# Low Level Design (LLD)

# Heart Disease Diagnostic Analysis

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# Document Version Control

| Date Issued | Version | Description | Author |
|---|---|---|---|
| 26th August, 2021 | 1.0 | Initial Draft of LLD | Shrey Shah |
| 6th September, 2021 | 1.1 | Added System Use Cases | Shrey Shah |
| 13th September, 2021 | 1.2 | Added Unit Test Cases | Shrey Shah |
| 31st October, 2021 | 1.3 | Updated Observations | Shrey Shah |

# Contents

# 1    Introduction

## 1.1    Purpose

The purpose of this Low Level Design Document is detailing HLD means it refers to component-level design process. It describes detailed description of each and every module and includes actual logic for every system component and it goes deep into each modules specification. It is also known as micro level/detailed design. It is created by designers and developers. It converts the High Level Solution into Detailed solution.

Low-level design fills in some of the gaps to provide extra detail that is necessary before developers can start writing code. It gives more specific guidance for how the parts of the system will work and how they will work internally. It refines the definitions of the database, the major classes, and the internal and external interfaces. It is created second means after High Level Design.

The LLD will cover the following aspects:

1.  Describe the user interface being implemented.
2.  Present the data description and define them in detail.
3.  Include design features and the architecture of the project.
4.  Define the Use Cases for the project.
5.  Design the Unit Test Cases for the project.

## 1.2    Scope

The LLD documentation presents the structure of the system, such as the database architecture design, application flow (navigation), use cases and technology architecture. The LLD uses strictly technical jargons which should be understandable to the developers of the system.

## 1.3    Intended Audience

The HLD document can be used as a reference by the following categories of people.

1.  Design Team
2.  Development Team
3.  Operations Team

## 1.4    Acronyms and Definitions

This sub - section includes the definitions of all acronyms required to interpret the LLD properly

| Sr. No. | Acronym | Definition |
|---------|---------|-----------|
| 1. | LLD | Low Level Design |
| 2. | csv | Comma separated value – a file format in which the fields are separated using comma – ( , ) as a delimiter |
| 3. | BI | Business Intelligence |
| 4. | LOD | Level of Detail |
| 5. | UI | User Interface |

# 2    Dataset Overview

## 2.1    Input Dataset Description

The dataset used for analysis is the Heart Disease dataset provided by the UCI Repository. It actually contains 76 attributes out of which only 14 are used. We will be using the Cleveland dataset.

Dataset source: https://archive.ics.uci.edu/ml/datasets/Heart+Disease

Dataset Variables Description is as follows:

**age**: The person's age in years

**sex**: The person's sex
— Value 1: male
— Value 0: female

**cp**: chest pain type
— Value 1: typical angina
— Value 2: atypical angina
— Value 3: non-anginal pain
— Value 4: asymptomatic

**trestbps**: The person's resting blood pressure (mm Hg on admission to the hospital)

**chol**: The person's cholesterol measurement in mg/dl

**fbs**: The person's fasting blood sugar > 120 mg/dl
— Value 1: true
— Value 0: false

**restecg**: resting electrocardiographic results
— Value 0: normal
— Value 1: having ST-T wave abnormality (T wave inversions and/or ST elevation or depression of > 0.05 mV)
— Value 2: showing probable or definite left ventricular hypertrophy by Estes' criteria

**thalach**: The person's maximum heart rate achieved

**exang**: Exercise induced angina
— Value 1: yes
— Value 0: no

**oldpeak**: ST depression induced by exercise relative to rest ('ST' relates to positions on the ECG plot)

**slope**: the slope of the peak exercise ST segment
— Value 1: upsloping
— Value 2: flat
— Value 3: downsloping

**ca**: The number of major vessels (0–3)

**thal**: A blood disorder called thalassemia
— Value 3: normal
— Value 6: fixed defect (no blood flow in some part of the heart)
— Value 7: reversible defect (a blood flow is observed but it is not normal)

**num**: diagnosis of heart disease (angiographic disease status)
— 0: < 50% diameter narrowing
— 1: > 50% diameter narrowing

## 2.2 Data Preprocessing

We will be using Python Numpy and Pandas to perform Preprocessing on the dataset.

Observations after Exploratory Data Analysis:

1. The data in the dataset showed that there are some columns in the dataset which are categorical variables but when loaded into Tableau behave as numerical variables. Even though they contain numeric data the values in them are repeating and only limited to a few numbers which means they have been encoded to represent some specific class / category under the variable.

   The columns include – sex, cp, fbs, restecg, exang, slope, ca, thal and num.

   As a part of preprocessing, the data type of these columns will be changed from integer to categorical.

2. There is no column which contains missing data as indicated by the count parameter. But still we need to check for incorrect data.

3. There are a few columns wherein there are unusual values / outliers. After observation based on the summary statistics of these columns it is somewhat clear that these are outliers. Maybe it is an outlier.

   The columns are – cp and thal.

4. The oldpeak column has many values as zeros and the data is also skewed. As a part of transformation, we will impute the zeros with either mean / median of the column values because the oldpeak values cannot be zero for a human being and also remove skewness by using Logarithmic transformation.

5. Remaining numerical columns seem normally distributed.

6. The chol column contains few outliers as these are very high values for human cholesterol. We can verify by drawing the boxplot of the chol column. We will treat these outliers by mean / median imputation.

As a part of preprocessing, we will impute these values with the median values of the data present in that column. We will use median / mode because if we use mean it may give us fractional values which again does not belong to a specific category.

We have used Numpy and Pandas for the above preprocessing steps to be applied. The code for the same is present in the Data Preprocessing.ipynb Jupyter notebook

## 2.3    Preprocessed Data

After the preprocessing steps, we export the existing Pandas DataFrame into a .csv file for carrying our actual Data Analysis in Tableau.

The clean dataset file: preprocessed_heart_disease_dataset.csv

## 2.4    Data Modification into Tableau Public Desktop

The exported .csv dataset file – preprocessed_heart_disease_dataset.csv will be imported into Tableau Public Desktop.

Since the dataset contains many categorical columns which store the categories in the form of integers we will convert these numbers into meaningful phrases which will be understandable to the viewer and also easy to understand the terms used in the visualizations.

We will provide these columns 'Aliases' as follows:

**sex**: The person's sex
— Value 1: Male
— Value 0: Female

**cp**: chest pain type
— Value 1: Typical Angina
— Value 2: Atypical Angina
— Value 3: Non-anginal pain
— Value 4: Asymptomatic

**fbs**: The person's fasting blood sugar > 120 mg/dl
— Value 1: True
— Value 0: False

**restecg**: resting electrocardiographic results
— Value 0: Normal
— Value 1: ST-T wave abnormality
— Value 2: Left ventricular hypertrophy

**thalach**: The person's maximum heart rate achieved

**exang**: Exercise induced angina
— Value 1: Yes
— Value 0: No

**slope**: the slope of the peak exercise ST segment
— Value 1: Upsloping
— Value 2: Flat
— Value 3: Downsloping

**thal**: A blood disorder called thalassemia
— Value 3: Normal
— Value 6: Fixed defect
— Value 7: Reversible defect

**num**: diagnosis of heart disease (angiographic disease status)
— 0: < 50%
— 1: > 50%

# 3    System Use Cases

## 1.1.    Variation of the 'age' with 'chol' (Cholesterol)

| Name | Visualization of 'age' with 'chol' variables |
|---|---|
| ID | HD_SUC_01 |
| Description | The user wishes to view the relationship between 'age' and 'chol' variables. |
| Actors | Tableau Public Server |
| Organizational Benefit | - |
| Frequency of Use | Multiple times |
| Triggers | When the user clicks on the worksheet named 'Age and Chol' |
| Pre-conditions | The user is logged in via personal credentials on Tableau Public Server |
| Post-Conditions | 1) The user will be able to view the graph corresponding to the 'age' and 'chol' variables.<br>2) The user will be able to read the analysis based on the graph in the worksheet captions and filter on 'sex' variable. |
| Main Course | The Tableau Server displays the corresponding worksheet. |
| Alternate Course | - |
| Exceptions | - |

## 1.2.    Variation of 'cp' (Chest Pain type) with 'sex'

| Name | Visualization of 'cp' with 'sex' variables |
|---|---|
| ID | HD_SUC_02 |
| Description | The user wishes to view the relationship between 'cp' and 'sex' variables. |
| Actors | Tableau Public Server |
| Organizational Benefit | - |
| Frequency of Use | Multiple times |
| Triggers | When the user clicks on the worksheet named 'Cp and Sex' |
| Pre-conditions | The user is logged in via personal credentials on Tableau Public Server |
| Post-Conditions | • The user will be able to view the graph corresponding to the 'cp' and 'sex' variables.<br>• The user will be able to read the analysis based on the graph in the worksheet captions and filter on 'cp' variable. |
| Main Course | The Tableau Server displays the corresponding worksheet. |
| Alternate Course | - |
| Exceptions | - |

## 1.3.    Variation of 'thal' (Thalassemia type) with 'sex'

| Name | Visualization of 'thal' with 'sex' variables |
|---|---|
| ID | HD_SUC_03 |
| Description | The user wishes to view the relationship between 'thal' and 'sex' variables. |
| Actors | Tableau Public Server |
| Organizational Benefit | - |
| Frequency of Use | Multiple times |
| Triggers | When the user clicks on the worksheet named 'Thal and Sex' |
| Pre-conditions | The user is logged in via personal credentials on Tableau Public Server |
| Post-Conditions | • The user will be able to view the graph corresponding to the 'thal' and 'sex' variables.<br>• The user will be able to read the analysis based on the graph in the worksheet captions and filter on 'thal' variable. |
| Main Course | The Tableau Server displays the corresponding worksheet. |
| Alternate Course | - |
| Exceptions | - |

## 1.4.    Variation of 'thalach' (Maximum heart rate) with 'age'

| Name | Visualization of 'thalach' with 'age' variables |
|---|---|
| ID | HD_SUC_04 |
| Description | The user wishes to view the relationship between 'thalach' and 'age' variables. |
| Actors | Tableau Public Server |
| Organizational Benefit | - |
| Frequency of Use | Multiple times |
| Triggers | When the user clicks on the worksheet named 'Thalach and Age' |
| Pre-conditions | The user is logged in via personal credentials on Tableau Public Server |
| Post-Conditions | • The user will be able to view the graph corresponding to the 'thalach' and 'age' variables.<br>• The user will be able to read the analysis based on the graph in the worksheet captions and filter on 'sex' variable. |
| Main Course | The Tableau Server displays the corresponding worksheet. |
| Alternate Course | - |
| Exceptions | - |

### 1.5. Variation of 'chol' (Cholesterol), 'trestbps' (Resting blood pressure) with 'fbs' (Fasting Blood Sugar)

| | |
|---|---|
| **Name** | Visualization of 'chol', 'trestbps' and 'fbs' variables |
| **ID** | HD_SUC_05 |
| **Description** | The user wishes to view the relationship between 'chol', 'trestbps' and 'fbs' variables. |
| **Actors** | Tableau Public Server |
| **Organizational Benefit** | - |
| **Frequency of Use** | Multiple times |
| **Triggers** | When the user clicks on the worksheet named 'Chol, Trestbps and Fbs' |
| **Pre-conditions** | The user is logged in via personal credentials on Tableau Public Server |
| **Post-Conditions** | • The user will be able to view the graph corresponding to the 'chol', 'trestbps' and 'fbs' variables.<br>• The user will be able to read the analysis based on the graph in the worksheet captions and filter on 'fbs' variable'. |
| **Main Course** | The Tableau Server displays the corresponding worksheet. |
| **Alternate Course** | - |
| **Exceptions** | - |

### 1.6. Variation of 'restecg' (Resting electrocardiograph results) with 'sex'

| | |
|---|---|
| **Name** | Visualization of 'restecg' and 'sec' variables |
| **ID** | HD_SUC_06 |
| **Description** | The user wishes to view the relationship between 'restecg' and 'sex' variables. |
| **Actors** | Tableau Public Server |
| **Organizational Benefit** | - |
| **Frequency of Use** | Multiple times |
| **Triggers** | When the user clicks on the worksheet named 'Restecg and Sex'. |
| **Pre-conditions** | The user is logged in via personal credentials on Tableau Public Server |
| **Post-Conditions** | • The user will be able to view the graph corresponding to the 'restecg' and 'sex' variables.<br>• The user will be able to read the analysis based on the graph in the worksheet captions and filter on 'restecg' variable. |
| **Main Course** | The Tableau Server displays the corresponding worksheet. |
| **Alternate Course** | - |
| **Exceptions** | - |

## 1.7. Variation of 'exang' (Exercise induced angina) with 'cp' (Chest Pain type)

| Name | Visualization of 'exang' and 'cp' variables |
|---|---|
| ID | HD_SUC_07 |
| Description | The user wishes to view the relationship between 'exang' and 'cp' variables. |
| Actors | Tableau Public Server |
| Organizational Benefit | - |
| Frequency of Use | Multiple times |
| Triggers | When the user clicks on the worksheet named 'Exang and Cp'. |
| Pre-conditions | The user is logged in via personal credentials on Tableau Public Server |
| Post-Conditions | • The user will be able to view the graph corresponding to the 'exang' and 'cp' variables.<br>• The user will be able to read the analysis based on the graph in the worksheet captions and filter on 'cp' variable. |
| Main Course | The Tableau Server displays the corresponding worksheet. |
| Alternate Course | - |
| Exceptions | - |

## 1.8. Variation of 'slope' (Slope of the peak exercise ST segment), 'restecg' (Resting Electrocardiograph results) and 'oldpeak' (ST depression induced by exercise relative to rest)

| Name | Visualization of 'slope', 'restecg' and 'oldpeak' variables |
|---|---|
| ID | HD_SUC_08 |
| Description | The user wishes to view the relationship between 'slope', 'restecg' and 'oldpeak' variables |
| Actors | Tableau Public Server |
| Organizational Benefit | - |
| Frequency of Use | Multiple times |
| Triggers | When the user clicks on the worksheet named 'Slope, Restecg and Oldpeak'. |
| Pre-conditions | The user is logged in via personal credentials on Tableau Public Server |
| Post-Conditions | • The user will be able to view the graph corresponding to the 'slope', 'restecg' and 'oldpeak' variables.<br>• The user will be able to read the analysis based on the graph in the worksheet captions and filter on 'restecg' variable. |
| Main Course | The Tableau Server displays the corresponding worksheet. |
| Alternate Course | - |
| Exceptions | - |

## 1.9. Distribution of 'ca' (Number of major vessels)

| Name | Visualization of 'ca' variables |
|---|---|
| ID | HD_SUC_09 |
| Description | The user wishes to view the relationship between 'ca' variables |
| Actors | Tableau Public Server |
| Organizational Benefit | - |
| Frequency of Use | Multiple times |
| Triggers | When the user clicks on the worksheet named 'Ca'. |
| Pre-conditions | The user is logged in via personal credentials on Tableau Public Server |
| Post-Conditions | • The user will be able to view the graph corresponding to the 'ca' variable.<br>• The user will be able to read the analysis based on the graph in the worksheet captions and filter on 'ca' variable. |
| Main Course | The Tableau Server displays the corresponding worksheet. |
| Alternate Course | - |
| Exceptions | - |

## 1.10. Variation of 'num' (Angiographic disease status) with 'sex'

| Name | Visualization of 'num' and 'sex' variables |
|---|---|
| ID | HD_SUC_10 |
| Description | The user wishes to view the relationship between 'num' and 'sex' variables |
| Actors | Tableau Public Server |
| Organizational Benefit | - |
| Frequency of Use | Multiple times |
| Triggers | When the user clicks on the worksheet named 'Num and Sex'. |
| Pre-conditions | The user is logged in via personal credentials on Tableau Public Server |
| Post-Conditions | • The user will be able to view the graph corresponding to the 'num' and 'sex' variables.<br>• The user will be able to read the analysis based on the graph in the worksheet captions and filter on 'num' variable. |
| Main Course | The Tableau Server displays the corresponding worksheet. |
| Alternate Course | - |
| Exceptions | - |

# 4    Unit Test Cases

## 4.1    Test for 'Age and Chol' visualization

| Test Case ID: HD_UTC_01 | | | | Test Designed By: Shrey Shah | |
|---|---|---|---|---|---|
| Test Case Title: Age and Cholesterol Test Case | | | | Test Designed Date: 07/09/2021 | |
| Test Case Description: When the user clicks on the worksheet named 'Age and Chol' the user must be able to view the graph on worksheet, read the captions, hover for information and filter based on 'sex' variable. | | | | Test Executed By: Shrey Shah | |
| | | | | Test Executed Date: 07/09/2021 | |
| Preconditions: The user is logged in via personal credentials on Tableau Public Server. | | | | | |
| Dependencies: The user has access to view the visualizations on Tableau Public Server. | | | | | |
| Sr. No. | Test Steps | Test Data | Expected Result | Actual Result | Status |
| 1. | The user clicks on the worksheet named 'Age and Chol'. | N.A. | 1) Tableau Public Server directs the user to the 'Age and Chol' worksheet and the user should be able to view the graph of 'age' and 'chol' variables.<br><br>2) The user should be able to read the analysis at the bottom of the worksheet under 'Analysis' section. | 1) Tableau Public Server directs the user to the 'Age and Chol' worksheet and the user is able to view the graph of 'age' and 'chol' variables.<br><br>2) The user is able to read the analysis at the bottom of the worksheet under 'Analysis' section. | Pass |
| 2. | The user hovers on the data points to get detailed information. | N.A. | 1) When the user hovers on a specific data point, the user should be able to read the facts about 'age', 'chol' and 'sex'. | 1) When the user hovers on a specific data point, the user is able to read the facts about 'age', 'chol' and 'sex'. | Pass |
| 3. | The user uses the filter on 'sex' selects 'Male'. | 'Male' is used in the 'sex' filter. | 1) When the user selects 'Male', the user should be able to view only the data or which sex is 'Male'. | 1) When the user selects 'Male', the user is able to view only the data or which sex is 'Male'. | Pass |
| 4. | The user uses the filter on 'sex' and selects 'Female'. | 'Female' is used in the 'sex' filter. | 1) When the user selects 'Female', the user should be able to view only the data for which sex is 'Female'. | 1) When the user selects 'Female', the user should be able to view only the data or which sex is 'Female'. | Pass |

## 4.2   Test for 'Cp and Sex' visualization

| Test Case ID: HD_UTC_02 | Test Designed By: Shrey Shah |
|---|---|
| Test Case Title: Chest Pain Type and Sex Test Case | Test Designed Date: 07/09/2021 |
| Test Case Description: When the user clicks on the worksheet named 'Cp and Sex' the user must be able to view the graph on worksheet, read the captions, hover for information and filter based on 'cp' variable. | Test Executed By: Shrey Shah |
| | Test Executed Date: 07/09/2021 |

| Preconditions: The user is logged in via personal credentials on Tableau Public Server. |
|---|

| Dependencies: The user has access to view the visualizations on Tableau Public Server. |
|---|

| Sr. No. | Test Steps | Test Data | Expected Result | Actual Result | Status |
|---|---|---|---|---|---|
| 1. | The user clicks on the worksheet named 'Cp and Sex'. | N.A. | 1) Tableau Public Server directs the user to the 'Cp and Sex' worksheet and the user should be able to view the graph of 'cp' and 'sex' variables.<br><br>2) The user should be able to read the analysis at the bottom of the worksheet under 'Analysis' section. | 1) Tableau Public Server directs the user to the 'Cp and Sex' worksheet and the user is able to view the graph of 'cp' and 'sex' variables.<br><br>2) The user is able to read the analysis at the bottom of the worksheet under 'Analysis' section. | Pass |
| 2. | The user hovers on the bar graph to get detailed information. | N.A. | 1) When the user hovers on a specific bar graph, the user should be able to read the facts about 'cp', 'sex' and percentage of total. | 1) When the user hovers on a specific bar graph, the user is be able to read the facts about 'cp', 'sex' and percentage of total. | Pass |
| 3. | The user uses the 'cp' filter and selects 'Typical Angina'. | 'Typical Angina' is used in the 'cp' filter. | 1) When the user selects 'Typical Angina', the user should be able to view only the data for which cp is 'Typical Angina'. | 1) When the user selects 'Typical Angina', the user is able to view only the data for which cp is 'Typical Angina'. | Pass |
| 4. | The user uses the 'cp' filter and selects 'Atypical Angina'. | 'Atypical Angina' is used in the 'cp' filter. | 1) When the user selects 'Atypical Angina', the user should be able to view only the data for which cp is 'Atypical Angina'. | 1) When the user selects 'Atypical Angina', the user is able to view only the data for which cp is 'Atypical Angina'. | Pass |
| 5. | The user uses the 'cp' filter and selects 'Non-anginal pain'. | 'Non-anginal pain' is used in the 'cp' filter. | 1) When the user selects 'Non-anginal pain', the user should be able to view only the data for which cp is 'Non-anginal pain'. | 1) When the user selects 'Non-anginal pain', the user is able to view only the data for which cp is 'Non-anginal pain'. | Pass |

| 6. | The user uses the 'cp' filter and selects 'Asymptomatic'. | 'Asympt omatic' is used in the 'cp' filter. | 1) When the user selects 'Asymptomatic', the user should be able to view only the data for which cp is 'Asymptomatic''. | 1) When the user selects 'Asymptomatic', the user is able to view only the data for which cp is 'Asymptomatic'. | Pass |
|----|------|------|------|------|------|

## 4.3    Test for 'Thal and Sex' visualization

| **Test Case ID:** HD_UTC_03 | | | | **Test Designed By:** Shrey Shah | |
|----|----|----|----|----|----|
| **Test Case Title:** Chest Pain Type and Sex Test Case | | | | **Test Designed Date:** 07/09/2021 | |
| **Test Case Description:** When the user clicks on the worksheet named 'Thal and Sex' the user must be able to view the graph on worksheet, read the captions, hover for information and filter based on 'sex' variable. | | | | **Test Executed By:** Shrey Shah | |
| | | | | **Test Executed Date:** 07/09/2021 | |
| **Preconditions:** The user is logged in via personal credentials on Tableau Public Server. | | | | | |
| **Dependencies:** The user has access to view the visualizations on Tableau Public Server. | | | | | |
| **Sr. No.** | **Test Steps** | **Test Data** | **Expected Result** | **Actual Result** | **Status** |
| 1. | The user clicks on the worksheet named 'Thal and Sex'. | N.A. | 1) Tableau Public Server directs the user to the 'Cp and Sex' worksheet and the user should be able to view the graph of 'thal' and 'sex' variables.<br><br>2) The user should be able to read the analysis at the bottom of the worksheet under 'Analysis' section. | 1) Tableau Public Server directs the user to the 'Cp and Sex' worksheet and the user is able to view the graph of 'thal' and 'sex' variables.<br><br>2) The user is able to read the analysis at the bottom of the worksheet under 'Analysis' section. | Pass |
| 2. | The user hovers on the bar graph to get detailed information. | N.A. | 1) When the user hovers on a specific bar graph, the user should be able to read the facts about 'thal', 'sex' and percentage of total. | 1) When the user hovers on a specific bar graph, the user is be able to read the facts about 'thal', 'sex' and percentage of total. | Pass |
| 3. | The user uses the 'sex' filter and selects 'Male'. | 'Male' is used in the 'sex' filter. | 1) When the user selects 'Male', the user should be able to view only the data for which sex is 'Male'. | 1) When the user selects 'Male', the user is able to view only the data for which sex is 'Male'. | Pass |
| 4. | The user uses the 'sex' filter and selects 'Female'. | 'Female' is used in the 'sex' filter. | 1) When the user selects 'Female', the user should be able to view only the data for which sex is 'Female'. | 1) When the user selects 'Female', the user is able to view only the data for which sex is 'Female'. | Pass |

## 4.4    Test for 'Thalach and Age' visualization

| Test Case ID: HD_UTC_04 | Test Designed By: Shrey Shah |
|---|---|
| Test Case Title: Thalach and Age Test Case | Test Designed Date: 07/09/2021 |
| Test Case Description: When the user clicks on the worksheet named 'Thalach and Age' the user must be able to view the graph on worksheet, read the captions, hover for information and filter based on 'sex' variable. | Test Executed By: Shrey Shah |
| | Test Executed Date: 07/09/2021 |

| Preconditions: The user is logged in via personal credentials on Tableau Public Server. |
|---|

| Dependencies: The user has access to view the visualizations on Tableau Public Server. |
|---|

| Sr. No. | Test Steps | Test Data | Expected Result | Actual Result | Status |
|---|---|---|---|---|---|
| 1. | The user clicks on the worksheet named 'Thalach and Age'. | N.A. | 1) Tableau Public Server directs the user to the 'Thalach and Age' worksheet and the user should be able to view the graph of 'thalach' and 'sex' variables.<br><br>2) The user should be able to read the analysis at the bottom of the worksheet under 'Analysis' section. | 1) Tableau Public Server directs the user to the 'Thalach and Age' worksheet and the user is able to view the graph of 'thalach' and 'sex' variables.<br><br>2) The user is able to read the analysis at the bottom of the worksheet under 'Analysis' section. | Pass |
| 2. | The user hovers on the data points to get detailed information. | N.A. | 1) When the user hovers on a specific data point, the user should be able to read the facts about 'thalach', 'sex' and 'age'. | 1) When the user hovers on a specific data point, the user is be able to read the facts about 'thal', 'sex' and 'age'. | Pass |
| 3. | The user uses the 'sex' filter and selects 'Male'. | 'Male' is used in the 'sex' filter. | 1) When the user selects 'Male', the user should be able to view only the data for which sex is 'Male'. | 1) When the user selects 'Male', the user is able to view only the data for which sex is 'Male'. | Pass |
| 4. | The user uses the 'sex' filter and selects 'Female'. | 'Female' is used in the 'sex' filter. | 1) When the user selects 'Female', the user should be able to view only the data for which sex is 'Female'. | 1) When the user selects 'Female', the user is able to view only the data for which sex is 'Female'. | Pass |

## 4.5    Test for 'Cholesterol, Trestbps and Fbs' visualization

| Test Case ID: HD_UTC_05 | | | | Test Designed By: Shrey Shah | |
|---|---|---|---|---|---|
| Test Case Title: Cholesterol, Trestbps and Fasting Blood Sugar Test Case | | | | Test Designed Date: 07/09/2021 | |
| Test Case Description: When the user clicks on the worksheet named 'Chol, Trestbps and Fbs' the user must be able to view the graph on worksheet, read the captions, hover for information and filter based on 'fbs' variable. | | | | Test Executed By: Shrey Shah | |
| | | | | Test Executed Date: 07/09/2021 | |
| Preconditions: The user is logged in via personal credentials on Tableau Public Server. | | | | | |
| Dependencies: The user has access to view the visualizations on Tableau Public Server. | | | | | |
| Sr. No. | Test Steps | Test Data | Expected Result | Actual Result | Status |
| 1. | The user clicks on the 'Chol, Trestbps and Fbs' worksheet named '. | N.A. | 1) Tableau Public Server directs the user to the 'Chol, Trestbps and Fbs' worksheet and the user should be able to view the graph of 'chol', 'trestbps' and 'fbs' variables.<br><br>2) The user should be able to read the analysis at the bottom of the worksheet under 'Analysis' section. | 1) Tableau Public Server directs the user to the 'Chol, Trestbps and Fbs' worksheet and the user is able to view the graph of 'chol', 'trestbps' and 'fbs' variables.<br><br>2) The user is able to read the analysis at the bottom of the worksheet under 'Analysis' section. | Pass |
| 2. | The user hovers on the bar graphs to get detailed information. | N.A. | 1) When the user hovers on a specific bar, the user should be able to read the facts about 'fbs', 'avg. chol' and 'avg. trestbps'. | 1) When the user hovers on a specific bar, the user is able to read the facts about 'fbs', 'avg. chol' and 'avg. trestbps'. | Pass |
| 3. | The user uses the 'fbs' filter and selects 'True'. | 'True' is used in the 'fbs' filter. | 1) When the user selects 'True', the user should be able to view only the bars of 'trestbps' and 'chol' for which 'fbs' is 'True'. | 1) When the user selects 'True', the user is able to view only the bars of 'trestbps' and 'chol' for which 'fbs' is 'True'. | Pass |
| 4. | The user uses the 'fbs' filter and selects 'False'. | 'False' is used in the 'fbs' filter. | 1) When the user selects 'False', the user should be able to view only the bars of 'trestbps' and 'chol' for which 'fbs' is 'False'. | 1) When the user selects 'False, the user should be able to view only the bars of 'trestbps' and 'chol' for which 'fbs' is 'False. | Pass |

## 4.6    Test for 'RestEcg and Sex' visualization

| Test Case ID: HD_UTC_06 | | | | Test Designed By: Shrey Shah | |
|---|---|---|---|---|---|
| Test Case Title: Resting Electrocardiograph Results and Sex Test Case | | | | Test Designed Date: 07/09/2021 | |
| Test Case Description: When the user clicks on the worksheet named 'Restecg and Sex' the user must be able to view the graph on worksheet, read the captions, hover for information and filter based on 'restecg' variable. | | | | Test Executed By: Shrey Shah | |
| | | | | Test Executed Date: 07/09/2021 | |
| Preconditions: The user is logged in via personal credentials on Tableau Public Server. | | | | | |
| Dependencies: The user has access to view the visualizations on Tableau Public Server. | | | | | |
| Sr. No. | Test Steps | Test Data | Expected Result | Actual Result | Status |
| 1. | The user clicks on the 'Restecg and Sex' worksheet named '. | N.A. | 1) Tableau Public Server directs the user to the 'Restecg and Sex' worksheet and the user should be able to view the graph of 'restecg' and 'sex' variables.<br><br>2) The user should be able to read the analysis at the bottom of the worksheet under 'Analysis' section. | 1) Tableau Public Server directs the user to the 'Restecg and Sex' worksheet and the user is able to view the graph of 'restecg' and 'sex' variables.<br><br>2) The user is able to read the analysis at the bottom of the worksheet under 'Analysis' section. | Pass |
| 2. | The user hovers on the bubble graphs to get detailed information. | N.A. | 1) When the user hovers on a specific bubble, the user should be able to read the facts about 'restecg', 'sex' and percentage of total. | 1) When the user hovers on a specific bubble, the user is able to read the facts about 'restecg', 'sex' and percentage of total. | Pass |
| 3. | The user uses the 'restecg' filter and selects 'Normal'. | 'Normal' is used in the 'restecg' filter. | 1) When the user selects 'Normal', the user should be able to view only the bubbles based on 'sex' for which 'restecg' is 'Normal'. | 1) When the user selects 'Normal', the user is able to view only the bubbles based on 'sex' for which 'restecg' is 'Normal'. | Pass |
| 4. | The user uses the 'restecg' filter and selects 'ST-T wave Abnormality. | 'ST-T wave Abnormality' is used in the 'restecg' filter. | 1) When the user selects 'ST-T wave Abnormality', the user should be able to view only the bubbles based on 'sex' for which 'restecg' is 'ST-T wave Abnormality'. | 1) When the user selects 'ST-T wave Abnormality', the user is able to view only the bubbles based on 'sex' for which 'restecg' is 'ST-T wave Abnormality'. | Pass |

| 5. | The user uses the 'restecg' filter and selects 'Left ventricular hypertrophy'. | 'Left ventricular hypertrophy is used in the 'restecg' filter. | 1) When the user selects 'Left ventricular hypertrophy', the user should be able to view only the bubbles based on 'sex' for which 'restecg' is 'Left ventricular hypertrophy'. | 1) When the user selects 'Left ventricular hypertrophy', the user is able to view only the bubbles based on 'sex' for which 'restecg' is 'Left ventricular hypertrophy'. | Pass |
|---|---|---|---|---|---|

## 4.7   Test for 'Exang and Cp' visualization

| Test Case ID: HD_UTC_07 | Test Designed By: Shrey Shah |
|---|---|
| Test Case Title: Exercise Induced Angina and Chest Pain Type Test Case | Test Designed Date: 07/09/2021 |
| Test Case Description: When the user clicks on the worksheet named 'Exang and Cp' the user must be able to view the graph on worksheet, read the captions, hover for information and filter based on 'cp' variable. | Test Executed By: Shrey Shah |
| | Test Executed Date: 07/09/2021 |

**Preconditions:** The user is logged in via personal credentials on Tableau Public Server.

**Dependencies:** The user has access to view the visualizations on Tableau Public Server.

| Sr. No. | Test Steps | Test Data | Expected Result | Actual Result | Status |
|---|---|---|---|---|---|
| 1. | The user clicks on the 'Exang and Cp' worksheet named '. | N.A. | 1) Tableau Public Server directs the user to the 'Exang and Cp' worksheet and the user should be able to view the graph of 'exang' and 'cp' variables.<br><br>2) The user should be able to read the analysis at the bottom of the worksheet under 'Analysis' section. | 1) Tableau Public Server directs the user to the 'Exang and Cp' worksheet and the user is able to view the graph of 'exang' and 'cp' variables.<br><br>2) The user is able to read the analysis at the bottom of the worksheet under 'Analysis' section. | Pass |
| 2. | The user hovers on the bar graphs to get detailed information. | N.A. | 1) When the user hovers on a specific bar, the user should be able to read the facts about 'cp', 'exang' and percentage of total. | 1) When the user hovers on a specific bar, the user is able to read the facts about 'cp', 'exang' and percentage of total. | Pass |
| 3. | The user uses the 'cp' filter and selects 'Typical Angina'. | 'Typical Angina' is used in the 'cp' filter. | 1) When the user selects 'Typical Angina', the user should be able to view only the data based on exang for which cp is 'Typical Angina'. | 1) When the user selects 'Typical Angina', the user is able to view only the data based on exang for which cp is 'Typical Angina'. | Pass |

| 4. | The user uses the 'cp' filter and selects 'Atypical Angina'. | 'Atypical Angina' is used in the 'cp' filter. | 1) When the user selects 'Atypical Angina', the user should be able to view only the data based on exang for which cp is 'Atypical Angina'. | 1) When the user selects 'Atypical Angina', the user is able to view only the data based on exang for which cp is 'Atypical Angina'. | Pass |
|----|---|---|---|---|---|
| 5. | The user uses the 'cp' filter and selects 'Non-anginal pain'. | 'Non-anginal pain' is used in the 'cp' filter. | 1) When the user selects 'Non-anginal pain', the user should be able to view only the data based on exang for which cp is 'Non-anginal pain'. | 1) When the user selects 'Non-anginal pain', the user is able to view only the data based on exang for which cp is 'Non-anginal pain'. | Pass |
| 6. | The user uses the 'cp' filter and selects 'Asymptomatic'. | 'Asymptomatic' is used in the 'cp' filter. | 1) When the user selects 'Asymptomatic', the user should be able to view only the data based on exang for which cp is 'Asymptomatic'. | 1) When the user selects 'Asymptomatic', the user is able to view only the data based on exang for which cp is 'Asymptomatic'. | Pass |

## 4.8 Test for 'Slope, RestEcg and Oldpeak' visualization

| Test Case ID: HD_UTC_08 | Test Designed By: Shrey Shah |
|---|---|
| Test Case Title: Slope, Resting Electrocardiograph Results and Oldpeak Test Case | Test Designed Date: 07/09/2021 |
| Test Case Description: When the user clicks on the worksheet named 'Slope, Restecg and Oldpeak' the user must be able to view the graph on worksheet, read the captions, hover for information and filter based on 'restecg' variable. | Test Executed By: Shrey Shah |
| | Test Executed Date: 07/09/2021 |

| Preconditions: The user is logged in via personal credentials on Tableau Public Server. |
|---|

| Dependencies: The user has access to view the visualizations on Tableau Public Server. |
|---|

| Sr. No. | Test Steps | Test Data | Expected Result | Actual Result | Status |
|---|---|---|---|---|---|
| 1. | The user clicks on the 'Slope, Restecg and Oldpeak' worksheet named '. | N.A. | 1) Tableau Public Server directs the user to the 'Slope, Restecg and Oldpeak' worksheet and the user should be able to view the graph of 'restecg', 'slope' and 'oldpeak' variables.<br><br>2) The user should be able to read the analysis at the bottom of the worksheet under 'Analysis' section. | 1) Tableau Public Server directs the user to the 'Slope, Restecg and Oldpeak' worksheet and the user is able to view the graph of 'restecg', 'slope' and 'oldpeak' variables.<br><br>2) The user is able to read the analysis at the bottom of the worksheet under 'Analysis' section. | Pass |

| 2. | The user hovers on the bar graphs to get detailed information. | N.A. | 1) When the user hovers on a specific bar, the user should be able to read the facts about 'restecg', 'slope' and 'avg. oldpeak. | 1) When the user hovers on a specific bar, the user is able to read the facts about 'restecg', 'slope' and 'avg. oldpeak. | Pass |
|---|---|---|---|---|---|
| 3. | The user uses the 'restecg' filter and selects 'Normal'. | 'Normal' is used in the 'restecg' filter. | 1) When the user selects 'Normal', the user should be able to view only the bubbles based on 'slope' for which 'restecg' is 'Normal'. | 1) When the user selects 'Normal', the user is able to view only the bubbles based on 'slope' for which 'restecg' is 'Normal'. | Pass |
| 4. | The user uses the 'restecg' filter and selects 'ST-T wave Abnormality. | 'ST-T wave Abnormality' is used in the 'restecg' filter. | 1) When the user selects 'ST-T wave Abnormality', the user should be able to view only the bubbles based on 'slope' for which 'restecg' is 'ST-T wave Abnormality'. | 1) When the user selects 'ST-T wave Abnormality', the user is able to view only the bubbles based on 'slope' for which 'restecg' is 'ST-T wave Abnormality'. | Pass |
| 5. | The user uses the 'restecg' filter and selects 'Left ventricular hypertrophy'. | 'Left ventricular hypertrophy is used in the 'restecg' filter. | 1) When the user selects 'Left ventricular hypertrophy', the user should be able to view only the bubbles based on 'slope' for which 'restecg' is 'Left ventricular hypertrophy'. | 1) When the user selects 'Left ventricular hypertrophy', the user is able to view only the bubbles based on 'slope' for which 'restecg' is 'Left ventricular hypertrophy'. | Pass |

## 4.9    Test for 'Ca' visualization

| Test Case ID: HD_UTC_09 | Test Designed By: Shrey Shah |
|---|---|
| Test Case Title: Major Vessels Test Case | Test Designed Date: 07/09/2021 |
| Test Case Description: When the user clicks on the worksheet named 'Ca' the user must be able to view the graph on worksheet, read the captions, hover for information and filter based on 'ca' variable. | Test Executed By: Shrey Shah |
| | Test Executed Date: 07/09/2021 |

**Preconditions:** The user is logged in via personal credentials on Tableau Public Server.

**Dependencies:** The user has access to view the visualizations on Tableau Public Server.

| Sr. No. | Test Steps | Test Data | Expected Result | Actual Result | Status |
|---|---|---|---|---|---|
| 1. | The user clicks on the 'Ca' worksheet named '. | N.A. | 1) Tableau Public Server directs the user to the 'Ca' worksheet and the user should be able to view the graph of 'ca' variables.<br><br>2) The user should be able to read the analysis at the bottom of the worksheet under 'Analysis' section. | 1) Tableau Public Server directs the user to the 'Ca' worksheet and the user is able to view the graph of 'ca' variables.<br><br>2) The user is able to read the analysis at the bottom of the worksheet under 'Analysis' section. | Pass |
| 2. | The user hovers on the bar graphs to get detailed information. | N.A. | 1) When the user hovers on a specific bar, the user should be able to read the distribution in percent of total about 'ca'. | 1) When the user hovers on a specific bar, the user is able to read the distribution in percent of total about 'ca'. | Pass |

### 4.10    Test for 'Num and Sex' visualization

| Test Case ID: HD_UTC_10 | Test Designed By: Shrey Shah |
|---|---|
| Test Case Title: Number and Sex Test Case | Test Designed Date: 07/09/2021 |
| Test Case Description: When the user clicks on the worksheet named 'Num and Sex' the user must be able to view the graph on worksheet, read the captions, hover for information and filter based on 'num' variable. | Test Executed By: Shrey Shah |
| | Test Executed Date: 07/09/2021 |

**Preconditions:** The user is logged in via personal credentials on Tableau Public Server.

**Dependencies:** The user has access to view the visualizations on Tableau Public Server.

| Sr. No. | Test Steps | Test Data | Expected Result | Actual Result | Status |
|---|---|---|---|---|---|
| 1. | The user clicks on the 'Num and Sex' worksheet named '. | N.A. | 1) Tableau Public Server directs the user to the 'Num and Sex' worksheet and the user should be able to view the graph of 'ca' variables.<br><br>2) The user should be able to read the analysis at the bottom of the worksheet under 'Analysis' section. | 1) Tableau Public Server directs the user to the 'Num and Sex' worksheet and the user is able to view the graph of 'ca' variables.<br><br>2) The user is able to read the analysis at the bottom of the worksheet under 'Analysis' section. | Pass |
| 2. | The user hovers on the bar graphs to get detailed information. | N.A. | 1) When the user hovers on a specific bar, the user should be able to read the facts about 'num', 'sex' and percent of total. | 1) When the user hovers on a specific bar, the user is able to read the facts about 'num', 'sex' and percent of total. | Pass |
| 3. | The user uses the 'num' filter and selects '< 50%'. | '< 50%' is used in the 'num' filter. | 1) When the user selects '< 50%', the user should be able to view only the data about both 'sex' for which 'num' is '< 50%'. | 1) When the user selects '< 50%', the user is able to view only the data about both 'sex' for which 'num' is '< 50%'. | Pass |
| 4. | The user uses the 'sex' filter and selects '> 50%'. | '> 50%' is used in the 'num' filter. | 1) When the user selects '> 50%', the user should be able to view only the data about both 'sex' for which 'num' is '> 50%'. | 1) When the user selects '> 50%', the user is able to view only the data about both 'sex' for which 'num' is '> 50%'. | Pass |