Assignment -2

Abalone Age Prediction

Assignment Date	6/10/2022
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Student Register Number	910619104035
Maximum Marks	

1. Download the dataset

In [1]:
```
# Dataset Downloaded
```

2. Load the dataset

In [87]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import warnings
warnings.filterwarnings('ignore')
```

In [3]:
```
df = pd.read_csv('abalone.csv')
```

In [4]:
```
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 [5]:
```
#Modifying the given dataset
Age=1.5+df.Rings
df["Age"]=Age
df=df.rename(columns = {'Whole weight':'Whole_weight','Shucked weight': 'Shucked_weight'
                        'Shell weight': 'Shell_weight'})
df=df.drop(columns=["Rings"],axis=1)
df.head()
```

Out[5]:

	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 [6]:

```
df.tail()
```

Out[6]:

	Sex	Length	Diameter	Height	Whole_weight	Shucked_weight	Viscera_weight	Shell_weight	Age
4172	F	0.565	0.450	0.165	0.8870	0.3700	0.2390	0.2490	12.5
4173	M	0.590	0.440	0.135	0.9660	0.4390	0.2145	0.2605	11.5
4174	M	0.600	0.475	0.205	1.1760	0.5255	0.2875	0.3080	10.5
4175	F	0.625	0.485	0.150	1.0945	0.5310	0.2610	0.2960	11.5
4176	M	0.710	0.555	0.195	1.9485	0.9455	0.3765	0.4950	13.5

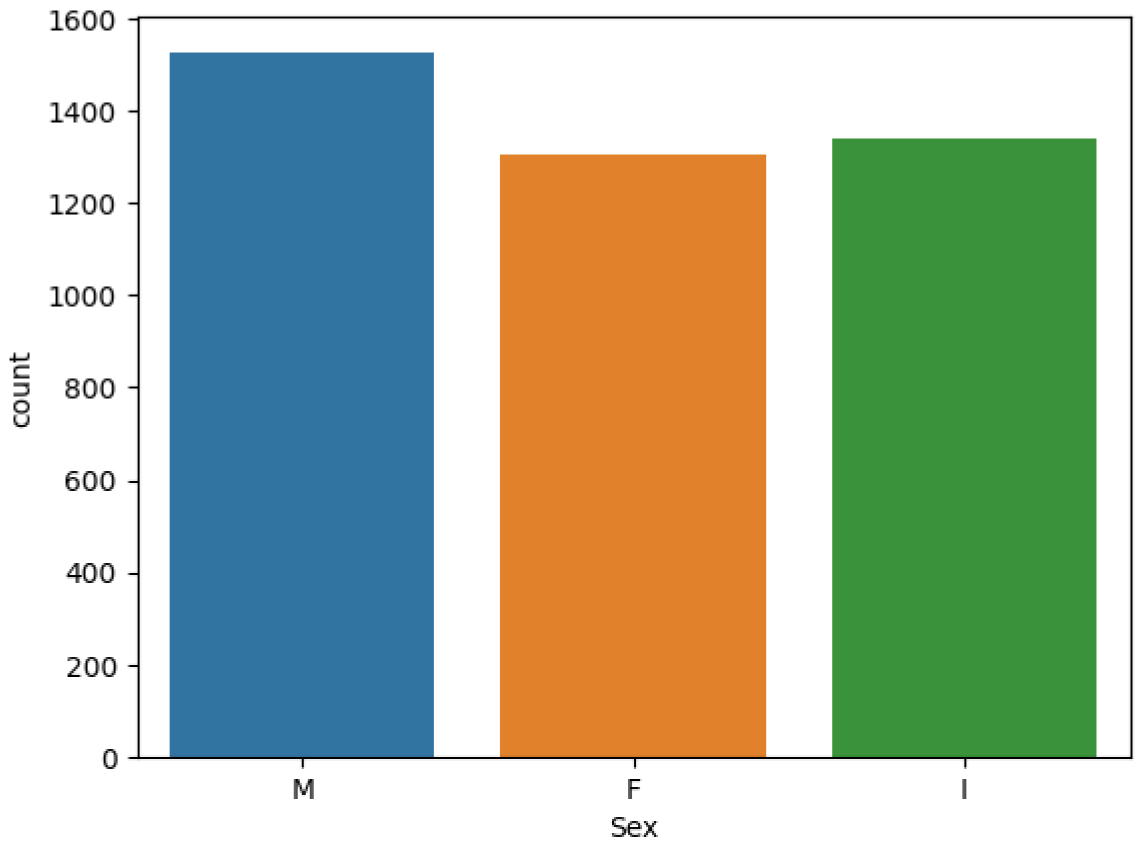
3. Perform Below Visualizations

Univariate Analysis

In [7]:

```
sns.countplot(x='Sex',data=df)
```

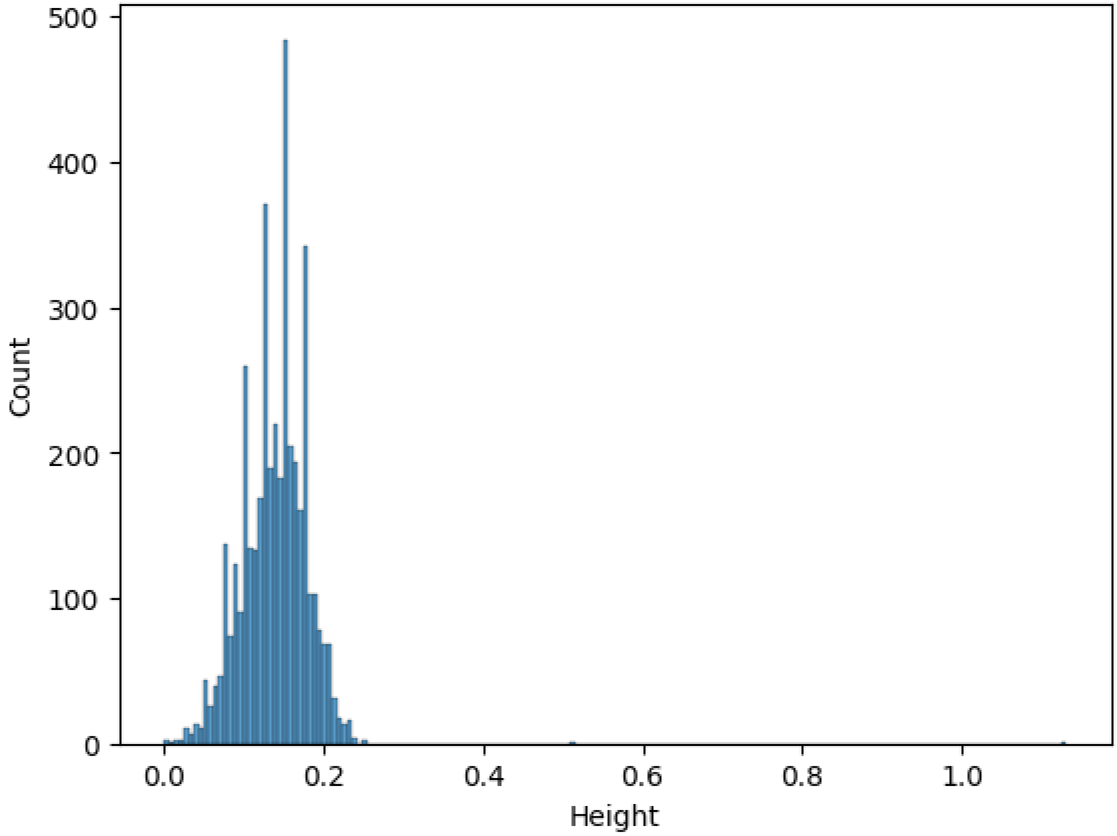
Out[7]: <AxesSubplot: xlabel='Sex', ylabel='count'>



In [8]:

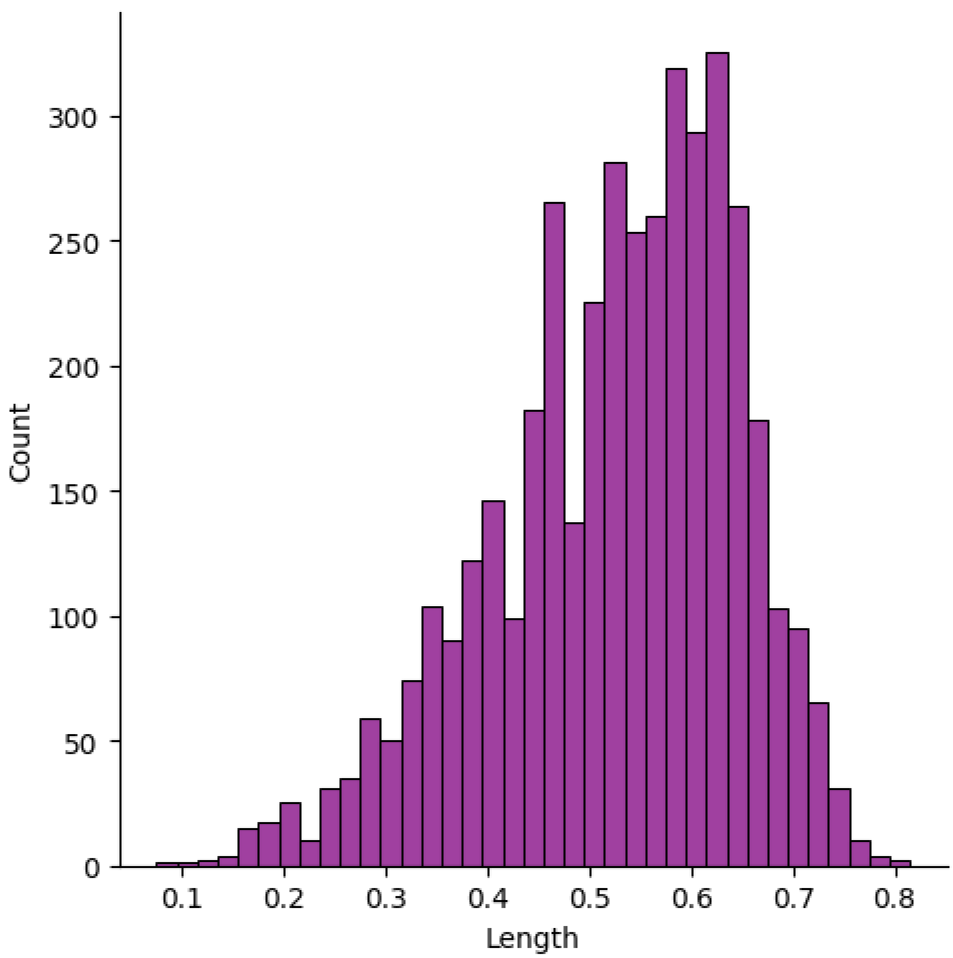
```
sns.histplot(x='Height',data=df)
```

Out[8]: <AxesSubplot: xlabel='Height', ylabel='Count'>



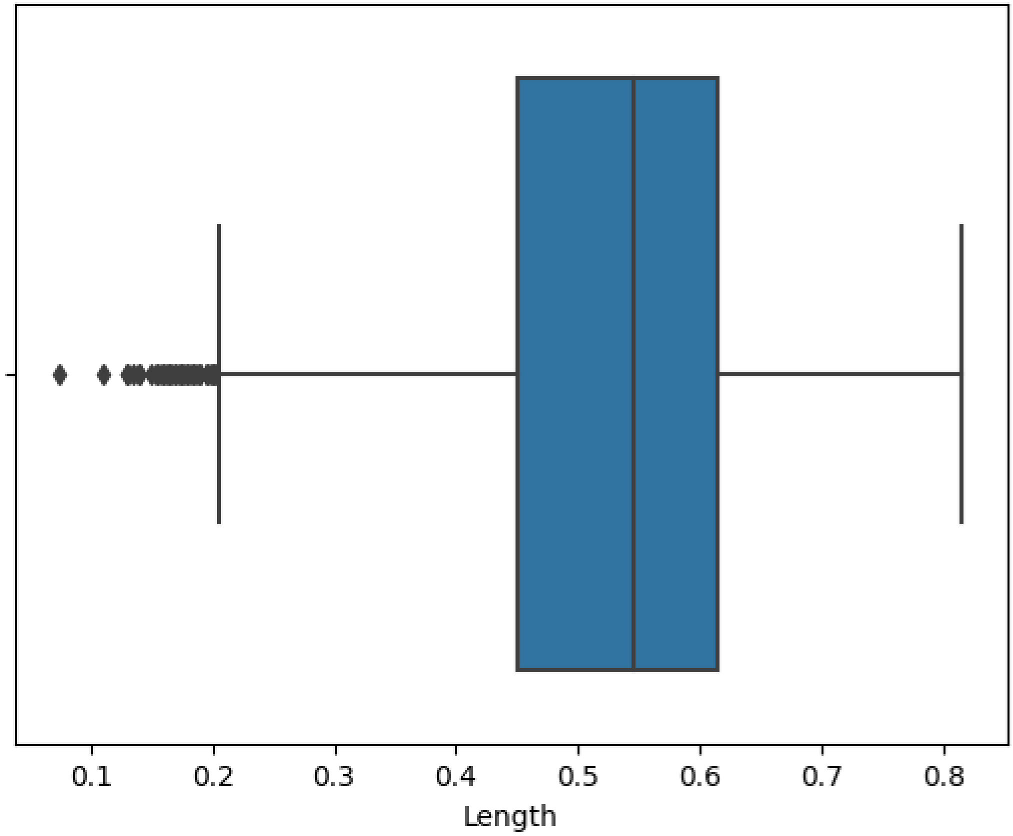
In [9]:
```
sns.displot(df["Length"],color='purple')
```

Out[9]: <seaborn.axisgrid.FacetGrid at 0x2baa1669d50>



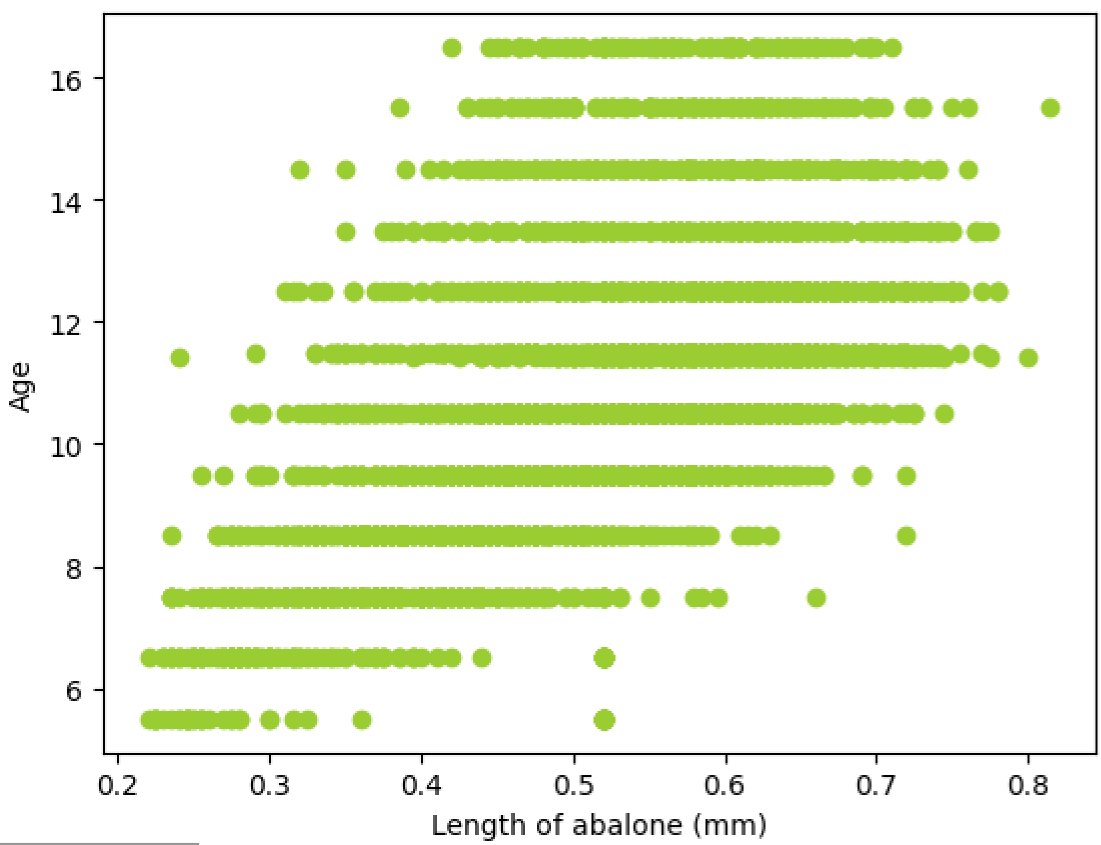
In [10]:
```
sns.boxplot(x=df["Length"])
```

Out[10]: <AxesSubplot: xlabel='Length'>

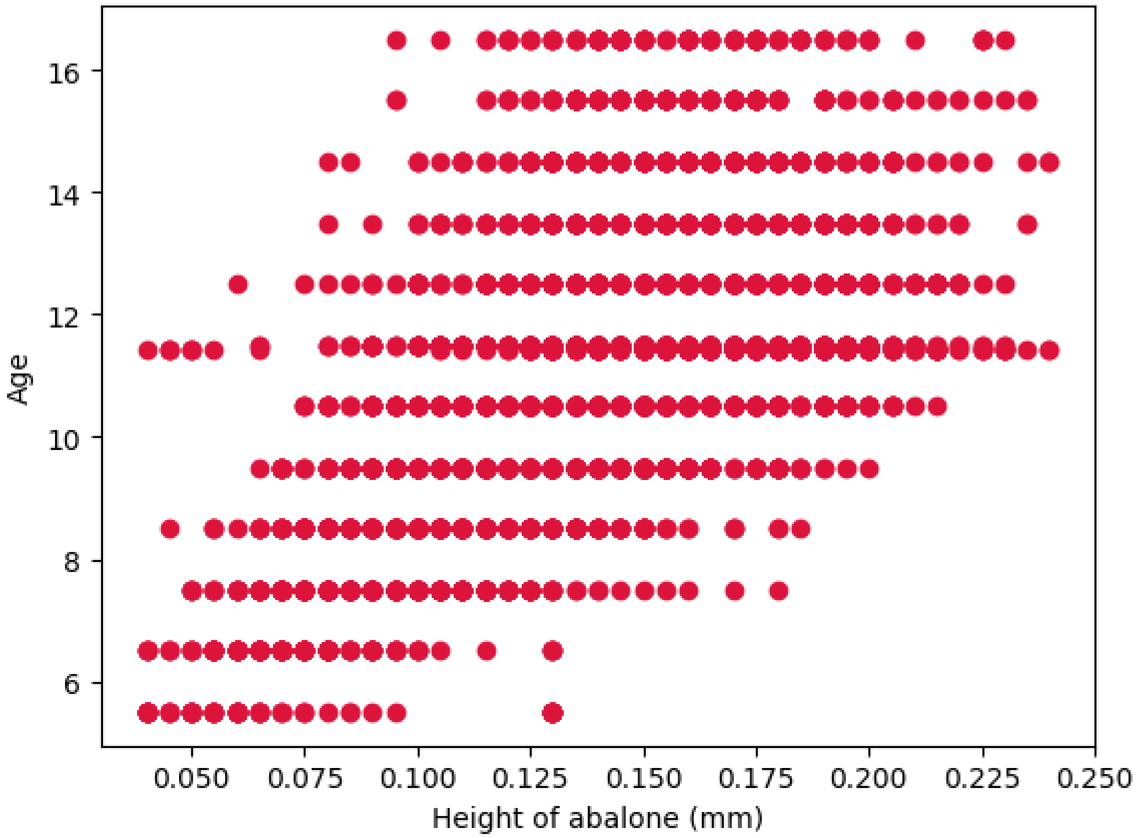


Bi-Variate Analysis

In [69]:
```
plt.scatter(df['Length'], df['Age'], c='yellowgreen')
plt.xlabel('Length of abalone (mm)')
plt.ylabel('Age')
plt.show()
```

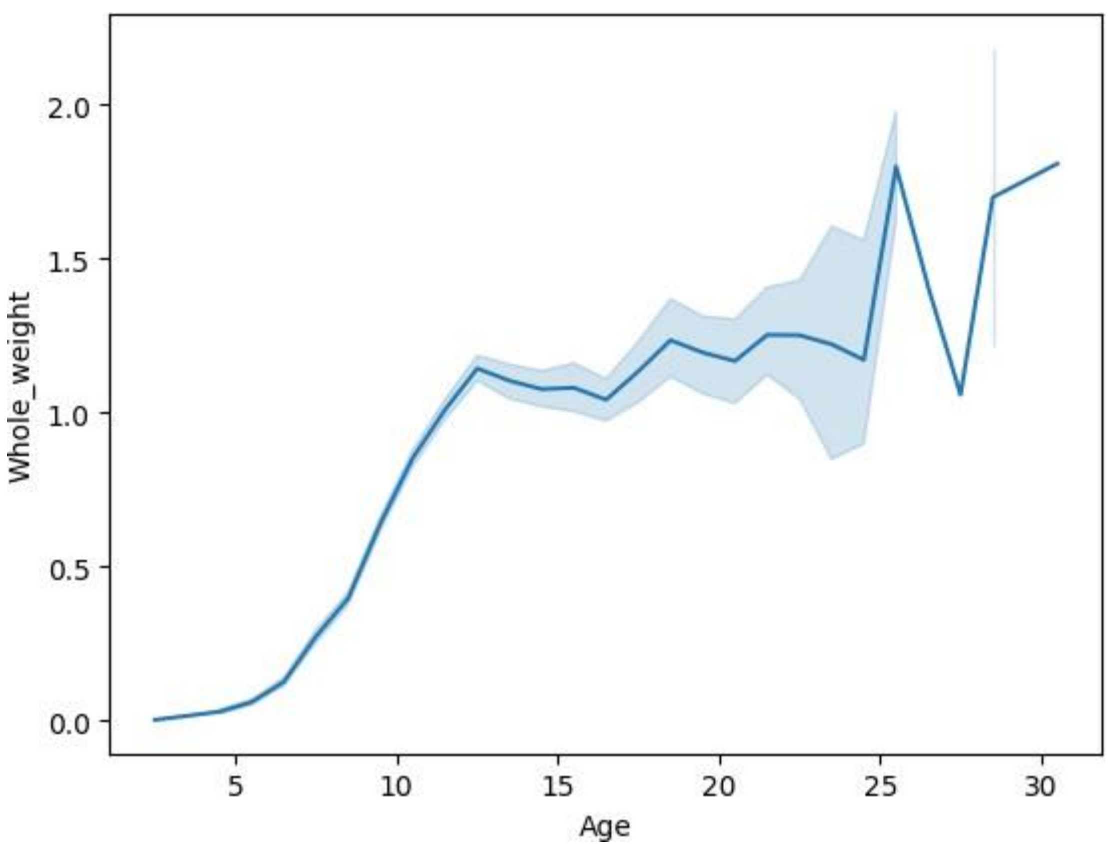


In [70]:
```python
plt.scatter(df['Height'], df['Age'], c='crimson')
plt.xlabel('Height of abalone (mm)')
plt.ylabel('Age')
plt.show()
```



In [13]:
```python
sns.lineplot(x=df["Age"],y=df["Whole_weight"])
```

Out[13]: <AxesSubplot: xlabel='Age', ylabel='Whole_weight'>



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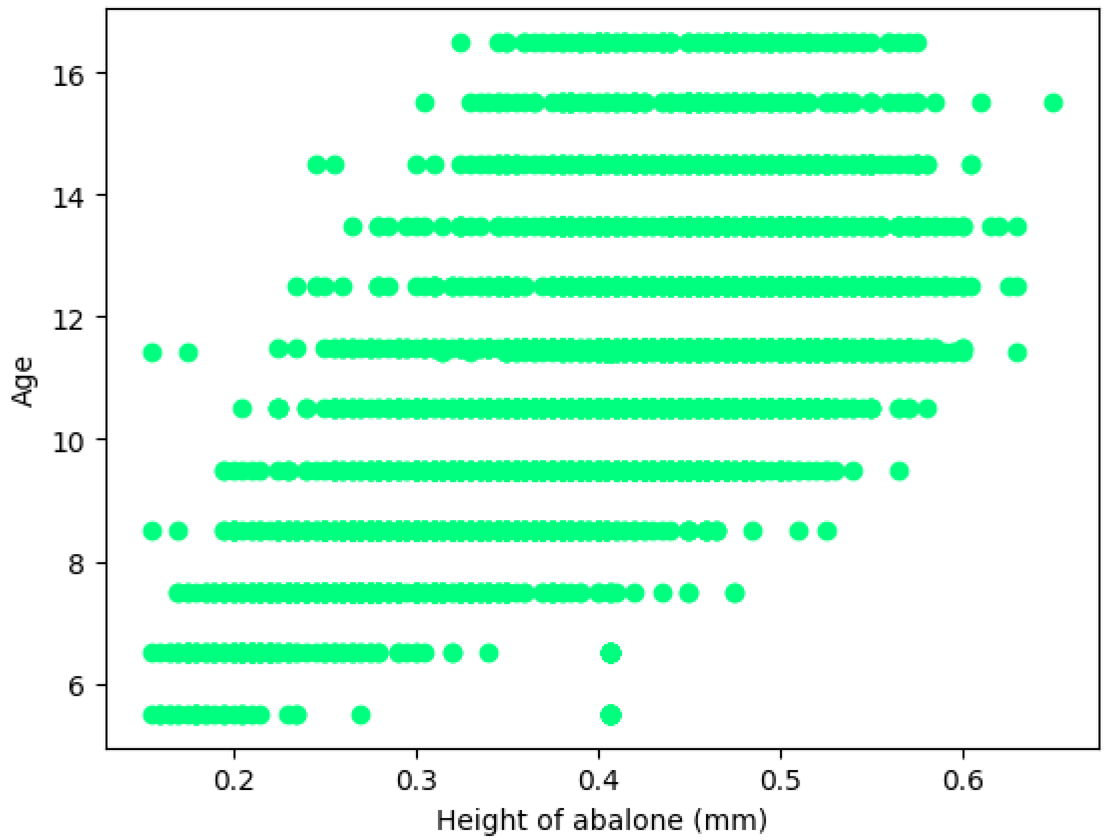
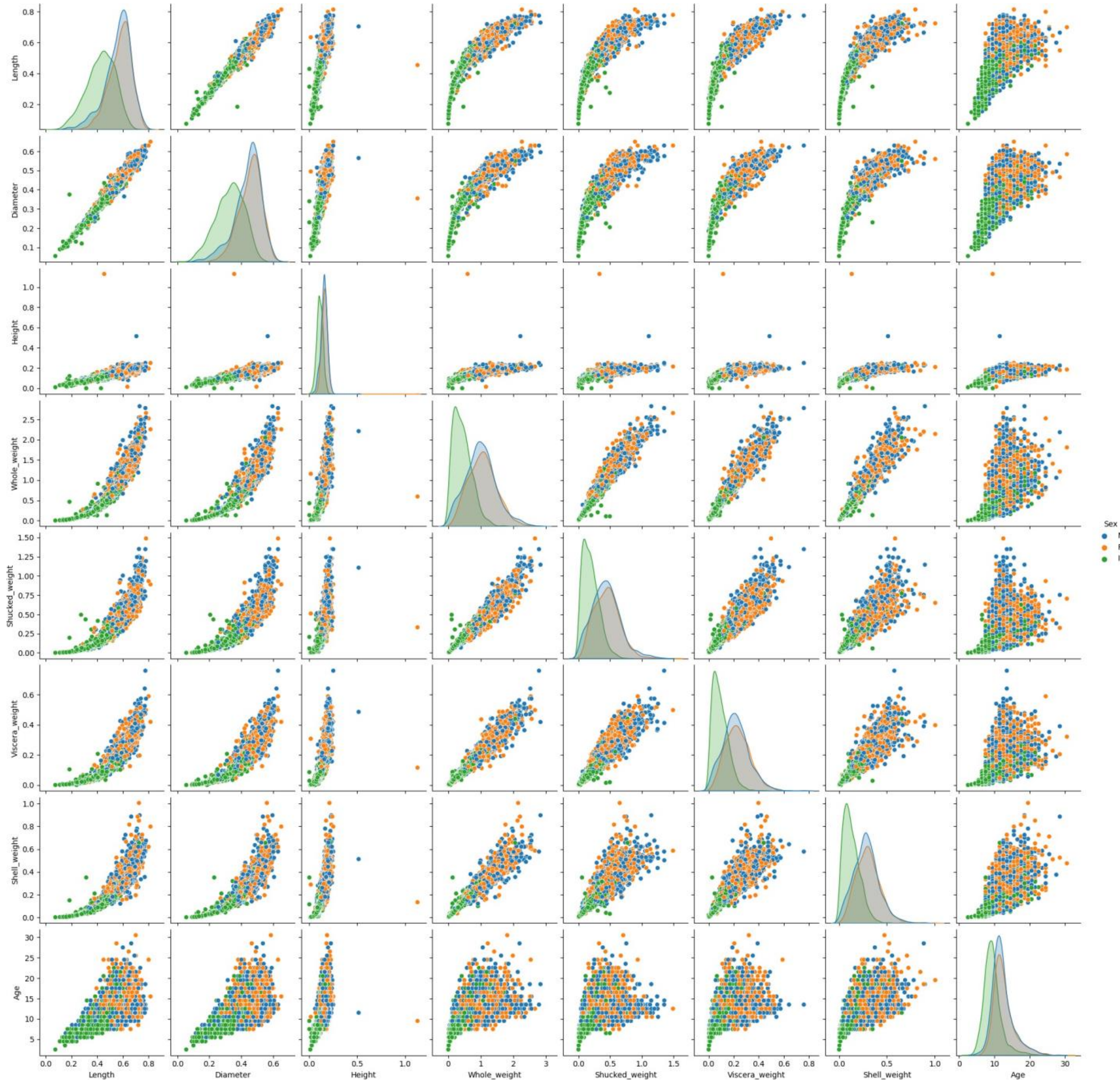
In [140…
```
plt.scatter(df['Diameter'], df['Age'],c='springgreen')
plt.xlabel('Height  of  abalone  (mm)')
plt.ylabel('Age')
plt.show()
```



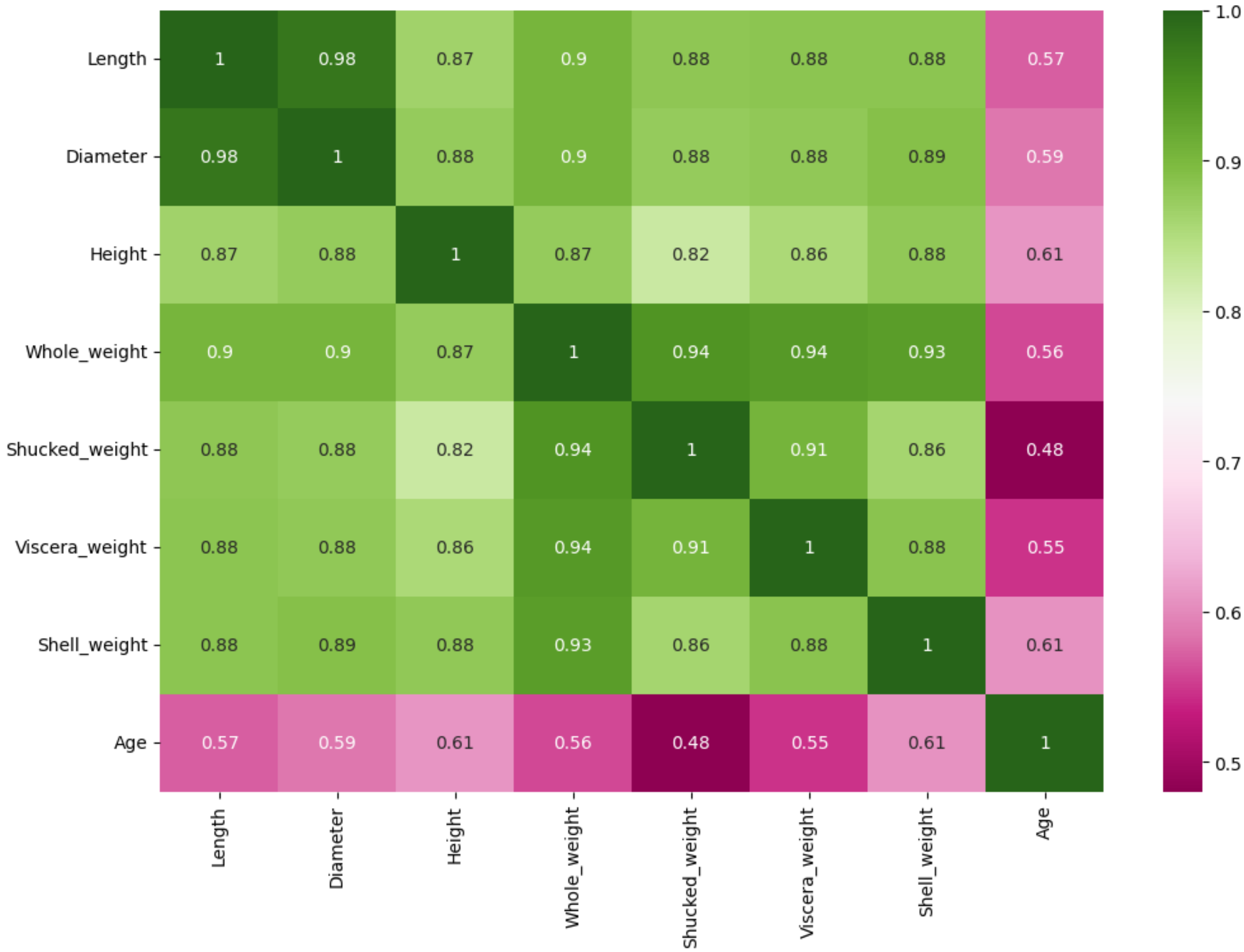
Multi-Variate Analysis

In [15]:
```
sns.pairplot(df,hue='Sex')
```

Out[15]: <seaborn.axisgrid.PairGrid at 0x2baa2926c20>



In [88]:
```
plt.figure(figsize=(12,8));
sns.heatmap(df.corr(), cmap="PiYG",annot=True);
```



4. Descriptive statistics

In [17]:
```
df.describe()
```

Out[17]:

	Length	Diameter	Height	Whole_weight	Shucked_weight	Viscera_weight	Shell_weight	
count	4177.000000	4177.000000	4177.000000	4177.000000	4177.000000	4177.000000	4177.000000	4
mean	0.523992	0.407881	0.139516	0.828742	0.359367	0.180594	0.238831	
std	0.120093	0.099240	0.041827	0.490389	0.221963	0.109614	0.139203	
min	0.075000	0.055000	0.000000	0.002000	0.001000	0.000500	0.001500	
25%	0.450000	0.350000	0.115000	0.441500	0.186000	0.093500	0.130000	
50%	0.545000	0.425000	0.140000	0.799500	0.336000	0.171000	0.234000	
75%	0.615000	0.480000	0.165000	1.153000	0.502000	0.253000	0.329000	
max	0.815000	0.650000	1.130000	2.825500	1.488000	0.760000	1.005000	

5. Check for Missing values and deal with them

In [18]:
```
df.isnull().sum()
```

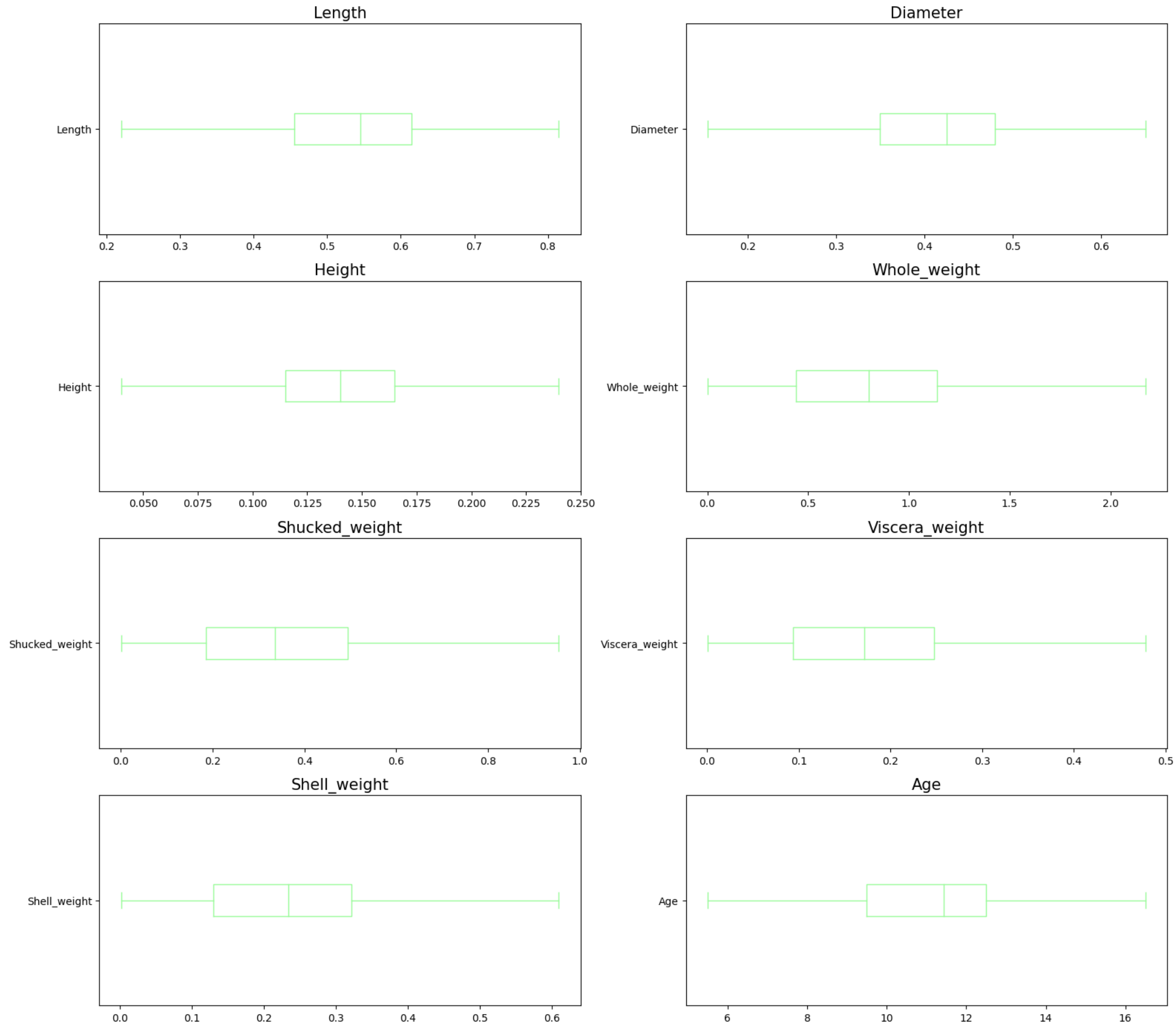
Out[18]:
```
Sex               0
Length            0
Diameter          0
Height            0
Whole_weight      0
Shucked_weight    0
Viscera_weight    0
Shell_weight      0
Age               0
dtype: int64
```

6. Find the outliers and Replace their outliers

In [19]:
```
col =['Length', 'Diameter', 'Height', 'Whole_weight', 'Shucked_weight',
       'Viscera_weight', 'Shell_weight', 'Age']
```

In [82]:
```
figfig, axes = plt.subplots(4,2,figsize=(16, 14))
axes = np.ravel(axes)
for i, c in enumerate(col):
    hist = df[c].plot(kind = 'box', ax=axes[i],color='palegreen', vert=False)
    axes[i].set_title(c, fontsize=15)

plt.tight_layout()
plt.show()
```



In [89]:
```
qnt = df.quantile([0.75,0.25])
qnt
```

Out[89]:

	Length	Diameter	Height	Whole_weight	Shucked_weight	Viscera_weight	Shell_weight	Age
0.75	0.615	0.48	0.165	1.1390	0.4935	0.2475	0.322	12.5
0.25	0.455	0.35	0.115	0.4415	0.1860	0.0935	0.130	9.5

In [90]:
```
IQR = qnt.loc[0.75] - qnt.loc[0.25]
IQR
```

Out[90]:
```
Length            0.1600
Diameter          0.1300
Height            0.0500
Whole_weight      0.6975
Shucked_weight    0.3075
Viscera_weight    0.1540
Shell_weight      0.1920
Age               3.0000
dtype: float64
```

In [91]:
```
lower = qnt.loc[0.25] - 1.5 * IQR
lower
```

Out[91]:
```
Length             0.21500
Diameter           0.15500
Height             0.04000
Whole_weight      -0.60475
Shucked_weight    -0.27525
Viscera_weight    -0.13750
Shell_weight      -0.15800
Age                5.00000
dtype: float64
```

In [92]:
```
upper = qnt.loc[0.75] + 1.5 * IQR
upper
```

Out[92]:
```
Length             0.85500
Diameter           0.67500
Height             0.24000
Whole_weight       2.18525
Shucked_weight     0.95475
Viscera_weight     0.47850
Shell_weight       0.61000
Age               17.00000
dtype: float64
```

In [93]:
```
df.mean()
```

Out[93]:
```
Length             0.529285
Diameter           0.411831
Height             0.139703
Whole_weight       0.815145
Shucked_weight     0.350291
Viscera_weight     0.177318
Shell_weight       0.233878
Age               10.944228
dtype: float64
```

In [94]:
```
df['Length']=np.where(df['Length']<0.22,0.52,df['Length'])
```

In [95]:
```
df['Diameter']=np.where(df['Diameter']<0.155,0.407,df['Diameter'])
```

In [96]:
```
df['Height']=np.where(df['Height']<0.04,0.13,df['Height'])
```

In [97]:
```
df['Height']=np.where(df['Height']>0.24,0.13,df['Height'])
```

In [98]:
```
df['Whole_weight']=np.where(df['Whole_weight']>2.18,0.83,df['Whole_weight'])
```

In [99]:
```
df['Shucked_weight']=np.where(df['Shucked_weight']>0.958,0.359367,df['Shucked_weight'])
```

In [100…
```
df['Viscera_weight']=np.where(df['Viscera_weight']>0.478,0.18,df['Viscera_weight'])
```

In [101…
```
df['Shell_weight']=np.where(df['Shell_weight']>0.61,0.238831,df['Shell_weight'])
```

In [102…
```
df['Age']=np.where(df['Age']<5.0,11.43,df['Age'])
```

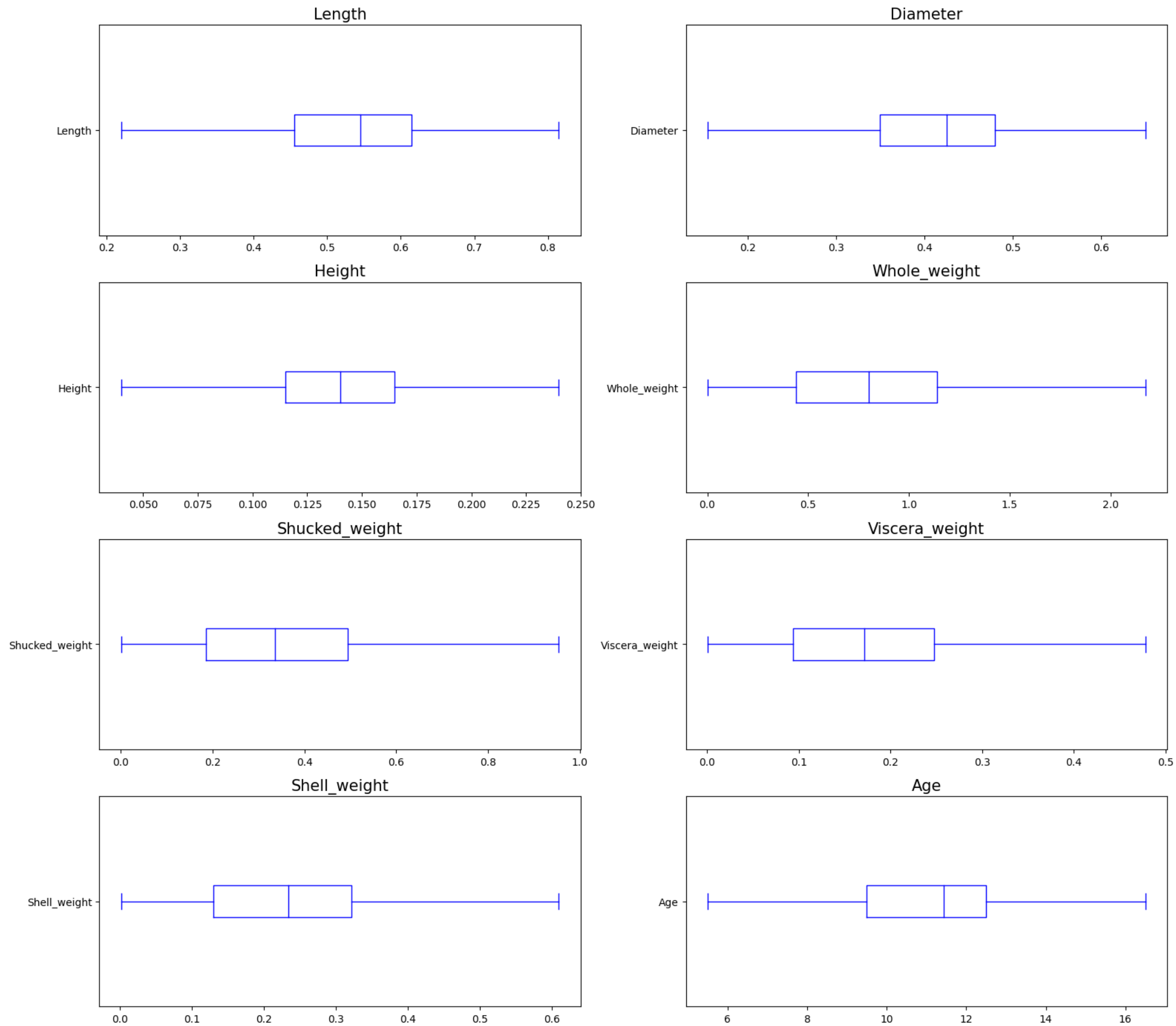
In [103…
```
df['Age']=np.where(df['Age']>17.0,11.43,df['Age'])
```

In [104…
```
figfig, axes = plt.subplots(4,2,figsize=(16, 14))
axes = np.ravel(axes)

numerate(col):
```

```python
    hist = df[c].plot(kind = 'box', ax=axes[i],color='blue', vert=False)
    axes[i].set_title(c, fontsize=15)

plt.tight_layout()
plt.show()
```



In [105…
```python
df.shape
```

Out[105]:
```
(4177, 9)
```

7. Check for Categorical columns and perform encoding

In [106…
```python
df['Sex'].unique()
```

Out[106]:
```
array(['M', 'F', 'I'], dtype=object)
```

In [107…
```python
x = pd.get_dummies(df)
```

In [108…
```python
x.head()
```

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Out[108]:

	Length	Diameter	Height	Whole_weight	Shucked_weight	Viscera_weight	Shell_weight	Age	Sex_F	Sex_
0	0.455	0.365	0.095	0.5140	0.2245	0.1010	0.150	16.5	0	
1	0.350	0.265	0.090	0.2255	0.0995	0.0485	0.070	8.5	0	
2	0.530	0.420	0.135	0.6770	0.2565	0.1415	0.210	10.5	1	
3	0.440	0.365	0.125	0.5160	0.2155	0.1140	0.155	11.5	0	
4	0.330	0.255	0.080	0.2050	0.0895	0.0395	0.055	8.5	0	

8. Split the data into dependent and independent variables

In [109…

```
x.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 4177 entries, 0 to 4176
Data columns (total 11 columns):
 #    Column          Non-Null Count  Dtype
---   ------          --------------  -----
 0    Length          4177 non-null   float64
 1    Diameter        4177 non-null   float64
 2    Height          4177 non-null   float64
 3    Whole_weight    4177 non-null   float64
 4    Shucked_weight  4177 non-null   float64
 5    Viscera_weight  4177 non-null   float64
 6    Shell_weight    4177 non-null   float64
 7    Age             4177 non-null   float64
 8    Sex_F           4177 non-null   uint8
 9    Sex_I           4177 non-null   uint8
 10   Sex_M           4177 non-null   uint8
dtypes: float64(8), uint8(3)
memory usage: 273.4 KB
```

In [110…

```
X = x.drop(['Age'], axis = 1)
```

In [128…

```
X.head()
```

Out[128]:

	Length	Diameter	Height	Whole_weight	Shucked_weight	Viscera_weight	Shell_weight	Sex_F	
0	-0.663474	-0.501673	-1.196422	-0.643390	-0.611770	-0.732343	-0.643590	-0.674834	-
1	-1.601273	-1.572915	-1.330241	-1.259765	-1.219694	-1.236126	-1.257424	-0.674834	-
2	0.006383	0.087510	-0.125873	-0.295144	-0.456142	-0.343709	-0.183214	1.481846	-
3	-0.797445	-0.501673	-0.393511	-0.639118	-0.655541	-0.607596	-0.605225	-0.674834	-
4	-1.779901	-1.680039	-1.597878	-1.303563	-1.268328	-1.322489	-1.372518	-0.674834	

In [112…

```
y = x['Age']
```

In [129…

```
y.head()
```

Out[129]:

```
0    16.5
1     8.5
2    10.5
3    11.5
4     8.5
Name: Age, dtype: float64
```

9. Scale the independent variables

In [114…
```
from sklearn.preprocessing import StandardScaler
```

In [115…
```
X_columns = X.select_dtypes(include=np.number).columns.tolist()
X_columns
```

Out[115]:
```
['Length',
 'Diameter',
 'Height',
 'Whole_weight',
 'Shucked_weight',
 'Viscera_weight',
 'Shell_weight',
 'Sex_F',
 'Sex_I',
 'Sex_M']
```

In [116…
```
scaler = StandardScaler()
```

In [117…
```
X[X_columns] = scaler.fit_transform(X[X_columns])
```

In [118…
```
X.head()
```

Out[118]:

	Length	Diameter	Height	Whole_weight	Shucked_weight	Viscera_weight	Shell_weight	Sex_F	
0	-0.663474	-0.501673	-1.196422	-0.643390	-0.611770	-0.732343	-0.643590	-0.674834	-
1	-1.601273	-1.572915	-1.330241	-1.259765	-1.219694	-1.236126	-1.257424	-0.674834	-
2	0.006383	0.087510	-0.125873	-0.295144	-0.456142	-0.343709	-0.183214	1.481846	-
3	-0.797445	-0.501673	-0.393511	-0.639118	-0.655541	-0.607596	-0.605225	-0.674834	-
4	-1.779901	-1.680039	-1.597878	-1.303563	-1.268328	-1.322489	-1.372518	-0.674834	

10. Split the data into training and testing

In [119…
```
X.shape, y.shape
```

Out[119]: ((4177, 10), (4177,))

In [120…
```
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 [121…
```
print(' x_train.shape : ',x_train.shape)
print(' y_train.shape : ',y_train.shape)
print(' x_test.shape : ',x_test.shape)
print(' y_test.shape : ',y_test.shape)
```

```
 x_train.shape :  (3341, 10)
 y_train.shape :  (3341,)
 x_test.shape :  (836, 10)
 y_test.shape :  (836,)
```

Build the Model, Train the Model and Test the Model

In [122…
```
#Linear Regression
```

```
from sklearn.linear_model import LinearRegression

lr = LinearRegression()
lr.fit(x_train, y_train)

lr_pred = lr.predict(x_test)
```

In [123…
```
#Random Forest
from sklearn.ensemble import RandomForestRegressor
from sklearn.metrics import mean_squared_error,make_scorer
from sklearn.model_selection import RandomizedSearchCV

rf = RandomForestRegressor()

param = {
    'max_depth':[3,6,9,12,15],
    'n_estimators' : [10,50,100,150,200]
}

rf_search = RandomizedSearchCV(rf,param_distributions=param,n_iter=5,scoring=make_scorer
                                n_jobs=-1,cv=5,verbose=3)

rf_search.fit(x_train,  y_train)
```

```
Fitting 5 folds for each of 5 candidates, totalling 25 fits
```

Out[123]:

```
▸ RandomizedSearchCV
▸ estimator: RandomForestRegressor
  ▸ RandomForestRegressor
```

In [124…
```
means = rf_search.cv_results_['mean_test_score']
params = rf_search.cv_results_['params']
for mean, param in zip(means, params):
    print("%f with: %r" % (mean, param))
    if mean == min(means):
        print('Best parameters with the minimum Mean Square Error are:',param)
```

```
2.640939 with: {'n_estimators': 100, 'max_depth': 6}
Best parameters with the minimum Mean Square Error are: {'n_estimators': 100, 'max_dept
h': 6}
2.700586 with: {'n_estimators': 10, 'max_depth': 6}
2.652001 with: {'n_estimators': 50, 'max_depth': 6}
2.908811 with: {'n_estimators': 50, 'max_depth': 3}
2.744786 with: {'n_estimators': 150, 'max_depth': 15}
```

In [125…
```
rf = RandomForestRegressor(n_estimators=50, max_depth=6)
rf.fit(x_train,y_train)

rf_pred =  rf.predict(x_test)
```

14. Measure the performance using Metrics

In [137…
```
from sklearn import metrics
RMSE1 = np.sqrt(metrics.mean_squared_error(y_test, lr_pred))
MAE = metrics.mean_absolute_error(y_test, lr_pred)
MSE = metrics.mean_squared_error(y_test, lr_pred)
r2_score(y_test,lr_pred)
```

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```
print('Linear Regression :')
print('--------------------------------- ')
print('MAE:', MAE)
print('MSE:', MSE)
print('RMSE:', RMSE1)
print('R2 Score :',R2)
print('\n\n')
```

```
Linear Regression :
---------------------
MAE: 1.3252222883409852
MSE: 2.9793407734555917
RMSE: 1.726076699760353
R2 Score : 0.4480445148439044
```

In [138…

```
from sklearn import metrics
RMSE2 = np.sqrt(metrics.mean_squared_error(y_test, rf_pred))
MAE = metrics.mean_absolute_error(y_test, rf_pred)
MSE = metrics.mean_squared_error(y_test, rf_pred)
R2 = metrics.r2_score(y_test,rf_pred)
print('Random Forest Contains:')
print('--------------------------------- ')
print('MAE:', MAE)
print('MSE:', MSE)
print('RMSE:', RMSE2)
print('R2 Score :',R2)
```

```
Random Forest Contains:
---------------------
MAE: 1.246195573419611
MSE: 2.532955077408326
RMSE: 1.5915260215932148
R2 Score : 0.5307423504267539
```

Compare Linear Regression and Random Forest

Random Forest got low rmse value than Linear Regression

In [139…

```
RMSE = RMSE1-RMSE2
print(RMSE)
```

```
0.13455067816713817
```