Effective Heart Disease Prediction Using IBM Auto AI Service

1. INTRODUCTION

1.1 Overview

According to estimates, 17.9 million people die from cardiovascular diseases (CVDs) each year, which accounts for 31% of all fatalities worldwide. Cardiovascular diseases remain the leading cause of disease burden in the world. CVD burden continues its decades-long rise for almost all countries outside high-income countries, and alarmingly, the age-standardized rate of CVD has begun to rise in some locations where it was previously declining in high-income countries. There is an urgent need to focus on implementing existing cost-effective policies and interventions if the world is to meet the targets for Sustainable Development Goal 3 and achieve a 30% reduction in premature mortality due to non communicable diseases. In the period between January-June 2021, nearly 3,000 people lost their lives to heart attacks every month which was around 500 in 2020. Nearly 23.8 per cent (17,880) of the total 75,165 deaths recorded till June last year in Mumbai were attributed to heart attacks.

Non-communicable diseases (NCDs), including CVDs, are estimated to account for 60% of total adult deaths in India

- CVDs account for over a quarter (26%) of these deaths.
- Some of the CVD related risks factors in adults in India are outlined below:

15% of the population smoke tobacco, 4.3 litres of pure alcohol consumed per person, Just over a fifth (21.1%) have hypertension which can increase risk of heart attack, heart failure, kidney disease or stroke.

1.2 Purpose

We can use this project for predicting heart condition of a human being for those who are suffering from severe heart deceases or for normal people also. So that in future they can save themselves.

2. LITERATURE SURVEY

2.1 Existing problem

Doctor will perform a physical exam and ask about your personal and family medical history. The tests you'll need to diagnose your heart disease depend on what condition your doctor thinks you might have. Besides blood tests and a chest X-ray, tests to diagnose heart disease can include:

Electrocardiogram (ECG or EKG). An ECG is a quick and painless test that records the electrical signals in your heart. It can spot abnormal heart rhythms. You may have an ECG while you're at rest or while exercising (stress electrocardiogram).

Holter monitoring. A Holter monitor is a portable ECG device you wear to continuously record your heart rhythm, usually for 24 to 72 hours. Holter monitoring is used to detect heart rhythm problems that aren't found during a regular ECG exam.

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Echocardiogram. This noninvasive exam uses sound waves to produce detailed images of your heart's structure. It shows how your heart beats and pumps blood.

Stress test. This type of test involves raising your heart rate with exercise or medicine while performing heart tests and imaging to check how your heart responds.

Cardiac catheterization. In this test, a short tube (sheath) is inserted into a vein or artery in your leg (groin) or arm. A hollow, flexible and longer tube (guide catheter) is then inserted into the sheath. Using X-ray images on a monitor as a guide, your doctor carefully threads the catheter through the artery until it reaches your heart.

Cardiac computerized tomography (CT) scan. In a cardiac CT scan, you lie on a table inside a doughnut-shaped machine. An X-ray tube inside the machine rotates around your body and collects images of your heart and chest.

Cardiac magnetic resonance imaging (MRI). A cardiac MRI uses a magnetic field and computer-generated radio waves to create detailed images of your heart.

Treatment

The type of treatment you receive depends on the type of heart disease you have. In general, treatment for heart disease usually includes:

- **Lifestyle changes.** You can lower your risk of heart disease by eating a low-fat and low-sodium diet, getting at least 30 minutes of moderate exercise on most days of the week, quitting smoking, and limiting alcohol intake.
- **Medications.** If lifestyle changes alone aren't enough, your doctor may prescribe medications to control your heart disease. The type of medication you receive will depend on the type of heart disease.
- **Medical procedures or surgery.** If medications aren't enough, it's possible your doctor will recommend specific procedures or surgery. The type of procedure or surgery will depend on the type of heart disease and the extent of the damage to your heart

2.2 Proposed solution

There are some parameters that assure your heart condition or these parameters can give the status of your heart disease .The correct prediction of heart disease can prevent life threats and incorrect prediction can prove to be fatal at the same time. These parameters are:

1. Avg.beats/min

2. Palpitations/day

3. BMI

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4. Heart Failure
5. Age
6. Sex
7. Family History
8. Smoker last 5 years
9. Exercise min/week

The above parameters are used in app creation with the help of using IBM auto ai service.
Heart failure is a common event caused by CVDs and this dataset contains nine above features that can be used to predict mortality by heart failure.
In this project, we need to build a model using Auto AI and build a web application where we can showcase the prediction of heart failure.

3. THEORITICAL ANALYSIS

3.1 Block diagram

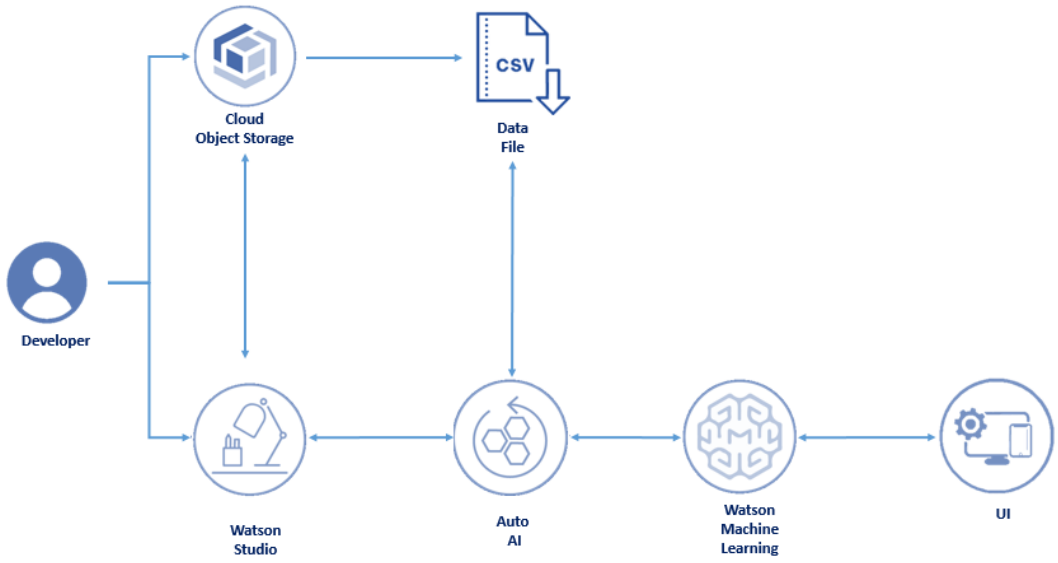

Figure 1 Health disease block diagram

4. Project Flow

1. Log in to IBM account
2. Create IBM Watson Studio and Node-RED Service
3. Create a Watson studio project

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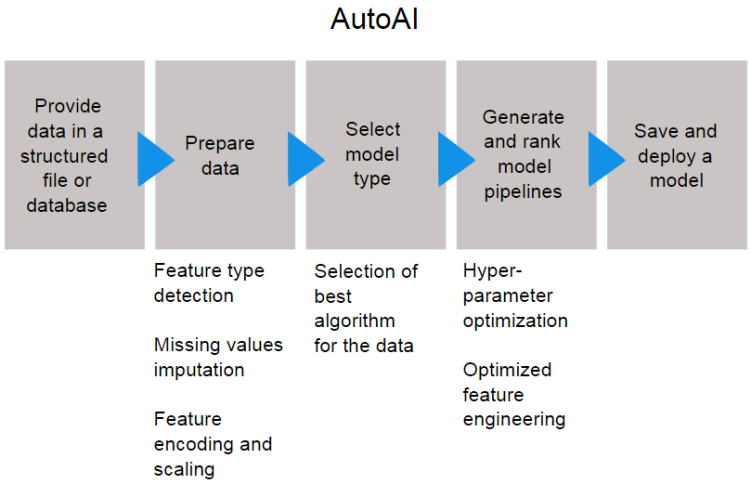
4. ADD Auto AI Experiment
5. Run the Auto AI Experiment to build a Machine learning model on the desired dataset
6. Save the model
7. Deploy the model as a web server and generate scoring End Point
8. Create a WEB application Using Node-RED to take user input and showcase Prediction on UI

5.1 What is Auto AI

The AutoAI graphical tool in Watson Studio automatically analyzes your data and generates candidate model pipelines customized for your predictive modeling problem. These model pipelines are created iteratively as AutoAI analyzes your dataset and discovers data transformations, algorithms, and parameter settings that work best for your problem setting. Results are displayed on a leaderboard, showing the automatically generated model pipelines ranked according to your problem optimization objective.
To add the project

- Click on Add Project from Watson Studio project
- Select Auto AI
- Specify a name and description for your experiment.
- Select a machine learning service instance and click Create.



4.2 Node –RED

Node-RED is a programming tool for wiring together hardware devices, APIs and online services in new and interesting ways.It provides a browser-based editor that makes it easy to wire together flows using the wide range of nodes in the palette that can be deployed to its runtime in a single-click.

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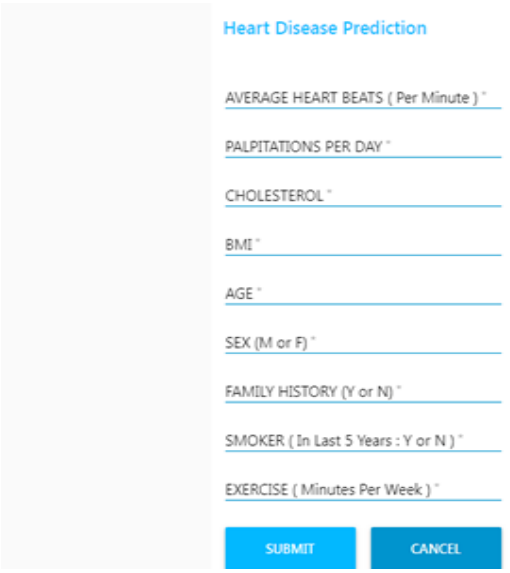
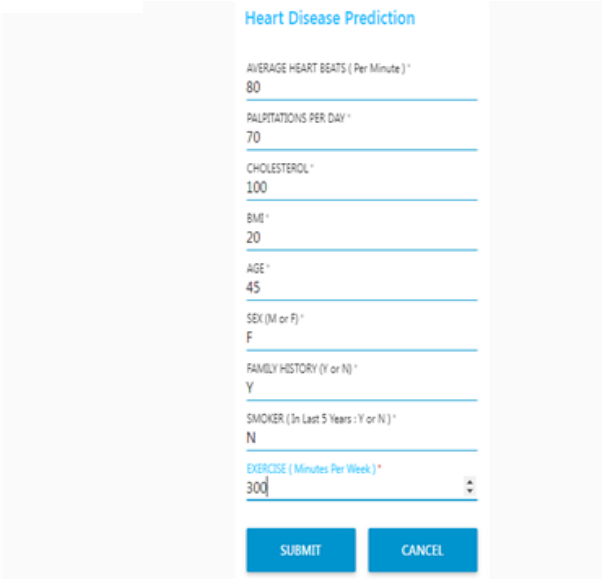
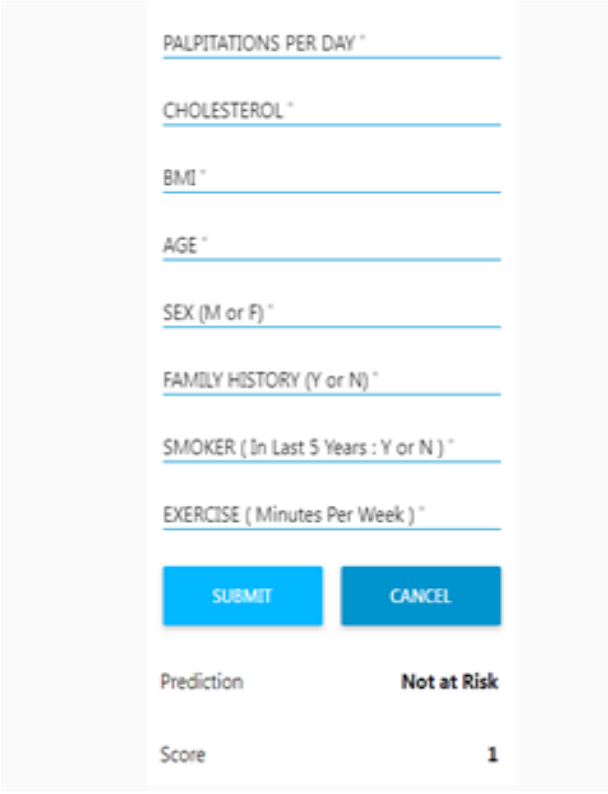
5. RESULT







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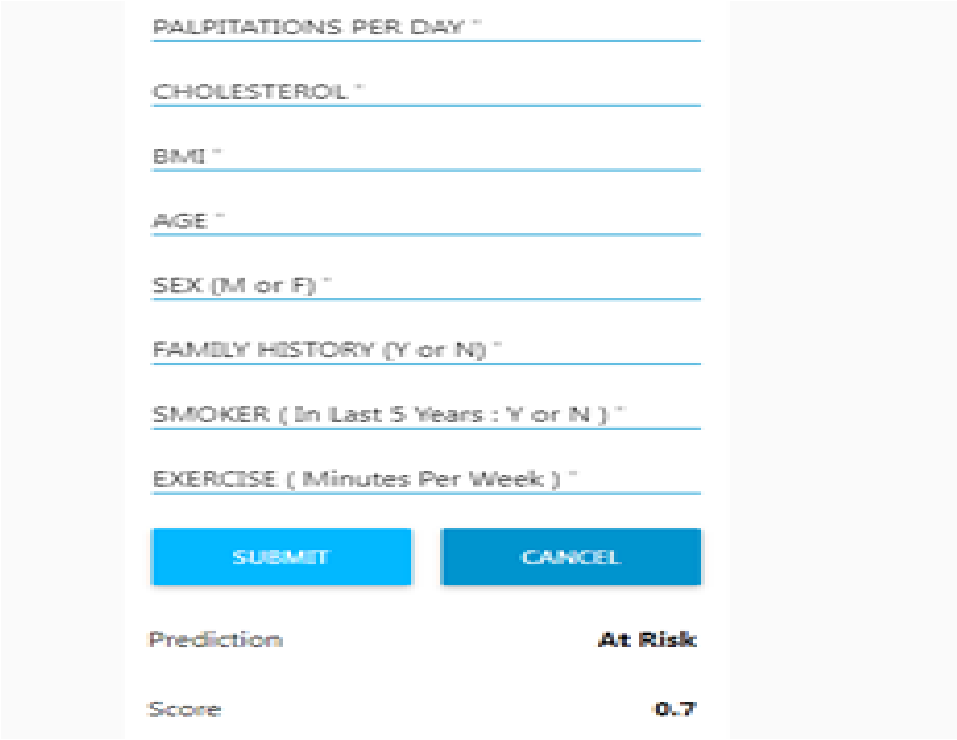

Result Table:I

Avg .beats/ min	Palpitations/day	Cholesterol	BMI	Age	Sex	FH	Smoker last 5 years	Exercisemin/week	Result (Heart Failure)	
80	70	100	20	45	F	Y	N	300	Not at Risk	100 %
80	100	300	30	45	F	Y	N	100	At risk	70 %

The above table shows the result which we get from Node red application.

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6. EXPERIMENTAL INVESTIGATIONS

Programming on Google Colab

```
[ ] import pandas as pd
    import numpy as np

    import matplotlib.pyplot as plt
    import seaborn as sns
```

```
[ ] df=pd.read_csv('patientdataV6.csv')
    df.head()
```

	AVGHEARTBEATSPERMIN	PALPITATIONSPERDAY	CHOLESTEROL	BMI	HEARTFAILURE	AGE	SEX	FAMILYHISTORY	SMOKERLAST5YRS	EXERCISEMINPERWEEK
0	93	22	163	25	N	49	F	N	N	110
1	108	22	181	24	N	32	F	N	N	192
2	86	0	239	20	N	60	F	N	N	121
3	80	36	164	31	Y	45	F	Y	N	141
4	66	36	185	23	N	39	F	N	N	63

```
[ ] df.shape
```

```
(10800, 10)
```

DATA CLEANING

```
[ ] df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 10800 entries, 0 to 10799
Data columns (total 10 columns):
 #   Column               Non-Null Count  Dtype
---  ------               --------------  -----
 0   AVGHEARTBEATSPERMIN  10800 non-null  int64
 1   PALPITATIONSPERDAY   10800 non-null  int64
 2   CHOLESTEROL          10800 non-null  int64
 3   BMI                  10800 non-null  int64
 4   HEARTFAILURE         10800 non-null  object
 5   AGE                  10800 non-null  int64
 6   SEX                  10800 non-null  object
 7   FAMILYHISTORY        10800 non-null  object
 8   SMOKERLAST5YRS       10800 non-null  object
 9   EXERCISEMINPERWEEK   10800 non-null  int64
dtypes: int64(6), object(4)
memory usage: 843.9+ KB
```

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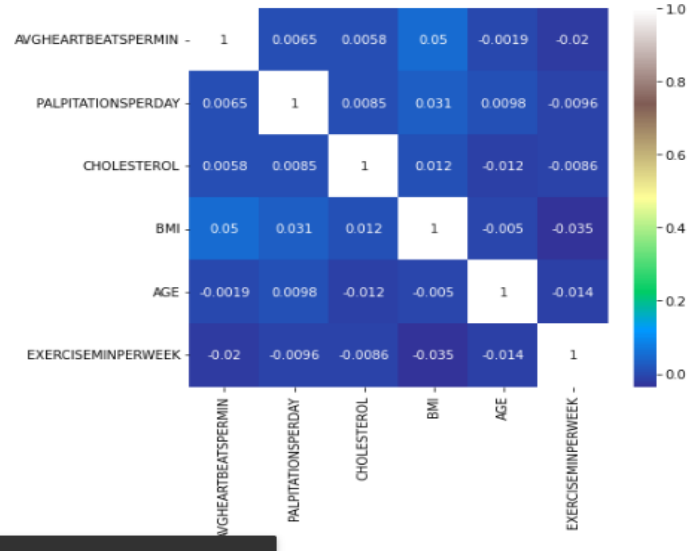
```
df.describe()
```

	AVGHEARTBEATSPERMIN	PALPITATIONSPERDAY	CHOLESTEROL	BMI	AGE	EXERCISEMINPERWEEK
count	10800.000000	10800.000000	10800.000000	10800.000000	10800.000000	10800.000000
mean	87.115093	20.423148	195.080278	26.359722	49.965185	119.729537
std	19.744375	12.165320	26.136732	3.820147	13.079281	71.147060
min	48.000000	0.000000	150.000000	20.000000	28.000000	0.000000
25%	72.000000	10.000000	173.000000	23.000000	39.000000	58.000000
50%	85.000000	20.000000	196.000000	26.000000	50.000000	119.000000
75%	100.000000	31.000000	217.000000	30.000000	61.000000	180.000000
max	161.000000	45.000000	245.000000	34.000000	72.000000	250.000000

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f78fd74c650>
```



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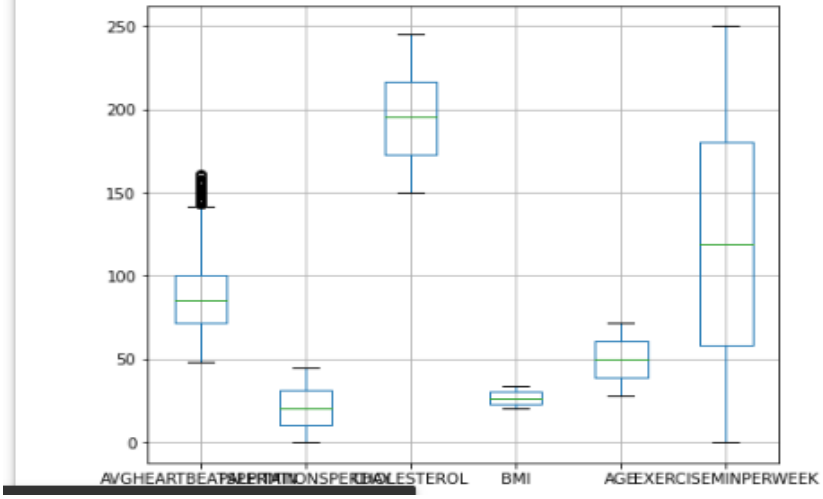
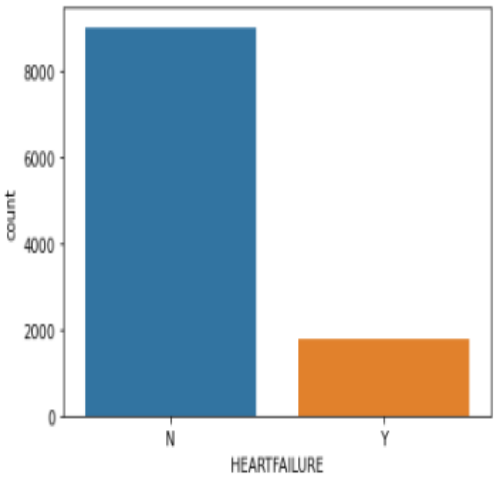
```
df.boxplot(figsize=(7,6))
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f78fa88f0d0>
```




```
sns.countplot(df['HEARTFAILURE'])
plt.show()
```

```
/usr/local/lib/python3.7/dist-packages/seaborn/_decorators.py:43: FutureWarning: Pass the following variable as a
  FutureWarning
```




```
[ ]  df.HEARTFAILURE.value_counts()
```

```
N    9012
Y    1788
Name: HEARTFAILURE, dtype: int64
```

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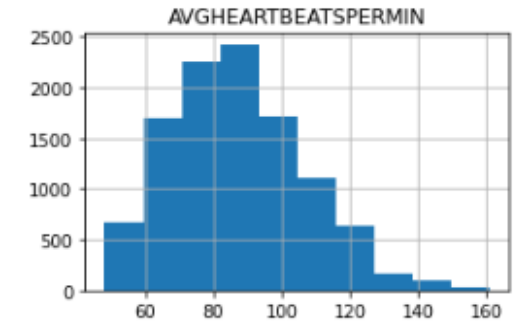
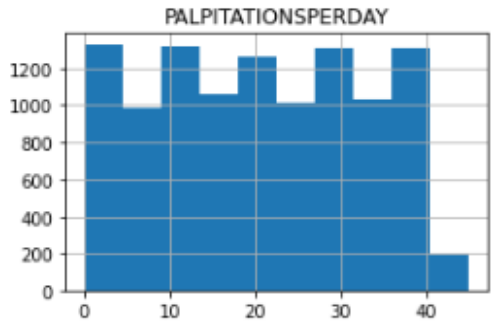
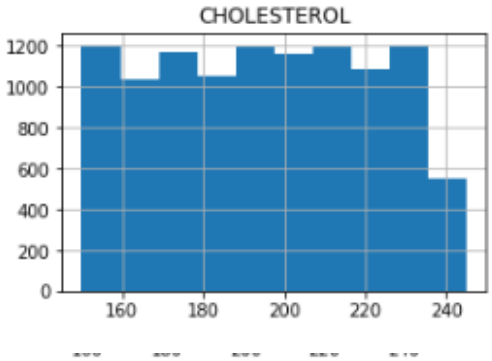
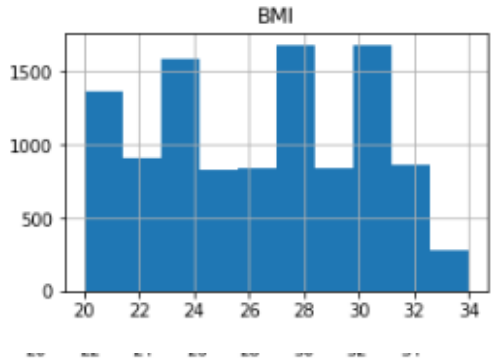
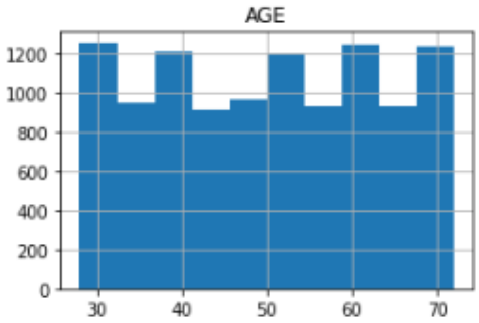
[ ]











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MODEL TRAINING

```
[ ] X=df.drop('HEARTFAILURE',axis=1)
```

```
[ ] Y=df['HEARTFAILURE']
```

```
[ ] from sklearn.model_selection import train_test_split
    X_train,X_test,Y_train,Y_test=train_test_split(X,Y,test_size=0.2,random_state=101,shuffle=True)
    X_train
```

	AVGHEARTBEATSPERMIN	PALPITATIONSPERDAY	CHOLESTEROL	BMI	AGE	SEX	FAMILYHISTORY	SMOKERLAST5YRS	EXERCISEMINPERWEEK
8458	106	2	173	28	35	M	Y	N	41
9486	61	40	229	32	32	F	Y	N	123
6967	101	40	230	31	67	F	N	N	86
5141	90	35	219	31	37	M	N	N	17
5386	112	6	214	20	37	F	N	N	5
...	...	...	...	...	...	...	...	...	...

```
X_test
```

	AVGHEARTBEATSPERMIN	PALPITATIONSPERDAY	CHOLESTEROL	BMI	AGE	SEX	FAMILYHISTORY	SMOKERLAST5YRS	EXERCISEMINPERWEEK
1550	102	2	221	22	66	F	N	N	112
4782	106	25	187	24	61	F	N	N	78
6343	71	23	190	26	54	F	N	N	233
4964	84	15	166	22	39	M	N	N	200
9445	84	11	180	29	38	F	N	N	117
...	...	...	...	...	...	...	...	...	...
8655	76	27	238	21	35	M	N	N	236
9388	92	36	177	24	36	M	N	N	210
1722	66	35	208	23	47	M	N	N	228
7296	58	45	170	33	39	F	Y	N	147
4478	74	0	189	24	49	F	N	N	62

2160 rows × 9 columns

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```
[ ]  Y_train
```

```
8458    N
9486    N
6967    N
5141    N
5386    N
       ..
599     N
5695    N
8006    N
1361    N
1547    N
Name: HEARTFAILURE, Length: 8640, dtype: object
```

```
Y_test
```

```
1550    N
4782    N
6343    N
4964    N
9445    N
       ..
8655    N
9388    N
1722    N
7296    Y
4478    N
Name: HEARTFAILURE, Length: 2160, dtype: object
```

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```
[ ] from sklearn.ensemble import RandomForestClassifier
    model = RandomForestClassifier()
    classify(model, X, y)

    Accuracy: 77.6239907727797
    CV Score: 74.29839772779255
```

7. CONCLUSION AND FUTURE SCOPE

In this project, we have learned various concepts like Watson cloud services, Node_RED,Auto AI and various machine learning algorithms and applied on above project and developed application on web to get the predicted result.
We could be found where we could integrate heart-disease-trained ML and DL models with certain multimedia for the ease of patients and doctors.
If a large dataset is present, the results can increase very much in deep learning and ML as well.

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