ML Report Lab Test 1

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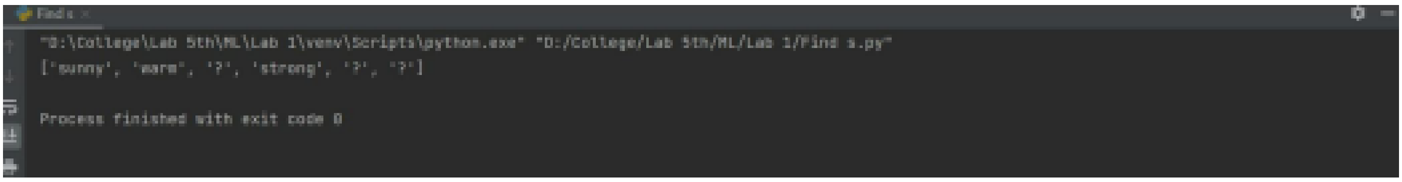
1.Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples

```
import csv
a=[]
with open('data.csv') as dataset:
 for x in csv.reader(dataset):
 a.append(x)
a.remove(a[0])
msh = ['0']*(len(a[0])-1)
for x in a:
 if x[len(x)-1]=='yes' or x[len(x)-1]=='Yes':
 for i in range(0,len(msh)):
 if msh[i]=='0' or msh[i]==x[i]:
 msh[i]=x[i]
 else:
 msh[i]='?'
print(msh)
```

Output:



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

```
import numpy as np
import pandas as pd
# Reading the data from CSV file
```

```
data = pd.read_csv('data.csv')

concepts = np.array(data.iloc[:,:-1])

print("\nInstances are:\n",concepts)

target = np.array(data.iloc[:,-1])

print("\nTarget Values are: ",target)



def train(concepts, target):


 # Initializing general and specific hypothesis

 specific_h = concepts[0].copy()

 print("\nInitialization of specific hypothesis and general hypothesis")

 print("\nSpecific Boundary: ", specific_h)

 general_h = [["?" for i in range(len(specific_h))] for i in range(len(specific_h))]

print("\nGeneric Boundary: ",general_h)



 for i, val in enumerate(concepts):

 print("\nInstance", i+1 , "is ", val)

 #positive example

 if target[i] == "yes":

 print("Instance is Positive ")

 for x in range(len(specific_h)):

 if val[x]!= specific_h[x]:

 specific_h[x] ='?'
 general_h[x][x] ='?'

 #negative example

 if target[i] == "no":

 print("Instance is Negative ")

 for x in range(len(specific_h)):

 if val[x]!= specific_h[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 == ['?', '?', '?', '?', '?', '?']]
 for i in indices:
 general_h.remove(['?', '?', '?', '?', '?', '?'])


 return specific_h, general_h
s_final, g_final = train(concepts, target)
# displaying Specific_hypothesis
print("Final Specific_h: ", s_final, sep="\n")
# displaying Generalized_Hypothesis
print("Final General_h: ", g_final, sep="\n")
```

Output:

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.

```
import pandas as pd

import numpy as np
```

```
import math
data=pd.read_csv('/content/data set-1.csv');

attributes=[feat for feat in data]
attributes.remove('answer')
# print(features)
class Node:
 def __init__(self):
 self.children=[];
 self.isLeaf=False;
 self.value="";
 self.pred="";

def main():
 res=ID3(data,attributes)
 printTree(res)

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)

# This function creates the decision tree recursively
def ID3(data_set,attributes):
```

```
root=Node()

max_gain=0.0;

max_feat="";

# Comparitively find out which attribute gives us the maximum information

for attribute in attributes:

gain=info_gain(data_set,attribute)

if gain>max_gain:

max_gain=gain

max_feat=attribute

# once we find the max gain, that will be the attribute which we use.

root.value=max_feat


# All types of a particular attribute. Ex: In outlook, we have sunny,rain,overcast

types=np.unique(data_set[max_feat])


for t in types:

# Get all instances which match a particular type

subdata=data_set[data_set[max_feat]==t]


# In case we find instances where we have only one type of data result (yes/no). Entropy will be zero
(Obviously!!)

if entropy(subdata)==0.0:

newNode=Node()

newNode.isLeaf=True

newNode.value=t

newNode.pred=np.unique(subdata["answer"])

root.children.append(newNode)
else:

# If even one instance has different type of data result, we still cannot come to conclusion,   # hence go to

the next attribute and create the node and apply the same algorithm on the next attribute.

dummyNode=Node()

dummyNode.value=t

new_attr=attributes.copy()
```

```
# We can remove the current attribute, only when we have come to a conclusion
# that we cannot decide with this attribute, we have gone to the next attribute. Hence we don't want to come back.
# + we may get stuck in cycle.
new_attr.remove(max_feat)

# Apply the algorithm on the next attribute with same current attributes which have been deleted.
child=ID3(subdata,new_attr)
dummyNode.children.append(child)
root.children.append(dummyNode)
return root


def info_gain(data_set,feature):
types=np.unique(data_set[feature])
# We are trying to get the entropy for the entire data_set we have taken into consideration.
gain=entropy(data_set)

for u in types:
subdata=data_set[data_set[feature]==u]
sub_e=entropy(subdata)
gain-=(float(len(subdata))/float(len(data_set))*sub_e)

return gain

def entropy(data):
pos=0
neg=0
# For the formula of entropy we need to see for how many of the +ve samples (yes) we have and how many -ve samples(no).
for _, row in data.iterrows():
if row['answer'] == "yes":
pos += 1
```

```
else:
neg += 1
if pos==0.0 or neg==0.0:
return 0.0
p=pos/(pos+neg)
n=neg/(pos+neg)
return -(p*math.log(p,2)+n*math.log(n,2))
main()
```

Output:

```
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 set

```
import math
import csv
import random
# 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

# 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

# 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

# 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)

# 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

# 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

# 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

# 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
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
# 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
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
filename="/content/bayes.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
```

Output:

```
     291
Out[ ]: 60.91954022988506
```

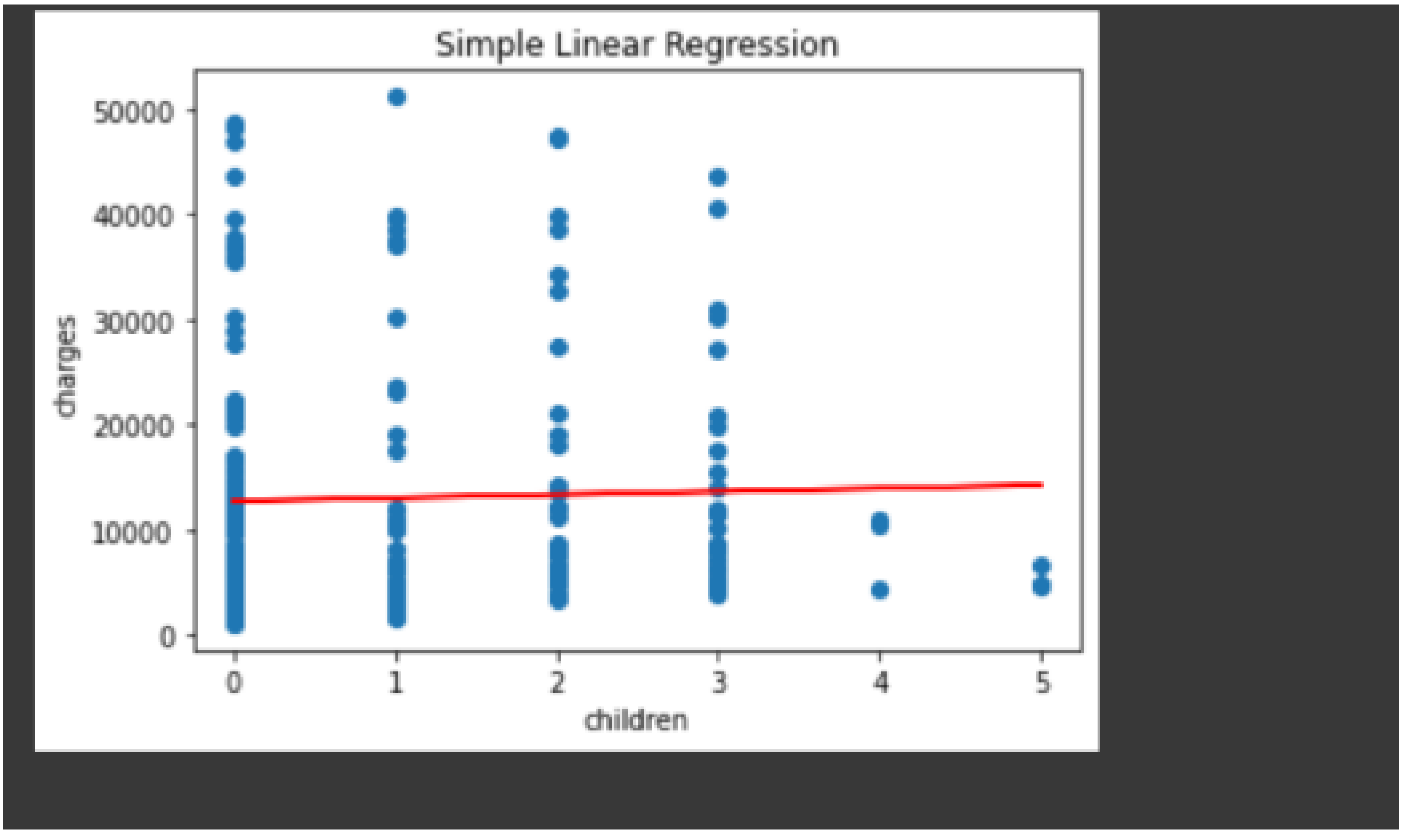
5. Implement the Linear Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs

```
import csv
import math
def calculate(X,Y):
 sum_x=sum(X)
 sum_y=sum(Y)
 n=len(Y)
 sum_xy=0
 for i in range(len(X)):
 sum_xy+=X[i]*Y[i]
 sum_x2=sum([x**2 for x in X])
 denomin=float((n*sum_x2)-(sum_x**2))
 # y=y_intercept+slope*x
 y_intercept=float((sum_y*sum_x2)-(sum_x*sum_xy))/denomin
```

```
 slope=float((n*sum_xy)-(sum_x*sum_y))/denomin

 return slope,y_intercept

filename='/content/insurance.csv'

file=open(filename)

dataset=csv.reader(file)

dataset=list(dataset)

X=[]

Y=[]

for x in dataset:

 X.append(x[3])

 Y.append(x[len(x)-1])

print(dataset[0])

x_tag=str(X[0])

y_tag=str(Y[0])

X=X[1:200]

Y=Y[1:200]

X=[float(x) for x in X]
Y=[float(y) for y in Y]

# print(Y)

slope,y_intercept=calculate(X,Y)

print(slope,y_intercept)
```

```
['age', 'sex', 'bmi', 'children', 'smoker', 'region', 'charges']
299.40712303629675 12768.55599860939
```

```
import matplotlib.pyplot as plt
plt.scatter(X,Y,marker='o')

plt.xlabel(x_tag)

plt.ylabel(y_tag)

plt.title('Simple Linear Regression')

y_pred=[slope*x+y_intercept for x in X]

plt.plot(X,y_pred,color='red')

plt.show()
```


Simple Linear Regression
50000
40000
30000
20000
10000
0
charges
0
1
2
3
4
5
children