

T.Y.B.C.A.(Science)  
DSE II BCA 357- Laboratory (Data Mining) Workbook  
Savitribai Phule Pune University  
Answers

### R Programming

Set A

1. Write a R program to add, multiply and divide two vectors of integer type.  
(vector length should be minimum 4)

Solution :

```
> vector1 = seq(10,40 , length.out=4)
> vector2 = c(20, 10, 40, 40)

> print("Original Vectors:")
[1] "Original Vectors:"

> print(vector1)
[1] 10 20 30 40

> print(vector2)
[1] 20 10 40 40

> add= vector1+vector2
> cat("Sum of vector is ",add, "\n")
Sum of vector is  30 30 70 80

> sub_vector= vector1-vector2
> cat("Substraction of vector is ",sub_vector, "\n")
Substraction of vector is  -10 10 -10 0

> mul_vector= vector1 * vector2
> cat("Multiplication of vector is ",mul_vector, "\n")
Multiplication of vector is  200 200 1200 1600

> print("Division of two Vectors:")
[1] "Division of two Vectors:"
> div_vector = vector1 / vector2
> print(div_vector)
[1] 0.50 2.00 0.75 1.00
```

2. Write a R program to calculate the multiplication table using a function.

```
number <- as.integer(readline(prompt = "Please Enter a Number for Table: "))
```

```
Disp_table(number)
Disp_table=function(number)
{
```

T.Y.B.C.A.(Science)  
DSE II BCA 357- Laboratory (Data Mining) Workbook  
Savitribai Phule Pune University  
Answers

```
for( t in 1:10)
{
  print ( paste ( number, '*', t, '=', number * t))
}
}
```

**Output**

```
[1] "3 * 1 = 3"
[1] "3 * 2 = 6"
[1] "3 * 3 = 9"
[1] "3 * 4 = 12"
[1] "3 * 5 = 15"
[1] "3 * 6 = 16"
[1] "3 * 7 = 21"
[1] "3 * 8 = 24"
[1] "3 * 9 = 27"
[1] "3 * 10 = 30"
```

3. Write a R program to sort a list of strings in ascending and descending order.

```
> stud_name = c("Ram","Sham","Arjun","Raj")
> print(stud_name)
[1] "Ram" "Sham" "Arjun" "Raj"
> cat("Names in ascending order ",print(sort(stud_name)),"\n")
[1] "Arjun" "Raj" "Ram" "Sham"
Names in ascending order Arjun Raj Ram Sham
> cat("Names in ascending order ",print(sort(stud_name,decreasing = TRUE)),"\n")
[1] "Sham" "Ram" "Raj" "Arjun"
Names in ascending order Sham Ram Raj Arjun
```

4. Write a script in R to create a list of employees(name) and perform the following:
- Display names of employees in the list.
  - Add an employee at the end of the list.
  - Remove the third element of the list.

```
#create list using vector
> list_data <- list("Ram Sharma","Sham Varma","Raj Jadhav", "Ved Sharma")

#display list
> print(list_data)
[[1]]
[1] "Ram Sharma"

[[2]]
[1] "Sham Varma"
```

T.Y.B.C.A.(Science)  
DSE II BCA 357- Laboratory (Data Mining) Workbook  
Savitribai Phule Pune University  
Answers

```
[[3]]  
[1] "Raj Jadhav"
```

```
[[4]]  
[1] "Ved Sharma"
```

```
#create new employee  
new_Emp <- "Kavya Anjali"  
#Add new employee at the end  
list_data <- append(list_data, new_Emp)
```

```
print(list_data)  
[[1]]  
[1] "Ram Sharma"
```

```
[[2]]  
[1] "Sham Varma"
```

```
[[3]]  
[1] "Raj Jadhav"
```

```
[[4]]  
[1] "Ved Sharma"
```

```
[[5]]  
[1] "Kavya Anjali"
```

```
#remove 3 employee  
list_data[3] <- NULL  
print(list_data)
```

```
[[1]]  
[1] "Ram Sharma"
```

```
[[2]]  
[1] "Sham Varma"
```

```
[[3]]  
[1] "Ved Sharma"
```

```
[[4]]  
[1] "Kavya Anjali"
```

Set B

T.Y.B.C.A.(Science)  
DSE II BCA 357- Laboratory (Data Mining) Workbook

Savitribai Phule Pune University

Answers

1. Write a R program to reverse a number and also calculate the sum of digits of that number.

```
Reverse_Sum = function(n)
{

    sum=0
    rev=0

    while(n>0)
    {
        r = n%%10
        sum= sum+r;
        rev=rev*10+r
        n=n%%10 # %/% is used for integer division
    }
    print(paste("Sum of digit : ",sum))
    print(paste("Reverse of number : ",rev))
}
n = as.integer(readline(prompt = "Enter a number :"))
Reverse_Sum(n)
```

Output

```
Enter a number :123
[1] "Sum of digit : 6"
[1] "Reverse of number : 321"
```

2. Write a R program to calculate the sum of two matrices of given size.

```
> # R program to add two matrices
>
> # Creating 1st Matrix
> A = matrix(c(1, 2, 3, 4, 5, 6), nrow = 2, ncol = 3)
>
> # Creating 2nd Matrix
> B = matrix(c(7, 8, 9, 10, 11, 12), nrow = 2, ncol = 3)
>
> # Getting number of rows and columns
> num_of_rows = nrow(A)
> num_of_cols = ncol(A)
>
> # Creating matrix to store results
> add = matrix(, nrow = num_of_rows, ncol = num_of_cols)
>
> # Printing Original matrices
> print(A)
```

T.Y.B.C.A.(Science)  
DSE II BCA 357- Laboratory (Data Mining) Workbook  
Savitribai Phule Pune University  
Answers

```
[,1] [,2] [,3]
[1,]  1  3  5
[2,]  2  4  6
> print(B)
      [,1] [,2] [,3]
[1,]    7    9   11
[2,]    8   10   12
>
> # Calculating diff of matrices
> for(row in 1:num_of_rows)
+ {
+   for(col in 1:num_of_cols)
+   {
+     add[row, col] <- A[row, col] + B[row, col]
+   }
+ }
>
> # Printing resultant matrix
> print(add)
      [,1] [,2] [,3]
[1,]    8   12   16
[2,]   10   14   18
```

3. Write a R program to concatenate two given factors.

```
> fac1 <- factor(letters[1:3])
> print ("Factor1 : ")
[1] "Factor1 : "
> print (fac1)
[1] a b c
Levels: a b c
> sapply(fac1,class)
[1] "factor" "factor" "factor"
>
> fac2 <- factor(c(1:4))
> print ("Factor2 : ")
[1] "Factor2 : "
> print (fac2)
[1] 1 2 3 4
Levels: 1 2 3 4
> sapply(fac2,class)
[1] "factor" "factor" "factor" "factor"
>
> # extracting levels of factor1
```

T.Y.B.C.A.(Science)  
DSE II BCA 357- Laboratory (Data Mining) Workbook  
Savitribai Phule Pune University  
Answers

```
> level1 <- levels(fac1)[fac1]
>
> # extracting levels of factor2
> level2 <- levels(fac2)[fac2]
>
> # combine into one factor
> combined <- factor(c( level1,level2 ))
> print ("Combined Factor : ")
[1] "Combined Factor : "
> print (combined)
[1] a b c 1 2 3 4
Levels: 1 2 3 4 a b c
>
> supply(combined,class)
[1] "factor" "factor" "factor" "factor" "factor" "factor" "factor"
>
```

4. Write a R program to create a data frame using two given vectors and display the duplicate elements

```
> companies <- data.frame(Shares = c("TCS", "Reliance", "HDFC Bank", "Infosys",
"Reliance"),
+       Price = c(3200, 1900, 1500, 2200, 1900))
> companies
  Shares Price
1   TCS 3200
2 Reliance 1900
3 HDFC Bank 1500
4 Infosys 2200
5 Reliance 1900
> cat("After removing Duplicates ", "\n")
After removing Duplicates
> companies[duplicated(companies),]
  Shares Price
5 Reliance 1900
```

Set C

1. Write a R program to perform the following:
- Display all rows of the data set having weight greater than 120.

```
> women
  height weight
```

T.Y.B.C.A.(Science)  
DSE II BCA 357- Laboratory (Data Mining) Workbook  
Savitribai Phule Pune University  
Answers

```
1  58 115
2  59 117
3  60 120
4  61 123
5  62 126
6  63 129
7  64 132
8  65 135
9  66 139
10 67 142
11 68 146
12 69 150
13 70 154
14 71 159
15 72 164
```

```
> result <- women[women$weight > 120,]
```

```
> result
```

```
  height weight
```

```
4  61 123
5  62 126
6  63 129
7  64 132
8  65 135
9  66 139
10 67 142
11 68 146
12 69 150
13 70 154
14 71 159
15 72 164
```

- b. Display all rows of data set in ascending order of weight.  
(Use inbuilt data set woman)

```
> data=women
```

```
> sorted_data=data[order(data$weight),]
```

```
> sorted_data
```

```
  height weight
```

```
1  58 115
2  59 117
3  60 120
4  61 123
5  62 126
6  63 129
7  64 132
8  65 135
9  66 139
```

T.Y.B.C.A.(Science)  
DSE II BCA 357- Laboratory (Data Mining) Workbook  
Savitribai Phule Pune University  
Answers

10 67 142  
11 68 146  
12 69 150  
13 70 154  
14 71 159  
15 72 164

>

2. Write a R program to perform the following:  
a. Display all the cars having mpg more than 20.

```
> data=mtcars
> result <- data[data$mpg>20,]
> result
```

	mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb
Mazda RX4	21.0	6	160.0	110	3.90	2.620	16.46	0	1	4	4
Mazda RX4 Wag	21.0	6	160.0	110	3.90	2.875	17.02	0	1	4	4
Datsun 710	22.8	4	108.0	93	3.85	2.320	18.61	1	1	4	1
Hornet 4 Drive	21.4	6	258.0	110	3.08	3.215	19.44	1	0	3	1
Merc 240D	24.4	4	146.7	62	3.69	3.190	20.00	1	0	4	2
Merc 230	22.8	4	140.8	95	3.92	3.150	22.90	1	0	4	2
Fiat 128	32.4	4	78.7	66	4.08	2.200	19.47	1	1	4	1
Honda Civic	30.4	4	75.7	52	4.93	1.615	18.52	1	1	4	2
Toyota Corolla	33.9	4	71.1	65	4.22	1.835	19.90	1	1	4	1
Toyota Corona	21.5	4	120.1	97	3.70	2.465	20.01	1	0	3	1
Fiat X1-9	27.3	4	79.0	66	4.08	1.935	18.90	1	1	4	1
Porsche 914-2	26.0	4	120.3	91	4.43	2.140	16.70	0	1	5	2
Lotus Europa	30.4	4	95.1	113	3.77	1.513	16.90	1	1	5	2
Volvo 142E	21.4	4	121.0	109	4.11	2.780	18.60	1	1	4	2

- b. Subset the data set by mpg column for values greater than 15.0

```
subset(data,data$mpg>15.0)
```

	mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb
Mazda RX4	21.0	6	160.0	110	3.90	2.620	16.46	0	1	4	4
Mazda RX4 Wag	21.0	6	160.0	110	3.90	2.875	17.02	0	1	4	4
Datsun 710	22.8	4	108.0	93	3.85	2.320	18.61	1	1	4	1
Hornet 4 Drive	21.4	6	258.0	110	3.08	3.215	19.44	1	0	3	1
Hornet Sportabout	18.7	8	360.0	175	3.15	3.440	17.02	0	0	3	2
Valiant	18.1	6	225.0	105	2.76	3.460	20.22	1	0	3	1
Merc 240D	24.4	4	146.7	62	3.69	3.190	20.00	1	0	4	2
Merc 230	22.8	4	140.8	95	3.92	3.150	22.90	1	0	4	2
Merc 280	19.2	6	167.6	123	3.92	3.440	18.30	1	0	4	4
Merc 280C	17.8	6	167.6	123	3.92	3.440	18.90	1	0	4	4
Merc 450SE	16.4	8	275.8	180	3.07	4.070	17.40	0	0	3	3
Merc 450SL	17.3	8	275.8	180	3.07	3.730	17.60	0	0	3	3
Merc 450SLC	15.2	8	275.8	180	3.07	3.780	18.00	0	0	3	3



T.Y.B.C.A.(Science)  
DSE II BCA 357- Laboratory (Data Mining) Workbook  
Savitribai Phule Pune University

Answers

```
Fiat 128      32.4  4 78.7 66 4.08 2.200 19.47 1 1  4  1
Honda Civic   30.4  4 75.7 52 4.93 1.615 18.52 1 1  4  2
Toyota Corolla 33.9  4 71.1 65 4.22 1.835 19.90 1 1  4  1
Toyota Corona 21.5  4 120.1 97 3.70 2.465 20.01 1 0  3  1
Dodge Challenger 15.5  8 318.0 150 2.76 3.520 16.87 0 0  3  2
AMC Javelin   15.2  8 304.0 150 3.15 3.435 17.30 0 0  3  2
Pontiac Firebird 19.2  8 400.0 175 3.08 3.845 17.05 0 0  3  2
Fiat X1-9      27.3  4 79.0 66 4.08 1.935 18.90 1 1  4  1
Porsche 914-2  26.0  4 120.3 91 4.43 2.140 16.70 0 1  5  2
Lotus Europa   30.4  4 95.1 113 3.77 1.513 16.90 1 1  5  2
Ford Pantera L 15.8  8 351.0 264 4.22 3.170 14.50 0 1  5  4
Ferrari Dino   19.7  6 145.0 175 3.62 2.770 15.50 0 1  5  6
Volvo 142E     21.4  4 121.0 109 4.11 2.780 18.60 1 1  4  2
```

- c. Display all cars having four gears.  
(Use inbuilt data set mtcars)

```
> data[data$gear==4,]
      mpg cyl  disp  hp drat   wt  qsec vs am gear carb
Mazda RX4    21.0   6 160.0 110 3.90 2.620 16.46 0 1   4   4
Mazda RX4 Wag 21.0   6 160.0 110 3.90 2.875 17.02 0 1   4   4
Datsun 710    22.8   4 108.0  93 3.85 2.320 18.61 1 1   4   1
Merc 240D     24.4   4 146.7  62 3.69 3.190 20.00 1 0   4   2
Merc 230      22.8   4 140.8  95 3.92 3.150 22.90 1 0   4   2
Merc 280      19.2   6 167.6 123 3.92 3.440 18.30 1 0   4   4
Merc 280C     17.8   6 167.6 123 3.92 3.440 18.90 1 0   4   4
Fiat 128      32.4   4 78.7  66 4.08 2.200 19.47 1 1   4   1
Honda Civic   30.4   4 75.7  52 4.93 1.615 18.52 1 1   4   2
Toyota Corolla 33.9   4 71.1  65 4.22 1.835 19.90 1 1   4   1
Fiat X1-9     27.3   4 79.0  66 4.08 1.935 18.90 1 1   4   1
Volvo 142E    21.4   4 121.0 109 4.11 2.780 18.60 1 1   4   2
```

>

3. Write a R Program to perform the following:  
a. Create a Scattered plot to compare wind speed and temperature.

```
> data=airquality
> data <- na.omit(data)
```

```
plot(data$Wind,data$Temp,main="Wind Speed vs Temperature",xlab="Wind Speed",ylab="Temperature",xlim=c(2,20),ylim=c(50,100),axes =TRUE)
```

- b. Create a Scattered plot to show the relationship between ozone and wind values by giving appropriate values to colour argument.

T.Y.B.C.A.(Science)  
DSE II BCA 357- Laboratory (Data Mining) Workbook  
Savitribai Phule Pune University  
Answers

```
mlev <- levels(with(airquality, as.factor(Month)))  
# This command extracts the level values but the mlev is of class character
```

```
> data=airquality  
> data <- na.omit(data)
```

```
with(data, plot(Ozone ~ Wind, pch=mlev, col=mlev))
```

#We have seen that for the plot() function the color option is called col. For the #shape option it is called pch which stands for **p**rint **c**haracter.

- c. Create a Bar plot to show the ozone level for all the days having temperature > 70.

(Use inbuilt dataset airquality)

```
> data<-data[data$Temp >70,]  
> data <-na.omit(data)  
> barplot(height=data$Ozone, main="ozone level for all the days having temper  
ature > 70", xlab="Temperature", ylab="Ozone", names.arg = data$Temp, borde  
r = "dark blue", col="pink")
```

### Data Pre-Processing

- 1) Write a python program to convert Categorical values in numeric format for a given Dataset (<https://codefires.com/how-convert-categorical-data-numerical-data-python/>)

```
import pandas as pd  
info = {  
    'Gender' : ['Male', 'Female', 'Female', 'Male', 'Female', 'Female'],  
    'Position' : ['Head', 'Asst.Prof.', 'Associate Prof.', 'Asst.Prof.', 'Head', 'Asst.Prof.'],  
}
```

```
df = pd.DataFrame(info)  
print(df)  
from sklearn.preprocessing import LabelEncoder
```

```
le = LabelEncoder()
```

```
gender_encoded = le.fit_transform(df['Gender'])  
encoded_position = le.fit_transform(df['Position'])
```

```
df['Encoded_Gender'] = gender_encoded  
df['Encoded_Position'] = encoded_position  
print(df)
```

T.Y.B.C.A.(Science)  
DSE II BCA 357- Laboratory (Data Mining) Workbook  
Savitribai Phule Pune University  
Answers

```
In [12]: import pandas as pd
info = {
    'Gender' : ['Male', 'Female', 'Female', 'Male', 'Female', 'Female'],
    'Position' : ['Head', 'Asst.Prof.', 'Associate Prof.', 'Asst.Prof.', 'Head', 'Asst.Prof.']
}
df = pd.DataFrame(info)
print(df)
from sklearn.preprocessing import LabelEncoder

le = LabelEncoder()

gender_encoded = le.fit_transform(df['Gender'])
encoded_position = le.fit_transform(df['Position'])

df['Encoded_Gender'] = gender_encoded
df['Encoded_Position'] = encoded_position
print(df)
```

	Gender	Position
0	Male	Head
1	Female	Asst.Prof.
2	Female	Associate Prof.
3	Male	Asst.Prof.
4	Female	Head
5	Female	Asst.Prof.

	Gender	Position	Encoded_Gender	Encoded_Position
0	Male	Head	1	2
1	Female	Asst.Prof.	0	1
2	Female	Associate Prof.	0	0
3	Male	Asst.Prof.	1	1
4	Female	Head	0	2
5	Female	Asst.Prof.	0	1

Using hot encoder

from sklearn.preprocessing import OneHotEncoder

```
gender_encoded = le.fit_transform(df['Gender'])
gender_encoded = gender_encoded.reshape(len(gender_encoded), -1)
one = OneHotEncoder(sparse=False)
```

```
print(one.fit_transform(gender_encoded))
```

```
: from sklearn.preprocessing import OneHotEncoder

gender_encoded = le.fit_transform(df['Gender'])
gender_encoded = gender_encoded.reshape(len(gender_encoded), -1)
one = OneHotEncoder(sparse=False)

print(one.fit_transform(gender_encoded))
```

```
[[0. 1.]
 [1. 0.]
 [1. 0.]
 [0. 1.]
 [1. 0.]
 [1. 0.]]
```

- 2) Write a python program to rescale the data between 0 and 1. (use inbuilt dataset) (IRIS DATA SET) <https://machinelearningmastery.com/rescaling-data-for-machine-learning-in-python-with-scikit-learn/>

1) Normalisation

# Normalize the data attributes for the Iris dataset.

```
from sklearn.datasets import load_iris
```

```
from sklearn import preprocessing
```

```
# load the iris dataset
```

```
iris = load_iris()
```

T.Y.B.C.A.(Science)  
DSE II BCA 357- Laboratory (Data Mining) Workbook

Savitribai Phule Pune University

Answers

```
print(iris.data.shape)
# separate the data from the target attributes
X = iris.data
y = iris.target
# normalize the data attributes
normalized_X = preprocessing.normalize(X)
```

```
# Normalize the data attributes for the Iris dataset.
from sklearn.datasets import load_iris
from sklearn import preprocessing
# Load the iris dataset
iris = load_iris()
print(iris.data.shape)
# separate the data from the target attributes
X = iris.data
y = iris.target
# normalize the data attributes
normalized_X = preprocessing.normalize(X)
```

(150, 4)

2) Data Standardization

# Standardize the data attributes for the Iris dataset.

```
from sklearn.datasets import load_iris
```

```
from sklearn import preprocessing
```

# load the Iris dataset

```
iris = load_iris()
```

```
print(iris.data.shape)
```

# separate the data and target attributes

```
X = iris.data
```

```
y = iris.target
```

# standardize the data attributes

```
standardized_X = preprocessing.scale(X)
```

```
# Standardize the data attributes for the Iris dataset.
from sklearn.datasets import load_iris
from sklearn import preprocessing
# Load the Iris dataset
iris = load_iris()
print(iris.data.shape)
# separate the data and target attributes
X = iris.data
y = iris.target
# standardize the data attributes
standardized_X = preprocessing.scale(X)
```

(150, 4)

3) Write a python program to splitting the dataset into training and testing set

1) Using pandas

T.Y.B.C.A.(Science)  
DSE II BCA 357- Laboratory (Data Mining) Workbook  
Savitribai Phule Pune University  
Answers

```
import pandas as pd
from sklearn.datasets import load_iris

iris_data = load_iris()
df = pd.DataFrame(iris_data.data, columns=iris_data.feature_names)
print(df)
training_data = df.sample(frac=0.8, random_state=25)
testing_data = df.drop(training_data.index)

print(f"No. of training examples: {training_data.shape[0]}")
print(f"No. of testing examples: {testing_data.shape[0]}")
```

```
import pandas as pd
from sklearn.datasets import load_iris

iris_data = load_iris()
df = pd.DataFrame(iris_data.data, columns=iris_data.feature_names)
print(df)
```

	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 x 4 columns]

```
training_data = df.sample(frac=0.8, random_state=25)
testing_data = df.drop(training_data.index)

print(f"No. of training examples: {training_data.shape[0]}")
print(f"No. of testing examples: {testing_data.shape[0]}")
```

```
No. of training examples: 120
No. of testing examples: 30
```

2) Using scikit-learn

```
from sklearn.model_selection import train_test_split
```

```
training_data, testing_data = train_test_split(df, test_size=0.2,
random_state=25)
```

```
print(f"No. of training examples: {training_data.shape[0]}")
print(f"No. of testing examples: {testing_data.shape[0]}")
```

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DSE II BCA 357- Laboratory (Data Mining) Workbook  
Savitribai Phule Pune University  
Answers

```
from sklearn.model_selection import train_test_split

training_data, testing_data = train_test_split(df, test_size=0.2, random_state=25)

print(f"No. of training examples: {training_data.shape[0]}")
print(f"No. of testing examples: {testing_data.shape[0]}")
```

```
No. of training examples: 120
No. of testing examples: 30
```

1. Write a python program to find all null values in a given data set and remove them.

```
import pandas as pd
dataset = pd.read_csv('city_day.csv')
dataset
dataset.isnull()
dataset.isnull().head(10)
dataset.isnull().sum()
dataset.isnull().head().sum()
modifieddataset=dataset.fillna(" ")
modifieddataset.isnull().sum()
```

```
dataset=dataset.dropna()
```

2. Write a python program the Categorical values in numeric format for a given dataset.  
import numpy as np  
import pandas as pd

```
dataset = pd.read_csv('Data2.csv')
dataset
from sklearn import preprocessing
le = preprocessing.LabelEncoder()
dataset['outlook'] = le.fit_transform(dataset.outlook)
dataset['temp'] = le.fit_transform(dataset.temp)
dataset['humidity'] = le.fit_transform(dataset.humidity)
dataset['playgolf'] = le.fit_transform(dataset.playgolf)
x = dataset.iloc[:, :-1].values
y = dataset.iloc[:, 5].values
from sklearn.preprocessing import StandardScaler
st_x = StandardScaler()
x1 = st_x.fit_transform(x)
print(x1)
```

3. Write a python program to splitting the dataset into training and testing set.  
import numpy as np  
import pandas as pd  
dataset = pd.read\_csv("play\_tennis.csv")  
dataset  
from sklearn import preprocessing

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DSE II BCA 357- Laboratory (Data Mining) Workbook

Savitribai Phule Pune University

Answers

```
le = preprocessing.LabelEncoder()
outlook_encoded = le.fit_transform(dataset.outlook)
print(outlook_encoded)
temp_encoded = le.fit_transform(dataset.temp)
print(temp_encoded)
humidity_encoded = le.fit_transform(dataset.humidity)
wind_encoded = le.fit_transform(dataset.wind)
play_encoded = le.fit_transform(dataset.play)
dataset['outlook'] = le.fit_transform(dataset.outlook)
dataset['temp'] = le.fit_transform(dataset.temp)
dataset['humidity'] = le.fit_transform(dataset.humidity)
dataset['wind'] = le.fit_transform(dataset.wind)
dataset['play'] = le.fit_transform(dataset.play)
x=dataset.iloc[:, :-1].values
print(x)
y=dataset.iloc[:, 4].values
print(y)
from sklearn.model_selection import train_test_split
x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.2)
print(x_train)
print(x_test)
```

4. Write a python program to implement complete data pre-processing in a given data set.(missing value, encoding categorical value, Splitting the dataset into the training and test sets and feature scaling.

5. Write a python program to Perform Classification using Decision Tree algorithm.

```
from sklearn import tree
clf = tree.DecisionTreeClassifier(criterion = 'entropy')
clf = clf.fit(X, y)
tree.plot_tree(clf)
X_pred = clf.predict(X)
X_pred == y
```

**Numpy :**

NumPy is a Python package. It stands for 'Numerical Python'. It is a library consisting of multidimensional array objects and a collection of routines for processing of array.

## Operations using NumPy

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Savitribai Phule Pune University  
Answers

- Mathematical and logical operations on arrays.
- Fourier transforms and routines for shape manipulation.
- Operations related to linear algebra. NumPy has in-built functions for linear algebra and random number generation.

#### Example 1

```
import numpy as np
a = np.array([1,2,3])
print a
```

The output is as follows –

[1, 2, 3]

#### Example 2

```
# more than one dimensions
import numpy as np
a = np.array([[1, 2], [3, 4]])
print a
```

The output is as follows –

```
[[1, 2]
 [3, 4]]
```

### NumPy – Data Types

**bool\_**  
Boolean (True or False) stored as a byte

**int\_**  
Default integer type (same as C long; normally either int64 or int32)

**intc**  
Identical to C int (normally int32 or int64)

**intp**  
An integer used for indexing (same as C ssize\_t; normally either int32 or int64)

**int8**  
Byte (-128 to 127)

**int16**  
Integer (-32768 to 32767)

**float\_**  
Shorthand for float64

**float64**  
Double precision float: sign bit, 11 bits exponent, 52 bits mantissa

**float64**  
Double precision float: sign bit, 11 bits exponent, 52 bits mantissa

**complex\_**  
Shorthand for complex128

**complex64**  
Complex number, represented by two 32-bit floats (real and imaginary components)

#### Example 1

```
# using array-scalar type
import numpy as np
dt = np.dtype(np.int32)
print dt
```

The output is as follows –

```
int32
```

#### pandas:

Pandas is built on top of two core Python libraries—[matplotlib](#) for data visualization and [NumPy](#) for mathematical operations. Pandas acts as a wrapper over these libraries, allowing you to access many of matplotlib's and NumPy's methods with less code.

### Pandas features

#### Time series analysis

- [Time Series / Date functionality](#)
- [Times series analysis with pandas](#)
- [Timeseries with pandas](#)



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DSE II BCA 357- Laboratory (Data Mining) Workbook  
Savitribai Phule Pune University  
Answers

#### split-apply-combine

Split-apply-combine is a common strategy used during analysis to summarize data—you split data into logical subgroups, apply some function to each subgroup, and stick the results back together again. In pandas, this is accomplished using the `groupby()` function and whatever functions you want to apply to the subgroups.

- [Group By: split-apply-combine](#)
- [Summarizing Data in Python with Pandas](#)
- [Using Pandas: Split-Apply-Combine](#)

#### Data visualization

- [Visualization](#)
- [Simple Graphing with IPython and Pandas](#)
- [Beautiful Plots With Pandas and Matplotlib](#)

#### Pivot tables

- [Reshaping and Pivot Tables](#)
- [Pandas Pivot Table Explained](#)
- [Pivot Tables in Python](#)

#### Working with missing data

- [Working with missing data](#)
- [Handling missing data](#)

#### Common features

[Creating Objects](#)  
[Viewing Data](#)  
[Selection](#)  
[Manipulating Data](#)  
[Grouping Data](#)  
[Merging, Joining and Concatenating](#)  
[Working with Date and Time](#)  
[Working With Text Data](#)  
[Working with CSV and Excel files](#)  
[Operations](#)  
[Visualization](#)  
[Applications and Projects](#)  
[Miscellaneous](#)

## sklearn.preprocessing

The `sklearn.preprocessing` package provides several common utility functions and transformer classes to change raw feature vectors into a representation that is more suitable for the downstream estimators.

### [sklearn.preprocessing](#).LabelEncoder

Encode target labels with value between 0 and `n_classes-1`.  
This transformer should be used to encode target values, *i.e.* `y`, and not the input `x`.

#### Attributes

**`classes_`**  
*ndarray of shape (n\_classes,)*  
Holds the label for each class.

#### Methods

<code>fit(y)</code>	Fit label encoder.
<code>fit_transform(y)</code>	Fit label encoder and return encoded labels.

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Savitribai Phule Pune University

Answers

`get_params([deep])` Get parameters for this estimator.

`inverse_transform(y)` Transform labels back to original encoding.

`set_params(**params)` Set the parameters of this estimator.

`transform(y)` Transform labels to normalized encoding.

`fit(y)`

Fit label encoder.

**Parameters**

**yarray-like of shape (n\_samples,)**

Target values.

**Returns**

**selfreturns an instance of self.**

Fitted label encoder.

`fit_transform(y)`

Fit label encoder and return encoded labels.

**Parameters**

**yarray-like of shape (n\_samples,)**

Target values.

**Returns**

**yarray-like of shape (n\_samples,)**

Encoded labels.

`transform(y)`

Transform labels to normalized encoding.

**Parameters**

**yarray-like of shape (n\_samples,)**

Target values.

**Returns**

**yarray-like of shape (n\_samples,)**

Labels as normalized encodings.

## pandas.DataFrame.iloc

### Differences between `loc` and `iloc`

The main distinction between `loc` and `iloc` is:

- `loc` is label-based, which means that you have to specify rows and columns based on their row and column **labels**.
- `iloc` is integer position-based, so you have to specify rows and columns by their **integer position values** (0-based integer position).

#### Syntax

```
loc[row_label, column_label]
iloc[row_position, column_position]
```

With `loc`, we can pass the row label `'Fri'` and the column label `'Temperature'`.

```
# To get Friday's temperature
>>> df.loc['Fri', 'Temperature']10.51
```

The equivalent `iloc` statement should take the row number `4` and the column number `1`.

```
# The equivalent `iloc` statement
>>> df.iloc[4, 1]10.51
```

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Answers

We can also use `:` to return all data. For example, to get all rows:

```
# To get all rows
>>> df.loc[:, 'Temperature']
Day
Mon    12.79
Tue    19.67
Wed    17.51
Thu    14.44
Fri    10.51
Sat    11.07
Sun    17.50
Name: Temperature, dtype: float64
# The equivalent `iloc` statement
>>> df.iloc[:, 1]
```

And to get all columns:

```
# To get all columns
>>> df.loc['Fri', :]
Weather    Shower
Temperature    10.51
Wind        26
Humidity     79
Name: Fri, dtype: object
# The equivalent `iloc` statement
>>> df.iloc[4, :]
```

We can use the syntax `A:B:S` to select data from label **A** to label **B** with step size **S** (Both **A** and **B** are included):

```
# Slicing with step
df.loc['Mon':'Fri':2, :]
```

	Weather	Temperature	Wind	Humidity
Day				
Mon	Sunny	12.79	13	30
Tue	Sunny	19.67	28	96
Wed	Sunny	17.51	16	20
Thu	Cloudy	14.44	11	22
Fri	Shower	10.51	26	79
Sat	Shower	11.07	27	62
Sun	Sunny	17.50	20	10

`df`

`df.loc['Mon':'Fri':2, :]`

	Weather	Temperature	Wind	Humidity
Day				
Mon	Sunny	12.79	13	30
Wed	Sunny	17.51	16	20
Fri	Shower	10.51	26	79

`iloc` with slice

With `iloc`, we can also use the syntax `n:m` to select data from position **n** (included) to position **m** (excluded). However, the main difference here is that the endpoint (**m**) is excluded from the `iloc` result.

For example, selecting columns from position 0 up to 3 (excluded):

```
df.iloc[:, 0 : 3]
```

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DSE II BCA 357- Laboratory (Data Mining) Workbook  
Savitribai Phule Pune University  
Answers

Weather Temperature Wind Humidity				
Day				
Mon	Sunny	12.79	13	30
Tue	Sunny	19.67	28	96
Wed	Sunny	17.51	16	20
Thu	Cloudy	14.44	11	22
Fri	Shower	10.51	26	79
Sat	Shower	11.07	27	62
Sun	Sunny	17.50	20	10

df

df.iloc[[1, 2], 0 : 3]

Weather Temperature Wind			
Day			
Tue	Sunny	19.67	28
Wed	Sunny	17.51	16

<b>In all Estimators:</b>
<code>model.fit()</code> : fit training data. For supervised learning applications, this accepts two arguments: the data <code>X</code> and the labels <code>y</code> (e.g. <code>model.fit(X, y)</code> ). For unsupervised learning applications, this accepts only a single argument, the data <code>X</code> (e.g. <code>model.fit(X)</code> ).
<b>In supervised estimators:</b>
<code>model.predict()</code> : given a trained model, predict the label of a new set of data. This method accepts one argument, the new data <code>X_new</code> (e.g. <code>model.predict(X_new)</code> ), and returns the learned label for each object in the array.
<code>model.predict_proba()</code> : For classification problems, some estimators also provide this method, which returns the probability that a new observation has each categorical label. In this case, the label with the highest probability is returned by <code>model.predict()</code> .
<code>model.score()</code> : for classification or regression problems, most (all?) estimators implement a score method. Scores are between 0 and 1, with a larger score indicating a better fit.
<b>In unsupervised estimators:</b>
<code>model.transform()</code> : given an unsupervised model, transform new data into the new basis. This also accepts one argument <code>X_new</code> , and returns the new representation of the data based on the unsupervised model.
<code>model.fit_transform()</code> : some estimators implement this method, which more efficiently performs a fit and a transform on the same input data.

**Classification:**

**SET A)**

1) write a Python program build Decision Tree Classifier using Scikit-learn package for diabetes data set (download database from <https://www.kaggle.com/uciml/pima-indians-diabetes-database>)

```
import pandas as pd
from sklearn.tree import DecisionTreeClassifier
from sklearn.model_selection import train_test_split
from sklearn import metrics

pima = pd.read_csv("C:\\Users\\Asus\\Desktop\\DMDWLab Book
Material\\diabetes.csv")
pima.head()
import seaborn as sns
corr = pima.corr()
ax = sns.heatmap(
    corr,
    vmin=-1, vmax=1, center=0,
```

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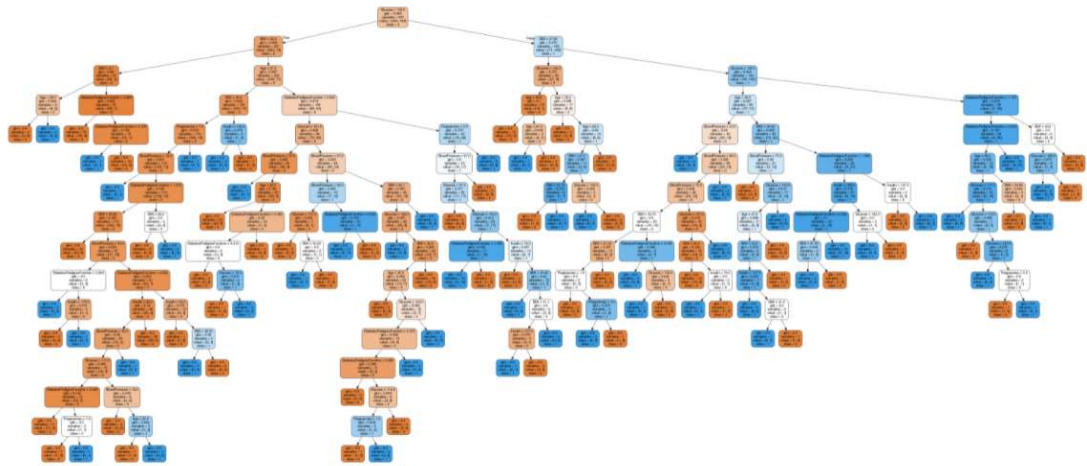
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Answers

```
cmap=sns.diverging_palette(20, 220, n=200),
square=True
)
ax.set_xticklabels(
    ax.get_xticklabels(),
    rotation=45,
    horizontalalignment='right'
);
# feature selection
feature_cols = ['Pregnancies', 'Insulin', 'BMI', 'Age', 'Glucose', 'BloodPressure',
'DiabetesPedigreeFunction']
x = pima[feature_cols]
y = pima.Outcome
# split data
X_train, X_test, Y_train, Y_test = train_test_split(x, y, test_size = 0.3,
random_state=1)
# build model
classifier = DecisionTreeClassifier()
classifier = classifier.fit(X_train, Y_train)
# predict
y_pred = classifier.predict(X_test)
print(y_pred)
from sklearn.metrics import confusion_matrix
confusion_matrix(Y_test, y_pred)
print(confusion_matrix(Y_test, y_pred))

# accuracy
print("Accuracy:", metrics.accuracy_score(Y_test,y_pred))
from six import StringIO
from IPython.display import Image
from sklearn.tree import export_graphviz
import pydotplus
dot_data = StringIO()
export_graphviz(classifier, out_file=dot_data,
                filled=True, rounded=True,
                special_characters=True, feature_names =
feature_cols,class_names=['0','1'])
graph = pydotplus.graph_from_dot_data(dot_data.getvalue())
graph.write_png('diabetes.png')
Image(graph.create_png())
```

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Answers



1. open command prompt and type command "pip install graphviz"
  2. go to my computer(this pc) and search with the keyword "graphviz"
  3. open the graphviz folder and copy its path and save it in notepad
  4. In graphviz look for the bin folder and copy the folder by right click of your mouse
  5. now again head back to my computer and search for "pydotplus"
  6. a folder named *pydotplus* is displayed. Open it and paste the copy of bin folder (of Graphviz) that you copied earlier
  7. head to control panel>system and security> system settings> advanced settings> environmental variables> add new path
  8. add the path that you copied in notepad and click a series of "ok"
- that's it now you can enjoy using graphviz

2)Write a Python program build Decision Tree Classifier for shows.csv from pandas and predict class label for show starring a 40 years old American comedian, with 10 years of experience, and a comedy ranking of 7? Create a csv file as shown in

[https://www.w3schools.com/python/python\\_ml\\_decision\\_tree.asp](https://www.w3schools.com/python/python_ml_decision_tree.asp)

import pandas

from sklearn import tree

import pydotplus

from sklearn.tree import DecisionTreeClassifier

import matplotlib.pyplot as plt

import matplotlib.image as pltimg

df = pandas.read\_csv("c:\shows.csv")

d = {'UK': 0, 'USA': 1, 'N': 2}

df['Nationality'] = df['Nationality'].map(d)

d = {'YES': 1, 'NO': 0}

df['Go'] = df['Go'].map(d)

features = ['Age', 'Experience', 'Rank', 'Nationality']

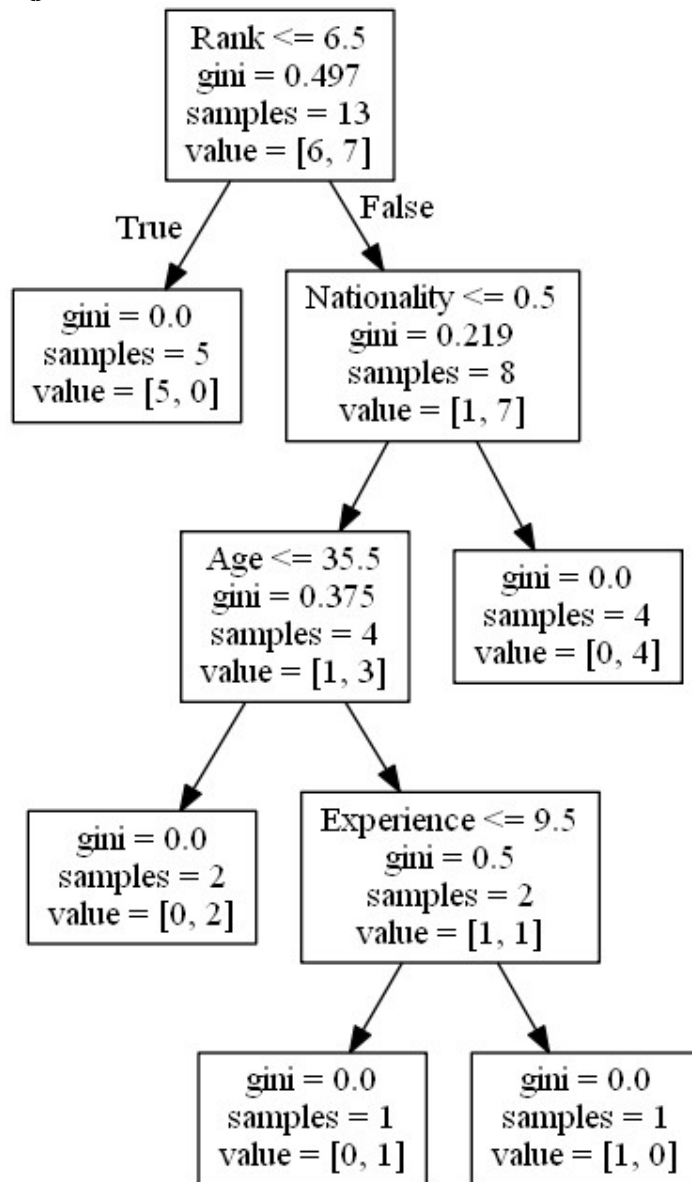
X = df[features]

y = df['Go']

dtree = DecisionTreeClassifier()

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DSE II BCA 357- Laboratory (Data Mining) Workbook  
Savitribai Phule Pune University  
Answers

```
dtree = dtree.fit(X, y)
data = tree.export_graphviz(dtree, out_file=None, feature_names=features)
graph = pydotplus.graph_from_dot_data(data)
graph.write_png('mydecisiontree.png')
img=pltimg.imread('mydecisiontree.png')
imgplot = plt.imshow(img)
plt.show()
```



SET B

1) Consider following dataset

weather=['Sunny','Sunny','Overcast','Rainy','Rainy','Rainy','Overcast','Sunny','Sunny','Rainy','Sunny','Overcast','Overcast','Rainy']  
temp=['Hot','Hot','Hot','Mild','Cool','Cool','Cool','Mild','Cool','Mild','Mi

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DSE II BCA 357- Laboratory (Data Mining) Workbook

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Answers

```
ld','Mild','Hot','Mild']
```

```
play=['No','No','Yes','Yes','Yes','No','Yes','No','Yes','Yes','Yes','Yes','Yes','No']. Use Naïve Bayes algorithm to predict[ 0:Overcast, 2:Mild] tuple belongs to which class whether to play the sports or not.
```

Ans→

```
# Assigning features and label variables
```

```
weather=['Sunny','Sunny','Overcast','Rainy','Rainy','Rainy','Overcast','Sunny','Sunny','Rainy','Sunny','Overcast','Overcast','Rainy']
```

```
temp=['Hot','Hot','Hot','Mild','Cool','Cool','Cool','Mild','Cool','Mild','Mild','Mild','Hot','Mild']
```

```
play=['No','No','Yes','Yes','Yes','No','Yes','No','Yes','Yes','Yes','Yes','Yes','No']
```

```
# Import LabelEncoder
```

```
from sklearn import preprocessing
```

```
#creating labelEncoder
```

```
le = preprocessing.LabelEncoder()
```

```
# Converting string labels into numbers.
```

```
wheather_encoded=le.fit_transform(weather)
```

```
print (wheather_encoded)
```

```
# Converting string labels into numbers
```

```
temp_encoded=le.fit_transform(temp)
```

```
label=le.fit_transform(play)
```

```
print ("Temp:",temp_encoded)
```

```
print ("Play:",label)
```

```
#Combinig weather and temp into single listof tuples
```

```
features=zip(wheather_encoded,temp_encoded)
```

```
print (features)
```

```
#Import Gaussian Naive Bayes model
```

```
from sklearn.naive_bayes import GaussianNB
```

```
#Create a Gaussian Classifier
```

```
model = GaussianNB()
```

```
# Train the model using the training sets
```

```
model.fit(features,label)
```

```
#Predict Output
```

```
predicted= model.predict([[0,2]]) # 0:Overcast, 2:Mild
```

```
print "Predicted Value:", predicted
```

```
output: Predicted Value: [1]
```

```
Here, 1 indicates that players can 'play'.
```

SET C

1) Write a Python program to build SVM model to Cancer dataset. The dataset is available in the scikit-learn library. Check the accuracy of model with precision and recall.

```
#Import scikit-learn dataset library
```



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Savitribai Phule Pune University  
Answers

```
from sklearn import datasets

#Load dataset
cancer = datasets.load_breast_cancer()
# print the names of the 13 features
print("Features: ", cancer.feature_names)

# print the label type of cancer('malignant' 'benign')
print("Labels: ", cancer.target_names)
# print data(feature)shape
cancer.data.shape
# print the cancer data features (top 5 records)
print(cancer.data[0:5])
# print the cancer labels (0:malignant, 1:benign)
print(cancer.target)
# Import train_test_split function
from sklearn.model_selection import train_test_split

# Split dataset into training set and test set
X_train, X_test, y_train, y_test = train_test_split(cancer.data, cancer.target,
test_size=0.3,random_state=109) # 70% training and 30% test
#Import svm model
from sklearn import svm

#Create a svm Classifier
clf = svm.SVC(kernel='linear') # Linear Kernel

#Train the model using the training sets
clf.fit(X_train, y_train)

#Predict the response for test dataset
y_pred = clf.predict(X_test)
#Import scikit-learn metrics module for accuracy calculation
from sklearn import metrics

# Model Accuracy: how often is the classifier correct?
print("Accuracy:",metrics.accuracy_score(y_test, y_pred))
```

### **Association Rules**

#### **SET A)**

1)Write a Python Programme to read the dataset ("Iris.csv"). dataset download from (<https://archive.ics.uci.edu/ml/datasets/iris>) and apply Apriori algorithm.

```
Ans→{
"cells": [
{
"cell_type": "markdown",
"id": "b58228cb",
"metadata": {},
```

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DSE II BCA 357- Laboratory (Data Mining) Workbook  
Savitribai Phule Pune University  
Answers

```
"source": [
  "# SET - A\n",
  "\n",
  "### 1) Write a code to read the dataset ("Iris.csv"). dataset download from
  (https://archive.ics.uci.edu/ml/datasets/iris) and apply Apriori algorithm."
]
},
{
  "cell_type": "code",
  "execution_count": 1,
  "id": "31f28134",
  "metadata": {},
  "outputs": [],
  "source": [
    "import numpy as np\n",
    "import matplotlib.pyplot as plt\n",
    "import pandas as pd\n",
    "from apyori import apriori"
  ]
},
{
  "cell_type": "code",
  "execution_count": null,
  "id": "91ef7af6",
  "metadata": {},
  "outputs": [],
  "source": [
    "store_data=pd.read_csv('iris.csv',header=None)"
  ]
},
{
  "cell_type": "code",
  "execution_count": null,
  "id": "cd4c9ed9",
  "metadata": {},
  "outputs": [],
  "source": [
    "store_data.head()\n"
  ]
},
{
  "cell_type": "code",
  "execution_count": null,
  "id": "88d01808",
  "metadata": {},
  "outputs": [],
  "source": [
    "records = []\n",
    "for i in range(0,300):\n"
```

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DSE II BCA 357- Laboratory (Data Mining) Workbook

Savitribai Phule Pune University

Answers

```
" records.append([str(store_data.values[i,j]) for j in range(0,20)])\n"
]
},
{
"cell_type": "code",
"execution_count": null,
"id": "ba30cca3",
"metadata": {},
"outputs": [],
"source": [

"association_rules=apriori(records,min_support=0.0045,min_confidence=0.2,min_lift=3,min
_length=2)\n",
"association_results=list(association_rules)\n"
]
},
{
"cell_type": "code",
"execution_count": null,
"id": "8ab0102a",
"metadata": {},
"outputs": [],
"source": [
"print(len(association_results))\n"
]
},
{
"cell_type": "code",
"execution_count": null,
"id": "daa923d5",
"metadata": {},
"outputs": [],
"source": [
"print(association_results[0])\n"
]
},
{
"cell_type": "code",
"execution_count": null,
"id": "4f9ceaad",
"metadata": {},
"outputs": [],
"source": [
"for item in association_results:\n",
"    pair = item[0]\n",
"    items = [x for x in pair]\n",
"    print(\"Rule:\"+items[0]+\"->\"+items[1])\n",
"    \n",
"    print(\"Support:\"+str(item[1]))\n",
```

T.Y.B.C.A.(Science)  
DSE II BCA 357- Laboratory (Data Mining) Workbook

Savitribai Phule Pune University

Answers

```
"\n",
" print(\"Confidence:\"+str(item[2][0][2]))\n",
" print(\"Lift:\"+str(item[2][0][3]))\n",
" print(\"=====\\")
]
}
],
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"name": "python3"
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"name": "ipython",
"version": 3
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"pygments_lexer": "ipython3",
"version": "3.7.9"
},
},
"nbformat": 4,
"nbformat_minor": 5
}
```

( does the dataset wrong)

2) Write a Python Programme to apply Apriori algorithm on Groceries dataset.

Dataset can be downloaded from

([https://github.com/amankharwal/Websitedata/blob/master/Groceries\\_dataset.csv](https://github.com/amankharwal/Websitedata/blob/master/Groceries_dataset.csv))

Also display support and confidence for each rule.

**Ans→ {**

```
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"id": "6df9f70d"
},
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"# SET - A\n",
"\n",
"### 2) Write a code to read the dataset ("Groceries.csv") dataset download from
```

(<https://github.com/amankharwal/Website->

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DSE II BCA 357- Laboratory (Data Mining) Workbook  
Savitribai Phule Pune University  
Answers

**data/blob/master/Groceries\_dataset.csv) and apply Apriori algorithm also display support and confidence for each rule."**

```
]
},
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  },
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    "import matplotlib.pyplot as plt\n",
    "import pandas as pd\n",
    "from apyori import apriori"
  ]
},
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  },
  "outputs": [],
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  ]
},
{
  "cell_type": "code",
  "execution_count": null,
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  "metadata": {
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  },
  "outputs": [],
  "source": [
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  ]
},
{
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  "metadata": {
    "id": "29964735"
  },
  "outputs": [],
  "source": [
    "store_data.head()\n"
  ]
}
```

T.Y.B.C.A.(Science)  
DSE II BCA 357- Laboratory (Data Mining) Workbook  
Savitribai Phule Pune University  
Answers

```
},
"outputs": [],
"source": [
    "records = []\n",
    "for i in range(0,300):\n",
    "    records.append([str(store_data.values[i,j]) for j in range(0,20)])\n"
]
},
{
    "cell_type": "code",
    "execution_count": null,
    "id": "0beac933",
    "metadata": {
        "id": "0beac933"
    },
    "outputs": [],
    "source": [

"association_rules=apriori(records,min_support=0.0045,min_confidence=0.2,min_lift
=3,min_length=2)\n",
    "association_results=list(association_rules)\n"
]
},
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    "id": "e4d1fd53",
    "metadata": {
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    },
    "outputs": [],
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        "print(len(association_results))\n"
    ]
},
{
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    "execution_count": null,
    "id": "55580074",
    "metadata": {
        "id": "55580074"
    },
    "outputs": [],
    "source": [
        "print(association_results[0])\n"
    ]
},
{
    "cell_type": "code",
```

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DSE II BCA 357- Laboratory (Data Mining) Workbook  
Savitribai Phule Pune University  
Answers

```
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"metadata": {
  "id": "80937225"
},
"outputs": [],
"source": [
  "for item in association_results:\n",
  "  pair = item[0]\n",
  "  items = [x for x in pair]\n",
  "  print(\"Rule:\"+items[0]+\"->\"+items[1])\n",
  "  \n",
  "  print(\"Support:\"+str(item[1]))\n",
  "  \n",
  "  print(\"Confidence:\"+str(item[2][0][2]))\n",
  "  print(\"Lift:\"+str(item[2][0][3]))\n",
  "  print(\"=====\")
]
},
"metadata": {
  "kernelspec": {
    "display_name": "Python 3 (ipykernel)",
    "language": "python",
    "name": "python3"
  },
  "language_info": {
    "codemirror_mode": {
      "name": "ipython",
      "version": 3
    },
    "file_extension": ".py",
    "mimetype": "text/x-python",
    "name": "python",
    "nbconvert_exporter": "python",
    "pygments_lexer": "ipython3",
    "version": "3.7.9"
  },
  "colab": {
    "name": "Data Mining Assignment-3.ipynb",
    "provenance": []
  }
},
"nbformat": 4,
"nbformat_minor": 5
}
```

**SET B**

1) Write a Python program to read "StudentsPerformance.csv" file. Solve following:

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DSE II BCA 357- Laboratory (Data Mining) Workbook

Savitribai Phule Pune University

Answers

- To display the shape of dataset.
- To display the top rows of the dataset with their columns.
- To display the number of rows randomly.
- To display the number of columns and names of the columns.

Note: Download dataset from following link :

(<https://www.kaggle.com/spscientist/students-performance-inexams?select=StudentsPerformance.csv>)

Ans→{

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"nbformat\_minor": 0,

"metadata": {

"colab": {

"name": "Data Mining Assignment-3 SET-B-1.ipynb",

"provenance": []

},

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"display\_name": "Python 3"

},

"language\_info": {

"name": "python"

}

},

"cells": [

{

"cell\_type": "markdown",

"source": [

"### SET-B\n",

"\n",

"1) Write a Python program to read \"StudentsPerformance.csv\" file. solve the following:\n",

"- To display the shape of dataset.\n",

"- To display the top rows of the dataset with their columns.\n",

"- To display the number of rows randomly.\n",

"- To display the number of columns and names of the columns.\n",

"- Note : Download dataset from following link:\n",

"(<https://www.kaggle.com/spscientist/students-performance-inexams?select=StudentsPerformance.csv>)"

],

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"id": "0hhW5uEs\_wK2"

}

},

{

"cell\_type": "code",

"source": [

"# Import required libraries\n",

"import numpy as np\n",

"import matplotlib.pyplot as plt\n",



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DSE II BCA 357- Laboratory (Data Mining) Workbook  
Savitribai Phule Pune University  
Answers

```
"import pandas as pd\n",  
{"metadata": {  
  "id": "W61H7Yo7E_sP"  
},  
"execution_count": 2,  
"outputs": []  
},  
{  
  "cell_type": "code",  
  "source": [  
    "# Read the downloaded dataset\n",  
    "store_data=pd.read_csv('StudentsPerformance.csv',header=None)"  
  ],  
  "metadata": {  
    "id": "uC2jGgIFFVa3"  
  },  
  "execution_count": null,  
  "outputs": []  
},  
{  
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  "source": [  
    "# To display the shape of dataset. (By Using shape method)\n",  
    "store_data.shape"  
  ],  
  "metadata": {  
    "id": "wU6-JdtCF3ar"  
  },  
  "execution_count": null,  
  "outputs": []  
},  
{  
  "cell_type": "code",  
  "source": [  
    "# To display the top rows of the dataset with their columns.(By using head method\n",  
    "store_data.head()"  
  ],  
  "metadata": {  
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  },  
  "execution_count": null,  
  "outputs": []  
},  
{  
  "cell_type": "code",  
  "source": [  
    "# To display the number of rows randomly.(By using sample method)\n",  
    "store_data.sample(10)"
```

T.Y.B.C.A.(Science)  
DSE II BCA 357- Laboratory (Data Mining) Workbook

Savitribai Phule Pune University

Answers

```
    ],
    "metadata": {
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    },
    "execution_count": null,
    "outputs": []
  },
  {
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    "source": [
      "# To display the number of columns and names of the columns. (By using columns
method)\n",
      "store_data.columns()"
    ],
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    },
    "execution_count": null,
    "outputs": []
  }
]
```

2) Write a Python program for Apriori Algorithm using ARM. And Print the Rule, Support, Confidence and Lift.

- (Set Min\_Support = 0.0040, Min\_Confidence=0.2, Min\_Lift=3, Min\_Length=2)

Note: Download dataset from following link :

(<https://www.kaggle.com/irfanasrullah/groceries>)

Ans→{

```
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    "provenance": []
  },
  "kernelspec": {
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    "display_name": "Python 3"
  },
  "language_info": {
    "name": "python"
  }
},
"cells": [
  {
    "cell_type": "markdown",
    "source": [
      "SET - B\n",

```

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DSE II BCA 357- Laboratory (Data Mining) Workbook

Savitribai Phule Pune University

Answers

"\n",  
"2) Write a code to read the dataset ("groceries.csv"). dataset download from  
(<https://www.kaggle.com/irfanasrullah/groceries>) and apply Apriori algorithm with  
min\_support=0.0040, min\_support=0.2, min\_lift=3, min\_length=2."

```
],  
"metadata": {  
  "id": "pVfZJLMAvGIJ"  
}  
},  
{  
  "cell_type": "code",  
  "source": [  
    "import numpy as np\n",  
    "import matplotlib.pyplot as plt\n",  
    "import pandas as pd\n",  
    "from apyori import apriori"  
  ],  
  "metadata": {  
    "id": "7KuTYHw1vNJf"  
  },  
  "execution_count": null,  
  "outputs": []  
},  
{  
  "cell_type": "code",  
  "source": [  
    "store_data=pd.read_csv('groceries.csv',header=None)"  
  ],  
  "metadata": {  
    "id": "QvImFxy16yLg"  
  },  
  "execution_count": null,  
  "outputs": []  
},  
{  
  "cell_type": "code",  
  "source": [  
    "store_data.head()"  
  ],  
  "metadata": {  
    "id": "wwm9lexq-pdY"  
  },  
  "execution_count": null,  
  "outputs": []  
},  
{  
  "cell_type": "code",  
  "source": [  
    "records = []\n",
```

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Answers

```
"for i in range(0,300):\n",
"  records.append([str(store_data.values[i,j]) for j in range(0,20)])\n"
],
"metadata": {
  "id": "p4_M413V-tkY"
},
"execution_count": null,
"outputs": []
},
{
  "cell_type": "code",
  "source": [
    "association_rules=apriori(records,min_support=0.0040,min_confidence=0.2,min_lift=3,min\n",
    "_length=2)\n",
    "association_results=list(association_rules)\n",
    ],
    "metadata": {
      "id": "7ZTOd9jQ-z5F"
    },
    "execution_count": null,
    "outputs": []
  },
  {
    "cell_type": "code",
    "source": [
      "print(len(association_results))"
    ],
    "metadata": {
      "id": "LYXHcNQs-Cj"
    },
    "execution_count": null,
    "outputs": []
  },
  {
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    "source": [
      "print(association_results[0])"
    ],
    "metadata": {
      "id": "1gmQcNZk_Ekl"
    },
    "execution_count": null,
    "outputs": []
  },
  {
    "cell_type": "code",
    "source": [
      "for item in association_results:\n",
```

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Answers

```

" pair = item[0]\n",
" items = [x for x in pair]\n",
" print("Rule:\n"+items[0]+\n->\n"+items[1])\n", " \n",
" print("Support:\n"+str(item[1]))\n", "\n",
" print("Confidence:\n"+str(item[2][0][2]))\n", "
print("\nLift:\n"+str(item[2][0][3]))\n",
" print("\n=====\\")"
],
"metadata": {
    "id": "mNizziCV_Jp-"
},
"execution_count": null,
"outputs": []
}
]
}

```

Set C

Write a Python Program to implement Apriori algorithm for following data set. Create csv file in excel. Apply Apriori algorithm and print the association results.

Wine	Chips	Bread	Butter	Milk	Apple
Wine	Chips		Butter	Milk	
		Bread	Butter	Milk	Apple
		Bread		Milk	Apple
Wine	Chips	Bread		Milk	
Wine	Chips		Butter	Milk	Apple
Wine	Chips		Butter		Apple
Wine	Chips	Bread	Butter	Milk	Apple
Wine	Chips	Bread	Butter	Milk	Apple
Wine	Chips		Butter	Milk	
			Butter		Apple
Wine		Bread	Butter	Milk	Apple
Wine	Chips	Bread	Butter	Milk	Apple
Wine	Chips	Bread		Milk	Apple

Ans→

### Regression Analysis and outlier detection

#### Set A : Simple Linear Regression

1) Consider following observations/data. And apply simple linear regression and find out estimated coefficients b0 and b1.( use numpy package)

x= [0, 1, 2, 3, 4, 5, 6, 7, 8, 9,11,13]

y = ([1, 3, 2, 5, 7, 8, 8, 9, 10, 12,16, 18])

Ans→

```
import numpy as np
```

```
import matplotlib.pyplot as plt
```

```
def estimate_coef(x, y):
```

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DSE II BCA 357- Laboratory (Data Mining) Workbook

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Answers

```
# number of observations/points
n = np.size(x)

# mean of x and y vector
m_x = np.mean(x)
m_y = np.mean(y)

# calculating cross-deviation and deviation about x
SS_xy = np.sum(y*x) - n*m_y*m_x
SS_xx = np.sum(x*x) - n*m_x*m_x

# calculating regression coefficients
b_1 = SS_xy / SS_xx
b_0 = m_y - b_1*m_x

return (b_0, b_1)

def plot_regression_line(x, y, b):
    # plotting the actual points as scatter plot
    plt.scatter(x, y, color = "m",
               marker = "o", s = 30)

    # predicted response vector
    y_pred = b[0] + b[1]*x

    # plotting the regression line
    plt.plot(x, y_pred, color = "g")

    # putting labels
    plt.xlabel('x')
    plt.ylabel('y')

    # function to show plot
    plt.show()

def main():
    # observations / data
    x = np.array([0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 13])
    y = np.array([1, 3, 2, 5, 7, 8, 8, 9, 10, 12, 16, 18])

    # estimating coefficients
    b = estimate_coef(x, y)
    print("Estimated coefficients:\nb_0 = {} \
          \nb_1 = {}".format(b[0], b[1]))

    # plotting regression line
    plot_regression_line(x, y, b)

if __name__ == "__main__":
```

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DSE II BCA 357- Laboratory (Data Mining) Workbook  
Savitribai Phule Pune University  
Answers

main()

2) Consider following observations/data. And apply simple linear regression and find out estimated coefficients b<sub>0</sub> and b<sub>1</sub>. Also analyse the performance of the model

(Use sklearn package)

```
x = np.array([1,2,3,4,5,6,7,8])
```

```
y = np.array([7,14,15,18,19,21,26,23])
```

Ans→

```
import matplotlib.pyplot as plt
```

```
from scipy import stats
```

```
x = np.array([1,2,3,4,5,6,7,8])
```

```
y = np.array([7,14,15,18,19,21,26,23])
```

```
slope, intercept, r, p, std_err = stats.linregress(x, y)
```

```
def myfunc(x):
```

```
    return slope * x + intercept
```

```
mymodel = list(map(myfunc, x))
```

```
plt.scatter(x, y)
```

```
plt.plot(x, mymodel)
```

```
plt.show()
```

3) Consider the student data set. It can be downloaded from:

[https://drive.google.com/open?id=1oakZCv7g3mlmCSdv9J8kdSaqO5\\_6dlOw](https://drive.google.com/open?id=1oakZCv7g3mlmCSdv9J8kdSaqO5_6dlOw)

Write a programme in python to apply simple linear regression and find out mean absolute error, mean squared error and root mean squared error.

### Set B: Multiple Linear Regression

1) Write a python program to implement multiple Linear Regression model for a car dataset.

Dataset can be downloaded from:

[https://www.w3schools.com/python/python\\_ml\\_multiple\\_regression.asp](https://www.w3schools.com/python/python_ml_multiple_regression.asp)

Ans→

```
import pandas
```

```
from sklearn import linear_model
```

```
df = pandas.read_csv("d:\dataset\carsm.csv")
```

```
X = df[['Weight', 'Volume']]
```

```
y = df['CO2']
```

```
regr = linear_model.LinearRegression()
```

```
regr.fit(X, y)
```

```
#predict the CO2 emission of a car where the weight is 2300kg, and the volume is 1300cm3:
```

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## Answers

```
predictedC02 = regr.predict([[2300, 1300]])
```

```
print(predictedC02)
```

2) Write a python programme to implement multiple linear regression model for stock market data frame as follows:

Stock\_Market = {'Year':

[2017,2017,2017,2017,2017,2017,2017,2017,2017,2017,2017,2017,2016,2016,2016,2016,2016,2016,2016,2016,2016,2016],

'Month': [12, 11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1, 12, 11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1],

'Interest\_Rate':

[2.75,2.5,2.5,2.5,2.5,2.5,2.5,2.25,2.25,2.25,2,2,1.75,1.75,1.75,1.75,1.75,1.75,1.75,1.75,1.75,1.75],

'Unemployment\_Rate':

[5.3,5.3,5.3,5.3,5.4,5.6,5.5,5.5,5.5,5.6,5.7,5.9,6,5.9,5.8,6.1,6.2,6.1,6.1,6.1,5.9,6.2,6.2,6.1],

'Stock\_Index\_Price':

[1464,1394,1357,1293,1256,1254,1234,1195,1159,1167,1130,1075,1047,965,943,958,971,949,884,866,876,822,704,719] }

And draw a graph of stock market price verses interest rate.

Ans→

```
import pandas as pd
```

```
import matplotlib.pyplot as plt
```

Stock\_Market = {'Year':

[2017,2017,2017,2017,2017,2017,2017,2017,2017,2017,2017,2017,2016,2016,2016,2016,2016,2016,2016,2016,2016,2016],

'Month': [12, 11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1, 12, 11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1],

'Interest\_Rate':

[2.75,2.5,2.5,2.5,2.5,2.5,2.5,2.25,2.25,2.25,2,2,1.75,1.75,1.75,1.75,1.75,1.75,1.75,1.75,1.75,1.75],

'Unemployment\_Rate':

[5.3,5.3,5.3,5.3,5.4,5.6,5.5,5.5,5.5,5.6,5.7,5.9,6,5.9,5.8,6.1,6.2,6.1,6.1,6.1,5.9,6.2,6.2,6.1],

'Stock\_Index\_Price':

[1464,1394,1357,1293,1256,1254,1234,1195,1159,1167,1130,1075,1047,965,943,958,971,949,884,866,876,822,704,719]

}

$$df =$$

```
pd.DataFrame(Stock_Market,columns=['Year','Month','Interest_Rate','Unemployment_Rate','
Stock_Index_Price'])
```

```
plt.scatter(df['Interest_Rate'], df['Stock_Index_Price'], color='red')
```

```
plt.title('Stock Index Price Vs Interest Rate', fontsize=14)
```

```
plt.xlabel('Interest Rate', fontsize=14)
```

```
plt.ylabel('Stock Index Price', fontsize=14)
```

```
plt.grid(True)
```

```
plt.show()
```



T.Y.B.C.A.(Science)  
DSE II BCA 357- Laboratory (Data Mining) Workbook  
Savitribai Phule Pune University  
Answers

Set C: Outlier Detection

1) Write a programme in python to print the number of outliers. Generate 200 samples, from a normal distribution, cantered around the value 100, with a standard deviation of 5.

Ans→

[Z-Score and How It's Used to Determine an Outlier | by Iden W. | Clarusway | Medium](#)

**Clustering**

Set A

1. Write a python program to implement k-means algorithm to build prediction model (Use Credit Card Dataset CC GENERAL.csv Download from kaggle.com)

Ans→

```
#dataset --> https://www.kaggle.com/mlg-ulb/creditcardfraud/version/3
import numpy as nm

import matplotlib.pyplot as mtp

import pandas as pd

dataset = pd.read_csv('creditcard.csv')

dataset

x = dataset.iloc[:, [3, 4]].values

print(x)

from sklearn.cluster import KMeans

wcss_list= []

for i in range(1, 11):

    kmeans = KMeans(n_clusters=i, init='k-means++', random_state= 42)

    kmeans.fit(x)

    wcss_list.append(kmeans.inertia_)

mtp.plot(range(1, 11), wcss_list)

mtp.title('The Elbow Method Graph')

mtp.xlabel('Number of clusters(k)')

mtp.ylabel('wcss_list')

mtp.show()

kmeans = KMeans(n_clusters=3, init='k-means++', random_state= 42)

y_predict= kmeans.fit_predict(x)
```

T.Y.B.C.A.(Science)  
DSE II BCA 357- Laboratory (Data Mining) Workbook

Savitribai Phule Pune University

Answers

```
mtp.scatter(x[y_predict == 0, 0], x[y_predict == 0, 1], s = 100, c = 'blue', label  
= 'Cluster 1') #for first cluster  
  
mtp.scatter(x[y_predict == 1, 0], x[y_predict == 1, 1], s = 100, c = 'green',  
label = 'Cluster 2') #for second cluster  
  
mtp.scatter(x[y_predict == 2, 0], x[y_predict == 2, 1], s = 100, c = 'red', label = 'Cluster 3')  
#for third cluster  
  
mtp.scatter(kmeans.cluster_centers_[0, 0], kmeans.cluster_centers_[0, 1], s = 300, c =  
'yellow', label = 'Centroid')  
  
mtp.title('Clusters of Credit Card')  
  
mtp.xlabel('V3')  
  
mtp.ylabel('V4')  
  
mtp.legend()  
  
mtp.show()
```

2. Write a python program to implement hierarchical Agglomerative clustering algorithm.  
(Download Customer.csv dataset from github.com).

```
Ans→dataset = pd.read_csv('Mall_Customers.csv')  
  
x = dataset.iloc[:, [3, 4]].values  
  
import scipy.cluster.hierarchy as shc  
dendro = shc.dendrogram(shc.linkage(x, method="ward"))  
mtp.title("Dendrogram Plot")  
mtp.ylabel("Euclidean Distances")  
mtp.xlabel("Customers")  
mtp.show()  
from sklearn.cluster import AgglomerativeClustering  
hc = AgglomerativeClustering(n_clusters=5, affinity='euclidean', linkage='ward')  
y_pred = hc.fit_predict(x)  
mtp.scatter(x[y_pred == 0, 0], x[y_pred == 0, 1], s = 100, c = 'blue', label = 'Cluster 1')  
mtp.scatter(x[y_pred == 1, 0], x[y_pred == 1, 1], s = 100, c = 'green', label = 'Cluster 2')  
mtp.scatter(x[y_pred == 2, 0], x[y_pred == 2, 1], s = 100, c = 'red', label = 'Cluster 3')  
mtp.scatter(x[y_pred == 3, 0], x[y_pred == 3, 1], s = 100, c = 'cyan', label = 'Cluster 4')  
mtp.scatter(x[y_pred == 4, 0], x[y_pred == 4, 1], s = 100, c = 'magenta', label = 'Cluster 5')  
mtp.title('Clusters of customers')  
mtp.xlabel('Annual Income (k$)')  
mtp.ylabel('Spending Score (1-100)')  
mtp.legend()  
mtp.show()
```

T.Y.B.C.A.(Science)  
DSE II BCA 357- Laboratory (Data Mining) Workbook  
Savitribai Phule Pune University  
Answers

Set B

1. Write a python program to implement k-means algorithms on a synthetic dataset.

Ans→import seaborn as sns

import matplotlib.pyplot as plt

from sklearn.datasets import make\_blobs

```
data = make_blobs(n_samples=300, n_features=2, centers=5,
cluster_std=1.8,random_state=101)
```

```
data[0].shape
```

```
data[1]
```

```
plt.scatter(data[0][:,0],data[0][:,1],c=data[1],cmap='brg')
```

```
from sklearn.cluster import KMeans
```

```
kmeans = KMeans(n_clusters=5)
```

```
kmeans.fit(data[0])
```

```
kmeans.cluster_centers_
```

```
kmeans.labels_ f, (ax1, ax2) = plt.subplots(1, 2, sharey=True,figsize=(10,6))
```

```
ax1.set_title('K Means')
```

```
ax1.scatter(data[0][:,0],data[0][:,1],c=kmeans.labels_,cmap='brg')
```

```
ax2.set_title("Original")
```

```
ax2.scatter(data[0][:,0],data[0][:,1],c=data[1],cmap='brg')
```

**1. Write a python program to implement hierarchical clustering algorithm. (Download Wholesale customers data dataset from github.com).**

```
import numpy as nm
```

```
import matplotlib.pyplot as mtp
```

```
import pandas as pd
```

```
dataset = pd.read_csv('Wholesale customers data.csv')
```

```
dataset
```

```
x = dataset.iloc[:, [3, 4]].values
```

```
print(x)
```

```
import scipy.cluster.hierarchy as shc
```

```
dendro = shc.dendrogram(shc.linkage(x, method="ward"))
```

```
mtp.title("Dendrogrma Plot")
```

```
mtp.ylabel("Euclidean Distances")
```

```
mtp.xlabel("Customers")
```

```
mtp.show()
```

```
from sklearn.cluster import AgglomerativeClustering
```

```
hc= AgglomerativeClustering(n_clusters=5, affinity='euclidean', linkage='ward')
```

```
y_pred= hc.fit_predict(x)
```

```
mtp.scatter(x[y_pred == 0, 0], x[y_pred == 0, 1], s = 100, c = 'blue', label = 'Cluster 1')
```

```
mtp.scatter(x[y_pred == 1, 0], x[y_pred == 1, 1], s = 100, c = 'green', label = 'Cluster 2')
```

```
mtp.scatter(x[y_pred== 2, 0], x[y_pred == 2, 1], s = 100, c = 'red', label = 'Cluster 3')
```

T.Y.B.C.A.(Science)  
DSE II BCA 357- Laboratory (Data Mining) Workbook  
Savitribai Phule Pune University

Answers

```
mtp.scatter(x[y_pred == 3, 0], x[y_pred == 3, 1], s = 100, c = 'cyan', label = 'Cluster 4')  
  
mtp.scatter(x[y_pred == 4, 0], x[y_pred == 4, 1], s = 100, c = 'magenta', label = 'Cluster 5')  
  
mtp.title('Clusters of customers')  
mtp.xlabel('Milk')  
mtp.ylabel('Grocery')  
mtp.legend()  
mtp.show()
```