

# VIT BUILD-A-THON

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## **Project Title: Predict heart failure using IBM auto AI service**

### **1. INTRODUCTION**

#### **1.1 Overview**

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 heart failure.

In this project, I built a model using Auto AI and built a web application where we can showcase the prediction of heart failure.

Services Used are:

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

#### **1.2 Purpose**

As we train the existing dataset using our created Auto AI experiment in Watson Studio we will be able to predict the values if a person has or will have a heart failure or not depending upon the features used and given as input . The webpage developed will help us get the prediction as Yes(Y) or No(N) according to the input given in that so that people can use this webpage and check their heart health status.It is very useful for elderly as well as mid age group people as now a days they are also prone to heart failure due to habits and other health circumstances like less amount of sleep, obesity etc.

## 2. LITERATURE SURVEY

### 2.1 Existing problem

This problem can be solved in python or jupyter notebook by providing inputs in the programming environment.

We can model any algorithm in the above mentioned ways and get output there.

We can also develop a webpage using HTML and CSS and link it to the model output obtained from jupyter notebook or python.

### 2.2 Proposed solution

First we build an AutoAI experiment using watson studio by IBM and create a machine learning service which can be linked with auto ai .We can then load the dataset , obtain the algorithm wise pipeline analysis and get the best model or algorithm suited for the dataset which is major plus with respect to machine learning.

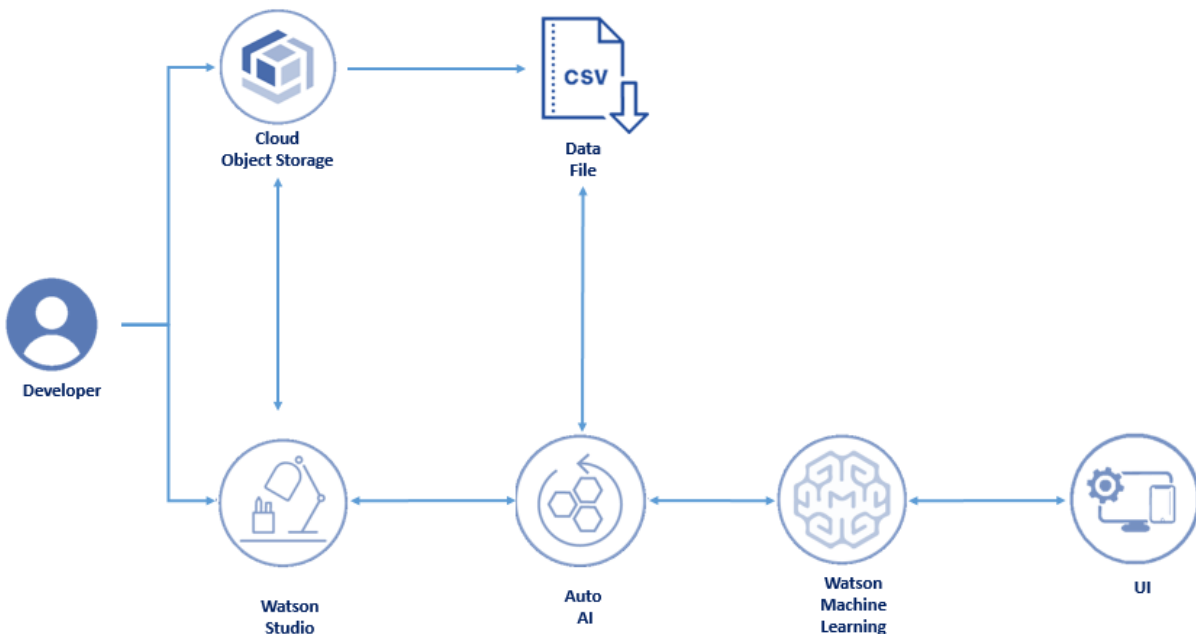
This makes our job easier compared to traditional coding methods.

Then we can create a web page using node red application in IBM and link the endpoint generated by the ai model to this code and get a prediction output in the web page displayed.We can modify the color and other graphic design parameter of our created website form using node red which can enhance the visual parameter for the user.

## 3 . THEORETICAL ANALYSIS

### 3.1 Block diagram

Diagrammatic overview of the project



### 3.2 Hardware / Software designing

*Hardware requirements:* None

*Software requirements:* IBM cloud account, IBM Cloud, IBM Watson, Node-RED, IBM Machine Learning, IBM Cloud Object Storage.

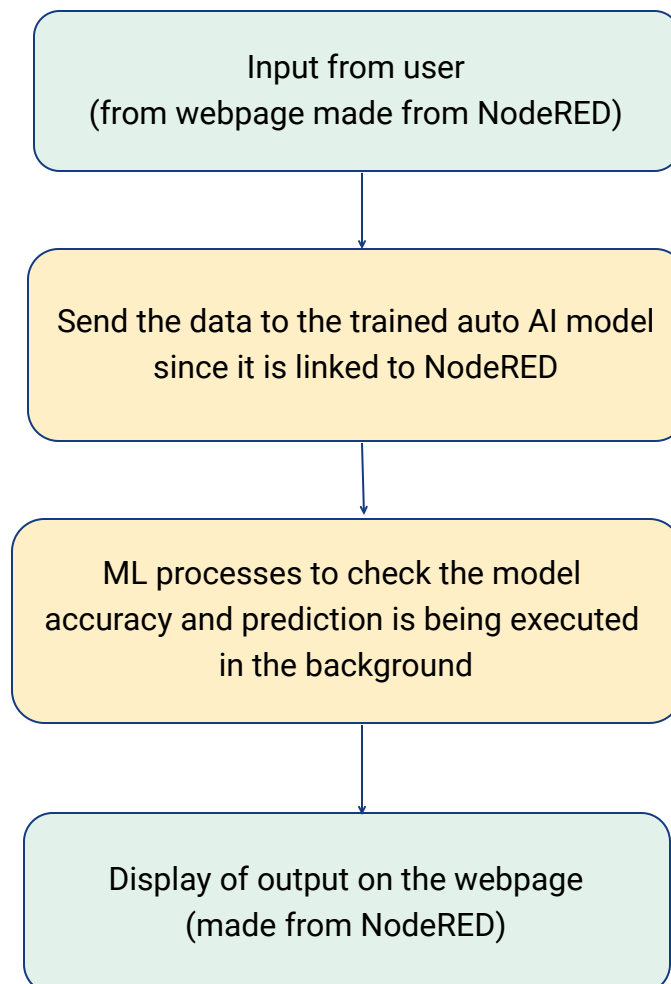
## 4 . EXPERIMENTAL INVESTIGATIONS

Analysis or the investigation made while working on the solution.

1. According to the dataset , the model is trained and the input values from the user are used for testing and getting the predicted value.
2. The model best suited for the dataset taken was gradient boosting classifier. As it gave more accuracy compared to other classification algorithms.
3. Node red helps us integrate to the dashboard and help us create forms or webpages where we can get input from the user and display their respective outputs.

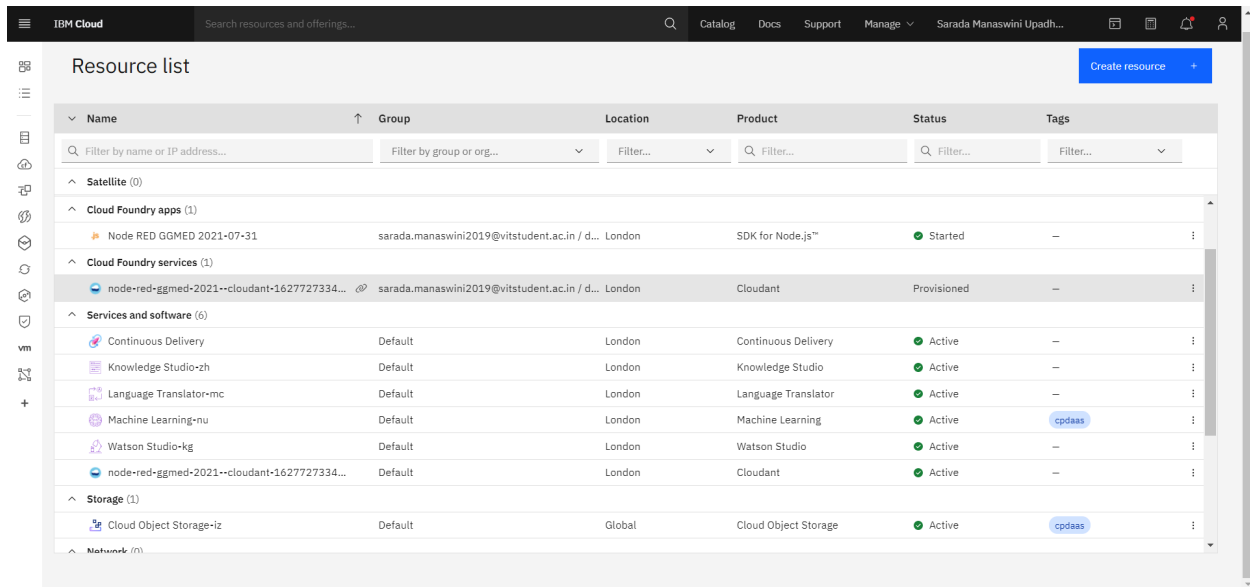
## 5. FLOWCHART

Diagram showing the control flow of the solution



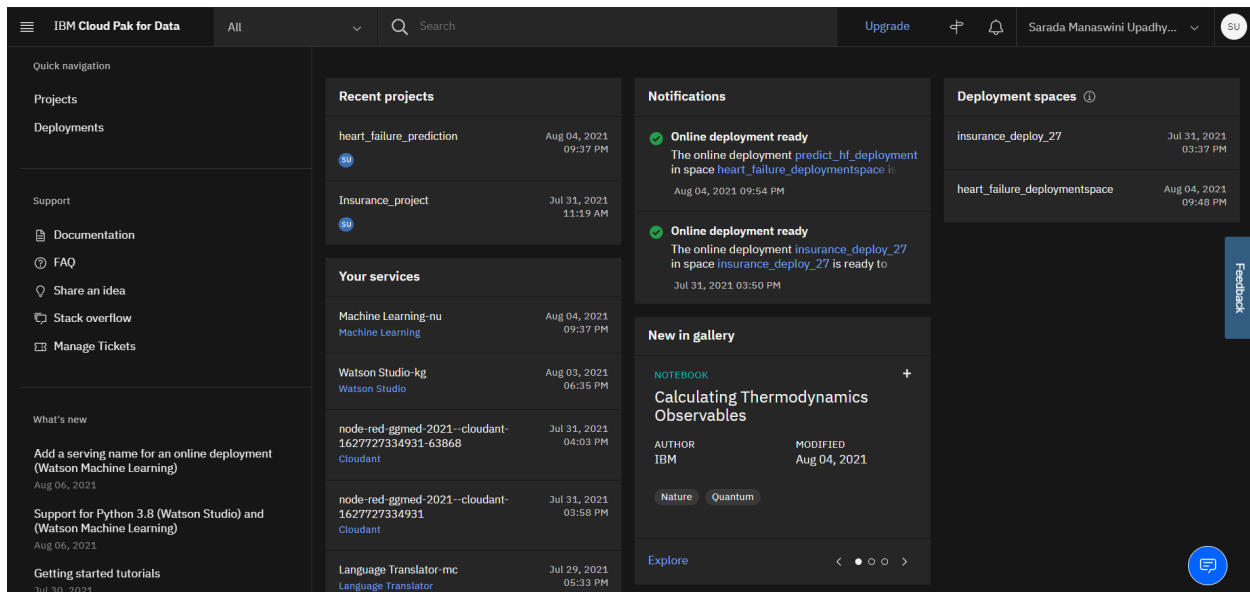
## 6. RESULT

Final findings (Output) of the project along with screenshots of the created services. IBM AutoAI and watson studio for heart failure prediction Services created screen shots and output predicted values for test values.



The screenshot shows the IBM Cloud console's 'Resource list' page. It features a table with columns for Name, Group, Location, Product, Status, and Tags. The table lists various resources including Satellite, Cloud Foundry apps, Cloud Foundry services, Services and software, and Storage. The 'Services and software' section is expanded, showing resources like Continuous Delivery, Knowledge Studio, Language Translator, Machine Learning, and Watson Studio, all with a status of 'Active'.

Name	Group	Location	Product	Status	Tags
Satellite (0)					
Cloud Foundry apps (1)					
Node RED GGMed 2021-07-31	sarada.manaswini2019@vitstudent.ac.in / d...	London	SDK for Node.js™	Started	—
Cloud Foundry services (1)					
node-red-ggmed-2021--cloudant-1627727334...	sarada.manaswini2019@vitstudent.ac.in / d...	London	Cloudant	Provisioned	—
Services and software (6)					
Continuous Delivery	Default	London	Continuous Delivery	Active	—
Knowledge Studio-zh	Default	London	Knowledge Studio	Active	—
Language Translator-mc	Default	London	Language Translator	Active	—
Machine Learning-nu	Default	London	Machine Learning	Active	cpdaas
Watson Studio-kg	Default	London	Watson Studio	Active	—
node-red-ggmed-2021--cloudant-1627727334...	Default	London	Cloudant	Active	—
Storage (1)					
Cloud Object Storage-iz	Default	Global	Cloud Object Storage	Active	cpdaas
Networks (0)					



The screenshot shows the IBM Cloud Pak for Data dashboard. It features a sidebar with navigation links for Projects, Deployments, Support, Documentation, FAQ, Share an idea, Stack overflow, and Manage Tickets. The main content area is divided into several sections: Recent projects, Your services, Notifications, and Deployment spaces. The 'Recent projects' section lists 'heart\_failure\_prediction' and 'Insurance\_project'. The 'Your services' section lists 'Machine Learning-nu', 'Watson Studio-kg', 'node-red-ggmed-2021--cloudant-1627727334931-63868', 'node-red-ggmed-2021--cloudant-1627727334931', and 'Language Translator-mc'. The 'Notifications' section shows two 'Online deployment ready' messages. The 'Deployment spaces' section lists 'insurance\_deploy\_27' and 'heart\_failure\_deploymentspace'. The 'New in gallery' section features a 'NOTEBOOK' titled 'Calculating Thermodynamics Observables' by IBM, modified on Aug 04, 2021.

Quick navigation

Projects

Deployments

Support

Documentation

FAQ

Share an idea

Stack overflow

Manage Tickets

What's new

Add a serving name for an online deployment (Watson Machine Learning)

Support for Python 3.8 (Watson Studio) and (Watson Machine Learning)

Getting started tutorials

Recent projects

heart\_failure\_prediction

Insurance\_project

Your services

Machine Learning-nu

Watson Studio-kg

node-red-ggmed-2021--cloudant-1627727334931-63868

node-red-ggmed-2021--cloudant-1627727334931

Language Translator-mc

Notifications

Online deployment ready

Online deployment ready

New in gallery

NOTEBOOK

Calculating Thermodynamics Observables

AUTHOR IBM

MODIFIED Aug 04, 2021

Nature Quantum

Explore

Deployment spaces

insurance\_deploy\_27

heart\_failure\_deploymentspace

Feedback

IBM Cloud Pak for Data

All

Search

Upgrade

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SU

Projects / heart\_failure\_prediction

Launch IDE

Add to project

Data assets

0 assets selected.

Name	Type	Created by	Last modified
CSV patientdataV6.csv	Data Asset	Sarada Manaswini Upadhyayula	Aug 04, 2021, 09:39 PM

AutoAI experiments

New AutoAI experiment

Name	Status	Model type	Last modified
heart_failure_AI	Completed	Binary Classification	Aug 04, 2021, 09:44 PM

Models

Watson Machine Learning models

New Model from file

Name	Type	Software specification	Last modified
heart_failure_AI - P4 Gradient Boosting Classifier	wml-hybrid_0.1	hybrid_0.1	Aug 04, 2021

Data

Load Files Catalog

Drop files here or browse for files to upload.

IBM Cloud Pak for Data

All

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Projects / heart\_failure\_prediction / heart\_failure\_AI

Rank by: Accuracy (Optimized) | Cross validation score

Experiment summary

Pipeline comparison

Relationship map

Prediction column: HEARTFAILURE

Progress map

Swap view

Experiment completed

8 PIPELINES GENERATED

8 pipelines generated from algorithms. See pipeline leaderboard below for more detail.

Time elapsed: 3 minutes

View log Save code

Pipeline leaderboard

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All

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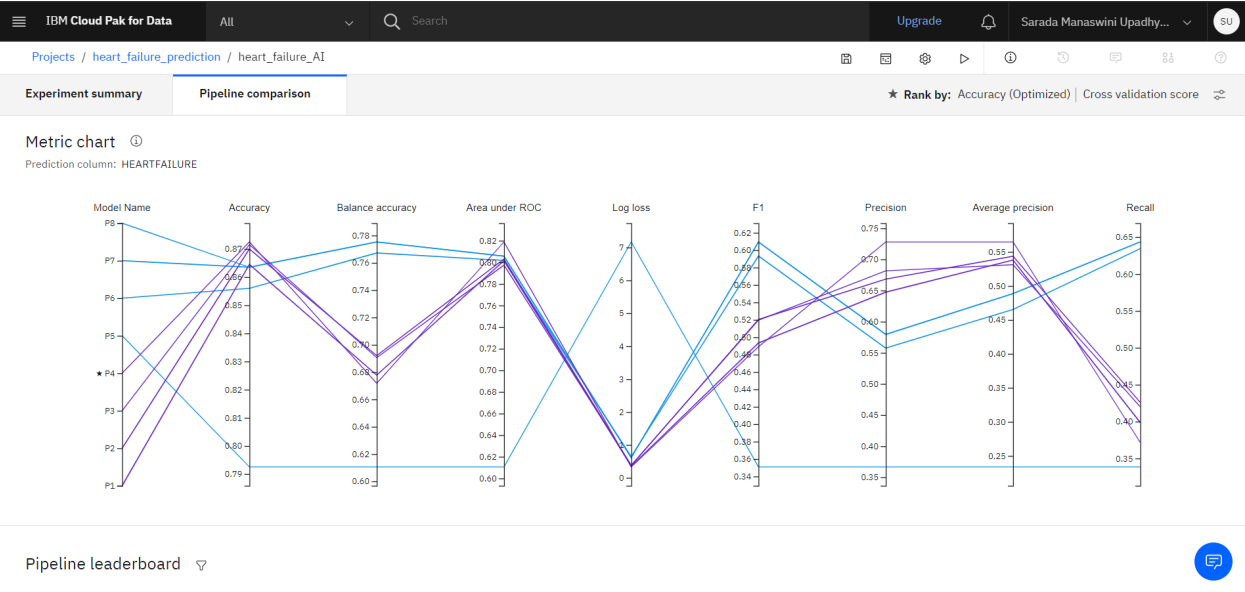
Projects / heart\_failure\_prediction / heart\_failure\_AI

Experiment summary

Pipeline comparison

★ Rank by: Accuracy (Optimized) | Cross validation score

	Rank	↑	Name	Algorithm	Accuracy (Optimized) Cross Validation	Enhancements	Build time
★	1		Pipeline 4	Gradient Boosting Classifier	0.872	HPO-1 FE HPO-2	00:00:23
	2		Pipeline 3	Gradient Boosting Classifier	0.872	HPO-1 FE	00:00:55
	3		Pipeline 2	Gradient Boosting Classifier	0.870	HPO-1	00:00:11
	4		Pipeline 1	Gradient Boosting Classifier	0.864	None	00:00:02
	5		Pipeline 7	Decision Tree Classifier	0.863	HPO-1 FE	00:00:22
	6		Pipeline 8	Decision Tree Classifier	0.863	HPO-1 FE HPO-2	00:00:10
	7		Pipeline 6	Decision Tree Classifier	0.856	HPO-1	00:00:03
	8		Pipeline 5	Decision Tree Classifier	0.793	None	00:00:01





## Test values Along with predicted output for - heart failure prediction

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Deployments / heart\_failure\_deploymentspace / heart\_failure\_AI - P4 Gradient B... / predict\_hf\_deployment

predict\_hf\_deployment Deployed Online

API reference | **Test**

**Enter input data**

AVGHEARTBEATSPERMIN  
Integer

PALPITATIONSPERDAY  
Integer

CHOLESTEROL  
Integer

BMI  
Integer

Add to list +

**Input list (1)**

[ 80, 20, 300, 67, 40, F, N, N, 50 ]

Predict (1)

**Result**

```
0 {
1   "predictions": [
2     {
3       "fields": [
4         "prediction",
5         "probability"
6       ],
7       "values": [
8         [
9           "N",
10          [
11            0.9335458665227879,
12            0.06645413347729218
13          ]
14        ]
15      ]
16    }
17  ]
18 }
```

IBM Cloud Pak for Data | All | Search | Upgrade | Sarada Manaswini Upadhy... | SU

Deployments / heart\_failure\_deploymentspace / heart\_failure\_AI - P4 Gradient B... / predict\_hf\_deployment

predict\_hf\_deployment Deployed Online

API reference | **Test**

**Enter input data**

other

FAMILYHISTORY  
other

SMOKERLASTSYRS  
other

EXERCISEMINPERWEEK  
Integer

Add to list +

**Input list (2)**

[ 80, 20, 300, 67, 40, F, N, N, 50 ]

[ 72, 3, 240, 40, 38, M, N, N, 20 ]

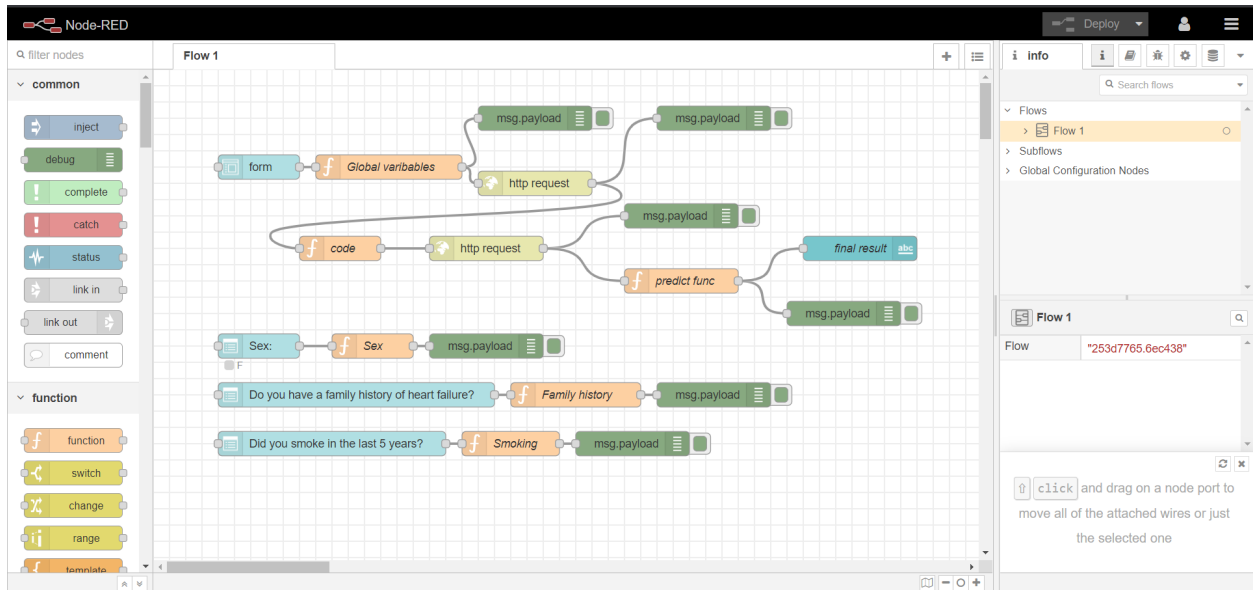
Predict (2)

**Result**

```
13   ],
14   [
15     "Y",
16     [
17       0.3263839241761694,
18       0.6736160758238306
19     ]
20   ]
21 ]
22 }
23 }
24 }
25 }
```



## NodeRED flow and output screenshots:



## Link to NodeRED:

<https://node-red-ggmed-2021-07-31.eu-gb.mybluemix.net/ui/#!/0?socketid=RpSkWcAJ5nkK34jPAAAK>

Heart failure Prediction Form

Enter the values

Sex:

Do you have a family history of heart failure?

Did you smoke in the last 5 years?

Average heart beats per minute \*

Palpitations per day \*

Heart failure Prediction Form

Cholestrol \*

Body mass index (BMI) \*

Age \*

Exercise minutes per week \*

SUBMIT

CANCEL

Do you have a chance of heart failure? **N**

## Testing values of NodeRED:

Heart failure Prediction Form

Enter the values

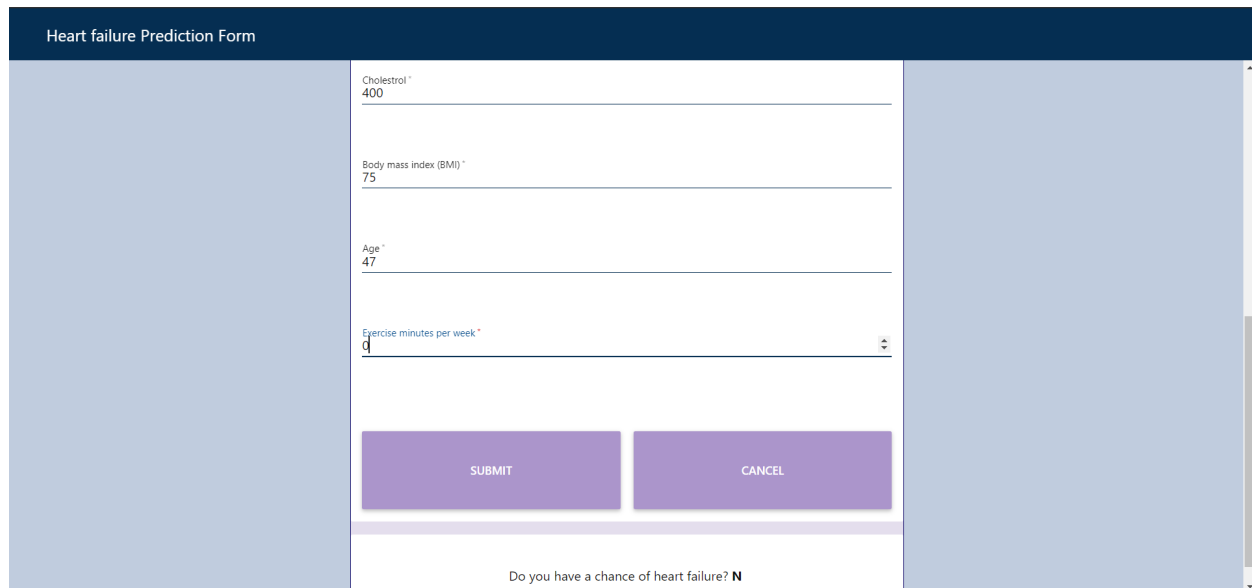
Sex: Male

Do you have a family history of heart failure? Yes

Did you smoke in the last 5 years? Yes

Average heart beats per minute \*  
90

Palpitations per day \*  
25



The image shows a web form titled "Heart failure Prediction Form". It has a dark blue header bar with the title in white. The form itself is white and contains four input fields, each with a label and a value: "Cholesterol \*" with "400", "Body mass index (BMI) \*" with "75", "Age \*" with "47", and "Exercise minutes per week \*" with "0". Below these fields are two purple buttons labeled "SUBMIT" and "CANCEL". At the bottom of the form, there is a question "Do you have a chance of heart failure?" followed by a radio button labeled "N". The form is flanked by two light blue vertical bars.

Heart failure Prediction Form	
Cholesterol *	400
Body mass index (BMI) *	75
Age *	47
Exercise minutes per week *	0
<input type="button" value="SUBMIT"/> <input type="button" value="CANCEL"/>	
Do you have a chance of heart failure? <input type="radio"/> N	

## 7. ADVANTAGES & DISADVANTAGES

### **Advantages:**

With this prediction, users can approach a doctor to get themselves checked at the early stages. In case of emergencies, it can predict heart failure and the user would make necessary arrangements in advance.

At hospitals, it could be of great help to identify heart failure patients and reduce doctors time complexity.

This prediction method is cost effective for the patients.

### **Disadvantages:**

The prediction generated by an automated system alone does not assure accuracy.

The prediction is only as perfect as the data that is provided in the dataset.

The system is not fully automated as it needs an user to feed the diagnosis.

## 8. APPLICATIONS

It allows users to get instant predictions on their heart well being status.

This model can be used to predict future heart failure medical data for people of all ages.

People who need immediate medical attention could use this prediction to check out if it might be a heart failure.

It will be helpful for people with heart related disease in predicting heart failure at early stages.

In hospitals for initial diagnosis the prediction could detect if the patient might suffer from heart failure.

## 9. CONCLUSION

The heart failure prediction auto AI based project executed successfully using IBM watson machine learning service and auto AI experiment. It predicted the apt machine learning model for the heart dataset which is the 'Gradient boosting classifier' Machine learning algorithm which had the maximum accuracy among the classification models. The web page/form developed using node red was very useful for providing the inputs through dropdown and text and can help the user see the output instantly.

## 10. FUTURE SCOPE

In the future, the predictions scalability and accuracy can be improved in numerous ways. Various other ways of normalizing the data can be analyzed and the results can be compared to give out better results. Advanced techniques and algorithms can be used to predict heart failure in less time complexity. Extra diagnostic factors can be too received from the user that can be helpful in increasing the effectiveness of the prediction. Even the user's old health history could be collected and the predictions can be done with respect to that data. With the prediction, the users can be provided with necessary instructions to follow to avoid any further complications and bring them to a risk free level.

## 11. BIBLIOGRAPHY

These are some of the links which were helpful in completing this project:

<https://dataplatform.cloud.ibm.com/docs/content/wsj/getting-started/projects.html?audience=wdp&context=wdp>

<https://dataplatform.cloud.ibm.com/docs/content/wsj/analyze-data/autoai-overview.html?audience=wdp&context=wdp>

<https://dataplatform.cloud.ibm.com/docs/content/wsj/analyze-data/autoai-build.html?audience=wdp&context=wdp>

## APPENDIX

### A. Source Code

**Auto AI python code for heart failure prediction:**

```
import requests
```

```
# NOTE: you must manually set API_KEY below using information retrieved from your IBM Cloud account.
```

```
API_KEY = "<your API key>"
```

```
token_response = requests.post('https://iam.cloud.ibm.com/identity/token', data={"apikey":
```

```

API_KEY, "grant_type": 'urn:ibm:params:oauth:grant-type:apikey'})
mltoken = token_response.json()["access_token"]
header = {'Content-Type': 'application/json', 'Authorization': 'Bearer ' + mltoken}
# NOTE: manually define and pass the array(s) of values to be scored in the next line
payload_scoring = {"input_data": [{"fields": [array_of_input_fields], "values":
[array_of_values_to_be_scored, another_array_of_values_to_be_scored]}]}
response_scoring =
requests.post('https://eu-gb.ml.cloud.ibm.com/ml/v4/deployments/cb292ec4-6c05-4511-8215-
28
81cc50228d/predictions?version=2021-08-04?version=2021-08-04', json=payload_scoring,
headers={'Authorization': 'Bearer ' + mltoken})
print("Scoring response")
print(response_scoring.json())

```

### **Node Red JSON code:**

```

{"id":"4ef11005.a90e","type":"tab","label":"Flow
1","disabled":false,"info":"","id":"f6c8b3b3.7c0a8","type":"ui_tab","name":"Heart Failure
Prediction","icon":"dashboard","disabled":false,"hidden":false},{id":"5ad0935c.097d0c","type":"ui
_base","theme":{"name":"theme-custom","lightTheme":{"default":"#0094CE","baseColor":"#0eb9
80","baseFont":"-apple-system,BlinkMacSystemFont,Segoe
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7479","baseFont":"-apple-system,BlinkMacSystemFont,Segoe
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Neue,sans-serif","edited":true,"reset":false},"customTheme":{"name":"Untitled Theme
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Neue,sans-serif","reset":false},"themeState":{"base-color":{"default":"#4B7930","value":"#4B793
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,BlinkMacSystemFont,Segoe UI,Roboto,Oxygen-Sans,Ubuntu,Cantarell,Helvetica
Neue,sans-serif"}},"angularTheme":{"primary":"indigo","accents":"blue","warn":"red","background
":"grey","palette":"light"}},"site":{"name":"Node-RED
Dashboard","hideToolbar":false,"allowSwipe":false,"lockMenu":false,"allowTempTheme":true,"dateFormat":"DD/MM/YYYY","sizes":{"sx":100,"sy":100,"gx":16,"gy":16,"cx":16,"cy":16,"px":
0,"py":0}}},{id":"4f06d606.e90c28","type":"ui_group","name":"Enter The
Values","tab":"f6c8b3b3.7c0a8","order":1,"disp":true,"width":6,"collapse":false},{id":"f2f2649a.0

```

```
d0d98","type":"debug","z":"4ef11005.a90e","name":"","active":false,"tosidebar":true,"console":false,"tostatus":false,"complete":"payload","targetType":"msg","statusVal":"","statusType":"auto","x":650,"y":140,"wires":[],{"id":"737d9db9.74be24","type":"ui_form","z":"4ef11005.a90e","name":"","label":"","group":"4f06d606.e90c28","order":4,"width":0,"height":0,"options":[{"label":"AVGHEART BEATSPERMIN","value":"avg","type":"number","required":true,"rows":null}, {"label":"PALPITATIONSPERDAY","value":"palp","type":"number","required":true,"rows":null}, {"label":"CHOLESTEROL","value":"cho","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":"EXERCISEMINPERWEEK","value":"exmin","type":"number","required":true,"rows":null}], "formValue":{"avg":"","palp":"","cho":"","bmi":"","age":"","exmin":""}, "payload":"","submit":"submit","cancel":"cancel","topic":"topic","topicType":"msg","splitLayout":"","x":120,"y":100,"wires":[{"6ff74694.596a98"}]}, {"id":"2f0f52af.464d8e","type":"ui_dropdown","z":"4ef11005.a90e","name":"","label":"Enter Your Sex","tooltip":"","place":"Select option","group":"4f06d606.e90c28","order":1,"width":0,"height":0,"passthru":true,"multiple":false,"options":[{"label":"M","value":"M","type":"str"}, {"label":"F","value":"F","type":"str"}], "payload":"","topic":"topic","topicType":"msg","x":120,"y":200,"wires":[{"478746e5.1e9bd8"}]}, {"id":"9641c753.567c78","type":"ui_dropdown","z":"4ef11005.a90e","name":"","label":"Enter Your Family History (Y/N)","tooltip":"","place":"Select option","group":"4f06d606.e90c28","order":2,"width":0,"height":0,"passthru":true,"multiple":false,"options":[{"label":"Y","value":"Y","type":"str"}, {"label":"N","value":"N","type":"str"}], "payload":"","topic":"topic","topicType":"msg","x":170,"y":260,"wires":[{"12598a75.40e2c6"}]}, {"id":"1612df5f.a21961","type":"ui_dropdown","z":"4ef11005.a90e","name":"","label":"Smoker Last 5 Yrs (Y/N)","tooltip":"","place":"Select option","group":"4f06d606.e90c28","order":3,"width":0,"height":0,"passthru":true,"multiple":false,"options":[{"label":"N","value":"N","type":"str"}, {"label":"Y","value":"Y","type":"str"}], "payload":"","topic":"topic","topicType":"msg","x":150,"y":320,"wires":[{"69efc678.f85038"}]}, {"id":"672a0d0c.5a4464","type":"debug","z":"4ef11005.a90e","name":"","active":false,"tosidebar":true,"console":false,"tostatus":false,"complete":"payload","targetType":"msg","statusVal":"","statusType":"auto","x":570,"y":220,"wires":[], {"id":"519836d7.077768","type":"debug","z":"4ef11005.a90e","name":"","active":false,"tosidebar":true,"console":false,"tostatus":false,"complete":"false","statusVal":"","statusType":"auto","x":610,"y":300,"wires":[], {"id":"78ad329c.c576dc","type":"debug","z":"4ef11005.a90e","name":"","active":false,"tosidebar":true,"console":false,"tostatus":false,"complete":"false","statusVal":"","statusType":"auto","x":570,"y":380,"wires":[], {"id":"6ff74694.596a98","type":"function","z":"4ef11005.a90e","name":"global variables for form node","func":"global.set(\"avg\",msg.payload.avg)\nglobal.set(\"palp\",msg.payload.palp)\nglobal.set(\"cho\",msg.payload.cho)\nglobal.set(\"bmi\",msg.payload.bmi)\nglobal.set(\"age\",msg.payload.age)\nglobal.set(\"exmin\",msg.payload.exmin)\nvar apikey=\"2rrvxgmeDtZ4U2D21QAmtYMXKkQP4POHnTx4vxhmvztH\"\nmsg.headers={\"content-type\":\"application/x-www-form-urlencoded\"}\nmsg.payload={\"grant_type\":\"urn:ibm:params:oauth\"}
```

```
gr
ant-type:apikey\", \"apikey\":apikey} \nreturn
msg;\", \"outputs\":1, \"noerr\":0, \"initialize\":\"\", \"finalize\":\"\", \"libs\":[], \"x\":410, \"y\":100, \"wires\":[[\"f2f2649a.0d
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.5a4464\"]], {\"id\": \"12598a75.40e2c6\", \"type\": \"function\", \"z\": \"4ef11005.a90e\", \"name\": \"fam\", \"func\":
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.c576dc\"]], {\"id\": \"9e13378f.bde478\", \"type\": \"http
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s://iam.cloud.ibm.com/identity/token\", \"tls\": \"\", \"persist\": false, \"proxy\": \"\", \"authType\": \"\", \"x\":880, \"y\":12
0, \"wires\":[[\"9b8916a3.5a9ae8\", \"62237452.f2596c\"]], {\"id\": \"9b8916a3.5a9ae8\", \"type\": \"debug\", \"z\"
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