**Internship Project Report**

ON

**“Predict heart failure using IBM auto ai-service main”**

Submitted for the Internship of

**MACHINE LEARNING**

BY

**NAME: RAHUL P.BHERE**

**A project report submitted to:**

Smart Bridge



**Index**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **1** | |  | **INTRODUCTION** | |
|  | |  | 1.1 Overview | |
|  | |  | 1.2 Purpose | |
| **2** | |  | **LITERATURE SURVEY** | |
|  | |  | 2.1 Existing problem | | |
|  | |  | 2.2 Proposed solution | | |
| **3** | |  | **THEORITICAL ANALYSIS** | |
|  | |  | 3.1 Block diagram | |
|  | |  | 3.2 Hardware / Software designing | | |
| **4** | |  | **EXPERIMENTAL INVESTIGATIONS** | | |
| **5** | |  | **FLOWCHART** | |
| **6** | |  | **RESULT** |  |
| **7** | |  | **ADVANTAGES & DISADVANTAGES** | | |
| **8** | |  | **APPLICATIONS** | |
| **9** | |  | **CONCLUSION** | |
| **10** | |  | **FUTURE SCOPE** | |
| **11** | |  | **BIBILOGRAPHY** | |
|  | |  | **APPENDIX** | |
|  |  | | A. Source code | |

1. **INTRODUCTION**
   1. **Overview**

Diagnosis of Cardio Vascular Diseases (CVDs) is a daunting and challenging task and researchers across the world have developed numerous artificially intelligent systems for enhanced heart disease diagnosis and clinical decision support. According to the World Heart Federation, “More people die from CVDs worldwide than from any other cause and over 17.9 million deaths every year worldwide, according to the World Health Organization. Of these deaths, 80% are due to coronary heart diseases and cerebrovascular diseases and mostly affect low and middle income countries.”

* 1. Purpose

The aim of the project, Prediction of Heart Failure using IBM Auto AI service, is to build a low cost, high efficiency and robust web application to predict the risk of heart failure using specific indicators or features. This is an important and pertinent project in current times since cardiovascular diseases are at a rise and the mortality rates are high, primarily due to lifestyle changes, which influence the health of the heart.

Most heart diseases are highly preventable and simple lifestyle modiﬁcations(such as reducing tobacco use, eating healthily, obesity and exercising) coupled with early treatment greately improve their prognoses. It is, however, diﬃcult to identify high risk patients because of the mulfactorial nature of several contributory risk factors such as diabetes, high blood pressure, high cholesterol et cetera. Due to such constraints, scientists have turned towards modern approaches like Data Mining and Machine Learning for predicting the disease.

Machine learning (ML), due to its superiority in pattern detection and classiﬁcation,proves to be effective in assisting decision making and risk assesment from the large quantity of data produced by the healthcare industry on heart disease.

1. LITERATURE SURVEY
   1. Existing problem

Cardio Vascular Diseases can be diagnosed by: Blood tests, ECG, Treadmill tests, Echocardiography, X- Ray, CT, MRI etc. These tests are either very expensive or invasive thereby creating a scope for a prediction tool which is non-invasive.

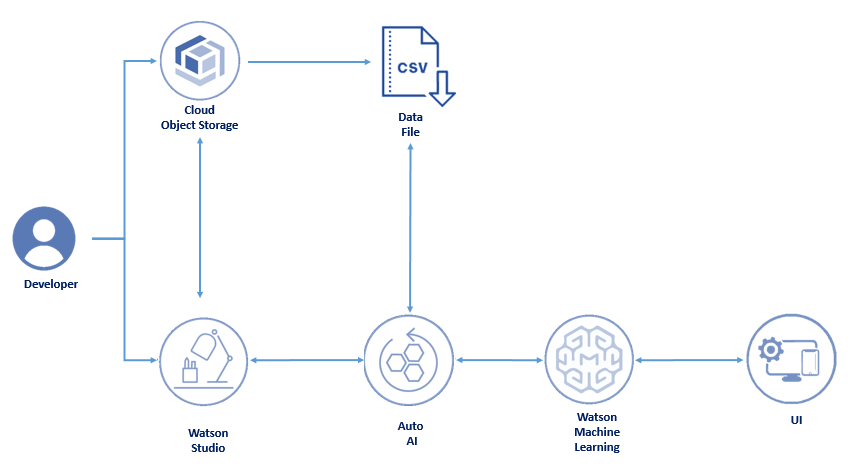
* 1. Proposed solution

The objective of this project is to come up with a solution to the challenge of diagnosing Cardio Vascular Diseases non-invasively, by employing Machine Learning tools and creating a web based application to predict heart failure.

1. **THEORITICAL ANALYSIS**
   1. **Block diagram**

Cardiovascular diseases (CVDs) are the number 1 cause of death globally, taking an estimated 17.9 million lives each year, which accounts for 31% of all deaths worldwide.Heart failure is a common event caused by CVDs and this dataset contains 9 features that can be used to predict mortality by In this project, you need to build a model using Auto AI and build a web application where we can get the prediction of heart failure.

**Architecture:**



**Fig. 3.1 Proposed Technical Architecture**

* 1. Hardware / Software designing

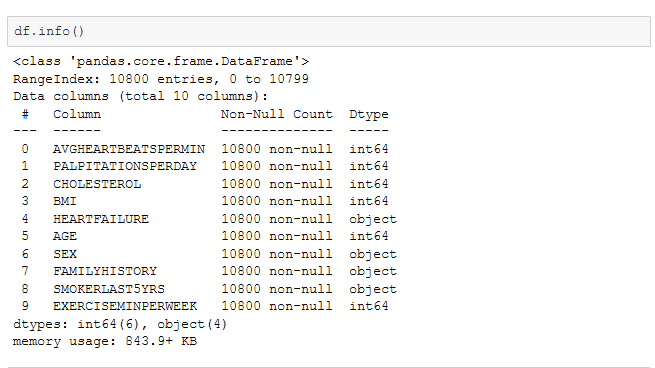
The following software tools are used in designing the heart failure prediction system: IBM AutoAI service, IBM Watson Studio, IBM Watson Machine Learning, Node-RED Dataset with nine input features and one output parameter heart failure prediction is used to train and build the prediction model: <https://github.com/IBM/predictive-model-on-watson-ml/blob/master/data/patientdataV6.csv>

**Services Used:**

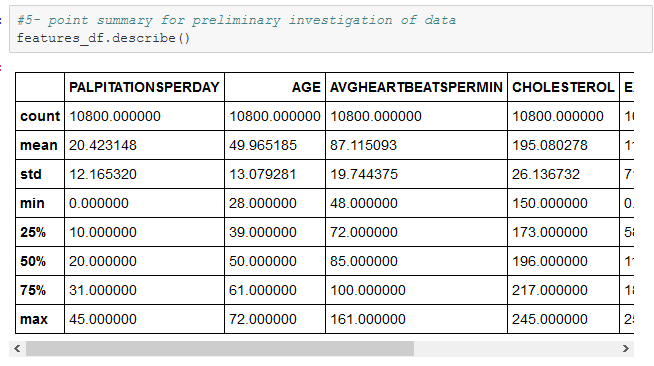
1. IBM Watson Studio
2. IBM Watson Machine Learning
3. Node-RED
4. IBM Cloud Object Storage
5. **EXPERIMENTAL INVESTIGATIONS**

The tools in Machine Learning and Watson Studio available in IBM services catalog were explored to create the project in addition to Node-RED to create the UI.

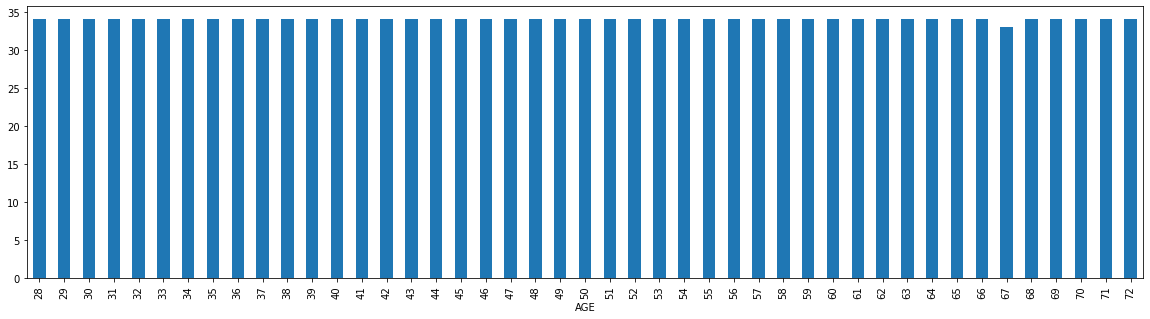
4.1 Exploratory Data Analysis (EDA)



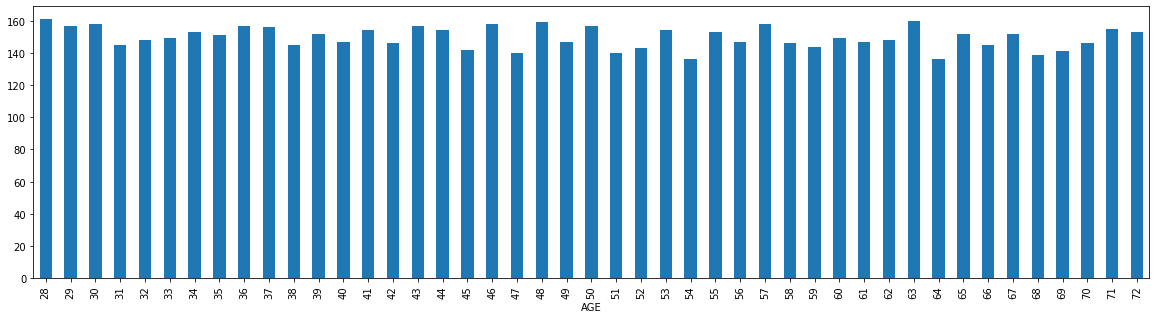
1. Five-point summary



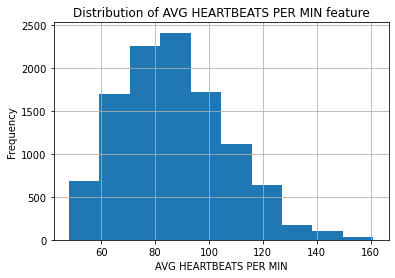
1. Age - BMI plot



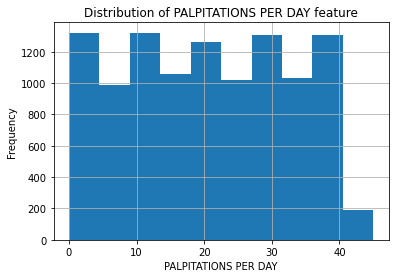
1. Age - AVG HEART BEATS PER MIN plot



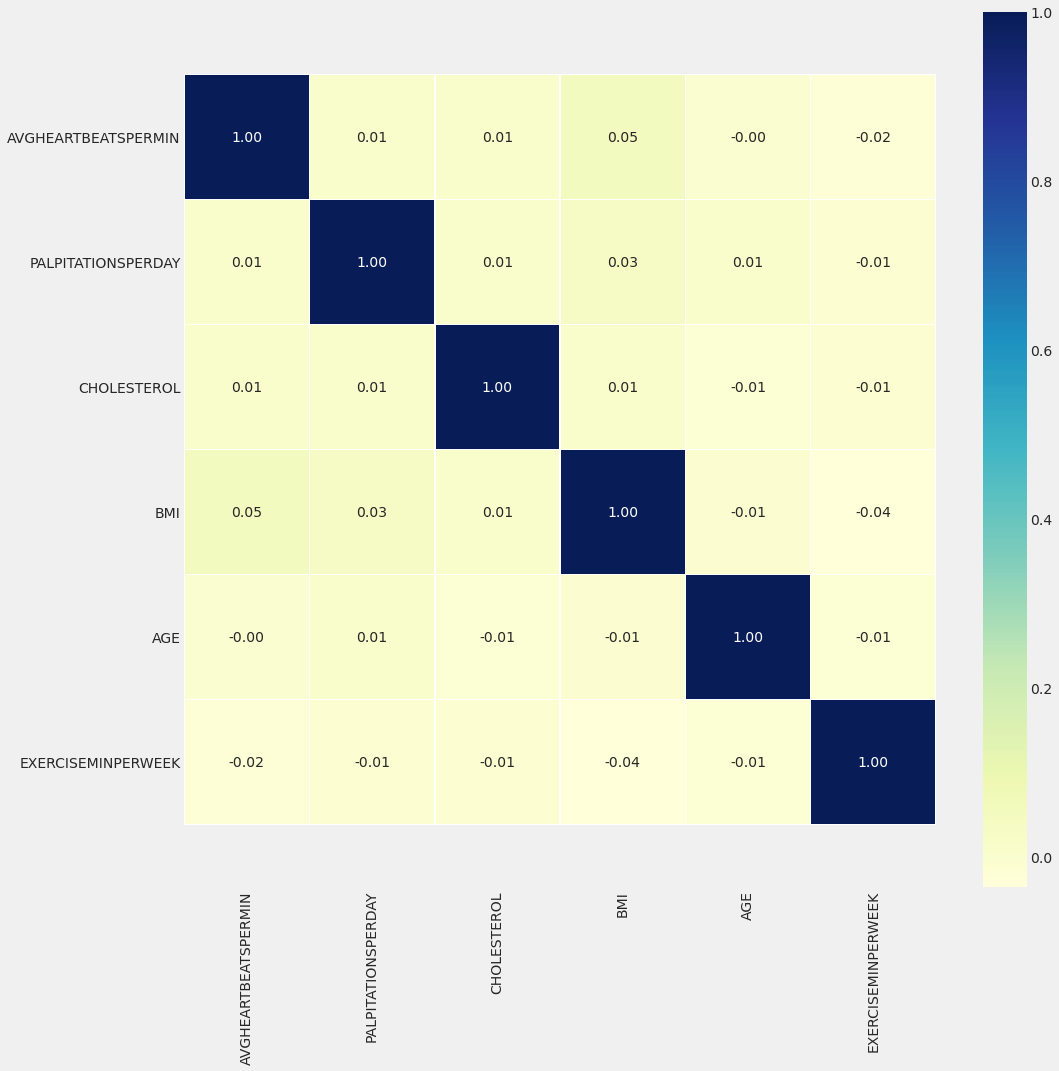
1. Histogram to show the frequency of AVGHEARTBEATSPERMIN



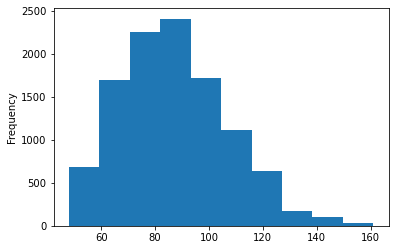
1. Histogram to show the frequency of AVGHEARTBEATSPERMIN



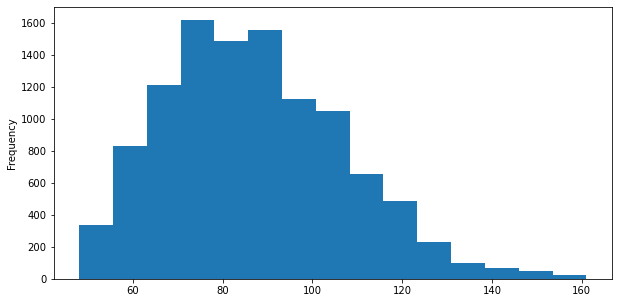
1. Correlation Matrix



1. histogram with the number of bins



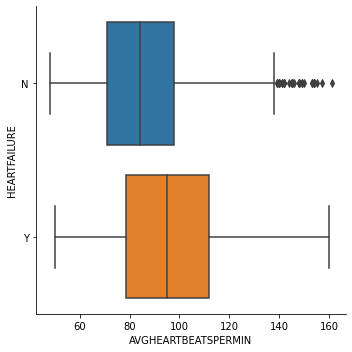
1. histogram with the figsize option



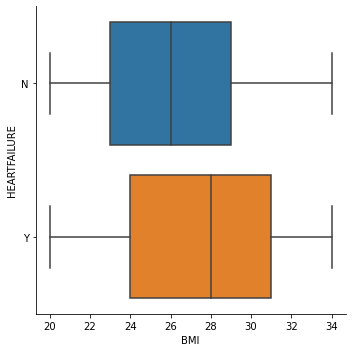
1. Bar Plot-1



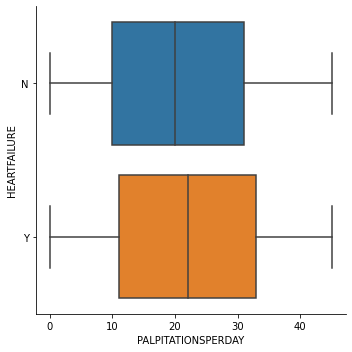
1. Box Plot-1



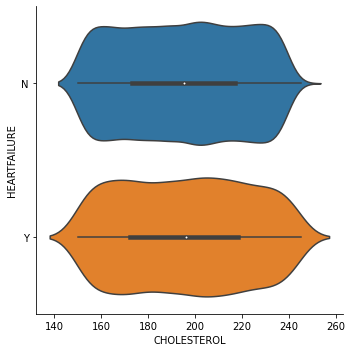
1. Box Plot-2



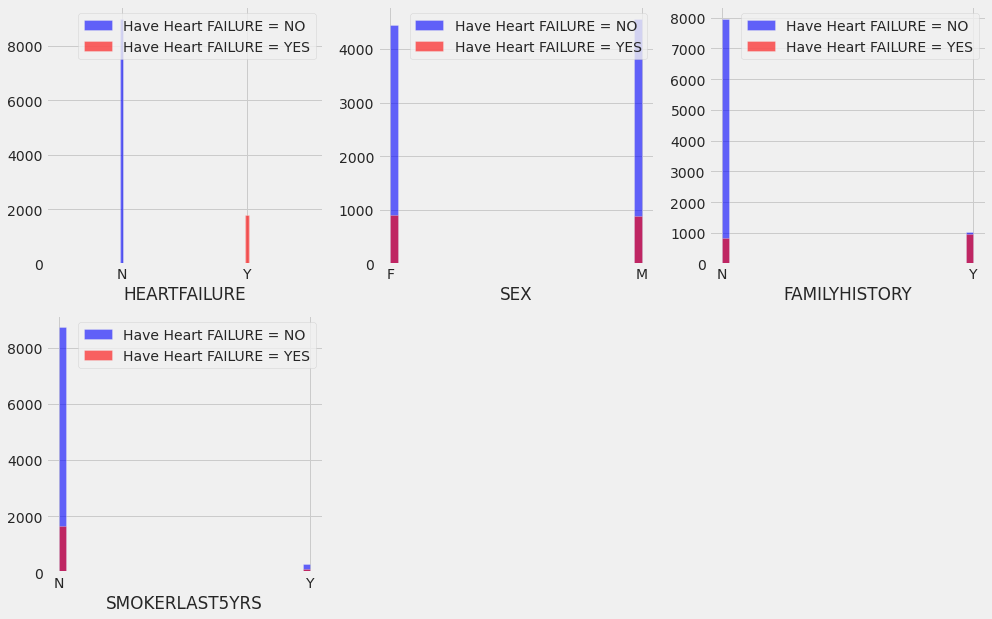
1. Box Plot-3



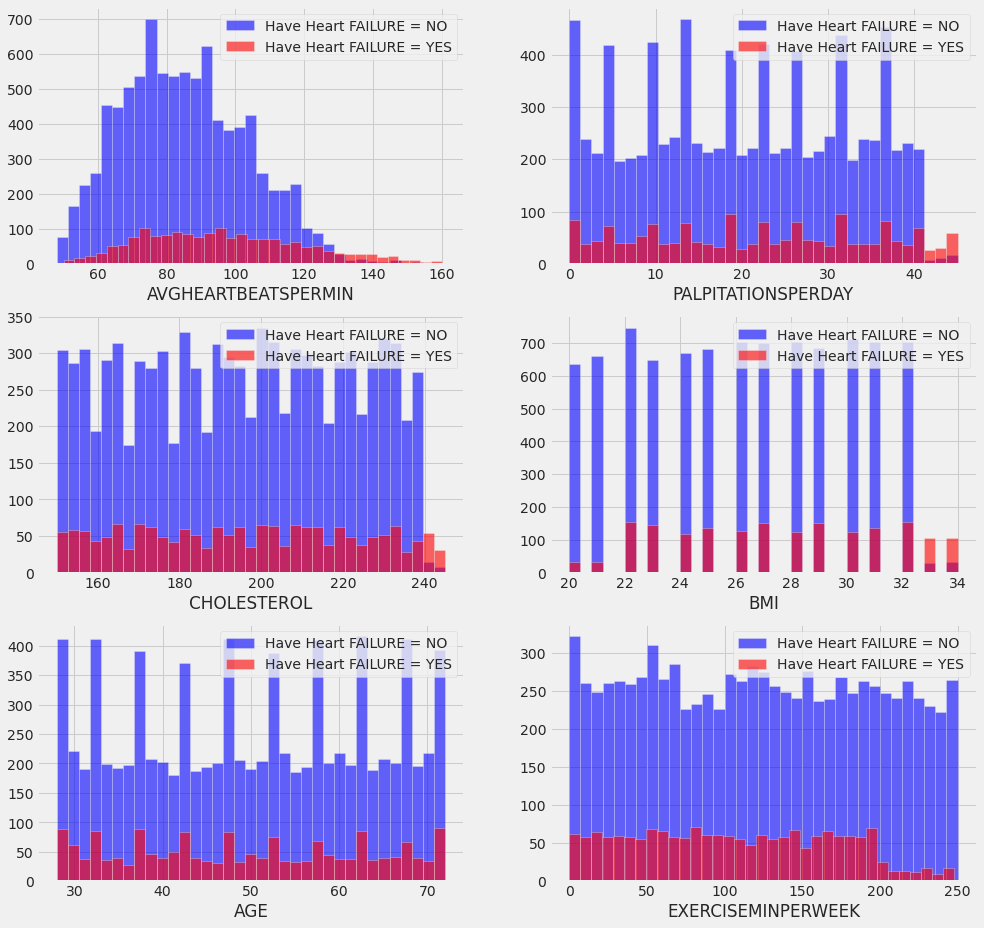
1. Violin Plot



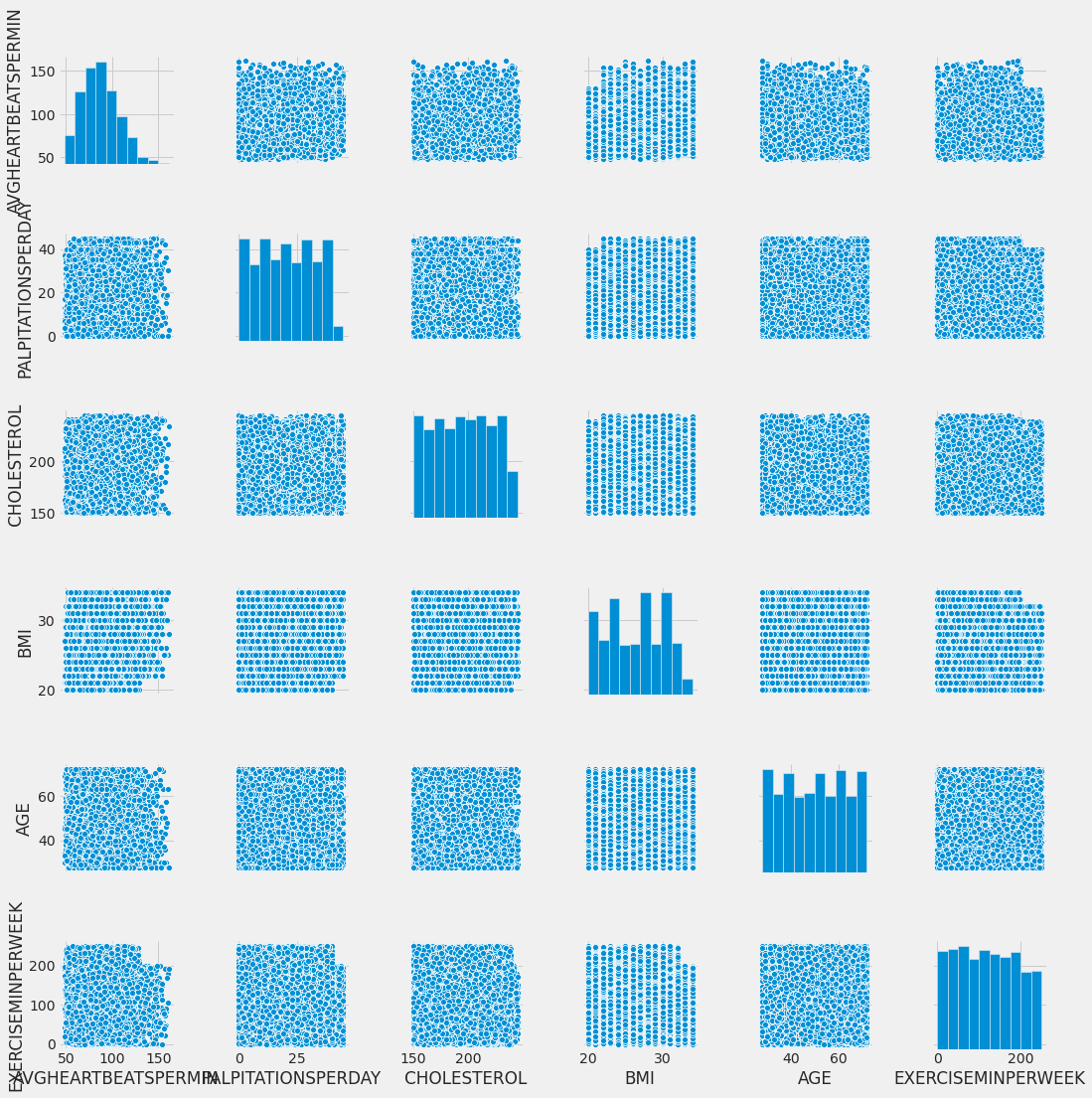
1. Plot using seaborn -1



1. Plot using seaborn -2



1. Plot using seaborn -3



* 1. **Steps to be followed to build the project:**

1. Create a project in IBM Watson Studio – Predict Heart Failure.
2. Add Auto AI experiment.
3. Create a Machine Learning instance.
4. Associate ML instance to the project.
5. Load the dataset to cloud object storage.
6. Select the target variable (HEARTFAILURE parameter) in the dataset
7. Train the model.
8. Deploy.
9. Build web application using Node-Red.

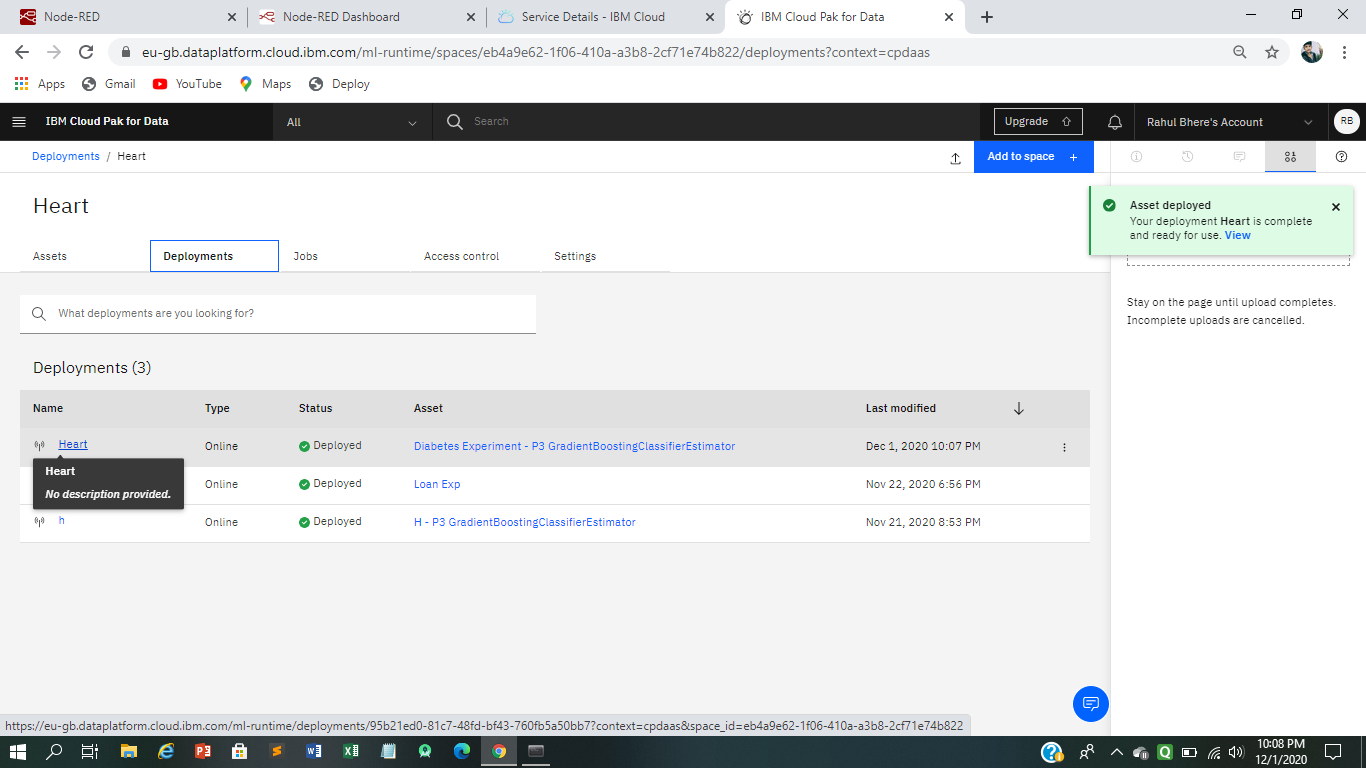


Figure 1:- IBM Auto AI Analyzing Data

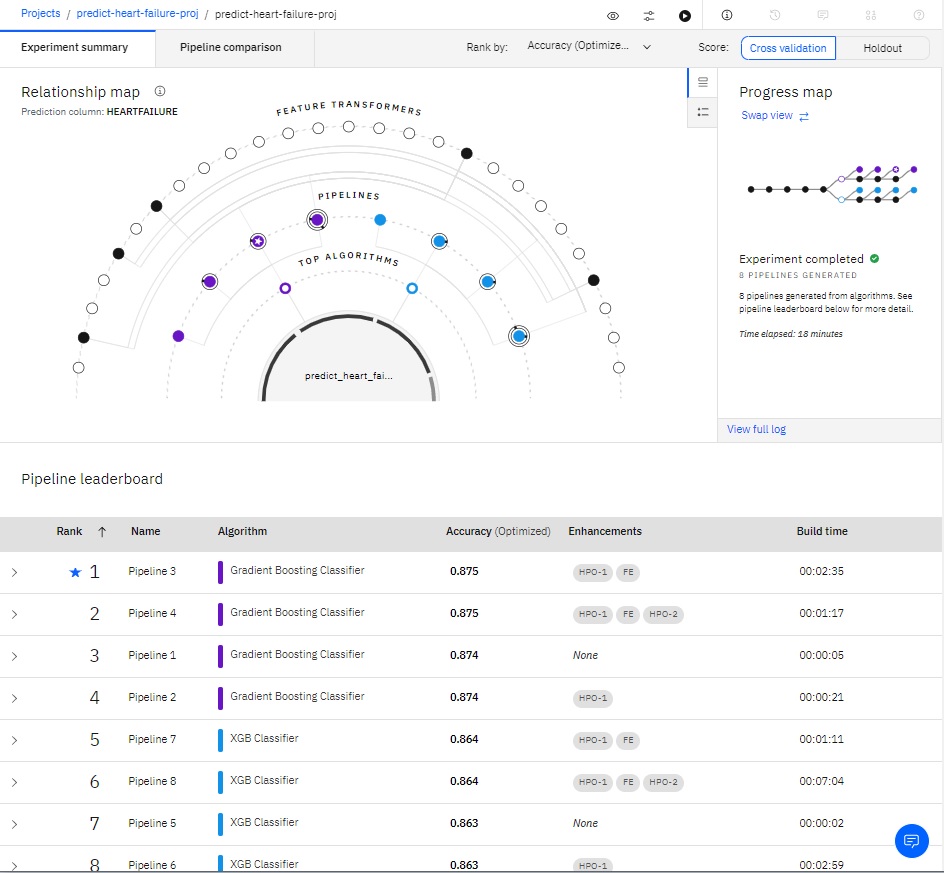


Figure 2:- Comparison between various algorithms

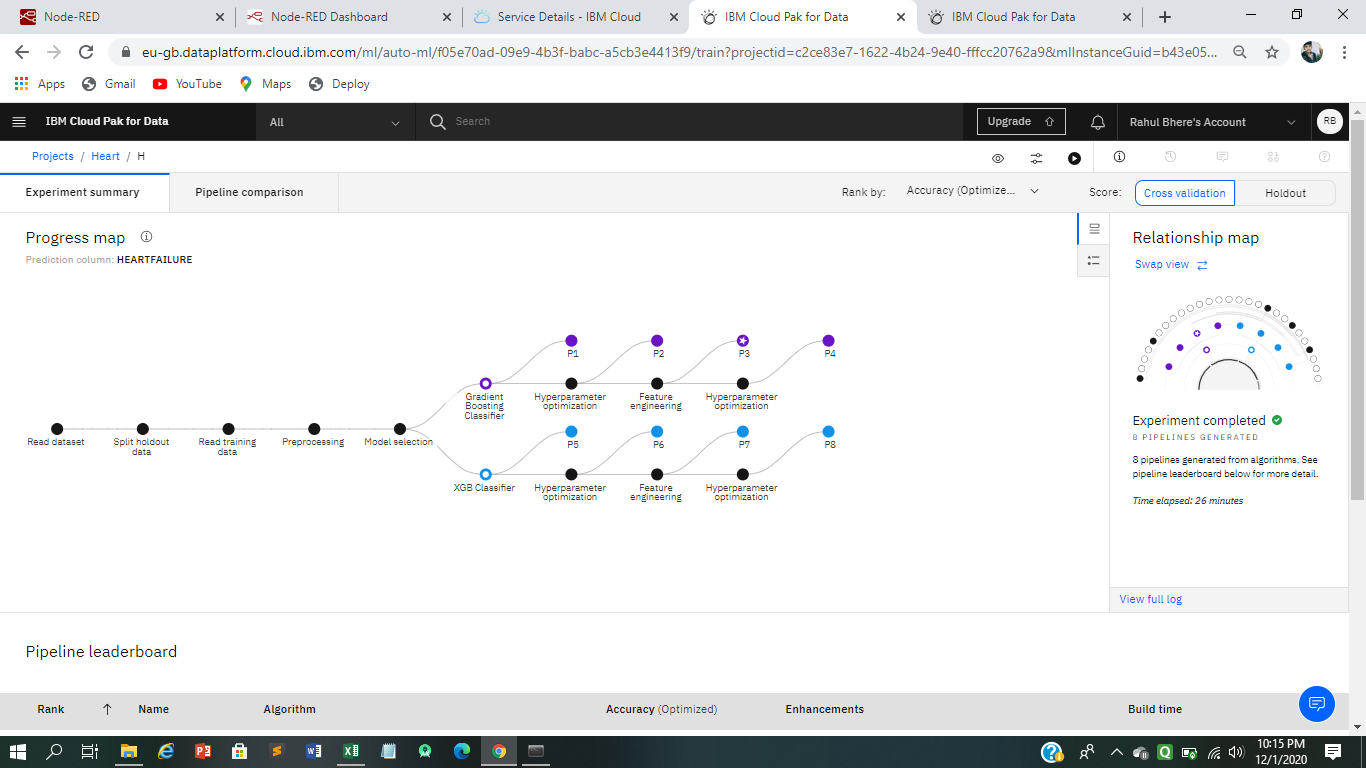


Figure 3:- Metric Chart Representation

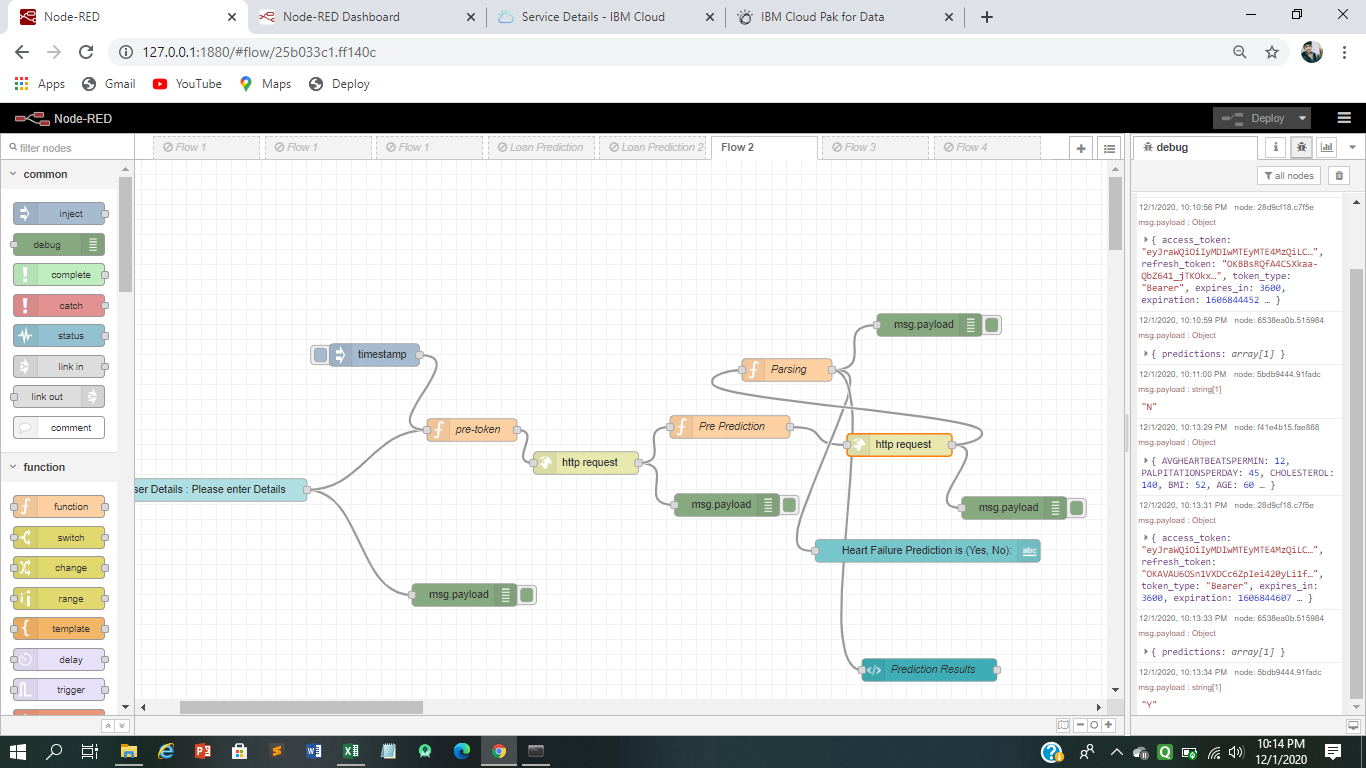
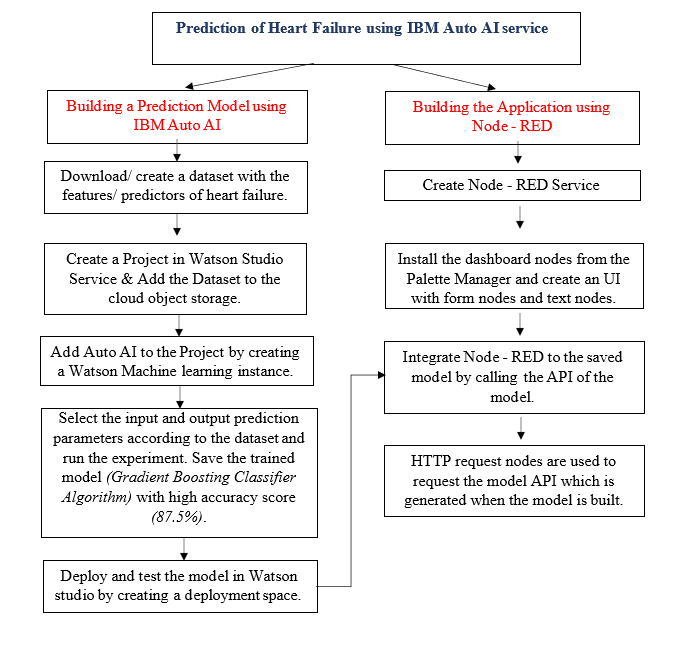


Figure 5:- Node-RED-Flow

1. **FLOWCHART**



1. **RESULT**

The web based application for Heart Failure Risk Prediction through Clinical Decision Support System (HFRP - CDSS) is developed using IBM AutoAI service, to predict the risk of heart failure using these nine input features – average heart beats per minute, no. of palpitations per day, cholesterol value, body mass index (BMI), age, sex, having a family history of CVDs, being a smoker for the last 5yrs, no. of minutes of exercise done per week.

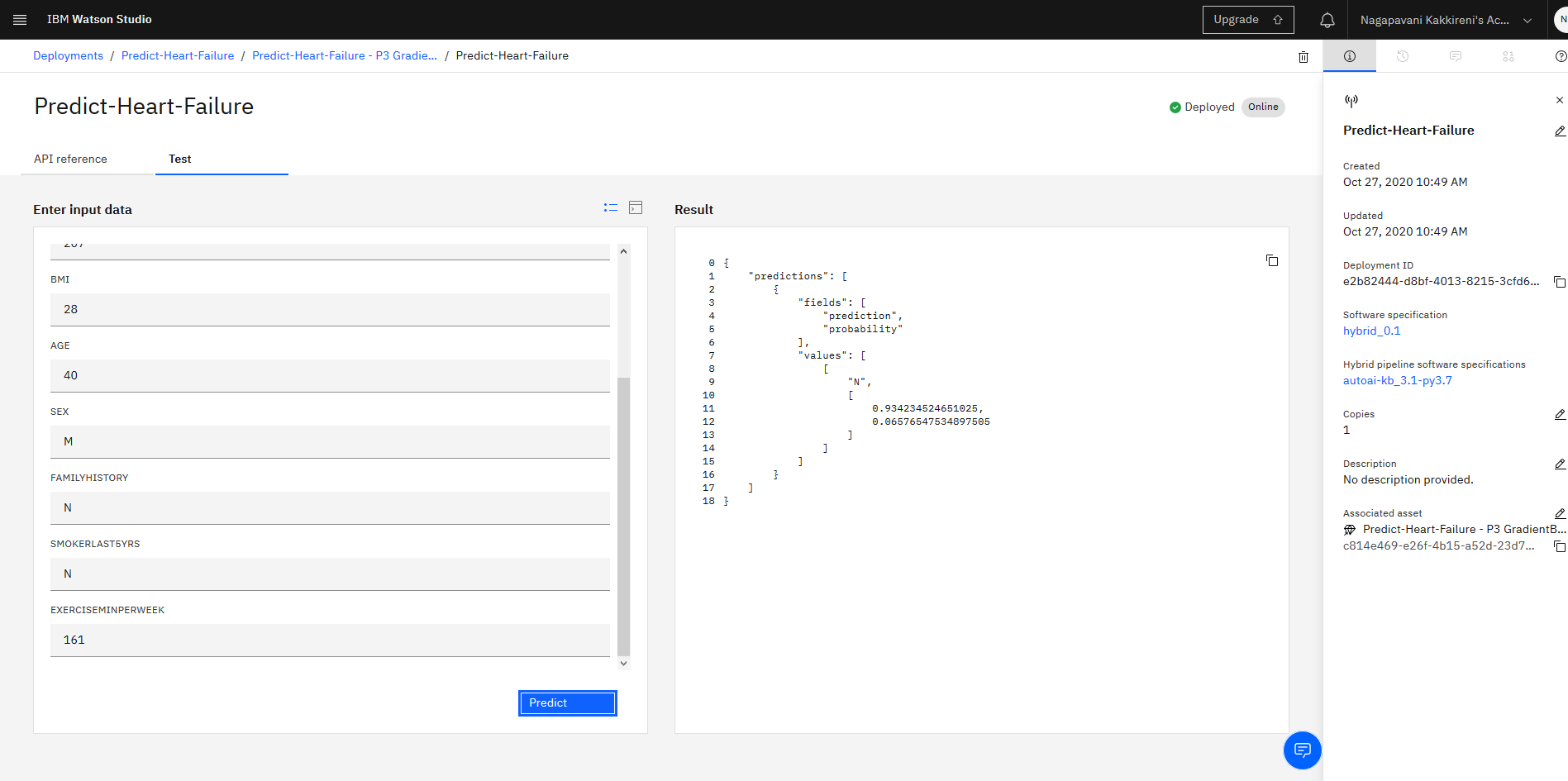


Figure 6:- Test\_Model\_Output(N)

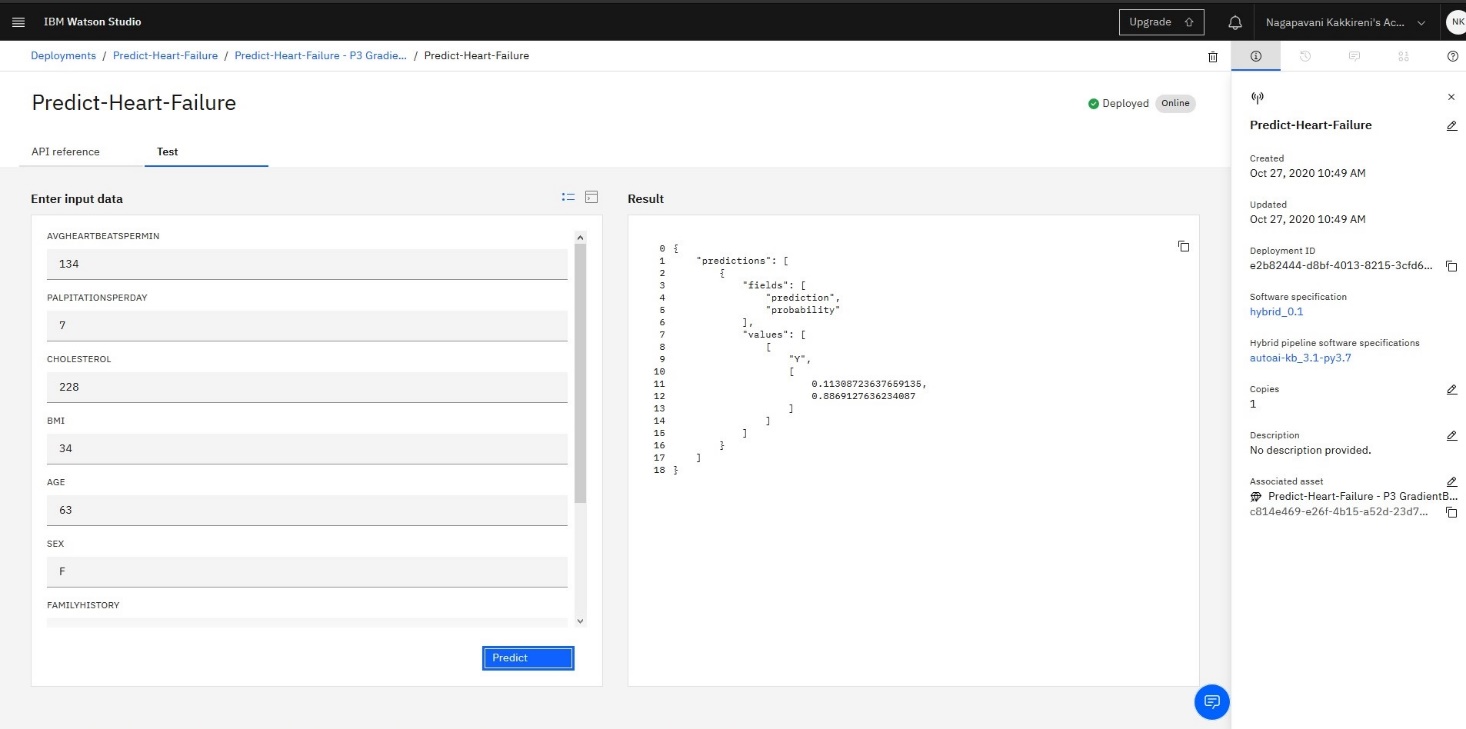
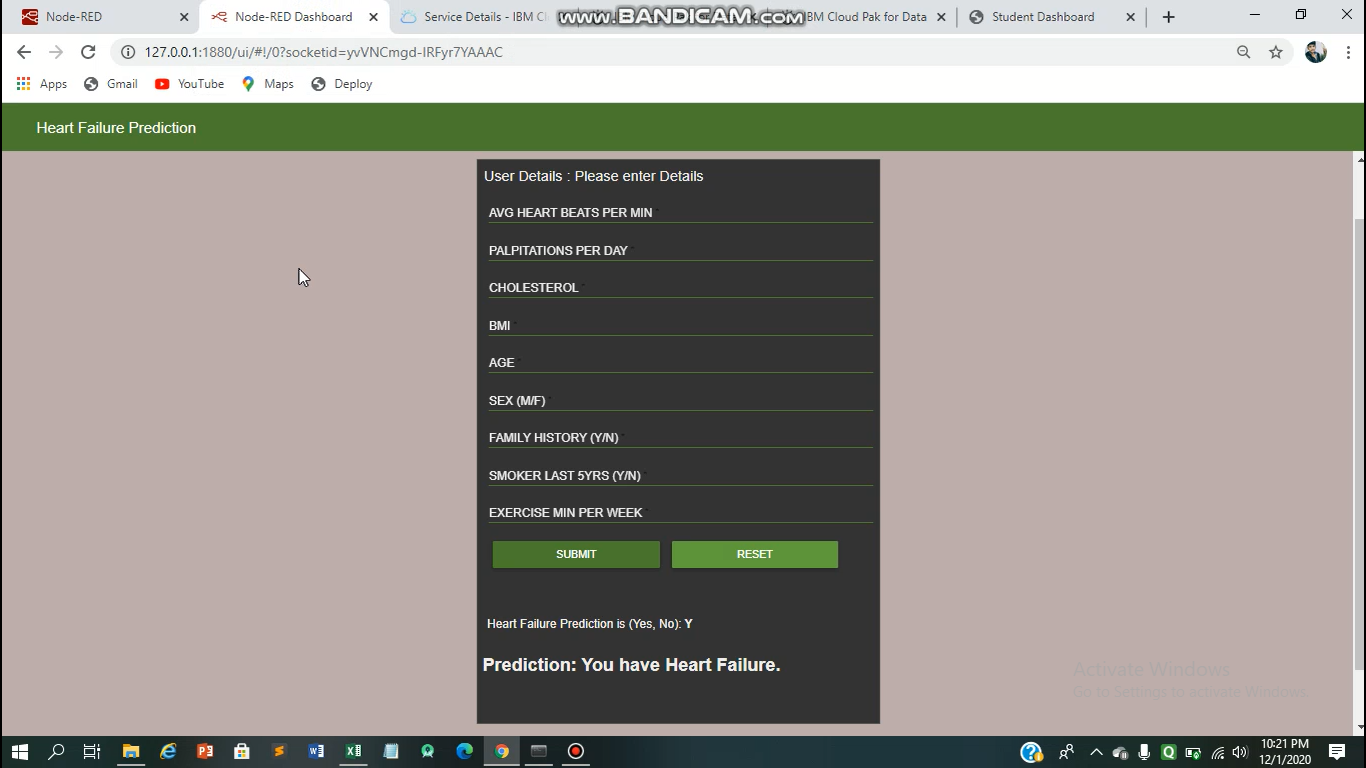


Figure 7:- Test\_Model\_Output(Y)



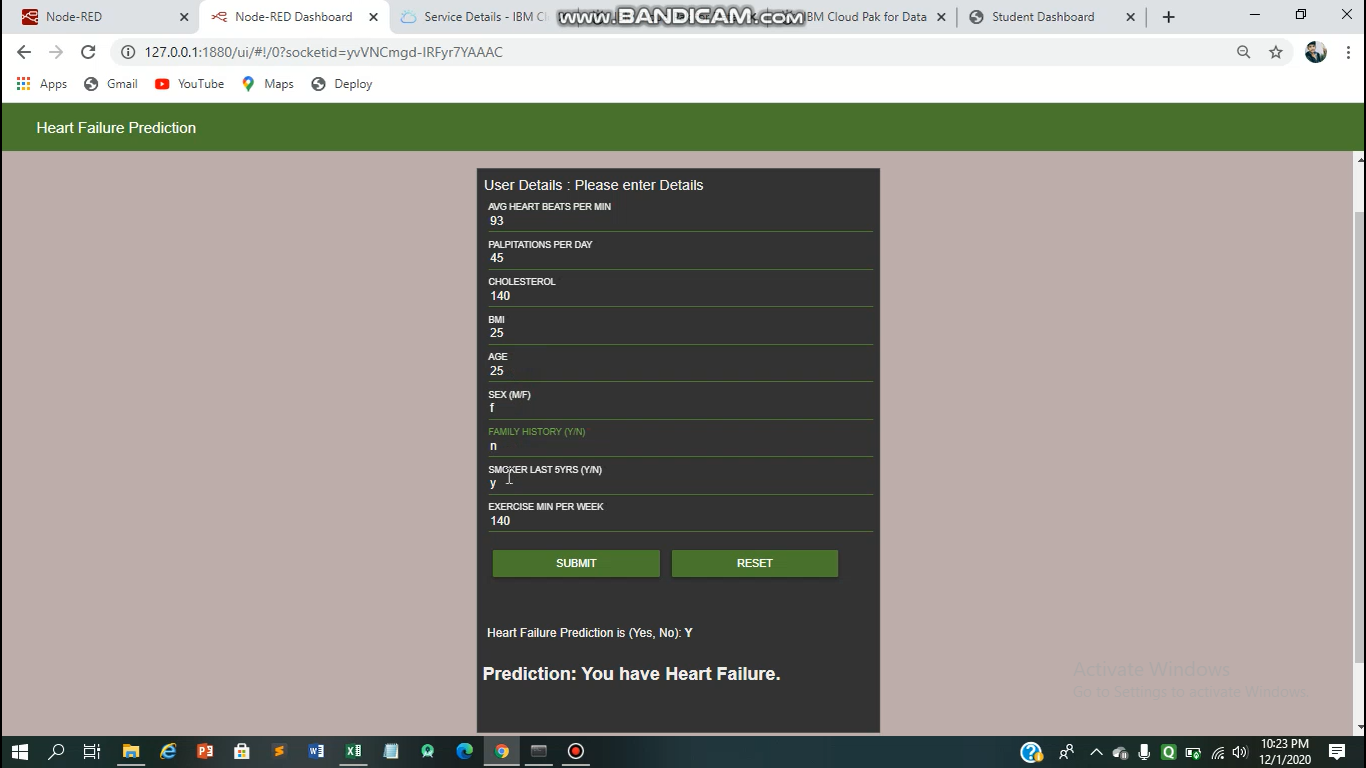


Figure 8:- Node -RED- App - O ut p u t ( N)



1. **ADVANTAGES & DISADVANTAGES**
   1. Advantages

HFRP – CDSS is a non-invasive, robust approach to predict heart failure caused by Cardio Vascular Diseases, as opposed to other invasive tests.

* 1. Disadvantages

The disadvantage of the online prediction tool is its sensitivity and accuracy for clinical use. It completely depends on the dataset used to train the model for prediction.

1. **APPLICATIONS**

The same machine learning prediction approach can be used to solve other challenging issues like diagnosis, classification and detection of various diseases like cancer, tumours, Alzheimer’s, Parkinson’s, skin diseases, renal failure etc.

1. **CONCLUSION**

The project built using Auto AI and Node-RED will aid in predicting the heart failure in humans with 87.5% accuracy using the Heart Failure Risk Prediction through Clinical Decision Support System (HFRP - CDSS) which employs the Gradient Boosting Classifier Algorithm.

1. **FUTURE SCOPE**

Signal and Image Processing tools in conjunction with machine learning algorithms can be applied to innovate non-invasive and robust solutions to several healthcare problems.

1. **BIBILOGRAPHY**
   1. **REFERENCES**
      * https:/[/www.kaggle.com/datasets](http://www.kaggle.com/datasets)
      * <https://cloud.ibm.com/>
      * <https://cloud.ibm.com/catalog/services/watson-studio>
      * <https://cloud.ibm.com/developer/appservice/create-app>
      * [https://smartinternz.com/assets/Steps-to-be-followed-to-download- Watson-Studio-in-your-Local-System.pdf](https://smartinternz.com/assets/Steps-to-be-followed-to-download-%20Watson-Studio-in-your-Local-System.pdf)
   2. **APPENDIX**
2. Source code:

**[{"id":"25b033c1.ff140c","type":"tab","label":"Flow 2","disabled":false,"info":""},{"id":"b68a53e3.546ef","type":"ui\_form","z":"25b033c1.ff140c","name":"","label":"User Details : Please enter Details","group":"8f6ca831.c6f7a8","order":2,"width":0,"height":0,"options":[{"label":"AVG HEART BEATS PER MIN","value":"AVGHEARTBEATSPERMIN","type":"number","required":true,"rows":null},{"label":"PALPITATIONS PER DAY","value":"PALPITATIONSPERDAY","type":"number","required":true,"rows":null},{"label":"CHOLESTEROL","value":"CHOLESTEROL","type":"number","required":true,"rows":null},{"label":"BMI","value":"BMI","type":"number","required":true,"rows":null},{"label":"AGE","value":"AGE","type":"number","required":true,"rows":null},{"label":"SEX (M/F)","value":"SEX","type":"text","required":true,"rows":null},{"label":"FAMILY HISTORY (Y/N)","value":"FAMILYHISTORY","type":"text","required":true,"rows":null},{"label":"SMOKER LAST 5YRS (Y/N)","value":"SMOKERLAST5YRS","type":"text","required":true,"rows":null},{"label":"EXERCISE MIN PER WEEK","value":"EXERCISEMINPERWEEK","type":"number","required":true,"rows":null}],"formValue":{"AVGHEARTBEATSPERMIN":"","PALPITATIONSPERDAY":"","CHOLESTEROL":"","BMI":"","AGE":"","SEX":"","FAMILYHISTORY":"","SMOKERLAST5YRS":"","EXERCISEMINPERWEEK":""},"payload":"","submit":"Submit","cancel":"Reset","topic":"","x":240,"y":440,"wires":[["f41e4b15.fae888","e8d86f54.afd53"]]},{"id":"f41e4b15.fae888","type":"debug","z":"25b033c1.ff140c","name":"","active":true,"tosidebar":true,"console":false,"tostatus":false,"complete":"payload","targetType":"msg","x":590,"y":580,"wires":[]},{"id":"e8d86f54.afd53","type":"function","z":"25b033c1.ff140c","name":"pre-token","func":"global.set(\"AVGHEARTBEATSPERMIN\",msg.payload.AVGHEARTBEATSPERMIN)\nglobal.set(\"PALPITATIONSPERDAY\",msg.payload.PALPITATIONSPERDAY)\nglobal.set(\"CHOLESTEROL\",msg.payload.CHOLESTEROL)\nglobal.set(\"BMI\",msg.payload.BMI)\nglobal.set(\"AGE\",msg.payload.AGE)\nglobal.set(\"SEX\",msg.payload.SEX)\nglobal.set(\"FAMILYHISTORY\",msg.payload.FAMILYHISTORY)\nglobal.set(\"SMOKERLAST5YRS\",msg.payload.SMOKERLAST5YRS)\nglobal.set(\"EXERCISEMINPERWEEK\",msg.payload.EXERCISEMINPERWEEK)\nvar apikey=\"6uAKe\_DH0OKqvkTR\_Y6oIsCf5nR7thrmkbZGLasq-kqA\";\nmsg.headers={\"content-type\":\"application/x-www-form-urlencoded\"}\nmsg.payload={\"grant\_type\":\"urn:ibm:params:oauth:grant-type:apikey\",\"apikey\":apikey}\nreturn msg;\n","outputs":1,"noerr":0,"x":600,"y":360,"wires":[["30efb459.224ccc"]]},{"id":"30efb459.224ccc","type":"http request","z":"25b033c1.ff140c","name":"","method":"POST","ret":"obj","paytoqs":"ignore","url":"https://iam.cloud.ibm.com/identity/token","tls":"","persist":false,"proxy":"","authType":"","x":752.0000038146973,"y":404.00000286102295,"wires":[["28d9cf18.c7f5e","48ba5c06.e21974"]]},{"id":"28d9cf18.c7f5e","type":"debug","z":"25b033c1.ff140c","name":"","active":true,"tosidebar":true,"console":false,"tostatus":false,"complete":"payload","targetType":"msg","x":940,"y":460,"wires":[]},{"id":"48ba5c06.e21974","type":"function","z":"25b033c1.ff140c","name":"Pre Prediction","func":"var AVGHEARTBEATSPERMIN = global.get(\"AVGHEARTBEATSPERMIN\")\nvar PALPITATIONSPERDAY = global.get(\"PALPITATIONSPERDAY\")\nvar CHOLESTEROL = global.get(\"CHOLESTEROL\")\nvar BMI = global.get(\"BMI\")\nvar AGE = global.get(\"AGE\")\nvar SEX = global.get(\"SEX\")\nvar FAMILYHISTORY = global.get(\"FAMILYHISTORY\")\nvar SMOKERLAST5YRS = global.get(\"SMOKERLAST5YRS\")\nvar EXERCISEMINPERWEEK = global.get(\"EXERCISEMINPERWEEK\")\nvar token=msg.payload.access\_token\nmsg.headers={'Content-Type': 'application/json',\"Authorization\":\"Bearer \"+token,\"Accept\":\"application/json\"}\nmsg.payload={\"input\_data\":[{\"fields\":[\"AVGHEARTBEATSPERMIN\",\"PALPITATIONSPERDAY\",\"CHOLESTEROL\",\"BMI\",\"AGE\",\"SEX\",\"FAMILYHISTORY\",\"SMOKERLAST5YRS\",\"EXERCISEMINPERWEEK\"],\"values\":[[AVGHEARTBEATSPERMIN,PALPITATIONSPERDAY,CHOLESTEROL,BMI,AGE,SEX,FAMILYHISTORY,SMOKERLAST5YRS,EXERCISEMINPERWEEK]]}]}\nreturn msg;","outputs":1,"noerr":0,"x":944.0000076293945,"y":356.0000021457672,"wires":[["3a8f87b9.bcfea8"]]},{"id":"6538ea0b.515984","type":"debug","z":"25b033c1.ff140c","name":"","active":true,"tosidebar":true,"console":false,"tostatus":false,"complete":"payload","targetType":"msg","x":1322.9999914169312,"y":464.00000381469727,"wires":[]},{"id":"1f15a866.0efbb8","type":"inject","z":"25b033c1.ff140c","name":"","topic":"","payload":"","payloadType":"date","repeat":"","crontab":"","once":false,"onceDelay":0.1,"x":470,"y":260,"wires":[["e8d86f54.afd53"]]},{"id":"5bdb9444.91fadc","type":"debug","z":"25b033c1.ff140c","name":"","active":true,"tosidebar":true,"console":false,"tostatus":false,"complete":"payload","targetType":"msg","x":1210,"y":220,"wires":[]},{"id":"a7d1a9e.5b8c758","type":"function","z":"25b033c1.ff140c","name":"Parsing","func":"msg.payload=msg.payload.predictions[0].values[0][0]\nreturn msg;","outputs":1,"noerr":0,"x":1020,"y":280,"wires":[["5bdb9444.91fadc","ec89297a.7295b8","8496c1fc.f09e7"]]},{"id":"ec89297a.7295b8","type":"ui\_text","z":"25b033c1.ff140c","group":"8f6ca831.c6f7a8","order":3,"width":0,"height":0,"name":"","label":"Heart Failure Prediction is (Yes, No):","format":"{{msg.payload}}","layout":"row-left","x":1207.6000366210938,"y":521.2000122070312,"wires":[]},{"id":"3a8f87b9.bcfea8","type":"http request","z":"25b033c1.ff140c","name":"","method":"POST","ret":"obj","paytoqs":true,"url":"https://eu-gb.ml.cloud.ibm.com/ml/v4/deployments/95b21ed0-81c7-48fd-bf43-760fb5a50bb7/predictions?version=2020-12-01","tls":"","persist":false,"proxy":"","authType":"","x":1170,"y":380,"wires":[["6538ea0b.515984","a7d1a9e.5b8c758"]]},{"id":"8496c1fc.f09e7","type":"ui\_template","z":"25b033c1.ff140c","group":"8f6ca831.c6f7a8","name":"Prediction Results","order":4,"width":0,"height":0,"format":"<!DOCTYPE html>\n<html lang=\"en\">\n <head>\n\t\t<meta charset=\"utf-8\">\n\t\t<meta name=\"viewport\" content=\"width=device-width, initial-scale=1.0\">\n\t\t<title>sps-5741-predict-heart-failure-using-IBM-Auto-AI-service</title>\n\t\t<link rel=\"shortcut icon\" href=\"https://image.freepik.com/free-vector/glossy-red-heart-with-white-heartbeat-pulse-blue-molecules-background-medical-concept\_1302-5653.jpg\">\n\t\t<link rel=\"stylesheet\" href=\"{{ url\_for('static', filename='styles.css') }}\">\n\t\t<script src=\"https://kit.fontawesome.com/5f3f547070.js\" crossorigin=\"anonymous\"></script>\n\t\t\n\t</head>\n<body>\n\t<!-- Result -->\n\t\t<div class=\"results\">\n <div ng-if=\"msg.payload == 'Y' \">\n \n <h1>Prediction: <span class='danger'>You have Heart Failure.</span></h1>\n\t\t\t\t\n\t\t\t\t<div class=\"gyan\">\n\t\t\t\t\t<h3 style=\"color: red;\"></h3>\n\t\t\t\t\t<ul>\n\t\t\t\t\t\t\t\t\t\n\t\t\t\t\t\t\n\t\t\t\t\t</ul>\t\t\t\t\n\t\t\t\t</div>\n \n </div>\n <div ng-if=\"msg.payload == 'N' \">\n \n <h1>Prediction: <span class='safe'>Great! You DON'T have Heart Disease.</span></h1>\n\t\t\t\t\n \n </div>\n <div ng-if=\"msg.payload == 'Null' \">\n \n \n \n </div>\n\n </div>\n \n</body>\n</html>","storeOutMessages":true,"fwdInMessages":true,"resendOnRefresh":true,"templateScope":"local","x":1210,"y":680,"wires":[[]]},{"id":"8f6ca831.c6f7a8","type":"ui\_group","z":"","name":"","tab":"c863a4c5.b67148","order":1,"disp":false,"width":10,"collapse":false},{"id":"c863a4c5.b67148","type":"ui\_tab","z":"","name":"Heart Failure Prediction","icon":"dashboard","order":1,"disabled":false,"hidden":false}]**