EDA_Haberman_Dataset_V2

October 20, 2018

1 Data Visualizaion on Haberman Dataset

```
9.16 Exercise: Perform EDA on Haberman dataset

Assignment:

Data Visualization with Haberman Dataset

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This is the first assignments on data visualization.

You can get the data from https://www.kaggle.com/gilsousa/habermans-survival-data-set.

try to document every plot and every analysis you do, please refer attached notebook.
Note: Upload both python notebook and pdf version of that notebook
Check this: https://ipython.org/ipython-doc/3/notebook/nbconvert.html  to convert python notebo
```

1. Download Haberman Cancer Survival dataset from Kaggle.
2. Perform following analysis:
    1. High level Statistics of the dataset
        1. Number of Points
        2. Number of Features
        3. Number of Classes
        4. Data-points per class
    2. Explain Objective
    3. Perform Univariate Analysis (to understand which features are useful towards classification)
        1. PDF
        2. CDF
        3. Boxplot
        4. Violin Plots
    4. Perform Bi-variate Analysis (to see if combinations of features are useful in classification)
        1. Scatter Plots

    2. Pair-plots

3. Write your Observation

```
In [1]: # Importing required packages for this analysis
        import pandas as pd # for handling CSV file as data frames
        import seaborn as sns # for pair-plot, box-plot, violin-plot
        import matplotlib.pyplot as plt # for subplots
```

2 Obtain the Data set

```
I have downloaded the dataset from https://www.kaggle.com/gilsousa/habermans-survival-data-set
```

2.1 What is in the given data set

```
In [2]: # read the data set
        df = pd.read_csv('haberman.csv')
        df.head()
```

```
Out[2]:    30  64   1  1.1
        0  30  62   3    1
        1  30  65   0    1
        2  31  59   2    1
        3  31  65   4    1
        4  33  58  10    1
```

2.1.1 Observation

- There is no column name, so nothing able to get from the CSV file.
- Also since there is no column names, one of the data point is considered as column name, which should be corrected
- I think I need to refer data set provider to know more about the data - Kaggle Site

2.2 What is given in the data set (Domain Knowledge)

- From https://www.kaggle.com/gilsousa/habermans-survival-data-set, I can see below information about the given dataset
    - Haberman's Survival Data Set
    - Survival of patients who had undergone surgery for breast cancer
    - The dataset contains cases from a study that was conducted between 1958 and 1970 at the University of Chicago's Billings Hospital on the survival of patients who had undergone surgery for breast cancer.
    - Data
        - Age of patient at time of operation (numerical)
            - Age of the patient when went through Cance Operation
        - Patient's year of operation (year - 1900, numerical)
            - In which year operation for cancer was made

- Number of positive axillary nodes detected (numerical)
  - Link - https://www.cancercenter.com/terms/lymph-nodes/
- Survival status (class attribute)
  - 1 = the patient survived 5 years or longer
  - 2 = the patient died within 5 year

2.2.1 Observation

- Following features are given
  - Age
  - Year Of Operation
  - Number of Nodes found
- Following Label is given
  - Survival Status of that patient

3 Highlevel Statistics - Understand the given Data Set

```
Get the Domain Knowledge to analyse the data in right way
```

3.1 Is the data intact?

3.1.1 Add Column Header

```
In [3]: # Add the column name for easy handling
        df = pd.read_csv('haberman.csv', names=['Age', 'YearOfOp', 'Nodes', 'SurvivalStatus'])
        df.head()
```

```
Out[3]:    Age  YearOfOp  Nodes  SurvivalStatus
        0   30        64      1               1
        1   30        62      3               1
        2   30        65      0               1
        3   31        59      2               1
        4   31        65      4               1
```

```
In [4]: ### Sort data according to year of operation
        # df.sort_values('YearOfOp',inplace=True)
```

3.2 Looking into Data

```
In [5]: # Shape of the data
        df.shape

        # Observation
        # 306 data-points
        # 4 features
```

```
Out[5]: (306, 4)
```

```
In [6]: # Names of the Columns
        df.columns

Out[6]: Index(['Age', 'YearOfOp', 'Nodes', 'SurvivalStatus'], dtype='object')

In [7]: # Whether all the data are numerical?
        df.dtypes

Out[7]: Age                 int64
        YearOfOp            int64
        Nodes               int64
        SurvivalStatus      int64
        dtype: object

In [8]: # look into data description for abnormality
        df.describe()

Out[8]:                Age    YearOfOp       Nodes  SurvivalStatus
        count  306.000000  306.000000  306.000000      306.000000
        mean    52.457516   62.852941    4.026144        1.264706
        std     10.803452    3.249405    7.189654        0.441899
        min     30.000000   58.000000    0.000000        1.000000
        25%     44.000000   60.000000    0.000000        1.000000
        50%     52.000000   63.000000    1.000000        1.000000
        75%     60.750000   65.750000    4.000000        2.000000
        max     83.000000   69.000000   52.000000        2.000000
```

3.3 Number of Data Points, Features

```
In [9]: # Find number of data-points in the given dataset
        df.shape

        # 306 data-poitns found in it
        # 4 Fields found in it

Out[9]: (306, 4)
```

3.4 Number of Classes

```
In [10]: # Find class attributes
         df.SurvivalStatus.unique()

Out[10]: array([1, 2])
```

3.5 Number of Data-Points per class

```
In [11]: # find how many data-points given for each class
         # This is to find whether the given data-set is balanced or not?

         df['SurvivalStatus'].value_counts()
```

```
Out[11]: 1    225
         2     81
         Name: SurvivalStatus, dtype: int64
```

3.6 Age Range of data set

```
In [12]: print(df.Age.min(), df.Age.max())
```

```
30 83
```

3.7 Nodes Range - how many nodes a people might had?

```
In [13]: print(df.Nodes.min(), df.Nodes.max())
         df.Nodes.unique()
```

```
0 52
```

```
Out[13]: array([ 1,  3,  0,  2,  4, 10,  9, 30,  7, 13,  6, 15, 21, 11,  5, 23,  8,
                20, 52, 14, 19, 16, 12, 24, 46, 18, 22, 35, 17, 25, 28])
```

3.8 Observation

- 306 data-points found in the given dataset
- 3 Features
  - Age of person at the time operation,
  - Year in which cancer operation was made
  - Number of Nodes found before operation
  - since all above three are not dependent to each other, those are independent variables
- 1 Label
  - Survival rate of the patient after the operation
    - This depends on above independent variables
  - There are two classes
    - 1
      - patient who survived less than 5 years after operation
    - 2
      - patient who survived more than 5 years after operation
- We have been given an Imbalanced data-set
  - 225 patiens belongs to Class 1
  - 81 patients belongs to Class 2
- All are Numerical
  - Both features and Label are numerical

4 Objective

`Identify/Define our Objective/ Task in this problem?`

From previous observation, it is clear that we need to predict (classify) the patients survival time based on their (1)Age, (2)Year of Operation recorded he had and (3) number of positive swollen lymph cells that he had at that time.

Only two classes of surival given, so it is a Binary Classification problem

Objective: is to classify a new cancer patient's survival rate (less than 5 years or more) using given Age, Year of Operation, Cancer Stage

5 Univariate Analysis

```
In [14]: # Configure SNS plotting
         sns.set_style('whitegrid')
```

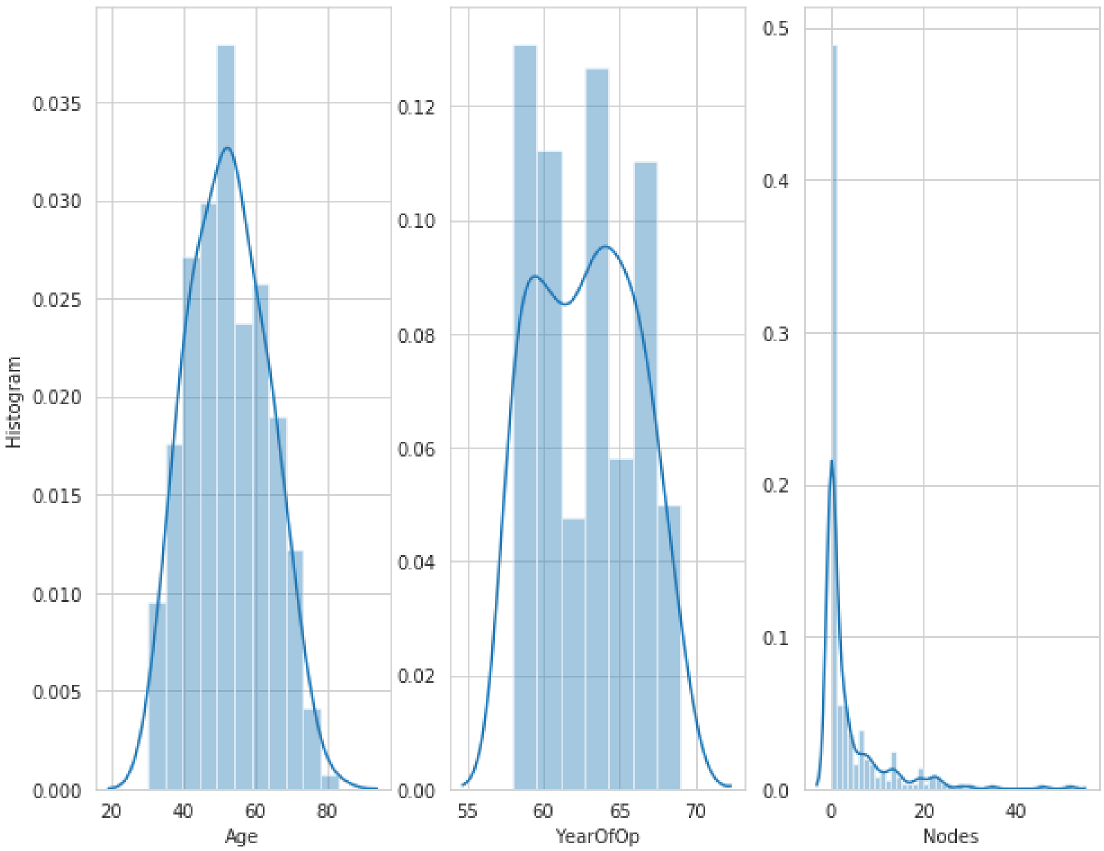
```
In [15]: # Create seprate data frames for each feature against the class
         df_s1 = df.loc[df.SurvivalStatus == 1]
         df_s2 = df.loc[df.SurvivalStatus == 2]
```

5.1 PDF, CDF

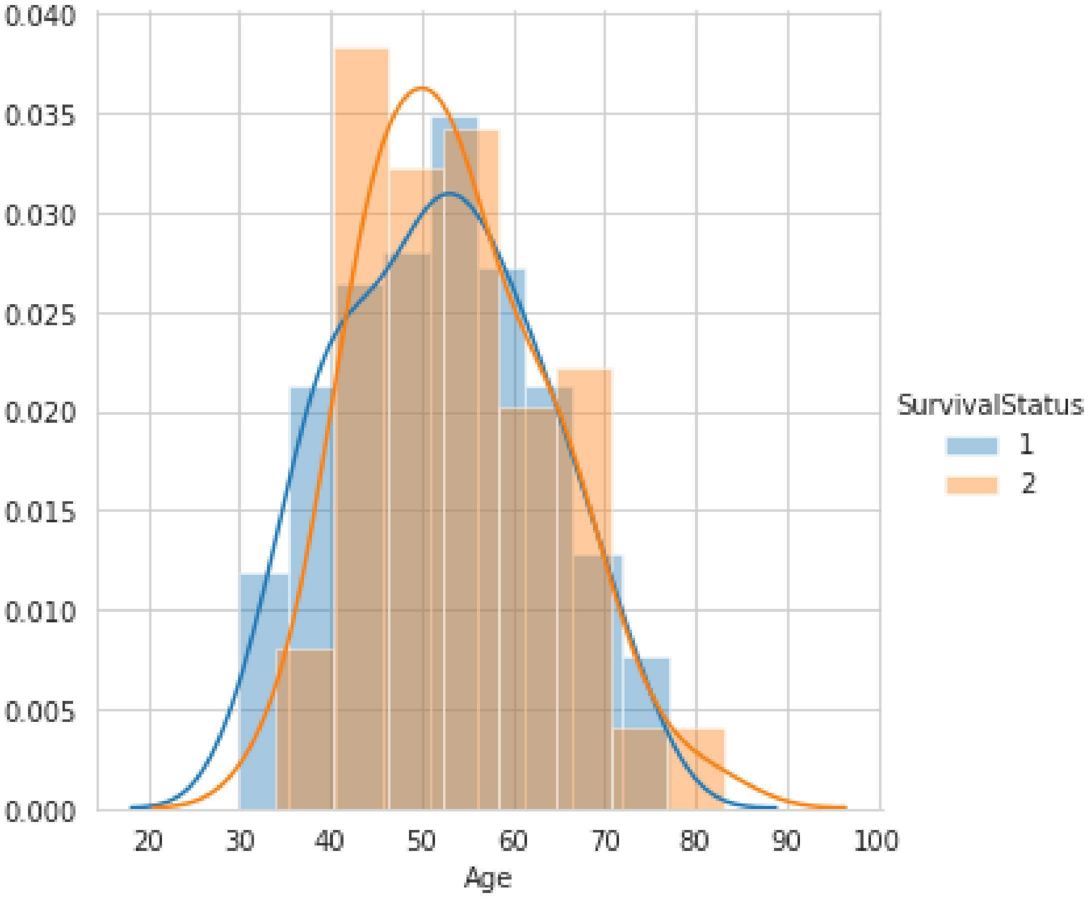
```
In [16]: # PDF
         f, axes = plt.subplots(nrows=1,ncols=3,figsize=(10,8)) # Creating a sub-plot of 1 row

         axes[0].set_ylabel('Histogram')
         sns.distplot(df['Age'], ax=axes[0])
         sns.distplot(df['YearOfOp'], ax=axes[1])
         sns.distplot(df['Nodes'], ax=axes[2])
```

```
/home/mlstudy/anaconda3/envs/mlstudy_1/lib/python3.6/site-packages/scipy/stats/stats.py:1713:
  return np.add.reduce(sorted[indexer] * weights, axis=axis) / sumval
```

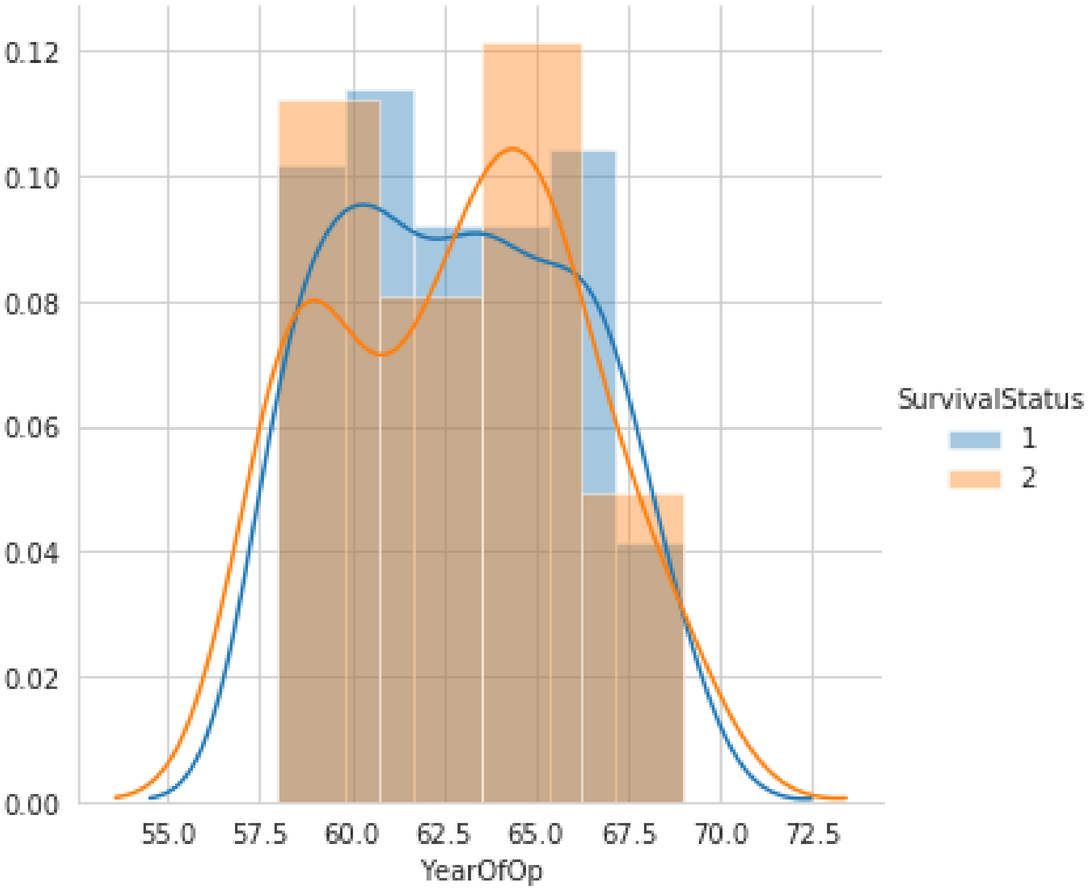
```
Out[16]: <matplotlib.axes._subplots.AxesSubplot at 0x7f325e2dd588>
```



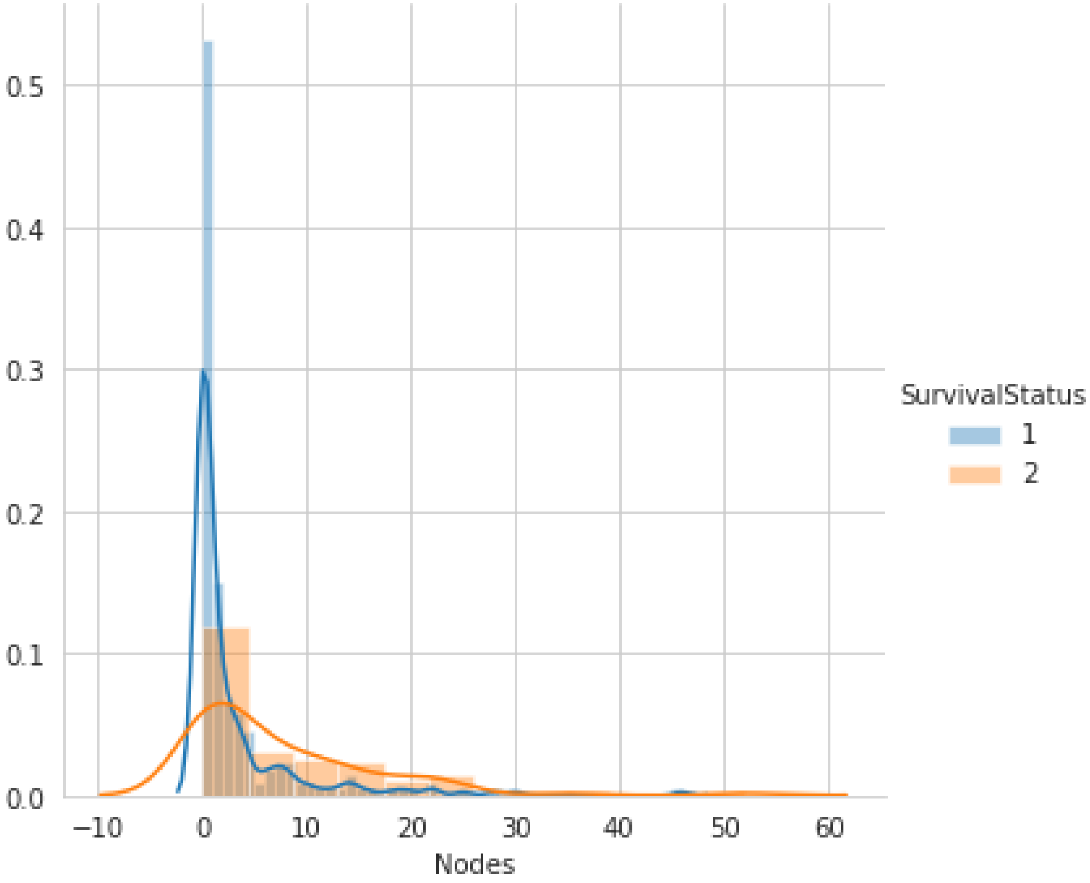
```
In [17]: # # PDF of Age against Survival Status
         # g = sns.FacetGrid(data=df, col='SurvivalStatus', size=5).add_legend()
         # g = g.map(sns.distplot, 'Age')

         # PDF of 'Age' having color variation over survival range
         sns.FacetGrid(df, hue='SurvivalStatus', height=5).map(sns.distplot, "Age").add_legend

Out[17]: <seaborn.axisgrid.FacetGrid at 0x7f325df81b38>
```



```
In [18]: # # PDF of YearOfOp against Survival Status
         # g = sns.FacetGrid(data=df, col='SurvivalStatus', size=5).add_legend()
         # g = g.map(sns.distplot, 'YearOfOp')

         # PDF of 'Year of Operation' having color variation over survival range
         sns.FacetGrid(df, hue='SurvivalStatus', height=5).map(sns.distplot, 'YearOfOp').add_le

Out[18]: <seaborn.axisgrid.FacetGrid at 0x7f325e0ee208>
```



```
In [19]: # # PDF based on Nodes against Survival Status
         # g = sns.FacetGrid(data=df, col='SurvivalStatus', size=5).add_legend()
         # g = g.map(sns.distplot, 'Nodes')

         # PDF of 'Nodes' having color variation over survival range
         sns.FacetGrid(df, hue='SurvivalStatus', height=5).map(sns.distplot, 'Nodes').add_legen

Out[19]: <seaborn.axisgrid.FacetGrid at 0x7f325e032198>
```

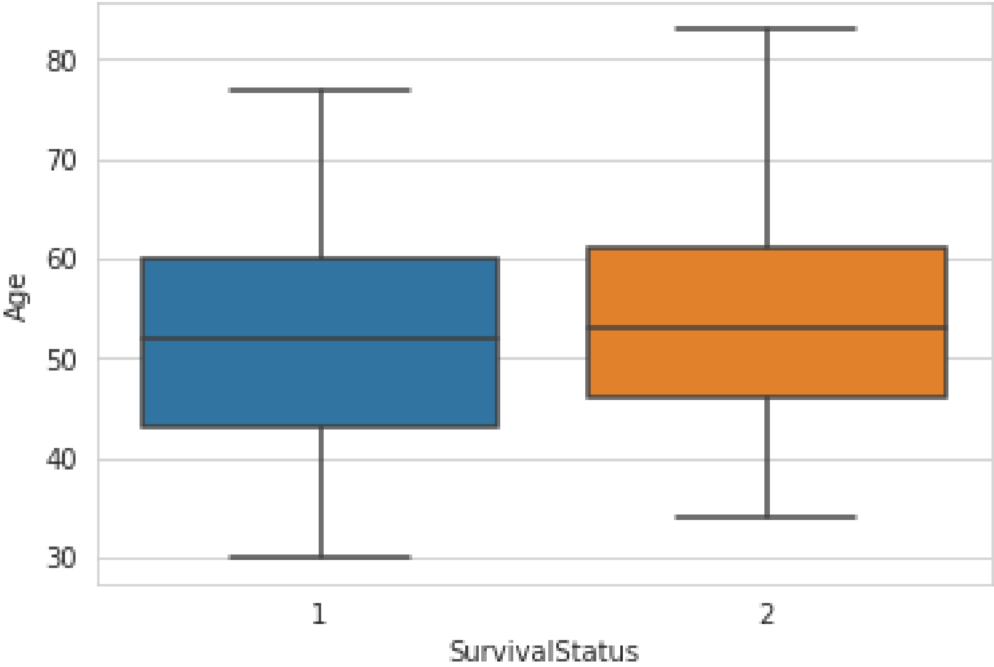


5.1.1 Observation

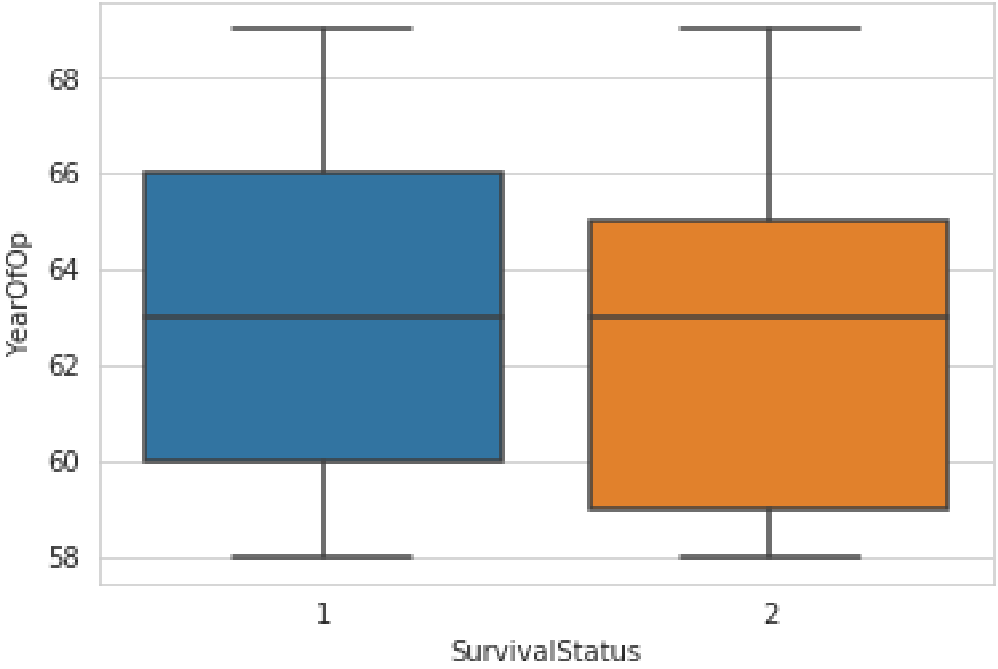
- Age
  - There is no direct relation between Age and Survival Category
  - Almost patients of all age group fall into both survival category. So using, only Age, we can't predict/classify
- Year Of Operation
  - There is no direct relation between Operation Year and Survival Category
  - So using only Year of Operation, we can't predict or we can't assume about their survival rate.
- Nodes
  - PDF is not meaningful in this data (since values starts from 0)
  - People who had more than 25 nodes didn't survive more than 5 years
  - People who had less than 6 nodes survived more thaan 5 years

5.2 Box Plot

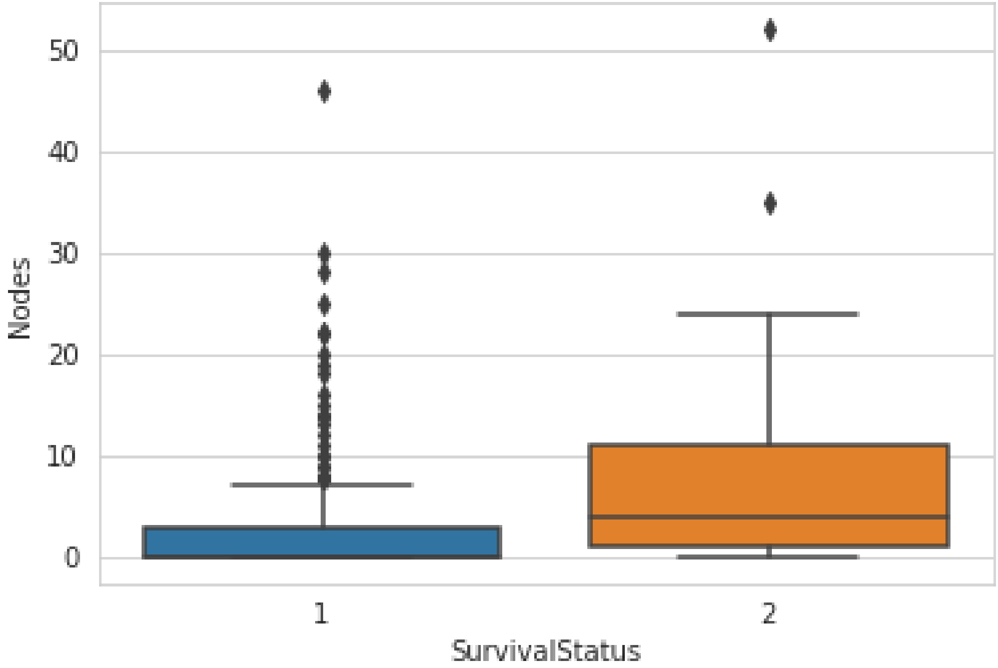
```
In [20]: # Box plot with Age vs SurvivalStatus
         sns.boxplot(data=df, x='SurvivalStatus', y='Age')

Out[20]: <matplotlib.axes._subplots.AxesSubplot at 0x7f325deb79e8>
```



```
In [21]: # Box plot with Age vs SurvivalStatus
         sns.boxplot(data=df, x='SurvivalStatus', y='YearOfOp')

Out[21]: <matplotlib.axes._subplots.AxesSubplot at 0x7f325de48e48>
```



```
In [22]: # Box plot with Age vs SurvivalStatus
         sns.boxplot(x='SurvivalStatus', y='Nodes', data=df)

Out[22]: <matplotlib.axes._subplots.AxesSubplot at 0x7f325ddb32b0>
```

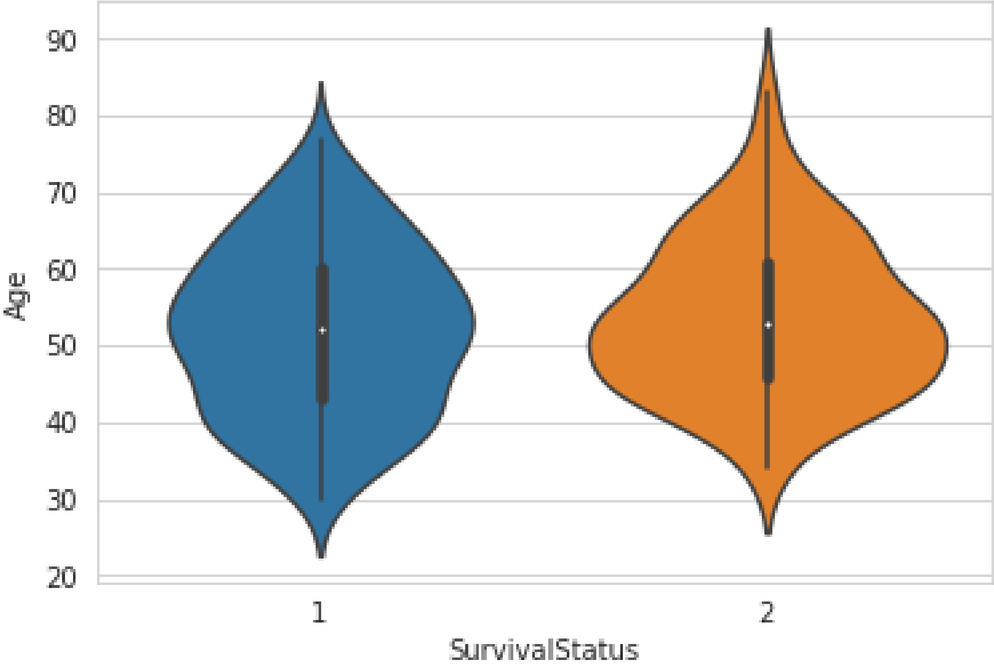


5.2.1 Observation

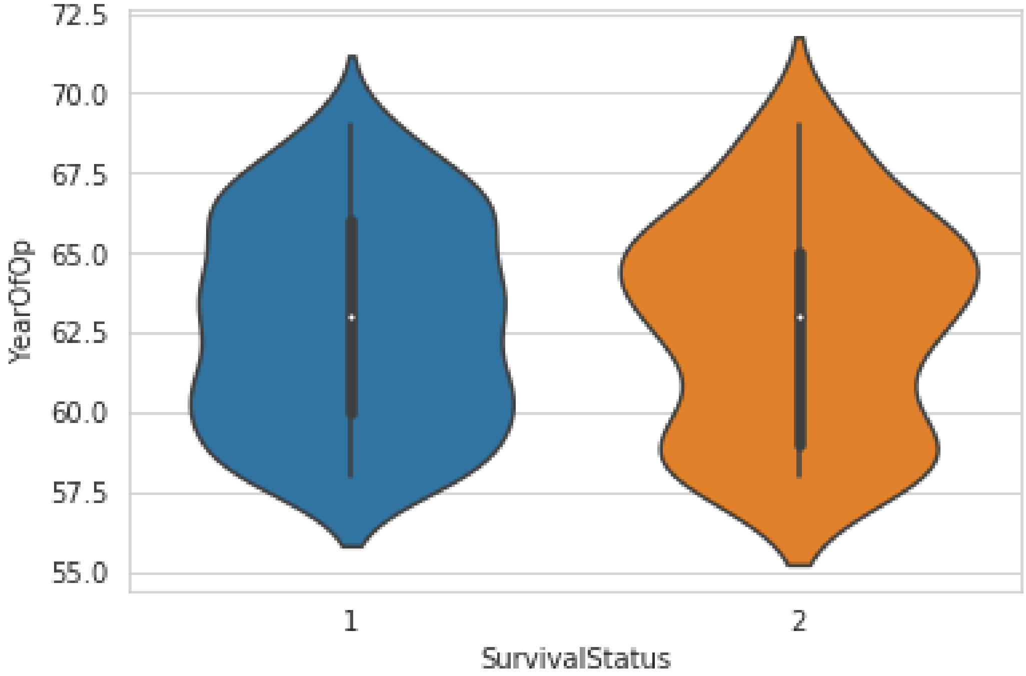
- Age
  - Equal survival status seen between people of age between 35 and 60.
  - So there is no relation between age and survival rate
- YearOfOp
  - Survival range between age of 59 to 63
- Nodes
  - Nothing able to deduce from this Box Plot

5.3 Violin Plot

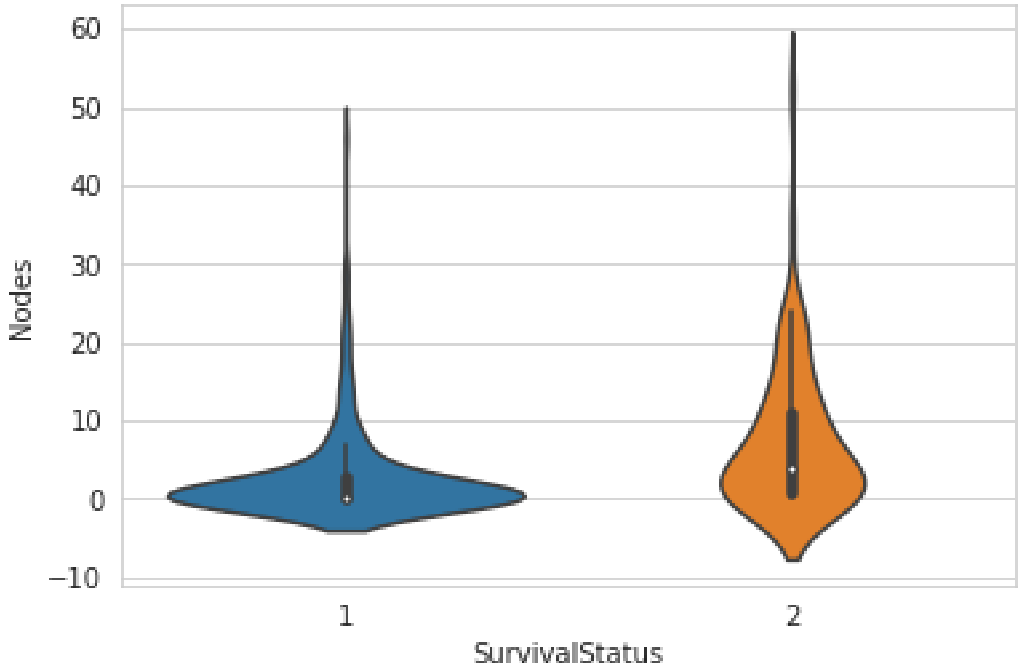
```
In [23]: # Violin based on Age against Surival Status
         sns.violinplot(x='SurvivalStatus',y='Age',data=df, size=10)

Out[23]: <matplotlib.axes._subplots.AxesSubplot at 0x7f325dd835c0>
```



```
In [24]: # Violin based on Year of Operation against Surival Status
         sns.violinplot(x='SurvivalStatus',y='YearOfOp',data=df, size=12)
         plt.show()
```



```
In [25]: # Violin based on Nodes against Surival Status
         sns.violinplot(x='SurvivalStatus',y='Nodes',data=df, size=10)
         plt.show()
```



5.3.1 Observataion

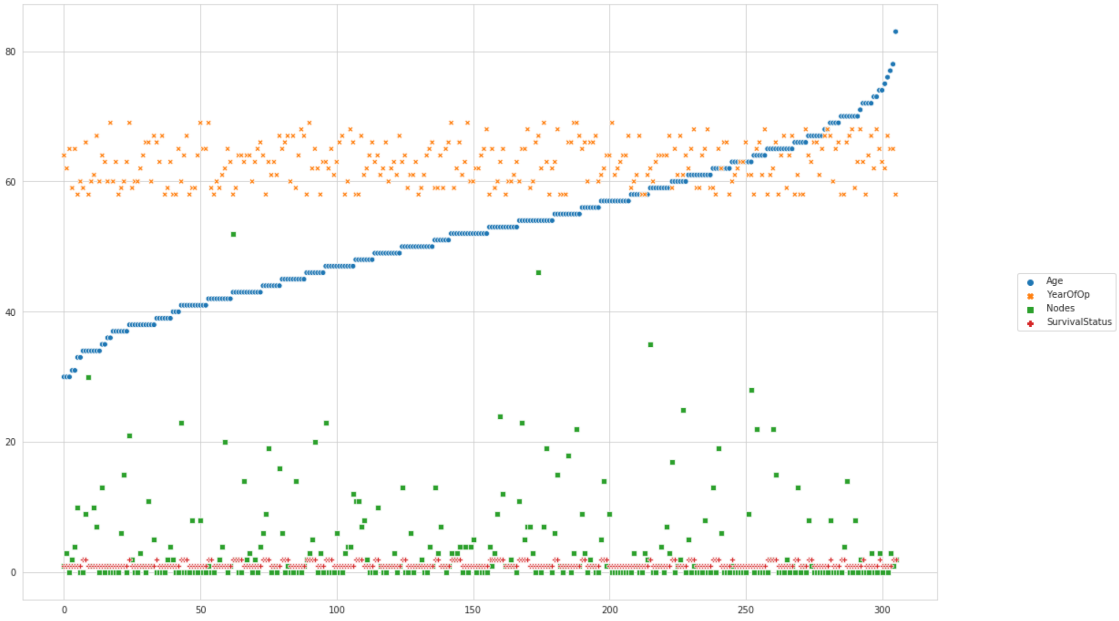
- Observation was similar to PDF. CDF. Boxplot
- Age
  - No relationship between Age and Surival Status
- Year of Operation
  - No relation between Year of Operation and Survival Status
  - Since data is imbalanced, there is little variance between violin plot of Survival Status '1' and '2' which I guess won't be there when we have balanced data
- Nodes
  - Mid 50% (IQR) of Nodes have both kind of Survival Status.
  - So, we can't make assume a direct relation between Nodes and Survival Status when considering Imbalanced data

6 Bivariate Analysis

6.1 Scatter Plots

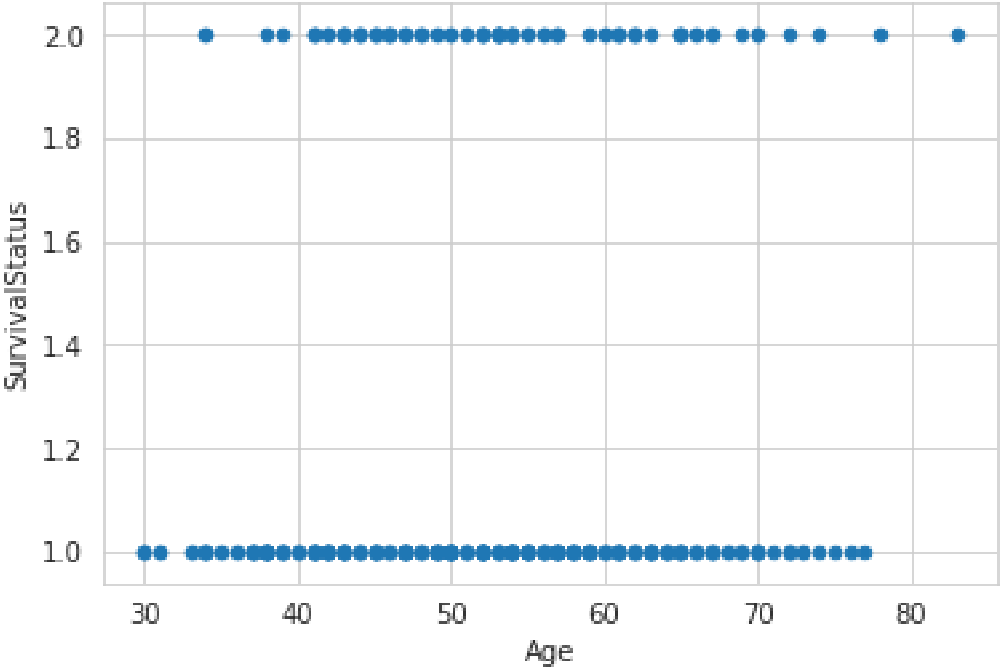
```
In [26]: g = sns.scatterplot(data=df)
         # resize figure box to -> put the legend out of the figure
         box = g.get_position() # get position of figure
         g.set_position([box.x0, box.y0, box.width * 3, box.height * 3]) # resize position
         # Put a legend to the right side
         g.legend(loc='center right', bbox_to_anchor=(1.2, 0.5), ncol=1)
```

```
Out[26]: <matplotlib.legend.Legend at 0x7f325dc3dcc0>
```

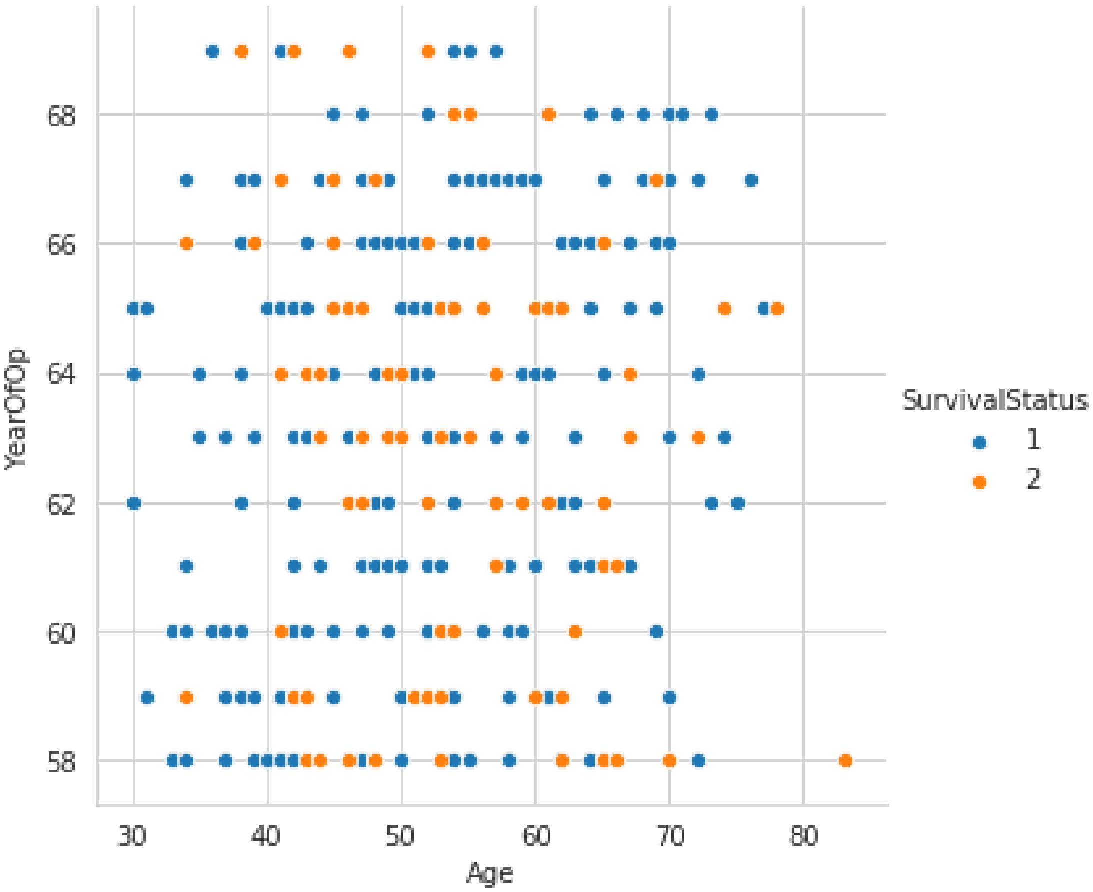


```
In [27]: # Scatter Plot Age vs SurvivalStatus
         df.plot(kind='scatter',x='Age',y='SurvivalStatus')
```

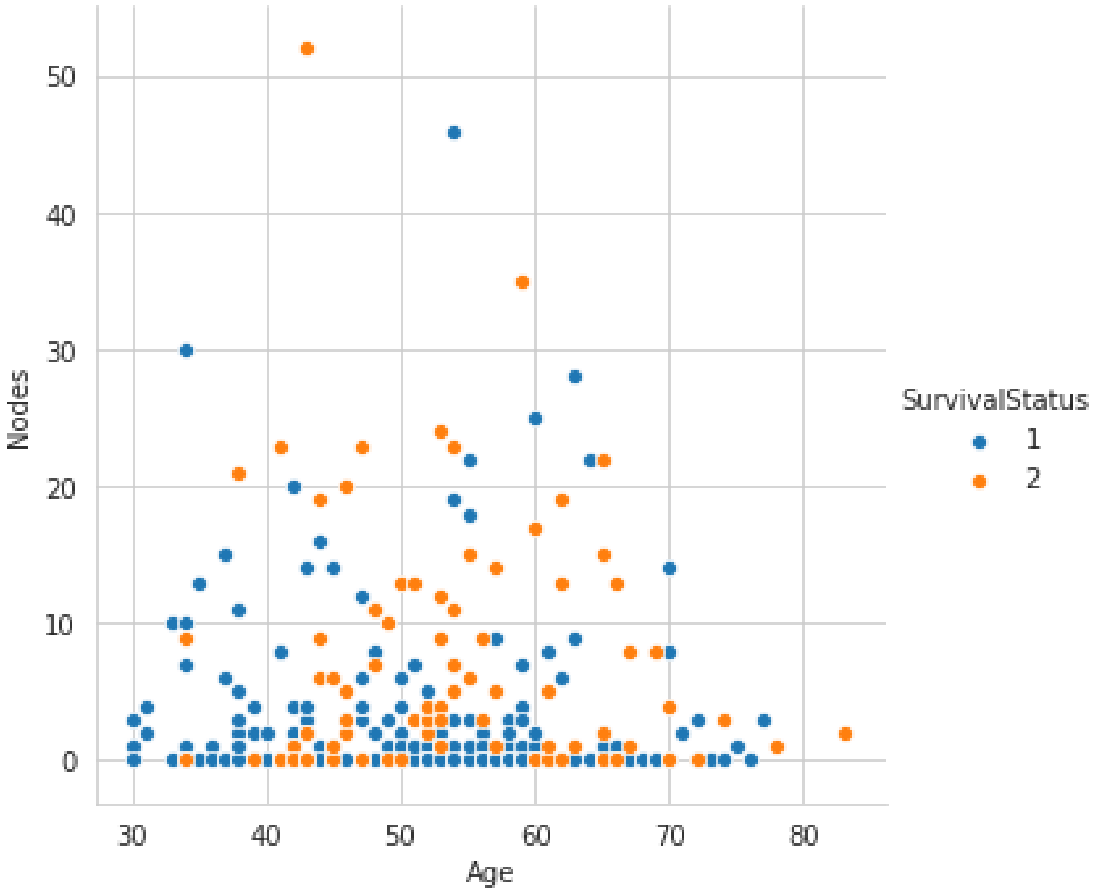
```
Out[27]: <matplotlib.axes._subplots.AxesSubplot at 0x7f325dc31358>
```



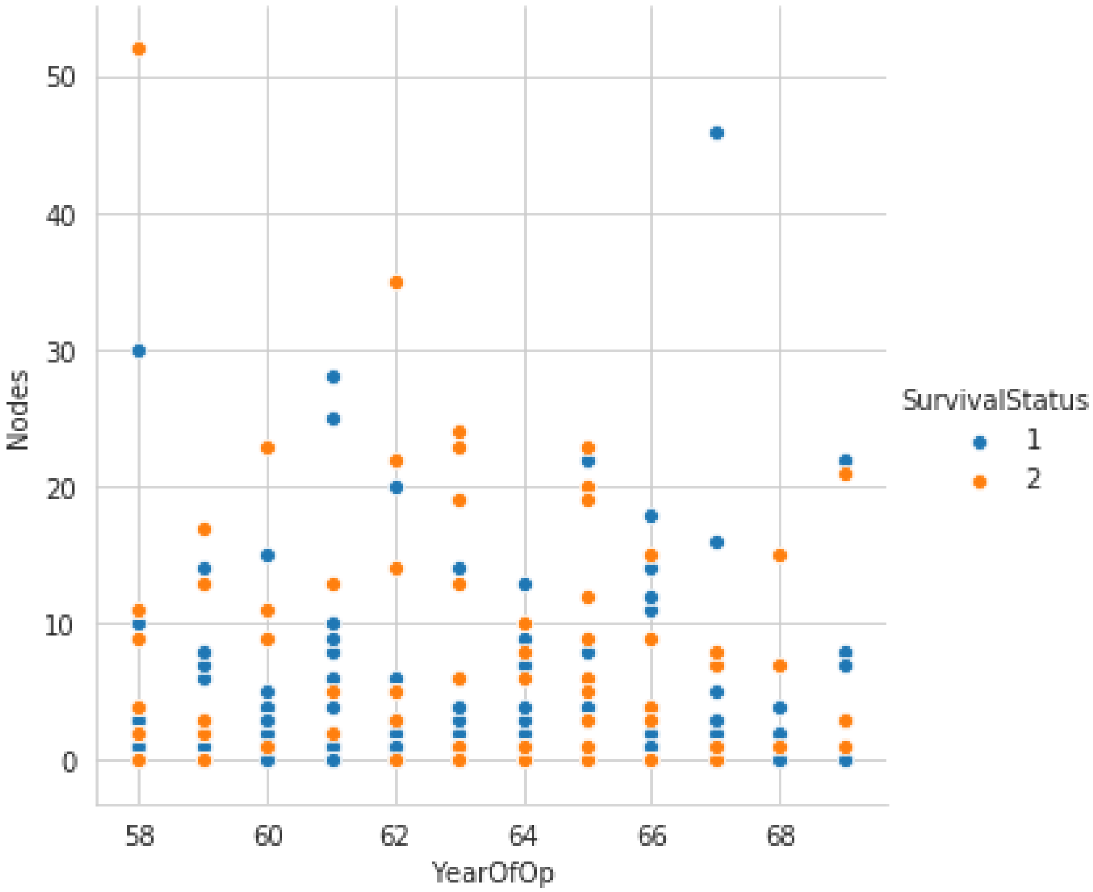
```
In [28]: # Age vs YearOfOp
         sns.FacetGrid(df, hue='SurvivalStatus', height=5).map(sns.scatterplot, 'Age', 'YearOf

Out[28]: <seaborn.axisgrid.FacetGrid at 0x7f325dbed128>
```



```
In [29]: # Age vs Nodes
         sns.FacetGrid(df, hue='SurvivalStatus', height=5).map(sns.scatterplot, 'Age', 'Nodes')

Out[29]: <seaborn.axisgrid.FacetGrid at 0x7f325c01b860>
```

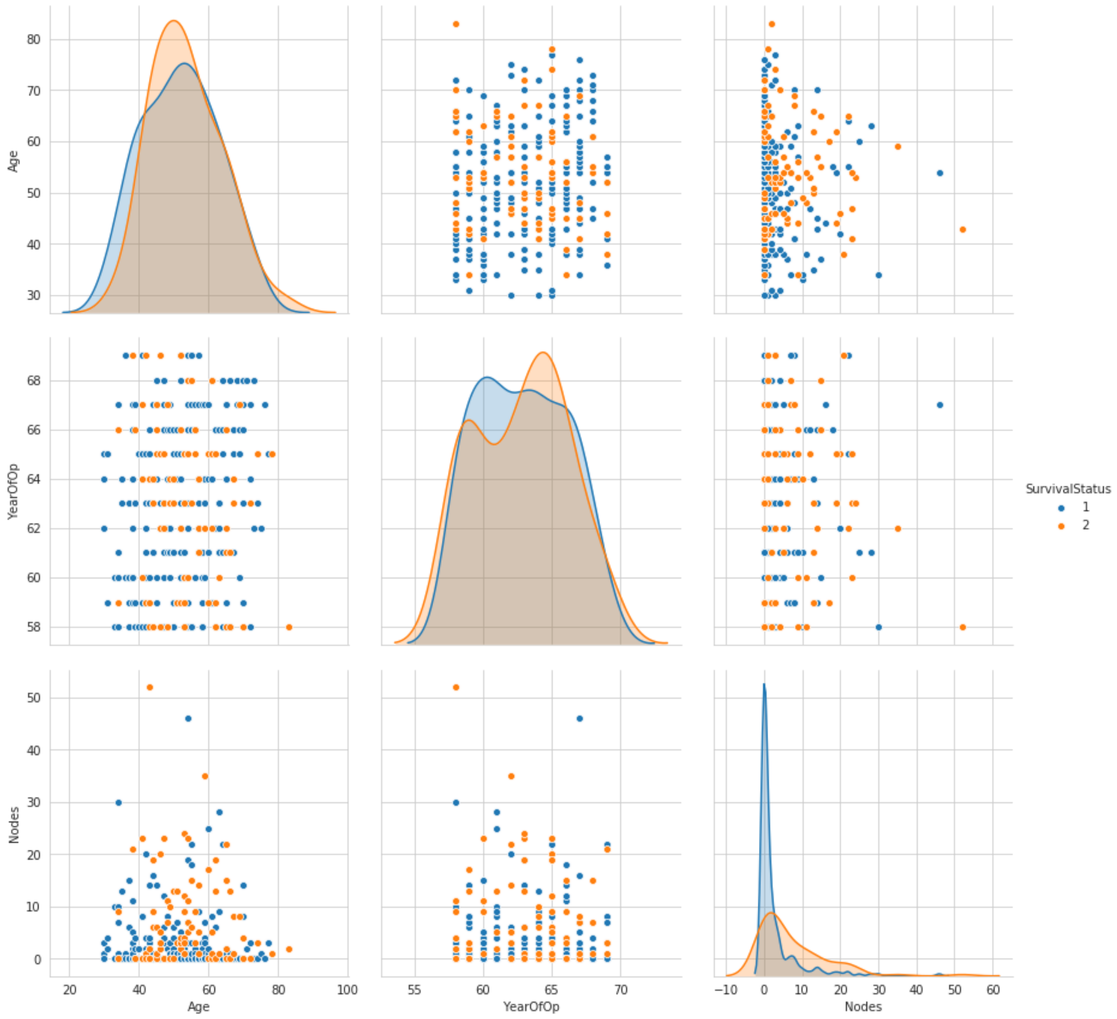


```
In [30]: # YearOfOp vs Nodes
         sns.FacetGrid(df, hue='SurvivalStatus', height=5).map(sns.scatterplot, 'YearOfOp', 'No

Out[30]: <seaborn.axisgrid.FacetGrid at 0x7f3257fe47b8>
```



6.2 Pair Plots

```
In [31]: sns.pairplot(df, hue='SurvivalStatus',vars=['Age','YearOfOp','Nodes'], height=4)

Out[31]: <seaborn.axisgrid.PairGrid at 0x7f3257fab390>
```



7 Observation

- We don't have any linearly seperable data
  - From Univariate analysis, it is clear that Age or YearOfOp or Nodes have no linearly seperable relationship with Surival Status
- We don't have bivariate relationship as well with survival data
  - Both surival case 1 and 2 are scatter along all the range of each pair
- In conclusion, we can't have either a simple if-else classifier model nor a linearly seperable classifier model