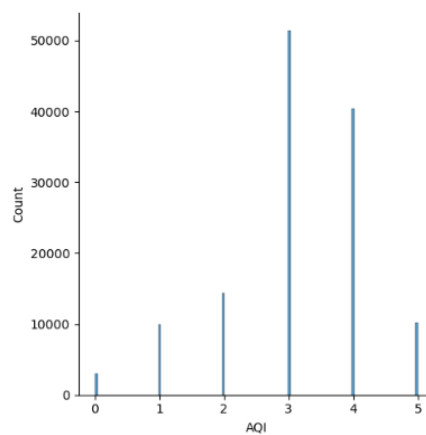
5. SCATTERPLOT

```
plt.scatter(df['O3'],df['AQI'])
```



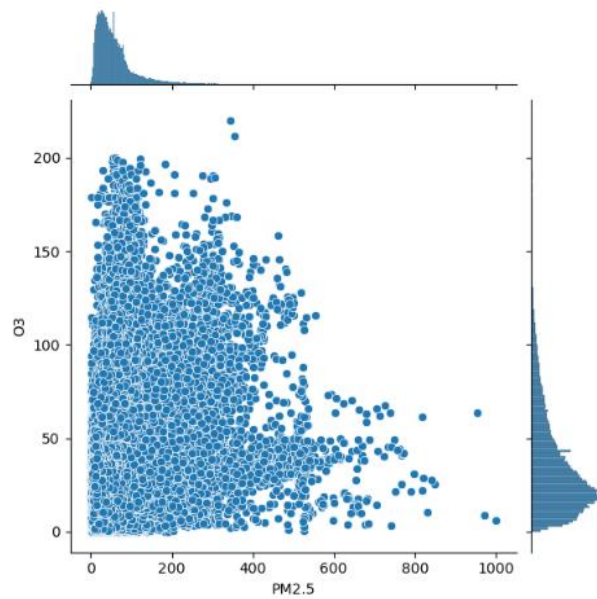
6. SEABORN

```
import seaborn as sns
sns.displot(df['AQI'])
```



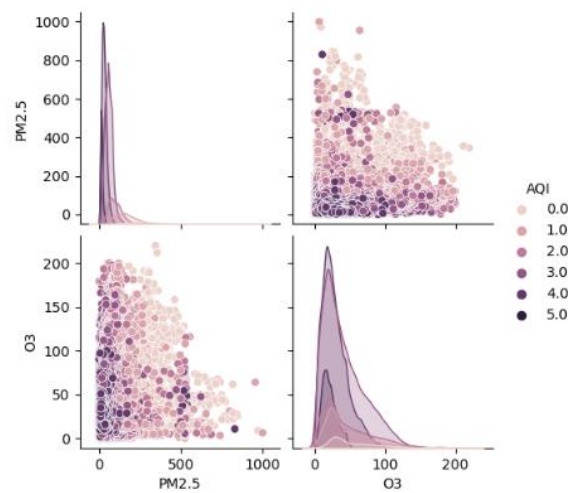
7. JOINTPLOT

```
sns.jointplot(x='PM2.5',y='O3',data=df)
```



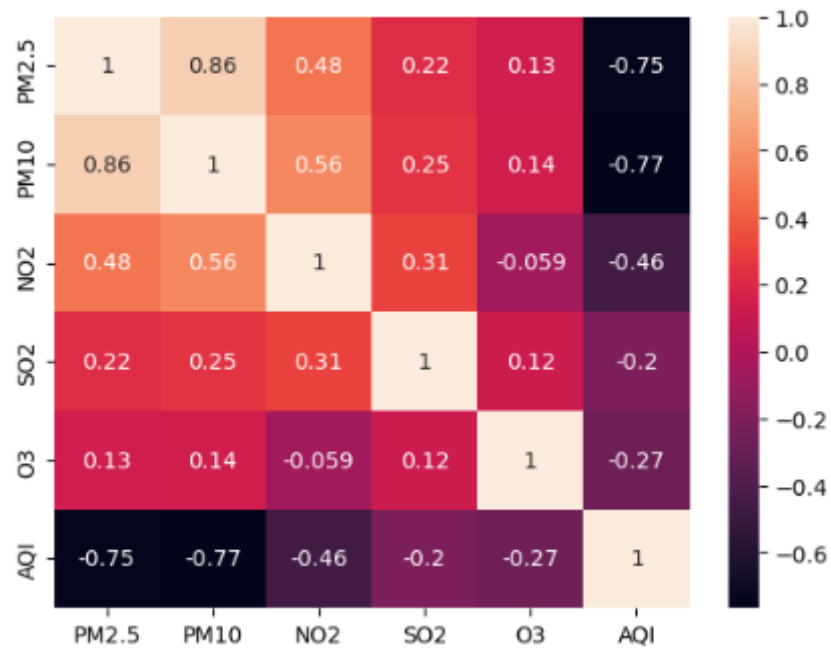
8. PAIRPLOT

```
sns.pairplot(df, vars=['PM2.5', 'O3'], hue='AQI')
```



9. HEATMAP

```
sns.heatmap(df.corr(), annot=True)
```

RESULT:

Thus, a study on the visualization tools in Python used for data analysis has been made.