

# **Visualizing and Predicting Heart Diseases with an Interactive Dashboard**

**NALAIYA THIRAN PROJECT REPORT  
2022**

*Submitted by*

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**Team ID: PNT2022TMID29391**

# Content

## **1. INTRODUCTION**

- 1.1 Project Overview
- 1.2 Purpose

## **2. LITERATURE SURVEY**

- 2.1 Existing problem
- 2.2 References
- 2.3 Problem Statement Definition

## **3. IDEATION & PROPOSED SOLUTION**

- 3.1 Empathy Map Canvas
- 3.2 Ideation & Brainstorming
- 3.3 Proposed Solution
- 3.4 Problem Solution fit

## **4. REQUIREMENT ANALYSIS**

- 4.1 Functional requirement
- 4.2 Non-Functional requirements

## **5. PROJECT DESIGN**

- 5.1 Data Flow Diagrams
- 5.2 Solution & Technical Architecture
- 5.3 User Stories

## **6. PROJECT PLANNING & SCHEDULING**

- 6.1 Sprint Planning & Estimation
- 6.2 Sprint Delivery Schedule
- 6.3 Reports from JIRA

## **7. CODING & SOLUTIONING (Explain the features added in the project along with code)**

- 7.1 Feature 1
- 7.2 Feature 2

## **8. TESTING**

- 8.1 Test Cases
- 8.2 User Acceptance Testing

## **9. RESULTS**

- 9.1 Performance Metrics

## **10. ADVANTAGES & DISADVANTAGES**

## **11. CONCLUSION**

## **12. FUTURE SCOPE**

## **13. APPENDIX**

- Source Code
- GitHub & Project Demo Link

**TEAM ID : PNT2022TMID29391**

## **VISUALIZING AND PREDICTING HEART DISEASES WITH AN INTERACTIVE DASHBOARD**

### **1. Introduction**

#### **1.1 Project Overview**

The leading cause of death in the developed world is heart disease. Therefore, there needs to be work done to help prevent the risks of having a heart attack or stroke. This project aims to create an interactive Dashboard using IBM Cognos Tool and dataset to predict which patients are most likely to suffer from a heart disease in the near future using the features given.

#### **1.2 Purpose**

Heart disease (HD) is a major cause of mortality in modern society. Medical diagnosis is an extremely important but complicated task that should be performed accurately and efficiently. Cardiovascular disease is difficult to detect due to several risk factors, including high blood pressure, cholesterol, and an abnormal pulse rate. Based on the analytics we can analyze which patients are most likely to suffer from heart disease in the near future and based on the patient details we will make decisions to cure them.

### **2. Literature Survey**

#### **2.1 Existing Problem**

Healthcare industries generate enormous amount of data, so called big data that accommodates hidden knowledge or pattern for decision making. The huge volume of data is used to make decision which is more accurate than intuition. Exploratory Data Analysis (EDA) detects mistakes, finds appropriate data, checks assumptions and determines the correlation among the explanatory variables. In the context, EDA is considered as analysing data that excludes inferences and statistical modelling. Analytics is an essential technique for any profession as it forecast the future and hidden pattern. Data analytics is considered as a cost effective technology in the recent past and it plays an essential role in healthcare which includes new research findings, emergency situations and outbreaks of disease. The use of analytics in healthcare improves care by facilitating preventive care and EDA is a vital step while analysing data..

## 2.2 References

### **“Heart Disease Prediction using Exploratory Data Analysis” R. Indrakumari, T.Poongodi, Soumya Ranjan Jena**

In this paper, the risk factors that causes heart disease is considered and predicted using K-means algorithm and the analysis is carried out using a publicly available data for heart disease. The dataset holds 209 records with 8 attributes such as age, chest pain type, blood pressure, blood glucose level, ECG in rest, heart rate and four types of chest pain. To predict the heart disease, K-means clustering algorithm is used along with data analytics and visualization tool. The paper discusses the pre-processing methods, classifier performances and evaluation metrics. In the result section, the visualized data shows that the prediction is accurate.

### **Prediction of heart disease at early stage using data mining and big data analytics: A survey N. K. Salma Banu, Suma Swamy**

Several studies have been carried out for developing prediction model using individual technique and also by combining two or more techniques. This paper provides a quick and easy review and understanding of available prediction models using data mining from 2004 to 2016. The comparison shows the accuracy level of each model given by different researchers. Into practice.

## 2.3 Problem Statement Definition

### **Who does the problem affect?**

People with unhealthy lifestyles, stress, depression, age above 40 and when their ancestors got heart disease (since heart disease is hereditary).

### **When does the issue occur?**

The issue occurs for people with unhealthy lifestyles and age above 40. Where is the issue occurring? The issue is originating from an unhealthy lifestyle. It mostly occurs in the blood valves of the heart.

### **What would happen if we didn't solve the problem?**

If we don't solve the problem, many people will die at a young age. The death rate due to heart disease will increase rapidly.

### **Why is it important to fix the problem?**

We should predict the problem before giving treatment to the patients. As the problem is predicted early, we can solve it easily and early.

## 3. Ideation and Proposed Solution

### 3.1 Empathy Map Canvas

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make decisions

Use Artificial  
Intelligence for  
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results

Trust your own  
decisions and  
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## What do they SEE?

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Observes in  
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List Out Pros  
and Cons

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the Analysis

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data

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predicted  
results

Predicting  
result on the  
test ,results  
input

## 3.2 Ideation and Brainstorming

### Step-1: Team Gathering, Collaboration and Select the Problem Statement

Template



# Brainstorm & idea prioritization

🕒 10 minutes to prepare

🕒 1 hour to collaborate

👤 2-8 people recommended

1


**Define your problem statement**

What problem are you trying to solve? Frame your problem as a How Might We statement. This will be the focus of your brainstorm.

🕒 5 minutes


PROBLEM


How do you Visualize and Predict Heart Diseases with an Interactive Dash Board





**Key rules of brainstorming**


To run an smooth and productive session


 Stay in topic.

 Encourage wild ideas.

 Defer judgment.

 Listen to others.

 Go for volume.

 If possible, be visual.

## Step-2: Brainstorm, Idea Listing and Grouping

2

### Brainstorm

Write down any ideas that come to mind that address your problem statement.

🕒 10 minutes

#### PRASHANTH L



#### DAVID M



#### MUGILAN M



#### PRAVEENKUMAR S



3

### Group Ideas

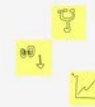
Take turns sharing your ideas while clustering similar or related notes as you go. In the last 10 minutes, give each cluster a sentence-like label. If a cluster is bigger than six sticky notes, try and see if you can break it up into smaller sub-groups.

🕒 20 minutes

#### HABITS



#### Drawings



#### Medical



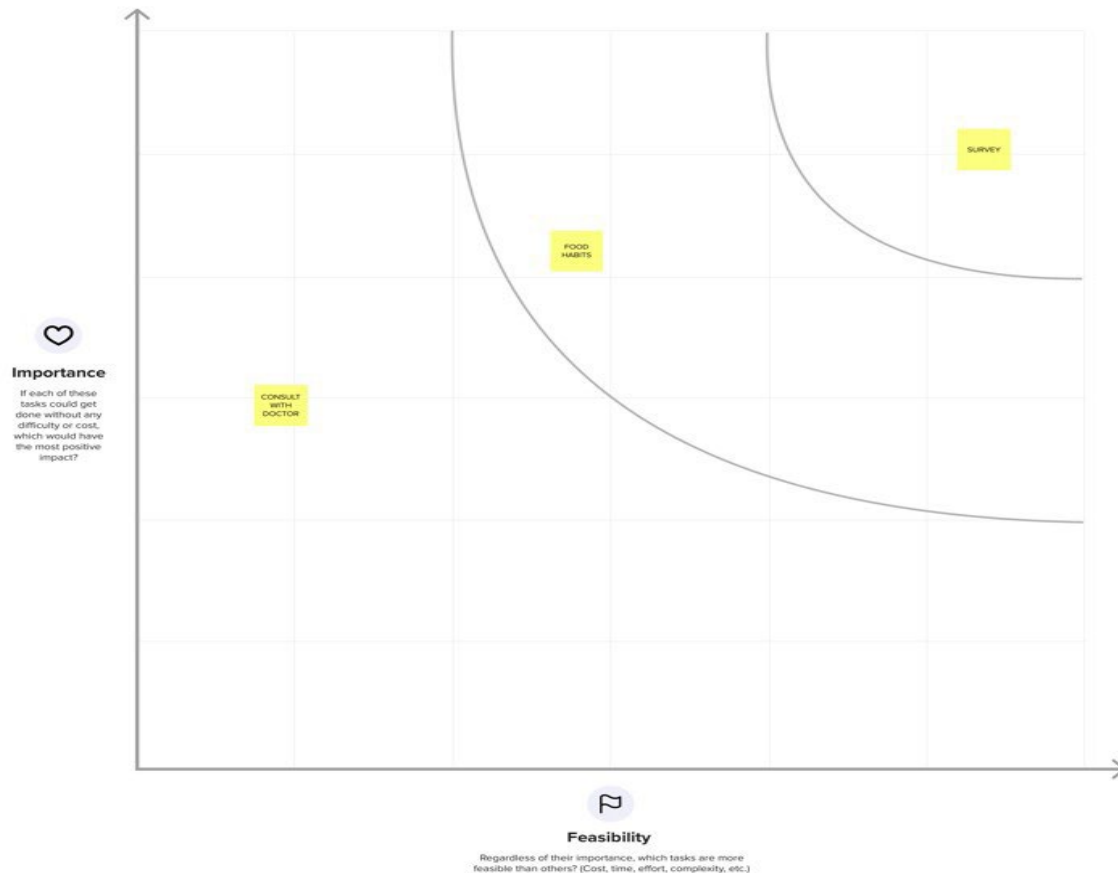
### Step-3: Idea Prioritization

4

#### Prioritize

Your team should all be on the same page about what's important moving forward. Place your ideas on this grid to determine which ideas are important and which are feasible.

🕒 20 minutes



### 3.3 Proposed Solution

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	Predicting the heart disease of a patient by analyzing Past or historical records. Where patient can get cure Or take necessary treatment before the disease is affected.Also, to develop am interactive dashboard to predict the disease accurately with few tests and attributes.
2.	Idea / Solution description	Analyzing data and identifying the heart disease using Cognos analytics.



		To predict the heart disease at the beginning stage and provide treatment for speedy recovery
3.	Novelty / Uniqueness	Comparing other models the prediction will vary. But our model will predict accurately and give effective results
4.	Social Impact / Customer Satisfaction	By this project people can able to diagnose the heart disease at initial stage by themselves
5.	Business Model (Revenue Model)	By subscription technique, one user will be allowed to predict the disease.
6.	Scalability of the Solution	In future, some more health associated prediction will be added with the same interactive dashboard.

### 3.4 Problem Solution Fit

Define CS, fit into CC	<b>1. CUSTOMER SEGMENT(S)</b> <small>Who is your customer? i.e. working parents of 0-5 yrs. kids</small> <b>CS</b> 1. Patients 2. Curoious users 3. Family members of the patients	<b>6. CUSTOMER CONSTRAINTS</b> <small>What constraints prevent your customers from taking action or limit their choices of solutions? i.e. spending power, budget, no cash, network connection, available devices</small> <b>CC</b> Some people are not willing to go to hospital due to financial constraints and some staying at remote locations	<b>5. AVAILABLE SOLUTIONS</b> <small>Which solutions are available to the customers when they face the problem or need to get the job done? What have they tried in the past? What pros &amp; cons do these solutions have? i.e. pen and paper is an alternative to digital note-taking</small> <b>AS</b> Visiting the experienced cardiologist to verify	Explore AS, differentiate
Focus on J&P, tap into BE, understand RC	<b>2. JOBS-TO-BE-DONE / PROBLEMS</b> <small>Which jobs-to-be-done (or problems) do you address for your customers? There could be more than one; explore different sides.</small> <b>J&amp;P</b> To predict whether the user has heart disease or not	<b>9. PROBLEM ROOT CAUSE</b> <small>What is the real reason that this problem exists? What is the back story behind the need to do this job? i.e. customers have to do it because of the change in regulations.</small> <b>RC</b> Users are in need of these kind of solutions because 1. Because heart disease is hereditary 2. Some people may be leading unhealthy lifestyles which might make them more susceptible to heart related diseases	<b>7. BEHAVIOUR</b> <small>What does your customer do to address the problems and get the job done? i.e. directly related: find the right solar panel installer, calculate usage and benefits, indirectly associated: customers spend free time on volunteering work (i.e. (un)employment)</small> <b>BE</b> 1. Schedule an appointment 2. Search for the best cardiologist online 3. Speak to family/friends regarding solutions	Focus on J&P, tap into BE, understand RC
Identify strong TR & EM	<b>3. TRIGGERS</b> <small>What triggers customers to act? i.e. seeing their neighbour installing solar panels, reading about a more efficient solution in the news.</small> <b>TR</b> Feeling discomfort in their chest. Users making sure that they are healthy	<b>10. YOUR SOLUTION</b> <small>If you are working on an existing business, write down your current solution first, fill in the canvas, and check how much it fits reality. If you are working on a new business proposition, then keep it blank until you fill in the canvas and come up with a solution that fits within customer limitations, solves a problem and matches customer behaviour.</small> <b>SL</b> Our application helps the user in finding out if they have heart disease or not. They can find out by entering details such as their heart rate, cholesterol blood pressure etc. A dashboard is also attached along with the results for better understanding where they can compare their blood pressure and similar metrics with other users	<b>8. CHANNELS OF BEHAVIOUR</b> <b>8.1 ONLINE</b> <small>What kind of actions do customers take online? Extract online channels from #7</small> 1. Talk with friends/family 2. Browse health related websites <b>8.2 OFFLINE</b> <small>What kind of actions do customers take offline? Extract offline channels from #7 and use them for customer development.</small> 1. Reach out to the nearest cardiologist <b>CH</b>	Extract online & offline CH of BE
	<b>4. EMOTIONS: BEFORE / AFTER</b> <small>How do customers feel when they face a problem or a job and afterwards? i.e. fear, insecure &gt; confident, in control - use it in your communication strategy &amp; design.</small> <b>EM</b> Before taking the test, the user will be anxious. After taking the test, the user will either be relieved that they are healthy or go to the hospital for double checking/treatment.			

## 4. Requirement Analysis

### 4.1 Functional Requirement

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Enables user to make registration for the application through Gmail
FR-2	User Confirmation	Once after registration, the user will get confirmation via Email
FR-3	Visualizing Data	User can visualize the trends on the heart disease through Dashboard created using IBM Cognos Analytics
FR-4	Generation Report	User can view his/her health report and can make decisions accordingly

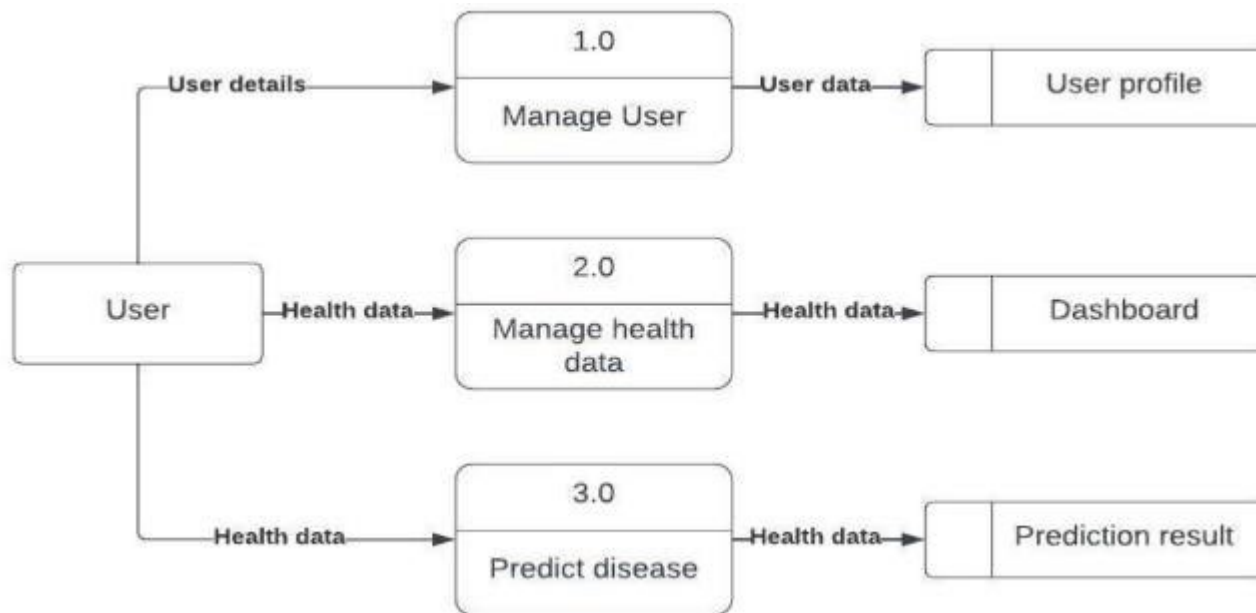
### 4.2 Non-Functional Requirement

Following are the non-functional requirements of the proposed solution.

FR No.	Non-Functional Requirement	Description
NFR-1	Usability	The application will have a simple and userfriendly graphical interface. Users will be able to understand and use all the features of the application easily. Any action has to be performed with just a few clicks
NFR-2	Security	For security of the application the technique known as database replication should be used so that all the important data should be kept safe. Incase of crash, the system should be able to backup and recover the data
NFR-3	Reliability	The application has to be consistent at every scenario and has to work without failure in any environment
NFR-4	Performance	Performance of the application depends on the response time and the speed of the data submission. The response time of the application is direct and faster which depends on the efficiency of implemented algorithm
NFR-5	Availability	The application has to be available 24 x 7 for users without any interruption
NFR-6	Scalability	The application can withstand the increase in the no. of users and has to be able to develop Higher versions

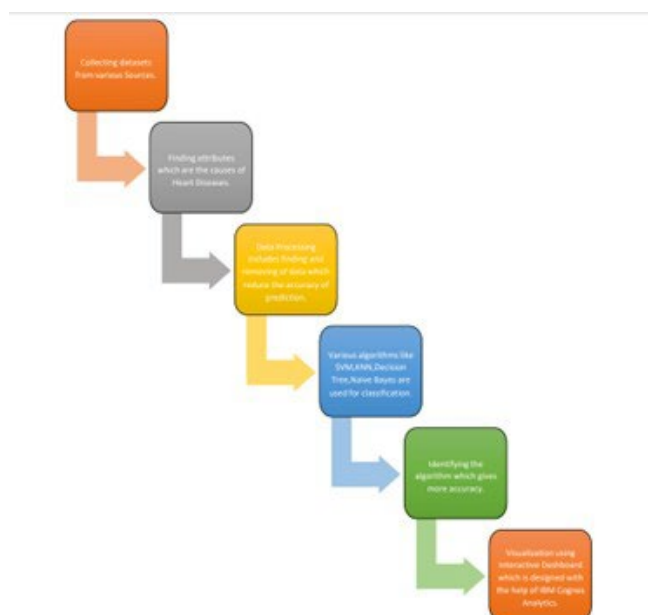
## 5. Project Design

### 5.1 Data Flow Diagram



### 5.2 Solution and Technical Architecture

#### 5.3



## 6. Project Planning and Scheduling

### 6.1 Script Planning and Execution

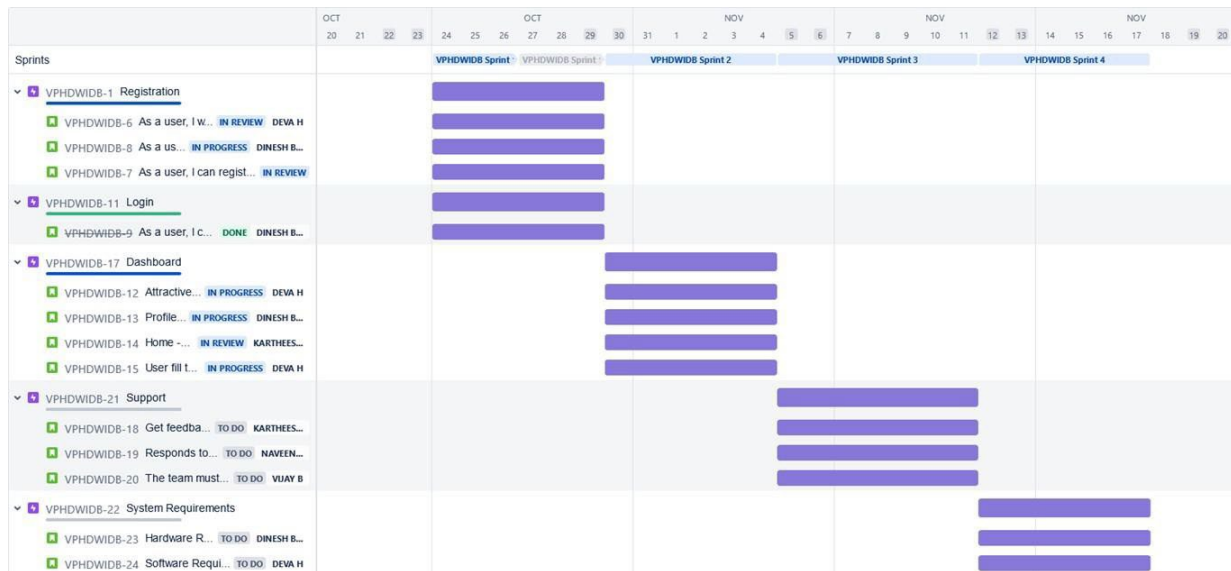
Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password	3	High	1
Sprint-1		USN-2	As a user, I will receive confirmation email once I have registered for the application	3	High	3
Sprint-1		USN-3	As a user, I can register for the application through Gmail	3	Medium	1
Sprint-1	Login	USN-4	As a user, I can log into the application by entering email & password	6	High	5
Sprint-2	Dashboard	USN-5	Attractive dashboard For the Application	3	Medium	3
Sprint-2		USN-6	Profile - view & update your profile	5	Low	2
Sprint-2		USN-7	Home - Analyze your Heart problem	2	High	4
Sprint-2		USN-8	The user will have to fill in the below 13 fields for the system to predict a disease -Age in year -Gender -Chest pain Type -Fasting Blood Sugar -Resting Electrographic Results -Exercise Induced Angina -Trust Blood Pressure	7	High	2
Sprint-3	Support	USN-9	Get feedback from users	10	Medium	3
Sprint-3		USN-10	Responds to user queries via telephone,email etc.	3	Medium	2
Sprint-3		USN-11	The team must respond immediately to the queries based on the priority	5	High	5
Sprint-4	System Requirements	USN-12	Hardware Requirement 3. Laptop or PC • i5 processor system or higher • 4 GB RAM or higher • 128 GB ROM or higher 4. Mobile • (12.0 and above)	5	Low	2
Sprint-4		USN-13	Software Requirement 2. Laptop or PC	8	Medium	4

			<ul style="list-style-type: none"> <li>Windows 10 or higher</li> <li>Android Studio</li> </ul>			
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## 6.2 Sprint Delivery Schedule

Sprint	Total Points	Story	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20		6 Days	24 Oct 2022	29 Oct 2022	20	29 Oct 2022
Sprint-2	20		6 Days	30 Oct 2022	04 Nov 2022	17	04 Nov 2022
Sprint-3	20		6 Days	05 Nov 2022	11 Nov 2022	18	11 Nov 2022
Sprint-4	20		6 Days	12 Nov 2022	17 Nov 2022	19	17 Nov 2022

## 6.3 Jira Report



## 7 Coding And Solutioning

### 7.1 Machine Learning

Learning which model is best for the given Dataset

```
data = {'Estimators': ['Linear Regression',
                      'Logistic Regression',
                      'Gaussian Naive Bayes',
                      'K-Nearest Neighbor',
                      'Random Forest',
                      'Bagging Decision Tree',
                      'Hard coting classifier'],
        'Accuracy': [r2,
                     LogisticRegressionScore,
                     gauss_score,
                     KNC_accuracy,
                     rnd_clf_accuracy,
                     bag_clf_accuracy,
                     voting_clf_accuracy]}

data = pd.DataFrame(data)
data.sort_values('Accuracy', ascending=False)
```

	Estimators	Accuracy
0	Linear Regression	0.447140
5	Bagging Decision Tree	0.772727
6	Hard coting classifier	0.772727
3	K-Nearest Neighbor	0.795455
4	Random Forest	0.795455
1	Logistic Regression	0.818182
2	Gaussian Naive Bayes	0.818182

From the Above results we can conclude that Logistic Regression and Gaussian Naive Bayes gives Highest accuracy than others for this particular data set . In our convinient we choose the Logistic Regression

*Comparing it with the accuracy gotten from Decision Tree:*

$TP = cm[0][0]$  #cm=Confusion Matrix

$TN = cm[1][1]$

$FN = cm[1][0]$

$FP = cm[0][1]$

$print('Testing Accuracy for Decision Tree:', (TP+TN)/(TP+TN+FN+FP))$

$print('Testing Sensitivity for Decision Tree:', (TP/(TP+FN)))$

$print('Testing Specificity for Decision Tree:', (TN/(TN+FP)))$

$print('Testing Precision for Decision Tree:', (TP/(TP+FP)))$

Testing Accuracy for Decision Tree: 0.9264705882352942

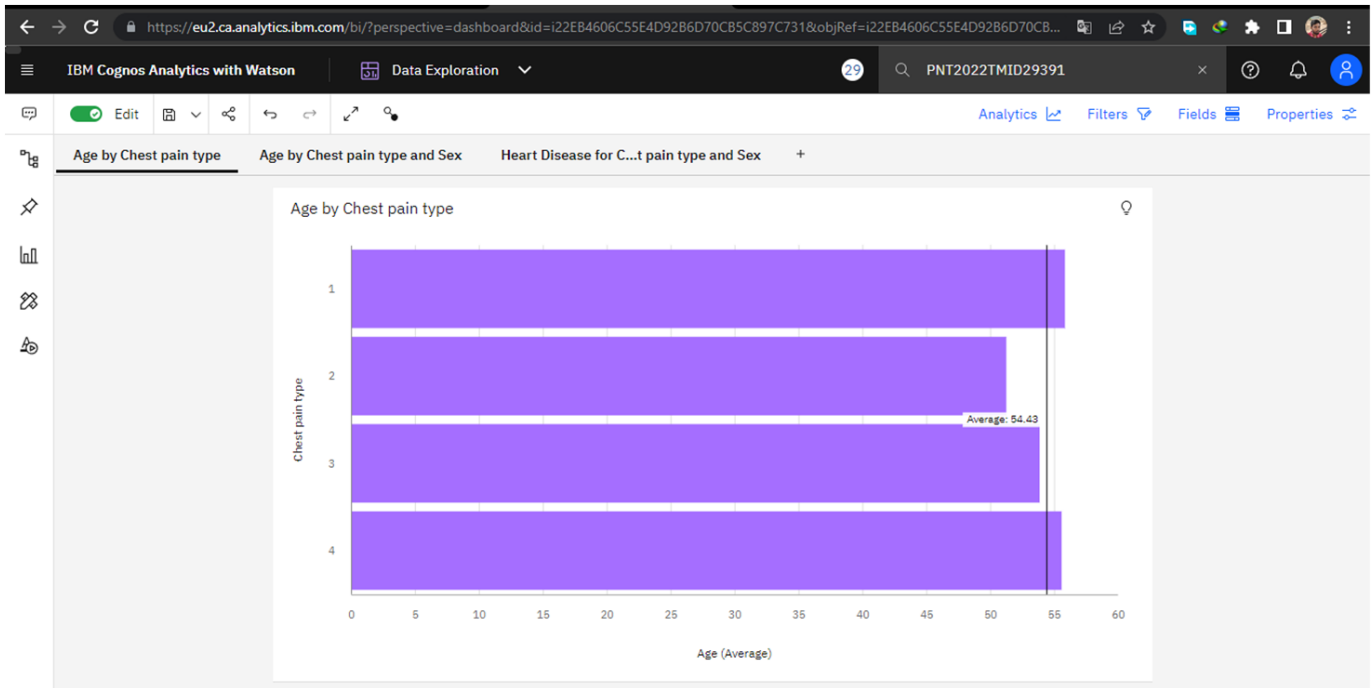
Testing Sensitivity for Decision Tree: 0.8888888888888888

Testing Specificity for Decision Tree: 1.0

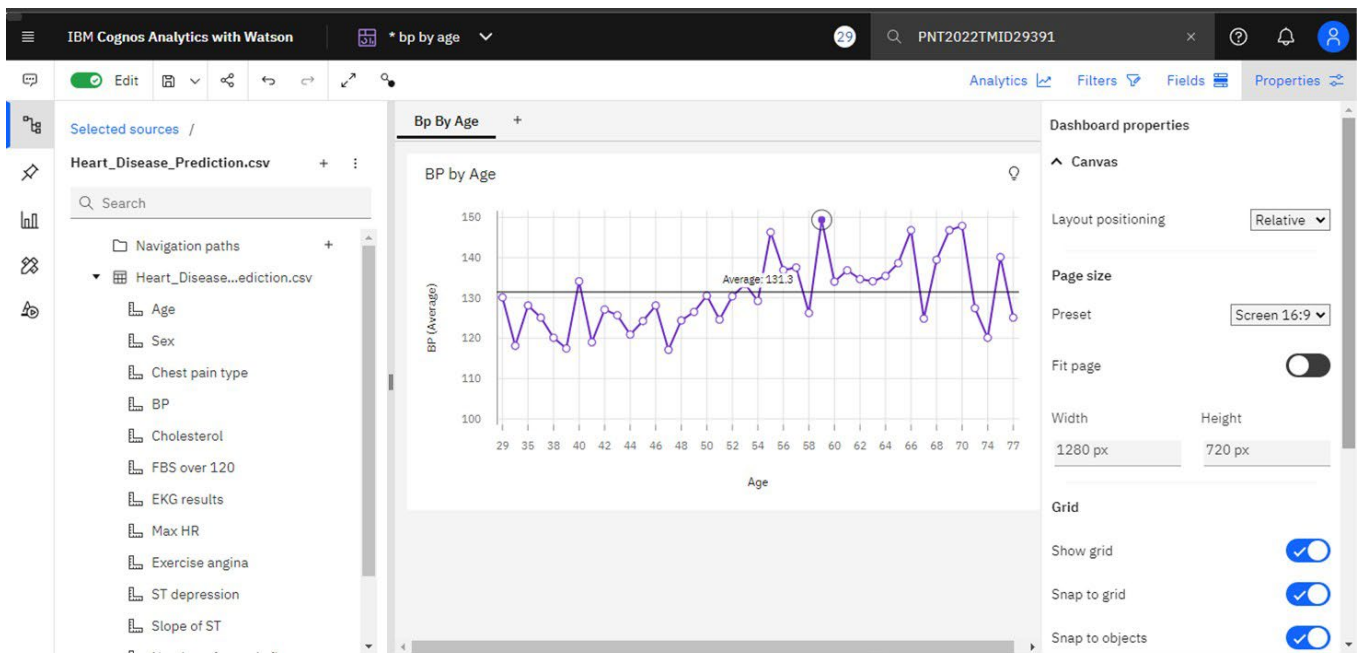
Testing Precision for Decision Tree: 1.0

## 7.2 Dashboard

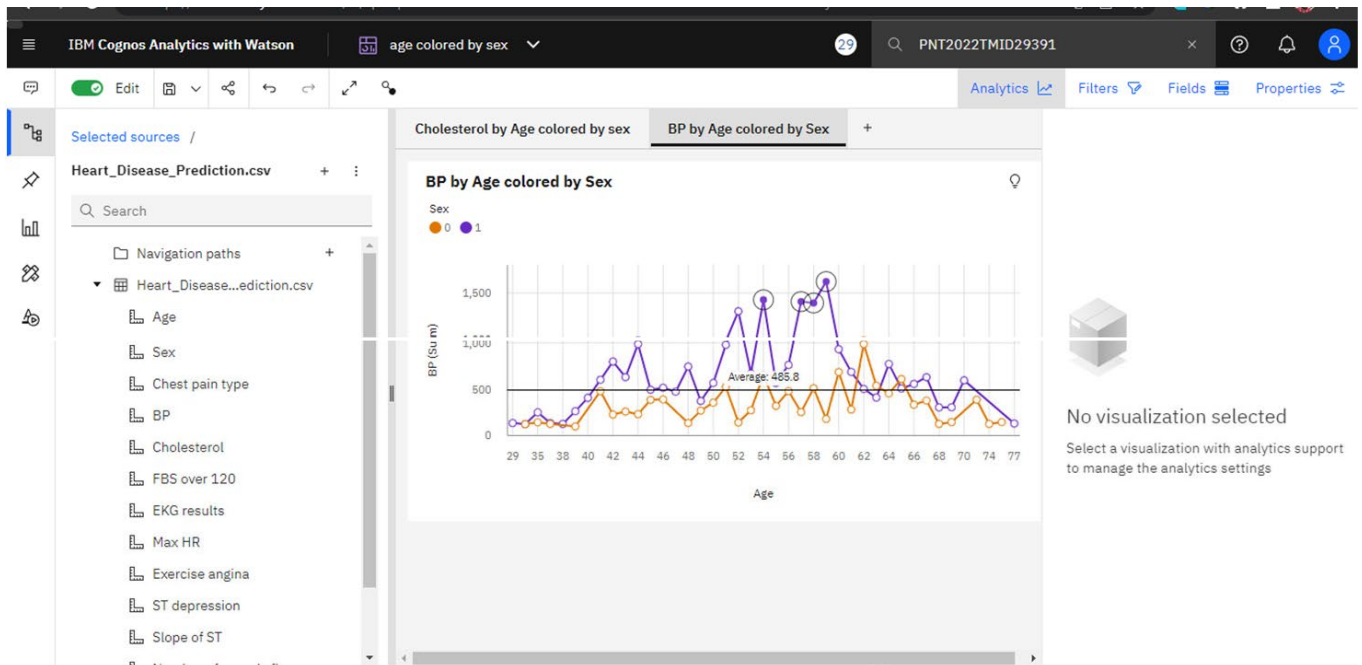
### Age by Chest Pain Type



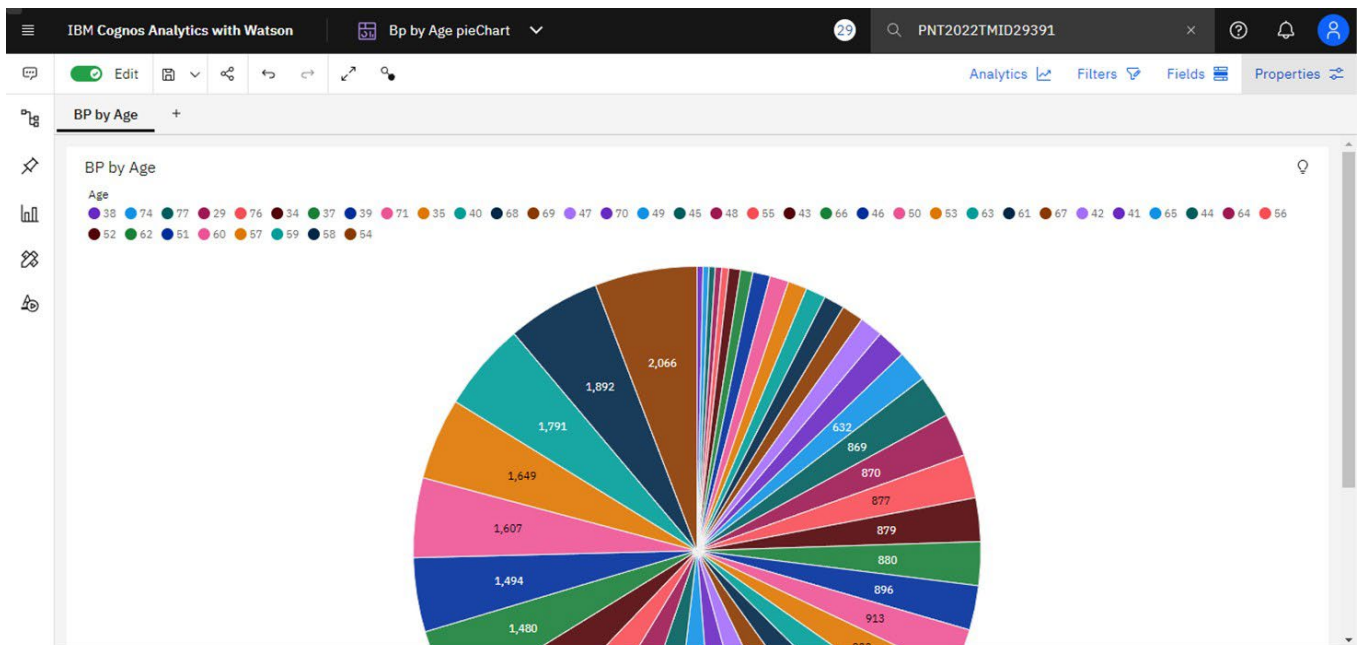
### BP by Age Line



## BP by Age coloured By sex

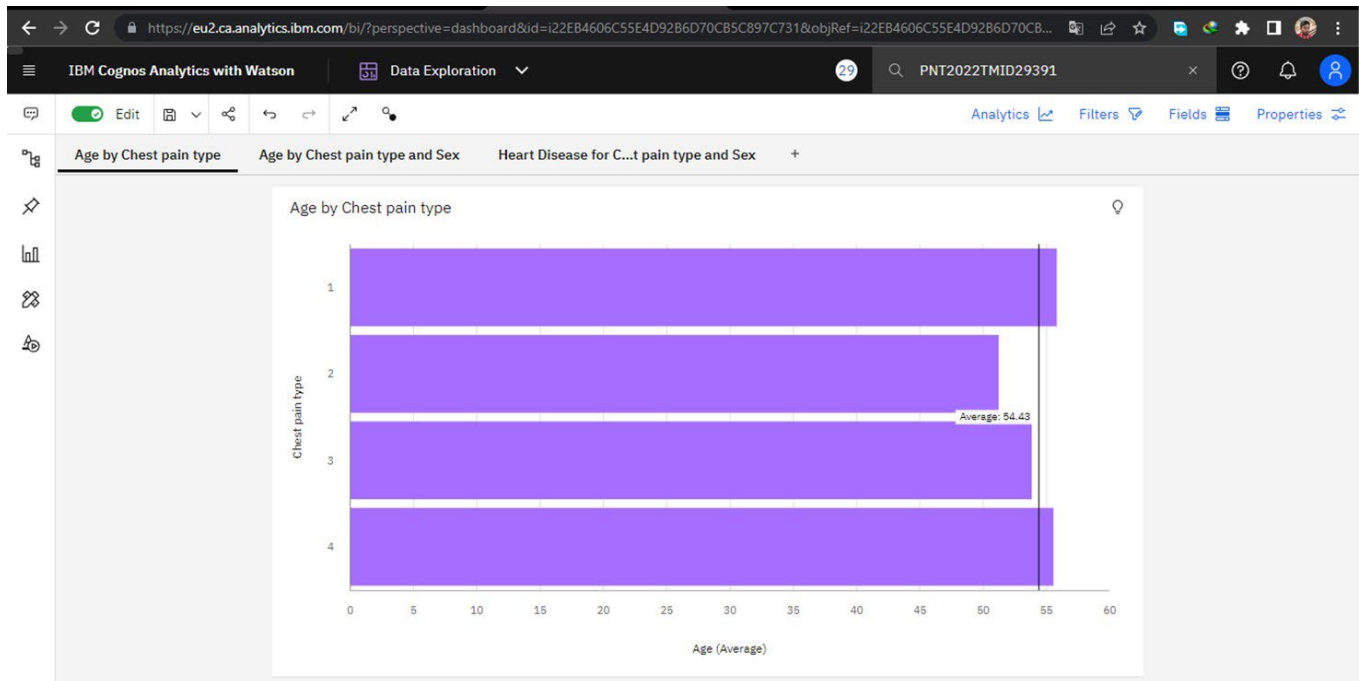


## Bp by Age Pie-chart

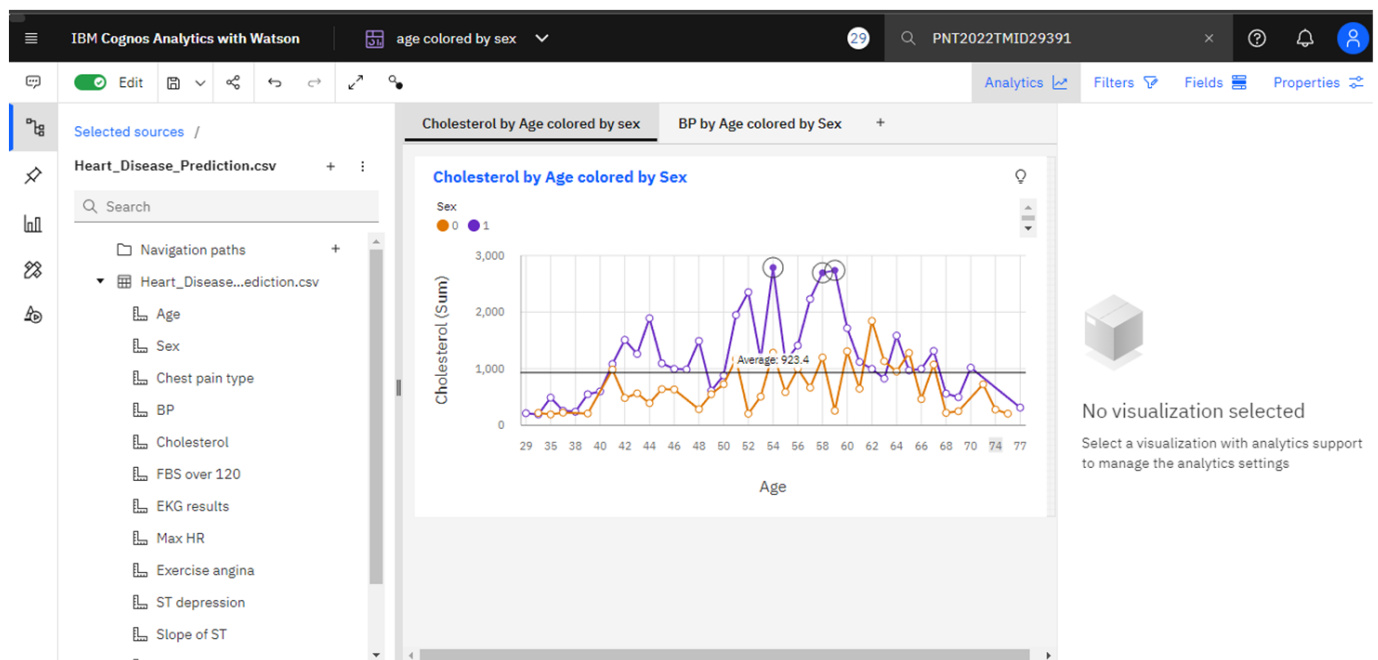




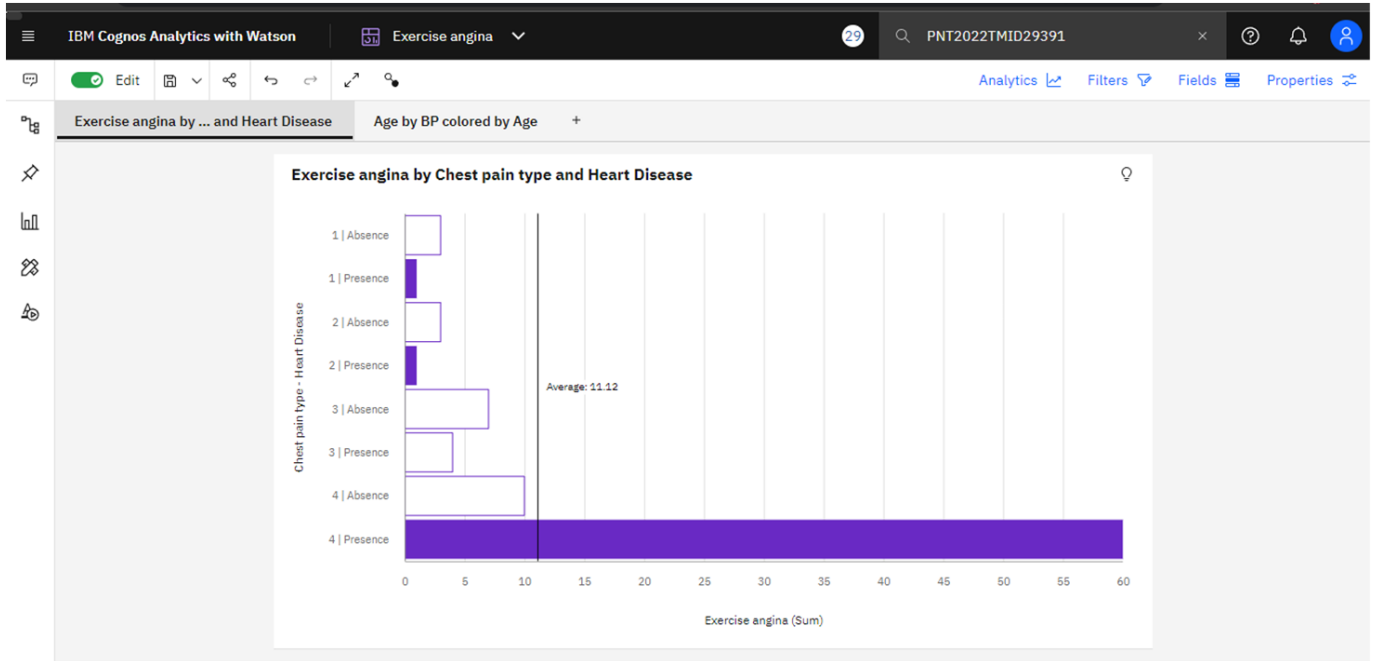
## Age by chest pain type and sex



## Cholestrol by age cloured by sex



## Exercise angina by Chest pain type and Heart Diseases



## Heart Diseases for chest pain type and sex

IBM Cognos Analytics with Watson | Data Exploration | 29 | PNT2022TMID29391

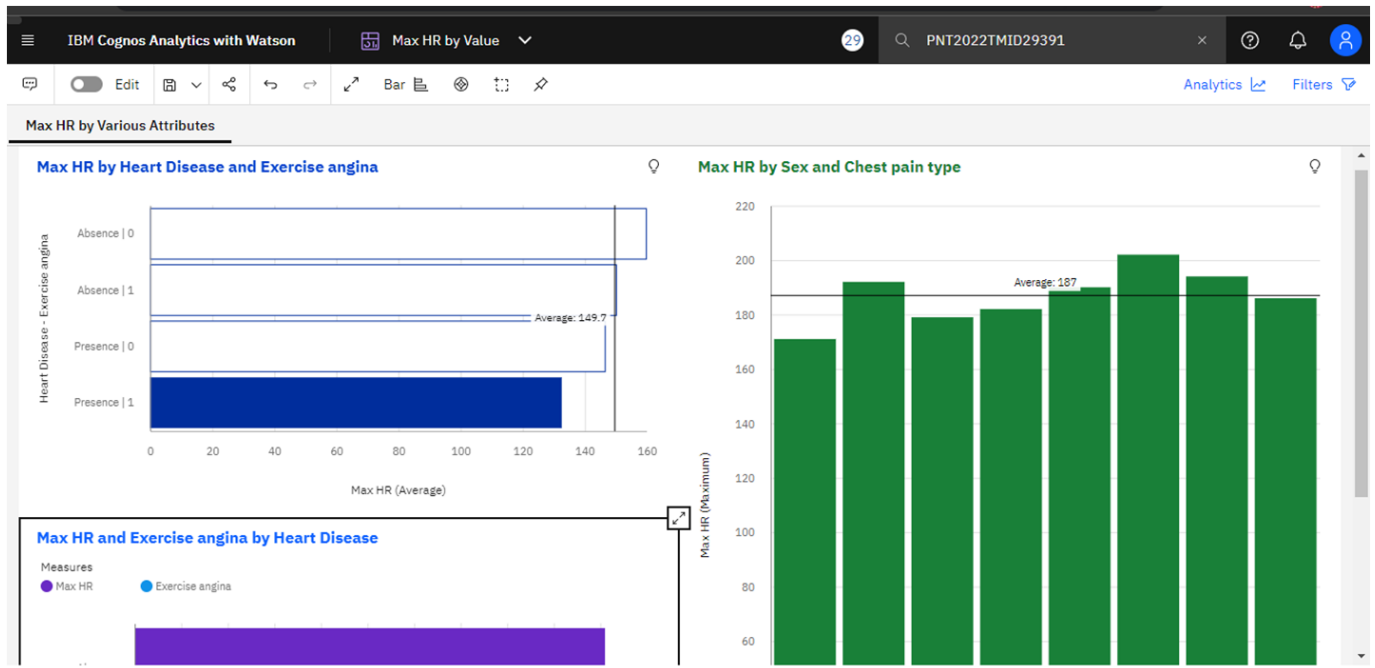
Analytics | Filters | Fields | Properties

Age by Chest pain type | Age by Chest pain type and Sex | **Heart Disease for Chest pain type and Sex** +

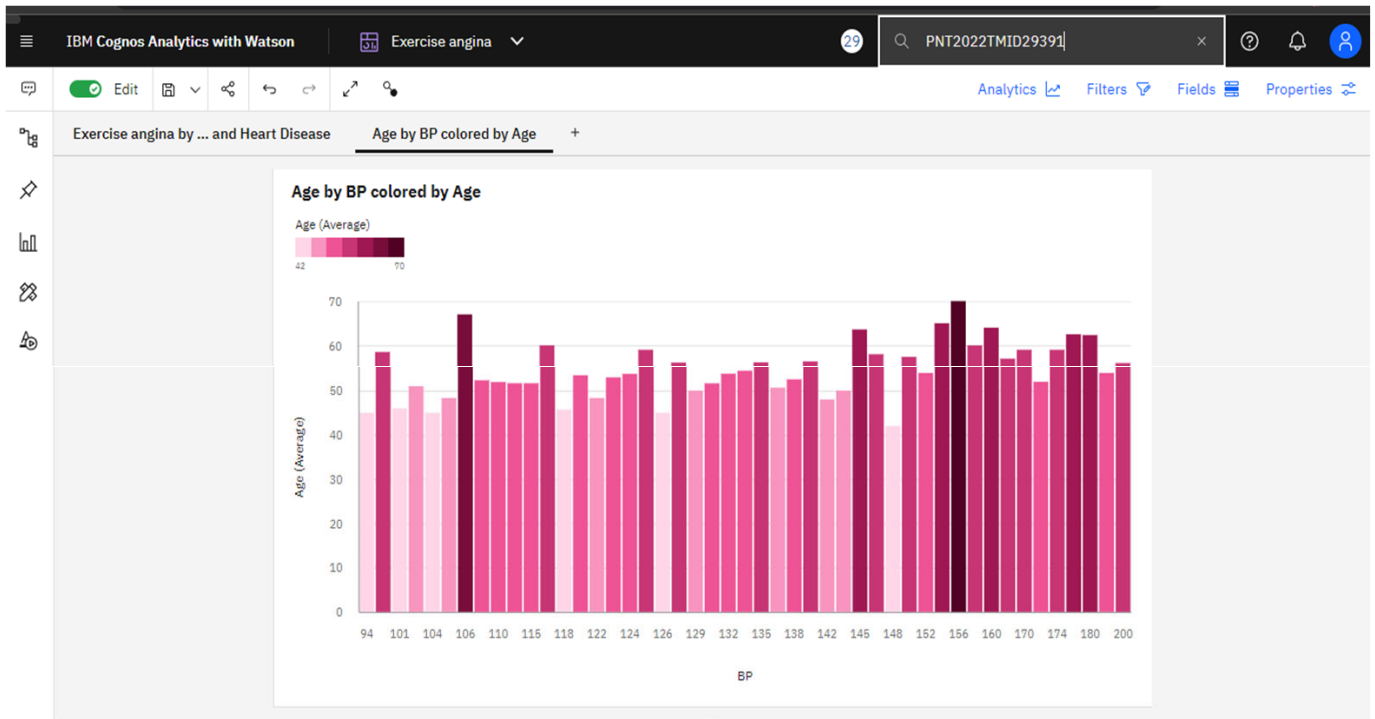
**Heart Disease for Chest pain type and Sex**

Heart Disease	1	2	3	4	Summary
0	1	2	2	2	2
1	2	2	2	2	2
Summary	2	2	2	2	2

## Showing Different Types Visuals



## Age by BP coloured by Age



## 8. Testing

### 8.1 Test Cases

Testing the data model for various input values.

```
In [ ]: from sklearn.metrics import accuracy_score
input=(63,1,3,145,200,150,98,0,0,0,0,0)
input_as_numpy=np.asarray(input)
input_resaped=input_as_numpy.reshape(1,-1)
pre1=tree_model.predict(input_resaped)
print(pre1)
a1 = accuracy_score(pre1,model1.predict(input_resaped)) * 100
print(a1)

['Absence']
100.0

In [ ]: from sklearn.metrics import accuracy_score
input=(70,1,4,130,322,0,2,109,0,2.4,2,3,3)
input_as_numpy=np.asarray(input)
input_resaped=input_as_numpy.reshape(1,-1)
pre1=tree_model.predict(input_resaped)
print(pre1)
a1 = accuracy_score(pre1,model1.predict(input_resaped)) * 100
print(a1)

['Presence']
100.0
```

## 82 User acceptance Testing

Testing a case where user not have heart disease

The screenshot shows a web application titled "Heart Disease Prediction". At the top, a message box says "localhost says: The patient not have a risk of heart heart Disese" with an "OK" button. Below the title, a paragraph states: "The leading death in the developed world is Heart Disease. Therefore there needs to be work done to help prevent the risk of having a heart attack or stroke". The form contains the following fields and options:

- Age (in years): 65
- Sex (0= female, 1= male): 1
- Chess pain type:
  - ☐ Typical Angina
  - ☐ Atypical Angina
  - ☒ Non-anginal pain
  - ☐ Non-anginal pain
- BP: 115
- cholesterol: 570
- FBS(> 120?True:False):
  - ☐ True
  - ☒ False
- EKG:
  - ☐ Normal
  - ☒ Aving ST-T wave abnormality
  - ☐ Showing probable or definite left ventricular
- Max-HR: xxx

Testing a case where user does have heart disease

The screenshot shows the same "Heart Disease Prediction" application. A message box at the top says "localhost says: The patient has increased risk of having Heart Disease" with an "OK" button. The form fields are filled with the following values:

- Age (in years): 70
- Sex (0= female, 1= male): 0
- Chess pain type:
  - ☐ Typical Angina
  - ☐ Atypical Angina
  - ☒ Non-anginal pain
  - ☐ Non-anginal pain
- BP: 130
- cholesterol: 250
- FBS(> 120?True:False):
  - ☐ True
  - ☒ False
- EKG:
  - ☐ Normal
  - ☒ Aving ST-T wave abnormality
  - ☐ Showing probable or definite left ventricular
- Max-HR: 145
- Exercise Angina: 0
- ST Depression: 2

## 9. Result

### 9.1 Performance Metrics

The confusion matrix below shows the performance metrics of the machine learning model.

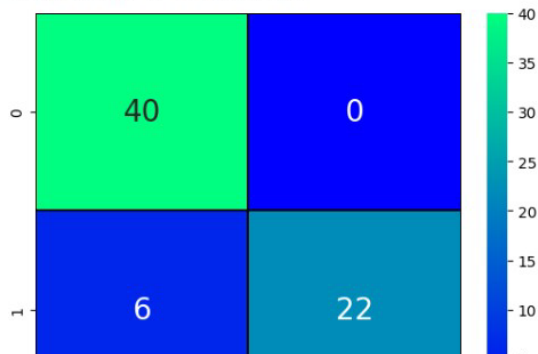
```
from sklearn.model_selection import RandomizedSearchCV
from sklearn.tree import DecisionTreeClassifier

tree_model = DecisionTreeClassifier(max_depth=5,criterion='entropy')
cv_scores = cross_val_score(tree_model, x, y, cv=10, scoring='accuracy')
m=tree_model.fit(x, y)
prediction=m.predict(X_test)
cm= confusion_matrix(y_test,prediction)
sns.heatmap(cm, annot=True,cmap='winter',linewidths=0.3, linecolor='black',annot_kws={"size": 20})
print(classification_report(y_test, prediction))
```

```
TP=cm[0][0]
TN=cm[1][1]
FN=cm[1][0]
FP=cm[0][1]
print('Testing Accuracy for Decision Tree:',(TP+TN)/(TP+TN+FN+FP))
print('Testing Sensitivity for Decision Tree:',(TP/(TP+FN)))
print('Testing Specificity for Decision Tree:',(TN/(TN+FP)))
print('Testing Precision for Decision Tree:',(TP/(TP+FP)))
```

	precision	recall	f1-score	support
Absence	0.87	1.00	0.93	40
Presence	1.00	0.79	0.88	28
accuracy			0.91	68
macro avg	0.93	0.89	0.91	68
weighted avg	0.92	0.91	0.91	68

```
Testing Accuracy for Decision Tree: 0.9117647058823529
Testing Sensitivity for Decision Tree: 0.8695652173913043
Testing Specificity for Decision Tree: 1.0
Testing Precision for Decision Tree: 1.0
```



## **10. Advantages Disadvantages**

### **Advantages:**

- This is one of the fastest ways to determine if a person is likely to suffer from a heart disease or not.
- Useful for medical practitioners to easily classify their patients.
- User Friendly
- Easy to understand
- Secure
- Dashboard provides insightful informations

### **Disadvantages:**

- Needs work
- Users need to know all the fields
- Does Not take null value as input
- Does not provide suggestions to user

## **11. Conclusion**

Complications of heart disease include heart attack and stroke. You can reduce the risk of complications with early diagnosis and treatment. So the suggestion that we get from the website might help save patients. It is always to get treated in the early stages of heart disease.

## **12. Future Scope**

Like the saying goes “Prevention is better than cure”. We have to look into methods to prevent heart diseases altogether other than just predicting it in early stages.

To use this website we need to take a lot of tests beforehand. So it would be better if we require less attributes and still give an effective result

## **13. Appendix**

Source Code:

<https://github.com/IBM-EPBL/IBM-Project-22109-1659805164/tree/main/Visualizing%20and%20Predicting%20Heart%20Diseases/Final%20deliverables/Source%20Code>

Demo Video link: