VISVESVARAYA TECHNOLOGICAL UNIVERSITY

“JnanaSangama”, Belgaum -590014, Karnataka.

LAB REPORT
on

MACHINE LEARNING
(20CS6PCMAL)

Submitted by

PRITHVI J (1BM19CS122)

in partial fulfillment for the award of the degree of
BACHELOR OF ENGINEERING
in
COMPUTER SCIENCE AND ENGINEERING

B.M.S. COLLEGE OF ENGINEERING
(Autonomous Institution under VTU)
BENGALURU-560019
May-2022 to July-2022

B. M. S. College of Engineering,

Bull Temple Road, Bangalore 560019

(Affiliated To Visvesvaraya Technological University, Belgaum)

Department of Computer Science and Engineering

CERTIFICATE

This is to certify that the Lab work entitled “**MACHINE LEARNING**” was carried out by **PRITHVI J (1BM19CS122),** who is a bona fide student of **B. M. S. College of Engineering.** It is in partial fulfillment for the award of **Bachelor of Engineering in Computer Science and Engineering** of the Visvesvaraya Technological University, Belgaum during the year 2022. The Lab report has been approved as it satisfies the academic requirements in respect of the course **MACHINE LEARNING (20CS6PCMAL)** work prescribed for the said degree.

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Course Outcome :-

At the end of the course the student will be able to

CO1	Ability to apply the different learning algorithms.
CO2	Ability to analyze the learning techniques for given dataset.
CO3	Ability to design a model using machine learning to solve a problem.
CO4	Ability to conduct practical experiments to solve problems using appropriate machine learning techniques.

Lab Program -1 :-

Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples.

Source code and output :-

```
+*In[1]:*+

[source, ipython3]

----

import csv

hypo = ['%','%','%','%','%','%'];


with open(r'C:\Users\Admin\OneDrive\Desktop\6th sem\ML\lab-ml\lab 1\finds.csv') as csv_file:

    readcsv = csv.reader(csv_file, delimiter=',')

    print(readcsv)


    data = []

    print("\nThe given training examples are:")

    for row in readcsv:

        print(row)

        if row[len(row)-1].upper() == "YES":

            data.append(row)

----
```

```
+*Out[1]:*+

----

<_csv.reader object at 0x0000013B7E4DFD60>
```

```
The given training examples are:
['sky', 'air temp', 'humidity', 'wind', 'water', 'forecast', 'enjoy sport']
['sunny', 'warm', 'normal', 'strong', 'warm', 'same', 'yes']
['sunny', 'warm', 'high', 'strong', 'warm', 'same', 'yes']
['rainy', 'cold', 'high', 'strong', 'warm', 'change', 'no']
['sunny', 'warm', 'high', 'strong', 'cool', 'change', 'yes']
----
```

+*In[2]:*+

```
[source, ipython3]
----
print("\nThe positive examples are:");
for x in data:
    print(x);
print("\n");
----
```

+*Out[2]:*+

```
----

The positive examples are:
['sunny', 'warm', 'normal', 'strong', 'warm', 'same', 'yes']
['sunny', 'warm', 'high', 'strong', 'warm', 'same', 'yes']
['sunny', 'warm', 'high', 'strong', 'cool', 'change', 'yes']
```

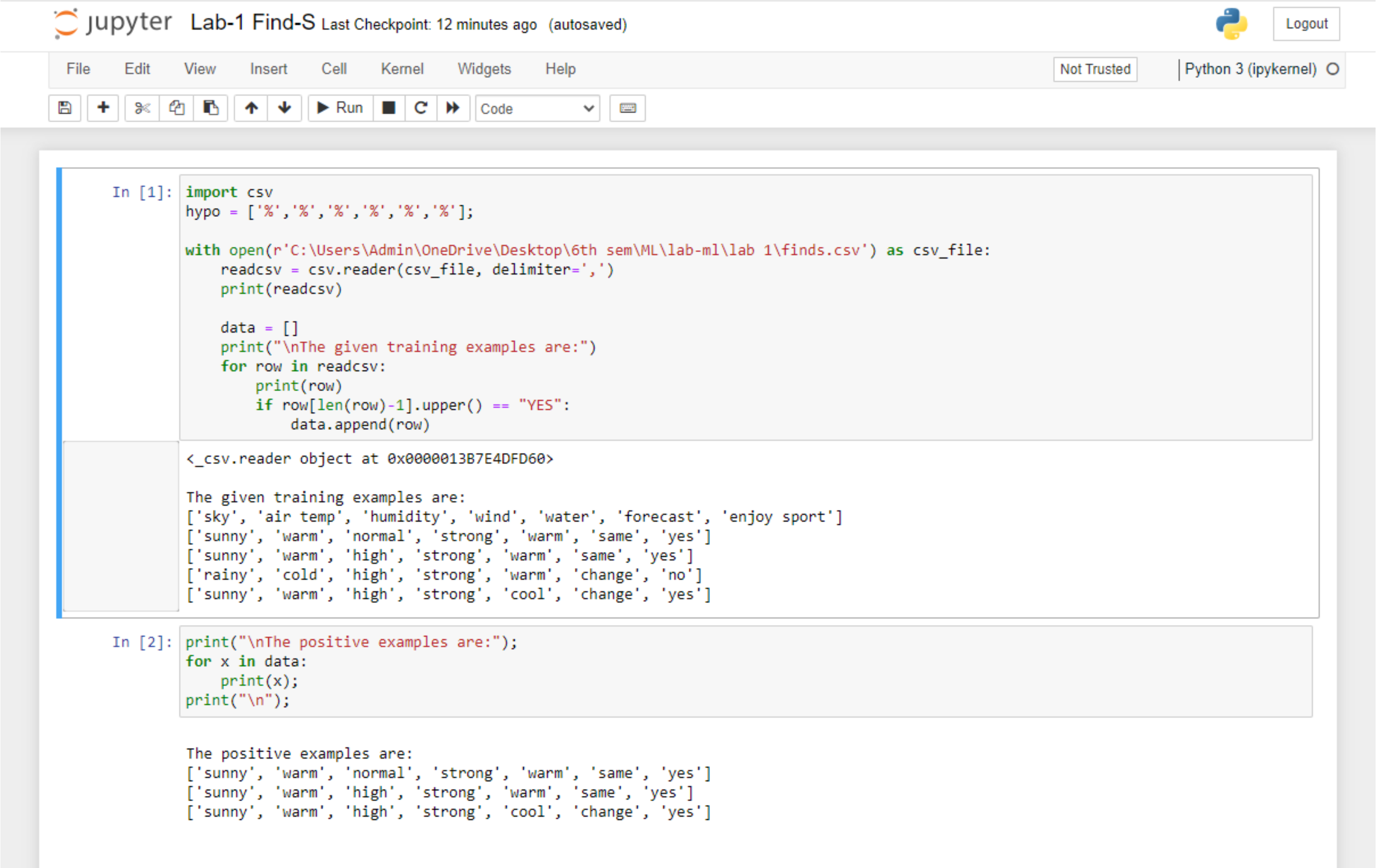
```
----



+*In[3]:*+
[source, ipython3]
----
TotalExamples = len(data);
i=0;
j=0;
k=0;
print("The steps of the Find-s algorithm are :\n",hypo);
list = [];
p=0;
d=len(data[p])-1;
for j in range(d):
    list.append(data[i][j]);
hypo=list;
i=1;
for i in range(TotalExamples):
    for k in range(d):
        if hypo[k]!=data[i][k]:
            hypo[k]='?';
            k=k+1;
        else:
            hypo[k];
    print(hypo);
i=i+1;
----
```

```
+*Out[3]:*+
----
The steps of the Find-s algorithm are :
 ['%', '%', '%', '%', '%', '%']
['sunny', 'warm', 'normal', 'strong', 'warm', 'same']
['sunny', 'warm', '?', 'strong', 'warm', 'same']
['sunny', 'warm', '?', 'strong', '?', '?']
----


+*In[4]:*+
[source, ipython3]
----
print("\nThe maximally specific Find-s hypothesis for the given training examples is :");
list=[];
for i in range(d):
    list.append(hypo[i]);
print(list);
----


+*Out[4]:*+
----

The maximally specific Find-s hypothesis for the given training examples is :
['sunny', 'warm', '?', 'strong', '?', '?']
----
```

+*In[ ]:*+

[source, ipython3]

<u>Output screenshots :-</u>

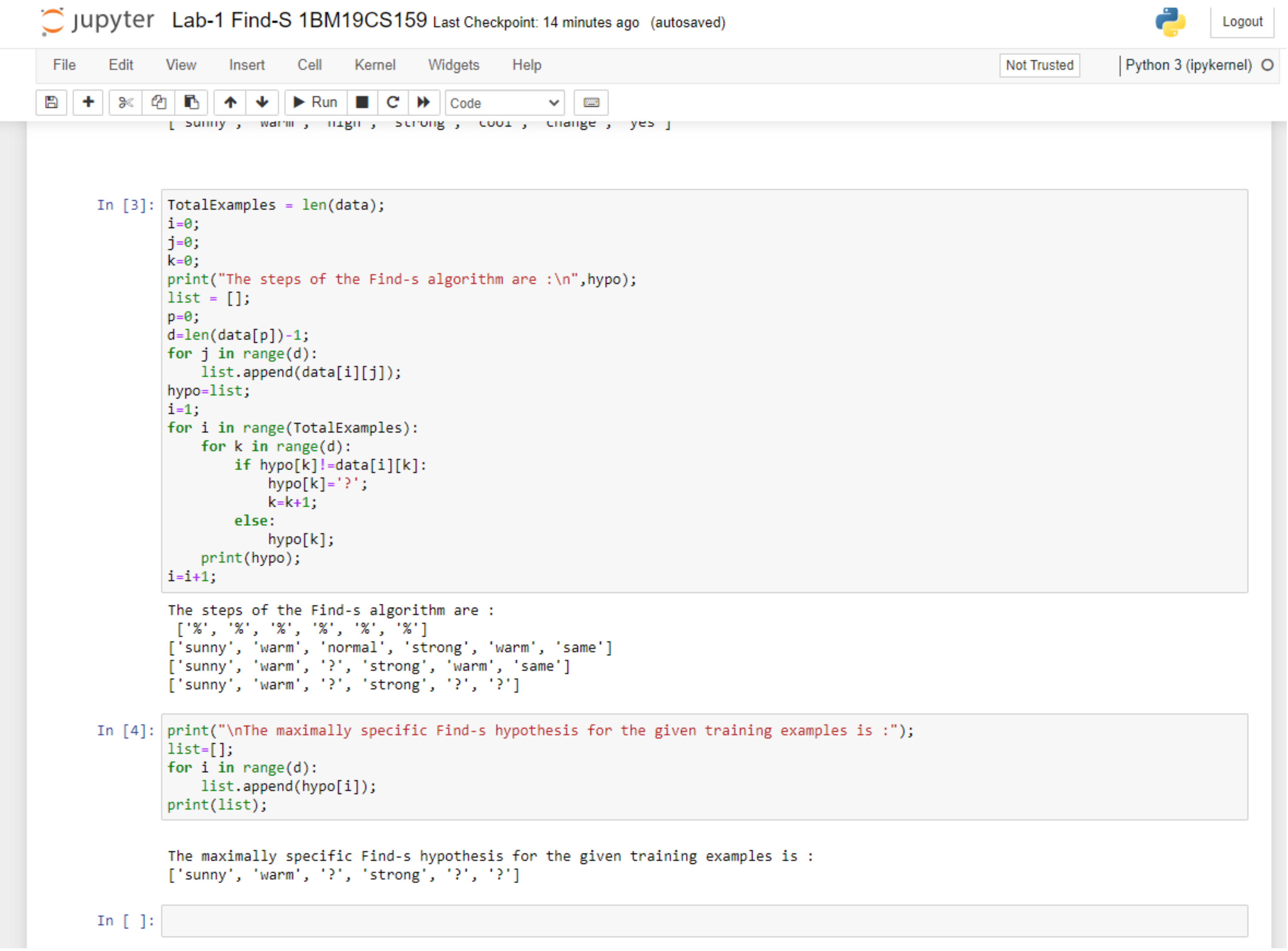


```
In [1]: import csv
        hypo = ['%','%','%','%','%','%'];

        with open(r'C:\Users\Admin\OneDrive\Desktop\6th sem\ML\lab-ml\lab 1\finds.csv') as csv_file:
            readcsv = csv.reader(csv_file, delimiter=',')
            print(readcsv)

            data = []
            print("\nThe given training examples are:")
            for row in readcsv:
                print(row)
                if row[len(row)-1].upper() == "YES":
                    data.append(row)
```

```
<_csv.reader object at 0x0000013B7E4DFD60>

The given training examples are:
['sky', 'air temp', 'humidity', 'wind', 'water', 'forecast', 'enjoy sport']
['sunny', 'warm', 'normal', 'strong', 'warm', 'same', 'yes']
['sunny', 'warm', 'high', 'strong', 'warm', 'same', 'yes']
['rainy', 'cold', 'high', 'strong', 'warm', 'change', 'no']
['sunny', 'warm', 'high', 'strong', 'cool', 'change', 'yes']
```

```
In [2]: print("\nThe positive examples are:");
        for x in data:
            print(x);
        print("\n");
```

```

The positive examples are:
['sunny', 'warm', 'normal', 'strong', 'warm', 'same', 'yes']
['sunny', 'warm', 'high', 'strong', 'warm', 'same', 'yes']
['sunny', 'warm', 'high', 'strong', 'cool', 'change', 'yes']
```



```
['sunny', 'warm', 'high', 'strong', 'cool', 'change', 'yes']
```

In [3]:

```
TotalExamples = len(data);
i=0;
j=0;
k=0;
print("The steps of the Find-s algorithm are :\n",hypo);
list = [];
p=0;
d=len(data[p])-1;
for j in range(d):
    list.append(data[i][j]);
hypo=list;
i=1;
for i in range(TotalExamples):
    for k in range(d):
        if hypo[k]!=data[i][k]:
            hypo[k]='?';
            k=k+1;
        else:
            hypo[k];
    print(hypo);
i=i+1;
```

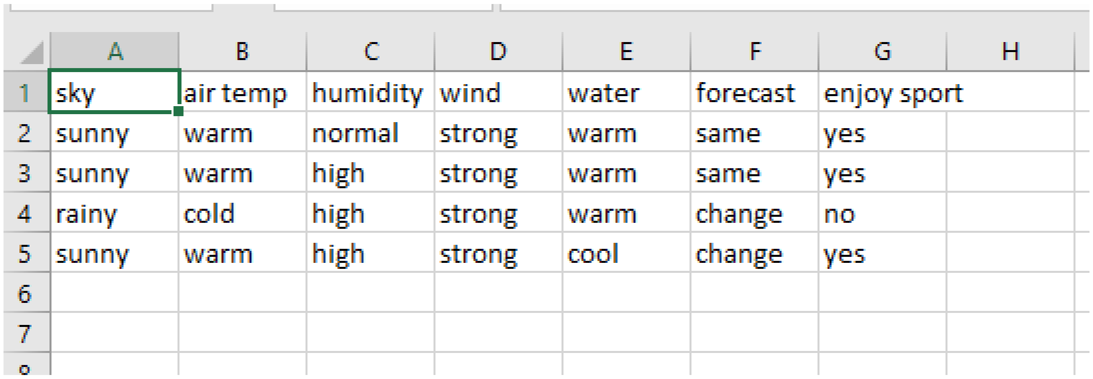
```
The steps of the Find-s algorithm are :
 ['%', '%', '%', '%', '%', '%']
['sunny', 'warm', 'normal', 'strong', 'warm', 'same']
['sunny', 'warm', '?', 'strong', 'warm', 'same']
['sunny', 'warm', '?', 'strong', '?', '?']
```

In [4]:

```
print("\nThe maximally specific Find-s hypothesis for the given training examples is :");
list=[];
for i in range(d):
    list.append(hypo[i]);
print(list);
```

```

The maximally specific Find-s hypothesis for the given training examples is :
['sunny', 'warm', '?', 'strong', '?', '?']
```

In [ ]:



	A	B	C	D	E	F	G	H
1	sky	air temp	humidity	wind	water	forecast	enjoy sport	
2	sunny	warm	normal	strong	warm	same	yes	
3	sunny	warm	high	strong	warm	same	yes	
4	rainy	cold	high	strong	warm	change	no	
5	sunny	warm	high	strong	cool	change	yes	
6								
7								

Lab Program -2 :-

For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.

<u>Source code and output :-</u>

```
+*In[7]:*+

[source, ipython3]

----

import numpy as np

import pandas as pd

----



+*In[10]:*+

[source, ipython3]

----

# Loading Data from a CSV File

data = pd.DataFrame(data=pd.read_csv(r'C:\Users\Admin\OneDrive\Desktop\6th
sem\ML\lab-ml\lab 2\trainingdata.csv'))

print(data)

----



+*Out[10]:*+
----
     sky airtemp humidity    wind water forecast enjoySport
0  Sunny    Warm   Normal  Strong  Warm     Same        Yes
1  Sunny    Warm     High  Strong  Warm     Same        Yes
2  Rainy    Cold     High  Strong  Warm   Change         No
3  Sunny    Warm     High  Strong  Cool   Change        Yes
----
```

+*In[11]:*+

[source, ipython3]

```
----
# Separating concept features from Target
concepts = np.array(data.iloc[:,0:-1])
print(concepts)
----
```

+*Out[11]:*+

```
----
[['Sunny' 'Warm' 'Normal' 'Strong' 'Warm' 'Same']
 ['Sunny' 'Warm' 'High' 'Strong' 'Warm' 'Same']
 ['Rainy' 'Cold' 'High' 'Strong' 'Warm' 'Change']
 ['Sunny' 'Warm' 'High' 'Strong' 'Cool' 'Change']]
----
```

```
+*In[12]:*+
[source, ipython3]
----
# Isolating target into a separate DataFrame
# copying last column to target array
target = np.array(data.iloc[:,-1])
print(target)
----


+*Out[12]:*+
----
['Yes' 'Yes' 'No' 'Yes']
----


+*In[13]:*+
[source, ipython3]
----
def learn(concepts, target):

    '''
    learn() function implements the learning method of the Candidate elimination algorithm.
    Arguments:
        concepts - a data frame with all the features
        target - a data frame with corresponding output values
    '''

    # Initialise S0 with the first instance from concepts
    # .copy() makes sure a new list is created instead of just pointing to the same memory location
    specific_h = concepts[0].copy()
    print("\nInitialization of specific_h and general_h")
    print(specific_h)
    #h=["#" for i in range(0,5)]
    #print(h)

    general_h = [["?" for i in range(len(specific_h))] for i in range(len(specific_h))]
    print(general_h)
    # The learning iterations
    for i, h in enumerate(concepts):

        # Checking if the hypothesis has a positive target
        if target[i] == "Yes":
            for x in range(len(specific_h)):

                # Change values in S & G only if values change
                if h[x] != specific_h[x]:
                    specific_h[x] = '?'
                    general_h[x][x] = '?'

        # Checking if the hypothesis has a positive target
        if target[i] == "No":
            for x in range(len(specific_h)):
                # For negative hyposthesis change values only  in G
                if h[x] != specific_h[x]:
                    general_h[x][x] = specific_h[x]
                else:
                    general_h[x][x] = '?'

        print("\nSteps of Candidate Elimination Algorithm",i+1)
        print(specific_h)
        print(general_h)

    # find indices where we have empty rows, meaning those that are unchanged
    indices = [i for i, val in enumerate(general_h) if val == ['?', '?', '?', '?', '?', '?']]
    for i in indices:
        # remove those rows from general_h
        general_h.remove(['?', '?', '?', '?', '?', '?'])
    # Return final values
    return specific_h, general_h
----



+*In[14]:*+
[source, ipython3]
----
s_final, g_final = learn(concepts, target)
```

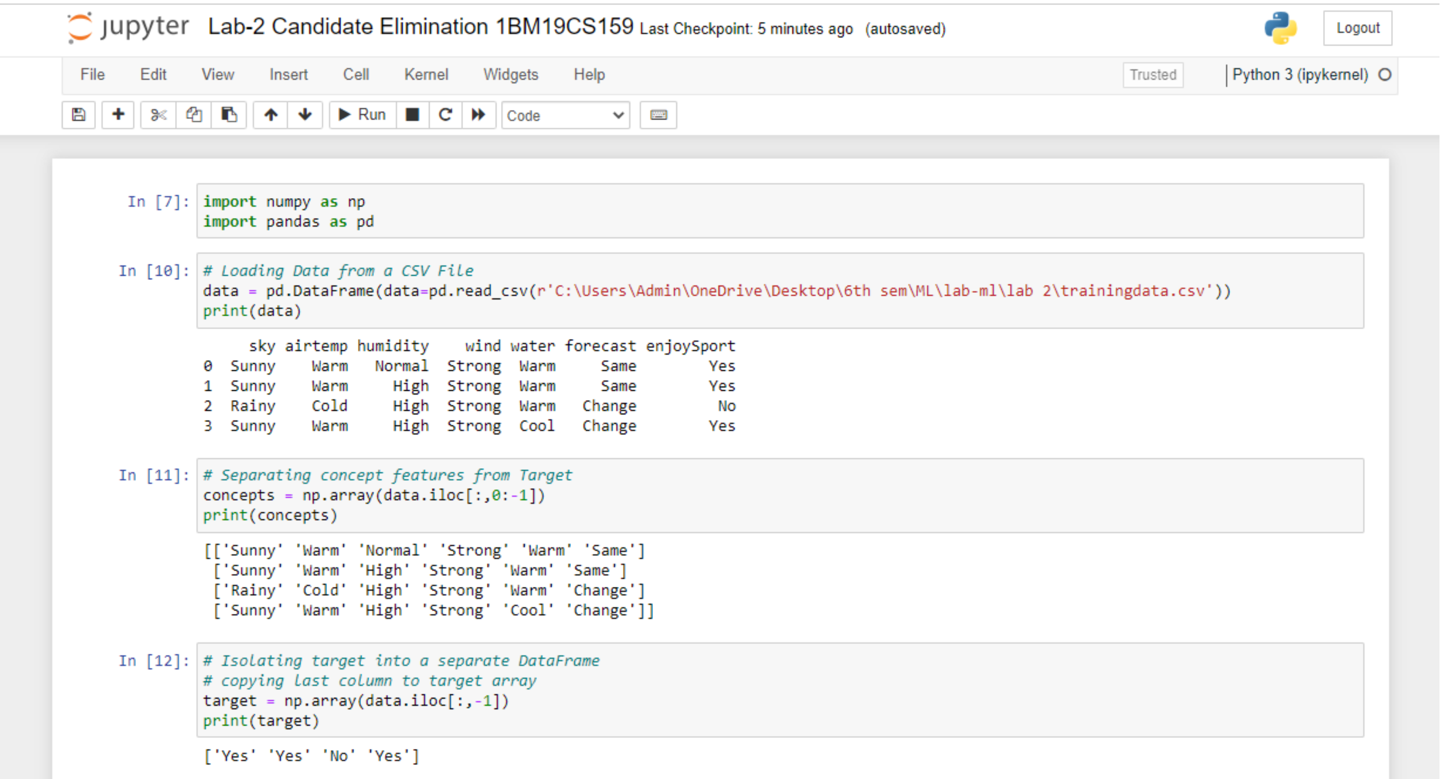
```
print("\nFinal Specific_h:", s_final, sep="\n")

print("\nFinal General_h:", g_final, sep="\n")
----
```

+*Out[14]:*+

```
----


Initialization of specific_h and general_h

['Sunny' 'Warm' 'Normal' 'Strong' 'Warm' 'Same']

[['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?',
'?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?']]


Steps of Candidate Elimination Algorithm 1

['Sunny' 'Warm' 'Normal' 'Strong' 'Warm' 'Same']

[['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?',
'?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?']]


Steps of Candidate Elimination Algorithm 2

['Sunny' 'Warm' '?' 'Strong' 'Warm' 'Same']

[['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?',
'?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?']]


Steps of Candidate Elimination Algorithm 3

['Sunny' 'Warm' '?' 'Strong' 'Warm' 'Same']

[['Sunny', '?', '?', '?', '?', '?'], ['?', 'Warm', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?',
'?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', 'Same']]
```

```
Steps of Candidate Elimination Algorithm 4

['Sunny' 'Warm' '?' 'Strong' '?' '?']

[['Sunny', '?', '?', '?', '?', '?'], ['?', 'Warm', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?']]


Final Specific_h:

['Sunny' 'Warm' '?' 'Strong' '?' '?']


Final General_h:

[['Sunny', '?', '?', '?', '?', '?'], ['?', 'Warm', '?', '?', '?', '?']]

----



+*In[ ]:*+

[source, ipython3]

----


----
```

<u>Output screenshots :-</u>



In [7]:

```
import numpy as np
import pandas as pd
```

In [10]:

```
# Loading Data from a CSV File
data = pd.DataFrame(data=pd.read_csv(r'C:\Users\Admin\OneDrive\Desktop\6th sem\ML\lab-ml\lab 2\trainingdata.csv'))
print(data)
```

```
     sky airtemp humidity    wind water forecast enjoySport
0  Sunny    Warm   Normal  Strong  Warm     Same        Yes
1  Sunny    Warm     High  Strong  Warm     Same        Yes
2  Rainy    Cold     High  Strong  Warm   Change         No
3  Sunny    Warm     High  Strong  Cool   Change        Yes
```

In [11]:

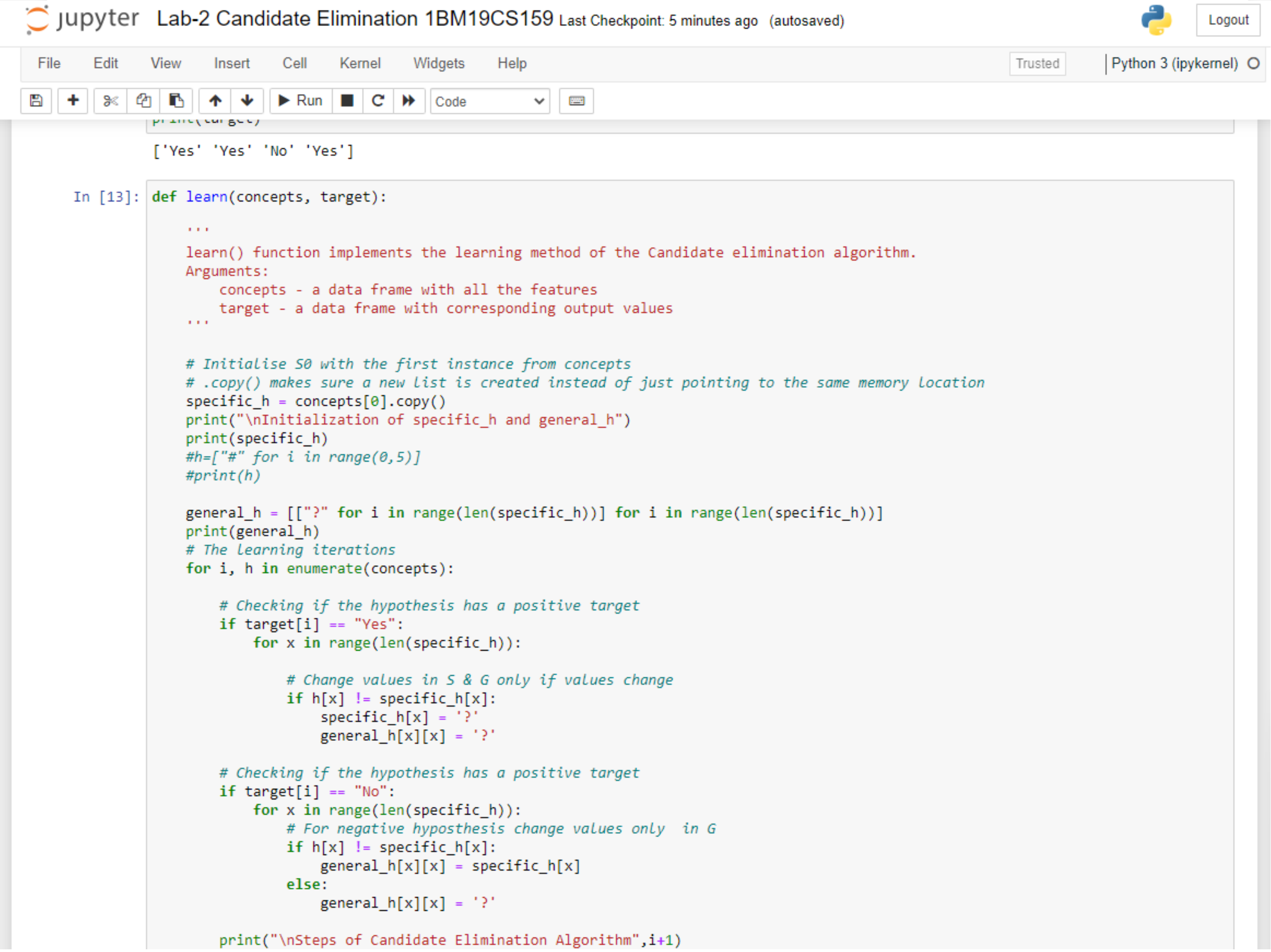
```
# Separating concept features from Target
concepts = np.array(data.iloc[:,0:-1])
print(concepts)
```

```
[['Sunny' 'Warm' 'Normal' 'Strong' 'Warm' 'Same']
 ['Sunny' 'Warm' 'High' 'Strong' 'Warm' 'Same']
 ['Rainy' 'Cold' 'High' 'Strong' 'Warm' 'Change']
 ['Sunny' 'Warm' 'High' 'Strong' 'Cool' 'Change']]
```

In [12]:

```
# Isolating target into a separate DataFrame
# copying last column to target array
target = np.array(data.iloc[:,-1])
print(target)
```

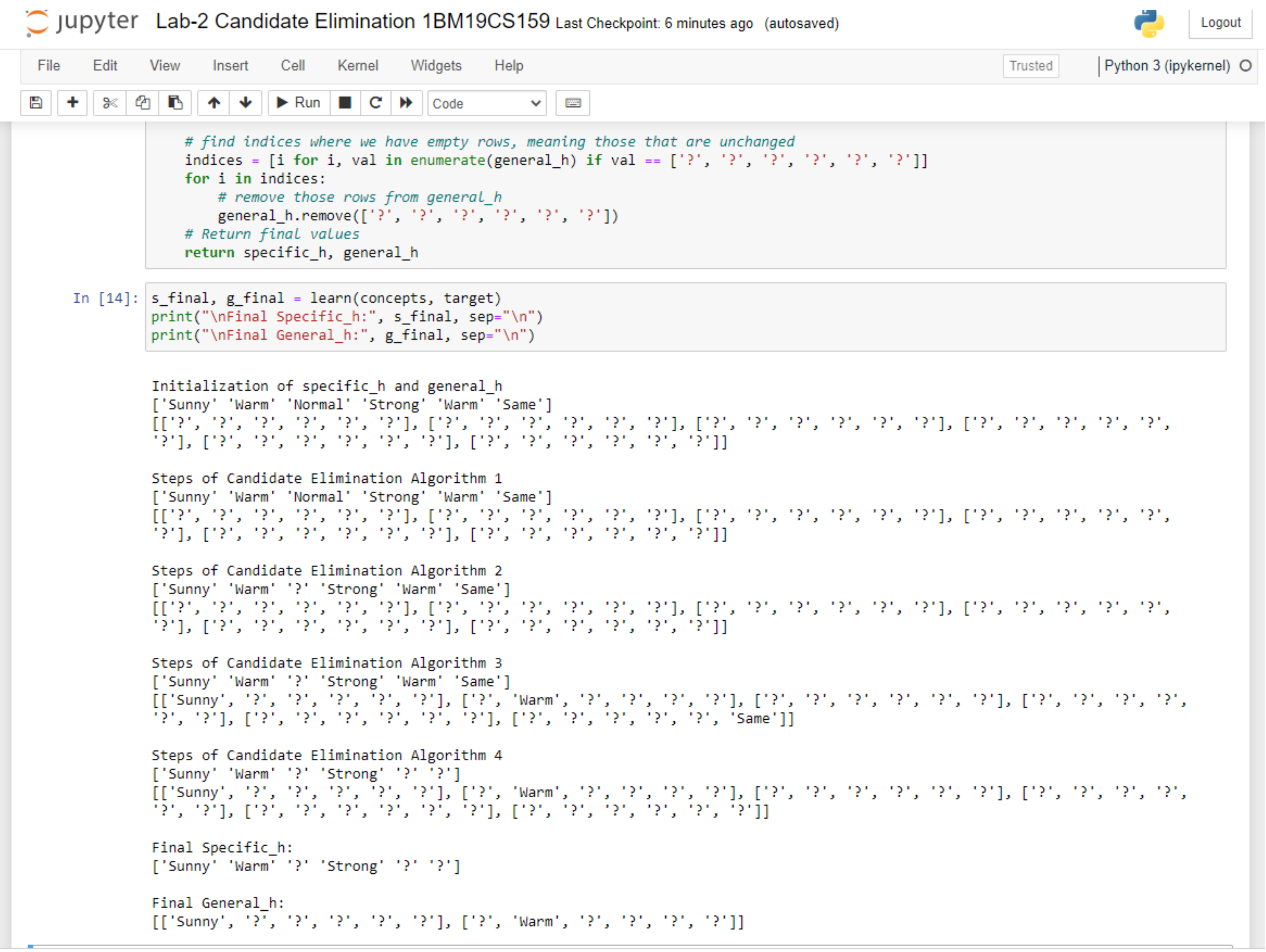
```
['Yes' 'Yes' 'No' 'Yes']
```



['Yes' 'Yes' 'No' 'Yes']

In [13]:

```
def learn(concepts, target):
    '''
    learn() function implements the learning method of the Candidate elimination algorithm.
    Arguments:
        concepts - a data frame with all the features
        target - a data frame with corresponding output values
    '''

    # Initialise S0 with the first instance from concepts
    # .copy() makes sure a new list is created instead of just pointing to the same memory location
    specific_h = concepts[0].copy()
    print("\nInitialization of specific_h and general_h")
    print(specific_h)
    #h=["#" for i in range(0,5)]
    #print(h)

    general_h = [["?" for i in range(len(specific_h))] for i in range(len(specific_h))]
    print(general_h)
    # The learning iterations
    for i, h in enumerate(concepts):

        # Checking if the hypothesis has a positive target
        if target[i] == "Yes":
            for x in range(len(specific_h)):

                # Change values in S & G only if values change
                if h[x] != specific_h[x]:
                    specific_h[x] = '?'
                    general_h[x][x] = '?'

        # Checking if the hypothesis has a positive target
        if target[i] == "No":
            for x in range(len(specific_h)):
                # For negative hypothesis change values only  in G
                if h[x] != specific_h[x]:
                    general_h[x][x] = specific_h[x]
                else:
                    general_h[x][x] = '?'

        print("\nSteps of Candidate Elimination Algorithm",i+1)
```

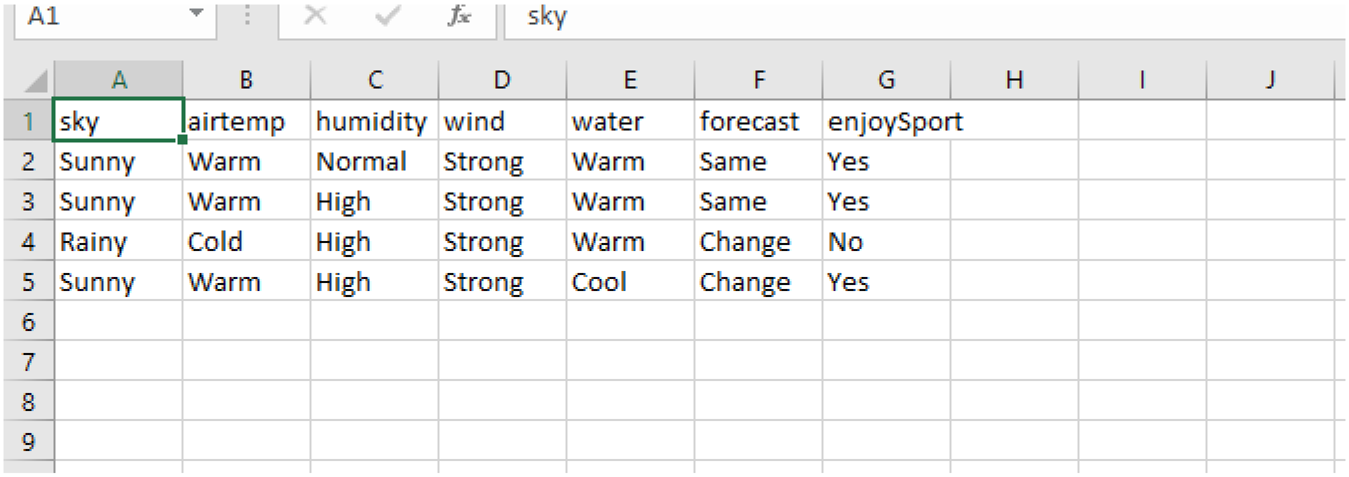


```
    # find indices where we have empty rows, meaning those that are unchanged
    indices = [i for i, val in enumerate(general_h) if val == ['?', '?', '?', '?', '?', '?']]
    for i in indices:
        # remove those rows from general_h
        general_h.remove(['?', '?', '?', '?', '?', '?'])
    # Return final values
    return specific_h, general_h
```

In [14]:

```
s_final, g_final = learn(concepts, target)
print("\nFinal Specific_h:", s_final, sep="\n")
print("\nFinal General_h:", g_final, sep="\n")
```

```
Initialization of specific_h and general_h
['Sunny' 'Warm' 'Normal' 'Strong' 'Warm' 'Same']
[['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?',
'?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?']]

Steps of Candidate Elimination Algorithm 1
['Sunny' 'Warm' 'Normal' 'Strong' 'Warm' 'Same']
[['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?',
'?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?']]

Steps of Candidate Elimination Algorithm 2
['Sunny' 'Warm' '?' 'Strong' 'Warm' 'Same']
[['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?',
'?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?']]

Steps of Candidate Elimination Algorithm 3
['Sunny' 'Warm' '?' 'Strong' 'Warm' 'Same']
[['Sunny', '?', '?', '?', '?', '?'], ['?', 'Warm', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?',
'?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', 'Same']]

Steps of Candidate Elimination Algorithm 4
['Sunny' 'Warm' '?' 'Strong' '?' '?']
[['Sunny', '?', '?', '?', '?', '?'], ['?', 'Warm', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?',
'?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?']]

Final Specific_h:
['Sunny' 'Warm' '?' 'Strong' '?' '?']

Final General_h:
[['Sunny', '?', '?', '?', '?', '?'], ['?', 'Warm', '?', '?', '?', '?']]
```



	A	B	C	D	E	F	G	H	I	J
1	sky	airtemp	humidity	wind	water	forecast	enjoySport			
2	Sunny	Warm	Normal	Strong	Warm	Same	Yes			
3	Sunny	Warm	High	Strong	Warm	Same	Yes			
4	Rainy	Cold	High	Strong	Warm	Change	No			
5	Sunny	Warm	High	Strong	Cool	Change	Yes			
6										
7										
8										
9										

Lab Program -3 :-

Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.

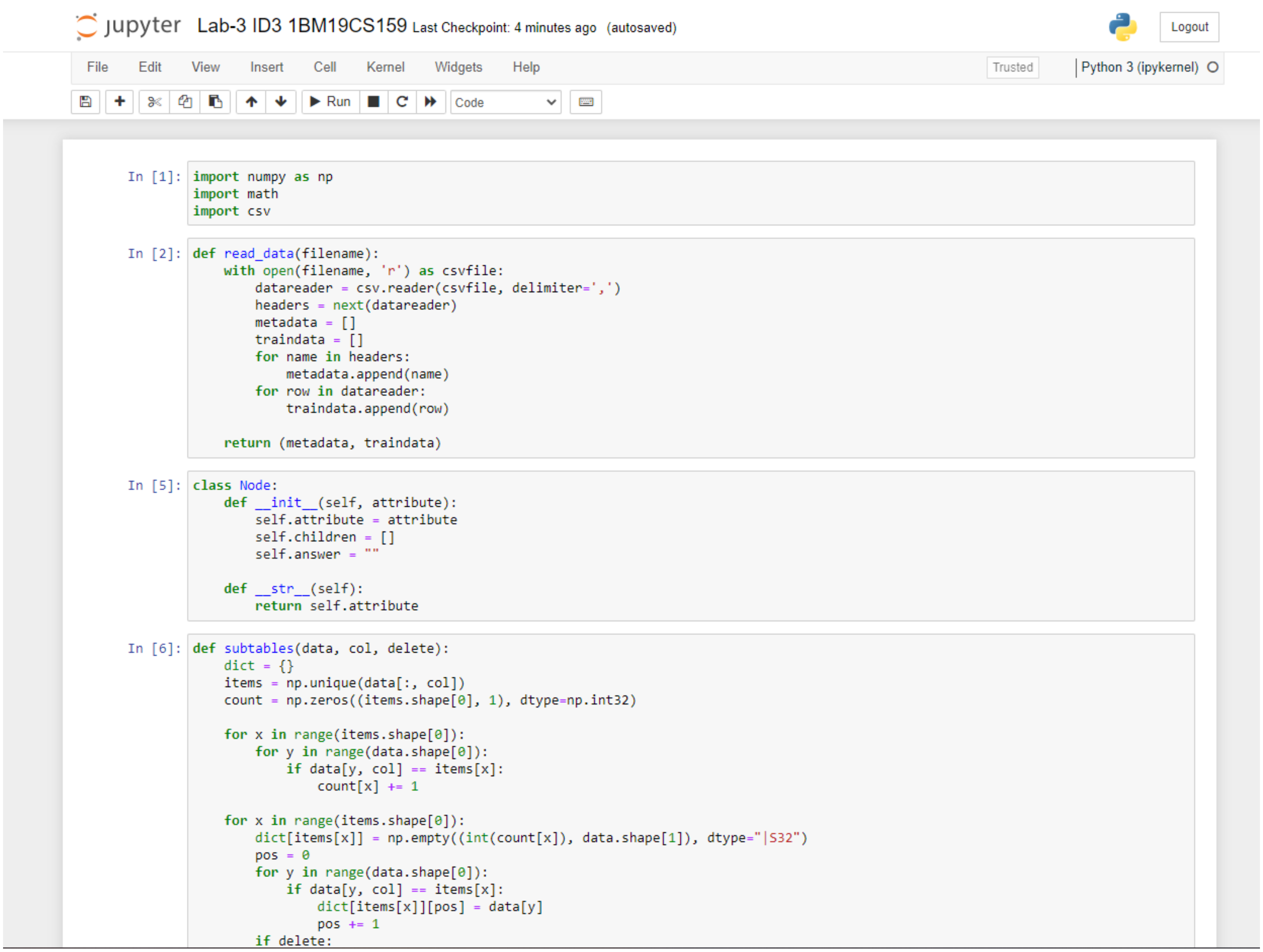
Source code and output :-

```
+*In[1]:*+

[source, ipython3]

----

import numpy as np

import math

import csv

----
```

```
+*In[2]:*+

[source, ipython3]

----

def read_data(filename):

    with open(filename, 'r') as csvfile:

        datareader = csv.reader(csvfile, delimiter=',')

        headers = next(datareader)

        metadata = []

        traindata = []

        for name in headers:

            metadata.append(name)
        for row in datareader:
            traindata.append(row)

    return (metadata, traindata)
----



+*In[5]:*+
[source, ipython3]
----
class Node:
    def __init__(self, attribute):
        self.attribute = attribute
        self.children = []
        self.answer = ""

    def __str__(self):
        return self.attribute
----



+*In[6]:*+
[source, ipython3]
----
def subtables(data, col, delete):
    dict = {}
    items = np.unique(data[:, col])
    count = np.zeros((items.shape[0], 1), dtype=np.int32)

    for x in range(items.shape[0]):
        for y in range(data.shape[0]):
            if data[y, col] == items[x]:
                count[x] += 1

    for x in range(items.shape[0]):
        dict[items[x]] = np.empty((int(count[x]), data.shape[1]), dtype="|S32")
        pos = 0
        for y in range(data.shape[0]):
            if data[y, col] == items[x]:
                dict[items[x]][pos] = data[y]
                pos += 1
        if delete:
            dict[items[x]] = np.delete(dict[items[x]], col, 1)

    return items, dict
----



+*In[7]:*+
[source, ipython3]
----
def entropy(S):
    items = np.unique(S)

    if items.size == 1:
        return 0

    counts = np.zeros((items.shape[0], 1))
    sums = 0

    for x in range(items.shape[0]):
        counts[x] = sum(S == items[x]) / (S.size * 1.0)

    for count in counts:
        sums += -1 * count * math.log(count, 2)
    return sums
----



+*In[8]:*+
[source, ipython3]
----
def gain_ratio(data, col):
    items, dict = subtables(data, col, delete=False)

    total_size = data.shape[0]
    entropies = np.zeros((items.shape[0], 1))
    intrinsic = np.zeros((items.shape[0], 1))
    for x in range(items.shape[0]):
        ratio = dict[items[x]].shape[0]/(total_size * 1.0)
        entropies[x] = ratio * entropy(dict[items[x]][:, -1])
        intrinsic[x] = ratio * math.log(ratio, 2)

    total_entropy = entropy(data[:, -1])
    iv = -1 * sum(intrinsic)

    for x in range(entropies.shape[0]):
        total_entropy -= entropies[x]

    return total_entropy / iv
----



+*In[9]:*+
[source, ipython3]
----
def create_node(data, metadata):
    if (np.unique(data[:, -1])).shape[0] == 1:
        node = Node("")
        node.answer = np.unique(data[:, -1])[0]
        return node

    gains = np.zeros((data.shape[1] - 1, 1))
    for col in range(data.shape[1] - 1):
        gains[col] = gain_ratio(data, col)

    split = np.argmax(gains)

    node = Node(metadata[split])
    metadata = np.delete(metadata, split, 0)

    items, dict = subtables(data, split, delete=True)

    for x in range(items.shape[0]):
        child = create_node(dict[items[x]], metadata)
        node.children.append((items[x], child))

    return node
----



+*In[10]:*+
[source, ipython3]
----
def empty(size):
    s = ""
    for x in range(size):
        s += "    "
    return s


def print_tree(node, level):
    if node.answer != "":
        print(empty(level), node.answer)
        return
    print(empty(level), node.attribute)
    for value, n in node.children:
        print(empty(level + 1), value)
        print_tree(n, level + 2)
----



+*In[11]:*+
[source, ipython3]
----
metadata, traindata = read_data(r"C:\Users\Admin\OneDrive\Desktop\6th sem\ML\lab-ml\Lab 3\id3 training dataset.csv")
data = np.array(traindata)
node = create_node(data, metadata)
print_tree(node, 0)
----



+*Out[11]:*+
----
 Outlook
```

```
   overcast
     b'yes'
   rain
     Wind
       b'strong'
         b'no'
       b'weak'
         b'yes'
   sunny
     Humidity
       b'high'
         b'no'
       b'normal'
         b'yes'
----



+*In[ ]:*+
[source, ipython3]
----

----
```

Output screenshots :-



In [1]:

```
import numpy as np
import math
import csv
```

In [2]:

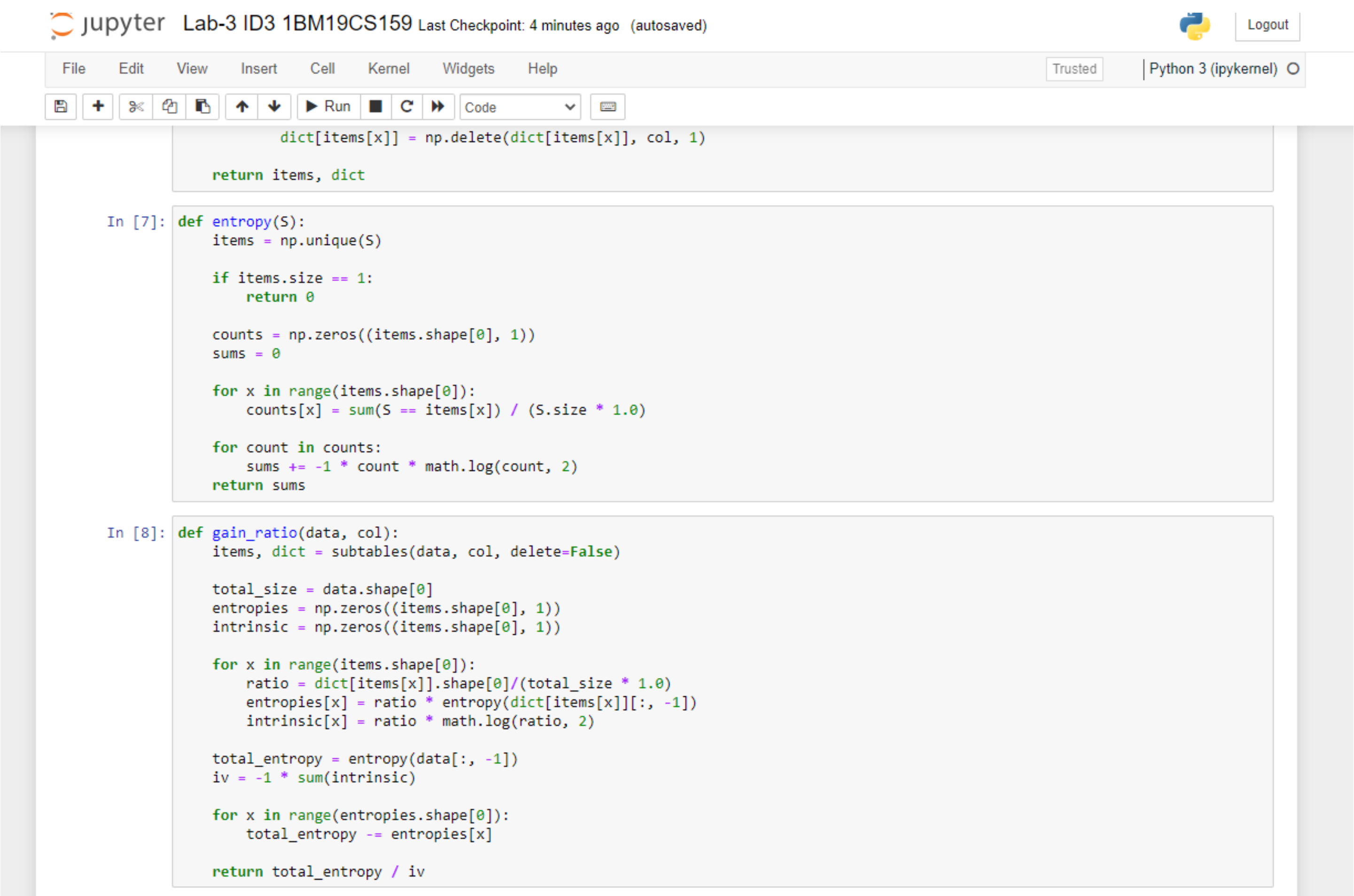
```
def read_data(filename):
    with open(filename, 'r') as csvfile:
        datareader = csv.reader(csvfile, delimiter=',')
        headers = next(datareader)
        metadata = []
        traindata = []
        for name in headers:
            metadata.append(name)
        for row in datareader:
            traindata.append(row)

    return (metadata, traindata)
```

In [5]:

```
class Node:
    def __init__(self, attribute):
        self.attribute = attribute
        self.children = []
        self.answer = ""

    def __str__(self):
        return self.attribute
```

In [6]:

```
def subtables(data, col, delete):
    dict = {}
    items = np.unique(data[:, col])
    count = np.zeros((items.shape[0], 1), dtype=np.int32)

    for x in range(items.shape[0]):
        for y in range(data.shape[0]):
            if data[y, col] == items[x]:
                count[x] += 1

    for x in range(items.shape[0]):
        dict[items[x]] = np.empty((int(count[x]), data.shape[1]), dtype="|S32")
        pos = 0
        for y in range(data.shape[0]):
            if data[y, col] == items[x]:
                dict[items[x]][pos] = data[y]
                pos += 1
        if delete:
```



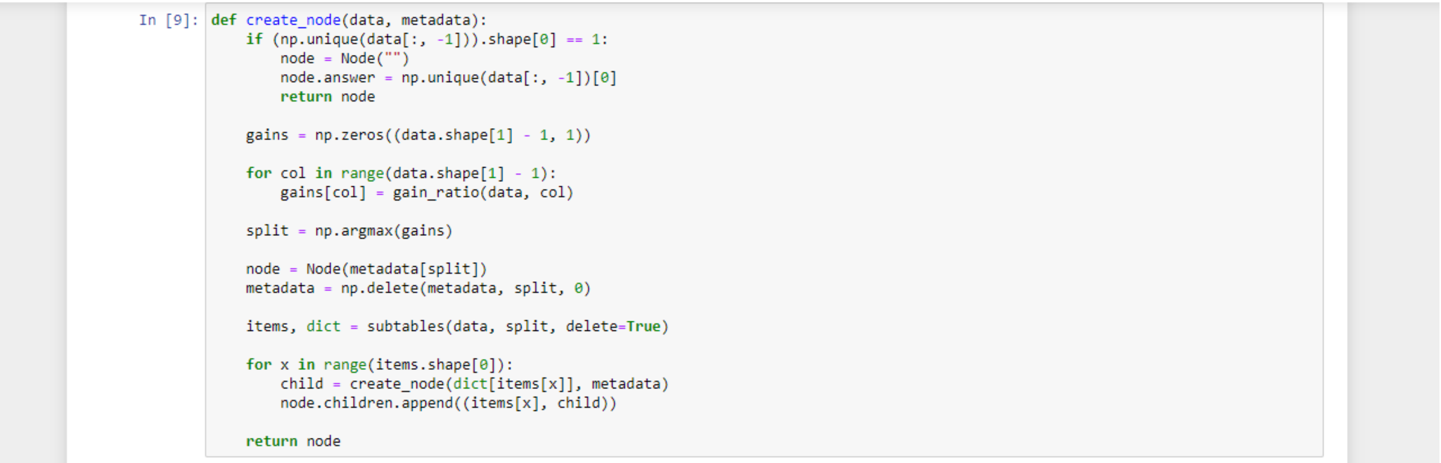
```
            dict[items[x]] = np.delete(dict[items[x]], col, 1)

    return items, dict
```

In [7]:

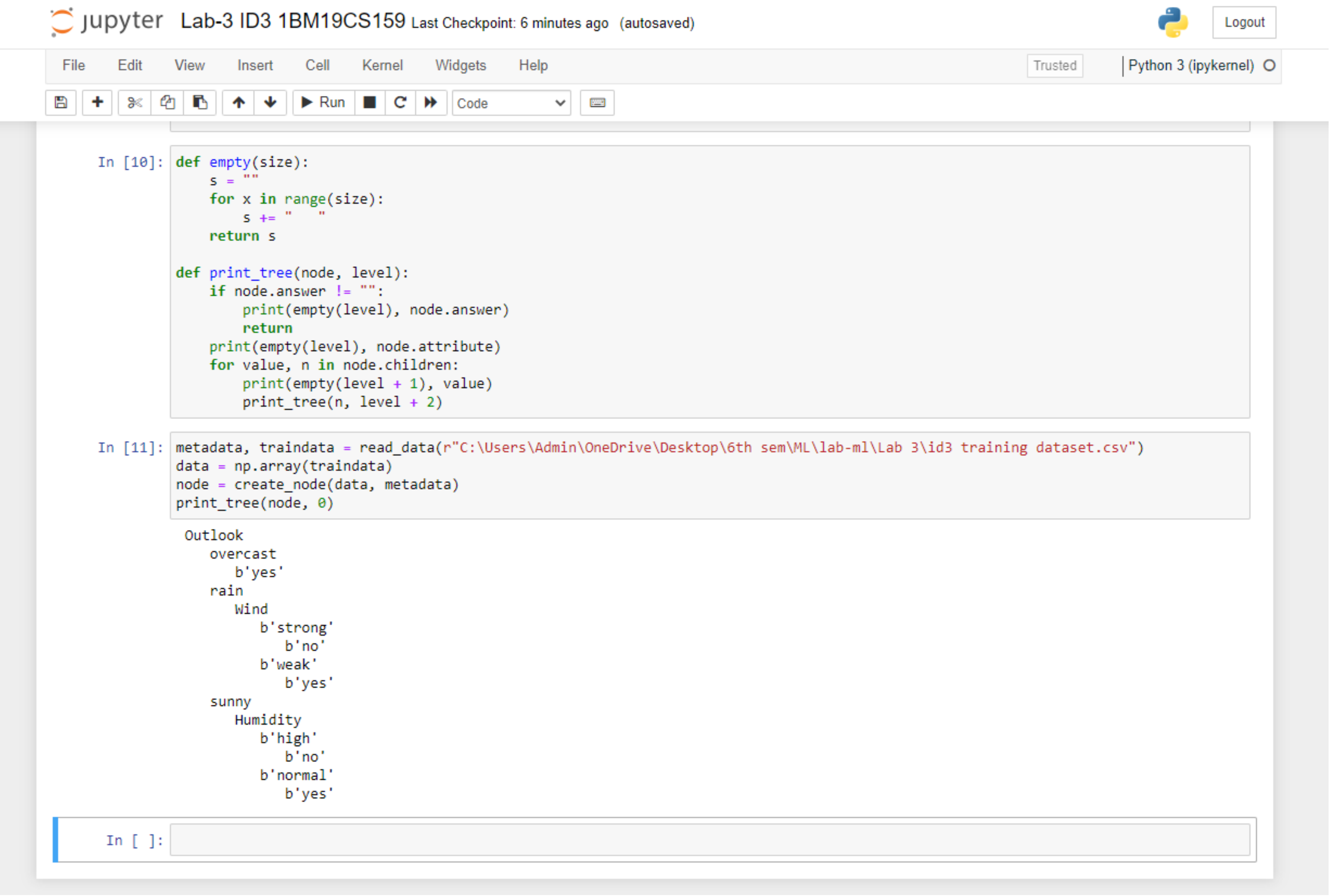
```
def entropy(S):
    items = np.unique(S)

    if items.size == 1:
        return 0

    counts = np.zeros((items.shape[0], 1))
    sums = 0

    for x in range(items.shape[0]):
        counts[x] = sum(S == items[x]) / (S.size * 1.0)

    for count in counts:
        sums += -1 * count * math.log(count, 2)
    return sums
```

In [8]:

```
def gain_ratio(data, col):
    items, dict = subtables(data, col, delete=False)

    total_size = data.shape[0]
    entropies = np.zeros((items.shape[0], 1))
    intrinsic = np.zeros((items.shape[0], 1))

    for x in range(items.shape[0]):
        ratio = dict[items[x]].shape[0]/(total_size * 1.0)
        entropies[x] = ratio * entropy(dict[items[x]][:, -1])
        intrinsic[x] = ratio * math.log(ratio, 2)

    total_entropy = entropy(data[:, -1])
    iv = -1 * sum(intrinsic)

    for x in range(entropies.shape[0]):
        total_entropy -= entropies[x]

    return total_entropy / iv
```



```
In [9]: def create_node(data, metadata):
            if (np.unique(data[:, -1])).shape[0] == 1:
                node = Node("")
                node.answer = np.unique(data[:, -1])[0]
                return node

            gains = np.zeros((data.shape[1] - 1, 1))

            for col in range(data.shape[1] - 1):
                gains[col] = gain_ratio(data, col)

            split = np.argmax(gains)

            node = Node(metadata[split])
            metadata = np.delete(metadata, split, 0)

            items, dict = subtables(data, split, delete=True)

            for x in range(items.shape[0]):
                child = create_node(dict[items[x]], metadata)
                node.children.append((items[x], child))

            return node
```



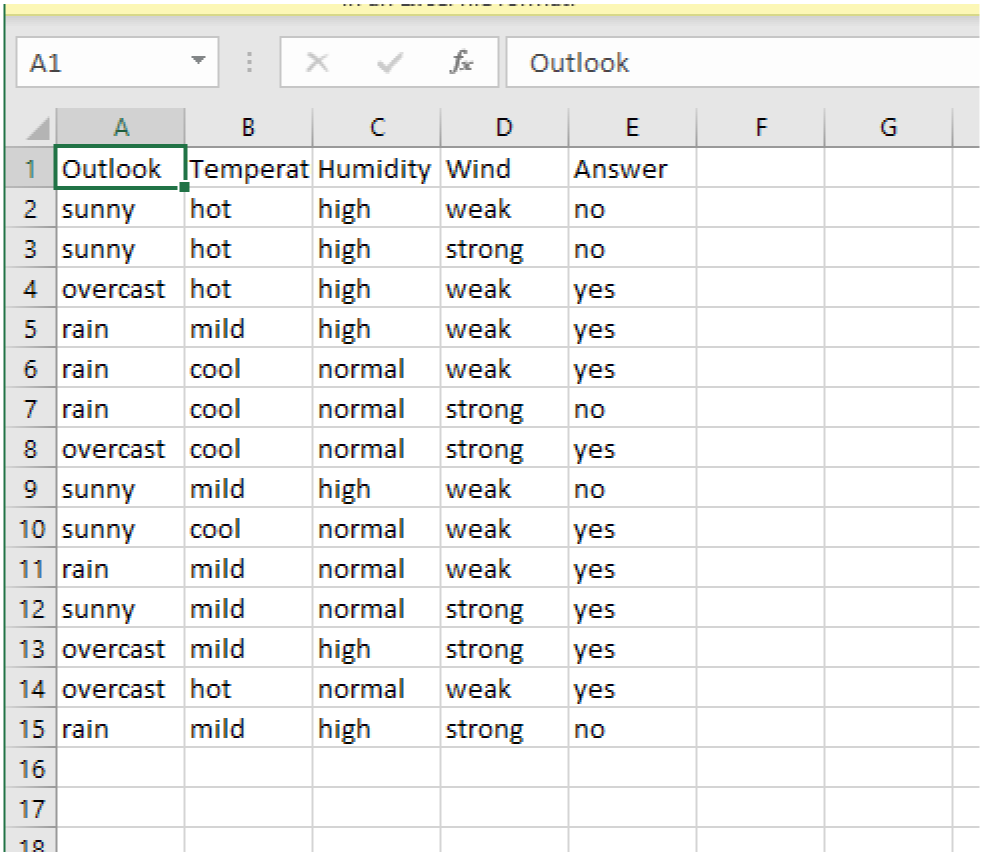
Jupyter Lab-3 ID3 1BM19CS159 Last Checkpoint: 6 minutes ago (autosaved)

```
In [10]: def empty(size):
             s = ""
             for x in range(size):
                 s += "   "
             return s

         def print_tree(node, level):
             if node.answer != "":
                 print(empty(level), node.answer)
                 return
             print(empty(level), node.attribute)
             for value, n in node.children:
                 print(empty(level + 1), value)
                 print_tree(n, level + 2)
```

```
In [11]: metadata, traindata = read_data(r"C:\Users\Admin\OneDrive\Desktop\6th sem\ML\lab-ml\Lab 3\id3 training dataset.csv")
         data = np.array(traindata)
         node = create_node(data, metadata)
         print_tree(node, 0)
```

```
 Outlook
    overcast
       b'yes'
    rain
       Wind
          b'strong'
             b'no'
          b'weak'
             b'yes'
    sunny
       Humidity
          b'high'
             b'no'
          b'normal'
             b'yes'
```

```
In [ ]:
```



	A	B	C	D	E	F	G
1	Outlook	Temperat	Humidity	Wind	Answer		
2	sunny	hot	high	weak	no		
3	sunny	hot	high	strong	no		
4	overcast	hot	high	weak	yes		
5	rain	mild	high	weak	yes		
6	rain	cool	normal	weak	yes		
7	rain	cool	normal	strong	no		
8	overcast	cool	normal	strong	yes		
9	sunny	mild	high	weak	no		
10	sunny	cool	normal	weak	yes		
11	rain	mild	normal	weak	yes		
12	sunny	mild	normal	strong	yes		
13	overcast	mild	high	strong	yes		
14	overcast	hot	normal	weak	yes		
15	rain	mild	high	strong	no		
16							
17							
18							

Lab Program -4.a.:-

Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets

Source code and output :-

```
+*In[1]:*+

[source, ipython3]

----

# import necessary libarities

import pandas as pd

from sklearn import tree

from sklearn.preprocessing import LabelEncoder

from sklearn.naive_bayes import GaussianNB


# load data from CSV

data = pd.read_csv(r"C:\Users\Admin\OneDrive\Desktop\6th sem\ML\lab-ml\Lab 4\Naive Bayesian classifier training dataset.csv")

print("THe first 5 values of data is :\n",data.head())

----
```

```
+*Out[1]:*+

----

THe first 5 values of data is :

    Outlook Temperature Humidity  Windy PlayTennis
```

```
0    Sunny       Hot    High  False       No
1    Sunny       Hot    High   True       No
2  Overcast       Hot    High  False      Yes
3    Rainy      Mild    High  False      Yes
4    Rainy      Cool   Normal  False      Yes
----
```

```
+*In[2]:*+
[source, ipython3]
----
# obtain Train data and Train output
X = data.iloc[:,:-1]
print("\nThe First 5 values of train data is\n",X.head())
----
```

```
+*Out[2]:*+
----

The First 5 values of train data is
    Outlook Temperature Humidity  Windy
0    Sunny       Hot    High  False
1    Sunny       Hot    High   True
2  Overcast       Hot    High  False
3    Rainy      Mild    High  False
```

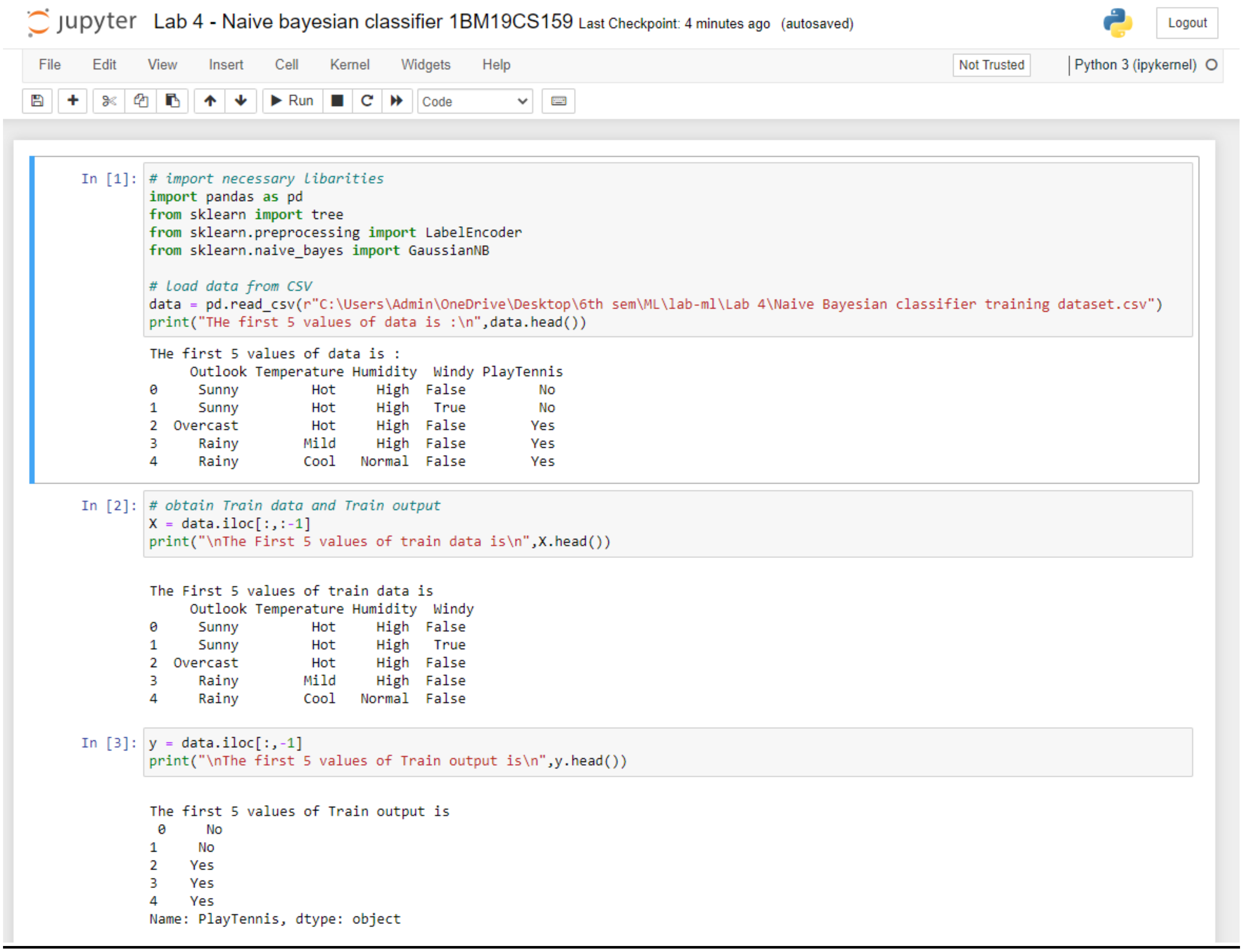
```
4     Rainy        Cool   Normal  False
----



+*In[3]:*+
[source, ipython3]
----
y = data.iloc[:,-1]
print("\nThe first 5 values of Train output is\n",y.head())
----



+*Out[3]:*+
----

The first 5 values of Train output is
 0     No
1     No
2    Yes
3    Yes
4    Yes
Name: PlayTennis, dtype: object
----



+*In[4]:*+
[source, ipython3]
----
# Convert then in numbers
le_outlook = LabelEncoder()
X.Outlook = le_outlook.fit_transform(X.Outlook)

le_Temperature = LabelEncoder()
X.Temperature = le_Temperature.fit_transform(X.Temperature)

le_Humidity = LabelEncoder()
X.Humidity = le_Humidity.fit_transform(X.Humidity)

le_Windy = LabelEncoder()
X.Windy = le_Windy.fit_transform(X.Windy)

print("\nNow the Train data is :\n",X.head())
----
```

```
+*Out[4]:*+
----

Now the Train data is :
   Outlook  Temperature  Humidity  Windy
0        2            1         0      0
1        2            1         0      1
```

```
2       0          1        0     0

3       1          2        0     0

4       1          0        1     0

----



+*In[5]:*+

[source, ipython3]

----

le_PlayTennis = LabelEncoder()

y = le_PlayTennis.fit_transform(y)

print("\nNow the Train output is\n",y)

----



+*Out[5]:*+

----


Now the Train output is

 [0 0 1 1 1 0 1 0 1 1 1 1 1 0]

----



+*In[6]:*+

[source, ipython3]

----
```

```
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X,y, test_size=0.20)

classifier = GaussianNB()
classifier.fit(X_train,y_train)

from sklearn.metrics import accuracy_score
print("Accuracy is:",accuracy_score(classifier.predict(X_test),y_test))
----



+*Out[6]:*+
----
Accuracy is: 0.3333333333333333
----



+*In[ ]:*+
[source, ipython3]
----


----
```

Output screenshots :-



In [1]:

```
# import necessary libarities
import pandas as pd
from sklearn import tree
from sklearn.preprocessing import LabelEncoder
from sklearn.naive_bayes import GaussianNB

# load data from CSV
data = pd.read_csv(r"C:\Users\Admin\OneDrive\Desktop\6th sem\ML\lab-ml\Lab 4\Naive Bayesian classifier training dataset.csv")
print("THe first 5 values of data is :\n",data.head())
```

```
THe first 5 values of data is :
      Outlook Temperature Humidity  Windy PlayTennis
0     Sunny         Hot     High  False         No
1     Sunny         Hot     High   True         No
2  Overcast         Hot     High  False        Yes
3     Rainy        Mild     High  False        Yes
4     Rainy        Cool   Normal  False        Yes
```

In [2]:

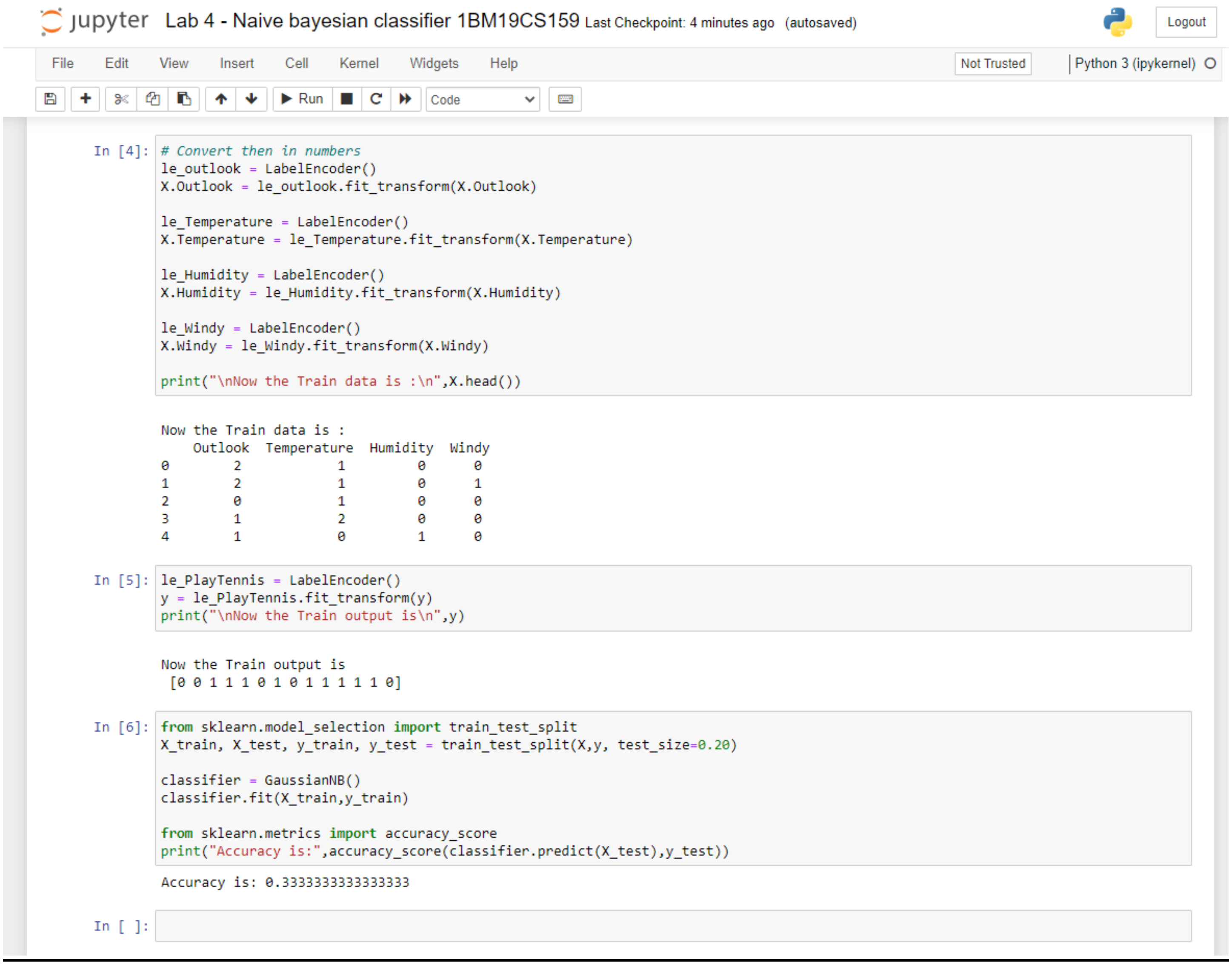
```
# obtain Train data and Train output
X = data.iloc[:,:-1]
print("\nThe First 5 values of train data is\n",X.head())
```

```

The First 5 values of train data is
      Outlook Temperature Humidity  Windy
0     Sunny         Hot     High  False
1     Sunny         Hot     High   True
2  Overcast         Hot     High  False
3     Rainy        Mild     High  False
4     Rainy        Cool   Normal  False
```

In [3]:

```
y = data.iloc[:,-1]
print("\nThe first 5 values of Train output is\n",y.head())
```

```

The first 5 values of Train output is
 0     No
1     No
2    Yes
3    Yes
4    Yes
Name: PlayTennis, dtype: object
```



In [4]:

```
# Convert then in numbers
le_outlook = LabelEncoder()
X.Outlook = le_outlook.fit_transform(X.Outlook)

le_Temperature = LabelEncoder()
X.Temperature = le_Temperature.fit_transform(X.Temperature)

le_Humidity = LabelEncoder()
X.Humidity = le_Humidity.fit_transform(X.Humidity)

le_Windy = LabelEncoder()
X.Windy = le_Windy.fit_transform(X.Windy)

print("\nNow the Train data is :\n",X.head())
```

```

Now the Train data is :
    Outlook  Temperature  Humidity  Windy
0        2            1         0      0
1        2            1         0      1
2        0            1         0      0
3        1            2         0      0
4        1            0         1      0
```

In [5]:

```
le_PlayTennis = LabelEncoder()
y = le_PlayTennis.fit_transform(y)
print("\nNow the Train output is\n",y)
```

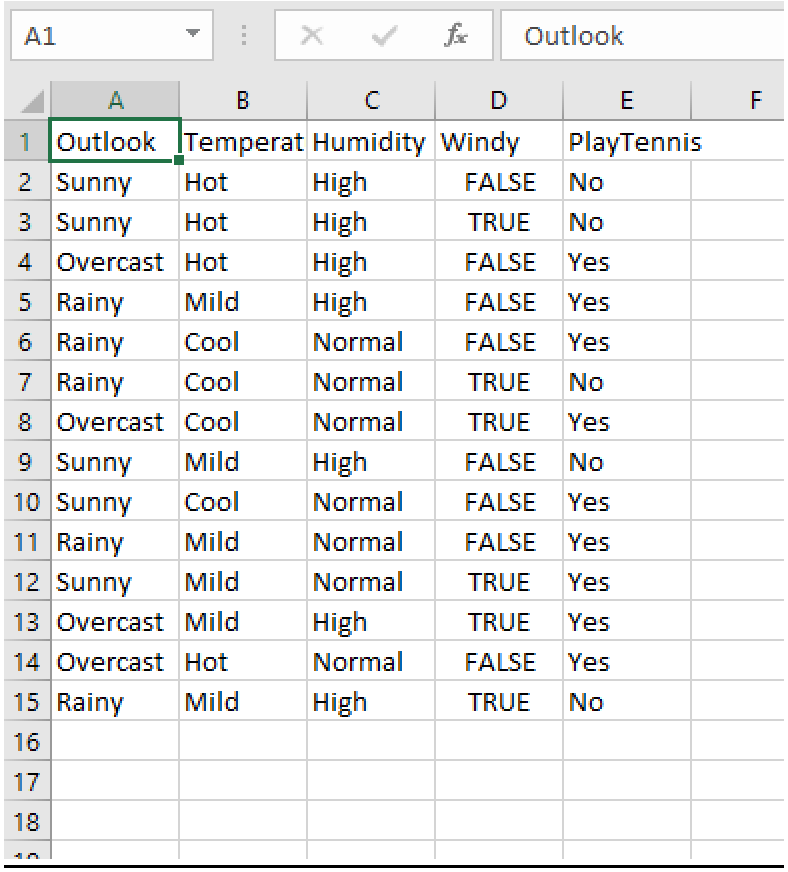
```

Now the Train output is
 [0 0 1 1 1 0 1 0 1 1 1 1 1 0]
```

In [6]:

```
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X,y, test_size=0.20)

classifier = GaussianNB()
classifier.fit(X_train,y_train)

from sklearn.metrics import accuracy_score
print("Accuracy is:",accuracy_score(classifier.predict(X_test),y_test))
```

```
Accuracy is: 0.3333333333333333
```

In [ ]:



	A	B	C	D	E	F
1	Outlook	Temperat	Humidity	Windy	PlayTennis	
2	Sunny	Hot	High	FALSE	No	
3	Sunny	Hot	High	TRUE	No	
4	Overcast	Hot	High	FALSE	Yes	
5	Rainy	Mild	High	FALSE	Yes	
6	Rainy	Cool	Normal	FALSE	Yes	
7	Rainy	Cool	Normal	TRUE	No	
8	Overcast	Cool	Normal	TRUE	Yes	
9	Sunny	Mild	High	FALSE	No	
10	Sunny	Cool	Normal	FALSE	Yes	
11	Rainy	Mild	Normal	FALSE	Yes	
12	Sunny	Mild	Normal	TRUE	Yes	
13	Overcast	Mild	High	TRUE	Yes	
14	Overcast	Hot	Normal	FALSE	Yes	
15	Rainy	Mild	High	TRUE	No	
16						
17						
18						

Lab Program -4.b.:-

Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets (without packages).

Source code and output :-

```
+*In[1]:*+

[source, ipython3]

----

import math

import csv

import random

----
```

```
+*In[2]:*+

[source, ipython3]

----

# This make sures that the dataset is in an ordered format. If we have some arbirary names in that column it difficult to deal with that.


def encode_class(dataset):

  classes=[]

  for i in range(len(dataset)):

    if dataset[i][-1] not in classes:

      classes.append(dataset[i][-1])
  # Looping across the classes which we have derived above.This will make sure that we have definitive classes (numeric) and not arbitrary
  for i in range(len(classes)):
    # Looping across all rows of dataset
    for j in range(len(dataset)):
      if dataset[j][-1] == classes[i]:
        dataset[j][-1]=i
  return dataset
```

+*In[3]:*+

[source, ipython3]

```
# Splitting the data between training set and testing set. Normally its a general understanding the training:testing=7:3


def train_test_split(dataset,ratio):
  test_num=int(ratio*len(dataset))
  train=list(dataset)
  test=[]
  for i in range(test_num):
    rand=random.randrange(len(train))
    test.append(train.pop(rand))
  return train,test
```

+*In[4]:*+

[source, ipython3]

```
----
# Now depending on resultant value (last column values), we need to group the rows. It will be usefult for calculating mean and std_dev

def groupUnderClass(train):
  dict={}
  for row in train:
    if row[-1] not in dict:
      dict[row[-1]]=[]
    dict[row[-1]].append(row)
  return dict
----
```

+*In[5]:*+

[source, ipython3]

```
----
# Standard formulae (just by-heart)

def mean(val):
  return sum(val)/float(len(val)) #Obvious

def stdDev(val):
  avg=mean(val)
  variance=sum([pow(x-avg,2) for x in val])/float(len(val)-1) # Especially this one
  return math.sqrt(variance)
----



+*In[6]:*+
[source, ipython3]
----
# We will calculte the mean and std dev with respect to each attribute. Important while calculating gaussian probablity


def meanStdDev(instances):
  info=[(mean(x),stdDev(x)) for x in zip(*instances)] # Here we are taking complete column's values of all instances.
  del info[-1]
  return info


----



+*In[7]:*+
[source, ipython3]
----
# As explained earlier why e need to group. We will be calculating the mean and std dev with respect each class.
```

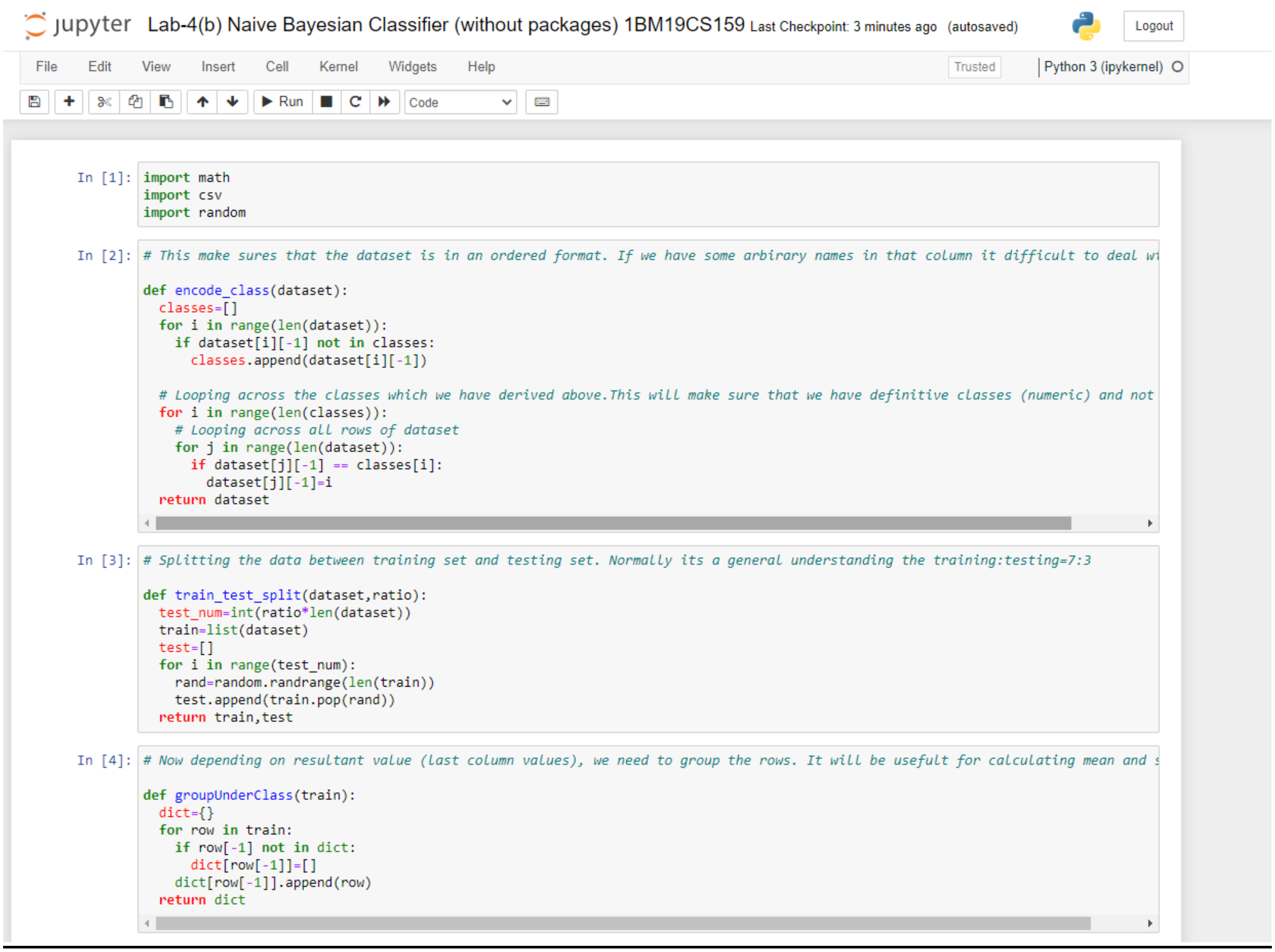
```
def MeanAndStdDevForClass(train):
  info={}
  dictionary=groupUnderClass(train)
  # print(dictionary)
  for key,value in dictionary.items():
    # dictionary[key]=meanStdDev(value)
    info[key]=meanStdDev(value) #Here value stands for a complete group.
  return info
----



+*In[8]:*+
[source, ipython3]
----
# Its a formula by heart (no choice)

def calculateGaussianProbablity(x,mean,std_dev):
  expo = math.exp(-(math.pow(x - mean, 2) / (2 * math.pow(std_dev, 2))))
  return (1 / (math.sqrt(2 * math.pi) * std_dev)) * expo

----



+*In[9]:*+
[source, ipython3]
----
```

```
# After calculating mean and std dev w.r.t training data now its time to check if the logic will work on testing data



def calculateClassProbablities(info,ele):
  probablities={}
  for key,summaries in info.items(): # Info contains the groupName (key) and list of (mean,std_dev) for each attribute of that group
    probablities[key]=1
    for i in range(len(summaries)): #Loop across all attributes
      mean,std_dev=summaries[i]
      x=ele[i] # Testing data's one instance's attribute value.
      probablities[key] *= calculateGaussianProbablity(x, mean, std_dev)
  return probablities

----



+*In[10]:*+
[source, ipython3]
----
def predict(info,ele):
  probablities=calculateClassProbablities(info,ele) # returns a dictionary of probablities for each group
  bestLabel,bestProb=None,-1
  # Consider group name whichever gives you the highest probablities for this instance of testing data
  for key,prob in probablities.items():
    if bestLabel==None or prob>bestProb:
      bestProb=prob
      bestLabel=key
  return bestLabel

----



+*In[11]:*+
[source, ipython3]
----
# Loop across testing data and store the predicted result from our model in the list.

def getPredictions(info,test):
  predictions=[]
  for ele in test:
    result=predict(info,ele) # This will give you the group to which it will belong.
    predictions.append(result)
  return predictions

----



+*In[12]:*+
[source, ipython3]
```

```
----
def check_accuracy(predictions,test):
  count=0
  for i in range(len(test)):
    if predictions[i]==test[i][-1]:
      count+=1
  return count/float(len(test))*100
----



+*In[13]:*+
[source, ipython3]
----
filename=r"C:\Users\Admin\OneDrive\Desktop\6th sem\ML\lab-ml\Lab 4\pima-indians-diabetes.csv"
dataset=csv.reader(open(filename))
dataset=list(dataset)
dataset=encode_class(dataset)
for i in range(len(dataset)):
  dataset[i]=[float(x) for x in dataset[i]]


ratio=0.3
print(len(dataset))
train,test=train_test_split(dataset,ratio)
info=MeanAndStdDevForClass(train)


predictions=getPredictions(info,test)
```

```
accuracy=check_accuracy(predictions,test)
accuracy

----



+*Out[13]:*+
----
768
75.21739130434783----



+*In[ ]:*+
[source, ipython3]
----

----
```

<u>Output screenshots :-</u>

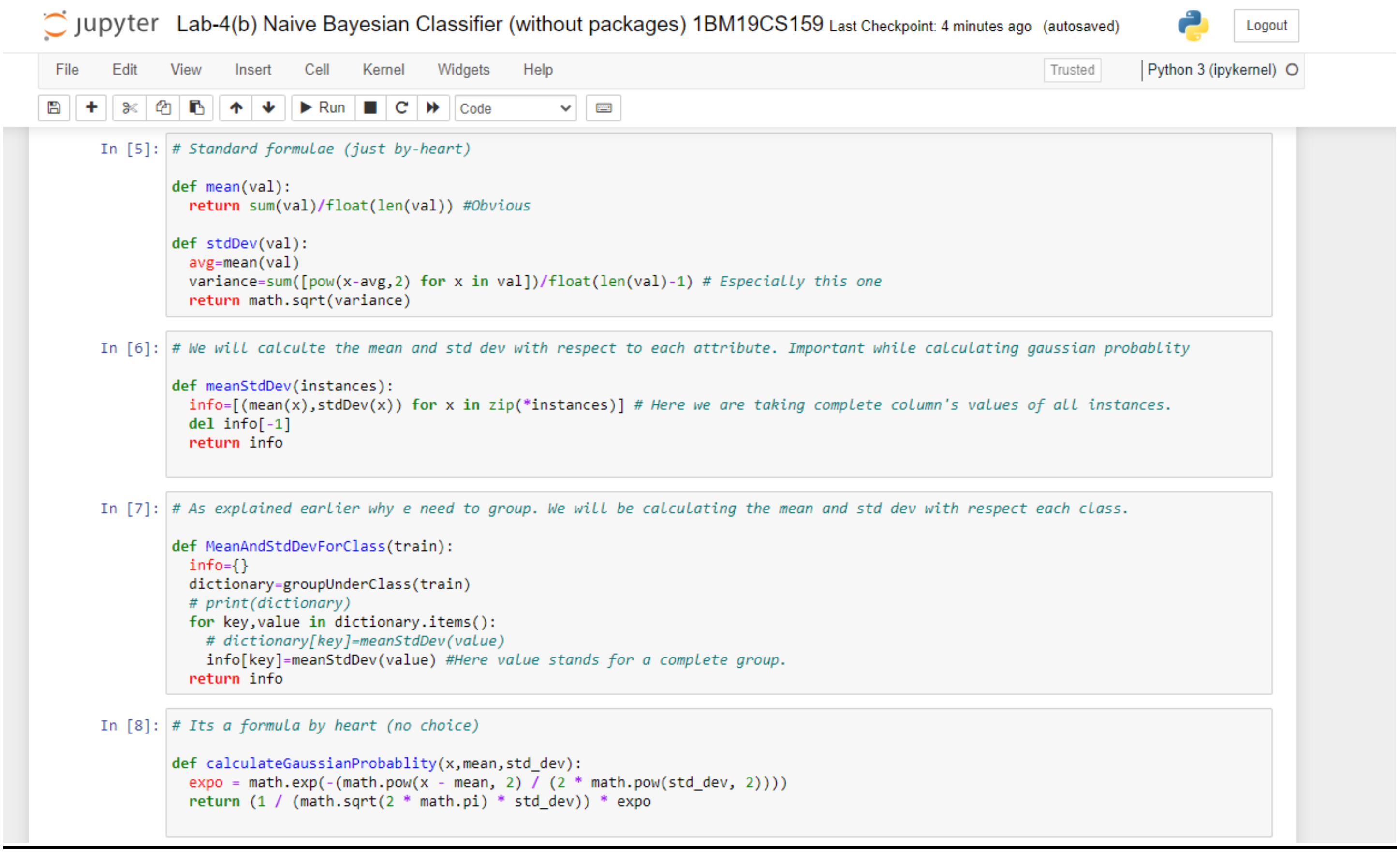

jupyter
Lab-4(b) Naive Bayesian Classifier (without packages) 1BM19CS159 Last Checkpoint: 3 minutes ago (autosaved)
Logout
File
Edit
View
Insert
Cell
Kernel
Widgets
Help
Trusted
Python 3 (ipykernel)
Run
Code

In [1]:
```
import math
import csv
import random
```

In [2]:
```
# This make sures that the dataset is in an ordered format. If we have some arbirary names in that column it difficult to deal wi

def encode_class(dataset):
  classes=[]
  for i in range(len(dataset)):
    if dataset[i][-1] not in classes:
      classes.append(dataset[i][-1])

  # Looping across the classes which we have derived above.This will make sure that we have definitive classes (numeric) and not
  for i in range(len(classes)):
    # Looping across all rows of dataset
    for j in range(len(dataset)):
      if dataset[j][-1] == classes[i]:
        dataset[j][-1]=i
  return dataset
```

In [3]:
```
# Splitting the data between training set and testing set. Normally its a general understanding the training:testing=7:3

def train_test_split(dataset,ratio):
  test_num=int(ratio*len(dataset))
  train=list(dataset)
  test=[]
  for i in range(test_num):
    rand=random.randrange(len(train))
    test.append(train.pop(rand))
  return train,test
```

In [4]:
```
# Now depending on resultant value (last column values), we need to group the rows. It will be usefult for calculating mean and s

def groupUnderClass(train):
  dict={}
  for row in train:
    if row[-1] not in dict:
      dict[row[-1]]=[]
    dict[row[-1]].append(row)
  return dict
```



Lab-4(b) Naive Bayesian Classifier (without packages) 1BM19CS159 Last Checkpoint: 4 minutes ago (autosaved)

In [5]:

```
# Standard formulae (just by-heart)

def mean(val):
  return sum(val)/float(len(val)) #Obvious

def stdDev(val):
  avg=mean(val)
  variance=sum([pow(x-avg,2) for x in val])/float(len(val)-1) # Especially this one
  return math.sqrt(variance)
```

In [6]:

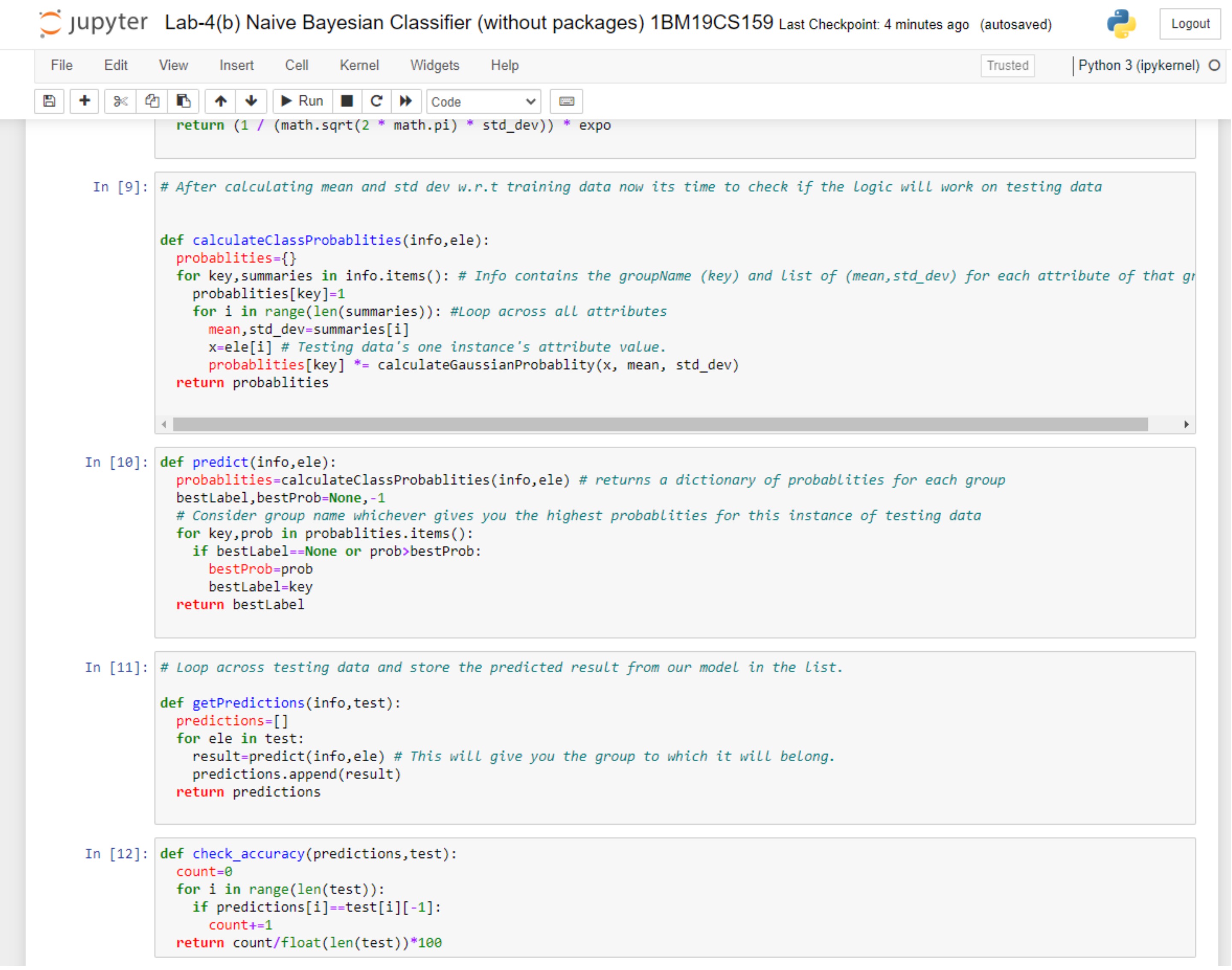
```
# We will calculte the mean and std dev with respect to each attribute. Important while calculating gaussian probablity

def meanStdDev(instances):
  info=[(mean(x),stdDev(x)) for x in zip(*instances)] # Here we are taking complete column's values of all instances.
  del info[-1]
  return info
```

In [7]:

```
# As explained earlier why e need to group. We will be calculating the mean and std dev with respect each class.

def MeanAndStdDevForClass(train):
  info={}
  dictionary=groupUnderClass(train)
  # print(dictionary)
  for key,value in dictionary.items():
    # dictionary[key]=meanStdDev(value)
    info[key]=meanStdDev(value) #Here value stands for a complete group.
  return info
```

In [8]:

```
# Its a formula by heart (no choice)

def calculateGaussianProbablity(x,mean,std_dev):
  expo = math.exp(-(math.pow(x - mean, 2) / (2 * math.pow(std_dev, 2))))
  return (1 / (math.sqrt(2 * math.pi) * std_dev)) * expo
```


jupyter
Lab-4(b) Naive Bayesian Classifier (without packages) 1BM19CS159 Last Checkpoint: 4 minutes ago (autosaved)
Logout
File
Edit
View
Insert
Cell
Kernel
Widgets
Help
Trusted
Python 3 (ipykernel)
Run
Code

```
  return (1 / (math.sqrt(2 * math.pi) * std_dev)) * expo
```

In [9]:

```
# After calculating mean and std dev w.r.t training data now its time to check if the logic will work on testing data

def calculateClassProbablities(info,ele):
  probablities={}
  for key,summaries in info.items(): # Info contains the groupName (key) and list of (mean,std_dev) for each attribute of that gr
    probablities[key]=1
    for i in range(len(summaries)): #Loop across all attributes
      mean,std_dev=summaries[i]
      x=ele[i] # Testing data's one instance's attribute value.
      probablities[key] *= calculateGaussianProbablity(x, mean, std_dev)
  return probablities
```

In [10]:

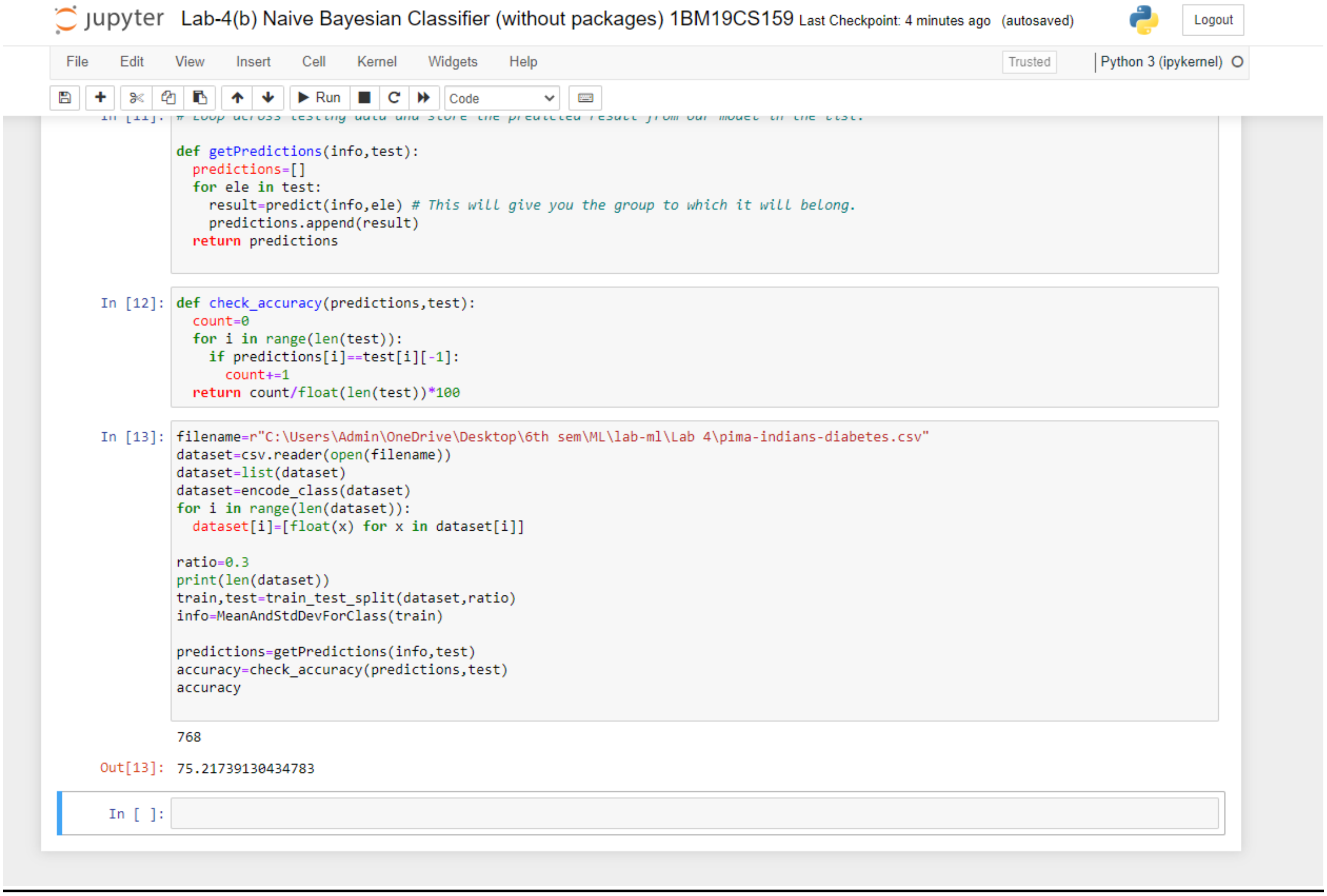
```
def predict(info,ele):
  probablities=calculateClassProbablities(info,ele) # returns a dictionary of probablities for each group
  bestLabel,bestProb=None,-1
  # Consider group name whichever gives you the highest probablities for this instance of testing data
  for key,prob in probablities.items():
    if bestLabel==None or prob>bestProb:
      bestProb=prob
      bestLabel=key
  return bestLabel
```

In [11]:

```
# Loop across testing data and store the predicted result from our model in the list.

def getPredictions(info,test):
  predictions=[]
  for ele in test:
    result=predict(info,ele) # This will give you the group to which it will belong.
    predictions.append(result)
  return predictions
```

In [12]:

```
def check_accuracy(predictions,test):
  count=0
  for i in range(len(test)):
    if predictions[i]==test[i][-1]:
      count+=1
  return count/float(len(test))*100
```



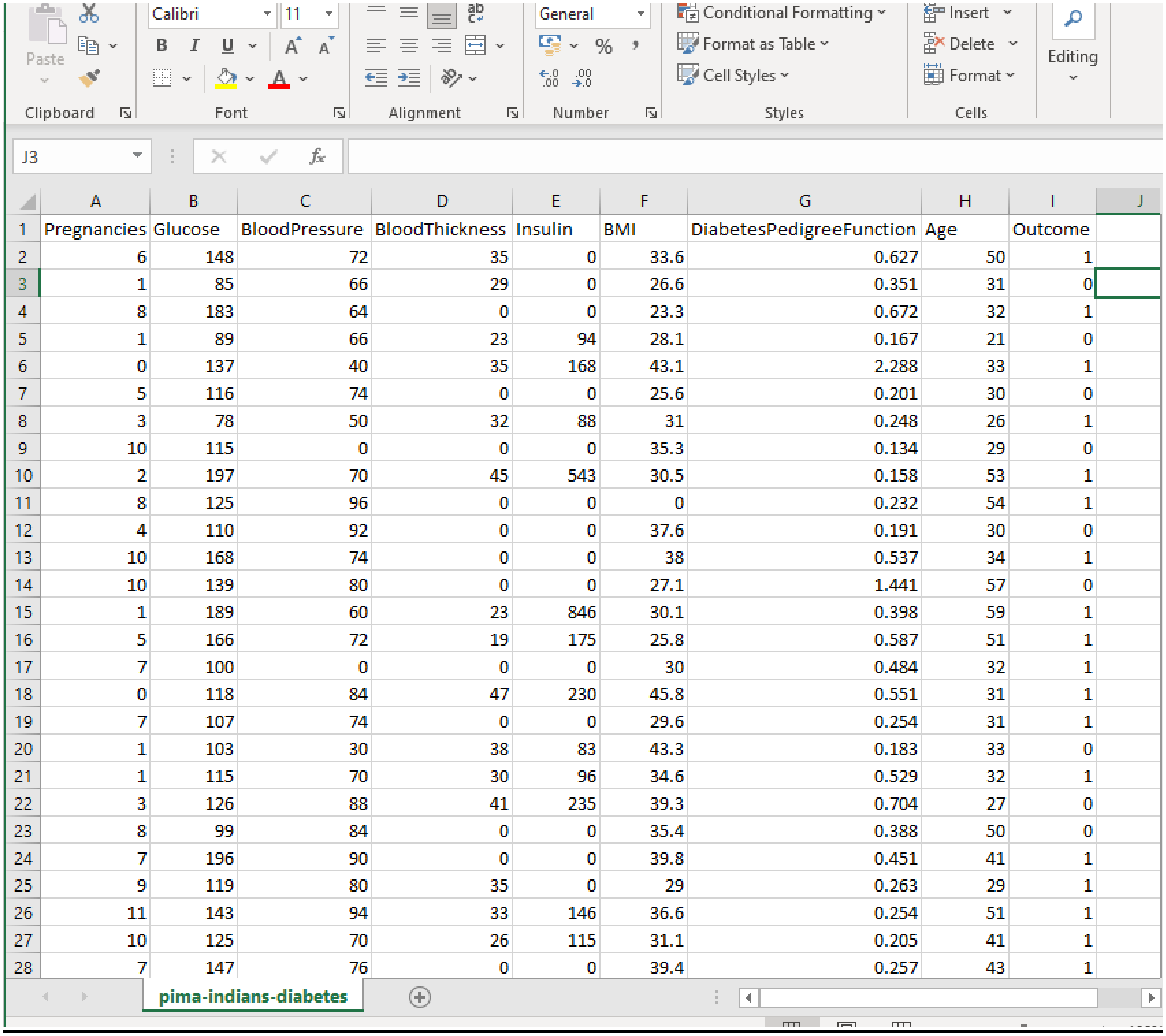
Lab-4(b) Naive Bayesian Classifier (without packages) 1BM19CS159

```
In [11]: # Loop across testing data and store the predicted result from our model in the list.

         def getPredictions(info,test):
           predictions=[]
           for ele in test:
             result=predict(info,ele) # This will give you the group to which it will belong.
             predictions.append(result)
           return predictions
```

```
In [12]: def check_accuracy(predictions,test):
           count=0
           for i in range(len(test)):
             if predictions[i]==test[i][-1]:
               count+=1
           return count/float(len(test))*100
```

```
In [13]: filename=r"C:\Users\Admin\OneDrive\Desktop\6th sem\ML\lab-ml\Lab 4\pima-indians-diabetes.csv"
         dataset=csv.reader(open(filename))
         dataset=list(dataset)
         dataset=encode_class(dataset)
         for i in range(len(dataset)):
           dataset[i]=[float(x) for x in dataset[i]]

         ratio=0.3
         print(len(dataset))
         train,test=train_test_split(dataset,ratio)
         info=MeanAndStdDevForClass(train)

         predictions=getPredictions(info,test)
         accuracy=check_accuracy(predictions,test)
         accuracy

         768

Out[13]: 75.21739130434783
```

```
In [ ]:
```



	A	B	C	D	E	F	G	H	I
1	Pregnancies	Glucose	BloodPressure	BloodThickness	Insulin	BMI	DiabetesPedigreeFunction	Age	Outcome
2	6	148	72	35	0	33.6	0.627	50	1
3	1	85	66	29	0	26.6	0.351	31	0
4	8	183	64	0	0	23.3	0.672	32	1
5	1	89	66	23	94	28.1	0.167	21	0
6	0	137	40	35	168	43.1	2.288	33	1
7	5	116	74	0	0	25.6	0.201	30	0
8	3	78	50	32	88	31	0.248	26	1
9	10	115	0	0	0	35.3	0.134	29	0
10	2	197	70	45	543	30.5	0.158	53	1
11	8	125	96	0	0	0	0.232	54	1
12	4	110	92	0	0	37.6	0.191	30	0
13	10	168	74	0	0	38	0.537	34	1
14	10	139	80	0	0	27.1	1.441	57	0
15	1	189	60	23	846	30.1	0.398	59	1
16	5	166	72	19	175	25.8	0.587	51	1
17	7	100	0	0	0	30	0.484	32	1
18	0	118	84	47	230	45.8	0.551	31	1
19	7	107	74	0	0	29.6	0.254	31	1
20	1	103	30	38	83	43.3	0.183	33	0
21	1	115	70	30	96	34.6	0.529	32	1
22	3	126	88	41	235	39.3	0.704	27	0
23	8	99	84	0	0	35.4	0.388	50	0
24	7	196	90	0	0	39.8	0.451	41	1
25	9	119	80	35	0	29	0.263	29	1
26	11	143	94	33	146	36.6	0.254	51	1
27	10	125	70	26	115	31.1	0.205	41	1
28	7	147	76	0	0	39.4	0.257	43	1

Lab Program -5.:-

Implement the Linear Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.

Source code and output :-

```
+*In[1]:*+

[source, ipython3]

----

import numpy as np

import matplotlib.pyplot as plt

import pandas as pd

----
```

```
+*In[11]:*+

[source, ipython3]

----

dataset = pd.read_csv(r"C:\Users\Admin\OneDrive\Desktop\6th sem\ML\lab-ml\Lab 5\Lr-Salary Dataset.csv")

X = dataset.iloc[:, :-1].values

y = dataset.iloc[:, 1].values

----
```

```
+*In[13]:*+
[source, ipython3]
----
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=1/3, random_state=0)
----



+*In[14]:*+
[source, ipython3]
----
# Fitting Simple Linear Regression to the Training set
from sklearn.linear_model import LinearRegression
regressor = LinearRegression()
regressor.fit(X_train, y_train)
----



+*Out[14]:*+
----LinearRegression()----



+*In[15]:*+
[source, ipython3]
----
# Predicting the Test set results
y_pred = regressor.predict(X_test)
```

+*In[19]:*+

[source, ipython3]

```
# Visualizing the Training set results
viz_train = plt
viz_train.scatter(X_train, y_train, color='red')
viz_train.plot(X_train, regressor.predict(X_train), color='blue')
viz_train.title('Salary VS Experience (Training set)')
viz_train.xlabel('Year of Experience')
viz_train.ylabel('Salary')
viz_train.show()
```

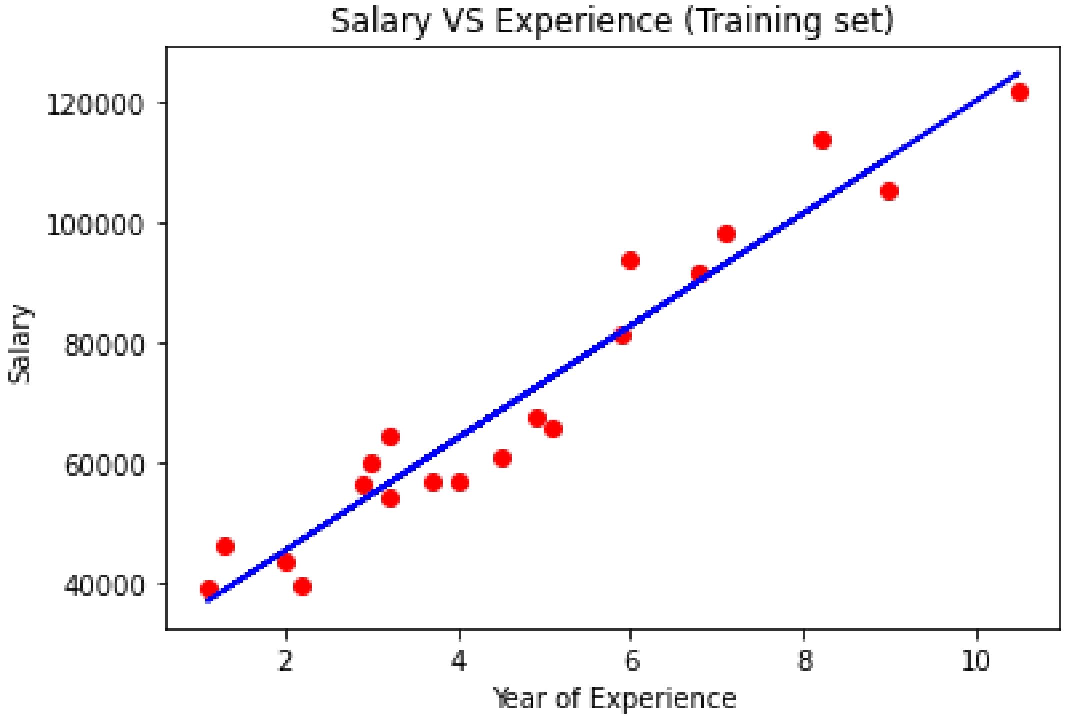
+*Out[19]:*+

![png](output_5_0.png)

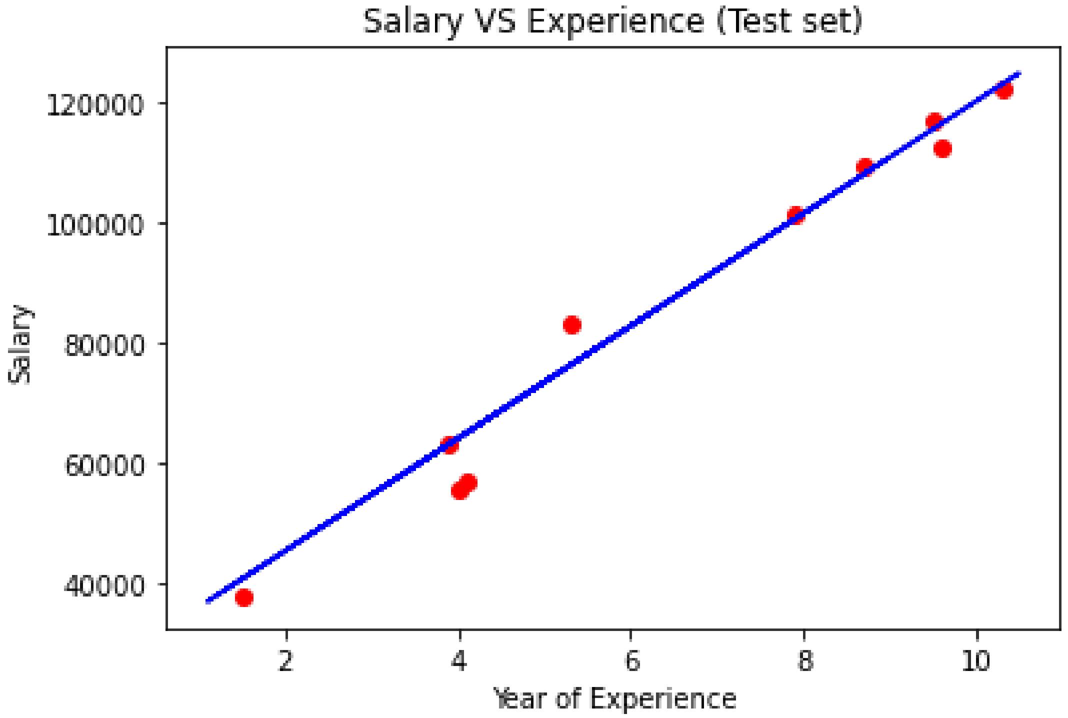
+*In[17]:*+

[source, ipython3]

```
----
# Visualizing the Test set results
viz_test = plt
viz_test.scatter(X_test, y_test, color='red')
viz_test.plot(X_train, regressor.predict(X_train), color='blue')
viz_test.title('Salary VS Experience (Test set)')
viz_test.xlabel('Year of Experience')
viz_test.ylabel('Salary')
viz_test.show()
----



+*Out[17]:*+
----
![png](output_6_0.png)
----



+*In[ ]:*+
[source, ipython3]
----


----
```

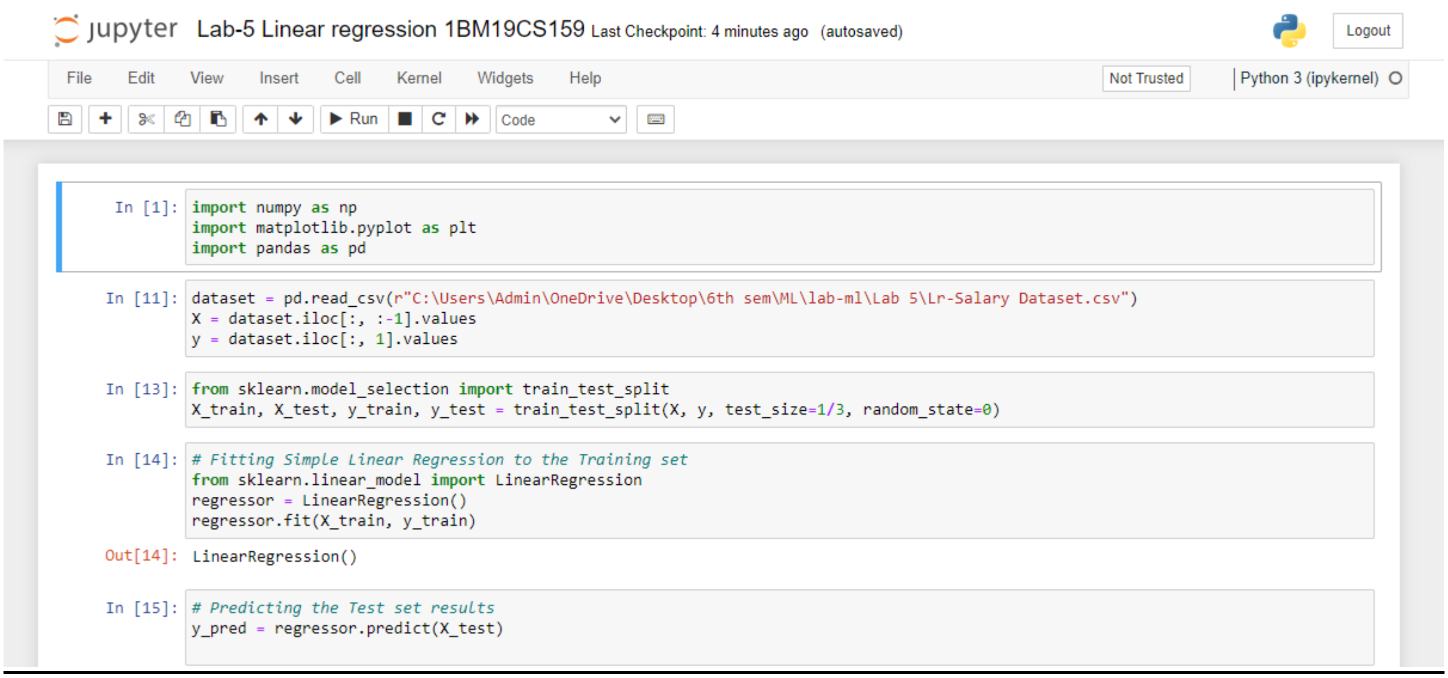


Salary VS Experience (Training set)



Salary VS Experience (Test set)

Output screenshots :-



In [1]:
```
import numpy as np
import matplotlib.pyplot as plt
import pandas as pd
```

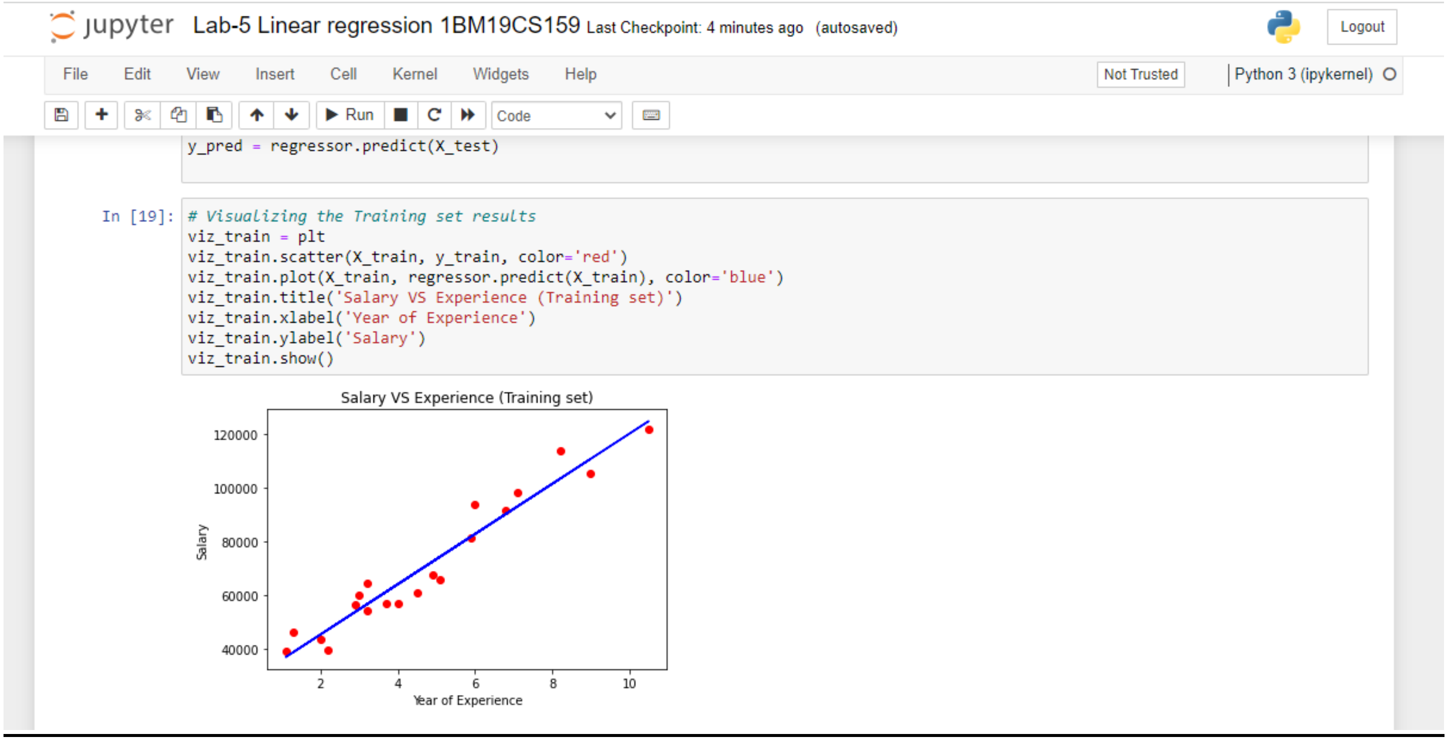
In [11]:
```
dataset = pd.read_csv(r"C:\Users\Admin\OneDrive\Desktop\6th sem\ML\lab-ml\Lab 5\Lr-Salary Dataset.csv")
X = dataset.iloc[:, :-1].values
y = dataset.iloc[:, 1].values
```

In [13]:
```
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=1/3, random_state=0)
```

In [14]:
```
# Fitting Simple Linear Regression to the Training set
from sklearn.linear_model import LinearRegression
regressor = LinearRegression()
regressor.fit(X_train, y_train)
```

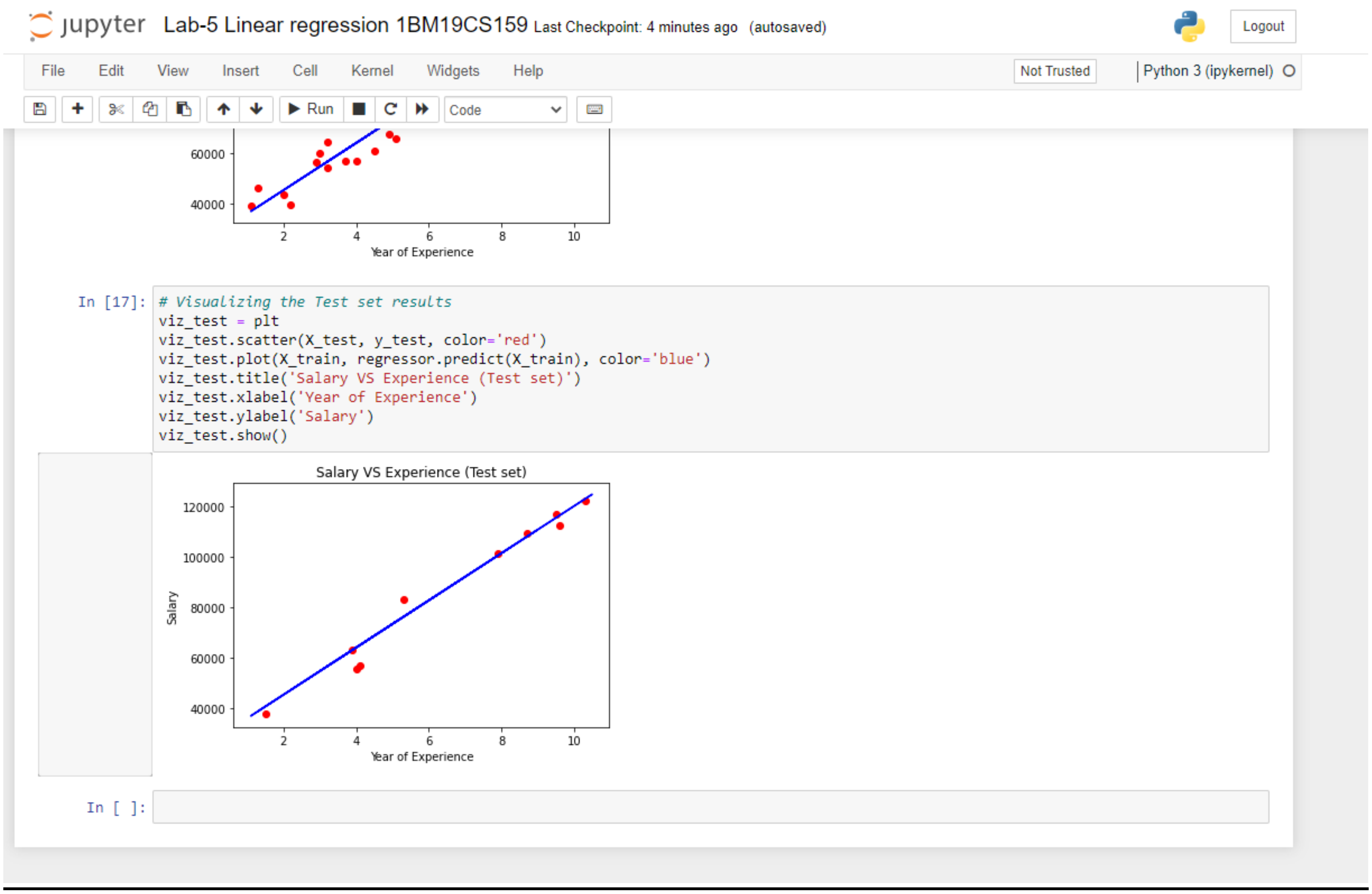
Out[14]:
```
LinearRegression()
```

In [15]:
```
# Predicting the Test set results
y_pred = regressor.predict(X_test)
```

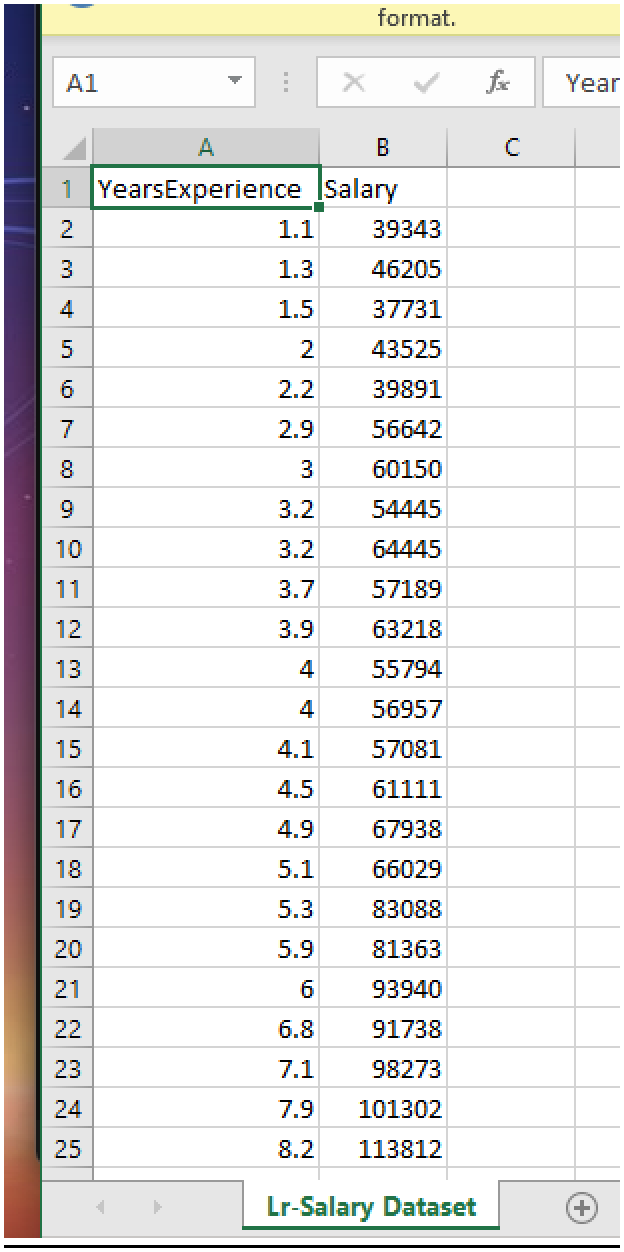


```
y_pred = regressor.predict(X_test)
```

In [19]:
```
# Visualizing the Training set results
viz_train = plt
viz_train.scatter(X_train, y_train, color='red')
viz_train.plot(X_train, regressor.predict(X_train), color='blue')
viz_train.title('Salary VS Experience (Training set)')
viz_train.xlabel('Year of Experience')
viz_train.ylabel('Salary')
viz_train.show()
```



```
In [17]: # Visualizing the Test set results
         viz_test = plt
         viz_test.scatter(X_test, y_test, color='red')
         viz_test.plot(X_train, regressor.predict(X_train), color='blue')
         viz_test.title('Salary VS Experience (Test set)')
         viz_test.xlabel('Year of Experience')
         viz_test.ylabel('Salary')
         viz_test.show()
```



	A	B	C
1	YearsExperience	Salary	
2	1.1	39343	
3	1.3	46205	
4	1.5	37731	
5	2	43525	
6	2.2	39891	
7	2.9	56642	
8	3	60150	
9	3.2	54445	
10	3.2	64445	
11	3.7	57189	
12	3.9	63218	
13	4	55794	
14	4	56957	
15	4.1	57081	
16	4.5	61111	
17	4.9	67938	
18	5.1	66029	
19	5.3	83088	
20	5.9	81363	
21	6	93940	
22	6.8	91738	
23	7.1	98273	
24	7.9	101302	
25	8.2	113812	