In [115]:

```
import pandas as pd
import numpy as np
```

Reading Data

In [116]:

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

data.info()
```

```
RangeIndex: 1309 entries, 0 to 1308
Data columns (total 14 columns):
 #   Column     Non-Null Count  Dtype  
---  ------     --------------  -----  
 0   pclass     1309 non-null   int64  
 1   survived   1309 non-null   bool   
 2   name       1309 non-null   object 
 3   sex        1309 non-null   object 
 4   age        1046 non-null   float64
 5   sibsp      1309 non-null   int64  
 6   parch      1309 non-null   int64  
 7   ticket     1309 non-null   object 
 8   fare       1308 non-null   float64
 9   cabin      295 non-null    object 
 10  embarked   1307 non-null   object 
 11  boat       486 non-null    object 
 12  body       121 non-null    float64
 13  home_dest  745 non-null    object 
dtypes: bool(1), float64(3), int64(3), object(7)
memory usage: 98.5+ KB
```

Data Cleaning

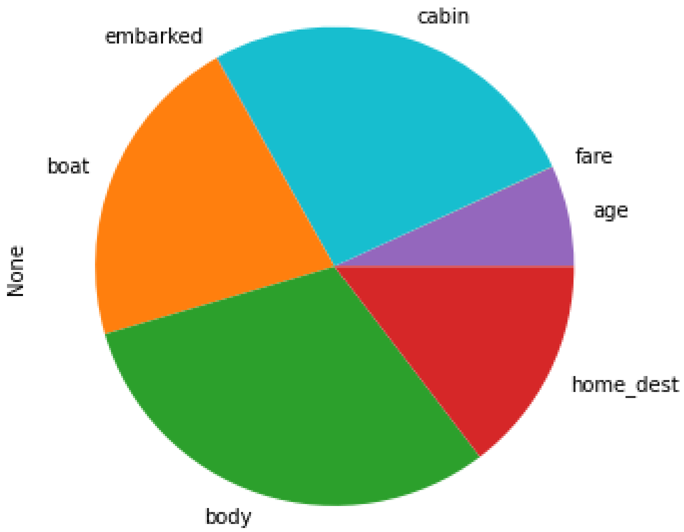
Checking Missing Values

In [117]:

```
data.isnull().sum().plot.pie(figsize=(5.5,5.5))
```

Out[117]:

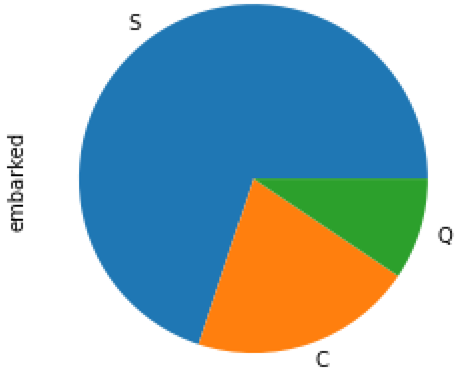
```
<matplotlib.axes._subplots.AxesSubplot at 0x1603eca0>
```



Embarked and Fare have low number of missing data

In [118]:
```
pd.value_counts(data['embarked'],sort=True).plot.pie()
```

Out[118]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x15fae598>
```



Mostly Embarked from S(Southampton)

In [119]:
```
data.embarked=data.embarked.fillna('S')
```

Filling Missing Data with most Frequent value

In [120]:
```
data.fare.fillna(data.fare.median(),inplace=True)
```

Filling Fare missing value with Meadian

In [121]:
```
data.insert(0,'cabinchar',data.cabin.str[0])
```

Extract First Character from Name

In [122]:

```
titleList=[]
for i in range(0,1309):
    f=data.name.values[i].find('.')
    g=data.name.values[i].find(',')
    titleList.append(data.name.values[i][g+2:f])

data['titleList']=titleList
```

Extracted Titles from Name

In [123]:

```
titleage =[]
for i in range(0,1309):
    if data.titleList[i] =='Master':
        titleage.append(1)
    elif data.titleList[i] =='Miss':
        titleage.append(2)
    else:
        titleage.append(3)


data['titleage']=titleage
```

Numerical weights to Selected Titles in order of Age

In [124]:

```
data['Mother']=np.where([data['titleList']=='Miss']and[data['parch']>2], 1, 0).re
```

New column 'Mother' (They had higher chances of Survival)

In [125]:

```
data.head(2)
```

Out[125]:

	cabinchar	pclass	survived	name	sex	age	sibsp	parch	ticket	fare	cabin
0	B	1	True	Allen, Miss. Elisabeth Walton	female	29.0000	0	0	24160	211.3375	B5
1	C	1	True	Allison, Master. Hudson Trevor	male	0.9167	1	2	113781	151.5500	C22 C26

In [126]:
```
data['family']=data.parch+data.sibsp
data.head(2)
```

Out[126]:

	cabinchar	pclass	survived	name	sex	age	sibsp	parch	ticket	fare	cabin
0	B	1	True	Allen, Miss. Elisabeth Walton	female	29.0000	0	0	24160	211.3375	B5
1	C	1	True	Allison, Master. Hudson Trevor	male	0.9167	1	2	113781	151.5500	C22 C26

New column 'Family'

In [127]:
```
data.drop(['boat','body','home_dest','ticket','name','cabin'],axis=1,inplace=True
data.head(2)
```

Out[127]:

	cabinchar	pclass	survived	sex	age	sibsp	parch	fare	embarked	titleList	titleag
0	B	1	True	female	29.0000	0	0	211.3375	S	Miss	
1	C	1	True	male	0.9167	1	2	151.5500	S	Master	

Dropping NonRelevent or Used columns

Filling CabinChar and Age using KNN

In [128]:
```
from sklearn.neighbors import KNeighborsClassifier,KNeighborsRegressor
```

In [129]:
```
traincabin= data[data.cabinchar.notnull()]
testcabin = data[data.cabinchar.isnull()]
```

In [130]:

```
clf=KNeighborsClassifier()
clf.fit(traincabin.drop(['cabinchar','age','embarked','titleList','sex'],axis=1),
data.cabinchar[data.cabinchar.isnull()] = clf.predict(testcabin.drop(['cabinchar'
```

```
<ipython-input-130-6c6c78f15607>:3: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/sta
ble/user_guide/indexing.html#returning-a-view-versus-a-copy (https://pandas.pyd
ata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-c
opy)
  data.cabinchar[data.cabinchar.isnull()] = clf.predict(testcabin.drop(['cabinc
har','age','embarked','titleList','sex'],axis=1))
```

In [131]:

```
trainAge=data[data.age.notnull()]
testAge=data[data.age.isnull()]
```

In [132]:

```
clfAge=KNeighborsRegressor()
clfAge.fit(trainAge.drop(['cabinchar','age','embarked','titleList','sex'],axis=1)
data.age[data.age.isnull()]=clfAge.predict(testAge.drop(['cabinchar','age','embar
```

```
<ipython-input-132-acd556305862>:3: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/sta
ble/user_guide/indexing.html#returning-a-view-versus-a-copy (https://pandas.pyd
ata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-c
opy)
  data.age[data.age.isnull()]=clfAge.predict(testAge.drop(['cabinchar','age','e
mbarked','titleList','sex'],axis=1))
```

Filled missing values with most probabalistic estimation using KNeighbors Algorithms

In [133]:

```
'NaN' in data.isnull()
```

Out[133]:

```
False
```

Final Null Check

In [134]:
```
data=pd.get_dummies(data)
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1309 entries, 0 to 1308
Data columns (total 40 columns):
 #   Column                  Non-Null Count  Dtype
---  ------                  --------------  -----
 0   pclass                  1309 non-null   int64
 1   survived                1309 non-null   bool
 2   age                     1309 non-null   float64
 3   sibsp                   1309 non-null   int64
 4   parch                   1309 non-null   int64
 5   fare                    1309 non-null   float64
 6   titleage                1309 non-null   int64
 7   Mother                  1309 non-null   int32
 8   family                  1309 non-null   int64
 9   cabinchar_A             1309 non-null   uint8
 10  cabinchar_B             1309 non-null   uint8
 11  cabinchar_C             1309 non-null   uint8
 12  cabinchar_D             1309 non-null   uint8
 13  cabinchar_E             1309 non-null   uint8
```

Dummy Encoding of Categorical Data

In [135]:
```
target=data.survived
```

Prediction of Survival given as target

Feature Extraction

In [136]:
```
from sklearn.decomposition import PCA
data=pd.DataFrame(PCA(n_components=8,random_state=0).fit_transform(data.drop('sur
```

PCA for reducing large variance

In [137]:
```
data.head(2)
```

Out[137]:

	0	1	2	3	4	5	6	7
0	177.780755	-9.766099	-2.826855	-0.636045	-0.079205	0.686435	-1.040244	-0.476214
1	116.746087	-35.058689	0.236209	0.331084	0.331235	-1.389845	-0.430874	-1.137526

In [138]:

```
from sklearn.model_selection import train_test_split
from sklearn.metrics import confusion_matrix,precision_score,recall_score,accurac
tnx,tsx,tny,tsy=train_test_split(data,target,test_size=0.3,random_state=0)
```

Spliting Training and Testing

Training Models

In [139]:

```
from sklearn.ensemble import VotingClassifier
from sklearn.svm import SVC
from sklearn.tree import DecisionTreeClassifier
from sklearn.naive_bayes import GaussianNB
from sklearn.model_selection import GridSearchCV
```

All necessary packages imported

Decision Tree

In [140]:

```
paramsdt = {'criterion':['gini','entropy'],'splitter':['random','best'],'max_dept
griddt = GridSearchCV(DecisionTreeClassifier(random_state=0),param_grid=paramsdt,
griddt.fit(tnx,tny)
griddt.best_params_
```

Out[140]:

```
{'criterion': 'gini', 'max_depth': 9, 'splitter': 'random'}
```

In [141]:

```
clfdt=DecisionTreeClassifier(criterion='entropy',splitter='random',max_depth=20,r
clfdt.fit(tnx,tny)
preddt=clfdt.predict(tsx)
```

In [142]:

```
print('Accuracy = ',format(accuracy_score(tsy,preddt),'.4f'))
print('F1 Score = ',format(f1_score(tsy,preddt),'.4f'))
print('Precision = ',format(precision_score(tsy,preddt),'.4f'))
print('Recall = ',format(recall_score(tsy,preddt),'.4f'))
```

```
Accuracy =  0.7430
F1 Score =  0.6406
Precision =  0.6716
Recall =  0.6122
```

Decesion Tree Cross Validation with Best parameters and Results

Logistic Regression

In [ ]:

In [143]:

```
clfknn=KNeighborsClassifier()
clfknn.fit(tnx,tny)
predknn=clfknn.predict(tsx)
```

In [144]:

```
print('Accuracy = ',format(accuracy_score(tsy,predknn),'.4f'))
print('F1 Score = ',format(f1_score(tsy,predknn),'.4f'))
print('Precision = ',format(precision_score(tsy,predknn),'.4f'))
print('Recall = ',format(recall_score(tsy,predknn),'.4f'))
```

```
Accuracy =  0.7023
F1 Score =  0.5895
Precision =  0.6087
Recall =  0.5714
```

Logistic Regression Cross Validation with Best parameters and Results

SVM

In [145]:

```
paramssvm={'kernel':[ 'poly', 'rbf' ],'C':[4,5,6]}
gridsvm=GridSearchCV(SVC(random_state=0),param_grid=paramssvm,cv=5)
gridsvm.fit(tnx,tny)
gridsvm.best_params_
```

Out[145]:

```
{'C': 6, 'kernel': 'rbf'}
```

In [146]:

```
clfsvm=SVC(C=6,kernel='rbf')
clfsvm.fit(tnx,tny)
predsvm=clfsvm.predict(tsx)
```

In [147]:

```
print('Accuracy = ',format(accuracy_score(tsy,predsvm),'.4f'))
print('F1 Score = ',format(f1_score(tsy,predsvm),'.4f'))
print('Precision = ',format(precision_score(tsy,predsvm),'.4f'))
print('Recall = ',format(recall_score(tsy,predsvm),'.4f'))
```

```
Accuracy =  0.7583
F1 Score =  0.6865
Precision =  0.6667
Recall =  0.7075
```

SVM Cross Validation with Best parameters and Results

Ensembling of All Three

Voting Method and Results

In [148]:
```
clfvot=VotingClassifier(estimators=[('dt',clfdt),('svm',clfsvm),('nb',clfknn)])
clfvot.fit(tnx,tny)
predvot=clfvot.predict(tsx)
```

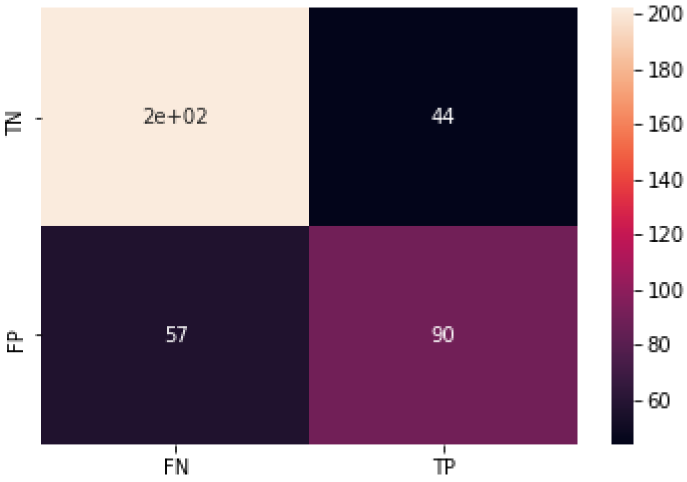
In [149]:
```
print('Accuracy = ',format(accuracy_score(tsy,predvot),'.4f'))
print('F1 Score = ',format(f1_score(tsy,predvot),'.4f'))
print('Precision = ',format(precision_score(tsy,predvot),'.4f'))
print('Recall = ',format(recall_score(tsy,predvot),'.4f'))
```

```
Accuracy =  0.7710
F1 Score =  0.6939
Precision =  0.6939
Recall =  0.6939
```

Confusion Matrix

In [150]:
```
import seaborn as sns
sns.heatmap(confusion_matrix(tsy,preddt),annot=True,xticklabels=['FN','TP'],ytick
```

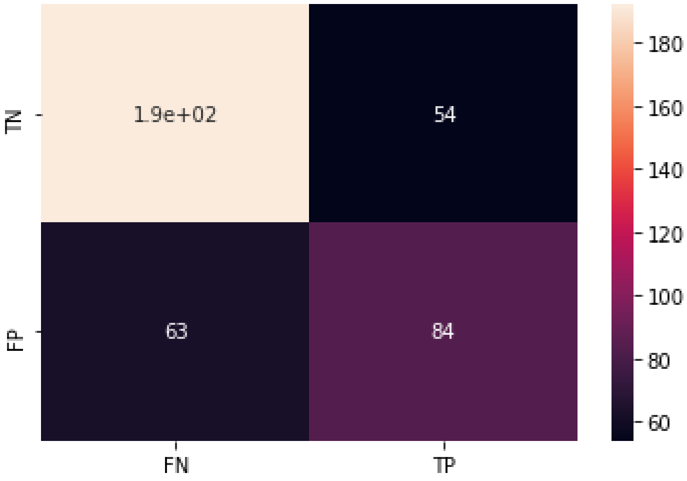
Out[150]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x1614f490>
```



CM for Decision Tree

```
In [151]: sns.heatmap(confusion_matrix(tsy,predknn),annot=True,xticklabels=['FN','TP'],ytic
```

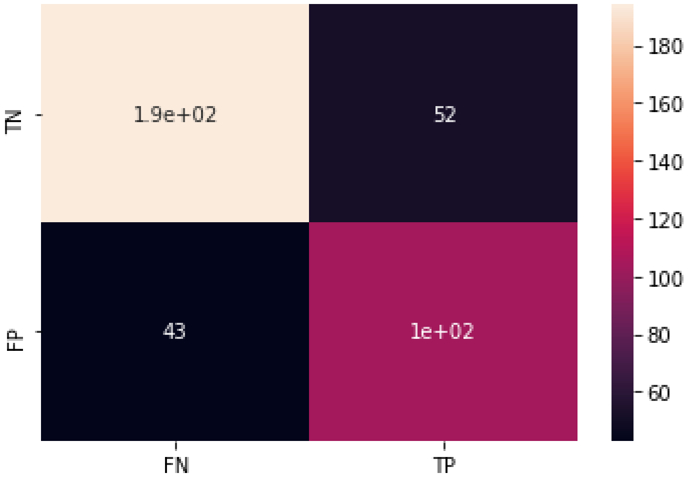
```
Out[151]: <matplotlib.axes._subplots.AxesSubplot at 0x16215970>
```



CM for KNN

```
In [152]: sns.heatmap(confusion_matrix(tsy,predsvm),annot=True,xticklabels=['FN','TP'],ytic
```

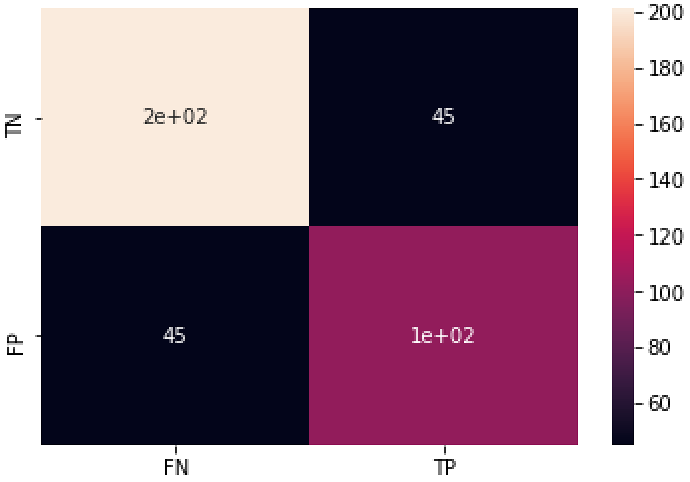
```
Out[152]: <matplotlib.axes._subplots.AxesSubplot at 0x1624eee0>
```



CM for SVM

In [153]:
```
sns.heatmap(confusion_matrix(tsy,predvot),annot=True,xticklabels=['FN','TP'],ytic
```

Out[153]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x162a0d78>
```



CM for Ensemble Learning

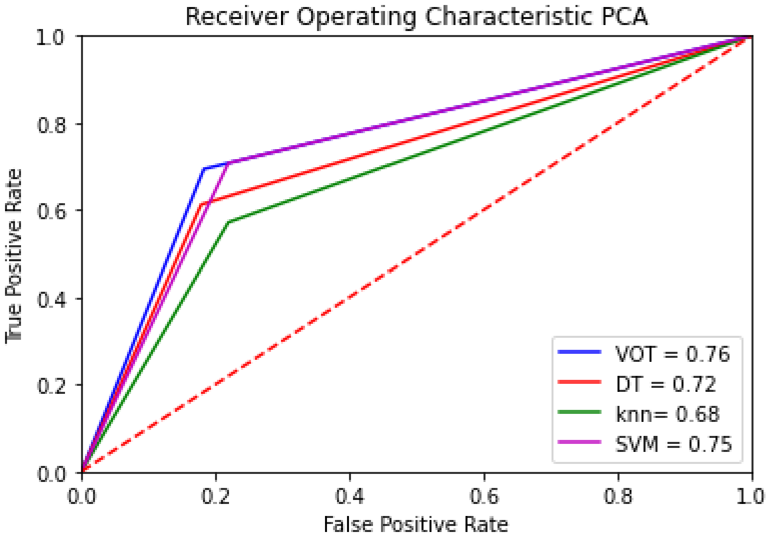
ROC Curve

In [154]:
```
fpr,tpr,threshold=roc_curve(tsy,predvot)
roc_auc=auc(fpr,tpr)
fpr1,tpr1,threshold1=roc_curve(tsy,preddt)
roc_auc1=auc(fpr1,tpr1)
fpr2,tpr2,threshold2=roc_curve(tsy,predknn)
roc_auc2=auc(fpr2,tpr2)
fpr3,tpr3,threshold3=roc_curve(tsy,predsvm)
roc_auc3=auc(fpr3,tpr3)
```

Calculating Area Under ROC Curve

In [155]:

```
import matplotlib.pyplot as plt
plt.title('Receiver Operating Characteristic PCA')
plt.plot(fpr, tpr, 'b', label = 'VOT = %0.2f' % roc_auc)
plt.plot(fpr1, tpr1, 'r', label = 'DT = %0.2f' % roc_auc1)
plt.plot(fpr2, tpr2, 'g', label = 'knn= %0.2f' % roc_auc2)
plt.plot(fpr2, tpr3, 'm', label = 'SVM = %0.2f' % roc_auc3)
plt.legend(loc = 'lower right')
plt.plot([0, 1], [0, 1],'r--')
plt.xlim([0, 1])
plt.ylim([0, 1])
plt.ylabel('True Positive Rate')
plt.xlabel('False Positive Rate')
plt.show()
```



Ensemble Learning gives best Predictions and Model among ALL.

In [ ]:

In [ ]:

In [ ]:

In [ ]:

In [ ]:

In [ ]:

In [ ]: