

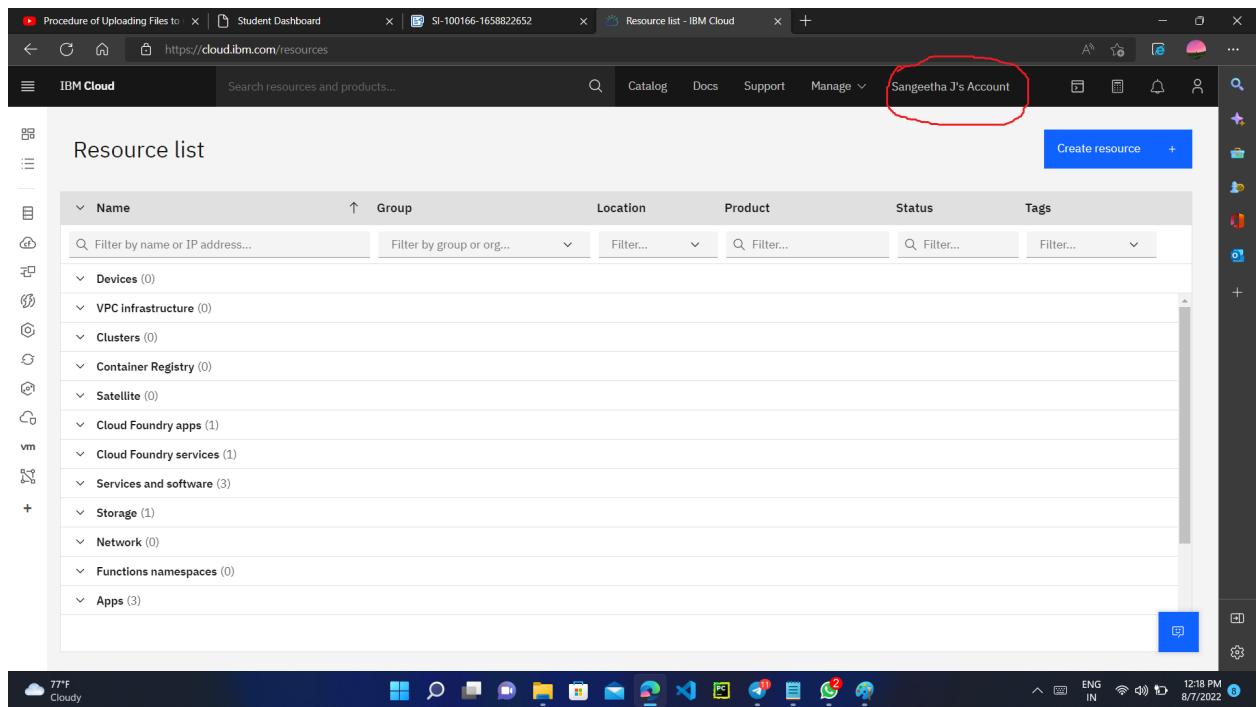
**1. Title of the project:** Effective Heart Disease Prediction Using IBM Auto AI Service

## **2. Result and Discussion:**

The following are the workdone steps in this project work:

### **2.1 Log in to IBM account**

We need to login through our login credentials.



**Figure 1: IBM Login**

### **2.2 Create IBM Services**

**IBM Watson Studio Services**

The screenshot shows the IBM Cloud Resource list interface. On the left, there's a sidebar with various service categories like Container Registry, Data, Cloud Foundry apps, Cloud Foundry services, Services and software, Storage, Network, Functions namespaces, Apps, and Developer tools. The main area displays a table with columns: Name, Group, Location, Product, Status, and Tags. A red box highlights a row for 'Watson Studio-7l'. The table contains the following data:

Name	Group	Location	Product	Status	Tags
Machine Learning-xv	Default	London	Machine Learning	Active	cpdaas
Watson Studio-7l	Default	London	Watson Studio	Active	
node-red-ixguu-2022--cloudant-16593...	Default	Sydney	Cloudant	Active	

Figure 2: IBM Watson Studio Services

## Node-RED Services

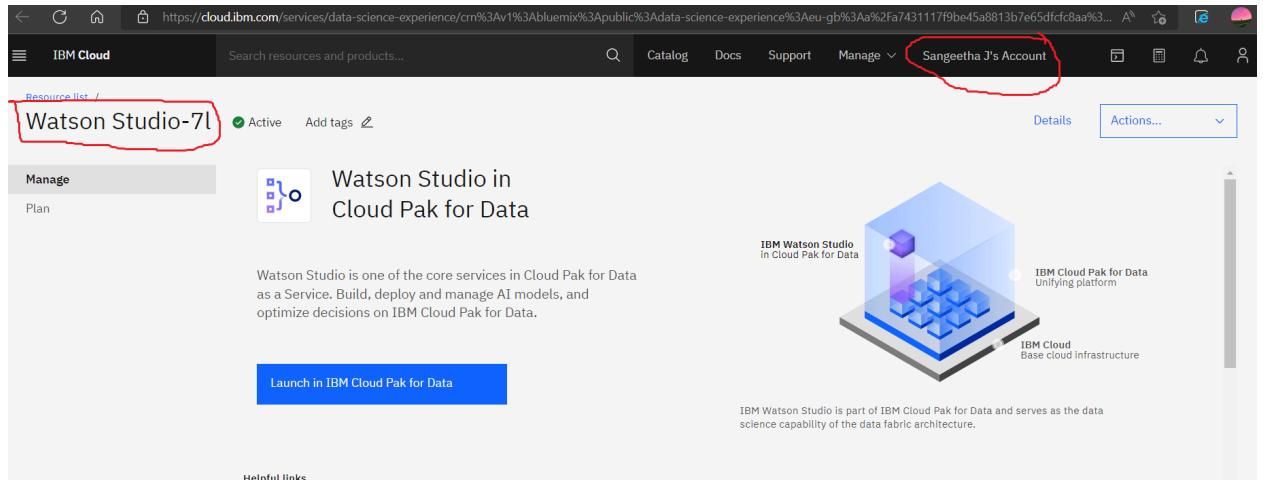
The screenshot shows the IBM Cloud Resource list interface. The sidebar categories are identical to Figure 2. The main area displays a table with columns: Name, Group, Location, Product, Status, and Tags. A red box highlights a row for 'Node RED IXGUU 2022-08-01'. The table contains the following data:

Name	Group	Location	Product	Status	Tags
Machine Learning-xv	Default	London	Machine Learning	Active	cpdaas
Watson Studio-7l	Default	London	Watson Studio	Active	
Node RED IXGUU 2022-08-01	m s ramaiah institute of technology / ...	Sydney	Node.js	Started	
node-red-ixguu-2022--cloudant-16593...	Default	Sydney	Cloudant	Active	

Figure 3: IBM Node-RED Services

## 2.3 Create a Watson studio project

After creating Watson studio and Node-RED services, the Cloud Object Storage service (COS) and Machine Learning service (ML) services will be created while creating a Watson Studio Project



**Figure 4: IBM Watson Studio Project Launch**

## 2.4 Build Machine Learning Model

- **Collect the data set**

Heart failure is a common event caused by CVDs and this dataset contains 09 features that can be used to predict mortality by heart failure. The following parameters are 09 input features:

- AVG HEART BEATS PER MIN
- PALPITATIONS PER DAY
- CHOLESTEROL
- BMI
- AGE
- SEX
- FAMILY HISTORY
- SMOKER LAST 5YRS
- EXERCISE MIN PER WEEK

The following are the output:

- HEART FAILURE - Prediction

	A	B	C	D	E	F	G	H	I	J	K	L
1	AVGHEARTBEATSPERMIN	PALPITATIONSPERDAY	CHOLESTEROL	BMI	HEARTFAILURE	AGE	SEX	FAMILYHISTORY	SMOKERLAST5YRS	EXERCISEMINPERWEEK		
2	93	22	163	25 N	49 F	N	N			110		
3	108	22	181	24 N	32 F	N	N			192		
4	86	0	239	20 N	60 F	N	N			121		
5	80	36	164	31 Y	45 F	Y	N			141		
6	66	36	185	23 N	39 F	N	N			63		
7	125	27	201	31 N	47 M	N	N			13		
8	83	27	169	20 N	71 F	Y	N			124		
9	107	31	199	32 N	55 F	N	N			22		
10	92	28	174	22 N	44 F	N	N			107		
11	84	12	206	25 N	50 M	N	N			199		
12	60	1	194	28 N	71 M	N	N			27		
13	134	7	228	34 Y	63 F	Y	N			92		
14	103	0	237	24 N	64 F	Y	N			34		
15	101	39	157	20 N	49 M	N	N			33		
16	92	2	169	26 N	36 M	N	N			217		
17	80	27	234	27 N	50 M	N	N			28		
18	82	14	155	30 N	70 F	N	N			207		

Figure 5: Heart Failure Prediction Dataset

- Add Auto AI experiment

Procedure of Uploading File | Student Dashboard | SI-100166-1658822652 | Resource list - IBM Cloud | Service Details - IBM Cloud | IBM Watson Studio

IBM Watson Studio | Sangeetha J's Account | London | Launch IDE

Projects / Train AutoAI and reference model

Overview Assets Jobs Manage

Find assets Import asset New asset +

7 assets All assets

Name	Last modified
Heart_AutoAI AutoAI experiment	4 days ago Sangeetha J (You)
Heart_AutoAI - P3 Random Forest Classifier Model	5 days ago Sangeetha J (You)
patientdataV6.csv CSV	5 days ago Sangeetha J (You)
reference-model-training-notebook Notebook from local system	5 days ago Service
select-winning-model Notebook from local system	5 days ago Service
german_credit_data_biased_training.csv	5 days ago

Data in this project  
Drop data files here or browse for files to upload

Figure 6: Auto AI Added

- Run AI Experiment

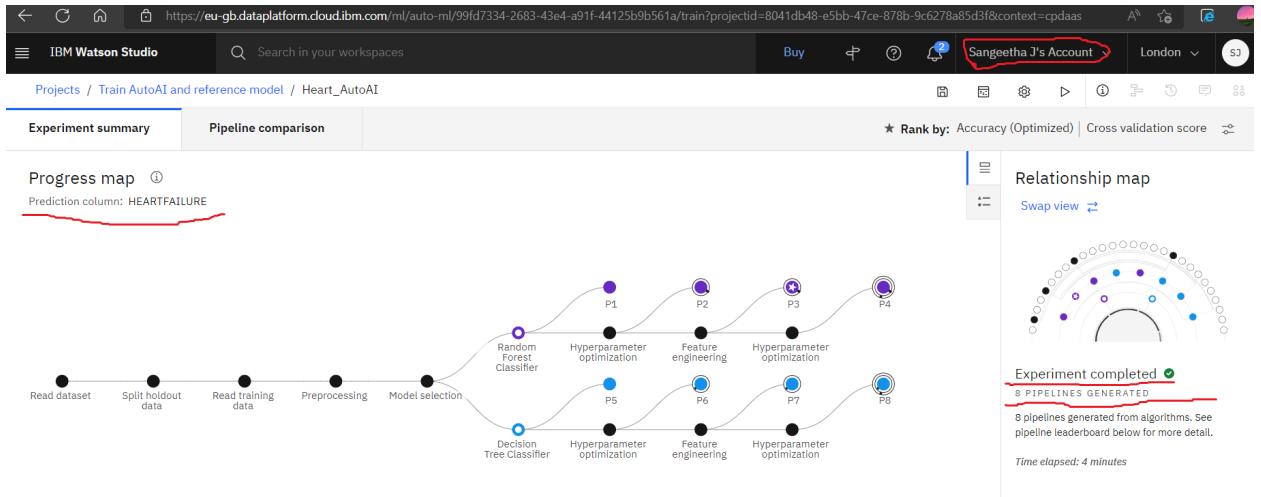


Figure 7: Run AutoAI Experiment

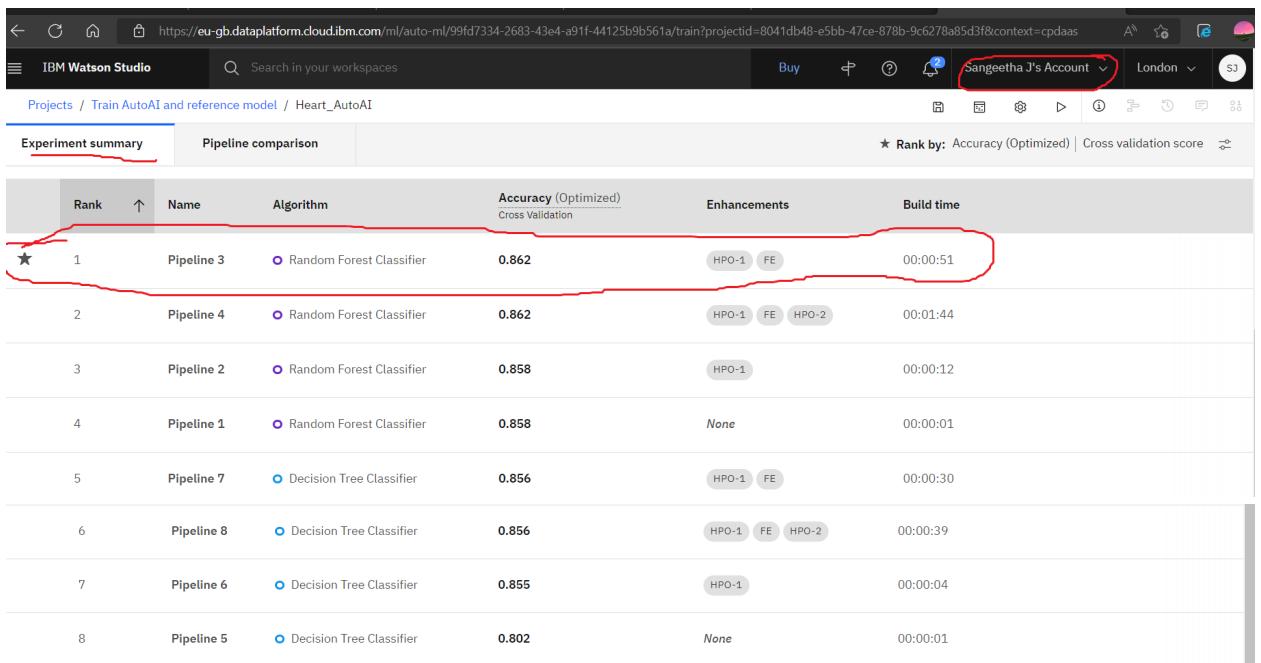


Figure 8: Eight Pipelines Generated

- Save the model

The screenshot shows the IBM Watson Studio interface with the 'Assets' tab selected. On the left, there's a sidebar for 'Asset types' with categories like Data, Experiments, Source Code, and Models. The main area lists 'All assets' with columns for Name and Last modified. One specific asset, 'Heart\_AutoAI - P3 Random Forest Classifier', is highlighted with a red box.

**Figure 9: Save the Highest Accuracy Model (Random Forest Classifier)**

This screenshot shows the detailed view of the 'Heart\_AutoAI - P3 Random Forest Classifier' model. It includes sections for 'Input Schema' (listing columns AGE, AVGHEARTBEATSPERMIN, BMI, and CHOLESTEROL with their respective types), 'Description' (No description provided), 'Created' (Aug 2, 2022 7:19 PM), 'Type' (wml-hybrid\_0.1), 'Model ID' (227c5bb9-0d3f-4c98-be50-10be8e99fac3), and 'Software specification' (hybrid).

**Figure 10: Save the Model - Input Schema**

- Deploy the model as a web server and generate scoring End Point

The dashboard features a 'Welcome, Sangeetha!' message at the top. Below it are three main sections: 'Take a tutorial', 'Work with data', and 'Learn what's new'. The 'Work with data' section includes a 'Projects' card showing 'Train AutoAI and reference model' and 'Heart' projects. The 'Notifications' card shows an 'Online deployment ready' message. The 'Deployments' card shows a deployment for 'Heart\_Deployment\_Space'.

**Figure 11: Projects and Deployment of the Model**

The screenshot shows the IBM Watson Studio interface. At the top, the URL is <https://eu-gb.dataplatform.cloud.ibm.com/ml-runtime/spaces/9ea5e542-6953-4eb8-9064-aa2dd871afac/overview?context=cpdaas>. The top navigation bar includes 'Buy', 'Sangeetha J's Account', 'London', and a user icon. A red box highlights the account dropdown. Below the header, there are tabs for 'Deployments' (selected), 'Assets', 'Jobs', and 'Manage'. The main area shows 'Space activity' with a message: 'Online deployment ready' (green checkmark) and 'The online deployment Heart\_Deployment in space Heart\_Deployment\_Space is ready to accept requests' (red box). Another message below says 'Online deployment created' with a timestamp 'Aug 02, 2022 07:26 PM'. On the right, there's a file upload section with a red box around it and a note: 'Stay on the page until upload completes. Incomplete uploads are canceled.'

Figure 12: Deploy the Model

The screenshot shows the IBM Watson Studio interface for the 'Heart\_Deployment\_Space' space. The URL is [https://eu-gb.dataplatform.cloud.ibm.com/ml-runtime/deployments/b629228e-c162-475e-a80e-a4be5abe88ab?context=cpdaas&space\\_id=9ea5e542-6953-4eb8-9064-aa2dd871afac](https://eu-gb.dataplatform.cloud.ibm.com/ml-runtime/deployments/b629228e-c162-475e-a80e-a4be5abe88ab?context=cpdaas&space_id=9ea5e542-6953-4eb8-9064-aa2dd871afac). The top navigation bar includes 'Buy', 'Sangeetha J's Account', 'London', and a user icon. A red box highlights the account dropdown. The main area shows the 'Heart\_Deployment' deployment with a green 'Deployed' status and an 'Online' button. It includes an 'API reference' tab, a 'Test' button, and a 'Direct link' section with an endpoint URL: <https://eu-gb.ml.cloud.ibm.com/ml/v4/deployments/b629228e-c162-475e-a80e-a4be5abe88ab/predictions?version=1>. To the right, there's a detailed view of the deployment with fields like 'Created' (Aug 2, 2022 7:26 PM), 'Updated' (Aug 2, 2022 7:26 PM), 'Deployment ID' (b629228e-c162-475e-a80e-a4...), 'Software specification' (hybrid\_0.1), and 'Hybrid pipeline software specifications' (autoai-kb\_rt22.1-py3.9). A red box highlights the deployment ID field.

Figure 13: Deploy the Model - Scoring End Point

The screenshot shows the IBM Watson Studio interface for a deployment named "Heart\_Deployment". The "Test" tab is selected. A table titled "Enter input data" contains a single row of data from a CSV file. The columns are labeled: AVGHEARTBEATSPERMIN, PALPITATIONSPERMIN, CHOLESTEROL (integer), BMI (integer), AGE (integer), SEX (other), FAMILYHISTORY (other), SMOKERLAST5YRS, and EXERCISEMINPERWEEK. The data row is as follows:

	AVGHEARTBEATSPERMIN	PALPITATIONSPERMIN	CHOLESTEROL (integer)	BMI (integer)	AGE (integer)	SEX (other)	FAMILYHISTORY (other)	SMOKERLAST5YRS	EXERCISEMINPERWEEK
1	114	29	194	34	61	f	n	n	164
2									
3									
4									
5									
6									

A "Predict" button is located at the bottom right of the input area.

**Figure 14: Deploy the Model - Input Features**

The screenshot shows the IBM Watson Studio interface for a deployment named "Heart\_AutoAI - P3 Random Forest Classifier test prediction". The "Table view" is selected. The interface displays the following information:

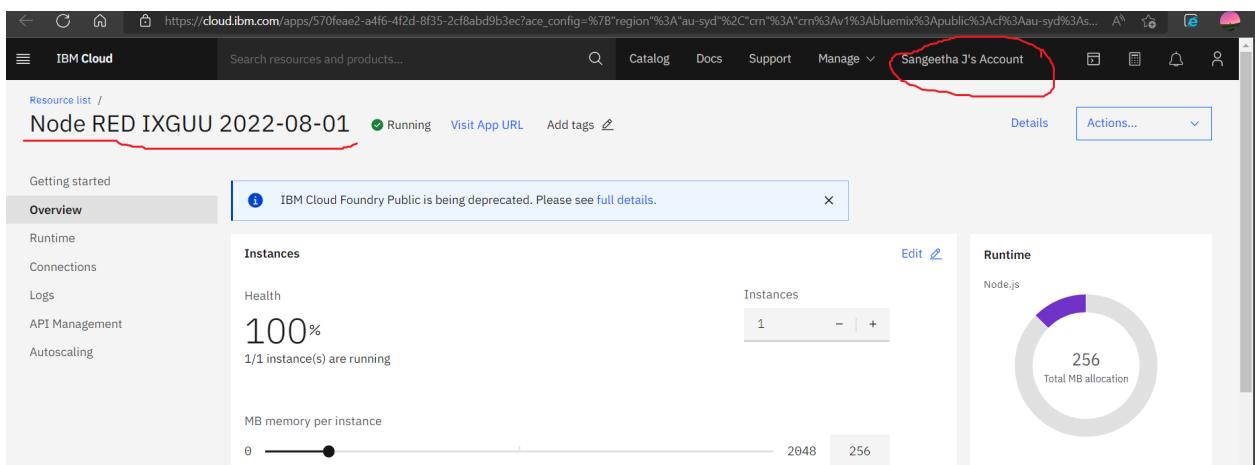
- Prediction type:** Binary classification
- Prediction percentage:** A pie chart indicating 1 Record.
- Confidence level distribution:** A bar chart showing the distribution of confidence levels for 15 records.
- Prediction table:**

	Prediction	Confidence
1	Y	80%
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		

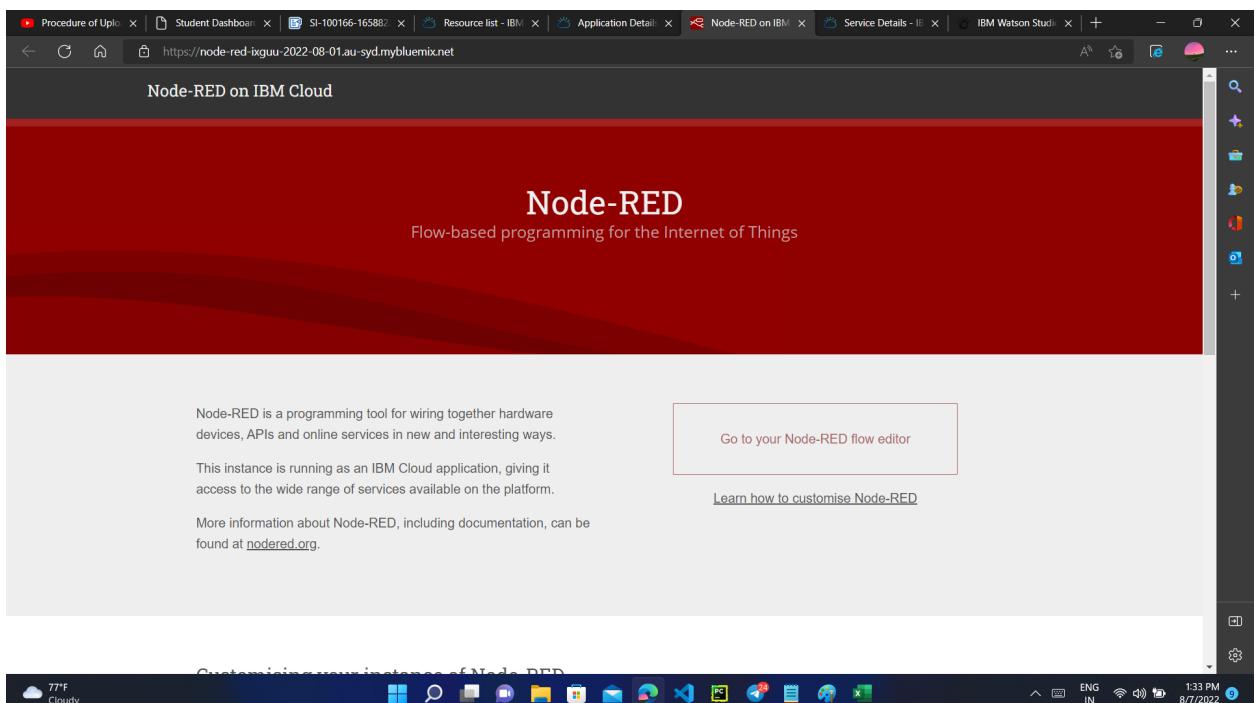
A "Download" button is located at the bottom right of the prediction table area.

**Figure 14: Deploy the Model - Prediction**

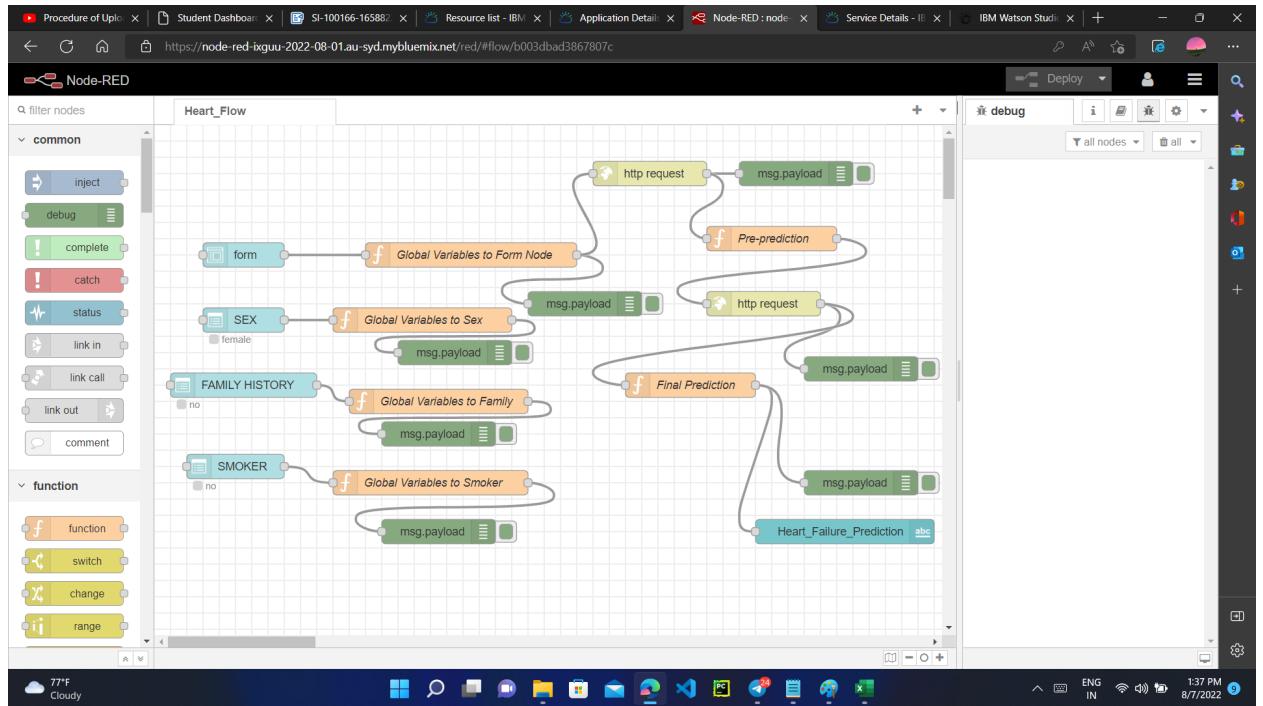
## 2.5 Create a WEB application Using Node-RED to take user input and showcase Prediction on UI



**Figure 15: Node-RED Service**



**Figure 16: Node-RED Application**



**Figure 17: Node-RED Flow for Heart Disease Prediction**

The screenshot shows a user interface titled "Prediction". It features a form titled "Enter the Values" with three dropdown menus: "SEX" (Male), "FAMILY HISTORY" (YES), and "SMOKER" (NO). Below the form is a section titled "Heart\_Failure\_Prediction" containing several input fields with placeholder values: "AVG HEART BEATS PER MIN" (119), "PALPITATIONS PER DAY" (67), "CHOLESTEROL" (256), "BMI" (38), "AGE" (49), and "EXERCISE MIN PER WEEK" (117). At the bottom of the form are two buttons: "SUBMIT" and "CANCEL".

**Figure 18: UI for Heart Disease Prediction**

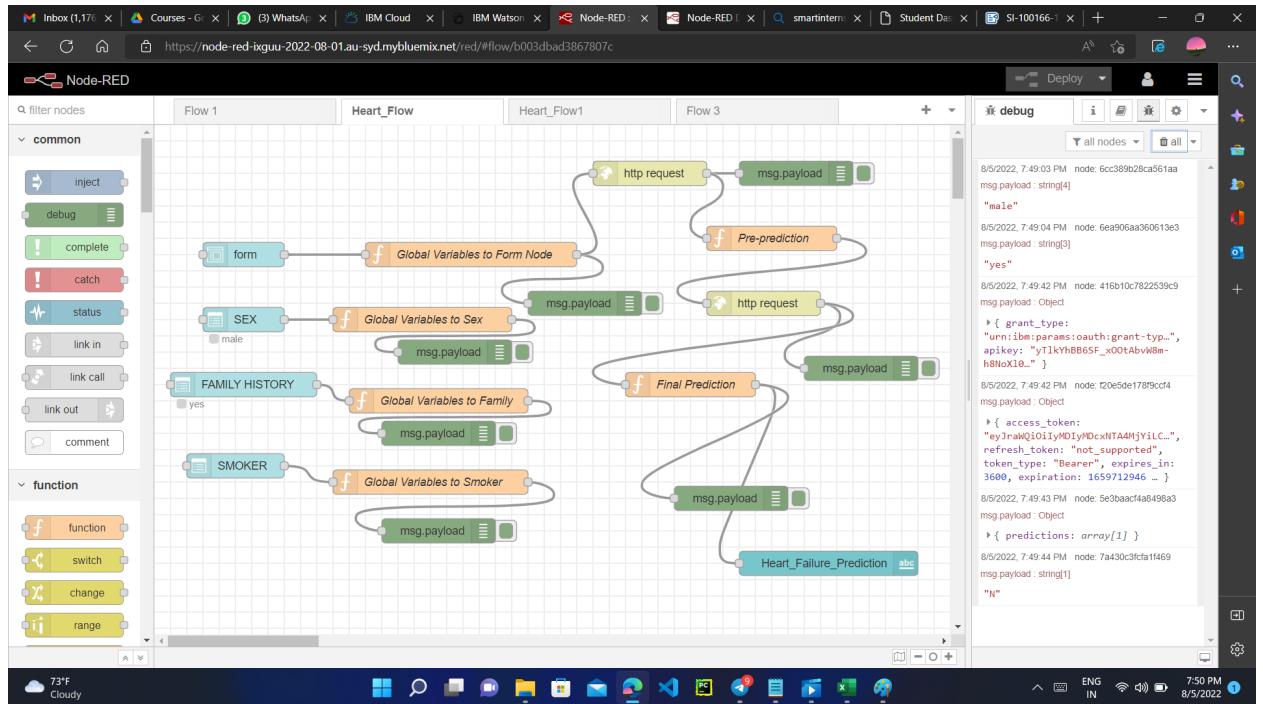


Figure 19: Node-RED Flow for Heart Disease Prediction - 'No'

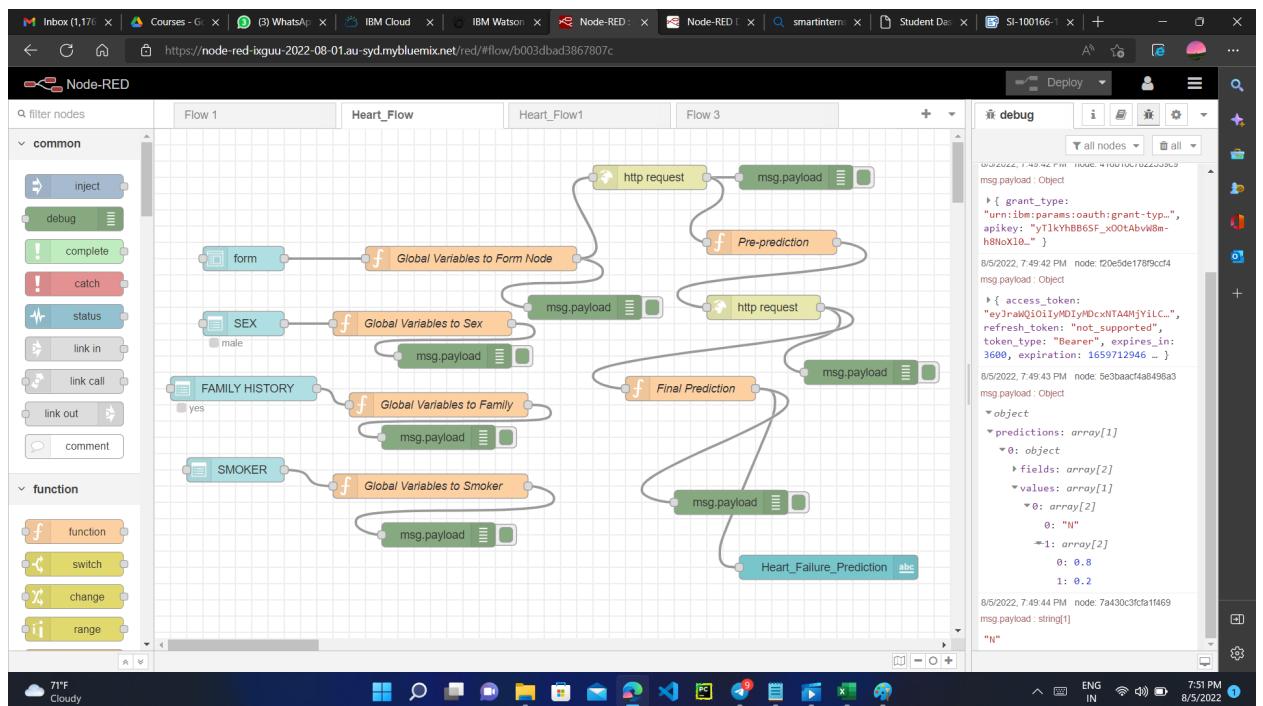


Figure 20: Node-RED Flow for Heart Disease Prediction - 'No' with 80% Confidence

The screenshot shows the IBM Watson Studio interface. The top navigation bar includes tabs for 'Inbox (1,176)', 'Courses - G...', '(1) WhatsApp', 'IBM Cloud', 'IBM Watson', 'Node-RED', 'Node-RED', 'smartintern...', 'Student Data...', 'SI-100166...', and a '+' icon. The main workspace title is 'Heart\_Deployment'. Below it, 'Deployments / Heart\_Deployment\_Space / Heart\_AutoAI - P3 Random Fore...' is selected. The 'Test' tab is active. A section titled 'Enter input data' contains a table with columns: AVGHEARTBEATSP..., PALPITATIONSPER..., CHOLESTEROL (integer), BMI (integer), AGE (integer), SEX (other), FAMILYHISTORY (ot...), SMOKERLAST5YRS ..., and EXERCISEMINPER... . The table has 6 rows, numbered 1 to 6. Row 1 has values: 114, 29, 194, 34, 61, f, n, n, 164. Row 2 has values: 119, 67, 256, 38, 49, m, y, n, 117. Rows 3 through 6 are empty. A 'Predict' button is located at the bottom right of the input area. The system tray at the bottom shows a weather icon (71°F Cloudy), various application icons, and system status like ENG IN, 8:29 PM, and 8/5/2022.

**Figure 21:Deployment of the model for Heart Disease Prediction - Input**

The screenshot shows the IBM Watson Studio interface with the same navigation bar as Figure 21. The main workspace title is 'Heart\_AutoAI - P3 Random Forest Classifier test prediction'. The 'Table view' is selected. The interface displays three sections: 'Binary classification' (showing a pie chart with 2 Records, 50% for each class Y and N), 'Prediction percentage' (a pie chart showing 2 Records, 50% for each class Y and N), and 'Confidence level distribution' (a bar chart showing the amount of records for each confidence level from 1 to 15). A table titled 'Prediction' shows rows for 1 through 15, with columns for 'Prediction' (values Y or N) and 'Confidence' (values 80% or 80%). A 'Download' button is located at the bottom right. The system tray at the bottom shows a weather icon (71°F Cloudy), various application icons, and system status like ENG IN, 8:29 PM, and 8/5/2022.

**Figure 22: Deployment of the model for Heart Disease Prediction - 'No' with 80% Confidence**

## Some More sample outputs for Heart Disease Prediction:

Inbox (1,176) | Courses - Gr... | WhatsApp | IBM Cloud | IBM Watson | Node-RED | Node-RED | smartintern... | Student D... | SI-100166- | +

https://node-red-ixguu-2022-08-01.au-syd.mybluemix.net/ui/#/1?socketId=PbtDn8FfQxJQlxAABV

Prediction

Enter the Values

Heart\_Failure\_Prediction **N**

SEX Male

FAMILY HISTORY YES

SMOKER YES

Avg Heart Beats per Min \*

Palpitations per Day \*

Cholesterol \*

BMI \*

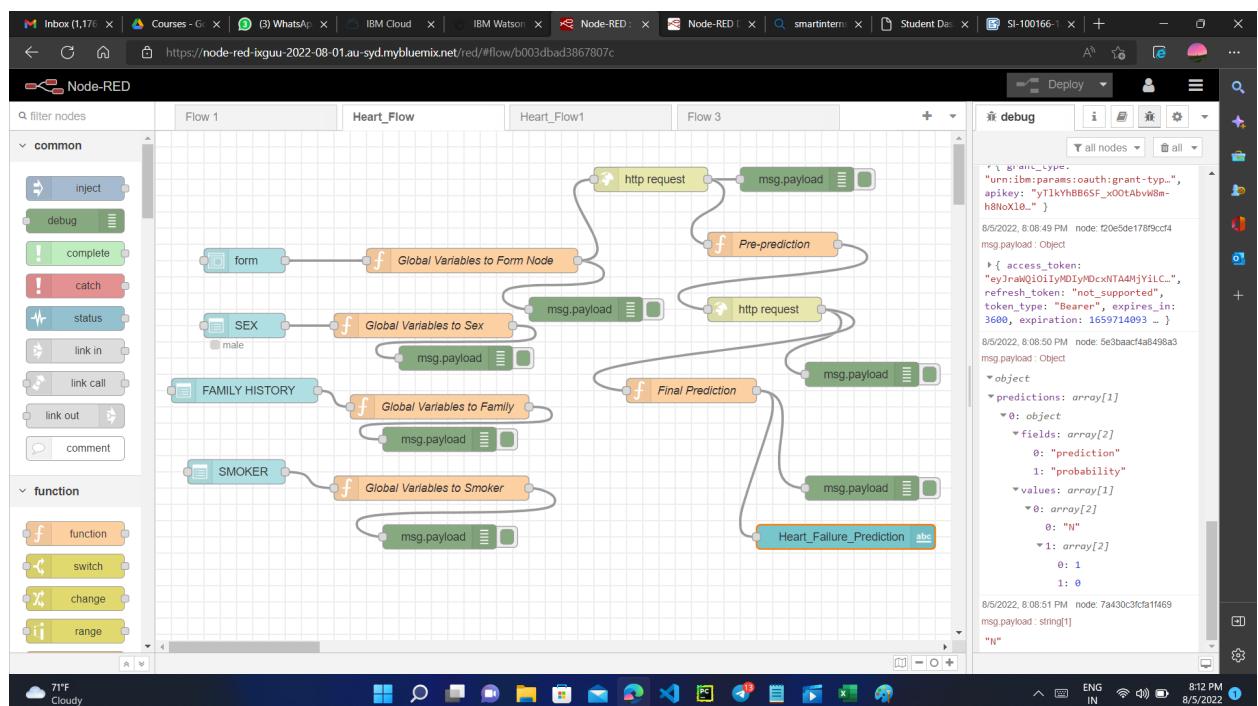
Age \*

Exercise min per week \*

**SUBMIT** **CANCEL**

Cloudy

8:11 PM 8/5/2022



Inbox (1,176) | Courses - G... | (3) WhatsApp | IBM Cloud | IBM Watson | Node-RED | smartintern... | Student Data... | SI-100166- | + | ...

https://node-red-ixguu-2022-08-01.au-syd.mybluemix.net/ui/#/1?socketId=PbtDn8FfQxJQlxAAVB

### Prediction

Enter the Values

Heart\_Failure\_Prediction

SEX: Female

FAMILY HISTORY: NO

SMOKER: NO

Avg Heart Beats per Min:

Palpitations per Day:

Cholesterol:

BMI:

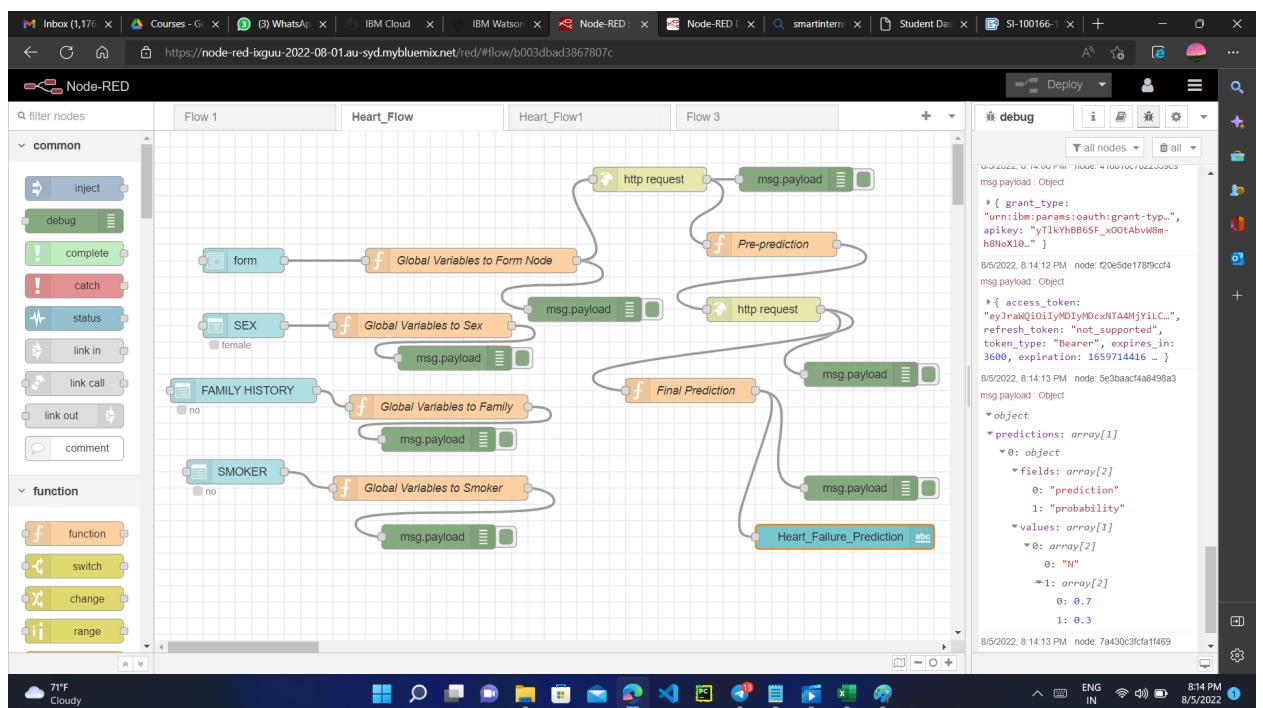
Age:

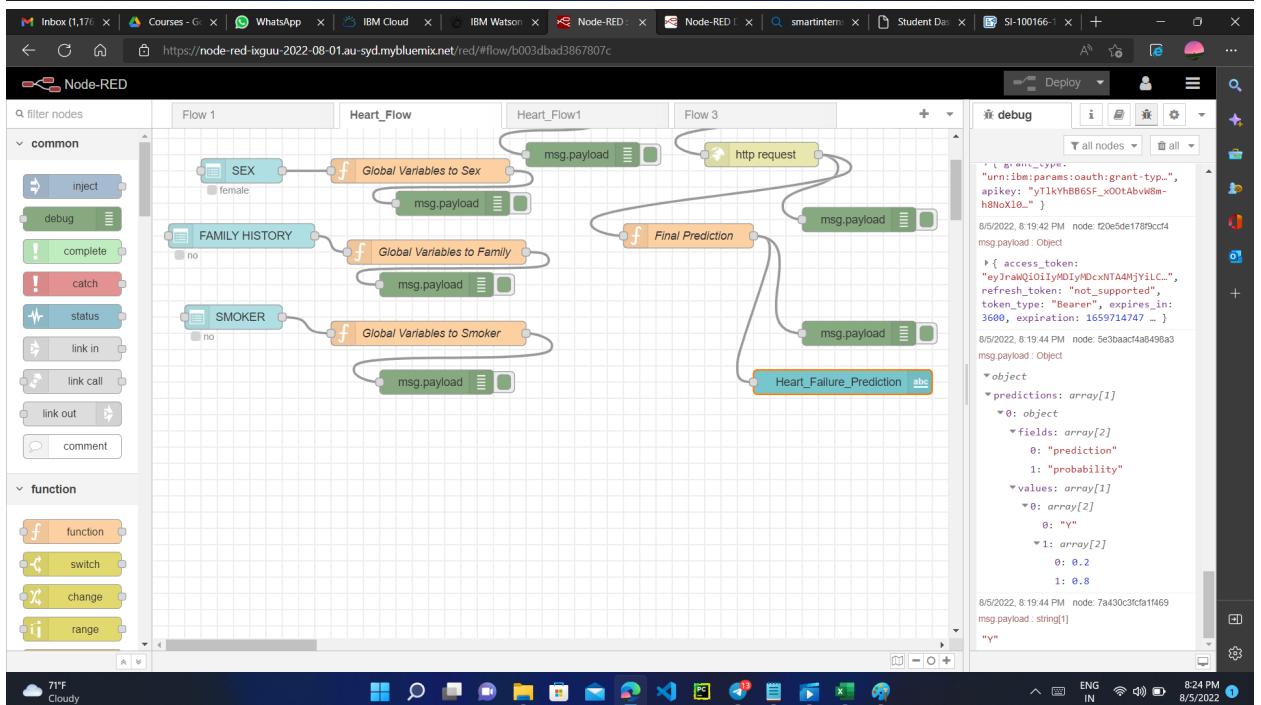
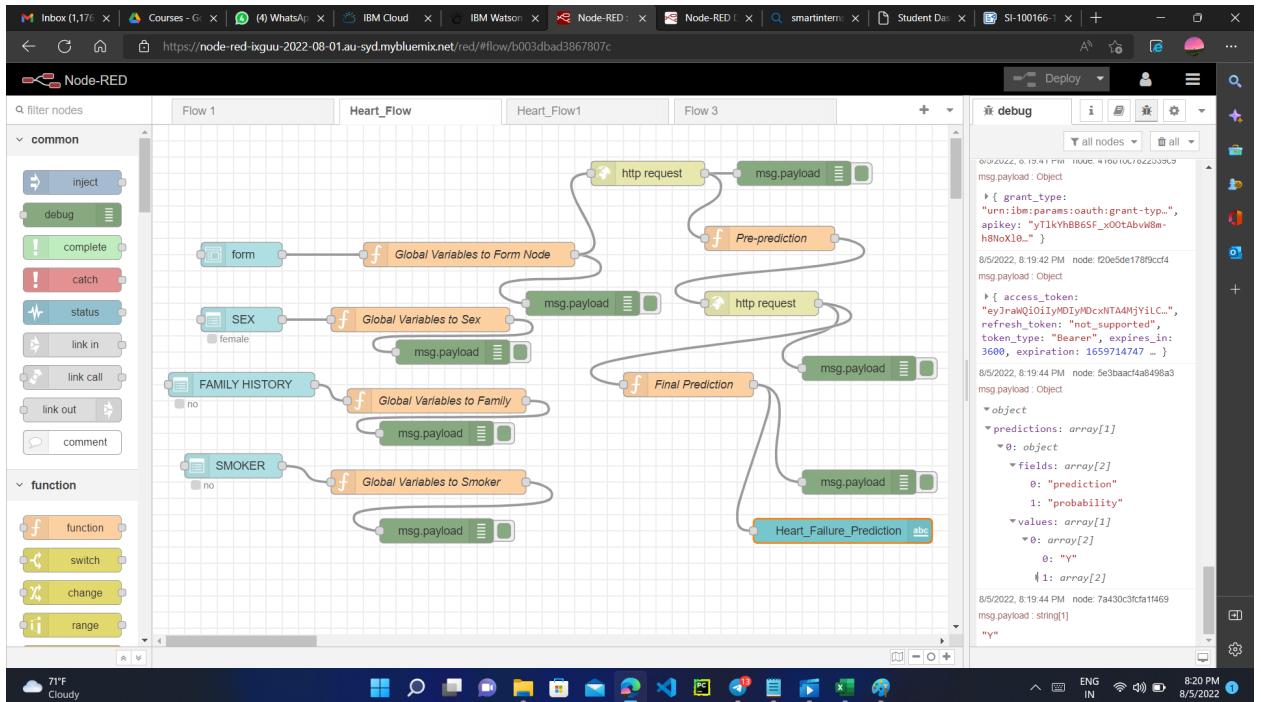
Exercise Min per Week:

**SUBMIT**   **CANCEL**

Cloudy

8:14 PM 8/5/2022





Inbox (1,176) | Courses - Go... | (4) WhatsApp | IBM Cloud | IBM Watson | Node-RED | smartintern... | Student Data | SI-100166- | + | <https://node-red-ixguu-2022-08-01.au-syd.mybluemix.net/ui/#/1?socketId=PbtDn8FfQxJQlxAAV>

### Prediction

Enter the Values

	Heart_Failure_Prediction	Y
SEX	Female	<input type="button" value="▼"/>
FAMILY HISTORY	NO	<input type="button" value="▼"/>
SMOKER	NO	<input type="button" value="▼"/>
AVG HEART BEATS PER MIN *		
PALPITATIONS PER DAY *		
CHOLESTEROL *		
BMI *		
AGE *		
EXERCISE MIN PER WEEK *		
<input type="button" value="SUBMIT"/> <input type="button" value="CANCEL"/>		

Cloudy 71°F

8:20 PM 8/5/2022

Inbox (1,176) | Courses - Go... | (1) WhatsApp | IBM Cloud | IBM Watson | Node-RED | smartintern... | Student Data | SI-100166- | + | [https://eu-gb.dataplatform.cloud.ibm.com/ml-runtime/deployments/b629228e-c162-475e-a80e-a4be5abe88ab/test?space\\_id=9ea5e542-6953-4eb8-9064-aa2dd871afac&context...](https://eu-gb.dataplatform.cloud.ibm.com/ml-runtime/deployments/b629228e-c162-475e-a80e-a4be5abe88ab/test?space_id=9ea5e542-6953-4eb8-9064-aa2dd871afac&context...)

### IBM Watson Studio

Search in your workspaces

Buy [?](#) [Notification](#) Sangeetha J's Account London [sj](#) [...](#)

Deployments / Heart\_Deployment\_Space / Heart\_AutoAI - P3 Random For... /

Heart\_Deployment [Deployed](#) [Online](#)

API reference [Test](#)

Enter input data

Input Paste JSON

Enter data manually or use a CSV file to populate the spreadsheet. Max file size is 50 MB.

Download CSV template [...](#) Browse local files [...](#) Search in space [...](#) Clear all [x](#)

	AVGHEARTBEATSP...	PALPITATIONSPER...	CHOLESTEROL (inte...	BMI (integer)	AGE (integer)	SEX (other)	FAMILYHISTORY (ot...	SMOKERLAST5YRS...	EXERCISEMINPER...
1	114	29	194	34	61	f	n	n	164
2									
3									
4									
5									
6									

Cloudy 8:26 PM 8/5/2022

Inbox (1,176) | Courses - Go... | (1) WhatsApp | IBM Cloud | IBM Watson | Node-RED | Node-RED | smartintern... | Student Data... | SI-100166... | +

IBM Watson Studio  Buy ? Sangeetha J's Account London ...

Deployments / Heart\_Deployment\_Space / Heart\_AutoAI - P3 Random Fore... /

### Heart\_AutoAI - P3 Random Forest Classifier test prediction

Prediction type: Binary classification

Prediction percentage: 1 Record

Confidence level distribution: 1 Record

Table view JSON view

	Prediction	Confidence
1	Y	80%
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		

Download

71°F Cloudy ENG IN 8:25 PM 8/5/2022

