# VISVESVARAYA TECHNOLOGICAL UNIVERSITY

**"JnanaSangama", Belgaum -590014, Karnataka.**

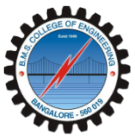
**LAB REPORT**
**on**

# COURSE TITLE

***Submitted by***

**NIRANJAN NAGARAJ SAVANUR (1BM19CS104)**

***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**
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# 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" carried out by **NIRANJAN NAGARAJ SAVANUR(1BM19CS104),** 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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## Course Outcome

| | |
|---|---|

**1.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]:
```
data = pd.read_csv("mydata.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 [3]:
```
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 [4]:
```
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

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

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

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

In [2]:
```
print("Enter features separated by space")
features = input().split()
print("Features ", features)
num_samples = int(input("enter number of samples: "))
```

```
Enter features separated by space
Time Weather Temperature Company Humidity Wind
Features  ['Time', 'Weather', 'Temperature', 'Company', 'Humidity', 'Wind']
enter number of samples: 4
```

In [11]:
```
def findS():
    specific_hypothesis = ["n"]*len(features)
    for a in range(num_samples):
        print("sample", a)

        temp_features = input("Enter features: ").split()
        target = input("Enter outcome: ")
        if target == "Yes":
            for x in range(len(specific_hypothesis)):
                if specific_hypothesis[x] == "n":
                    specific_hypothesis[x] = temp_features[x]
                elif temp_features[x] != specific_hypothesis[x]:
                    specific_hypothesis[x] = '?'
        print("Specific hypothesis: ", specific_hypothesis)
    return specific_hypothesis
```

In [12]:
```
print("\n The final hypothesis is:",findS())
```

```
sample 0
Enter features: Morning Sunny Warm Yes Mild Strong
Enter outcome: Yes
Specific hypothesis:  ['Morning', 'Sunny', 'Warm', 'Yes', 'Mild', 'Strong']
sample 1
Enter features: Evening Rainy Cold No Mild Normal
Enter outcome: No
Specific hypothesis:  ['Morning', 'Sunny', 'Warm', 'Yes', 'Mild', 'Strong']
sample 2
Enter features: Morning Sunny Moderate Yes Normal Normal
Enter outcome: Yes
Specific hypothesis:  ['Morning', 'Sunny', '?', 'Yes', '?', '?']
sample 3
Enter features: Evening Sunny Cold Yes High Strong
Enter outcome: Yes
Specific hypothesis:  ['?', 'Sunny', '?', 'Yes', '?', '?']

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

**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.**

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

In [2]:
```
data = pd.read_csv('mydata.csv')
concepts = np.array(data.iloc[:,0:-1])
print("\nInstances are:\n",concepts)
target = np.array(data.iloc[:,-1])
print("\nTarget Values are: ",target)
```

```
Instances 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']]

Target Values are:  ['yes' 'yes' 'no' 'yes']
```

In [5]:
```
def learn(concepts, target):
    specific_h = ["null"]*len(concepts[0])
    print("\nInitialization of specific_h and genearal_h")
    print("\nSpecific Boundary: ", specific_h)
    specific_h = concepts[0].copy()
    general_h = [["?" for i in range(len(specific_h))] for i in range(len(specific_h))]
    print("\nGeneric Boundary: ",general_h)

    for i, h in enumerate(concepts):
        print("\nInstance", i+1 , "is ", h)
        if target[i] == "yes":
            print("Instance is Positive ")
            for x in range(len(specific_h)):
                if h[x]!= specific_h[x]:
                    specific_h[x] ='?'
                    general_h[x][x] ='?'

        if target[i] == "no":
            print("Instance is Negative ")
            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] = '?'
```

```
                    general_h[x][x] = specific_h[x]
                else:
                    general_h[x][x] = '?'

        print("Specific Bundary after ", i+1, "Instance is ", specific_h)
        print("Generic Boundary after ", i+1, "Instance is ", general_h)
        print("\n")

    indices = [i for i, val in enumerate(general_h) if val == ['?']*len(concepts[0])]
    for i in indices:
        general_h.remove(['?', '?', '?', '?', '?', '?'])
    return specific_h, general_h
```

In [6]:
```
s_final, g_final = learn(concepts, target)

print("Final Specific_h: ", s_final, sep="\n")
print("Final General_h: ", g_final, sep="\n")
```

```
Initialization of specific_h and genearal_h

Specific Boundary:  ['null', 'null', 'null', 'null', 'null', 'null']

Generic Boundary:  [['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'],
['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?']]

Instance 1 is  ['sunny' 'warm' 'normal' 'strong' 'warm' 'same']
Instance is Positive
Specific Bundary after  1 Instance is  ['sunny' 'warm' 'normal' 'strong' 'warm' 'same']
Generic Boundary after  1 Instance is  [['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?',
'?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?']]



Instance 2 is  ['sunny' 'warm' 'high' 'strong' 'warm' 'same']
Instance is Positive
Specific Bundary after  2 Instance is  ['sunny' 'warm' '?' 'strong' 'warm' 'same']
Generic Boundary after  2 Instance is  [['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?',
'?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?']]



Instance 3 is  ['rainy' 'cold' 'high' 'strong' 'warm' 'change']
Instance is Negative
Specific Bundary after  3 Instance is  ['sunny' 'warm' '?' 'strong' 'warm' 'same']
Generic Boundary after  3 Instance is  [['sunny' '?' '?' '?' '?' '?'] ['?' 'warm' '?' '?' '?' '?'] ['?' '?' '?' '?' '?' '?'] ['?'
```

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

Instance 1 is  ['sunny' 'warm' 'normal' 'strong' 'warm' 'same']
Instance is Positive
Specific Bundary after  1 Instance is  ['sunny' 'warm' 'normal' 'strong' 'warm' 'same']
Generic Boundary after  1 Instance is  [['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?',
'?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?']]



Instance 2 is  ['sunny' 'warm' 'high' 'strong' 'warm' 'same']
Instance is Positive
Specific Bundary after  2 Instance is  ['sunny' 'warm' '?' 'strong' 'warm' 'same']
Generic Boundary after  2 Instance is  [['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?',
'?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?']]



Instance 3 is  ['rainy' 'cold' 'high' 'strong' 'warm' 'change']
Instance is Negative
Specific Bundary after  3 Instance is  ['sunny' 'warm' '?' 'strong' 'warm' 'same']
Generic Boundary after  3 Instance is  [['sunny', '?', '?', '?', '?', '?'], ['?', 'warm', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?',
'?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', 'same']]



Instance 4 is  ['sunny' 'warm' 'high' 'strong' 'cool' 'change']
Instance is Positive
Specific Bundary after  4 Instance is  ['sunny' 'warm' '?' 'strong' '?' '?']
Generic Boundary after  4 Instance is  [['sunny', '?', '?', '?', '?', '?'], ['?', 'warm', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?',
'?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?']]


Final Specific_h:
['sunny' 'warm' '?' 'strong' '?' '?']
Final General_h:
[['sunny', '?', '?', '?', '?', '?'], ['?', 'warm', '?', '?', '?', '?']]
```

In [ ]:

## 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.

In [1]:
```
import pandas as pd
import numpy as np
from sklearn.datasets import load_iris
data = load_iris()
```

In [2]:
```
df = pd.DataFrame(data.data, columns = data.feature_names)
```

In [3]:
```
df.head()
```

Out[3]:

| | 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 |

In [4]:
```
df['Species'] = data.target
#replace this with the actual names
target = np.unique(data.target)
target_names = np.unique(data.target_names)
targets = dict(zip(target, target_names))
df['Species'] = df['Species'].replace(targets)
```

In [5]:
```
x = df.drop(columns="Species")
```

In [5]:
```
x = df.drop(columns="Species")

y = df["Species"]
```

In [6]:
```
feature_names = x.columns
labels = y.unique()
```

In [7]:
```
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)
```

In [10]:
```
from sklearn.tree import DecisionTreeClassifier
clf = DecisionTreeClassifier(random_state = 42, criterion="entropy")
```

In [11]:
```
clf.fit(X_train, y_train)
```

Out[11]:
```
DecisionTreeClassifier(criterion='entropy', random_state=42)
```

In [12]:
```
test_pred = clf.predict(test_x)
```

In [13]:
```
from sklearn import metrics

import seaborn as sns

import matplotlib.pyplot as plt

confusion_matrix = metrics.confusion_matrix(test_lab,test_pred)
```

In [14]:
```
confusion_matrix
```

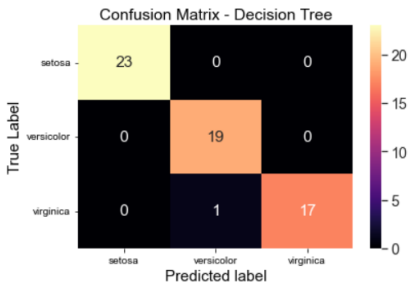
Out[14]:
```
array([[23,  0,  0],
       [ 0, 19,  0],
       [ 0,  1, 17]], dtype=int64)
```

In [15]:
```
matrix_df = pd.DataFrame(confusion_matrix)
```

In [14]:
```
confusion_matrix
```

Out[14]:
```
array([[23,  0,  0],
       [ 0, 19,  0],
       [ 0,  1, 17]], dtype=int64)
```

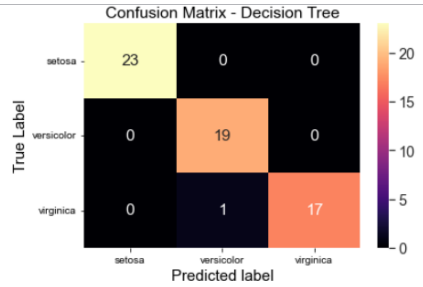
In [15]:
```
matrix_df = pd.DataFrame(confusion_matrix)
ax = plt.axes()
sns.set(font_scale=1.3)
plt.figure(figsize=(10,7))
sns.heatmap(matrix_df, annot=True, fmt="g", ax=ax, cmap="magma")
ax.set_title('Confusion Matrix - Decision Tree')
ax.set_xlabel("Predicted label", fontsize =15)
ax.set_xticklabels(['']+labels)
ax.set_ylabel("True Label", fontsize=15)
ax.set_yticklabels(list(labels), rotation = 0)
plt.show()
```




```
<Figure size 720x504 with 0 Axes>
```

In [16]:
```
clf.score(test_x,test_lab)
```

Out[16]:
```
0.9833333333333333
```

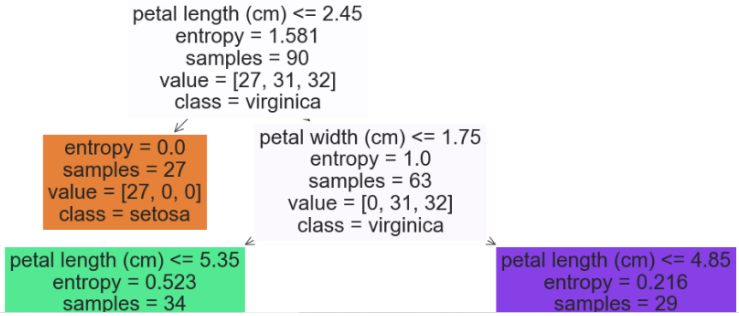


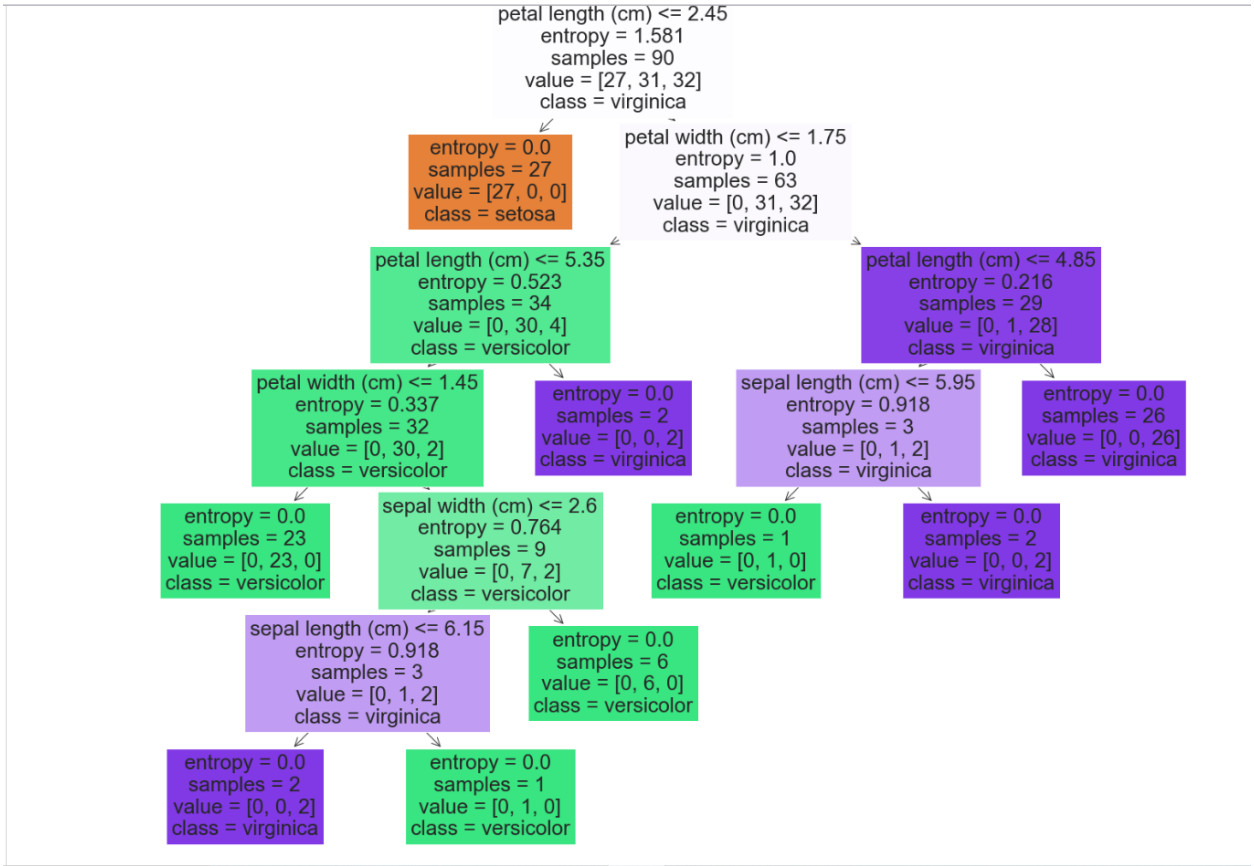

```
<Figure size 720x504 with 0 Axes>
```

In [16]:
```
clf.score(test_x,test_lab)
```

Out[16]:
```
0.9833333333333333
```

In [17]:
```
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 [1]:
```
import pandas as pd
import math
import numpy as np
```

In [2]:
```
data = pd.read_csv("dataset.csv")
features = [feat for feat in data]
features.remove("answer")
```

In [7]:
```
features
```

Out[7]:
```
['outlook', 'temperature', 'humidity', 'wind']
```

In [4]:
```
data
```

Out[4]:

| | outlook | temperature | humidity | wind | answer |
|---|---|---|---|---|---|
| 0 | sunny | hot | high | weak | no |
| 1 | sunny | hot | high | strong | no |
| 2 | overcast | hot | high | weak | yes |
| 3 | rain | mild | high | weak | yes |
| 4 | rain | cool | normal | weak | yes |
| 5 | rain | cool | normal | strong | no |
| 6 | overcast | cool | normal | strong | yes |
| 7 | sunny | mild | high | weak | no |
| 8 | sunny | cool | normal | weak | yes |
| 9 | rain | mild | normal | weak | yes |
| 10 | sunny | mild | normal | strong | yes |
| 11 | overcast | mild | high | strong | yes |
| 12 | overcast | hot | normal | weak | yes |

| | | | | | |
|---|---|---|---|---|---|
| 11 | overcast | mild | high | strong | yes |
| 12 | overcast | hot | normal | weak | yes |
| 13 | rain | mild | high | strong | no |

In [3]:
```
class Node:
    def __init__(self):
        self.children = []
        self.value = ""
        self.isLeaf = False
        self.pred = ""
```

In [5]:
```
def entropy(examples):
    pos = 0.0
    neg = 0.0
    for _, row in examples.iterrows():
        if row["answer"] == "yes":
            pos += 1
        else:
            neg += 1
    if pos == 0.0 or neg == 0.0:
        return 0.0
    else:
        p = pos / (pos + neg)
        n = neg / (pos + neg)
        return -(p * math.log(p, 2) + n * math.log(n, 2))
```

In [6]:
```
def info_gain(examples, attr):
    uniq = np.unique(examples[attr])
    #print ("\n",uniq)
    gain = entropy(examples)
    #print ("\n",gain)
    for u in uniq:
        subdata = examples[examples[attr] == u]
        #print ("\n",subdata)
        sub_e = entropy(subdata)
        gain -= (float(len(subdata)) / float(len(examples))) * sub_e
        #print ("\n",gain)
    return gain
```

In [8]:
```
def ID3(examples, attrs):
```

In [8]:
```
def ID3(examples, attrs):
    root = Node()

    max_gain = 0
    max_feat = ""
    for feature in attrs:
        #print ("\n",examples)
        gain = info_gain(examples, feature)
        if gain > max_gain:
            max_gain = gain
            max_feat = feature
    root.value = max_feat
    #print ("\nMax feature attr",max_feat)
    uniq = np.unique(examples[max_feat])
    #print ("\n",uniq)
    for u in uniq:
        #print ("\n",u)
        subdata = examples[examples[max_feat] == u]
        #print ("\n",subdata)
        if entropy(subdata) == 0.0:
            newNode = Node()
            newNode.isLeaf = True
            newNode.value = u
            newNode.pred = np.unique(subdata["answer"])
            root.children.append(newNode)
        else:
            dummyNode = Node()
            dummyNode.value = u
            new_attrs = attrs.copy()
            new_attrs.remove(max_feat)
            child = ID3(subdata, new_attrs)
            dummyNode.children.append(child)
            root.children.append(dummyNode)
    return root
```

In [9]:
```
def printTree(root: Node, depth=0):
    for i in range(depth):
        print("\t", end="")
    print(root.value, end="")
    if root.isLeaf:
        print(" -> ", root.pred)
    print()
```


```
            new_attrs = attrs.copy()
            new_attrs.remove(max_feat)
            child = ID3(subdata, new_attrs)
            dummyNode.children.append(child)
            root.children.append(dummyNode)
    return root
```

In [9]:
```
def printTree(root: Node, depth=0):
    for i in range(depth):
        print("\t", end="")
    print(root.value, end="")
    if root.isLeaf:
        print(" -> ", root.pred)
    print()
    for child in root.children:
        printTree(child, depth + 1)
```


In [10]:
```
root = ID3(data, features)
printTree(root)
```

```
outlook
        overcast ->  ['yes']

        rain
                wind
                        strong ->  ['no']

                        weak ->  ['yes']

        sunny
                humidity
                        high ->  ['no']

                        normal ->  ['yes']
```

In [ ]:

## 4.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 [1]:
```
import numpy as np
import pandas as pd
```

In [2]:
```
data = pd.read_csv('/content/dataset.csv')
data.head()
```

Out[2]:

| | 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 |

In [3]:
```
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']
 ['Rain' 'Mild' 'High' 'Strong']]
```

In [4]:
```
y_train = y[:8]
y_val = y[8:]
X_train = X[:8]
X_val = X[8:]
print(f"Number of instances in training set: {len(X_train)}")
print(f"Number of instances in testing set: {len(X_val)}")
```

```
Number of instances in training set: 8
Number of instances in testing set: 6
```

In [5]:
```
class NaiveBayesClassifier:
    def __init__(self, X, y):
        self.X, self.y = X, y
        self.N = len(self.X)
        self.dim = len(self.X[0])
        self.attrs = [[] for _ in range(self.dim)]
        self.output_dom = {}
        self.data = []
        for i in range(len(self.X)):
            for j in range(self.dim):
                if not self.X[i][j] in self.attrs[j]:
                    self.attrs[j].append(self.X[i][j])
            if not self.y[i] in self.output_dom.keys():
                self.output_dom[self.y[i]] = 1
            else:
                self.output_dom[self.y[i]] += 1
            self.data.append([self.X[i], self.y[i]])
    def classify(self, entry):
        solve = None
        max_arg = -1
        for y in self.output_dom.keys():
            prob = self.output_dom[y]/self.N
            for i in range(self.dim):
                cases = [x for x in self.data if x[0][i] == entry[i] and x[1] == y]
                n = len(cases)
                prob *= n/self.N
            if prob > max_arg:
                max_arg = prob
                solve = y
        return solve
```

```
        for y in self.output_dom.keys():
            prob = self.output_dom[y]/self.N
            for i in range(self.dim):
                cases = [x for x in self.data if x[0][i] == entry[i] and x[1] == y]
                n = len(cases)
                prob *= n/self.N
            if prob > max_arg:
                max_arg = prob
                solve = y
        return solve
```

In [6]:

```
nbc = NaiveBayesClassifier(X_train, y_train)
total_cases = len(y_val)
good = 0
bad = 0
predictions = []
for i in range(total_cases):
    predict = nbc.classify(X_val[i])
    predictions.append(predict)
    if y_val[i] == predict:
        good += 1
    else:
        bad += 1
print('Predicted values:', predictions)
print('Actual values:', y_val)
print()
print('Total number of testing instances in the dataset:', total_cases)
print('Number of correct predictions:', good)
print('Number of wrong predictions:', bad)
print()
print('Accuracy of Bayes Classifier:', good/total_cases)
```

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

Total number of testing instances in the dataset: 6
Number of correct predictions: 4
Number of wrong predictions: 2

Accuracy of Bayes Classifier: 0.6666666666666666
```

In [18]:
```
import numpy as np
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.naive_bayes import GaussianNB
from sklearn import metrics

df = pd.read_csv("pima_indian.csv")
feature_col_names = ['num_preg', 'glucose_conc', 'diastolic_bp', 'thickness', 'insulin', 'bmi', 'diab_pred', 'age']
predicted_class_names = ['diabetes']
X = df[feature_col_names].values
y = df[predicted_class_names].values
xtrain,xtest,ytrain,ytest=train_test_split(X,y,test_size=0.33)
```

In [19]:
```
df.head()
```

Out[19]:

| | num_preg | glucose_conc | diastolic_bp | thickness | insulin | bmi | diab_pred | age | diabetes |
|---|---|---|---|---|---|---|---|---|---|
| **0** | 6 | 148 | 72 | 35 | 0 | 33.6 | 0.627 | 50 | 1 |
| **1** | 1 | 85 | 66 | 29 | 0 | 26.6 | 0.351 | 31 | 0 |
| **2** | 8 | 183 | 64 | 0 | 0 | 23.3 | 0.672 | 32 | 1 |
| **3** | 1 | 89 | 66 | 23 | 94 | 28.1 | 0.167 | 21 | 0 |
| **4** | 0 | 137 | 40 | 35 | 168 | 43.1 | 2.288 | 33 | 1 |

In [29]:
```
clf = GaussianNB().fit(xtrain,ytrain.ravel())
predicted = clf.predict(xtest)
predictTestData= clf.predict([[6,148,72,35,0,33.6,0.627,50]])
```

In [30]:
```
metrics.confusion_matrix(ytest,predicted)
```

Out[30]:
```
array([[139,  26],
       [ 33,  56]], dtype=int64)
```

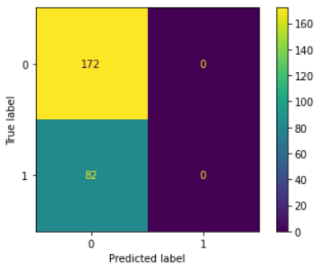
In [28]:
```
print('\nConfusion matrix')
print(metrics.plot_confusion_matrix(clf,ytest,predicted))
```

In [30]:
```
metrics.confusion_matrix(ytest,predicted)
```

Out[30]:
```
array([[139,  26],
       [ 33,  56]], dtype=int64)
```

In [28]:
```
print('\nConfusion matrix')
print(metrics.plot_confusion_matrix(clf,ytest,predicted))
```

```
Confusion matrix
<sklearn.metrics._plot.confusion_matrix.ConfusionMatrixDisplay object at 0x00000190E55B3670>
```




In [31]:
```
print(metrics.classification_report(ytest,predicted))
```

```
              precision    recall  f1-score   support

           0       0.81      0.84      0.82       165
           1       0.68      0.63      0.65        89

    accuracy                           0.77       254
   macro avg       0.75      0.74      0.74       254
weighted avg       0.76      0.77      0.77       254
```

In [8]:
```
print("Predicted Value for individual Test Data:", predictTestData)
```

```
Predicted Value for individual Test Data: [1]
```

## 5.Write a program to construct a Bayesian network considering training data. Use this model to make predictions.

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

In [2]:
```
dataset = pd.read_csv('salary_dataset.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 [ ]: