

VISVESVARAYA TECHNOLOGICAL UNIVERSITY

“JnanaSangama”, Belgaum -590014, Karnataka.



LAB REPORT on

Machine Learning

Submitted by

LOCHAN M R(1BM20CS407)

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



**B.M.S. COLLEGE OF ENGINEERING BENGALURU-560019 May-2022 to
July-2022**

(Autonomous Institution under VTU)

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 **LOCHAN M R (1BM20CS407)**, 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.

Dr G R Asha
Assistant Professor
Department of CSE
BMSCE, Bengaluru

Dr. Jyothi S Nayak
Professor and Head
Department of CSE
BMSCE, Bengaluru

Index Sheet

Sl. No.	Experiment Title	Page No.
1	Find-S	
2	Candidate Elimination	
3	Decision Tree	
4	Naïve Bayes	
5	Linear Regression	

Course Outcome

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.

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

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

```
In [15]: data = pd.read_csv("finddata.csv")
print(data,"\n")
```

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

```
In [19]: 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']
['Evening' 'Rainy' 'Cold' 'No' 'Mild']
['Morning' 'Sunny' 'Moderate' 'Yes' 'Normal']
['Evening' 'Sunny' 'Cold' 'Yes' 'High']]

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

```
In [17]: 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 [18]: print("\n The final hypothesis is:",findS(d,target))
```

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

```
In [ ]:
```

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 [4]: 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("\n Initialization of specific_h and general_h")
    print(specific_h)
    general_h = [["?" for i in range(len(specific_h))] for i in
range(len(specific_h))]
    print(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] = '?'
            # print(specific_h)
        if target[i] == "no":
            for x in range(len(specific_h)):
                if h[x] != specific_h[x]:
```

```

print(specific_h)
print(general_h)
indices = [i for i, val in enumerate(general_h) if val ==
['?', '?', '?', '?', '?', '?']]
for i in indices:
    general_h.remove(['?', '?', '?', '?', '?', '?'])
return specific_h, general_h
s_final, g_final = learn(concepts, target)

```

#obtaining the final hypothesis

```

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

```

	sky	temp	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

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']

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

```

Steps of Candidate Elimination Algorithm 4

```

['sunny' 'warm' '?' 'strong' '?' '?']
[['sunny', '?', '?', '?', '?', '?'], ['?', 'warm', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?']]

```

Final Specific_h:

```

['sunny' 'warm' '?' 'strong' '?' '?']

```

Final General_h:

```

[['sunny', '?', '?', '?', '?', '?'], ['?', 'warm', '?', '?', '?', '?']]

```

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 [24]: import pandas as pd
import math
import numpy as np
```

```
In [34]: data = pd.read_csv("data.csv")
features = [feat for feat in data]
features.remove("answer")
```

```
In [37]: class Node:
    def __init__(self):
        self.children = []
        self.value = ""
        self.isLeaf = False
        self.pred = ""
```

```
In [38]: 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 [39]: 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 [40]: 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 [41]: 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 [42]: root = ID3(data, features)
printTree(root)

```

```

outlook
  overcast -> ['yes']
  rain
    wind
      strong -> ['no']
      weak -> ['yes']
    sunny
      humidity
        high -> ['no']
        normal -> ['yes']

```


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}')
```

```
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
```

```
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
```

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

```
In [17]: import numpy as np
import matplotlib.pyplot as plt
import pandas as pd
from sklearn.metrics import r2_score
```

```
In [9]: dataset = pd.read_csv('salary_dataset.csv')
X = dataset.iloc[:, :-1].values
y = dataset.iloc[:, 1].values
```

```
In [10]: 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 [11]: # Fitting Simple Linear Regression to the Training set
from sklearn.linear_model import LinearRegression
regressor = LinearRegression()
regressor.fit(X_train, y_train)
```

```
Out[11]: LinearRegression()
```

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

```
Out[15]: array([ 40835.10590871, 123079.39940819,  65134.55626083,  63265.36777221,
 115602.64545369, 108125.8914992 , 116537.23969801,  64199.96201652,
 76349.68719258, 100649.1375447 ])
```

```
In [18]: r2_score(y_test, y_pred)
```

```
Out[18]: 0.9749154407708353
```

```
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 [14]: # 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()
```

