In [1]:

```
#import libraries
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
```

In [2]:

```
#Load Dataset
df=pd.read_csv("data_Proj_2.csv")
df.head()
```

Out[2]:

	Area	Perimeter	MajorAxisLength	MinorAxisLength	AspectRation	Eccentricity	ConvexA
0	28395	610.291	208.178117	173.888747	1.197191	0.549812	28
1	28734	638.018	200.524796	182.734419	1.097356	0.411785	29
2	29380	624.110	212.826130	175.931143	1.209713	0.562727	29
3	30008	645.884	210.557999	182.516516	1.153638	0.498616	30
4	30140	620.134	201.847882	190.279279	1.060798	0.333680	30

In [3]:

```
#Basic Operations
```

In [4]:

```
#shape
df.shape
```

Out[4]:

```
(13611, 17)
```

In [5]:

```
#size
df.size
```

Out[5]:

```
231387
```

In [6]:

```
#info
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 13611 entries, 0 to 13610
Data columns (total 17 columns):
 #   Column           Non-Null Count  Dtype  
---  ------           --------------  -----  
 0   Area             13611 non-null  int64  
 1   Perimeter        13611 non-null  float64
 2   MajorAxisLength  13611 non-null  float64
 3   MinorAxisLength  13611 non-null  float64
 4   AspectRation     13611 non-null  float64
 5   Eccentricity     13611 non-null  float64
 6   ConvexArea       13611 non-null  int64  
 7   EquivDiameter    13611 non-null  float64
 8   Extent           13611 non-null  float64
 9   Solidity         13611 non-null  float64
 10  roundness        13611 non-null  float64
 11  Compactness      13611 non-null  float64
 12  ShapeFactor1     13611 non-null  float64
 13  ShapeFactor2     13611 non-null  float64
 14  ShapeFactor3     13611 non-null  float64
 15  ShapeFactor4     13611 non-null  float64
 16  Class            13611 non-null  object 
dtypes: float64(14), int64(2), object(1)
memory usage: 1.8+ MB
```

In [7]:

```
#Check for null values
df.isnull().sum()
```

Out[7]:

```
Area               0
Perimeter          0
MajorAxisLength    0
MinorAxisLength    0
AspectRation       0
Eccentricity       0
ConvexArea         0
EquivDiameter      0
Extent             0
Solidity           0
roundness          0
Compactness        0
ShapeFactor1       0
ShapeFactor2       0
ShapeFactor3       0
ShapeFactor4       0
Class              0
dtype: int64
```

In [8]:

```
#Converting target column into numeric
# We'll use dictionary encoding
Class_dict={"DERMASON":0,"SIRA":1,"SEKER":2,"HOROZ":3,"CALI":4,"BARBUNYA":5,"BOMBAY
df["Class_enc"]=df.Class.map(Class_dict)
```

In [9]:

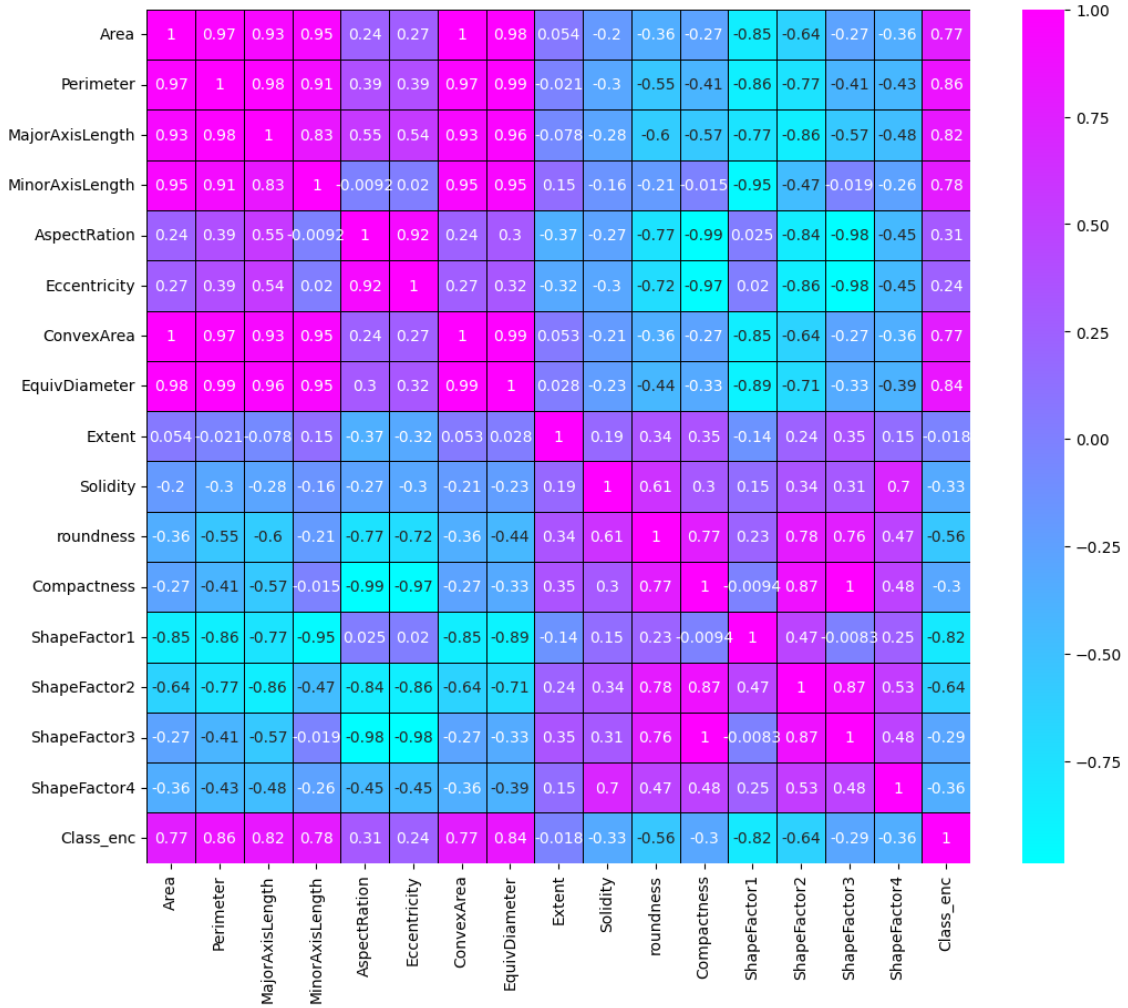
```
df1=df.drop(["Class"],axis=1)
```

In [10]:

```
plt.figure(figsize=(12,10))
sns.heatmap(df1.corr(),annot=True,cmap="cool",linewidths=0.7,linecolor="black")
```

Out[10]:

<Axes: >



In [11]:

```
from sklearn.preprocessing import MinMaxScaler
scaler=MinMaxScaler()
data_scaled=scaler.fit_transform(df1.iloc[:, :-1])
df1=pd.DataFrame(data_scaled,columns=df1.columns[:-1])
df1.head()
```

Out[11]:

	Area	Perimeter	MajorAxisLength	MinorAxisLength	AspectRation	Eccentricity	Conv
0	0.034053	0.058574	0.044262	0.152142	0.122612	0.477797	0.
1	0.035500	0.077557	0.030479	0.178337	0.051577	0.278472	0.
2	0.038259	0.068035	0.052633	0.158190	0.131521	0.496448	0.
3	0.040940	0.082942	0.048548	0.177691	0.091623	0.403864	0.
4	0.041504	0.065313	0.032862	0.200679	0.025565	0.165680	0.

In [12]:

```
X=df1
y=df["Class_enc"]
```

In [13]:

```
print("X Shape: ",X.shape)
print("y Shape: ", y.shape)
```

```
X Shape:  (13611, 16)
y Shape:  (13611,)
```

In [14]:

```
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,random_state=42)
```

In [15]:

```
print("X_train: ",X_train.shape)
print("X_test: ",X_test.shape)
print("y_train: ",y_train.shape)
print("y_test: ",y_test.shape)
```

```
X_train:  (10888, 16)
X_test:  (2723, 16)
y_train:  (10888,)
y_test:  (2723,)
```

1.Logistic Regression

In [16]:

```
from sklearn.linear_model import LogisticRegression
lr=LogisticRegression()
lr.fit(X_train,y_train)
```

```
D:\Users\ROHIT\anaconda3\lib\site-packages\sklearn\linear_model\_logisti
c.py:814: ConvergenceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown i
n:
    https://scikit-learn.org/stable/modules/preprocessing.html (https://s
cikit-learn.org/stable/modules/preprocessing.html)
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-re
gression (https://scikit-learn.org/stable/modules/linear_model.html#logis
tic-regression)
  n_iter_i = _check_optimize_result(
```

Out[16]:

```
LogisticRegression()
```

In [17]:

```
#Accuracy On training set
print("Accuracy on training : ",lr.score(X_train,y_train))
#Accuracy On testing set
print("Accuracy on testing : ",lr.score(X_test,y_test))
```

```
Accuracy on training :  0.9171565025716385
Accuracy on testing :  0.9203084832904884
```

In [18]:

```
from sklearn.metrics import confusion_matrix,accuracy_score,recall_score,precision_
y_pred=lr.predict(X_test)
print("confusion matrix:\n",
      confusion_matrix(y_test,y_pred))
print("\n")
print("Accuracy score:" ,accuracy_score(y_test,y_pred))
print("recall: ",recall_score(y_test,y_pred,average="micro"))
print("Precison: ",precision_score(y_test,y_pred,average="micro"))
print("F1-score: ", f1_score(y_test,y_pred,average="micro"))
print("Specifity: ",confusion_matrix(y_test, y_pred)[0,0] / (confusion_matrix(y_tes
```

```
confusion matrix:
 [[602  58  11   0   0   0   0]
 [ 41 479   8   7   0   1   0]
 [ 13  10 385   0   0   5   0]
 [  4   8   0 391   5   0   0]
 [  0   5   0   4 299   9   0]
 [  0  10   2   1  15 233   0]
 [  0   0   0   0   0   0 117]]


Accuracy score: 0.9203084832904884
recall:  0.9203084832904884
Precison:  0.9203084832904884
F1-score:  0.9203084832904884
Specifity:  0.9121212121212121
```

2.Decision Tree

In [19]:

```
from sklearn.tree import DecisionTreeClassifier
dt=DecisionTreeClassifier()
dt.fit(X_train,y_train)
```

Out[19]:

```
DecisionTreeClassifier()
```

In [20]:

```
#Accuracy On training set
print("Accuracy on training : ",dt.score(X_train,y_train))
#Accuracy On testing set
print("Accuracy on testing : ",dt.score(X_test,y_test))
```

```
Accuracy on training :  1.0
Accuracy on testing :  0.8920308483290489
```

In [21]:

```
from sklearn.metrics import confusion_matrix,accuracy_score,recall_score,precision_
y_pred=dt.predict(X_test)
print("confusion matrix:\n",
      confusion_matrix(y_test,y_pred))
print("\n")
print("Accuracy score:" ,accuracy_score(y_test,y_pred))
print("recall: ",recall_score(y_test,y_pred,average="micro"))
print("Precison: ",precision_score(y_test,y_pred,average="micro"))
print("F1-score: ", f1_score(y_test,y_pred,average="micro"))
print("Specifity: ",confusion_matrix(y_test, y_pred)[0,0] / (confusion_matrix(y_tes
```

```
confusion matrix:
 [[589  62  14   5   0   1   0]
 [ 53 453  13  12   3   2   0]
 [ 21  13 377   0   0   2   0]
 [  3  10   0 378  12   5   0]
 [  0   2   0   5 286  24   0]
 [  0   8   2   1  21 229   0]
 [  0   0   0   0   0   0 117]]


Accuracy score: 0.8920308483290489
recall:  0.8920308483290489
Precison:  0.8920308483290489
F1-score:  0.8920308483290489
Specifity:  0.9047619047619048
```

3.Random Forest

In [22]:

```
from sklearn.ensemble import RandomForestClassifier
rf=RandomForestClassifier()
rf.fit(X_train,y_train)
```

Out[22]:

```
RandomForestClassifier()
```

In [23]:

```
#Accuracy On training set
print("Accuracy on training : ",rf.score(X_train,y_train))
#Accuracy On testing set
print("Accuracy on testing : ",rf.score(X_test,y_test))
```

```
Accuracy on training :  1.0
Accuracy on testing :  0.9243481454278369
```

In [ ]:

```

```

In [ ]:

```
1
```

In [ ]:

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1
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In [ ]:

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