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Course: Bil470

Importing the Dependincies

In [1]:
```
import numpy as np
import pandas as pd
from sklearn import svm
from sklearn import metrics
from sklearn.metrics import accuracy_score, precision_score
from sklearn.metrics import confusion_matrix
from sklearn.metrics import precision_recall_fscore_support
from sklearn.metrics import classification_report
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.metrics import roc_curve, auc
from sklearn.preprocessing import label_binarize
from sklearn.preprocessing import LabelEncoder
from sklearn.model_selection import train_test_split
from lr import LinearRegression
from tabulate import tabulate
from sklearn.model_selection import learning_curve
```

Exploratory Data Analysis (EDA) for 500 Person Gender-Height-Weight-Body Mass Index

In [2]:
```
data = pd.read_csv('Index.csv')
data_visual = pd.read_csv('Index.csv')
data.head()
```

Out[2]:

	Gender	Height	Weight	Index
0	Male	174	96	4
1	Male	189	87	2
2	Female	185	110	4
3	Female	195	104	3
4	Male	149	61	3

In [3]:
```
data.describe()
```

Out[3]:

	Height	Weight	Index
count	500.000000	500.000000	500.000000
mean	169.944000	106.000000	3.748000
std	16.375261	32.382607	1.355053
min	140.000000	50.000000	0.000000
25%	156.000000	80.000000	3.000000
50%	170.500000	106.000000	4.000000
75%	184.000000	136.000000	5.000000
max	199.000000	160.000000	5.000000

In [4]:

```
def convert_status_to_description(x):
    if x['Index'] == 0:
        return 'Extremely Weak'
    elif x['Index'] == 1:
        return 'Weak'
    elif x['Index'] == 2:
        return 'Normal'
    elif x['Index'] == 3:
        return 'Overweight'
    elif x['Index']== 4:
        return 'Obesity'
    elif x['Index'] == 5:
        return 'Extreme Obesity'
data_visual['Status'] = data_visual.apply(convert_status_to_description,axis=1)
data_visual.head()
```

Out[4]:

	Gender	Height	Weight	Index	Status
0	Male	174	96	4	Obesity
1	Male	189	87	2	Normal
2	Female	185	110	4	Obesity
3	Female	195	104	3	Overweight
4	Male	149	61	3	Overweight

In [5]:

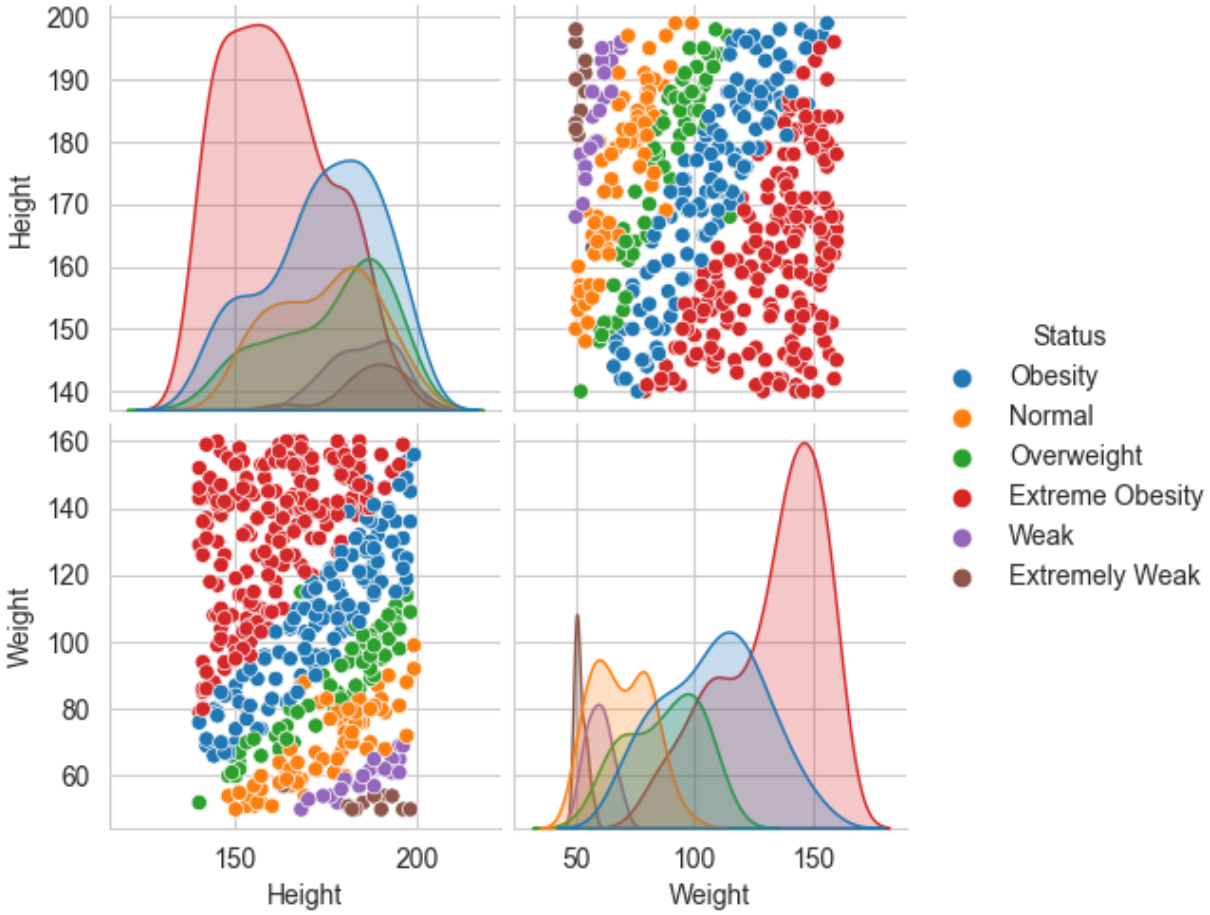
```
def convert_gender_to_label(x):
    if x['Gender'] == 'Male':
        return 1
    elif x['Gender'] == 'Female':
        return 0
data_visual['gender_lbl'] = data_visual.apply(convert_gender_to_label,axis=1)
data_visual.head()
```

Out[5]:

	Gender	Height	Weight	Index	Status	gender_lbl
0	Male	174	96	4	Obesity	1
1	Male	189	87	2	Normal	1
2	Female	185	110	4	Obesity	0
3	Female	195	104	3	Overweight	0
4	Male	149	61	3	Overweight	1

In [63]:

```
exclude_datas = ["gender_lbl","Index"]
subset_data = data_visual.drop(exclude_datas, axis=1)
sns.pairplot(subset_data, diag_kind='kde', hue='Status')
plt.show()
```



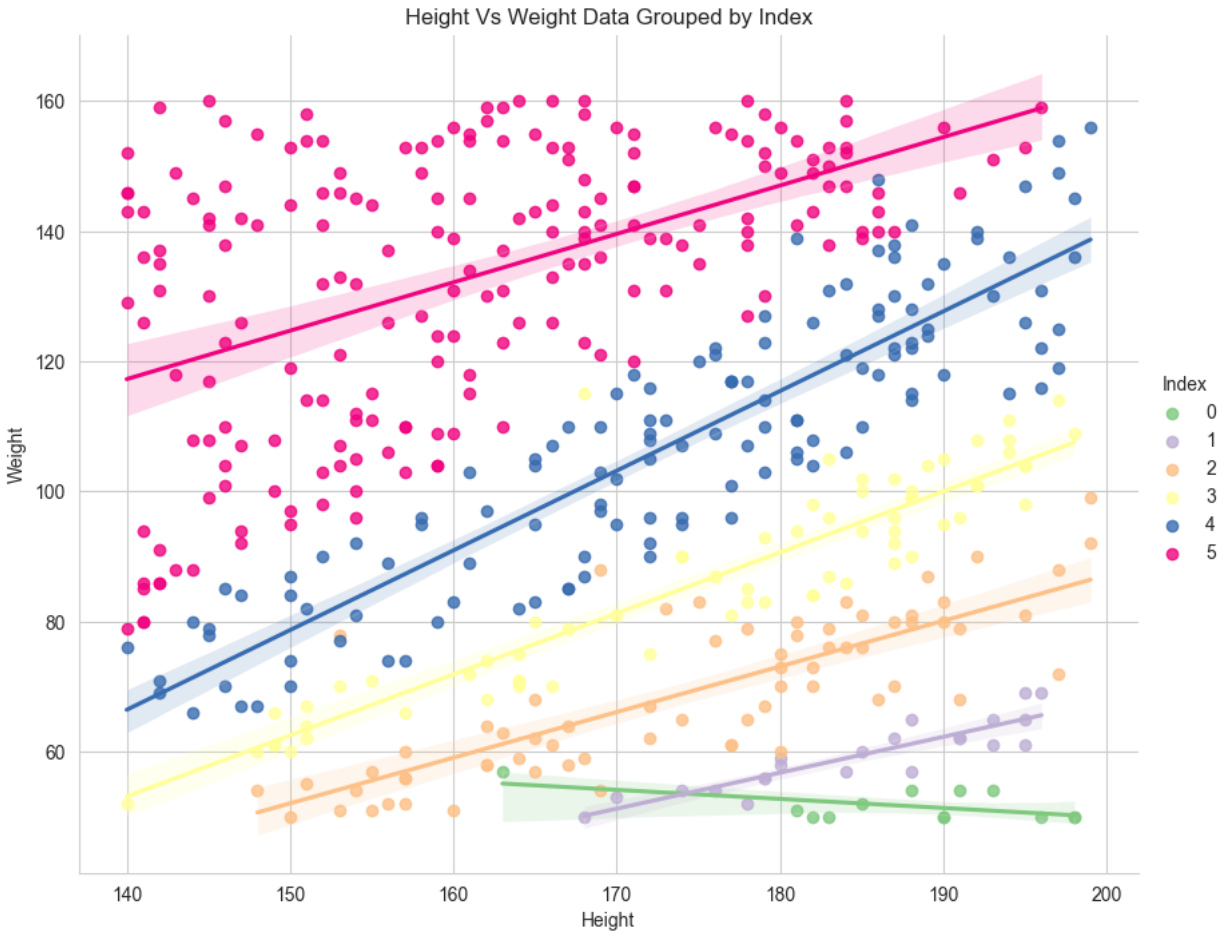
In [33]:

```
sns.set_style('whitegrid')
sns.lmplot(x='Height', y='Weight', data=data_visual,
           fit_reg=False,
           hue='Status',
           legend=False,
           palette='Set1',
           height=8,   # Use 'height' instead of 'size'
           aspect=1
          )
ax1 = plt.gca()
ax1.set_title('Height vs Weight', size=15)
box = ax1.get_position()
ax1.set_position([box.x0, box.y0, box.width * 0.8, box.height])
```

```
ax1.legend(loc='center left', bbox_to_anchor=(1, 0.5),prop={'size': 15})
plt.show()
```

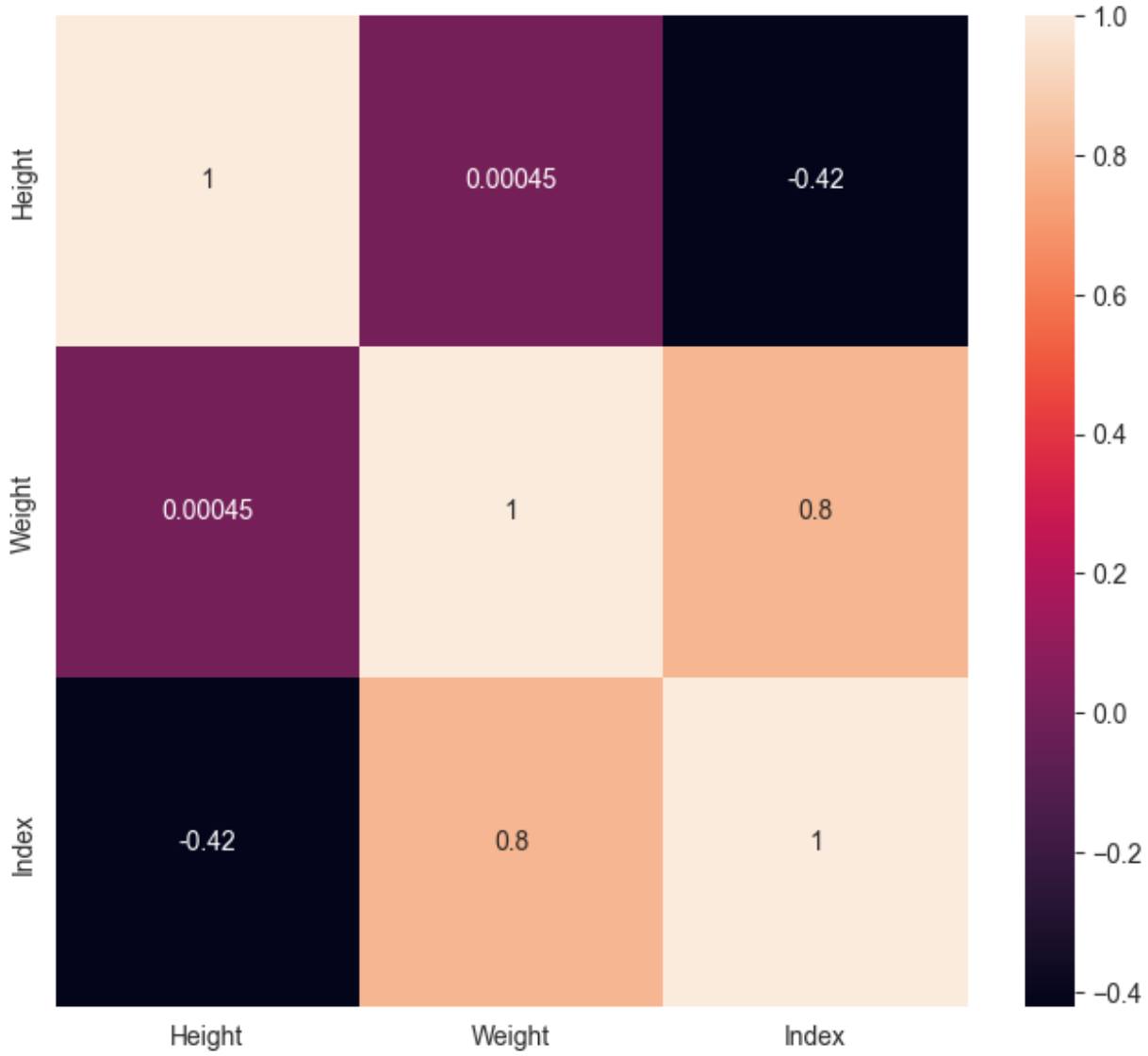
In [45]:
```
sns.lmplot(x='Height', y='Weight', hue='Index', data=data,
           fit_reg=True, height=7, aspect=1.25, palette='Accent')
ax = plt.gca()
ax.set_title("Height Vs Weight Data Grouped by Index")
```

Out[45]:
```
Text(0.5, 1.0, 'Height Vs Weight Data Grouped by Index')
```



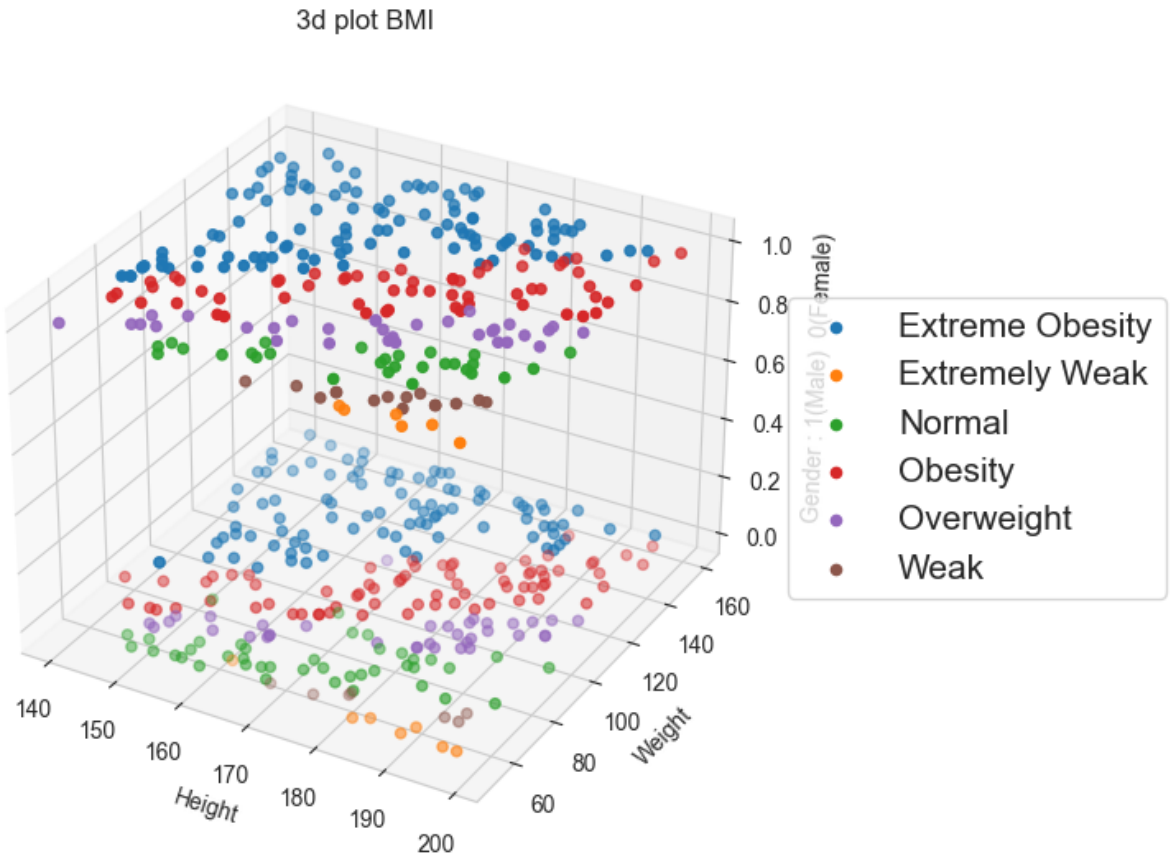
In [46]:
```
correlation_matrix = data.corr(numeric_only=True)
sns.heatmap(correlation_matrix, annot=True)
```

Out[46]:
```
<AxesSubplot: >
```



In [34]:

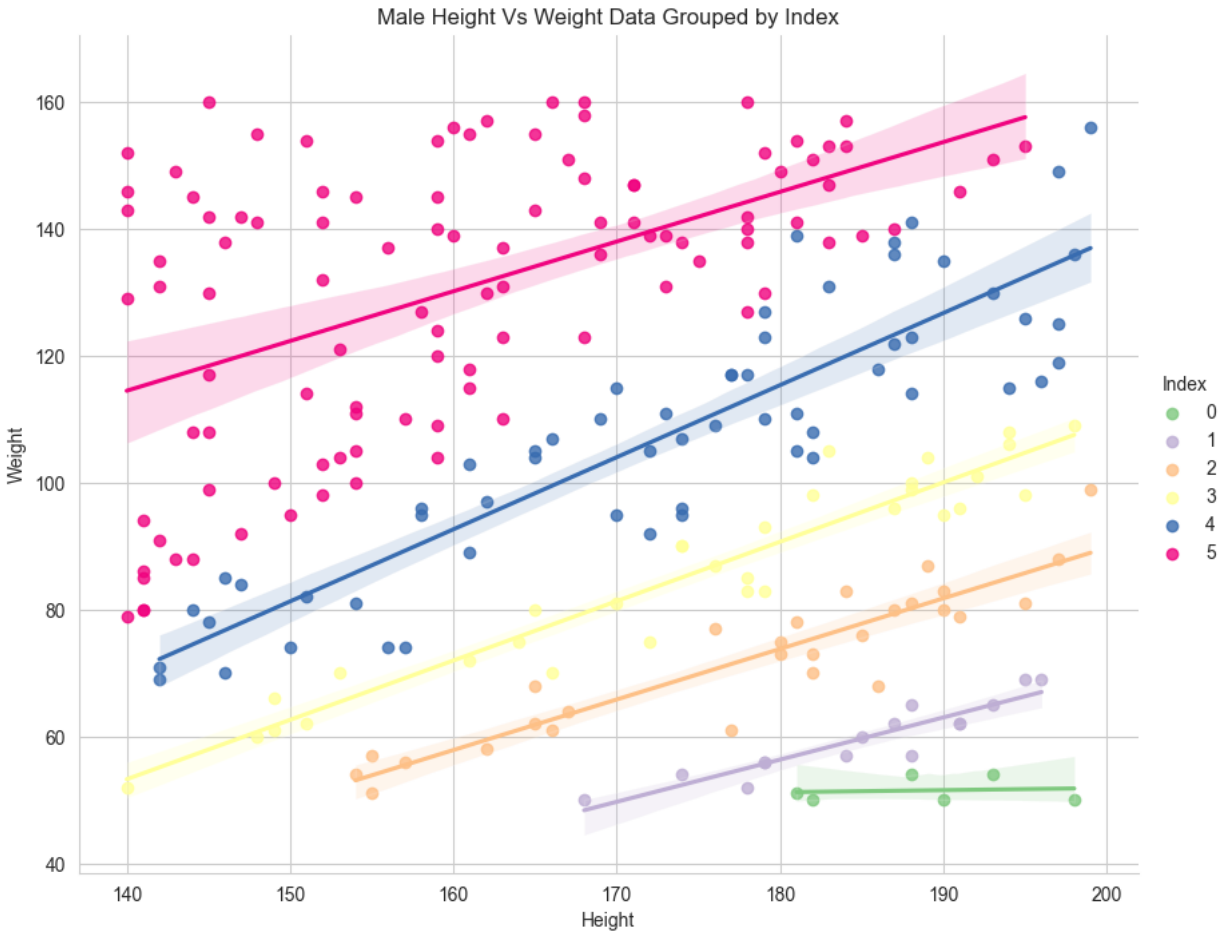
```
groups = data_visual.groupby('Status')

from mpl_toolkits.mplot3d import Axes3D
colors = ['#e41a1c','#377eb8','#4daf4a','#984ea3','#ff7f00','#ffff33']
fig = plt.figure(figsize=(10,8))
ax = fig.add_subplot(111, projection='3d')

# ax.scatter(data_visual['Height'],data_visual['Weight'] , data_visual['gender_lbl'],
#            c=data_visual['Index'],
#            cmap=matplotlib.colors.ListedColormap(colors))


for name, group in groups:
    ax.scatter(group.Height, group.Weight, group.gender_lbl, label=name)
ax.set_xlabel('Height')
ax.set_ylabel('Weight')
ax.set_zlabel('Gender : 1(Male)  0(Female)')
ax.set_title('3d plot BMI')

box = ax.get_position()
ax.set_position([box.x0, box.y0, box.width * 0.8, box.height])
ax.legend(loc='center left', bbox_to_anchor=(1, 0.5), prop={'size': 15})
plt.show()
```

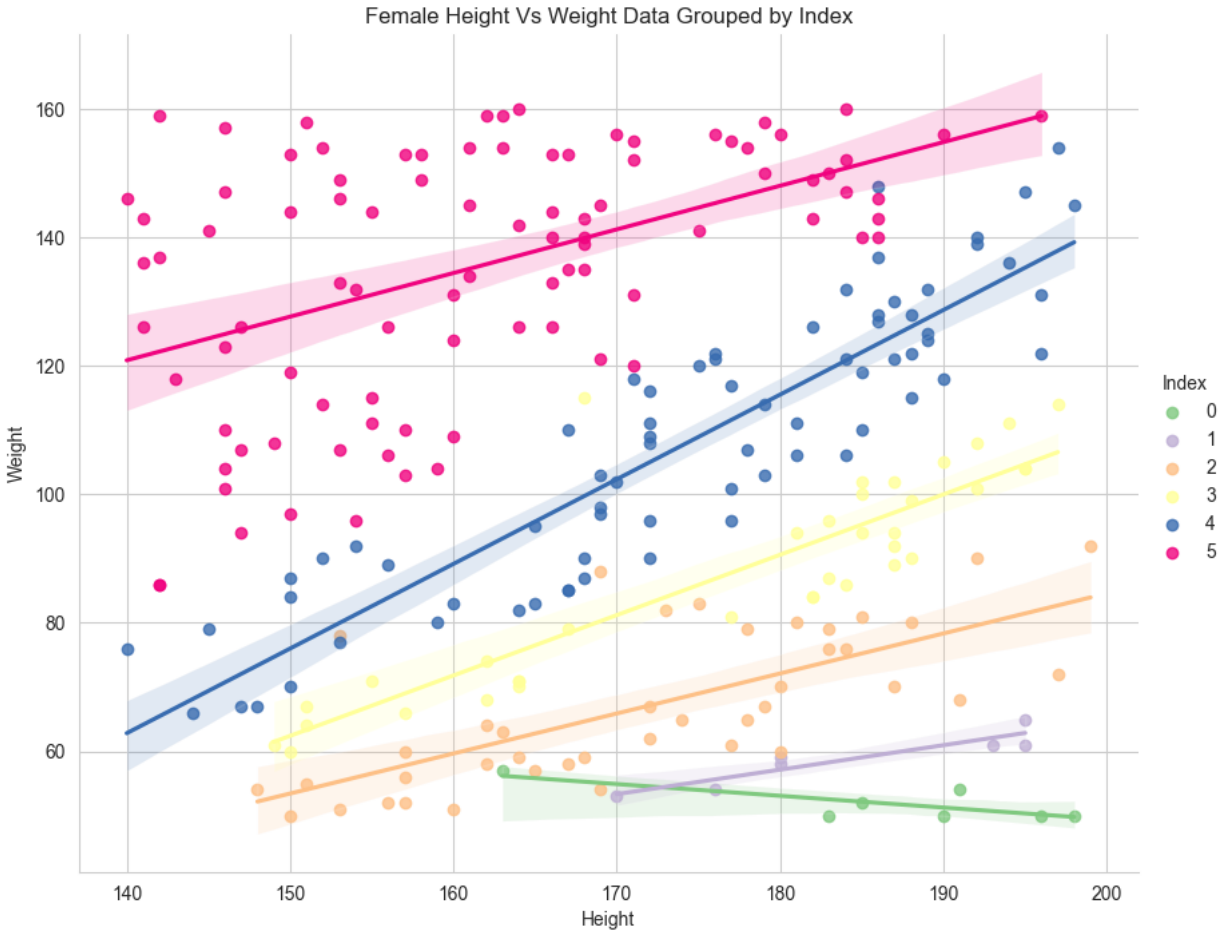


In [ ]:

In [44]:
```
male_data = data[data['Gender']=='Male']
female_data = data[data['Gender']=='Female']
sns.lmplot(x='Height', y='Weight', hue='Index', data=male_data,
           fit_reg=True, height=7, aspect=1.25,palette='Accent')
ax = plt.gca()
ax.set_title("Male Height Vs Weight Data Grouped by Index")

sns.lmplot(x='Height', y='Weight', hue='Index', data=female_data,
           fit_reg=True, height=7, aspect=1.25,palette='Accent')
ax = plt.gca()
ax.set_title("Female Height Vs Weight Data Grouped by Index")
```

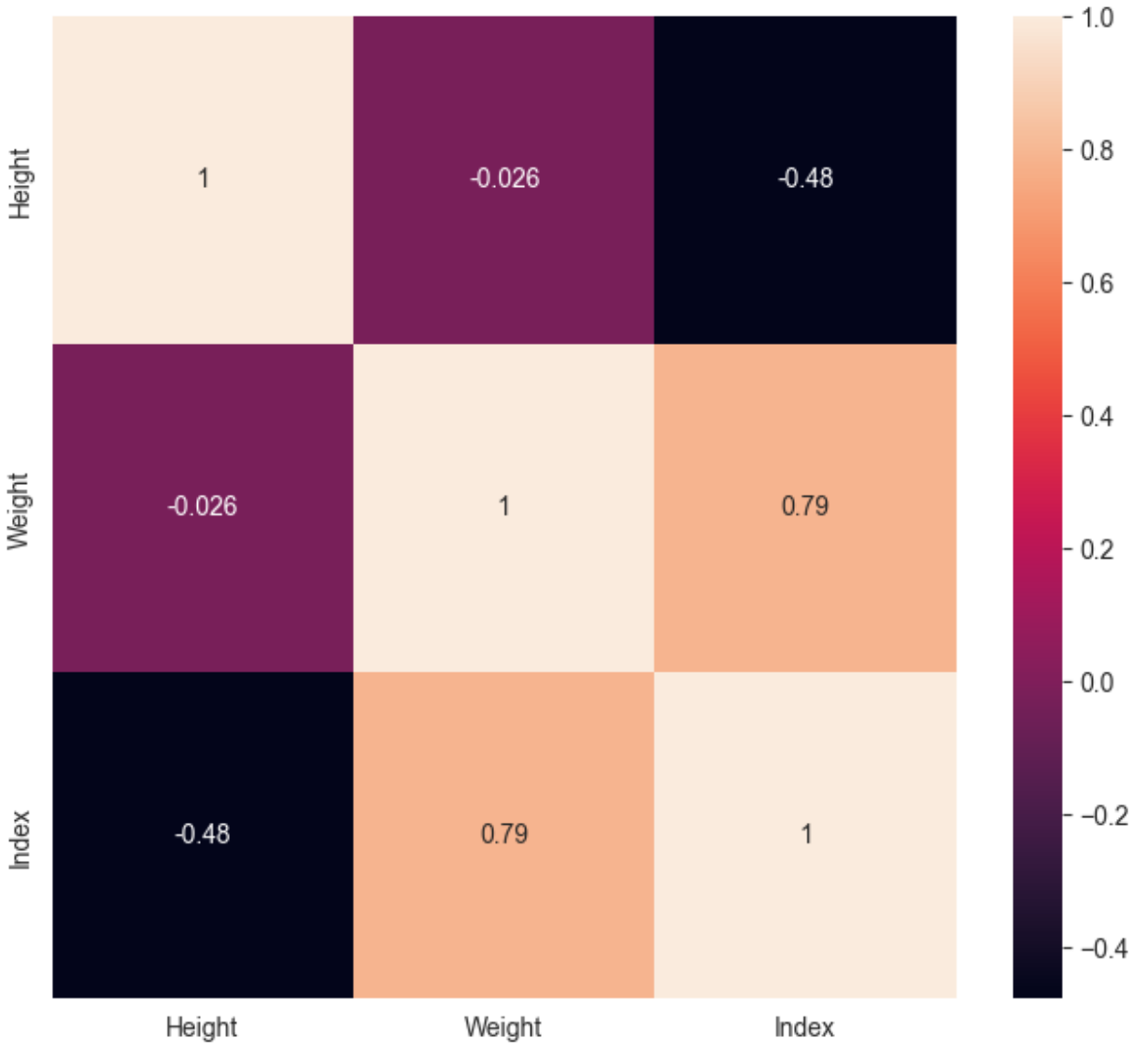
Out[44]:
```
Text(0.5, 1.0, 'Female Height Vs Weight Data Grouped by Index')
```


Male Height Vs Weight Data Grouped by Index
Weight
Height
Index
0
1
2
3
4
5
160
140
120
100
80
60
40
140
150
160
170
180
190
200


Female Height Vs Weight Data Grouped by Index
Weight
Height
Index
0
1
2
3
4
5
160
140
120
100
80
60
140
150
160
170
180
190
200

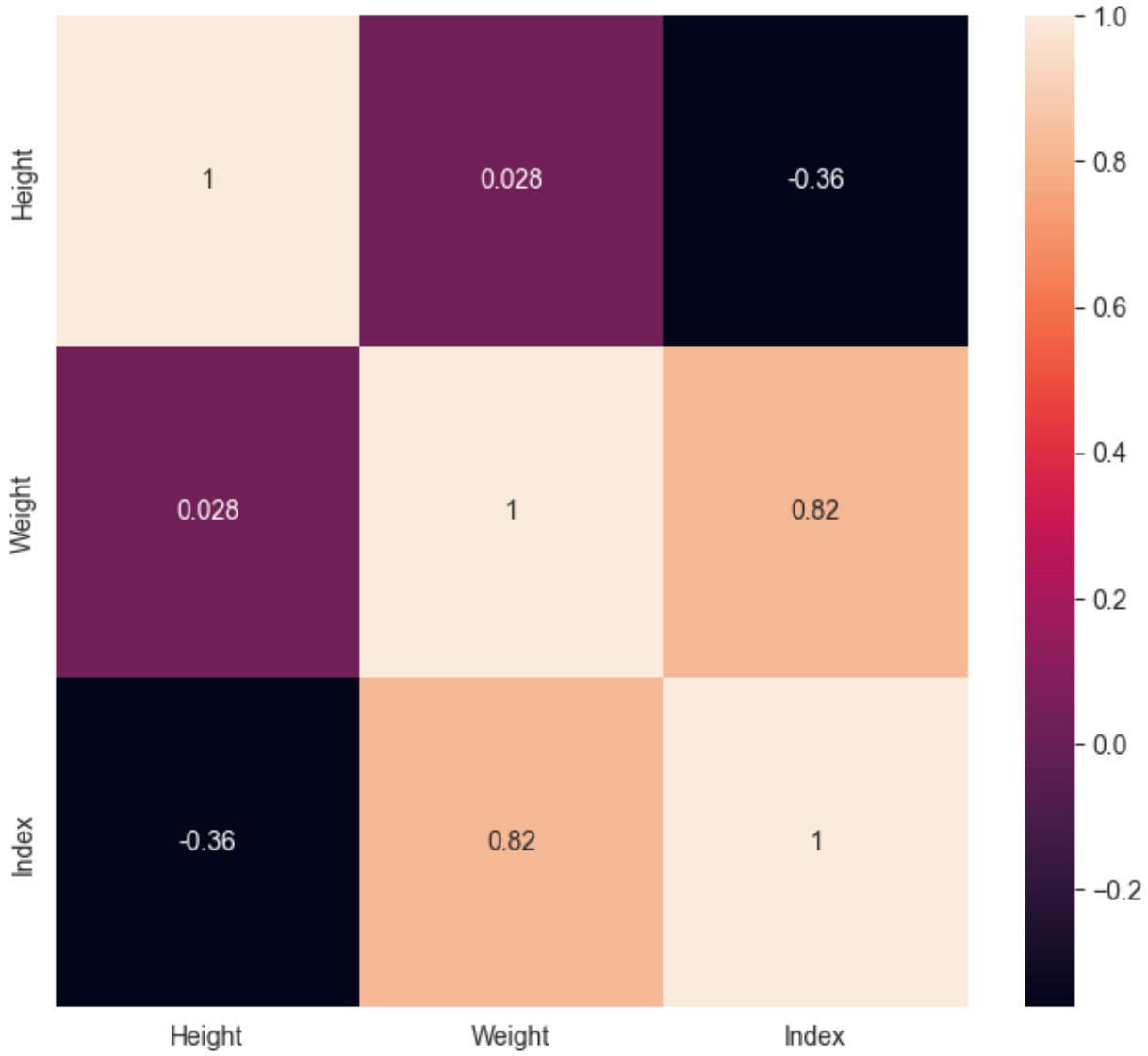
In [40]:
```
male_data = data[data['Gender']=='Male']
male_correlation_matrix = male_data.corr(numeric_only=True)
sns.heatmap(male_correlation_matrix, annot=True)
```

Out[40]: <AxesSubplot: >



In [43]:
```
female_data = data[data['Gender']=='Female']
female_correlation_matrix = female_data.corr(numeric_only=True)
sns.heatmap(female_correlation_matrix, annot=True)
```

Out[43]: <AxesSubplot: >



Train the classifier

In [3]:
```
x = data['Height']
y = data['Weight']
z = data['Index']
```

In [4]:
```
x_train, x_test, y_train, y_test, z_train, z_test = train_test_split(x, y, z, test
```

In [5]:
```
model = LinearRegression()
```

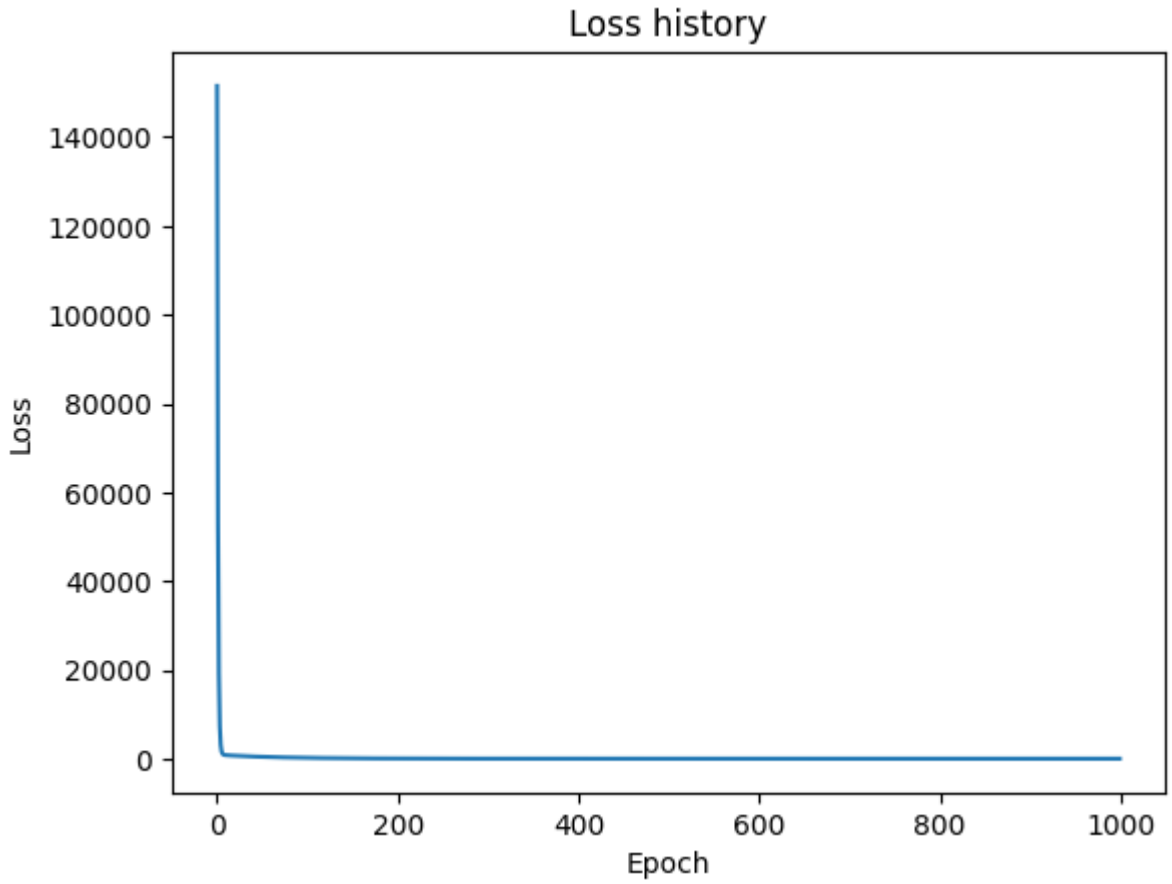
In [6]:
```
model.fit(x_train.tolist(),y_train.tolist(),z_train.tolist())
```

Trained data evaluation

In [7]:
```
prediction_of_train, prediction_integer_of_train = model.predict(x_train.tolist(),
```

In [8]:
```
loss_history = model.error_history
fig = plt.figure()
```

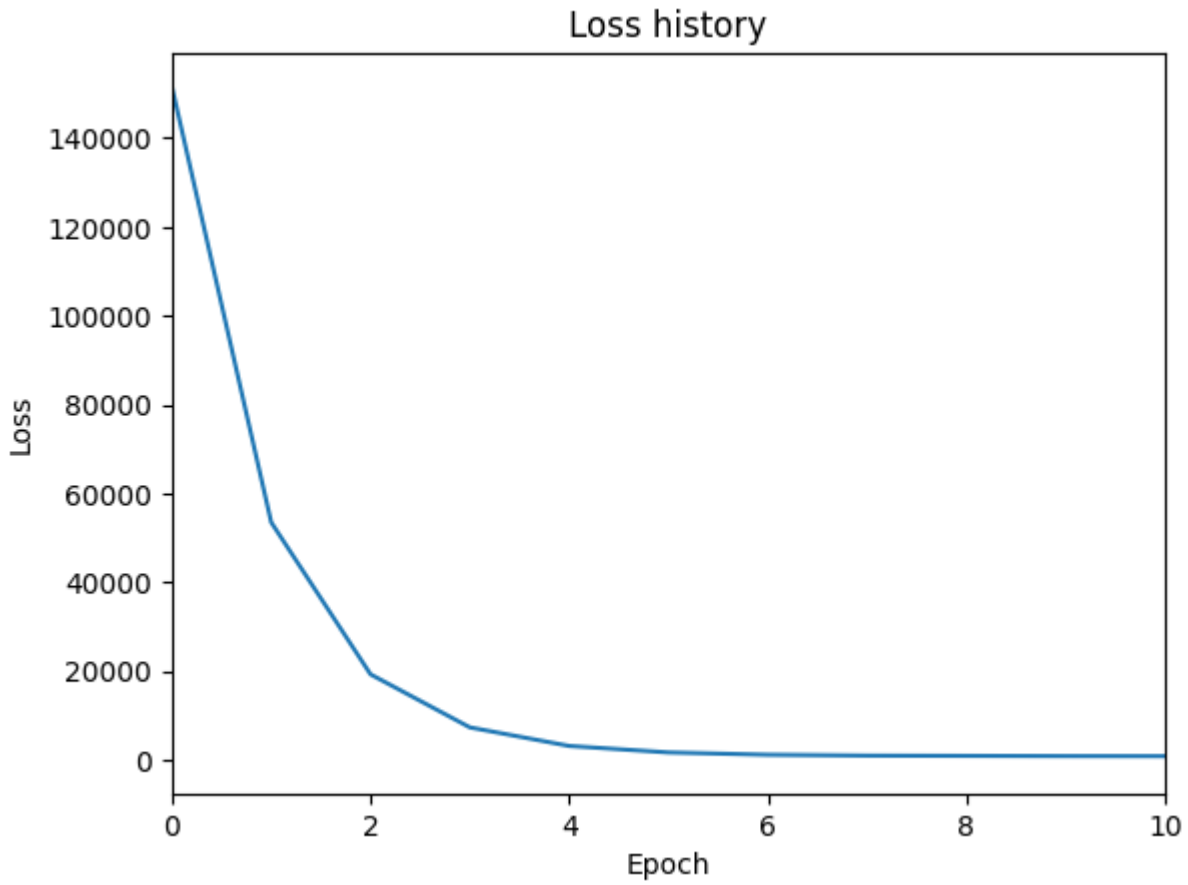
```
ax = fig.add_subplot(111)
ax.plot(loss_history)

plt.title("Loss history")

plt.xlabel("Epoch")
plt.ylabel("Loss")

plt.show()
```



Zoom for first 10 epoch

In [9]:

```
loss_history = model.error_history
fig = plt.figure()

ax = fig.add_subplot(111)
ax.set_xlim(0, 10)

ax.plot(loss_history)

plt.title("Loss history")

plt.xlabel("Epoch")
plt.ylabel("Loss")

plt.show()
```



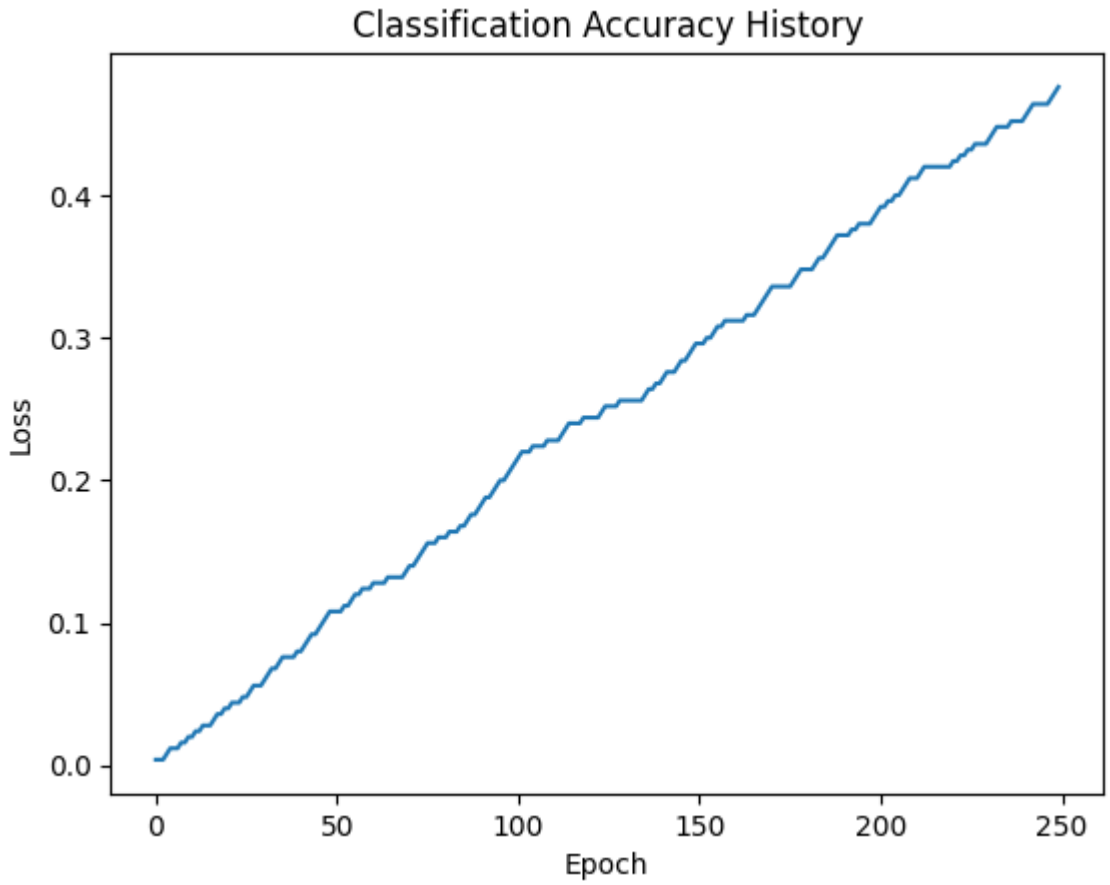
In [25]:
```
train_acc = model.accuracy(z_train.tolist(),prediction_integer_of_train)
print(train_acc)
```

```
0.476
```

In [24]:
```
train_rsquare = model.rsquared(z_train.tolist(),prediction_integer_of_train)
print(train_rsquare)
```

```
0.5150364103553695
```

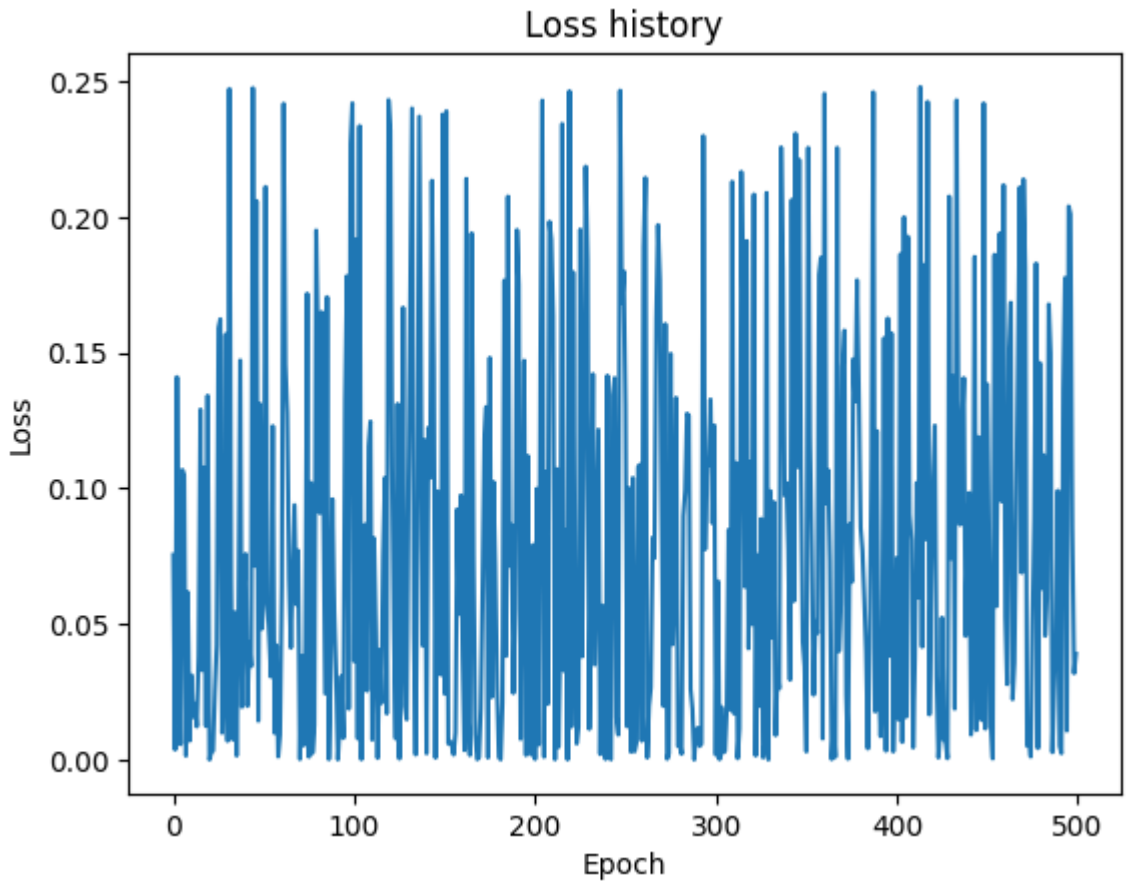
In [16]:
```
acc = model.accuracy_history
fig = plt.figure()

ax = fig.add_subplot(111)

ax.plot(acc)

plt.title("Classification Accuracy History")

plt.xlabel("Epoch")
plt.ylabel("Loss")

plt.show()
```



Test data evaluation

In [17]:
```
prediction, prediction_integer = model.predict(x_test.tolist(),y_test.tolist())
```

In [18]:
```
loss_history = model.test_error_history

fig = plt.figure()
ax = fig.add_subplot(111)
ax.plot(loss_history)

plt.title("Loss history")

plt.xlabel("Epoch")
plt.ylabel("Loss")

plt.show()
```



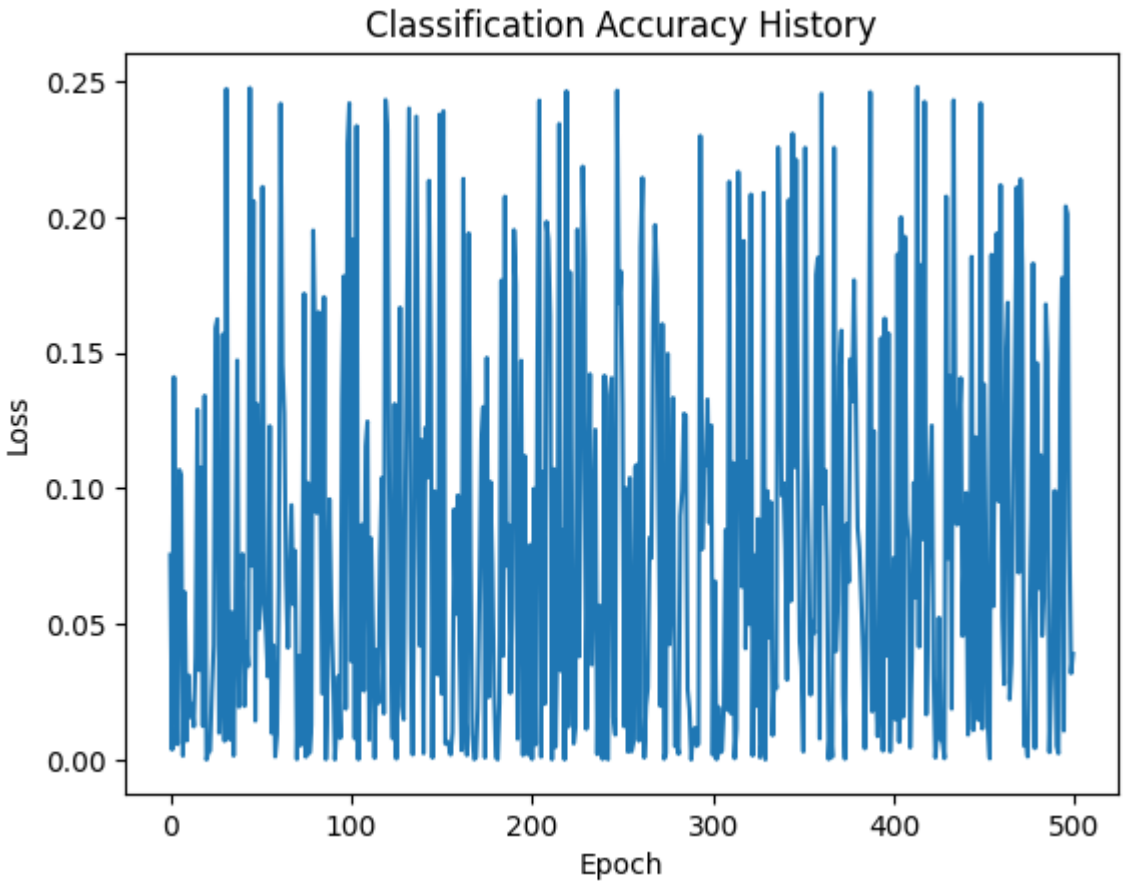
In [22]:
```
test_acc = model.accuracy(z_test.tolist(),prediction_integer)
print(test_acc)
```

```
0.46
```

In [23]:
```
test_rsquare = model.rsquared(z_test.tolist(),prediction_integer)
print(test_rsquare)
```

```
0.6260950074781
```

In [21]:
```
acc = model.accuracy_history
fig = plt.figure()

ax = fig.add_subplot(111)

ax.plot(loss_history)

plt.title("Classification Accuracy History")

plt.xlabel("Epoch")
plt.ylabel("Loss")

plt.show()
```



YORUMLAMA

Yazmış olduğum lineer regresyon modelinin çıktılarına bakınca modelin overfitlemediğini, hatta test verisinde daha iyi çalıştığını söyleyebilirim. Modelin çalışmasının iyi ama çok iyi olmamasının sebebi verilerin %50'si ile eğitmiş olmamdan dolayı olabilir. Başka bir sebep olarak regresyon sonuçlarını en yakın tam sayıya yuvarlayıp classification probleme benzettiğim bu çıktılarda, sayının diğer kısma yuvarlanması da modelin classifcation anlamında iyi çalışmamasına neden oldu. Çıktılara baktığımda en yakın 2 tamsayıdan yanlış olanın çokça seçildiğini farkettim (3.4 olan sayı 3'e yuvarlanıyor fakat gerçek değeri 4). Dolayısıyla modelin daha iyi öğrenmesiyle de bu problemin üstesinden gelinerek classification çıktıları daha güvenilir olabilir. Train edilirkenki loss ve accuracy değerlerinin grafikleştirilmesi, model kendini geliştirdiği için anlamlı bir çıktı ifade ederken; test verilerinden elde ettiğim grafikler anlamlı bir çıktı ifade etmedi. Bu modelin daha iyi çalışması için gender değişkenini kullanmakta etkili olabilir.