In [1]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns

from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
import statsmodels.api as sma
from statsmodels.stats.outliers_influence import variance_inflation_factor

from sklearn.linear_model import LogisticRegression
from sklearn.svm import SVC
from sklearn.neighbors import KNeighborsClassifier
from sklearn.tree import DecisionTreeClassifier
from sklearn.model_selection import cross_val_score

from sklearn.model_selection import GridSearchCV
from sklearn.metrics import classification_report
from sklearn.metrics import confusion_matrix
import warnings
warnings.filterwarnings('ignore')
```

In [4]:
```
df = pd.read_csv('https://raw.githubusercontent.com/dsrscientist/dataset1/master/abalone.csv')
df.head()
```

Out[4]:

	Sex	Length	Diameter	Height	Whole weight	Shucked weight	Viscera weight	Shell weight	Rings
0	M	0.455	0.365	0.095	0.5140	0.2245	0.1010	0.150	15
1	M	0.350	0.265	0.090	0.2255	0.0995	0.0485	0.070	7
2	F	0.530	0.420	0.135	0.6770	0.2565	0.1415	0.210	9
3	M	0.440	0.365	0.125	0.5160	0.2155	0.1140	0.155	10
4	I	0.330	0.255	0.080	0.2050	0.0895	0.0395	0.055	7

In [6]:
```
df.rename(columns={"Sex":"sex", "Length":"length", "Diameter":"diameter",
                   "Height":"height", "Whole weight":"whole_weight",
                   "Shucked weight":"shucked_weight", "Viscera weight":"viscera_weight",
                   "Shell weight":"shell_weight", "Rings":"rings"}, inplace = True)
```

In [7]:
```
df.shape
```

Out[7]:
```
(4177, 9)
```

In [8]:
```
df.describe()
```

Out[8]:

	length	diameter	height	whole_weight	shucked_weight	viscera_weight	shell_weight	rings
count	4177.000000	4177.000000	4177.000000	4177.000000	4177.000000	4177.000000	4177.000000	4177.000000
mean	0.523992	0.407881	0.139516	0.828742	0.359367	0.180594	0.238831	9.933684
std	0.120093	0.099240	0.041827	0.490389	0.221963	0.109614	0.139203	3.224169
min	0.075000	0.055000	0.000000	0.002000	0.001000	0.000500	0.001500	1.000000
25%	0.450000	0.350000	0.115000	0.441500	0.186000	0.093500	0.130000	8.000000
50%	0.545000	0.425000	0.140000	0.799500	0.336000	0.171000	0.234000	9.000000
75%	0.615000	0.480000	0.165000	1.153000	0.502000	0.253000	0.329000	11.000000
max	0.815000	0.650000	1.130000	2.825500	1.488000	0.760000	1.005000	29.000000

In [9]:
```
df[df['height'] == 0]  #need to drop these rows.
```

Out[9]:

	sex	length	diameter	height	whole_weight	shucked_weight	viscera_weight	shell_weight	rings
1257	I	0.430	0.34	0.0	0.428	0.2065	0.0860	0.1150	8
3996	I	0.315	0.23	0.0	0.134	0.0575	0.0285	0.3505	6

In [10]:
```
df.drop(index=[1257,3996], inplace = True)
```

```
df.shape
```

Out[10]: (4175, 9)

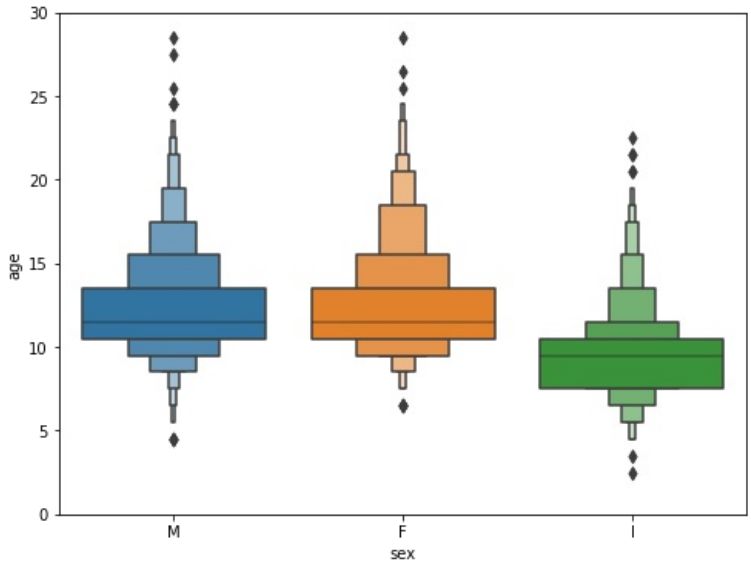
In [11]:
```
df['age'] = df['rings']+1.5 #AS per the problem statement
df.drop('rings', axis = 1, inplace = True)
df.head()
```

Out[11]:

	sex	length	diameter	height	whole_weight	shucked_weight	viscera_weight	shell_weight	age
0	M	0.455	0.365	0.095	0.5140	0.2245	0.1010	0.150	16.5
1	M	0.350	0.265	0.090	0.2255	0.0995	0.0485	0.070	8.5
2	F	0.530	0.420	0.135	0.6770	0.2565	0.1415	0.210	10.5
3	M	0.440	0.365	0.125	0.5160	0.2155	0.1140	0.155	11.5
4	I	0.330	0.255	0.080	0.2050	0.0895	0.0395	0.055	8.5

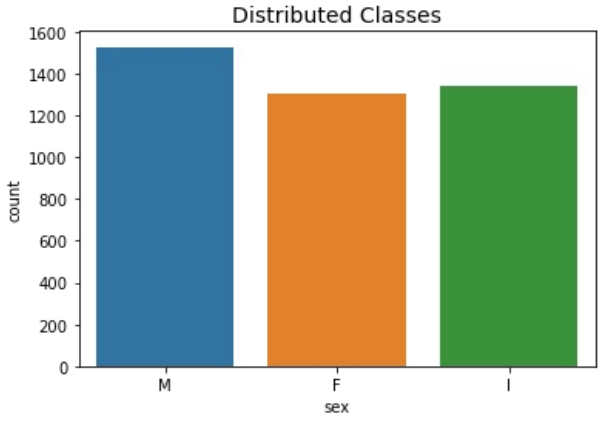
In [12]:
```
temp = pd.concat([df['age'], df['sex']], axis=1)

f, ax = plt.subplots(figsize=(8, 6))
fig = sns.boxenplot(x='sex', y="age", data=df)
fig.axis(ymin=0, ymax=30);
```



In [ ]:
```
##countplot
```

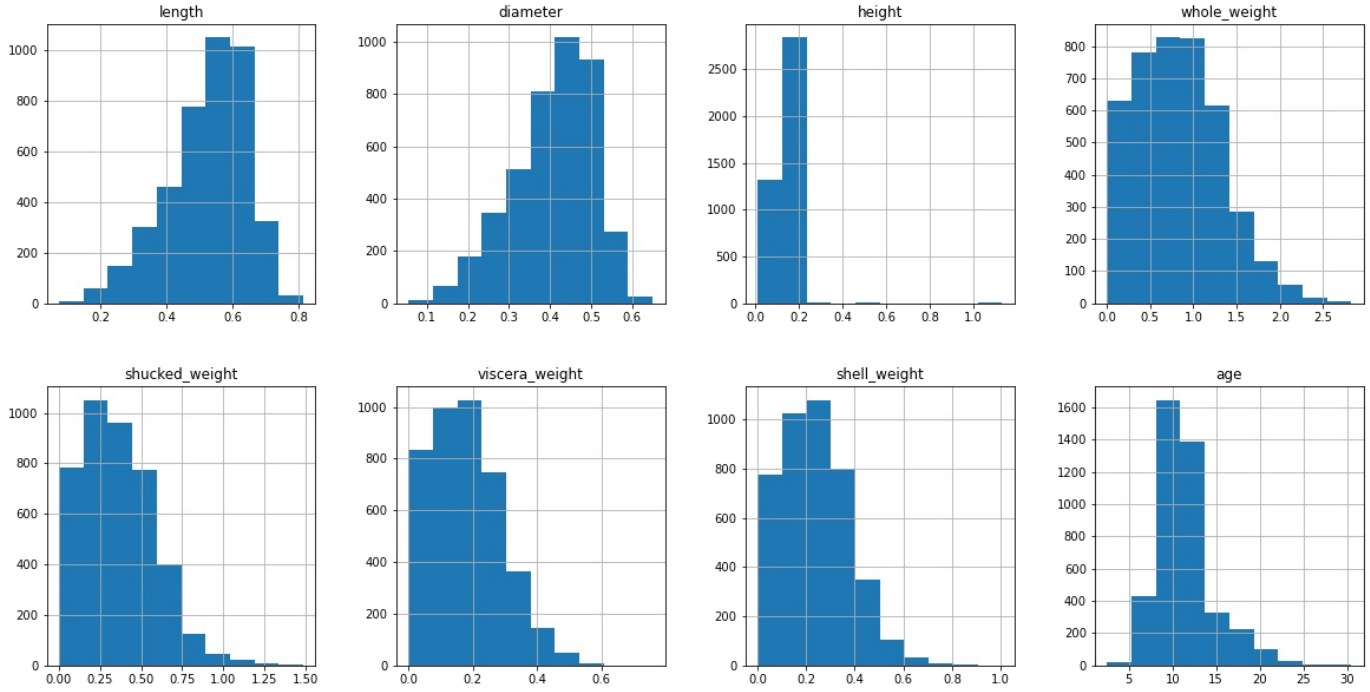
In [13]:
```
sns.countplot('sex', data=df)
plt.title('Distrubuted Classes', fontsize=14)
plt.show()
```



In [ ]:
```
## checking histogram of features
```

In [14]:
```
df.hist(figsize = (20,10), layout = (2,4))
```

Out[14]:
```
array([[<AxesSubplot:title={'center':'length'}>,
        <AxesSubplot:title={'center':'diameter'}>,
        <AxesSubplot:title={'center':'height'}>,
        <AxesSubplot:title={'center':'whole_weight'}>],
       [<AxesSubplot:title={'center':'shucked_weight'}>,
        <AxesSubplot:title={'center':'viscera_weight'}>,
        <AxesSubplot:title={'center':'shell_weight'}>,
        <AxesSubplot:title={'center':'age'}>]], dtype=object)
```



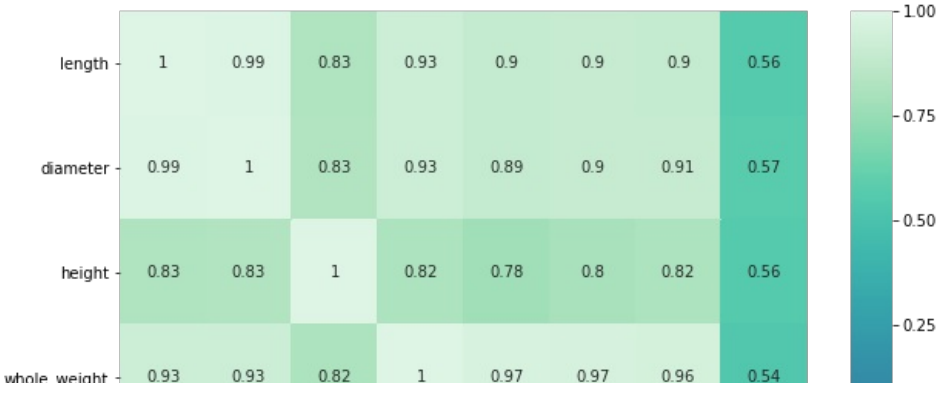
In [ ]:
```
##checking skewness
```

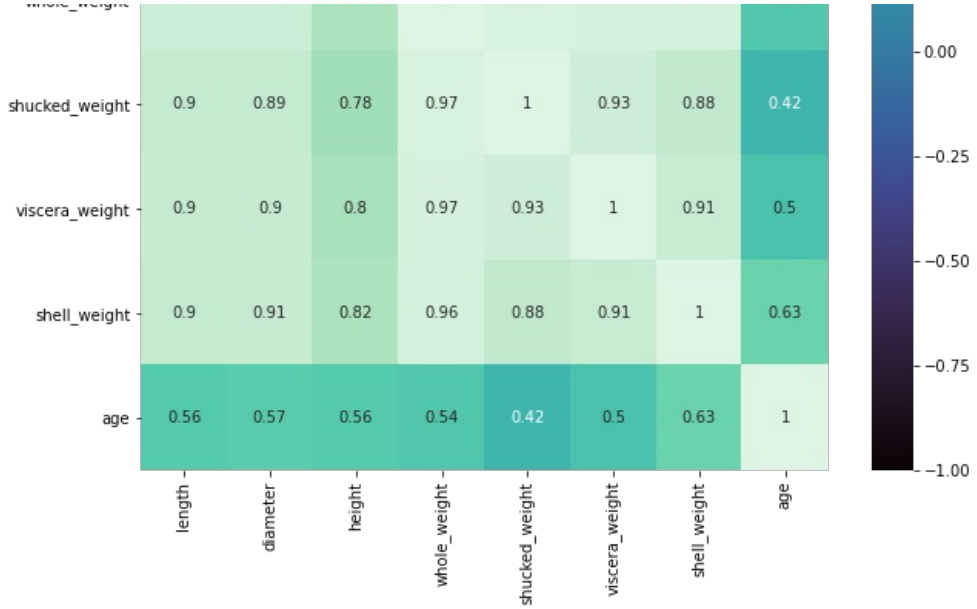
In [15]:
```
df.skew().sort_values(ascending = False)
```

Out[15]:
```
height            3.166364
age               1.113754
shucked_weight    0.718735
shell_weight      0.621081
viscera_weight    0.591455
whole_weight      0.530549
diameter         -0.610182
length           -0.640993
dtype: float64
```

In [ ]:
```
## plotting correlation and checking highest correlation features
```

In [16]:
```
corr = df.corr()
plt.figure(figsize = (10,10))
ax = sns.heatmap(corr, vmin = -1, center = 0, annot = True, cmap = 'mako')
```





In [ ]:
```
## drop high correlation columns
```

In [17]:
```
upper_tri = corr.where(np.triu(np.ones(corr.shape),k=1).astype(np.bool))
columns_to_drop = [column for column in upper_tri.columns if any(upper_tri[column] > 0.95)] #highly correlated va

print("Columns to drop:\n", columns_to_drop)
```

```
Columns to drop:
 ['diameter', 'shucked_weight', 'viscera_weight', 'shell_weight']
```

In [18]:
```
df.drop(columns_to_drop, axis=1, inplace = True)
```

In [19]:
```
df.head()
```

Out[19]:

	sex	length	height	whole_weight	age
0	M	0.455	0.095	0.5140	16.5
1	M	0.350	0.090	0.2255	8.5
2	F	0.530	0.135	0.6770	10.5
3	M	0.440	0.125	0.5160	11.5
4	I	0.330	0.080	0.2050	8.5

In [ ]:
```
## calculate vif
```

In [20]:
```
#calculating VIF
def vif_arr(df1):
    vif = pd.DataFrame()
    df1 = sma.add_constant(df1)
    vif["Features"] = df1.columns
    vif['VIF'] = [variance_inflation_factor(df1.values, i) for i in range(df1.shape[1])]
    return(vif)
```

In [21]:
```
temp = df.drop('sex', axis = 1) #i.e. categorical
vif_arr(temp).sort_values(by = 'Features', ascending = False)
```

Out[21]:

	Features	VIF
3	whole_weight	7.425114
1	length	7.833655
2	height	3.532659
0	const	62.359271
4	age	1.515261

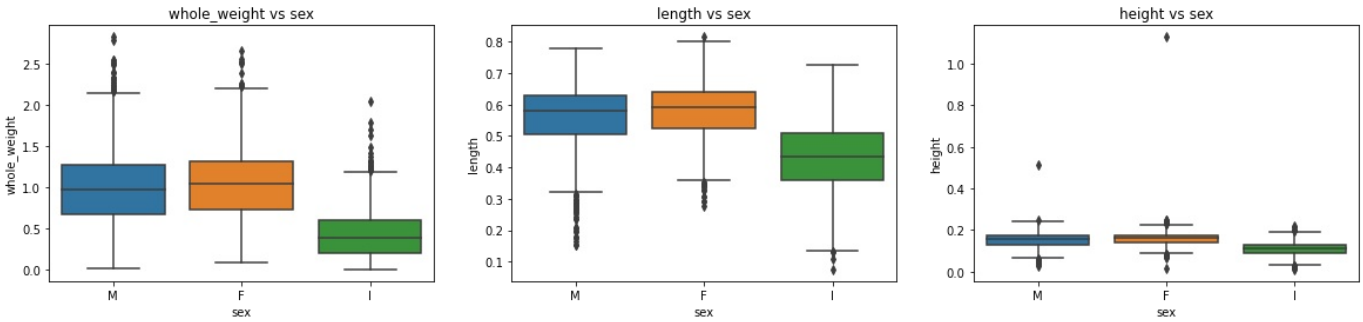
In [23]:
```
f,axes = plt.subplots(ncols = 3, figsize = (20,4))

sns.boxplot(x = 'sex', y = 'whole_weight', data = df, ax = axes[0])
axes[0].set_title('whole_weight vs sex')

sns.boxplot(x = 'sex', y = 'length', data = df, ax = axes[1])
axes[1].set_title('length vs sex')

sns.boxplot(x = 'sex', y = 'height', data = df, ax = axes[2])
axes[2].set_title('height vs sex')
```

Out[23]:
```
Text(0.5, 1.0, 'height vs sex')
```



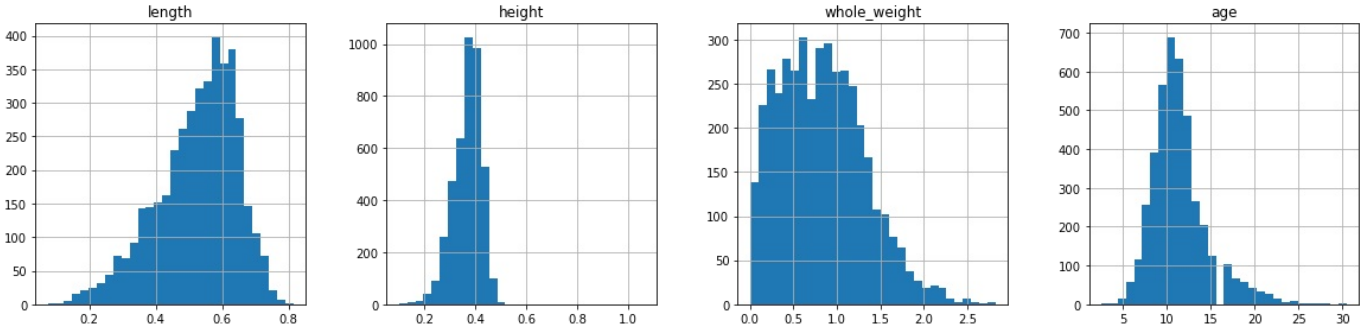
In [24]:
```
df['height'] = np.sqrt(df['height'])
```

In [25]:
```
df.skew().sort_values(ascending = False)
```

Out[25]:
```
age             1.113754
whole_weight    0.530549
height         -0.176012
length         -0.640993
dtype: float64
```

In [26]:
```
df.hist(figsize = (20,10), layout = (2,4), bins = 30)
```

Out[26]:
```
array([[<AxesSubplot:title={'center':'length'}>,
        <AxesSubplot:title={'center':'height'}>,
        <AxesSubplot:title={'center':'whole_weight'}>,
        <AxesSubplot:title={'center':'age'}>],
       [<AxesSubplot:>, <AxesSubplot:>, <AxesSubplot:>, <AxesSubplot:>]],
      dtype=object)
```



In [27]:
```
df.head()
```

Out[27]:

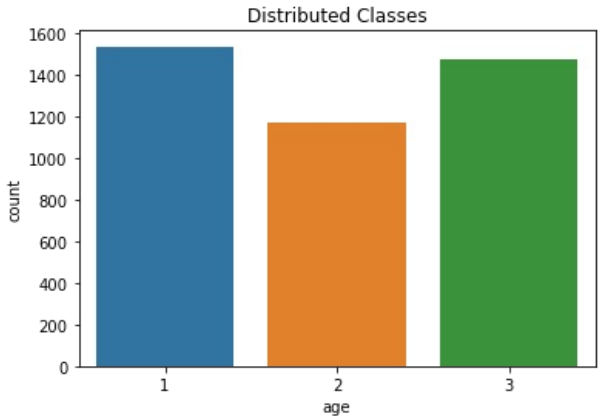
	sex	length	height	whole_weight	age
0	M	0.455	0.308221	0.5140	16.5
1	M	0.350	0.300000	0.2255	8.5
2	F	0.530	0.367423	0.6770	10.5
3	M	0.440	0.353553	0.5160	11.5
4	I	0.330	0.282843	0.2050	8.5

In [28]:
```
Age = []
for i in df["whole_weight"]:
    if i < 0.6:
        Age.append(1)
    elif i > 0.6 and i < 1.0 :
        Age.append(2)
    else:
        Age.append(3)
df["age"] = Age
#df_1.drop("age" , axis =1,inplace=True)
df.head()
```

Out[28]:

	sex	length	height	whole_weight	age
0	M	0.455	0.308221	0.5140	1
1	M	0.350	0.300000	0.2255	1
2	F	0.530	0.367423	0.6770	2
3	M	0.440	0.353553	0.5160	1
4	I	0.330	0.282843	0.2050	1

In [29]:
```
sns.countplot('age', data=df)
plt.title('Distributed Classes')
plt.show()
```



In [30]:
```
new_df = pd.get_dummies(df, columns = ['sex'], prefix_sep='_', drop_first = True)
new_df['age'].value_counts()
```

Out[30]:
```
1    1534
3    1473
2    1168
Name: age, dtype: int64
```

In [31]:
```
vif_arr(new_df).sort_values(by = 'Features', ascending = False)
```

Out[31]:

	Features	VIF
3	whole_weight	9.799019
6	sex_M	1.384868
5	sex_I	1.983488
1	length	9.680103
2	height	4.979747
0	const	128.016288
4	age	5.326806

In [32]:
```
new_df['length'] = np.sqrt(new_df['length'])
vif_arr(new_df).sort_values(by = 'Features', ascending = False)
```

Out[32]:

	Features	VIF
3	whole_weight	8.556129
6	sex_M	1.384512
5	sex_I	1.984036
1	length	7.495609
2	height	5.302027
0	const	249.609951
4	age	5.264169

In [ ]:
```
##model buiding
```

In [33]:
```
X = new_df.drop('age', axis = 1)
y = new_df['age']
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

sc = StandardScaler()
sc.fit(X_train)
X_train_std = sc.transform(X_train)
X_test_std = sc.transform(X_test)
X_train_std = pd.DataFrame(X_train_std, columns=X_train.columns)
X_test_std = pd.DataFrame(X_test_std, columns=X_train.columns)

X_train = X_train_std.values
X_test = X_test_std.values
y_train = y_train.values
y_test = y_test.values

classifiers = {"LogisiticRegression": LogisticRegression(),
               "KNearest": KNeighborsClassifier(),
               "Support Vector Classifier": SVC(),
               "DecisionTreeClassifier": DecisionTreeClassifier()}
for key, classifier in classifiers.items():
    classifier.fit(X_train, y_train)
    training_score = cross_val_score(classifier, X_train, y_train, cv=5)
    print("Classifiers: ", classifier.__class__.__name__, "Has a training score of", round(training_score.mean(),
```

```
Classifiers:  LogisticRegression Has a training score of 98.0 % accuracy score
Classifiers:  KNeighborsClassifier Has a training score of 97.0 % accuracy score
Classifiers:  SVC Has a training score of 97.0 % accuracy score
Classifiers:  DecisionTreeClassifier Has a training score of 100.0 % accuracy score
```

In [ ]:
```
##hyperparameter tuning
```

In [34]:
```
log_reg_params = {"penalty": ['l1', 'l2'], 'C': [0.001, 0.01, 0.1, 1, 10, 100, 1000],
                  'solver': ['newton-cg', 'lbfgs', 'liblinear', 'sag', 'saga']}

grid_log = GridSearchCV(LogisticRegression(), log_reg_params)
grid_log.fit(X_train, y_train)
log_reg = grid_log.best_estimator_
print('Best Estimators: ', log_reg)
```

```
Best Estimators:  LogisticRegression(C=1000, solver='newton-cg')
```

In [35]:
```
log_reg_score = cross_val_score(log_reg, X_train, y_train, cv=5) #We will use best parameters for modeling
print('Logistic Regression Cross Validation Score: ', round(log_reg_score.mean() * 100, 2).astype(str) + '%')
```

```
Logistic Regression Cross Validation Score:  99.73%
```

In [36]:
```
model = LogisticRegression(C=1000, solver='newton-cg')
model.fit(X_train, y_train)
y_pred = model.predict(X_test)
print(classification_report(y_test, y_pred))
print(confusion_matrix(y_test, y_pred))
```

```
              precision    recall  f1-score   support

           1       0.99      0.99      0.99       305
```

```
           2       0.99      0.98      0.99       238
           3       1.00      1.00      1.00       292

    accuracy                           0.99       835
   macro avg       0.99      0.99      0.99       835
weighted avg       0.99      0.99      0.99       835

[[303   2   0]
 [  3 234   1]
 [  0   0 292]]
```

In [ ]: