BHARATIYA VIDYA BHAVAN'S
SARDAR PATEL INSTITUTE OF TECHNOLOGY
Bhavan's Campus, Munshi Nagar, Andheri (West), Mumbai – 400058-India

DEPARTMENT OF COMPUTER ENGINEERING
SUBJECT: Artificial Intelligence and Machine Learning

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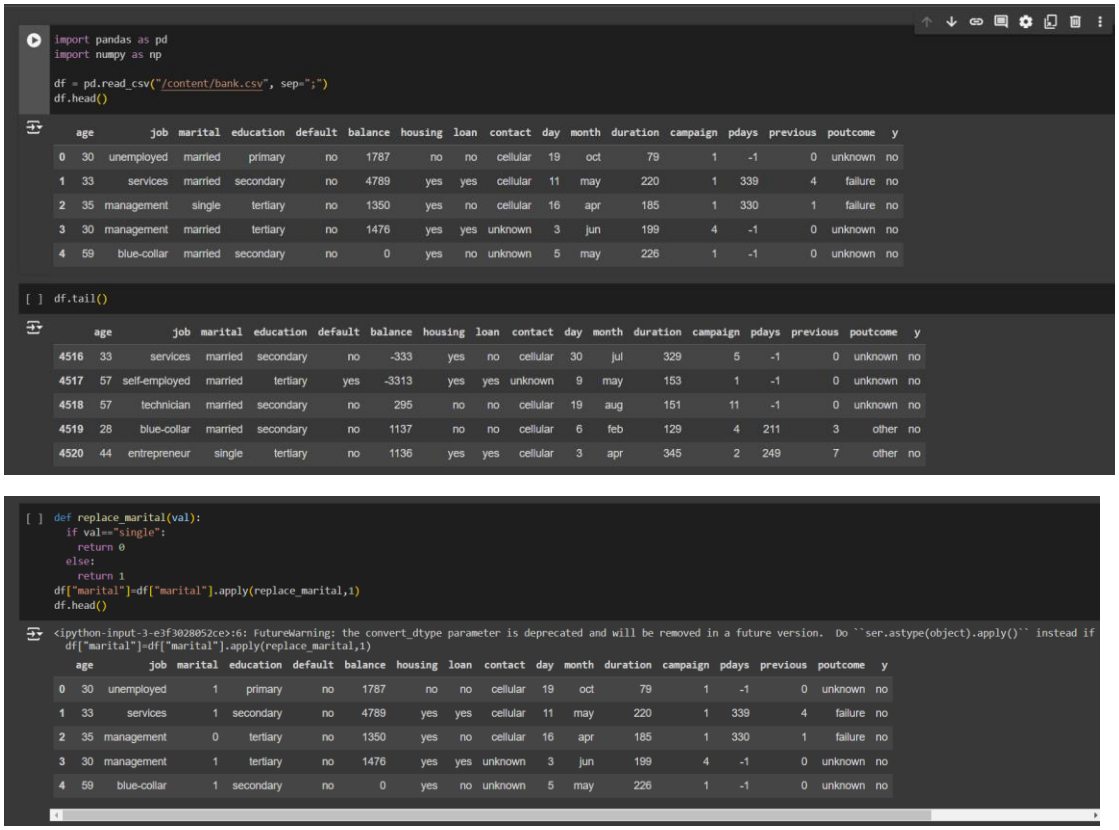
Experiment 6

AIM :	Data Pre-Processing.
Collab Link:	https://colab.research.google.com/drive/1weCny5-rolPMLCUR8TG-TRkeg7kGOAzh?usp=drive_link
Output:	

```
import pandas as pd
import numpy as np

df = pd.read_csv("/content/bank.csv", sep=";")
df.head()
```

	age	job	marital	education	default	balance	housing	loan	contact	day	month	duration	campaign	pdays	previous	poutcome	y
0	30	unemployed	married	primary	no	1787	no	no	cellular	19	oct	79	1	-1	0	unknown	no
1	33	services	married	secondary	no	4789	yes	yes	cellular	11	may	220	1	339	4	failure	no
2	35	management	single	tertiary	no	1350	yes	no	cellular	16	apr	185	1	330	1	failure	no
3	30	management	married	tertiary	no	1476	yes	yes	unknown	3	jun	199	4	-1	0	unknown	no
4	59	blue-collar	married	secondary	no	0	yes	no	unknown	5	may	226	1	-1	0	unknown	no

```
df.tail()
```

	age	job	marital	education	default	balance	housing	loan	contact	day	month	duration	campaign	pdays	previous	poutcome	y
4516	33	services	married	secondary	no	-333	yes	no	cellular	30	jul	329	5	-1	0	unknown	no
4517	57	self-employed	married	tertiary	yes	-3313	yes	yes	unknown	9	may	153	1	-1	0	unknown	no
4518	57	technician	married	secondary	no	295	no	no	cellular	19	aug	151	11	-1	0	unknown	no
4519	28	blue-collar	married	secondary	no	1137	no	no	cellular	6	feb	129	4	211	3	other	no
4520	44	entrepreneur	single	tertiary	no	1136	yes	yes	cellular	3	apr	345	2	249	7	other	no

```
def replace_marital(val):
  if val=="single":
    return 0
  else:
    return 1
df["marital"]=df["marital"].apply(replace_marital,1)
df.head()
```

```
<ipython-input-3-e3f3028052ce>:6: FutureWarning: the convert_dtype parameter is deprecated and will be removed in a future version.  Do ``ser.astype(object).apply()`` instead if
  df["marital"]=df["marital"].apply(replace_marital,1)
```

	age	job	marital	education	default	balance	housing	loan	contact	day	month	duration	campaign	pdays	previous	poutcome	y
0	30	unemployed	1	primary	no	1787	no	no	cellular	19	oct	79	1	-1	0	unknown	no
1	33	services	1	secondary	no	4789	yes	yes	cellular	11	may	220	1	339	4	failure	no
2	35	management	0	tertiary	no	1350	yes	no	cellular	16	apr	185	1	330	1	failure	no
3	30	management	1	tertiary	no	1476	yes	yes	unknown	3	jun	199	4	-1	0	unknown	no
4	59	blue-collar	1	secondary	no	0	yes	no	unknown	5	may	226	1	-1	0	unknown	no

```
[ ] df["housing"]=df["housing"].map({
     "no":0,
     "yes":1
    }.get)
    df.head()
```

	age	job	marital	education	default	balance	housing	loan	contact	day	month	duration	campaign	pdays	previous	poutcome	y
0	30	unemployed	1	primary	no	1787	0	no	cellular	19	oct	79	1	-1	0	unknown	no
1	33	services	1	secondary	no	4789	1	yes	cellular	11	may	220	1	339	4	failure	no
2	35	management	0	tertiary	no	1350	1	no	cellular	16	apr	185	1	330	1	failure	no
3	30	management	1	tertiary	no	1476	1	yes	unknown	3	jun	199	4	-1	0	unknown	no
4	59	blue-collar	1	secondary	no	0	1	no	unknown	5	may	226	1	-1	0	unknown	no

```
df["loan"]=df["loan"].replace({
 "no":0,
 "yes":1
})
df.head()
```

```
<ipython-input-5-d4641d45ef28>:1: FutureWarning: Downcasting behavior in `replace` is deprecated and will be removed in a future version. To retain th
  df["loan"]=df["loan"].replace({
```

	age	job	marital	education	default	balance	housing	loan	contact	day	month	duration	campaign	pdays	previous	poutcome	y
0	30	unemployed	1	primary	no	1787	0	0	cellular	19	oct	79	1	-1	0	unknown	no
1	33	services	1	secondary	no	4789	1	1	cellular	11	may	220	1	339	4	failure	no
2	35	management	0	tertiary	no	1350	1	0	cellular	16	apr	185	1	330	1	failure	no
3	30	management	1	tertiary	no	1476	1	1	unknown	3	jun	199	4	-1	0	unknown	no
4	59	blue-collar	1	secondary	no	0	1	0	unknown	5	may	226	1	-1	0	unknown	no

```
df["job"].unique() #to find unique value of column job
```

```
array(['unemployed', 'services', 'management', 'blue-collar',
       'self-employed', 'technician', 'entrepreneur', 'admin.', 'student',
       'housemaid', 'retired', 'unknown'], dtype=object)
```

inplace instead of creating new dataframe it copies in the old data frame

```
df["job"].replace({
 'unknown':np.nan,
 'unemployed':0, 'services':1, 'management':2, 'blue-collar':3,
 'self-employed':4, 'technician':5, 'entrepreneur':6,
'admin.':7, 'student':8,
 'housemaid':9, 'retired':10
},inplace=True)
df.head()
```

```
<ipython-input-7-b2109e05a277>:1: FutureWarning: A value is trying to be set on a copy of a DataFrame or Series through chained assignment usin
The behavior will change in pandas 3.0. This inplace method will never work because the intermediate object on which we are setting values alwa

For example, when doing 'df[col].method(value, inplace=True)', try using 'df.method({col: value}, inplace=True)' or df[col] = df[col].method(va


  df["job"].replace({
<ipython-input-7-b2109e05a277>:1: FutureWarning: Downcasting behavior in `replace` is deprecated and will be removed in a future version. To re
  df["job"].replace({
```

	age	job	marital	education	default	balance	housing	loan	contact	day	month	duration	campaign	pdays	previous	poutcome	y
0	30	0.0	1	primary	no	1787	0	0	cellular	19	oct	79	1	-1	0	unknown	no
1	33	1.0	1	secondary	no	4789	1	1	cellular	11	may	220	1	339	4	failure	no
2	35	2.0	0	tertiary	no	1350	1	0	cellular	16	apr	185	1	330	1	failure	no
3	30	2.0	1	tertiary	no	1476	1	1	unknown	3	jun	199	4	-1	0	unknown	no
4	59	3.0	1	secondary	no	0	1	0	unknown	5	may	226	1	-1	0	unknown	no

```
[ ] df["education"].unique()
```

```
array(['primary', 'secondary', 'tertiary', 'unknown'], dtype=object)
```

```
[ ] df["education"].replace({
     'primary':0, 'secondary':1, 'tertiary':2, 'unknown':np.nan
    } ,inplace=True)
    df.head()
```

```
<ipython-input-9-645a1db32540>:1: FutureWarning: A value is trying to be set on a copy of a DataFrame or Series through chained assignment using an inplace
The behavior will change in pandas 3.0. This inplace method will never work because the intermediate object on which we are setting values always behaves a

For example, when doing 'df[col].method(value, inplace=True)', try using 'df.method({col: value}, inplace=True)' or df[col] = df[col].method(value) instead


  df["education"].replace({
<ipython-input-9-645a1db32540>:1: FutureWarning: Downcasting behavior in `replace` is deprecated and will be removed in a future version. To retain the old
  df["education"].replace({
```

	age	job	marital	education	default	balance	housing	loan	contact	day	month	duration	campaign	pdays	previous	poutcome	y
0	30	0.0	1	0.0	no	1787	0	0	cellular	19	oct	79	1	-1	0	unknown	no
1	33	1.0	1	1.0	no	4789	1	1	cellular	11	may	220	1	339	4	failure	no
2	35	2.0	0	2.0	no	1350	1	0	cellular	16	apr	185	1	330	1	failure	no
3	30	2.0	1	2.0	no	1476	1	1	unknown	3	jun	199	4	-1	0	unknown	no
4	59	3.0	1	1.0	no	0	1	0	unknown	5	may	226	1	-1	0	unknown	no

```
df["default"].replace({
  "no":0,
  "yes":1
},inplace=True)
df.head()
```

```
<ipython-input-10-83ce5d7dfc10>:1: FutureWarning: A value is trying to be set on a copy of a DataFrame or Series through chained assignment u
The behavior will change in pandas 3.0. This inplace method will never work because the intermediate object on which we are setting values al

For example, when doing 'df[col].method(value, inplace=True)', try using 'df.method({col: value}, inplace=True)' or df[col] = df[col].method(

  df["default"].replace({
<ipython-input-10-83ce5d7dfc10>:1: FutureWarning: Downcasting behavior in `replace` is deprecated and will be removed in a future version. To
  df["default"].replace({
```

	age	job	marital	education	default	balance	housing	loan	contact	day	month	duration	campaign	pdays	previous	poutcome	y
0	30	0.0	1	0.0	0	1787	0	0	cellular	19	oct	79	1	-1	0	unknown	no
1	33	1.0	1	1.0	0	4789	1	1	cellular	11	may	220	1	339	4	failure	no
2	35	2.0	0	2.0	0	1350	1	0	cellular	16	apr	185	1	330	1	failure	no
3	30	2.0	1	2.0	0	1476	1	1	unknown	3	jun	199	4	-1	0	unknown	no
4	59	3.0	1	1.0	0	0	1	0	unknown	5	may	226	1	-1	0	unknown	no

```
[ ] df["balance"].min()
```

```
-3313
```

```
[ ] df["balance"].max()
```

```
71188
```

Apply min-max normalization to attribute balance

```
df["balance"]=df["balance"].apply(lambda v: (v -
df["balance"].min()))/(df["balance"].max()-df["balance"].min())
df.head()
```

	age	job	marital	education	default	balance	housing	loan	contact	day	month	duration	campaign	pdays	previous	poutcome	y
0	30	0.0	1	0.0	0	0.068455	0	0	cellular	19	oct	79	1	-1	0	unknown	no
1	33	1.0	1	1.0	0	0.108750	1	1	cellular	11	may	220	1	339	4	failure	no
2	35	2.0	0	2.0	0	0.062590	1	0	cellular	16	apr	185	1	330	1	failure	no
3	30	2.0	1	2.0	0	0.064281	1	1	unknown	3	jun	199	4	-1	0	unknown	no
4	59	3.0	1	1.0	0	0.044469	1	0	unknown	5	may	226	1	-1	0	unknown	no

```
df.contact.replace({"unknown":np.nan, "telephone":0, "cellular":1},
inplace=True)
df.head()
```

```
<ipython-input-15-b74c0a009967>:1: FutureWarning: A value is trying to be set on a copy of a DataFrame or Series through chained assignment using an i
The behavior will change in pandas 3.0. This inplace method will never work because the intermediate object on which we are setting values always beha

For example, when doing 'df[col].method(value, inplace=True)', try using 'df.method({col: value}, inplace=True)' or df[col] = df[col].method(value) in

  df.contact.replace({"unknown":np.nan, "telephone":0, "cellular":1},
<ipython-input-15-b74c0a009967>:1: FutureWarning: Downcasting behavior in `replace` is deprecated and will be removed in a future version. To retain t
  df.contact.replace({"unknown":np.nan, "telephone":0, "cellular":1},
```

	age	job	marital	education	default	balance	housing	loan	contact	day	month	duration	campaign	pdays	previous	poutcome	y
0	30	0.0	1	0.0	0	0.068455	0	0	1.0	19	oct	79	1	-1	0	unknown	no
1	33	1.0	1	1.0	0	0.108750	1	1	1.0	11	may	220	1	339	4	failure	no
2	35	2.0	0	2.0	0	0.062590	1	0	1.0	16	apr	185	1	330	1	failure	no
3	30	2.0	1	2.0	0	0.064281	1	1	NaN	3	jun	199	4	-1	0	unknown	no
4	59	3.0	1	1.0	0	0.044469	1	0	NaN	5	may	226	1	-1	0	unknown	no

```
df.contact.unique()
```

```
array([ 1., nan,  0.])
```

```
df.month.unique()
```

```
array(['oct', 'may', 'apr', 'jun', 'feb', 'aug', 'jan', 'jul', 'nov',
       'sep', 'mar', 'dec'], dtype=object)
```

```
df.month=df.month.map({'oct':10, 'may':5, 'apr':4, 'jun':6, 'feb':2,
'aug':8, 'jan':1, 'jul':7, 'nov':11,
 'sep':9, 'mar':3, 'dec':12})
df.head()
```

	age	job	marital	education	default	balance	housing	loan	contact	day	month	duration	campaign	pdays	previous	poutcome	y
0	30	0.0	1	0.0	0	0.068455	0	0	1.0	19	10	79	1	-1	0	unknown	no
1	33	1.0	1	1.0	0	0.108750	1	1	1.0	11	5	220	1	339	4	failure	no
2	35	2.0	0	2.0	0	0.062590	1	0	1.0	16	4	185	1	330	1	failure	no
3	30	2.0	1	2.0	0	0.064281	1	1	NaN	3	6	199	4	-1	0	unknown	no
4	59	3.0	1	1.0	0	0.044469	1	0	NaN	5	5	226	1	-1	0	unknown	no

```
[ ] df.poutcome.unique()
```

```
array(['unknown', 'failure', 'other', 'success'], dtype=object)
```

```
[ ] df.poutcome=df.poutcome.map({'unknown':np.nan, 'failure':0, 'other':1,
    'success':2})
    df.head()
```

	age	job	marital	education	default	balance	housing	loan	contact	day	month	duration	campaign	pdays	previous	poutcome	y
0	30	0.0	1	0.0	0	0.068455	0	0	1.0	19	10	79	1	-1	0	NaN	no
1	33	1.0	1	1.0	0	0.108750	1	1	1.0	11	5	220	1	339	4	0.0	no
2	35	2.0	0	2.0	0	0.062590	1	0	1.0	16	4	185	1	330	1	0.0	no
3	30	2.0	1	2.0	0	0.064281	1	1	NaN	3	6	199	4	-1	0	NaN	no
4	59	3.0	1	1.0	0	0.044469	1	0	NaN	5	5	226	1	-1	0	NaN	no

```
[ ] df.pdays=df.pdays.apply(lambda v:(v-df.pdays.min())/(df.pdays.max()-
    df.pdays.min()))
    df.head()
```

	age	job	marital	education	default	balance	housing	loan	contact	day	month	duration	campaign	pdays	previous	poutcome	y
0	30	0.0	1	0.0	0	0.068455	0	0	1.0	19	10	79	1	0.000000	0	NaN	no
1	33	1.0	1	1.0	0	0.108750	1	1	1.0	11	5	220	1	0.389908	4	0.0	no
2	35	2.0	0	2.0	0	0.062590	1	0	1.0	16	4	185	1	0.379587	1	0.0	no
3	30	2.0	1	2.0	0	0.064281	1	1	NaN	3	6	199	4	0.000000	0	NaN	no
4	59	3.0	1	1.0	0	0.044469	1	0	NaN	5	5	226	1	0.000000	0	NaN	no

```
[ ] df.y.unique()
```

```
array(['no', 'yes'], dtype=object)
```

```
df.y.replace({'no':0, 'yes':1}, inplace=True)
df.head()
```

```
<ipython-input-23-ce21d4741977>:1: FutureWarning: A value is trying to be set on a copy of a DataFrame or Series through chained assignment using an
The behavior will change in pandas 3.0. This inplace method will never work because the intermediate object on which we are setting values always be

For example, when doing 'df[col].method(value, inplace=True)', try using 'df.method({col: value}, inplace=True)' or df[col] = df[col].method(value)


  df.y.replace({'no':0, 'yes':1}, inplace=True)
<ipython-input-23-ce21d4741977>:1: FutureWarning: Downcasting behavior in `replace` is deprecated and will be removed in a future version. To retain
  df.y.replace({'no':0, 'yes':1}, inplace=True)
```

	age	job	marital	education	default	balance	housing	loan	contact	day	month	duration	campaign	pdays	previous	poutcome	y
0	30	0.0	1	0.0	0	0.068455	0	0	1.0	19	10	79	1	0.000000	0	NaN	0
1	33	1.0	1	1.0	0	0.108750	1	1	1.0	11	5	220	1	0.389908	4	0.0	0
2	35	2.0	0	2.0	0	0.062590	1	0	1.0	16	4	185	1	0.379587	1	0.0	0
3	30	2.0	1	2.0	0	0.064281	1	1	NaN	3	6	199	4	0.000000	0	NaN	0
4	59	3.0	1	1.0	0	0.044469	1	0	NaN	5	5	226	1	0.000000	0	NaN	0

```
df.duration=df.duration.apply(lambda v:(v-df.duration.min())/(df.duration.max()-df.duration.min()))
df.head()
```

	age	job	marital	education	default	balance	housing	loan	contact	day	month	duration	campaign	pdays	previous	poutcome	y
0	30	0.0	1	0.0	0	0.068455	0	0	1.0	19	10	0.024826	1	0.000000	0	NaN	0
1	33	1.0	1	1.0	0	0.108750	1	1	1.0	11	5	0.071500	1	0.389908	4	0.0	0
2	35	2.0	0	2.0	0	0.062590	1	0	1.0	16	4	0.059914	1	0.379587	1	0.0	0
3	30	2.0	1	2.0	0	0.064281	1	1	NaN	3	6	0.064548	4	0.000000	0	NaN	0
4	59	3.0	1	1.0	0	0.044469	1	0	NaN	5	5	0.073486	1	0.000000	0	NaN	0

```
[ ] df.describe()
```

	age	job	marital	education	default	balance	housing	loan	contact	day	month	duration	campaign	pdays
count	4521.000000	4483.000000	4521.000000	4334.000000	4521.000000	4521.000000	4521.000000	4521.000000	3197.000000	4521.000000	4521.000000	4521.000000	4521.000000	4521.000000
mean	41.170095	4.037252	0.735457	1.155053	0.016810	0.063565	0.566025	0.152842	0.905849	15.915284	6.166777	0.086051	2.793630	0.046751
std	10.576211	2.534139	0.441138	0.666325	0.128575	0.040397	0.495676	0.359875	0.292084	8.247667	2.378380	0.086017	3.109807	0.114818
min	19.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	1.000000	1.000000	0.000000	1.000000	0.000000
25%	33.000000	2.000000	0.000000	1.000000	0.000000	0.045395	0.000000	0.000000	1.000000	9.000000	5.000000	0.033102	1.000000	0.000000
50%	39.000000	3.000000	1.000000	1.000000	0.000000	0.050429	1.000000	0.000000	1.000000	16.000000	6.000000	0.059914	2.000000	0.000000
75%	49.000000	5.000000	1.000000	2.000000	0.000000	0.064335	1.000000	0.000000	1.000000	21.000000	8.000000	0.107580	3.000000	0.000000
max	87.000000	10.000000	1.000000	2.000000	1.000000	1.000000	1.000000	1.000000	1.000000	31.000000	12.000000	1.000000	50.000000	1.000000

```
[ ] df.shape
(4521, 17)
```

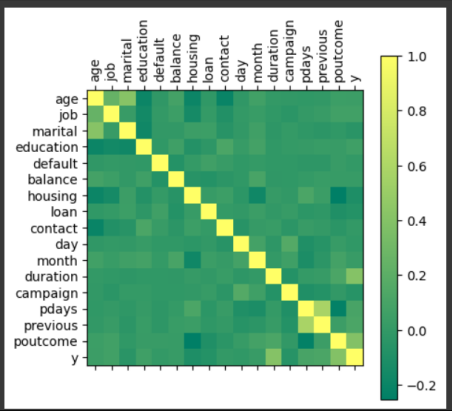
```
df.to_csv("/content/bank_preprocessed.csv",index=False)
new_df=pd.read_csv("/content/bank_preprocessed.csv")
new_df.head()
```

	age	job	marital	education	default	balance	housing	loan	contact	day	month	duration	campaign	pdays	previous	poutcome	y
0	30	0.0	1	0.0	0	0.068455	0	0	1.0	19	10	0.024826	1	0.000000	0	NaN	0
1	33	1.0	1	1.0	0	0.108750	1	1	1.0	11	5	0.071500	1	0.389908	4	0.0	0
2	35	2.0	0	2.0	0	0.062590	1	0	1.0	16	4	0.059914	1	0.379587	1	0.0	0
3	30	2.0	1	2.0	0	0.064281	1	1	NaN	3	6	0.064548	4	0.000000	0	NaN	0
4	59	3.0	1	1.0	0	0.044469	1	0	NaN	5	5	0.073486	1	0.000000	0	NaN	0

```
new_df.corr()
```

	age	job	marital	education	default	balance	housing	loan	contact	day	month	duration	campaign	pdays	previous	poutcome	y
age	1.000000	0.246948	0.410768	-0.190484	-0.017885	0.083820	-0.193888	-0.011250	-0.204200	-0.017853	0.073764	-0.002367	-0.005148	-0.008894	-0.003511	0.048548	0.045092
job	0.246948	1.000000	0.022194	-0.159257	0.000797	0.046488	-0.140553	0.009586	-0.084848	0.000524	0.026193	-0.009160	-0.041718	0.001408	0.022125	0.073736	0.066550
marital	0.410768	0.022194	1.000000	-0.169967	-0.007391	-0.007525	0.041449	0.048496	-0.056938	-0.006769	0.061882	-0.024560	0.008093	-0.020693	-0.035558	-0.009813	-0.045815
education	-0.190484	-0.159257	-0.169967	1.000000	-0.011623	0.056585	-0.072716	-0.024752	0.117748	0.017107	0.083234	-0.011193	0.009714	0.011531	0.030396	0.023715	0.055368
default	-0.017885	0.000797	-0.007391	-0.011623	1.000000	-0.070886	0.006881	0.063994	0.023372	-0.013261	0.008917	-0.011615	-0.012348	-0.026317	-0.026656	0.025369	0.001303
balance	0.083820	0.046488	-0.007525	0.056585	-0.070886	1.000000	-0.050227	-0.071349	-0.036326	-0.008677	0.099872	-0.015950	-0.009976	0.009437	0.026196	0.020393	0.017905
housing	-0.193888	-0.140553	0.041449	-0.072716	0.006881	-0.050227	1.000000	0.018451	0.046484	-0.031291	-0.170922	0.015740	-0.003574	0.116893	0.038621	-0.253137	-0.104683
loan	-0.011250	0.009586	0.048496	-0.024752	0.063994	-0.071349	0.018451	1.000000	0.007166	-0.004879	0.039226	-0.004997	0.017120	-0.031086	-0.022115	-0.096067	-0.070517
contact	-0.204200	-0.084848	-0.056938	0.117748	0.023372	-0.036326	0.046484	0.007166	1.000000	-0.055509	0.014321	0.027292	-0.033973	0.024204	0.001642	-0.037807	-0.002108
day	-0.017853	0.000524	-0.006769	0.017107	-0.013261	-0.008677	-0.031291	-0.004879	-0.055509	1.000000	0.080436	-0.024629	0.160706	-0.094352	-0.059114	0.019975	-0.011244
month	0.073764	0.026193	0.061882	0.083234	0.008917	0.099872	-0.170922	0.039226	0.014321	0.080436	1.000000	-0.000282	0.059214	-0.112003	-0.037410	0.080557	0.023335
duration	-0.002367	-0.009160	-0.024560	-0.011193	-0.011615	-0.015950	0.015740	-0.004997	0.027292	-0.024629	-0.000282	1.000000	-0.068382	0.010380	0.018080	0.115722	0.401118
campaign	-0.005148	-0.041718	0.008093	0.009714	-0.012348	-0.009976	-0.003574	0.017120	-0.033973	0.160706	0.059214	-0.068382	1.000000	-0.093137	-0.067833	-0.006457	-0.061147
pdays	-0.008894	0.001408	-0.020693	0.011531	-0.026317	0.009437	0.116893	-0.031086	0.024204	-0.094352	-0.112003	0.010380	-0.093137	1.000000	0.577562	-0.235082	0.104087
previous	-0.003511	0.022125	-0.035558	0.030396	-0.026656	0.026196	0.038621	-0.022115	0.001642	-0.059114	-0.037410	0.018080	-0.067833	0.577562	1.000000	0.043307	0.116714
poutcome	0.048548	0.073736	-0.009813	0.023715	0.025369	0.020393	-0.253137	-0.096067	-0.037807	0.019975	0.080557	0.115722	-0.006457	-0.235082	0.043307	1.000000	0.396350

```
import matplotlib.pyplot as plt
%matplotlib inline
plt.matshow(new_df.corr(), cmap='summer')
plt.colorbar()
plt.xticks(list(range(len(new_df.columns))), new_df.columns,
rotation='vertical')
plt.yticks(list(range(len(new_df.columns))), new_df.columns,
rotation='horizontal')
plt.show()
```




```
new_df.corr()["y"].sort_values(ascending=False)
```

	y
y	1.000000
duration	0.401118
poutcome	0.396350
previous	0.116714
pdays	0.104087
job	0.066550
education	0.055368
age	0.045092
month	0.023335
balance	0.017905
default	0.001303
contact	-0.002108
day	-0.011244
marital	-0.045815
campaign	-0.061147
loan	-0.070517
housing	-0.104683

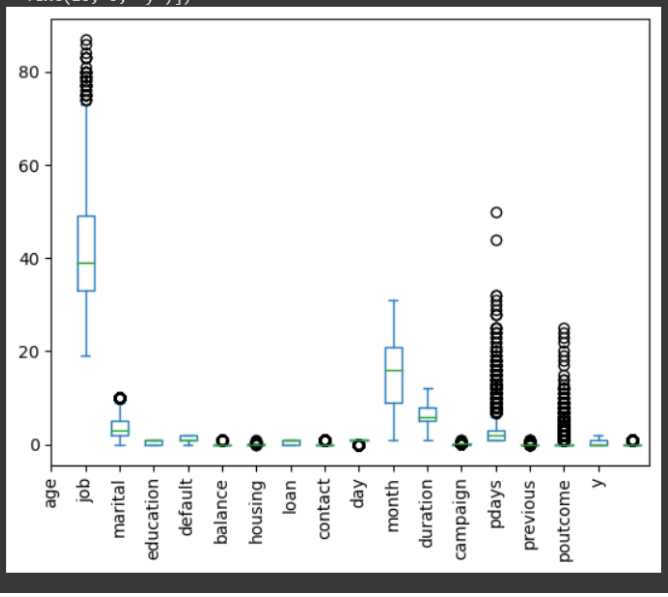
dtype: float64

```
new_df.plot.box()
plt.xticks(list(range(len(new_df.columns))), new_df.columns,
rotation='vertical')
```

```
([<matplotlib.axis.XTick at 0x7cca18dea2c0>,
  <matplotlib.axis.XTick at 0x7cca18dea290>,
  <matplotlib.axis.XTick at 0x7cca18de9540>,
  <matplotlib.axis.XTick at 0x7cca168b1810>,
  <matplotlib.axis.XTick at 0x7cca168b22c0>,
  <matplotlib.axis.XTick at 0x7cca168b2d70>,
  <matplotlib.axis.XTick at 0x7cca168b2950>,
  <matplotlib.axis.XTick at 0x7cca168b3940>,
  <matplotlib.axis.XTick at 0x7cca168d8430>,
  <matplotlib.axis.XTick at 0x7cca168d8ee0>,
  <matplotlib.axis.XTick at 0x7cca168d9990>,
  <matplotlib.axis.XTick at 0x7cca168b35b0>,
  <matplotlib.axis.XTick at 0x7cca168da3b0>,
  <matplotlib.axis.XTick at 0x7cca168dae60>,
  <matplotlib.axis.XTick at 0x7cca168db910>,
  <matplotlib.axis.XTick at 0x7cca168ec400>,
  <matplotlib.axis.XTick at 0x7cca168d9f00>],
 [Text(0, 0, 'age'),
  Text(1, 0, 'job'),
  Text(2, 0, 'marital'),
  Text(3, 0, 'education'),
  Text(4, 0, 'default'),
  Text(5, 0, 'balance'),
  Text(6, 0, 'housing'),
  Text(7, 0, 'loan'),
  Text(8, 0, 'contact'),
  Text(9, 0, 'day'),
  Text(10, 0, 'month'),
  Text(11, 0, 'duration'),
  Text(12, 0, 'campaign'),
  Text(13, 0, 'pdays'),
  Text(14, 0, 'previous'),
```

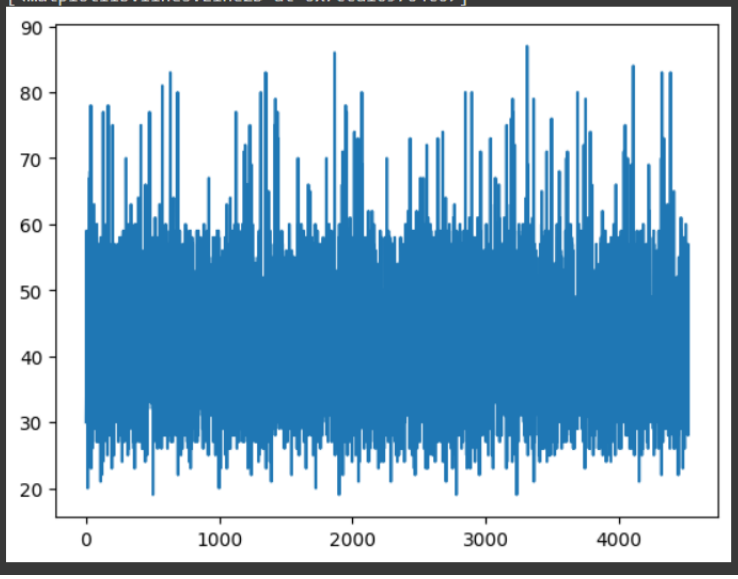
```
[ ]
```

```
  Text(13, 0, 'pdays'),
  Text(14, 0, 'previous'),
  Text(15, 0, 'poutcome'),
  Text(16, 0, 'y')])
```



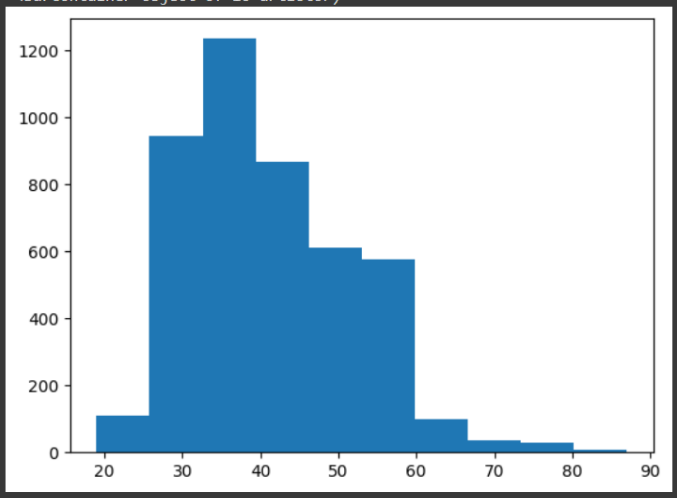
```
plt.plot(df.age.values) #line plot
```

```
[<matplotlib.lines.Line2D at 0x7cca169704c0>]
```




```
plt.hist(df.age.values) #histogram
```

```
(array([ 111.,  944., 1235.,  869.,  612.,  576.,  100.,   36.,   30.,
          8.]),
 array([19. , 25.8, 32.6, 39.4, 46.2, 53. , 59.8, 66.6, 73.4, 80.2, 87. ]),
 <BarContainer object of 10 artists>)
```



CONCLUSION:	Hence by completing this experiment I came to know about implement Data Pre-processing.

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DEPARTMENT OF COMPUTER ENGINEERING

SUBJECT: Artificial Intelligence and Machine Learning