ex15

January 8, 2024

[26]:
```
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt

import warnings
warnings.filterwarnings("ignore")
# sns.set_style("darkgrid", {"grid.color": ".6",
#                            "grid.linestyle": ":"})

from sklearn.preprocessing import StandardScaler
from sklearn.model_selection import train_test_split
from sklearn.ensemble import RandomForestClassifier,GradientBoostingClassifier
from sklearn.linear_model import LogisticRegression
from sklearn.svm import SVC
import seaborn as sns
from sklearn.metrics import accuracy_score
from sklearn.model_selection import GridSearchCV
from sklearn.model_selection import RandomizedSearchCV
from sklearn.tree import DecisionTreeClassifier

# from xgboost import XGBClassifier
# from sklearn.metrics import r2_score
# from sklearn.metrics import mean_squared_error
# from sklearn.model_selection import GridSearchCV
```

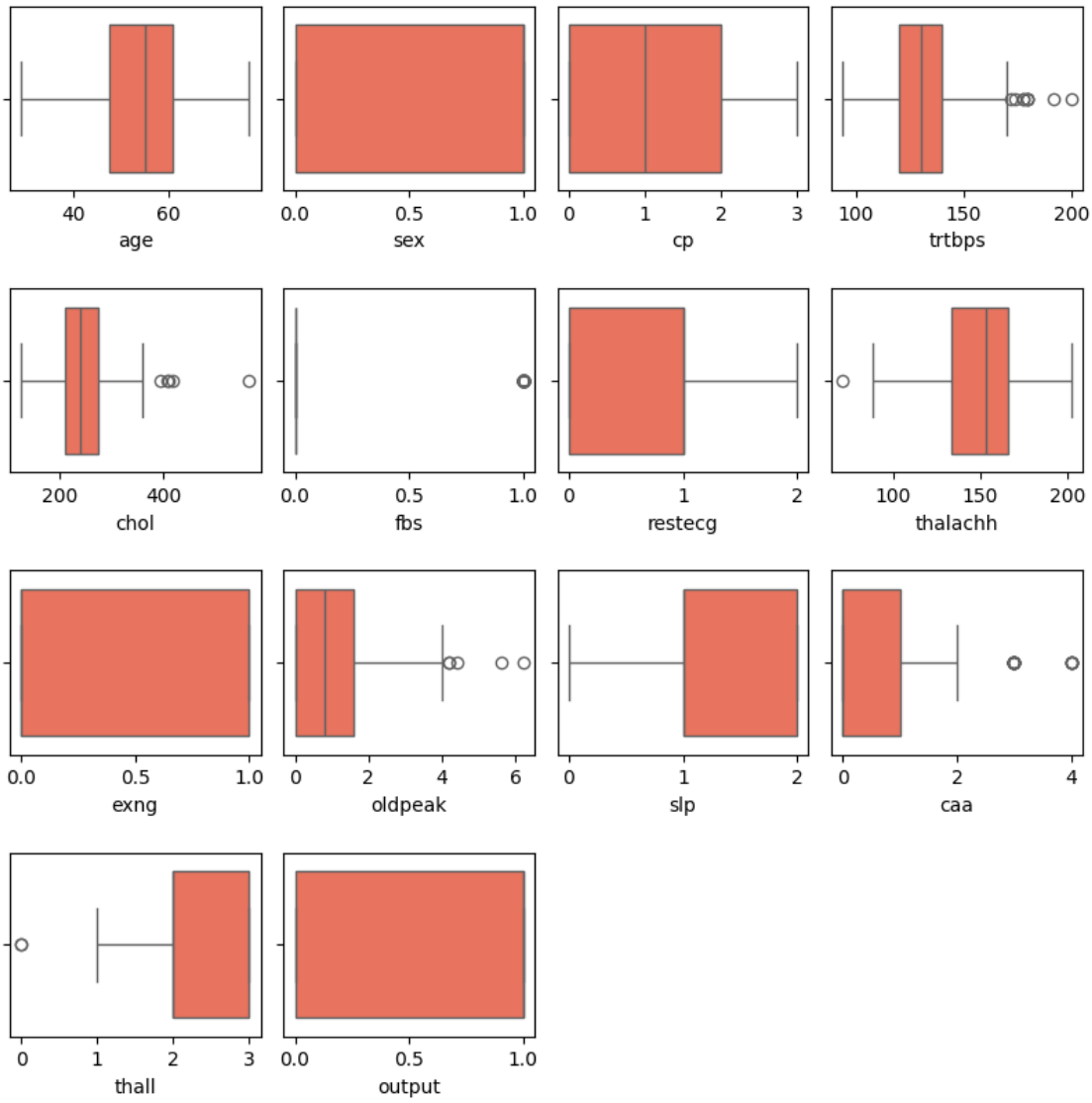
[3]:
```
df = pd.read_csv('/Users/thutranghoa/Code/Data_analysis/Data/heart.csv')
df
```

[3]:

	age	sex	cp	trtbps	chol	fbs	restecg	thalachh	exng	oldpeak	slp	\
0	63	1	3	145	233	1	0	150	0	2.3	0	
1	37	1	2	130	250	0	1	187	0	3.5	0	
2	41	0	1	130	204	0	0	172	0	1.4	2	
3	56	1	1	120	236	0	1	178	0	0.8	2	
4	57	0	0	120	354	0	1	163	1	0.6	2	
..	…	…	..	…	…	…	…	…	…	…	…	
298	57	0	0	140	241	0	1	123	1	0.2	1	
299	45	1	3	110	264	0	1	132	0	1.2	1	

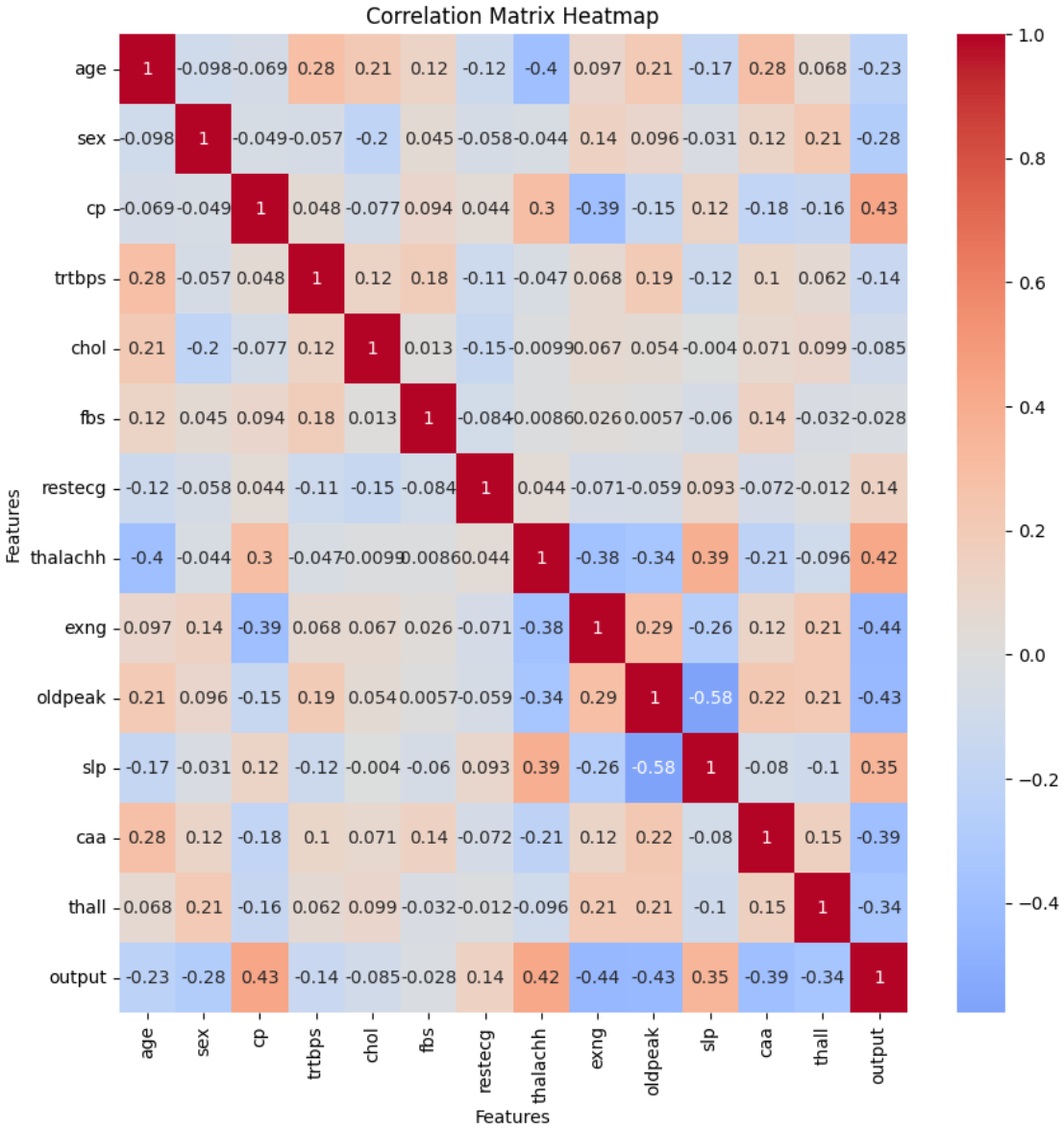
```
300   68    1   0     144   193    1        1       141     0      3.4    1
301   57    1   0     130   131    0        1       115     1      1.2    1
302   57    0   1     130   236    0        0       174     0      0.0    1

     caa  thall  output
0      0      1       1
1      0      2       1
2      0      2       1
3      0      2       1
4      0      2       1
..   …    …      …
298    0      3       0
299    0      3       0
300    2      3       0
301    1      3       0
302    1      2       0

[303 rows x 14 columns]
```

[4]:
```
'1 - Boxplot '
fig = plt.figure(figsize=(8, 8))
temp = df.columns.tolist()
for i, item in enumerate(temp):
    plt.subplot(4, 4, i+1)
    sns.boxplot(data=df, x=item, color='tomato')
plt.tight_layout(pad=0.4, w_pad=0.5, h_pad=2.0)
plt.show()
```



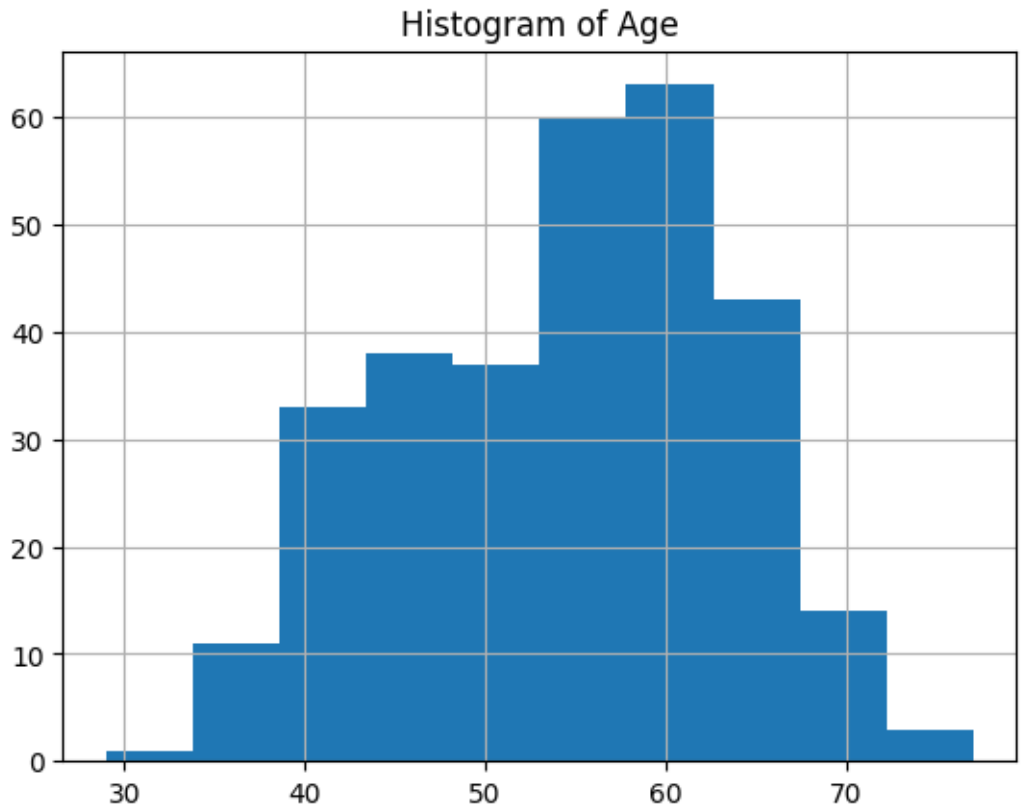
[8]:
```
'2 - Heatmap'
plt.figure(figsize=(10, 10))
correlation  = df.corr()

# Create heatmap
sns.heatmap(correlation, cmap='coolwarm',
            center=0, annot=True)

# Set title and axis labels
plt.title('Correlation Matrix Heatmap')
plt.xlabel('Features')
plt.ylabel('Features')
```

```
# plt.yticks(rotation = 30)

# Show plot
plt.show()
```



[17]:
```
'3- Histogram to dertermine distribution of age'
# plt.figure(figsize=(30, 30))
plt.title('Histogram of Age')

df['age'].hist()
```

[17]: <Axes: title={'center': 'Histogram of Age'}>



[20]:
```
df.columns
```

[20]:
```
Index(['age', 'sex', 'cp', 'trtbps', 'chol', 'fbs', 'restecg', 'thalachh',
       'exng', 'oldpeak', 'slp', 'caa', 'thall', 'output'],
      dtype='object')
```

[33]:
```
standardScaler = StandardScaler()
columns_to_scale = ['age', 'trtbps', 'chol', 'thalachh', 'oldpeak']
df[columns_to_scale] = standardScaler.fit_transform(df[columns_to_scale])
```

[22]:
```
df
```

[22]:

	age	sex	cp	trtbps	chol	fbs	restecg	thalachh	exng	\
0	0.952197	1	3	0.763956	-0.256334	1	0	0.015443	0	
1	-1.915313	1	2	-0.092738	0.072199	0	1	1.633471	0	
2	-1.474158	0	1	-0.092738	-0.816773	0	0	0.977514	0	
3	0.180175	1	1	-0.663867	-0.198357	0	1	1.239897	0	
4	0.290464	0	0	-0.663867	2.082050	0	1	0.583939	1	
..	…	…	..	…	…	…	…	…	…	

```
298  0.290464    0   0  0.478391 -0.101730    0        1 -1.165281     1
299 -1.033002    1   3 -1.234996  0.342756    0        1 -0.771706     0
300  1.503641    1   0  0.706843 -1.029353    1        1 -0.378132     0
301  0.290464    1   0 -0.092738 -2.227533    0        1 -1.515125     1
302  0.290464    0   1 -0.092738 -0.198357    0        0  1.064975     0

      oldpeak  slp  caa  thall  output
0    1.087338    0    0      1       1
1    2.122573    0    0      2       1
2    0.310912    2    0      2       1
3   -0.206705    2    0      2       1
4   -0.379244    2    0      2       1
..        …   …  …    …      …
298 -0.724323    1    0      3       0
299  0.138373    1    0      3       0
300  2.036303    1    2      3       0
301  0.138373    1    1      3       0
302 -0.896862    1    1      2       0

[303 rows x 14 columns]
```

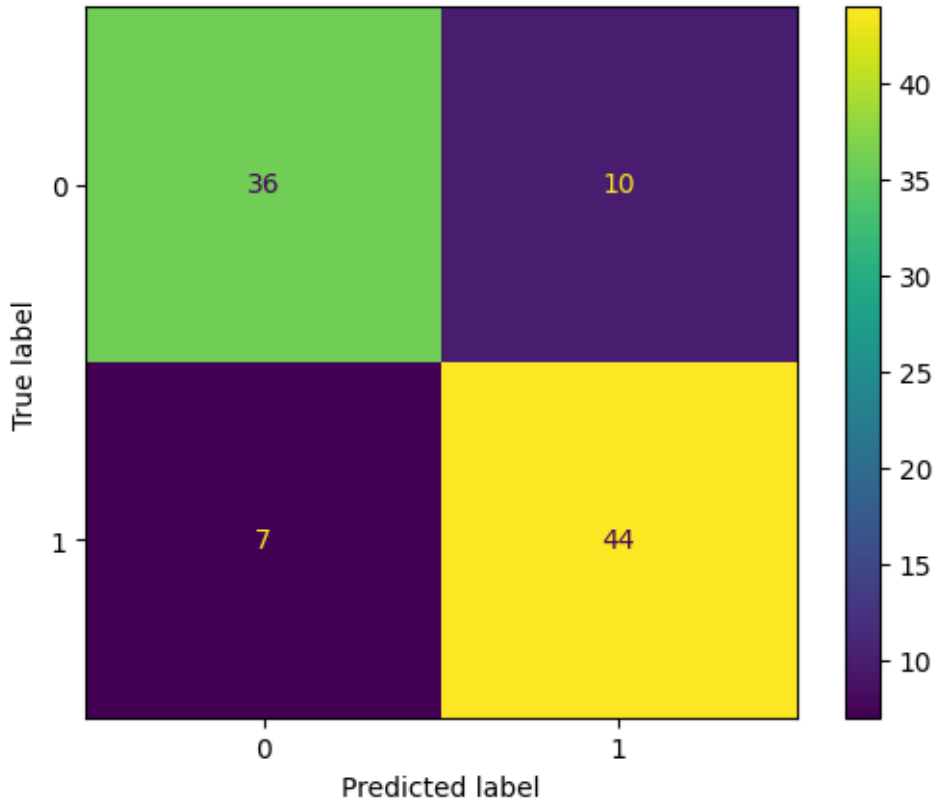
[34]:
```
y = df['output']
X = df.drop(['output'], axis = 1)
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size = 0.32,␣
 ↪random_state = 0)
```

[27]:
```
rf=RandomForestClassifier()
dt=DecisionTreeClassifier()
lr=LogisticRegression()
```

[49]:
```
'RF '
print ('Random Forest model : ')
rf.fit(X_train,y_train)
y_pred_rf=rf.predict(X_test)
print ('Train : ', accuracy_score(y_train,rf.predict(X_train)))
print ('Test : ', accuracy_score(y_test,y_pred))
```

```
Random Forest model :
Train :  1.0
Test :  0.6804123711340206
```

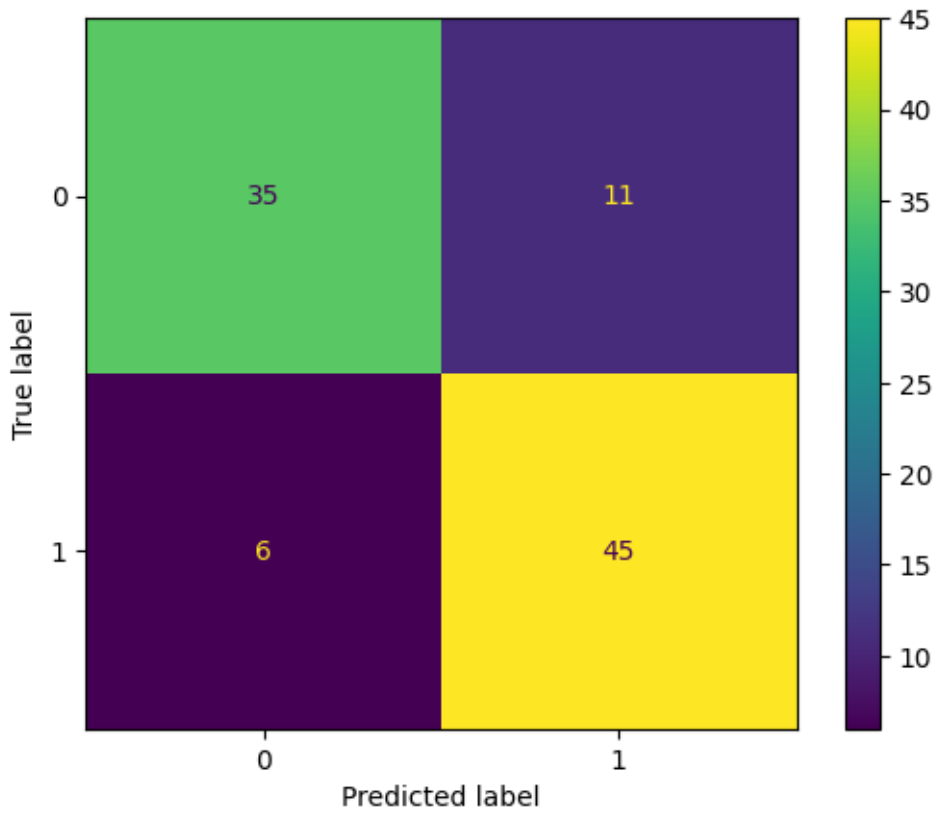
[50]:
```
from sklearn.metrics import ConfusionMatrixDisplay,confusion_matrix,␣
 ↪classification_report

disp = ConfusionMatrixDisplay.from_predictions(y_test, y_pred_rf)

plt.show()
```



[52]:
```
'Logistic '
print ('Logistic regression model : ')
lr.fit(X_train,y_train)
y_pred_lr=lr.predict(X_test)
print ('Train : ', accuracy_score(y_train,lr.predict(X_train)))
print ('Test : ', accuracy_score(y_test,y_pred_lr))
```

```
Logistic regression model :
Train :  0.8737864077669902
Test :  0.8247422680412371
```

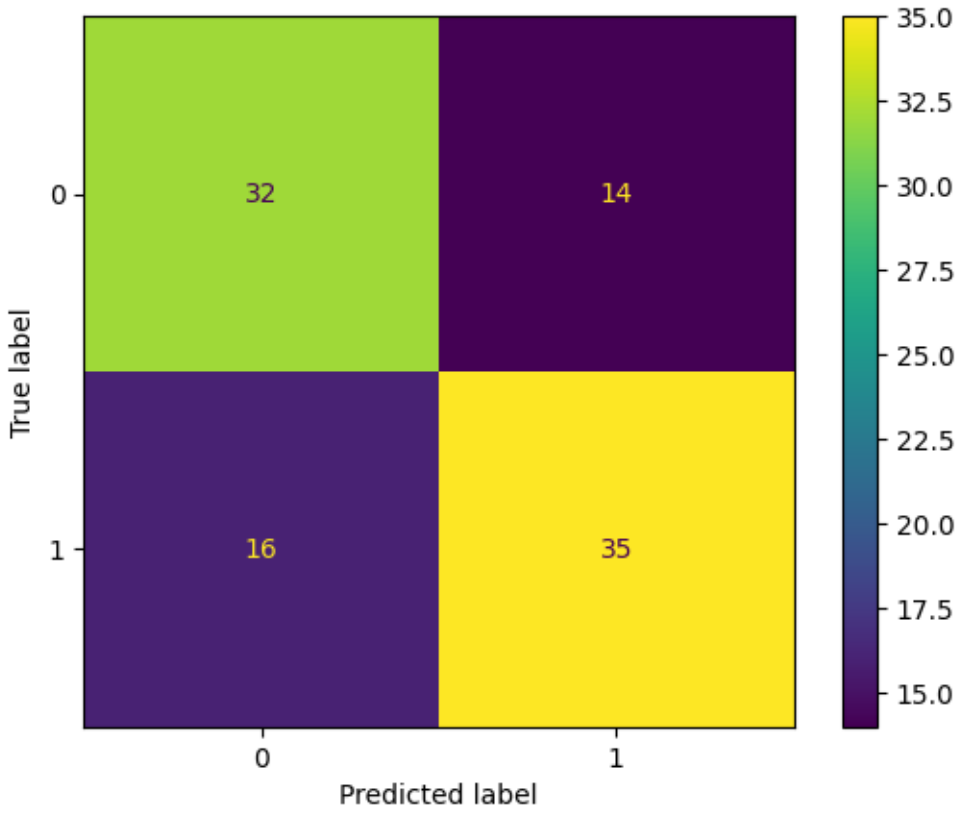
[53]:
```
disp = ConfusionMatrixDisplay.from_predictions(y_test, y_pred_lr)

plt.show()
```



[54]:
```
'DT '
print ('Decision Tree model : ')
dt.fit(X_train,y_train)
y_pred_dt=dt.predict(X_test)
print ('Train : ', accuracy_score(y_train,dt.predict(X_train)))
print ('Test : ', accuracy_score(y_test,y_pred_dt))
```

```
Decision Tree model :
Train :  1.0
Test :  0.6907216494845361
```

[55]:
```
disp = ConfusionMatrixDisplay.from_predictions(y_test, y_pred_dt)

plt.show()
```



[48]:
```
para={'n_estimators':[20,60,100,120],
      'max_features' : [0.2,0.6,1.0],
      'max_depth':[2,8,None],
      'max_samples':[0.5,0.75,1.0]
     }

# param_grid = {
#     'n_estimators': [200, 500],
#     'max_features': ['auto', 'sqrt', 'log2'],
#     'max_depth' : [4,5,6,7,8],
#     'criterion' :['gini', 'entropy']
# }

rf = RandomForestClassifier()
CV_rfc = GridSearchCV(estimator=rf, param_grid=para, cv= 5)
CV_rfc.fit(X_train, y_train)

# rf_grid.fit(X_train,y_train)
```

[48]:
```
GridSearchCV(cv=5, estimator=RandomForestClassifier(),
             param_grid={'max_depth': [2, 8, None],
                         'max_features': [0.2, 0.6, 1.0],
                         'max_samples': [0.5, 0.75, 1.0],
                         'n_estimators': [20, 60, 100, 120]})
```

[62]:
```
CV_rfc.fit(X_train,y_train)
print (CV_rfc.best_params_)
print ('Best score : ',CV_rfc.best_score_)
```

```
{'max_depth': None, 'max_features': 0.2, 'max_samples': 1.0, 'n_estimators':
100}
Best score :  0.8544715447154472
```

[43]:
```
param_grid = {'max_features': ['auto', 'sqrt', 'log2'],
              'ccp_alpha': [0.1, .01, .001],
              'max_depth' : [5, 6, 7, 8, 9],
              'criterion' :['gini', 'entropy']
             }
tree_clas = DecisionTreeClassifier(random_state=1024)
grid_search = GridSearchCV(estimator=tree_clas, param_grid=param_grid, cv=5,␣
 ↪verbose=True)
grid_search.fit(X_train, y_train)
```

```
Fitting 5 folds for each of 90 candidates, totalling 450 fits
```

[43]:
```
GridSearchCV(cv=5, estimator=DecisionTreeClassifier(random_state=1024),
             param_grid={'ccp_alpha': [0.1, 0.01, 0.001],
                         'criterion': ['gini', 'entropy'],
                         'max_depth': [5, 6, 7, 8, 9],
                         'max_features': ['auto', 'sqrt', 'log2']},
             verbose=True)
```

[45]:
```
print (grid_search.best_params_)
print (grid_search.best_score_)
```

```
{'ccp_alpha': 0.001, 'criterion': 'entropy', 'max_depth': 7, 'max_features':
'sqrt'}
0.8155632984901278
```

[46]:
```
grid={"C":np.logspace(-3,3,7), "penalty":["l1","l2"]}# l1 lasso l2 ridge
logreg=LogisticRegression()
logreg_cv=GridSearchCV(logreg,grid,cv=10)
logreg_cv.fit(X_train,y_train)

print(logreg_cv.best_params_)
print(logreg_cv.best_score_)
```

```
{'C': 0.1, 'penalty': 'l2'}
0.8545238095238096
```

[61]:
```
plt.bar (['RF', 'DT', 'LR'], [CV_rfc.best_score_, grid_search.best_score_,␣
 ↪logreg_cv.best_score_])
plt.title('Accurancy of each model')
```

[61]: Text(0.5, 1.0, 'Accurancy of each model')