MACHINE LEARNING PROJECT PHASE 1

Data Preprocessing:

- **Importing Necessary Libraries and loading the dataset.**

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
```

```
In [3]: #Loading the dataset

        data=pd.read_csv('Heart_Disease_Prediction.csv')

        #Verifying the output by printing first5 rows of the dataset

        data.head(6)
Out[3]:
```

	Age	Sex	Chest pain type	BP	Cholesterol	FBS over 120	EKG results	Max HR	Exercise angina	ST depression	Slope of ST	Number of vessels fluro	Thallium	Heart Disease
0	70	1	4	130	322	0	2	109	0	2.4	2	3	3	Presence
1	67	0	3	115	564	0	2	160	0	1.6	2	0	7	Absence
2	57	1	2	124	261	0	0	141	0	0.3	1	0	7	Presence
3	64	1	4	128	263	0	0	105	1	0.2	2	1	7	Absence
4	74	0	2	120	269	0	2	121	1	0.2	1	1	3	Absence
5	65	1	4	120	177	0	0	140	0	0.4	1	0	7	Absence

- **Checking the size of the dataset**

```
In [4]: data.shape
Out[4]: (270, 14)
```

Inference: This dataset contains 270 rows and 14 columns including the target variable.

- **Checking the type of each feature in the dataset**

```
In [5]: data.dtypes
Out[5]: Age                          int64
        Sex                          int64
        Chest pain type              int64
        BP                           int64
        Cholesterol                  int64
        FBS over 120                 int64
        EKG results                  int64
        Max HR                       int64
        Exercise angina              int64
        ST depression              float64
        Slope of ST                  int64
        Number of vessels fluro      int64
        Thallium                     int64
        Heart Disease               object
        dtype: object
```

Inference: Out of the 14 features 12 features are of int types , 1 feature (ST Depression) is of float type and the target variable is of type string

- **Checking if the dataset contains any missing data**

```
In [8]: data.isnull()
Out[8]:
```

	Age	Sex	Chest pain type	BP	Cholesterol	FBS over 120	EKG results	Max HR	Exercise angina	ST depression	Slope of ST	Number of vessels fluro	Thallium	Heart Disease
0	False	False	False	False	False	False	False	False	False	False	False	False	False	False
1	False	False	False	False	False	False	False	False	False	False	False	False	False	False
2	False	False	False	False	False	False	False	False	False	False	False	False	False	False
3	False	False	False	False	False	False	False	False	False	False	False	False	False	False
4	False	False	False	False	False	False	False	False	False	False	False	False	False	False
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
265	False	False	False	False	False	False	False	False	False	False	False	False	False	False
266	False	False	False	False	False	False	False	False	False	False	False	False	False	False
267	False	False	False	False	False	False	False	False	False	False	False	False	False	False
268	False	False	False	False	False	False	False	False	False	False	False	False	False	False
269	False	False	False	False	False	False	False	False	False	False	False	False	False	False

270 rows × 14 columns

Inference: The dataset does not contain any missing data.

- **Converting target label to binary values using one hot encoding**

```python
from sklearn.preprocessing import OneHotEncoder



enc=OneHotEncoder()

enc_data=pd.DataFrame(enc.fit_transform(data[['Heart Disease Predicted']]).toarray())
new_data=data.join(enc_data)
new_data.drop('Heart Disease', inplace=True, axis=1)

new_data.drop('Heart Diease Predicted', inplace=True, axis=1)
```

Output:

```python
new_data.head(5)
```

	Age	Sex	Chest pain type	BP	Cholesterol	FBS over 120	EKG results	Max HR	Exercise angina	ST depression	Slope of ST	Number of vessels fluro	Thallium	Heart Disease Predicted	0	1
0	70	1	4	130	322	0	2	109	0	2.4	2	3	3	1	0.0	1.0
1	67	0	3	115	564	0	2	160	0	1.6	2	0	7	0	1.0	0.0
2	57	1	2	124	261	0	0	141	0	0.3	1	0	7	1	0.0	1.0
3	64	1	4	128	263	0	0	105	1	0.2	2	1	7	0	1.0	0.0
4	74	0	2	120	269	0	2	121	1	0.2	1	1	3	0	1.0	0.0

Type of each feature after one hot encoding:

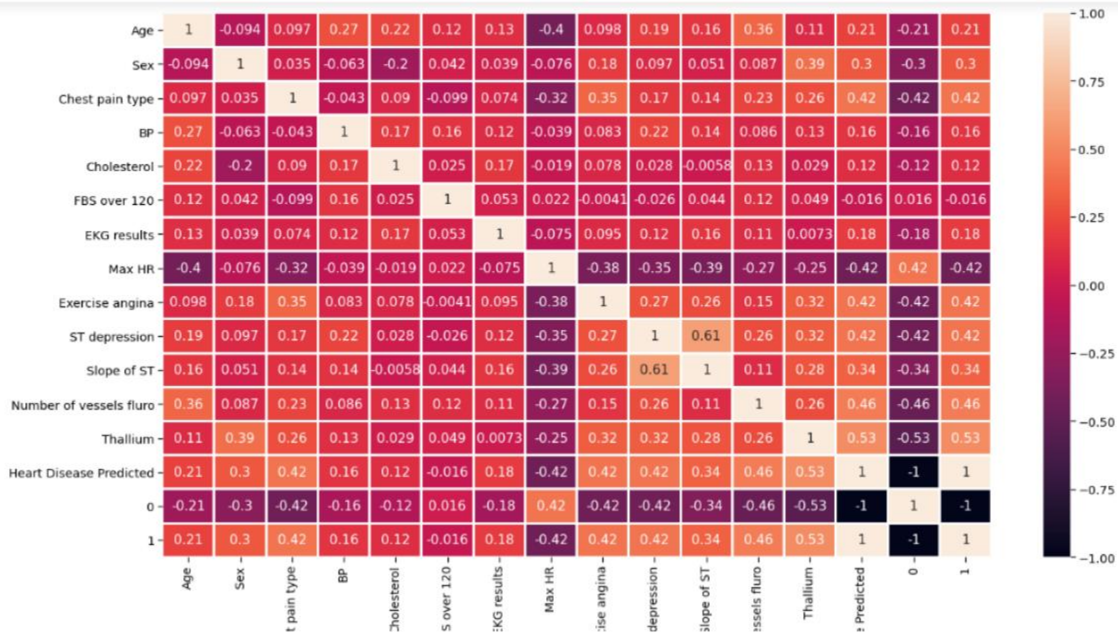
```python
new_data.dtypes
```

```
Age                          int64
Sex                          int64
Chest pain type              int64
BP                           int64
Cholesterol                  int64
FBS over 120                 int64
EKG results                  int64
Max HR                       int64
Exercise angina              int64
ST depression              float64
Slope of ST                  int64
Number of vessels fluro      int64
Thallium                     int64
Heart Disease Predicted       int8
0                          float64
1                          float64
dtype: object
```

Data Summarization:

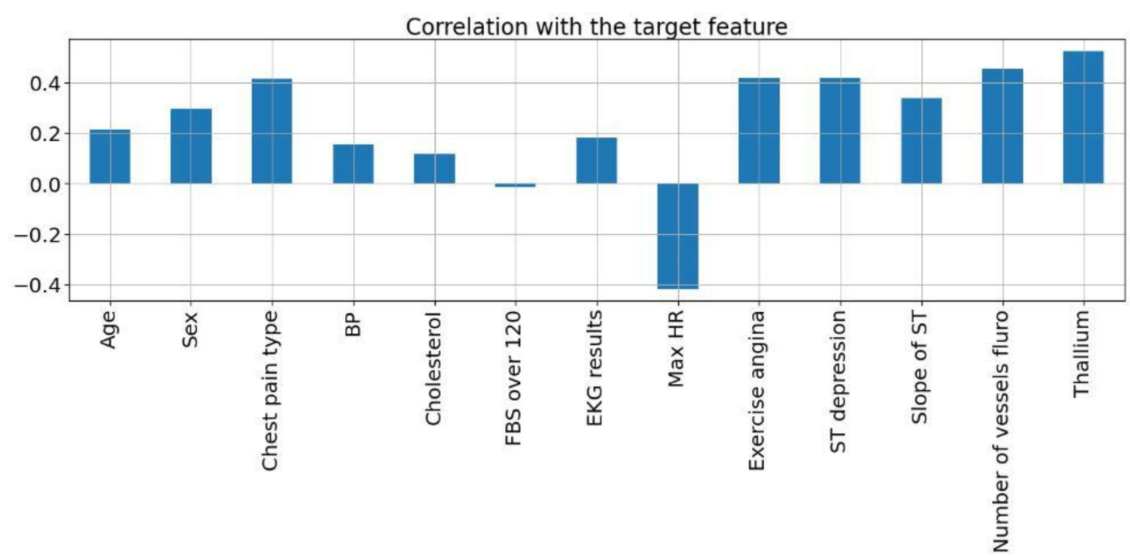
- **Checking the correlation between various features of the dataset.**

```python
import seaborn as sns

plt.figure(figsize=(20,12))
sns.set_context('notebook',font_scale = 1.3)
sns.heatmap(new_data.corr(),annot=True,linewidth =2)
plt.tight_layout()
```



- **Checking the correlation of the target variable**

```python
sns.set_context('notebook',font_scale = 2.3)
new_data.drop('Heart Disease Predicted', axis=1).corrwith(data['Heart Disease Predicted']).plot(kind='bar', grid=True,
                                                                          figsize=(20, 10), title="Correlation with the target feature")
plt.tight_layout()
```



Inference: 1 feature ("Max Hr") is negatively correlated with the target feature and all other features are positively correlated with the target feature.

- **Understanding the statistical details of the data**

```
data.describe()
```

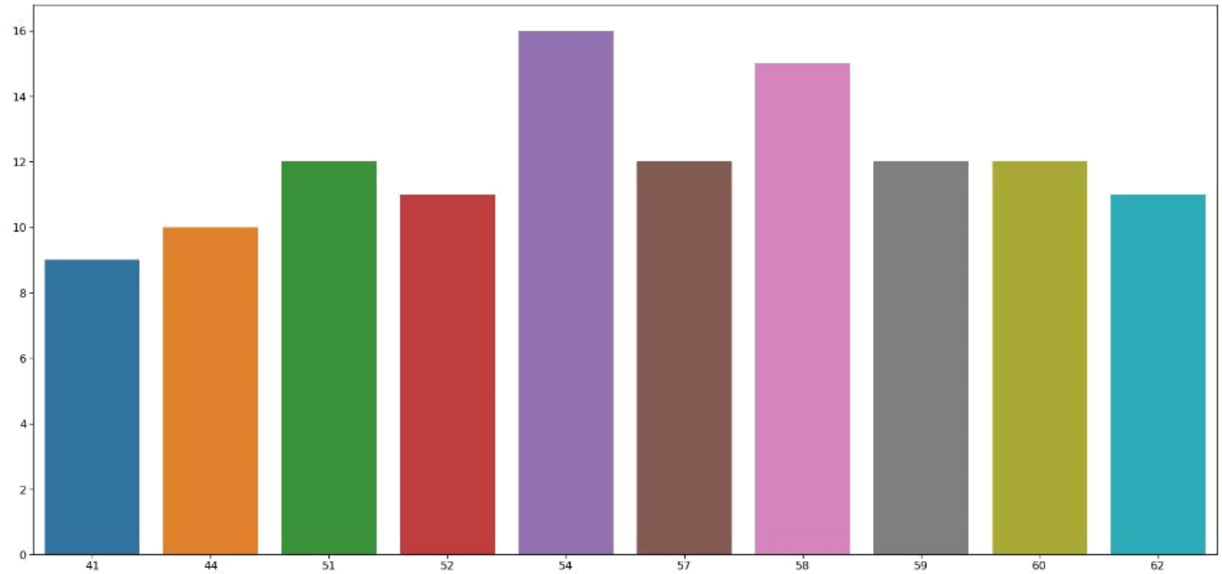
	Age	Sex	Chest pain type	BP	Cholesterol	FBS over 120	EKG results	Max HR	Exercise angina	ST depression	Slope of ST	Number of vessels fluro	Thallium	Heart Disease Predicted
count	270.000000	270.000000	270.000000	270.000000	270.000000	270.000000	270.000000	270.000000	270.000000	270.00000	270.000000	270.000000	270.000000	270.000000
mean	54.433333	0.677778	3.174074	131.344444	249.659259	0.148148	1.022222	149.677778	0.329630	1.05000	1.585185	0.670370	4.696296	0.444444
std	9.109067	0.468195	0.950090	17.861608	51.686237	0.355906	0.997891	23.165717	0.470952	1.14521	0.614390	0.943896	1.940659	0.497827
min	29.000000	0.000000	1.000000	94.000000	126.000000	0.000000	0.000000	71.000000	0.000000	0.00000	1.000000	0.000000	3.000000	0.000000
25%	48.000000	0.000000	3.000000	120.000000	213.000000	0.000000	0.000000	133.000000	0.000000	0.00000	1.000000	0.000000	3.000000	0.000000
50%	55.000000	1.000000	3.000000	130.000000	245.000000	0.000000	2.000000	153.500000	0.000000	0.80000	2.000000	0.000000	3.000000	0.000000
75%	61.000000	1.000000	4.000000	140.000000	280.000000	0.000000	2.000000	166.000000	1.000000	1.60000	2.000000	1.000000	7.000000	1.000000
max	77.000000	1.000000	4.000000	200.000000	564.000000	1.000000	2.000000	202.000000	1.000000	6.20000	3.000000	3.000000	7.000000	1.000000

Data Visualization:

➢ **Analyzing Individual features of the dataset.**

- **"Age" Feature Analysis (Checking 10 ages with their counts)**

```
plt.figure(figsize=(25,12))
sns.set_context('notebook',font_scale = 1.5)
sns.barplot(x=new_data['Age'].value_counts()[:10].index,y=new_data['Age'].value_counts()[:10].values)
plt.tight_layout()
```



Inference: 58 Age column has the highest frequency

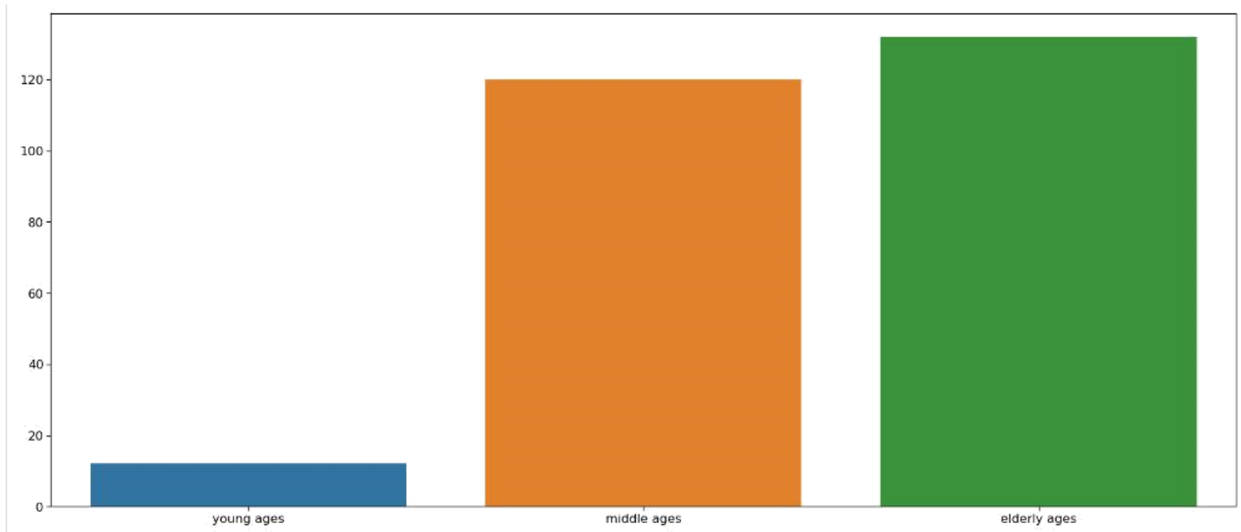
- Checking the range of ages in the dataset

```
minAge=min(new_data['Age'])
maxAge=max(new_data['Age'])
meanAge=new_data['Age'].mean()
print('Minimum Age :',minAge)
print('Maximum Age :',maxAge)
print('Mean Age :',meanAge)
```

```
Minimum Age : 29
Maximum Age : 77
Mean Age : 54.43333333333333
```

- Dividing Age feature into three different categories and plotting the graph

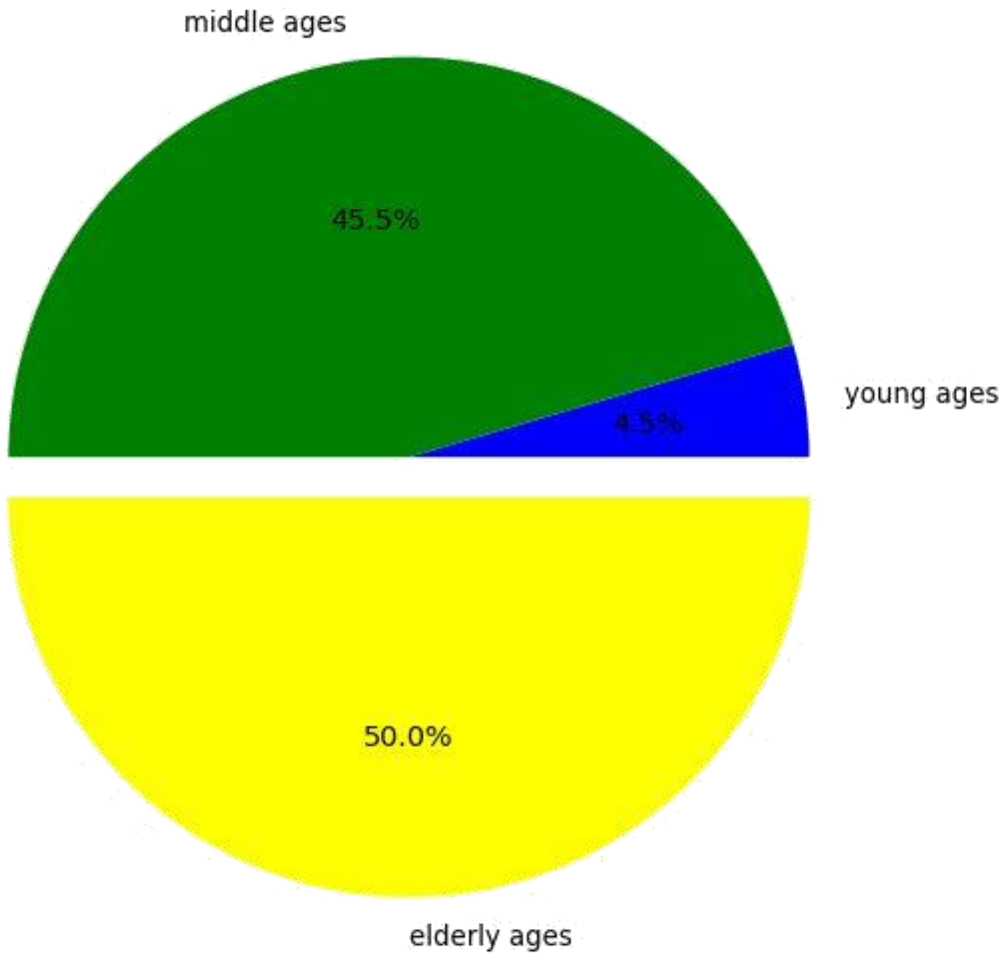
```
Young = new_data[(new_data['Age']>=29)&(new_data['Age']<40)]
Middle = new_data[(new_data['Age']>=40)&(new_data['Age']<55)]
Elder = new_data[(new_data['Age']>55)]

plt.figure(figsize=(23,10))
sns.set_context('notebook',font_scale = 1.5)
sns.barplot(x=['young ages','middle ages','elderly ages'],y=[len(Young),len(Middle),len(Elder)])
plt.tight_layout()
```



Inference: From the above graph we can infer that elder people are the most affected by the heart disease and the younger ones are the least affected,

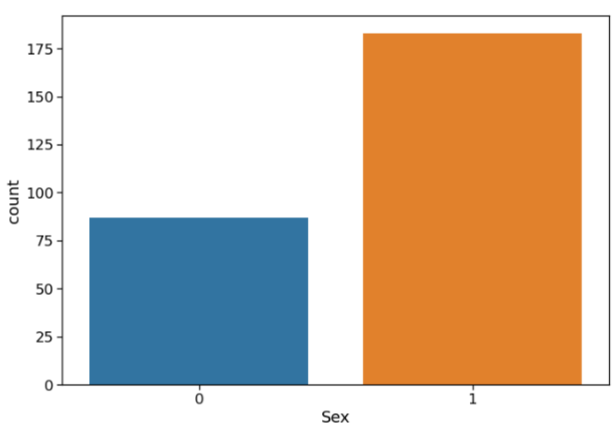
- **Plotting pie chart of people belonging to different age categories**

```
colors = ['blue','green','yellow']
explode = [0,0,0.1]
plt.figure(figsize=(10,10))
sns.set_context('notebook',font_scale = 1.2)
plt.pie([len(Young),len(Middle),len(Elder)],labels=['young ages','middle ages','elderly ages'],explode=explode,colors=colors
plt.tight_layout()
```



- **“Sex” Feature Analysis**

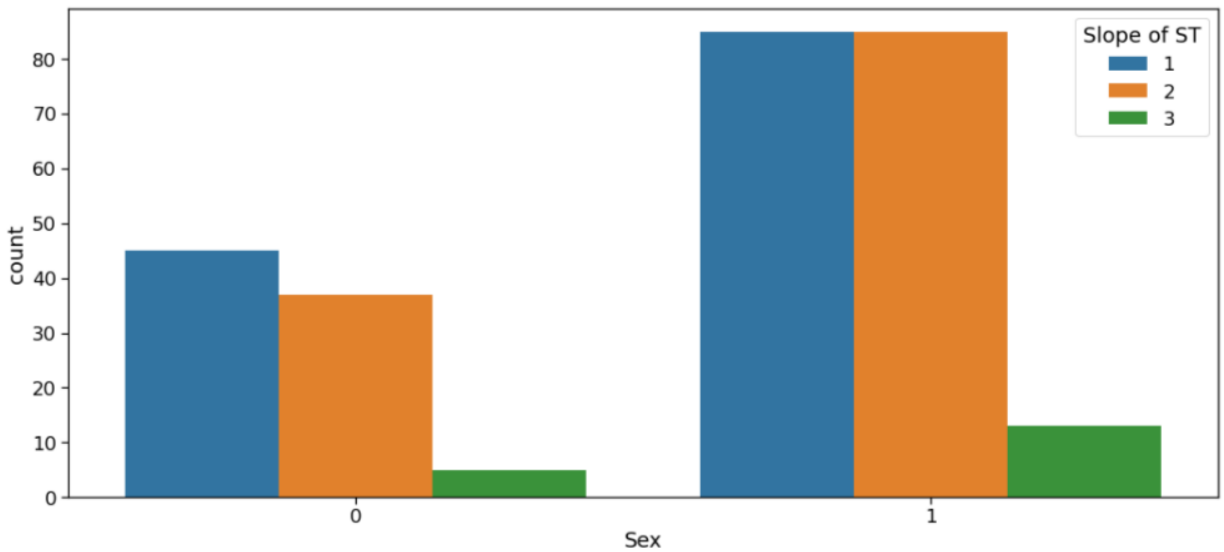
```
plt.figure(figsize=(18,9))
sns.set_context('notebook',font_scale = 1.5)
sns.countplot(new_data['Sex'])
plt.tight_layout()
```



Inference: Ratio of male to female is approximately 2:1

- **Plotting the relation between "Sex" and "Slope"**

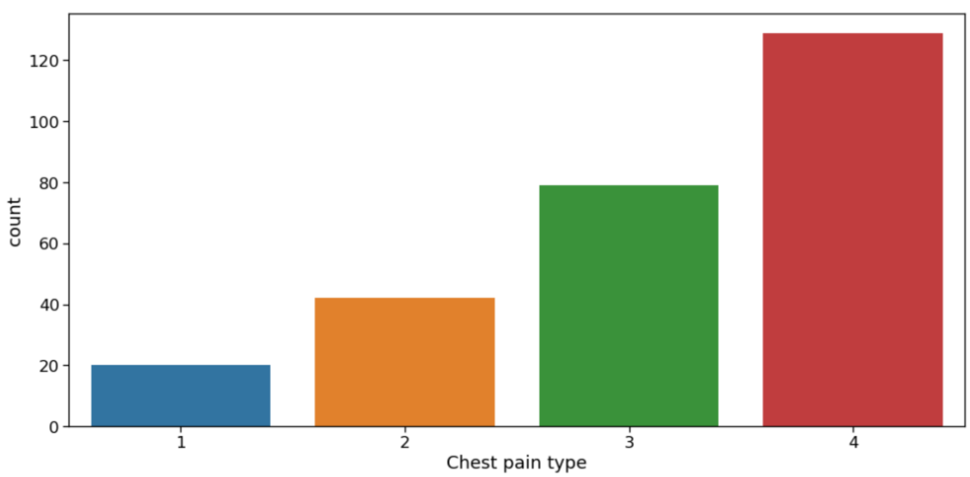
```
plt.figure(figsize=(15,7))
sns.set_context('notebook',font_scale = 1.5)
sns.countplot(data['Sex'],hue=data["Slope of ST"])
plt.tight_layout()
```



Inference: Slope value is higher as in the case of Males(1)

- **"Chest Pain Type" Feature Analysis**

```
plt.figure(figsize=(14,7))
sns.set_context('notebook',font_scale = 1.5)
sns.countplot(data['Chest pain type'])
plt.tight_layout()
```

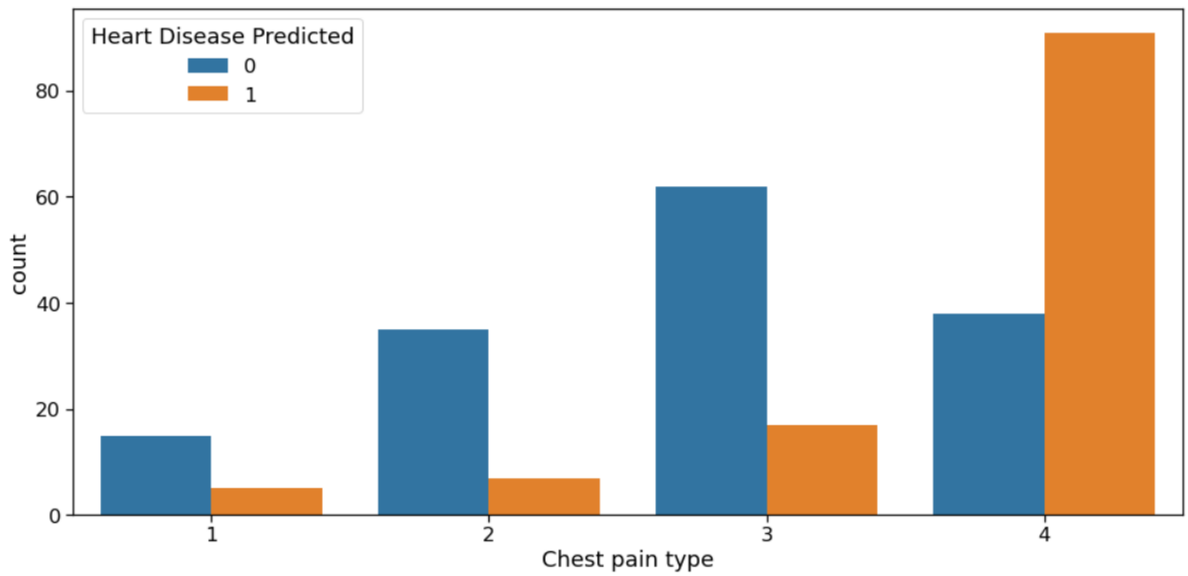


Inference: As seen above, there are 4 types of chest pain

1. Status at least
2. Condition slightly distressed
3. Condition medium problem
4. Condition too bad

- ## Analyzing “Chest Pain” vs Target Label

```
plt.figure(figsize=(14,7))
sns.set_context('notebook',font_scale = 1.5)
sns.countplot(data['Chest pain type'],hue=data["Heart Disease Predicted"])
plt.tight_layout()
```

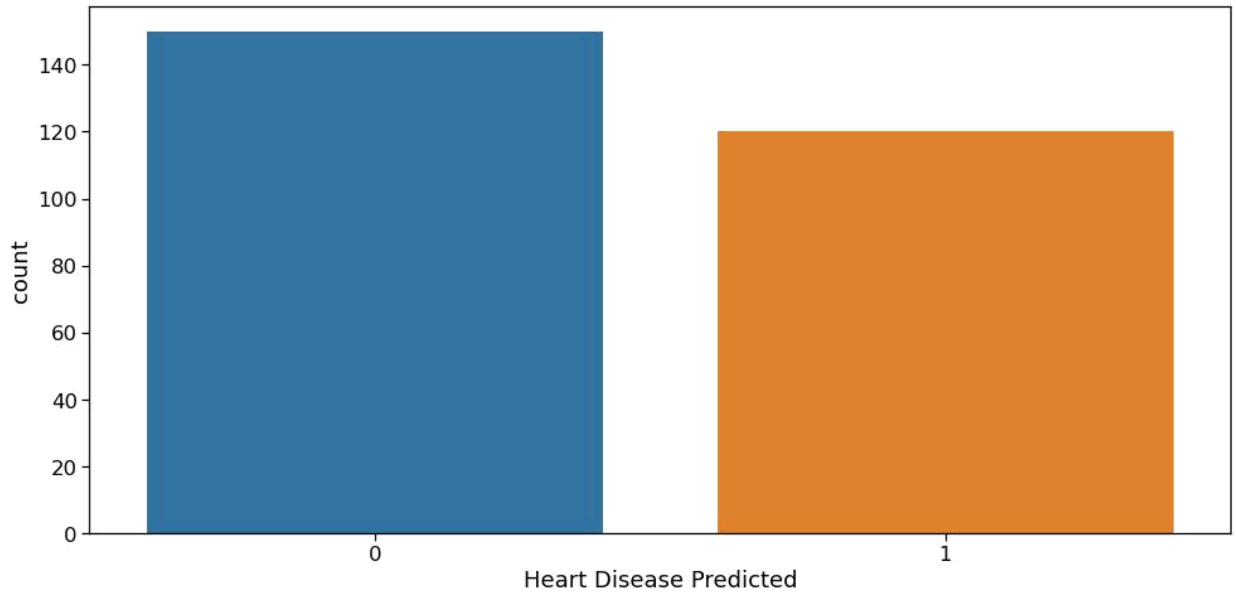


Inference:

★ People having the least chest pain are not likely to have heart disease.
★ People having severe chest pain are likely to have heart disease.
★ Elderly people are most likely to have chest pain.

- ## Analyzing Target Variable

```
plt.figure(figsize=(14,7))
sns.set_context('notebook',font_scale = 1.5)
sns.countplot(new_data['Heart Disease Predicted'])
plt.tight_layout()
```



Inference: The ratio between 1 and 0 is much less than 1.5 which indicates that the target label is not imbalanced.

Links:

Original dataset: https://1drv.ms/u/s!AkrIeHMjcOiBmFnCn5MRdjarUnlD?e=7N6S5B

Cleaned dataset: https://1drv.ms/u/s!AkrIeHMjcOiBmFoGANVkIWR8bTMe?e=feEznZ

Pynb file: https://1drv.ms/u/s!AkrIeHMjcOiBmF4Ipxxh68KdtT15?e=CV2k7M

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