Program 25

October 25, 2022

1 PROGRAM 25

Aim : Program to implement k-NN classification using the datasets (Breastcancer.csv,Telco-Customer-Churn.csv) and find the accuracy of the algorithm

Date: 28/09/2022

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```
[718]: import numpy as np
import pandas as pd
!pip install scikit-learn

Defaulting to user installation because normal site-packages is not writeable
```

Requirement already satisfied: scikit-learn in
/opt/anaconda3/lib/python3.9/site-packages (1.0.2)
Requirement already satisfied: threadpoolctl>=2.0.0 in
/opt/anaconda3/lib/python3.9/site-packages (from scikit-learn) (2.2.0)
Requirement already satisfied: numpy>=1.14.6 in
/opt/anaconda3/lib/python3.9/site-packages (from scikit-learn) (1.21.5)
Requirement already satisfied: scipy>=1.1.0 in
/opt/anaconda3/lib/python3.9/site-packages (from scikit-learn) (1.7.3)
Requirement already satisfied: joblib>=0.11 in
/opt/anaconda3/lib/python3.9/site-packages (from scikit-learn) (1.1.0)

```
[719]: import pandas as pd df=pd.read_csv('Telco-Customer-Churn.csv') #print(df)
```

```
[720]: cols=df.columns print(cols)
```

```
[721]:
              SeniorCitizen
                                            MonthlyCharges
                                    tenure
                7043.000000 7043.000000
                                               7043.000000
       count
       mean
                    0.162147
                                32.371149
                                                  64.761692
                    0.368612
                                24.559481
                                                  30.090047
       std
       min
                    0.000000
                                  0.000000
                                                  18.250000
       25%
                    0.000000
                                  9.000000
                                                  35.500000
       50%
                    0.000000
                                29.000000
                                                  70.350000
       75%
                    0.000000
                                55.000000
                                                  89.850000
                    1.000000
                                72.000000
       max
                                                 118.750000
[722]:
      df.isnull().sum()
[722]: customerID
                            0
       gender
                            0
       SeniorCitizen
                            0
                            0
       Partner
       Dependents
                            0
                            0
       tenure
       PhoneService
                            0
       MultipleLines
                            0
       InternetService
                            0
       OnlineSecurity
       OnlineBackup
                            0
       DeviceProtection
                            0
       TechSupport
                            0
       StreamingTV
                            0
                            0
       StreamingMovies
       Contract
                            0
       PaperlessBilling
                            0
       PaymentMethod
                            0
       MonthlyCharges
                            0
       TotalCharges
                            0
       Churn
                            0
       dtype: int64
      df.value_counts("Churn")
[723]:
[723]: Churn
       No
              5174
              1869
       Yes
       dtype: int64
[724]: df ["TotalCharges"] = pd.to_numeric(df ["TotalCharges"], errors='coerce')
       df=df.dropna()
```

[721]: df.describe()

```
[725]: y=df['Churn'] ##Dependent variable
       df.drop('Churn',axis=1,inplace=True)
       print(y)
      0
                No
      1
                No
      2
               Yes
      3
                No
      4
               Yes
      7038
                No
      7039
                No
      7040
                No
               Yes
      7041
      7042
                No
      Name: Churn, Length: 7032, dtype: object
[726]: df.drop('customerID', axis = 1,inplace=True)
       cols=df.columns
       print(cols)
       x=df
       print(x)
      Index(['gender', 'SeniorCitizen', 'Partner', 'Dependents', 'tenure',
              'PhoneService', 'MultipleLines', 'InternetService', 'OnlineSecurity',
              'OnlineBackup', 'DeviceProtection', 'TechSupport', 'StreamingTV',
              'StreamingMovies', 'Contract', 'PaperlessBilling', 'PaymentMethod',
              'MonthlyCharges', 'TotalCharges'],
             dtype='object')
             gender SeniorCitizen Partner Dependents
                                                        tenure PhoneService
      0
             Female
                                  0
                                        Yes
                                                     No
                                                              1
                                                                           No
               Male
      1
                                  0
                                         No
                                                     No
                                                             34
                                                                          Yes
      2
               Male
                                  0
                                         No
                                                     No
                                                              2
                                                                          Yes
      3
                                                             45
               Male
                                  0
                                         No
                                                     No
                                                                           Nο
      4
             Female
                                  0
                                         No
                                                     No
                                                              2
                                                                          Yes
                                  0
                                                                          Yes
      7038
              Male
                                        Yes
                                                    Yes
                                                             24
      7039
            Female
                                  0
                                        Yes
                                                    Yes
                                                             72
                                                                          Yes
            Female
      7040
                                  0
                                        Yes
                                                    Yes
                                                             11
                                                                           No
      7041
               Male
                                  1
                                        Yes
                                                     No
                                                              4
                                                                          Yes
      7042
                                  0
               Male
                                         No
                                                     No
                                                             66
                                                                          Yes
                MultipleLines InternetService OnlineSecurity OnlineBackup \
             No phone service
                                                            No
                                                                         Yes
      0
                                           DSL
      1
                                           DSL
                                                           Yes
                                                                          No
                           No
      2
                           No
                                           DSL
                                                           Yes
                                                                         Yes
      3
             No phone service
                                           DSL
                                                           Yes
                                                                          No
      4
                           No
                                   Fiber optic
                                                            No
                                                                          No
```

```
7038
                                            DSL
                           Yes
                                                            Yes
                                                                           No
      7039
                           Yes
                                   Fiber optic
                                                             No
                                                                          Yes
      7040
            No phone service
                                            DSL
                                                            Yes
                                                                           No
                                                             No
      7041
                           Yes
                                   Fiber optic
                                                                           No
      7042
                            No
                                   Fiber optic
                                                                           No
                                                            Yes
            DeviceProtection TechSupport StreamingTV StreamingMovies
                                                                                 Contract
      0
                           No
                                        No
                                                     No
                                                                          Month-to-month
                          Yes
                                        Nο
      1
                                                     Nο
                                                                      No
                                                                                 One year
      2
                           No
                                        No
                                                     No
                                                                      No
                                                                          Month-to-month
      3
                          Yes
                                       Yes
                                                     No
                                                                      No
                                                                                 One year
      4
                           No
                                        No
                                                     No
                                                                          Month-to-month
                                                                      No
      7038
                          Yes
                                       Yes
                                                    Yes
                                                                     Yes
                                                                                 One year
      7039
                          Yes
                                                    Yes
                                                                     Yes
                                        No
                                                                                 One year
      7040
                           No
                                        No
                                                     No
                                                                      No
                                                                          Month-to-month
      7041
                           No
                                        No
                                                     No
                                                                      No
                                                                          Month-to-month
      7042
                          Yes
                                       Yes
                                                   Yes
                                                                     Yes
                                                                                 Two year
            PaperlessBilling
                                                            MonthlyCharges
                                                                             TotalCharges
                                            PaymentMethod
      0
                          Yes
                                         Electronic check
                                                                      29.85
                                                                                     29.85
      1
                           No
                                             Mailed check
                                                                      56.95
                                                                                   1889.50
      2
                          Yes
                                             Mailed check
                                                                      53.85
                                                                                    108.15
      3
                           Nο
                               Bank transfer (automatic)
                                                                      42.30
                                                                                   1840.75
      4
                          Yes
                                         Electronic check
                                                                      70.70
                                                                                    151.65
                                             Mailed check
      7038
                          Yes
                                                                      84.80
                                                                                   1990.50
                                 Credit card (automatic)
      7039
                          Yes
                                                                     103.20
                                                                                   7362.90
      7040
                          Yes
                                         Electronic check
                                                                      29.60
                                                                                    346.45
      7041
                          Yes
                                             Mailed check
                                                                      74.40
                                                                                    306.60
                               Bank transfer (automatic)
                                                                                   6844.50
      7042
                          Yes
                                                                     105.65
       [7032 rows x 19 columns]
[727]: from sklearn.preprocessing import LabelEncoder
       label_encoder_y=LabelEncoder()
       y=label_encoder_y.fit_transform(y)
       print("After labeling :\n",y)
      After labeling:
       [0 0 1 ... 0 1 0]
[728]: label_encoder_x=LabelEncoder()
       x.iloc[:,0]=label_encoder_x.fit_transform(x.iloc[:,0])
       print("After labeling :\n",x)
```

After labeling:

	gender	SeniorC	itizen F	Partner	Dependents	tenure	PhoneServ	ice \	
0	0		0	Yes	No	1		No	
1	1		0	No	No	34	Y	es	
2	1		0	No	No	2	Y	es	
3	1		0	No	No	45		No	
4	0		0	No	No	2	Y	es	
•••	•••	•••	•••		•••				
7038	1		0	Yes	Yes	24		es	
7039	0		0	Yes	Yes	72		es	
7040	0		0	Yes	Yes	11		No	
7041	1		1	Yes	No	4		es	
7042	1		0	No	No	66	Y	es	
	M7+4		T +	+ Q÷	O1÷	: + O-	- 1 D l	\	
^		_	Interne		ce OnlineSed	-		_	
0	No phone				SL	No	Ye		
1		No No			SL	Yes	N		
2	No mbono	No			SL	Yes	Ye		
3	No phone		TO S I		SL : -	Yes	N		
4		No	FIL	per opt:		No	N	O	
 7038		 Yes			SL	Yes	 N	0	
7039		Yes	Fil	ار er opt:		No	Ye		
7040	No phone		1 1 1	_	SL	Yes	N		
7041	no phone	Yes	Fil	per opt:		No	N		
7042		No		per opt:		Yes	N		
1012		110	1 11	oci opu		105	.,		
	DevicePro	tection [ГесhSupp	ort St	reamingTV St	treaming	Movies	Contract	\
0		No		No	No	Ü		nth-to-month	
1		Yes		No	No		No	One year	
2		No		No	No		No Mo	nth-to-month	
3		Yes		Yes	No		No	One year	
4		No		No	No		No Mo	nth-to-month	
•••		•••	•••		••	•••	***		
7038		Yes		Yes	Yes		Yes	One year	
7039		Yes		No	Yes		Yes	One year	
7040		No		No	No		No Mo	nth-to-month	
7041		No		No	No		No Mo	nth-to-month	
7042		Yes		Yes	Yes		Yes	Two year	
	Paperless	Billing		P:	aymentMethod	d Month	lyCharges	TotalCharge	s
0		Yes			tronic check		29.85	29.8	
1		No			Mailed check		56.95	1889.5	
2		Yes			Mailed check		53.85	108.1	
3		No	Bank tı		(automatic)		42.30	1840.7	
4		Yes		Elect	tronic check	ζ	70.70	151.6	5
4		Yes 		Elect	tronic check 		70.70	151.6	5
•••		•••			•••		••	•••	
		Yes Yes Yes	Credi	1	tronic check Mailed check (automatic)	ζ.			0

7040 7041	Yes Yes	Electronic check Mailed check	29.60 74.40	346.45 306.60		
7042	Yes I	Bank transfer (automatic)	105.65	6844.50		
[7032 rows x 19 columns]						

[729]: x.iloc[:,2]=label_encoder_x.fit_transform(x.iloc[:,2]) #partner

After		peling		+izon	Dartner	Donondonta	+001170	Dhono	Sorvice \	
0	ge	ender O	Seniorci	.tizen	rarther 1	Dependents No	tenure 1	Phone	Service \ No	
1		1		0	0	No	34		Yes	
2		1		0	0	No	2		Yes	
3		1		0	0	No	45		No	
4		0		0	0	No	2		Yes	
 7038	•••	1	•••	 0	 1	 Yes	 24		Yes	
7039		0		0	1	Yes	72		Yes	
7040		0		0	1	Yes	11		No	
7041		1		1	1	No	4		Yes	
7041		1		0	0	No	66		Yes	
		Multir	oleLines	Intern	etServic	e OnlineSecu	ıritv Onl	lineBa	ıckup \	
)	No	-	service		DSI		No		Yes	
L		1	No		DSI		Yes		No	
2			No		DS		Yes		Yes	
3	No	phone	service		DS		Yes		No	
1		•	No	Fi	ber opti		No		No	
 7038			 Yes		 DSI		 Yes		No	
7039			Yes	Fi	ber opti		No		Yes	
7040	No	phone	service		DSI		Yes		No	
7041		1	Yes	Fi	ber opti		No		No	
7042			No		ber opti		Yes		No	
]	Devi	iceProt	tection T	'echSup	port Str	eamingTV Str	reamingMo	ovies	Contract	;
О			No	_	No	No	_	No	Month-to-month	ı
1			Yes		No	No		No	One year	•
2			No		No	No		No	Month-to-month	
3			Yes		Yes	No		No	One year	•
4			No		No	No		No	Month-to-month	
 7038			 Yes	•••	Yes	Yes	•••	Yes	 One year	•
7039			Yes		No	Yes		Yes	One year	
7040			No		No	No		No	Month-to-month	
7041			No		No	No		No	Month-to-month	
7042			Yes		Yes	Yes		Yes	Two year	

	PaperlessBilling	${\tt PaymentMethod}$	MonthlyCharges	TotalCharges
0	Yes	Electronic check	29.85	29.85
1	No	Mailed check	56.95	1889.50
2	Yes	Mailed check	53.85	108.15
3	No	Bank transfer (automatic)	42.30	1840.75
4	Yes	Electronic check	70.70	151.65
•••	•••	•••	•••	•••
7038	Yes	Mailed check	84.80	1990.50
7039	Yes	Credit card (automatic)	103.20	7362.90
7040	Yes	Electronic check	29.60	346.45
7041	Yes	Mailed check	74.40	306.60
7042	Yes	Bank transfer (automatic)	105.65	6844.50

[7032 rows x 19 columns]

```
[730]: x.iloc[:,3]=label_encoder_x.fit_transform(x.iloc[:,3]) #Dependents
    x.iloc[:,5]=label_encoder_x.fit_transform(x.iloc[:,5]) #PhoneService
    x.iloc[:,6]=label_encoder_x.fit_transform(x.iloc[:,6]) #multiplelines
    x.iloc[:,7]=label_encoder_x.fit_transform(x.iloc[:,7]) #internet service
    x.iloc[:,8]=label_encoder_x.fit_transform(x.iloc[:,8]) #Online Security
    x.iloc[:,9]=label_encoder_x.fit_transform(x.iloc[:,9]) #Online Backup
    x.iloc[:,10]=label_encoder_x.fit_transform(x.iloc[:,10]) #DeviceProtection
    x.iloc[:,11]=label_encoder_x.fit_transform(x.iloc[:,11]) #TechSupport
    x.iloc[:,12]=label_encoder_x.fit_transform(x.iloc[:,12]) #StreamingTV
    x.iloc[:,13]=label_encoder_x.fit_transform(x.iloc[:,14]) #Contract
    x.iloc[:,14]=label_encoder_x.fit_transform(x.iloc[:,14]) #Contract
    x.iloc[:,15]=label_encoder_x.fit_transform(x.iloc[:,15]) #PaperlessBilling
    x.iloc[:,16]=label_encoder_x.fit_transform(x.iloc[:,16]) #PaymentMethod
    print("After labeling :\n",x)
```

After labeling :

	gender	SeniorCitizen	Partner	Dependents	tenure	PhoneService	\
0	0	0	1	0	1	0	
1	1	0	0	0	34	1	
2	1	0	0	0	2	1	
3	1	0	0	0	45	0	
4	0	0	0	0	2	1	
•••	•••		•••	•••	•••		
7038	1	0	1	1	24	1	
7039	0	0	1	1	72	1	
7040	0	0	1	1	11	0	
7041	1	1	1	0	4	1	
7042	1	0	0	0	66	1	

```
MultipleLines InternetService OnlineSecurity OnlineBackup \setminus 0 1 0 0 2 1 0 0 2 0
```

```
2
                                                                2
                           0
                                              0
                                                                                2
       3
                                              0
                                                                2
                                                                                0
                           1
       4
                                                                0
                           0
                                              1
                                                                                0
                           2
                                                                2
                                              0
                                                                                0
      7038
                                                                                2
       7039
                           2
                                              1
                                                                0
                                                                2
      7040
                           1
                                              0
                                                                                0
       7041
                           2
                                                                0
                                              1
                                                                                0
       7042
                                                                                0
             DeviceProtection TechSupport
                                                {\tt StreamingTV}
                                                               StreamingMovies
                                                                                  Contract
      0
                                                                               0
                                             0
                                                            0
                                                                                          0
                              2
                                             0
                                                            0
                                                                               0
       1
                                                                                          1
       2
                              0
                                             0
                                                            0
                                                                               0
                                                                                          0
       3
                              2
                                                            0
                                                                               0
                                                                                          1
       4
                                                            0
                                                                               0
                                                                                          0
       7038
                              2
                                             2
                                                            2
                                                                               2
                                                                                          1
       7039
                              2
                                             0
                                                            2
                                                                               2
                                                                                          1
       7040
                              0
                                             0
                                                            0
                                                                               0
                                                                                          0
      7041
                                                            0
                                                                               0
                                                                                          0
                              0
                                             0
       7042
                              2
                                             2
                                                            2
                                                                               2
                                                                                          2
             PaperlessBilling
                                 PaymentMethod MonthlyCharges TotalCharges
      0
                                               2
                                                             29.85
                                                                             29.85
                                                             56.95
       1
                              0
                                               3
                                                                           1889.50
       2
                                               3
                              1
                                                             53.85
                                                                           108.15
       3
                              0
                                               0
                                                             42.30
                                                                           1840.75
       4
                                                             70.70
                                               2
                                                                            151.65
                                               3
       7038
                              1
                                                             84.80
                                                                           1990.50
       7039
                              1
                                               1
                                                            103.20
                                                                          7362.90
       7040
                                               2
                                                             29.60
                                                                           346.45
                              1
       7041
                              1
                                               3
                                                             74.40
                                                                           306.60
       7042
                                               0
                                                            105.65
                                                                           6844.50
       [7032 rows x 19 columns]
[731]: x.shape
[731]: (7032, 19)
[732]: x=df
       one_hot_encoding_columns=["MultipleLines", "InternetService", "OnlineSecurity", "OnlineBackup", "I
       x=pd.get_dummies(x,columns=one_hot_encoding_columns)
       print(x)
```

gender SeniorCitizen Partner Dependents tenure PhoneService \

0 1	0 1	0	1 0	0 0	1 34	0 1
2	1	0	0	0	2	1
3	1	0	0	0	45	0
4	0	0	0	0	2	1
-			***	•••	- 	_
7038	1	0	1	1	24	1
7039	0	0	1	1	72	1
7040	0	0	1	1	11	0
7041	1	1	1	0	4	1
7042	1	0	0	0	66	1
	PaperlessBi	lling Montl		TotalCharges	MultipleI	Lines_0 \
0		1	29.85	29.85		0
1		0	56.95	1889.50		1
2		1	53.85	108.15		1
3		0	42.30	1840.75		0
4		1	70.70	151.65		1
 7038		1	 84.80	 1990.50	*** ***	0
7039		1	103.20	7362.90		0
7040		1	29.60	346.45		0
7041		1	74.40	306.60		0
7042		1	105.65	6844.50		1
	StreamingMo	ovies_0 Str	eamingMovies	s_1 Streaming	Movies_2	Contract_0 \
0	StreamingMo	ovies_0 Stre	${\sf eamingMovies}$	0	0	1
1	StreamingMo	_	${ t eaming} { t Movies}$	0 0	0 0	1 0
1 2	StreamingMo	1 1 1	${ t eaming Movies}$	0 0 0	0 0 0	1 0 1
1 2 3	StreamingMo	1 1 1	${ t eaming Movies}$	0 0 0 0	0 0 0	1 0 1 0
1 2	StreamingMo	1 1 1	eamingMovies	0 0 0	0 0 0	1 0 1
1 2 3 4 	StreamingMo	1 1 1 1 1	eamingMovies 	0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1 0 1 0 1
1 2 3 4 7038	StreamingMo	1 1 1 1 1 	eamingMovies 	0 0 0 0 0	0 0 0 0 0	1 0 1 0 1
1 2 3 4 7038 7039	StreamingMo	1 1 1 1 1 	eamingMovies 	0 0 0 0 0	0 0 0 0 0 	1 0 1 0 1
1 2 3 4 7038 7039 7040	StreamingMo	1 1 1 1 1 	eamingMovies 	0 0 0 0 0 0	0 0 0 0 0 0 1 1	1 0 1 0 1 0 0 1
1 2 3 4 7038 7039	StreamingMo	1 1 1 1 1 	eamingMovies 	0 0 0 0 0	0 0 0 0 0 	1 0 1 0 1
1 2 3 4 7038 7039 7040 7041	StreamingMo	1 1 1 1 1 	eamingMovies 	0 0 0 0 0 0	0 0 0 0 0 	1 0 1 0 1 0 0 0 1 1
1 2 3 4 7038 7039 7040 7041	StreamingMo	1 1 1 1 1 		0 0 0 0 0 0 0 0	0 0 0 0 0 	1 0 1 0 1 0 0 0 1 1
1 2 3 4 7038 7039 7040 7041		1 1 1 1 1 0 0		0 0 0 0 0 0 0 0	0 0 0 0 0 1 1 1 0 0	1 0 1 0 1 0 0 1 1 1
1 2 3 4 7038 7039 7040 7041 7042	Contract_1 0 1	1 1 1 1 1 0 0 0 1 1 1 0 Contract_2 0		0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 1 1 0 0 1	1 0 1 0 1 0 0 1 1 1
1 2 3 4 7038 7040 7041 7042	Contract_1	1 1 1 1 0 0 0 1 1 1 0 Contract_2 0 0		0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 1 1 1 0 0 1 tMethod_1 0	1 0 1 0 1 0 0 1 1 1
1 2 3 4 7038 7040 7041 7042 0 1 2 3	Contract_1	1 1 1 1 1 0 0 1 1 1 0 Contract_2 0 0 0		0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 1 1 1 0 0 0 1 .tMethod_1 0 0	1 0 1 0 1 0 0 1 1 1
1 2 3 4 7038 7040 7041 7042	Contract_1	1 1 1 1 0 0 0 1 1 1 0 Contract_2 0 0		0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 1 1 1 0 0 1 tMethod_1 0	1 0 1 0 1 0 0 1 1 1
1 2 3 4 7038 7040 7041 7042 0 1 2 3 4 	Contract_1	1 1 1 1 1 0 0 0 1 1 1 0 Contract_2 0 0 0 0 0 0		0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 1 1 1 0 0 0 1 tMethod_1 0 0	1 0 1 0 1 0 0 1 1 1
1 2 3 4 7038 7040 7041 7042 0 1 2 3 4 7038	Contract_1	1 1 1 1 1 0 0 1 1 1 0 Contract_2 0 0 0 0 0 0		0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 1 1 1 0 0 0 1 tMethod_1 0 0	1 0 1 0 1 0 0 1 1 1
1 2 3 4 7038 7040 7041 7042 0 1 2 3 4 	Contract_1	1 1 1 1 1 0 0 0 1 1 1 0 Contract_2 0 0 0 0 0 0		0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 1 1 1 0 0 0 1 tMethod_1 0 0	1 0 1 0 1 0 0 1 1 1

	7041 0		0		0	0
	7042 0		1		1	0
	${\tt PaymentMetho}$	od_2 Pa	$\mathtt{aymentMethod}$	_3		
	0	1	v	0		
	1	0		1		
	2	0		1		
	3	0		0		
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			•••			
	7038	0		1		
	7039	0		0		
	7040	1		0		
	7041	0		1		
	7042	0		0		
	[7032 rows x 40 co	olumns]				
[734]:	x.isnull().sum()					
[734]:	gender	0				
	SeniorCitizen	0				
	Partner	0				
	Dependents	0				
	tenure	0				
	PhoneService	0				
	PaperlessBilling	0				
	MonthlyCharges	0				
	TotalCharges	0				
	MultipleLines_0	0				
	MultipleLines_1	0				
	MultipleLines_2	0				
	InternetService_0	0				
	<pre>InternetService_1</pre>					
	<pre>InternetService_2</pre>	0				
	OnlineSecurity_0	0				
	OnlineSecurity_1	0				
	OnlineSecurity_2	0				
	OnlineBackup_0	0				
	OnlineBackup_1	0				
	OnlineBackup_2	0				
	DeviceProtection_	0 0				
	DeviceProtection_	1 0				
	DeviceProtection_	2 0				
	TechSupport_0	0				
	TechSupport_1	0				
	TechSupport_2	0				

```
StreamingTV_0
                               0
       StreamingTV_1
                               0
       StreamingTV_2
                               0
       StreamingMovies_0
       StreamingMovies_1
                               0
       StreamingMovies_2
                               0
       Contract_0
                               0
                               0
       Contract_1
       Contract 2
                               0
       PaymentMethod_0
                               0
       PaymentMethod_1
                               0
       PaymentMethod_2
                               0
       PaymentMethod_3
                               0
       dtype: int64
[735]: #convert total charge into numeric
       x["TotalCharges"] = pd.to_numeric(x["TotalCharges"], errors='coerce')
       print(x)
             gender
                     SeniorCitizen Partner
                                               Dependents
                                                            tenure PhoneService \
      0
                  0
                                  0
                                            1
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                                                                 2
                                                                                 1
      7038
                  1
                                                                24
                                                                                 1
                                  0
                                            1
                                                         1
      7039
                  0
                                                                72
                                                                                 1
                                  0
                                            1
                                                         1
      7040
                  0
                                  0
                                            1
                                                         1
                                                                11
                                                                                 0
      7041
                  1
                                  1
                                                         0
                                                                 4
                                            1
                                                                                 1
      7042
                  1
                                  0
                                            0
                                                         0
                                                                66
                                                                                 1
             PaperlessBilling MonthlyCharges TotalCharges MultipleLines_0
      0
                             1
                                          29.85
                                                         29.85
                                                                                0
      1
                             0
                                          56.95
                                                       1889.50
                                                                                1
      2
                             1
                                          53.85
                                                        108.15
      3
                             0
                                          42.30
                                                       1840.75
                                                                                0
                                                        151.65
      4
                                          70.70
                             1
                                                                                1
      7038
                                          84.80
                                                       1990.50
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      7039
                                         103.20
                                                       7362.90
                             1
                                                                                0
      7040
                             1
                                          29.60
                                                        346.45
                                                                                0
      7041
                             1
                                          74.40
                                                                                0
                                                        306.60
      7042
                             1
                                         105.65
                                                       6844.50
                                 StreamingMovies_1 StreamingMovies_2 Contract_0 \
             StreamingMovies_0
```

1		1	0	0	0
2		1	0	0	1
3		1	0	0	0
4		1	0	0	1
 7038				1	0
7039		0	0	1	0
7039		1	0	0	1
7040			0	-	
7041		1		0	1
7042		0	0	1	0
	Contract_1	Contract_2	PaymentMethod_0	PaymentMethod_1	\
0	0	0	0 PaymentHethod	0	\
1		0	0	0	
2	1	0	0	0	
3		0			
4	1 0	0	1 0	0	
				U	
 7038	 1				
7039	1	0	0	1	
7040	0	0	0	0	
7040	0	0	0	0	
7041	0	1	1	0	
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	PaymentMeth	nd 2 Paymen	tMethod_3		
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3		0	0		
4		1	0		
		•			
 7038	•••	0	1		
7039		0	0		
7040		1	0		
7040		0	1		
7041		0	0		
1042		U	U		
[7032	rows x 40 c	olumns]			
: x.dt;	ypes				
			1		
gende		int64 int64			
	orCitizen				
Parti		int64			
	ndents	int64			
tenu	re	int64	± •		

int64

[736]

[736]

PhoneService

PaperlessBilling	int64
MonthlyCharges	float64
TotalCharges	float64
MultipleLines_0	uint8
MultipleLines_1	uint8
MultipleLines_2	uint8
InternetService_0	uint8
<pre>InternetService_1</pre>	uint8
<pre>InternetService_2</pre>	uint8
OnlineSecurity_0	uint8
OnlineSecurity_1	uint8
OnlineSecurity_2	uint8
OnlineBackup_0	uint8
OnlineBackup_1	uint8
OnlineBackup_2	uint8
<pre>DeviceProtection_0</pre>	uint8
DeviceProtection_1	uint8
DeviceProtection_2	uint8
TechSupport_0	uint8
TechSupport_1	uint8
TechSupport_2	uint8
$StreamingTV_0$	uint8
StreamingTV_1	uint8
StreamingTV_2	uint8
StreamingMovies_0	uint8
StreamingMovies_1	uint8
StreamingMovies_2	uint8
Contract_0	uint8
Contract_1	uint8
Contract_2	uint8
$PaymentMethod_0$	uint8
PaymentMethod_1	uint8
PaymentMethod_2	uint8
PaymentMethod_3	uint8
dtype: object	

 $from \ sklearn.preprocessing \ import \ MinMaxScaler \ st_x=MinMaxScaler() \ x=st_x.fit_transform(x) \\ print(x)$

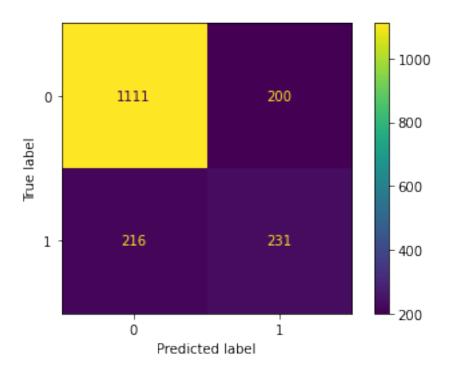
```
0
       MonthlyCharges
       TotalCharges
                              0
                              0
       MultipleLines_0
       MultipleLines_1
       MultipleLines_2
                              0
       InternetService_0
                              0
       InternetService_1
                              0
       InternetService 2
                              0
       OnlineSecurity_0
                              0
       OnlineSecurity_1
       OnlineSecurity_2
       OnlineBackup_0
                              0
       OnlineBackup_1
                              0
       OnlineBackup_2
                              0
       DeviceProtection_0
                              0
       DeviceProtection_1
       DeviceProtection_2
       TechSupport_0
       TechSupport_1
                              0
       TechSupport_2
                              0
       StreamingTV_0
                              0
       StreamingTV_1
                              0
       StreamingTV 2
                              0
       StreamingMovies_0
       StreamingMovies_1
       StreamingMovies_2
       Contract_0
       Contract_1
                              0
       Contract_2
                              0
       PaymentMethod_0
                              0
       PaymentMethod_1
                              0
       PaymentMethod_2
                              0
       PaymentMethod_3
                              0
       dtype: int64
[738]: x=x.dropna()
[739]: from sklearn.model selection import train test split
       x_train,x_test,y_train,y_test=train_test_split(x, y,test_size= 0.
        \rightarrow25, random state=0)
[740]: from sklearn.preprocessing import MinMaxScaler
       st_x=MinMaxScaler()
       x train=st x.fit transform(x train)
       x_test=st_x.fit_transform(x_test)
       print("Taining data \n",x_train)
```

PaperlessBilling

0

```
Taining data
       [[0. 0. 1. ... 0. 0. 0.]
       [1. 0. 1. ... 0. 0. 0.]
       [0. 0. 0. ... 0. 1. 0.]
       [1. 0. 1. ... 1. 0. 0.]
       [0. 0. 1. ... 1. 0. 0.]
       [1. 0. 0. ... 1. 0. 0.]]
      Testing data
       [[1. 0. 0. ... 0. 1. 0.]
       [1. 0. 0. ... 1. 0. 0.]
       [0. 0. 0. ... 1. 0. 0.]
       [1. 0. 0. ... 0. 1. 0.]
       [1. 1. 0. ... 0. 0. 0.]
       [0. 0. 1. ... 0. 0. 1.]]
[741]: from sklearn.neighbors import KNeighborsClassifier
       classifier=KNeighborsClassifier(n_neighbors=5)
       classifier.fit(x_train,y_train)
[741]: KNeighborsClassifier()
[742]: y_pred=classifier.predict(x_test)
       print(y_pred)
      [0 0 0 ... 1 0 0]
[743]: from sklearn.metrics import confusion_matrix
       cm=confusion_matrix (y_test,y_pred,labels=classifier.classes_)
       print(cm)
      [[1111 200]
       [ 216 231]]
[744]: from sklearn.metrics import ConfusionMatrixDisplay
       disp=ConfusionMatrixDisplay(confusion_matrix=cm, display_labels=classifier.
        →classes_)
       disp.plot()
[744]: <sklearn.metrics._plot.confusion_matrix.ConfusionMatrixDisplay at
       0x7f15f1363eb0>
```

print("Testing data \n",x_test)



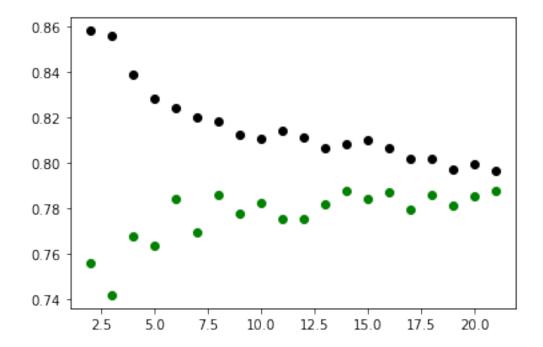
```
[745]: training_score=classifier.score(x_train, y_train)
test_score=classifier.score(x_test, y_test)
print("Training Accuracy:",training_score)
print("Testing Accuracy:",test_score)
```

Training Accuracy: 0.8282138794084186 Testing Accuracy: 0.7633674630261661

```
[748]: K=[]
       training=[]
       test=[]
       scores={}
       for k in range(2, 22):
           clf=KNeighborsClassifier(n_neighbors=k)
           clf.fit(x_train,y_train)
           training_score=clf.score(x_train, y_train)
           test_score=clf.score(x_test, y_test)
           K.append(k)
           training.append(training_score)
           test.append(test_score)
           scores[k]=[training_score, test_score]
       for keys, values in scores.items():
           print(keys,':',values)
       # visualization
       import matplotlib.pyplot as plt
```

```
plt.scatter(K,training,color='k')
plt.scatter(K,test,color='g')
plt.show()
```

2: [0.8581721653394009, 0.7559726962457338] 3: [0.8558968524838833, 0.7417519908987485] 4 : [0.8386423966628744, 0.767349260523322] 5: [0.8282138794084186, 0.7633674630261661] 6: [0.8244216913158893, 0.7838452787258248] 7: [0.820250284414107, 0.7696245733788396] 8: [0.8179749715585893, 0.7861205915813424] 9: [0.8122866894197952, 0.7775881683731513] 10: [0.810580204778157, 0.7821387940841866] 11 : [0.8141827834660599, 0.7753128555176336] 12 : [0.8109594235874099, 0.7753128555176336] 13 : [0.8064087978763747, 0.7815699658703071] 14 : [0.8081152825180129, 0.7878270762229806] 15 : [0.8102009859689041, 0.7838452787258248] 16: [0.8064087978763747, 0.7872582480091013] 17: [0.8020477815699659, 0.7792946530147895] 18: [0.801668562760713, 0.7861205915813424] 19: [0.7973075464543041, 0.7810011376564278] 20 : [0.7992036405005688, 0.785551763367463] 21 : [0.7963594994311718, 0.7878270762229806]



[]: