VISVESVARAYA TECHNOLOGICAL UNIVERSITY

"JnanaSangama", Belgaum -590014, Karnataka.

LAB REPORT
on

Machine Learning
(20CS6PCMAL)

Submitted by

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(1BM19CS057)

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

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Department of Computer Science and Engineering

CERTIFICATE

This is to certify that the Lab work entitled "**MACHINE LEARNING**" carried out by **HARSHIL DOSHI B (1BM19CS057),** who is bonafide 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 a **Machine Learning - (20CS6PCMAL)** work prescribed for the said degree.

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Index Sheet

Course Outcome

CO 1	Ability to **apply** the different learning algorithms.
CO 2	Ability to **analyse** the learning techniques for given dataset.
CO 3	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.

1. Find S Algorithm

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

In [1]:
```
import numpy as np
import pandas as pd
```

In [2]:
```
from google.colab import drive
drive.mount("/content/drive")
```

```
Drive already mounted at /content/drive; to attempt to forcibly remount, call drive.mount("/content/drive", force_remount=Tru
e).
```

In [3]:
```
data = pd.read_csv("/content/drive/MyDrive/finddata.csv")
print(data,"\n")
```

```
      Time Weather Temperature Company Humidity    Wind Goes
0  Morning   Sunny        Warm     Yes     Mild  Strong  Yes
1  Evening   Rainy        Cold      No     Mild  Normal   No
2  Morning   Sunny    Moderate     Yes   Normal  Normal  Yes
3  Evening   Sunny        Cold     Yes     High  Strong  Yes
```

In [4]:
```
d = np.array(data)[:,:-1]
print("\n The attributes are: ",d)
target = np.array(data)[:,-1]
print("\n The target is: ",target)
```

```
 The attributes are:  [['Morning' 'Sunny' 'Warm' 'Yes' 'Mild' 'Strong']
 ['Evening' 'Rainy' 'Cold' 'No' 'Mild' 'Normal']
 ['Morning' 'Sunny' 'Moderate' 'Yes' 'Normal' 'Normal']
 ['Evening' 'Sunny' 'Cold' 'Yes' 'High' 'Strong']]

 The target is:  ['Yes' 'No' 'Yes' 'Yes']
```

In [5]:
```
def findS(c,t):
    for i, val in enumerate(t):
        if val == "Yes":
            specific_hypothesis = c[i].copy()
            break
```


```
 The attributes are:  [['Morning' 'Sunny' 'Warm' 'Yes' 'Mild' 'Strong']
 ['Evening' 'Rainy' 'Cold' 'No' 'Mild' 'Normal']
 ['Morning' 'Sunny' 'Moderate' 'Yes' 'Normal' 'Normal']
 ['Evening' 'Sunny' 'Cold' 'Yes' 'High' 'Strong']]

 The target is:  ['Yes' 'No' 'Yes' 'Yes']
```

In [5]:
```
def findS(c,t):
    for i, val in enumerate(t):
        if val == "Yes":
            specific_hypothesis = c[i].copy()
            break

    for i, val in enumerate(c):
        if t[i] == "Yes":
            for x in range(len(specific_hypothesis)):
                if val[x] != specific_hypothesis[x]:
                    specific_hypothesis[x] = '?'
                else:
                    pass

    return specific_hypothesis
```


In [6]:
```
print("\n The final hypothesis is:",findS(d,target))
```

```
 The final hypothesis is: ['?' 'Sunny' '?' 'Yes' '?' '?']
```

2. Candidate Elimination Algorithm

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.

In [14]:
```
import numpy as np
import pandas as pd

#to read the data in the csv file
data = pd.DataFrame(data=pd.read_csv('enjoysport.csv'))
print(data,"\n")

#making an array of all the attributes
concepts = np.array(data.iloc[:,0:-1])
print("The attributes are: ",concepts)

#segregating the target that has positive and negative examples
target = np.array(data.iloc[:,-1])
print("\n The target is: ",target)

#training function to implement candidate_elimination algorithm
def learn(concepts, target):
    specific_h = concepts[0].copy()
    print("Initialization of specific hypothesis and general hypothesis:")
    print("S0: ",specific_h)
    general_h = [["?" for i in range(len(specific_h))] for i in range(len(specific_h))]
    print("G0: ",general_h)
    for i, h in enumerate(concepts):
        if target[i] == "yes":
            for x in range(len(specific_h)):
                if h[x] != specific_h[x]:
                    specific_h[x] = "?"
                    general_h[x][x] = "?"
        if target[i] == "no":
            for x in range(len(specific_h)):
                if h[x] !=specific_h[x]:
                    general_h[x][x] = specific_h[x]
                else:
                    general_h[x][x] = "?"
        print("The steps of Candidate Elimination Algorithm ", i+1)
        print(f"S{i+1}: " ,specific_h)
        actual_general_h= [i for i in general_h if i != ["?" for i in range(len(specific_h))]]
        print(f"G{i+1}: ",actual_general_h)
        print(general_h)
    actual_general_h= [i for i in general_h if i != ["?" for i in range(len(specific_h))]]
```

```
1  sunny  warm     high  strong  warm    same        yes
2  rainy  cold     high  strong  warm  change         no
3  sunny  warm     high  strong  cool  change        yes

The attributes are:  [['sunny' 'warm' 'normal' 'strong' 'warm' 'same']
 ['sunny' 'warm' 'high' 'strong' 'warm' 'same']
 ['rainy' 'cold' 'high' 'strong' 'warm' 'change']
 ['sunny' 'warm' 'high' 'strong' 'cool' 'change']]

 The target is:  ['yes' 'yes' 'no' 'yes']
```

In [15]:
```
s_final, g_final = learn(concepts, target)
print("The final Specific hypothesis is: ", s_final, sep="\n")
print("The final General Hypothesis is: ", g_final, sep="\n")
```

```
Initialization of specific hypothesis and general hypothesis:
S0:  ['sunny' 'warm' 'normal' 'strong' 'warm' 'same']
G0:  [['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?',
'?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?']]
The steps of Candidate Elimination Algorithm  1
S1:  ['sunny' 'warm' 'normal' 'strong' 'warm' 'same']
G1:  []
[['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?',
'?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?']]
The steps of Candidate Elimination Algorithm  2
S2:  ['sunny' 'warm' '?' 'strong' 'warm' 'same']
G2:  []
[['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?',
'?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?']]
The steps of Candidate Elimination Algorithm  3
S3:  ['sunny' 'warm' '?' 'strong' 'warm' 'same']
G3:  [['sunny', '?', '?', '?', '?', '?'], ['?', 'warm', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', 'same']]
[['sunny', '?', '?', '?', '?', '?'], ['?', 'warm', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?',
'?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', 'same']]
The steps of Candidate Elimination Algorithm  4
S4:  ['sunny' 'warm' '?' 'strong' '?' '?']
G4:  [['sunny', '?', '?', '?', '?', '?'], ['?', 'warm', '?', '?', '?', '?']]
[['sunny', '?', '?', '?', '?', '?'], ['?', 'warm', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?',
'?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?']]
The final Specific hypothesis is:
['sunny' 'warm' '?' 'strong' '?' '?']
The final General Hypothesis is:
[['sunny', '?', '?', '?', '?', '?'], ['?', 'warm', '?', '?', '?', '?']]
```

3. ID3 Algorithm

Write a program to demonstrate the working of the decision tree based ID3algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.

```
In [32]: import pandas as pd

         import numpy as np

         from sklearn.datasets import load_iris

         data = load_iris()
```

```
In [33]: df = pd.DataFrame(data.data, columns = data.feature_names)
```

```
In [34]: df
```

Out[34]:

	sepal length (cm)	sepal width (cm)	petal length (cm)	petal width (cm)
0	5.1	3.5	1.4	0.2
1	4.9	3.0	1.4	0.2
2	4.7	3.2	1.3	0.2
3	4.6	3.1	1.5	0.2
4	5.0	3.6	1.4	0.2
...	...	...	...	...
145	6.7	3.0	5.2	2.3
146	6.3	2.5	5.0	1.9
147	6.5	3.0	5.2	2.0
148	6.2	3.4	5.4	2.3
149	5.9	3.0	5.1	1.8

150 rows × 4 columns

```
In [20]: df['Species'] = data.target

         #replace this with the actual names

         target = np.unique(data.target)
         print(target)

         target_names = np.unique(data.target_names)
         print(target_names)
         targets = dict(zip(target, target_names))
         print(targets)
         df['Species'] = df['Species'].replace(targets)
```

```
[0 1 2]
['setosa' 'versicolor' 'virginica']
{0: 'setosa', 1: 'versicolor', 2: 'virginica'}
```

```
In [21]: x = df.drop(columns="Species")

         y = df["Species"]
```

```
In [22]: feature_names = x.columns
         labels = y.unique()
```

```
In [36]: from sklearn.model_selection import train_test_split

         x_train, test_x, y_train, test_lab = train_test_split(x,y,test_size = 0.4,random_state = 42)
         # print(x_train)
         # print(test_x)
         # print(y_train)
         # print(test_lab)
```

In [24]:
```
from sklearn.tree import DecisionTreeClassifier
clf = DecisionTreeClassifier(max_depth =3, random_state = 42,criterion='entropy')
```

Out[25]: DecTsion+reeciassi-fier (c rTterion= ' entropy ‘, cax_depth=3 randon_state=42)

In [35]:
```
test_pred = clf.predict(test_x)
test_pred
```

Out[35]: array([' versicolor ', 'setosa ‘ , 'vl rgint ca‘ , "verslcotor ‘ , ‘vers i color',
'set as a 'vensTc a 1ar f 'vTngändca' 'vepsTcoLor ' 'versicolor'

'virginica', 'setosa', 'virginica', 'virginica', 'virginica',
'virginica', 'virginica', 'setosa', 'setosa', 'setosa', 'setc
'versicolor', 'setosa', 'setosa', 'virginica', 'versicolor',
'setosa', 'setosa', 'setosa', 'virginica', 'versicolor',
'versicolor', 'setosa', 'setosa', 'versicolor', 'versicolor',

' setosa ', ' setosa ' , * versicofor '], dtype-object)

```
ii-t wtpiotlib. pypJot as pJt
confusion_matrix = at ri cs . conf us Ton_ℤatrix (Iest_1ab, tes t_pred )
```

In [28]: confus ion oatrix

out [zsj : array([[23, 6, 0],

In [28a : ' conf-usion_matr1x

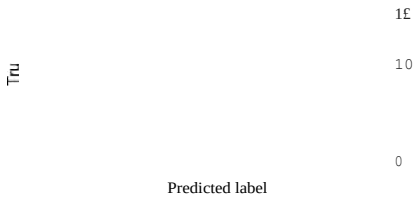
Out 2B§ : a r r'ay ([ )23, B , 0,§

[0, 1, 17]], dtype=int64)

In [29]:
```
matrix df = pd.OataFrame(confusionmatrix)
```

```
plt.figure(figsize=(10,7))
ax.set_title('Confusion Matrix - Decision Tree')
ax.set xlabel("Predicted label", fontsize =15)
ax.set_xticklabeIs(['']+labels)
ax.set la6el("True Label", fontsize=15)
ax.set icklabels(list(labels), rotation = B)
```

Confusion Mabix - decision Tree

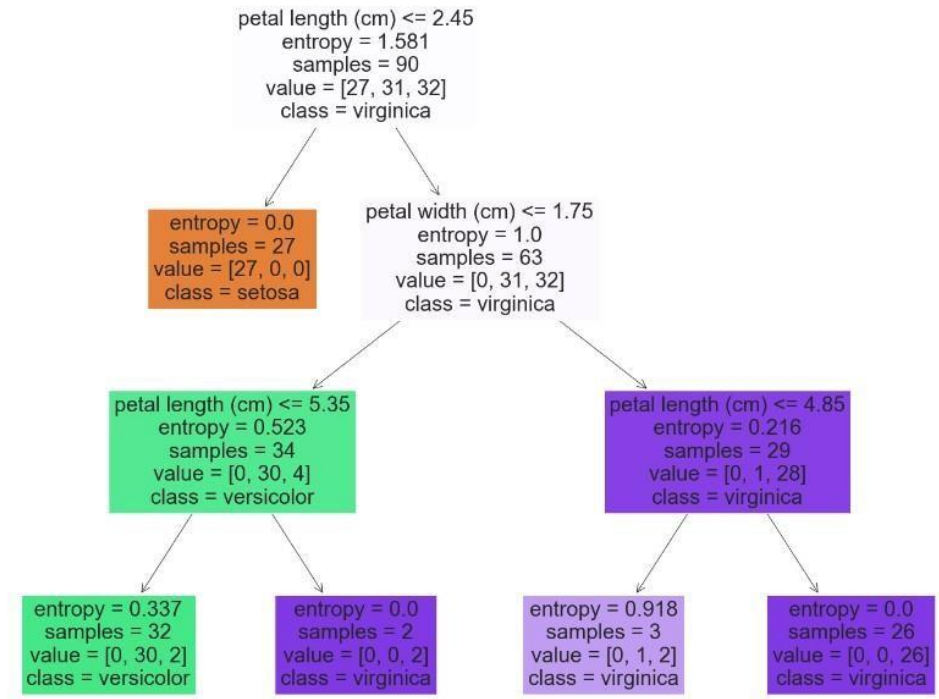


Predicted label

‹ Figure size 720x504 with 0 Axes>

```
fig = plt.figure(figsize=(25,20))
                featvre_names=data.feature_names,
                class names=data.target names,
```

In [31]:
```
from sklearn import tree
fig = plt.figure(figsize=(25,20))
_ = tree.plot_tree(clf,
                   feature_names=data.feature_names,
                   class_names=data.target_names,
                   filled=True)
```



In [ ]:

4. Naïve Bayes

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

In [10]:
```
import pandas as pd
data = pd.read_csv('PlayTennis.csv')
data
```

Out[10]:

	PlayTennis	Outlook	Temperature	Humidity	Wind
0	No	Sunny	Hot	High	Weak
1	No	Sunny	Hot	High	Strong
2	Yes	Overcast	Hot	High	Weak
3	Yes	Rain	Mild	High	Weak
4	Yes	Rain	Cool	Normal	Weak
5	No	Rain	Cool	Normal	Strong
6	Yes	Overcast	Cool	Normal	Strong
7	No	Sunny	Mild	High	Weak
8	Yes	Sunny	Cool	Normal	Weak
9	Yes	Rain	Mild	Normal	Weak
10	Yes	Sunny	Mild	Normal	Strong
11	Yes	Overcast	Mild	High	Strong
12	Yes	Overcast	Hot	Normal	Weak
13	No	Rain	Mild	High	Strong

In [11]:
```
y = list(data['PlayTennis'].values)
X = data.iloc[:,1:].values

print(f'Target Values: {y}')
print(f'Features: \n{X}')
```

```
Target Values: ['No', 'No', 'Yes', 'Yes', 'Yes', 'No', 'Yes', 'No', 'Yes', 'Yes', 'Yes', 'Yes', 'Yes', 'No']
Features:
[['Sunny' 'Hot' 'High' 'Weak']
 ['Sunny' 'Hot' 'High' 'Strong']
 ['Overcast' 'Hot' 'High' 'Weak']
 ['Rain' 'Mild' 'High' 'Weak']
 ['Rain' 'Cool' 'Normal' 'Weak']
 ['Rain' 'Cool' 'Normal' 'Strong']
 ['Overcast' 'Cool' 'Normal' 'Strong']
 ['Sunny' 'Mild' 'High' 'Weak']
 ['Sunny' 'Cool' 'Normal' 'Weak']
 ['Rain' 'Mild' 'Normal' 'Weak']
 ['Sunny' 'Mild' 'Normal' 'Strong']
 ['Overcast' 'Mild' 'High' 'Strong']
 ['Overcast' 'Hot' 'Normal' 'Weak']
```

```
['Sunny' 'Mild' 'Normal' 'Strong']

['Rain' 'Mild' 'High' 'Strong']]
```

```
        se 1f  x,  s elf.y  =  x,  y

        selC dim   lan(s 1f.x[c]

        s lT ou+put_dom    {)

        for i in range(len(self.X)):
            for j in range(self.dim):

                    self.attrs[j].append(self.X[i][j])
            if not self.y[i] in self.output_dom.keys():
                s e l f . aul p ut_don [ s e Tf y [ i j • 1

                self.output_dom[self.y[i]] += 1
            self.data.append([self.X[i], self.y[i]])
            print(self.attrs)
            print(self.output_dom)
#             print(self.data)



            prob = self.output_dom[y]/self.N
```

```
Jn .1 : ,nbc- Nai'eBayezClza•ifier(X i'ain, y brain,

        |total_cases = len(y_val)

            p r e d i c l i a ns . app end p re dT cl

            if y_val[i] == predict:
```

```
[['Sunny', 'Overcast'], ['Hot'], ['High'], ['Weak', 'Strong']]

[['$u n nj","Oc'e r c a s I','R a i n'],['H o t"'1 l i l d ?,[H i g h,j['I e a k','I t r e n g ]]

[['Sunny', 'Overcast', 'Rain'], ['Hot', 'Mild', 'Cool'], ['High', 'Normal'], ['Weak', 'Strong']]

[['Sunny', 'Overcast', 'Rain'], ['Hot', 'Mild', 'Cool'], ['High', 'Normal'], ['Weak', 'Strong']]

[['Sunny', 'Overcast', 'Rain'], ['Hot', 'Mild', 'Cool'], ['High', 'Normal'], ['Weak', 'Strong']]

[['Sunny', 'Overcast', 'Rain'], ['Hot', 'Mild', 'Cool'], ['High', 'Normal'], ['Weak', 'Strong']]

Predicted values: ['No', 'Yes', 'No', 'Yes', 'Yes', 'No']
Actual values: ['Yes', 'Yes', 'Yes', 'Yes', 'Yes', 'No']
```

5. Linear Regression

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

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

In [2]:
```
dataset = pd.read_csv('salary_data.csv')
X = dataset.iloc[:, :-1].values
y = dataset.iloc[:, 1].values
```

In [3]:
```
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)
```

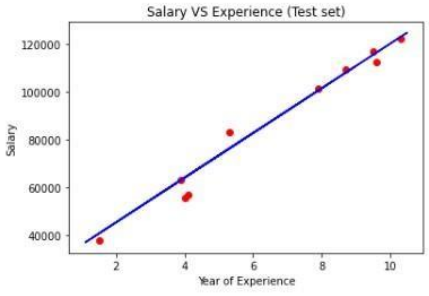
In [4]:
```
# Fitting Simple Linear Regression to the Training set
from sklearn.linear_model import LinearRegression
regressor = LinearRegression()
regressor.fit(X_train, y_train)
```

Out[4]:
```
LinearRegression()
```

In [5]:
```
# Predicting the Test set results
y_pred = regressor.predict(X_test)
```

In [6]:
```
# 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 [7]:
```
# 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()
```



In [ ]: