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IV Semester Assignment

Report on

Health Care

Submitted in Partial fulfilment of the requirement

for the IV Semester MCA Academic requirements for the course

18MCA442

MASTER OF COMPUTER APPLICATIONS

By

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1RD19MCA24	Thejashree.R

Department of Master of Computer ApplicationsRV College of Engineering®,
Mysuru Road

RV Vidyanikethan Post, Bengaluru –

560059June -2021

Domain: Healthcare

Topic: Heart Disease Prediction

Problem Statement

Heart Disease Prediction uses soft computing techniques to categorize whether a person has heart disease or not .The main problem of this project is to identify different parameters building soft computing model neural network in this case and training the model in such a way that accuracy is maximum .Building a final model and giving the relevant inputs as a parameters and getting the output whether a person is likely to have heart disease or not.

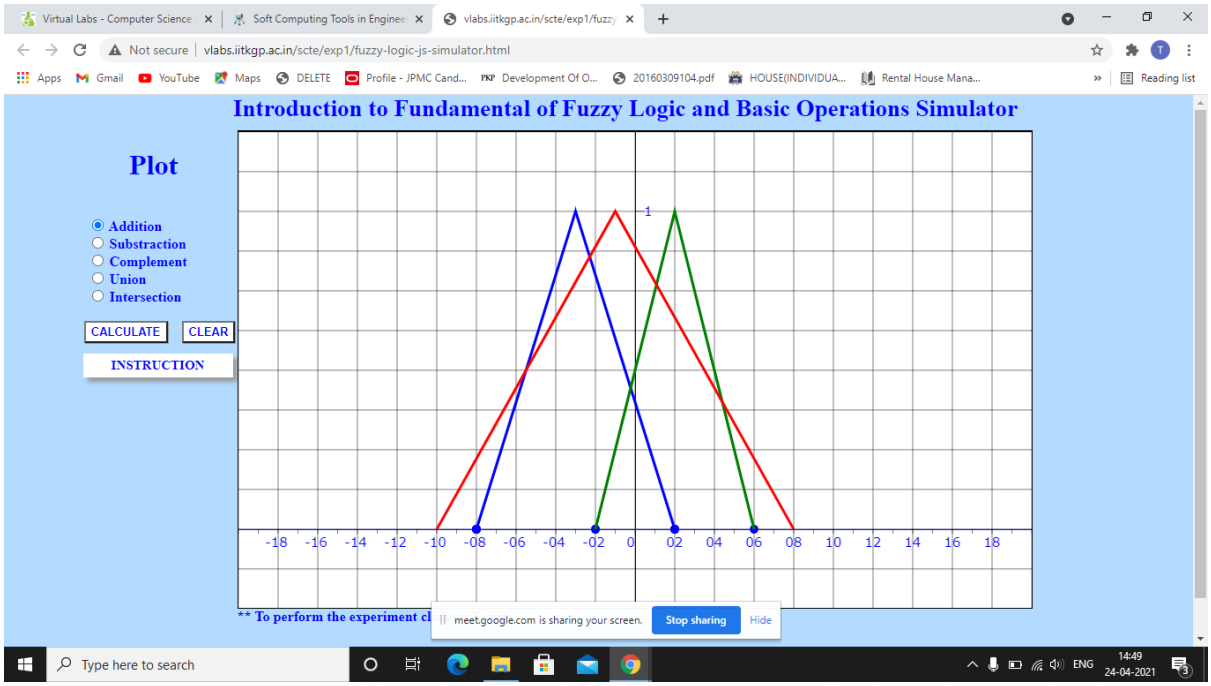
Explanations and screen shots of the virtual lab program execution

Virtual labs are simulated learning environments that allow students to complete laboratory experiments online and explore concepts and theories without stepping into a physical science lab. ... Virtual lab software creates opportunities for alternative access to science education.

Fuzzy logic was developed by Lotfi A. Zadeh in the 1960s in order to provide mathematical rules and functions which permitted natural language queries. Fuzzy logic provides a means of calculating intermediate values between absolute true and absolute false with resulting values ranging between 0.0 and 1.0. With fuzzy logic

Fuzzy Set Operations:

- Fuzzy Addition
- Fuzzy Subtraction
- Fuzzy Complement
- Fuzzy Intersection
- Fuzzy Union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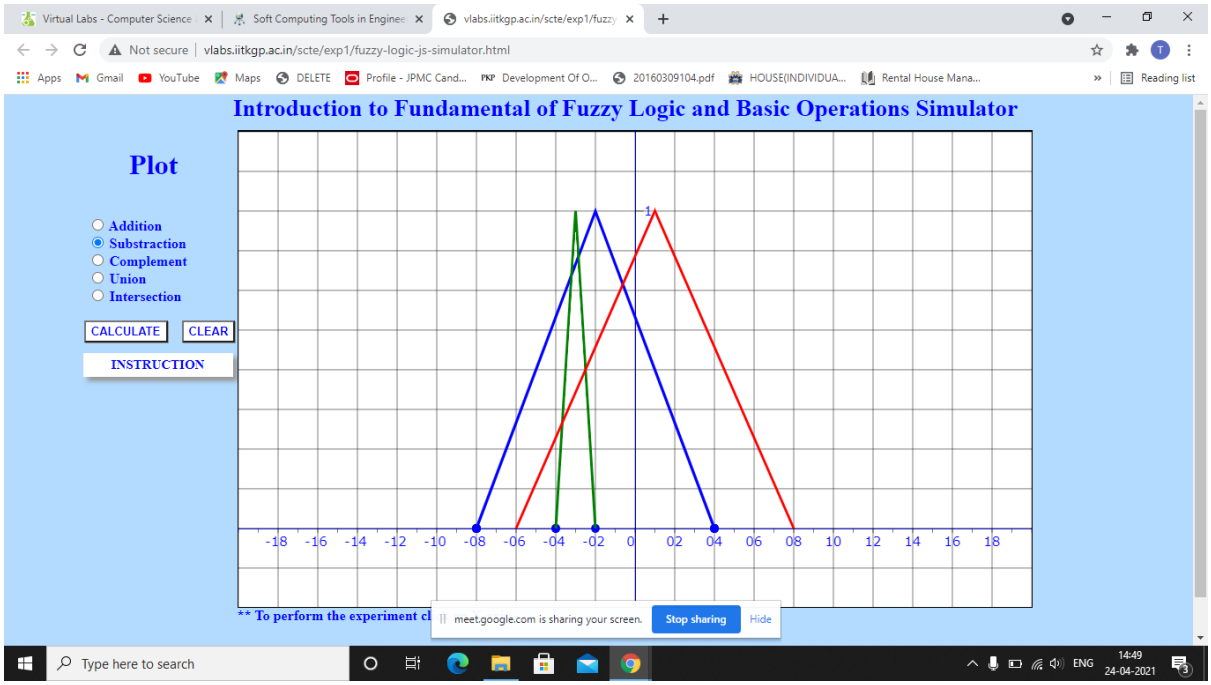
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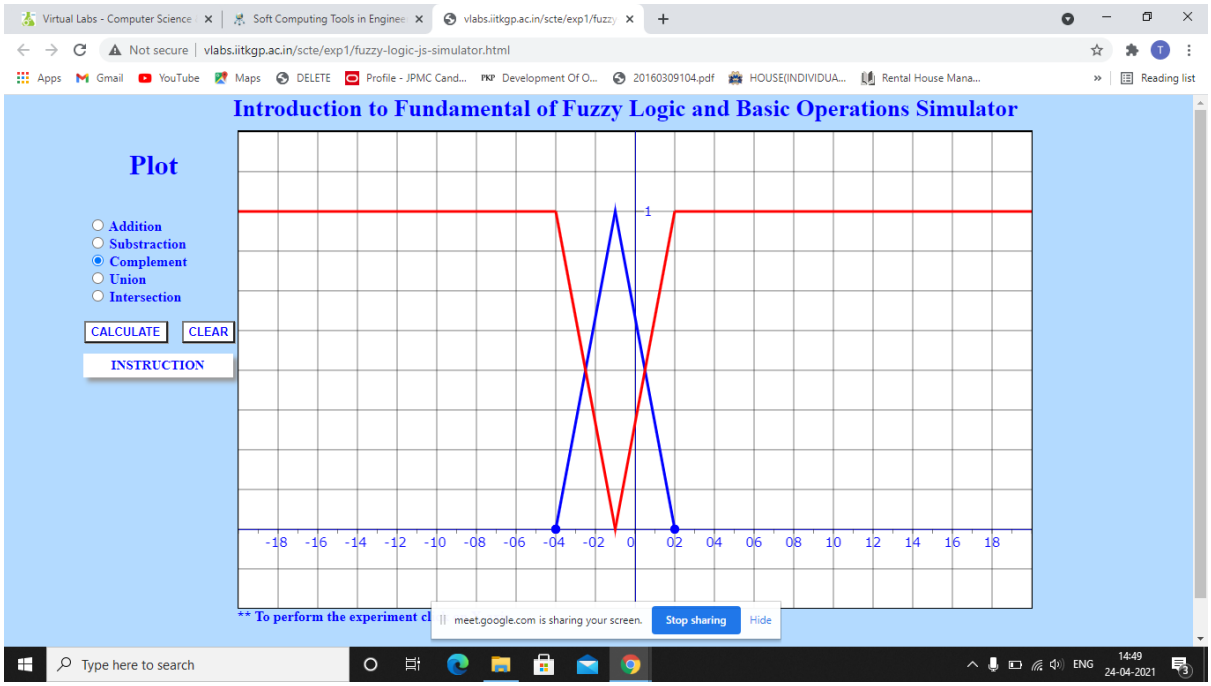
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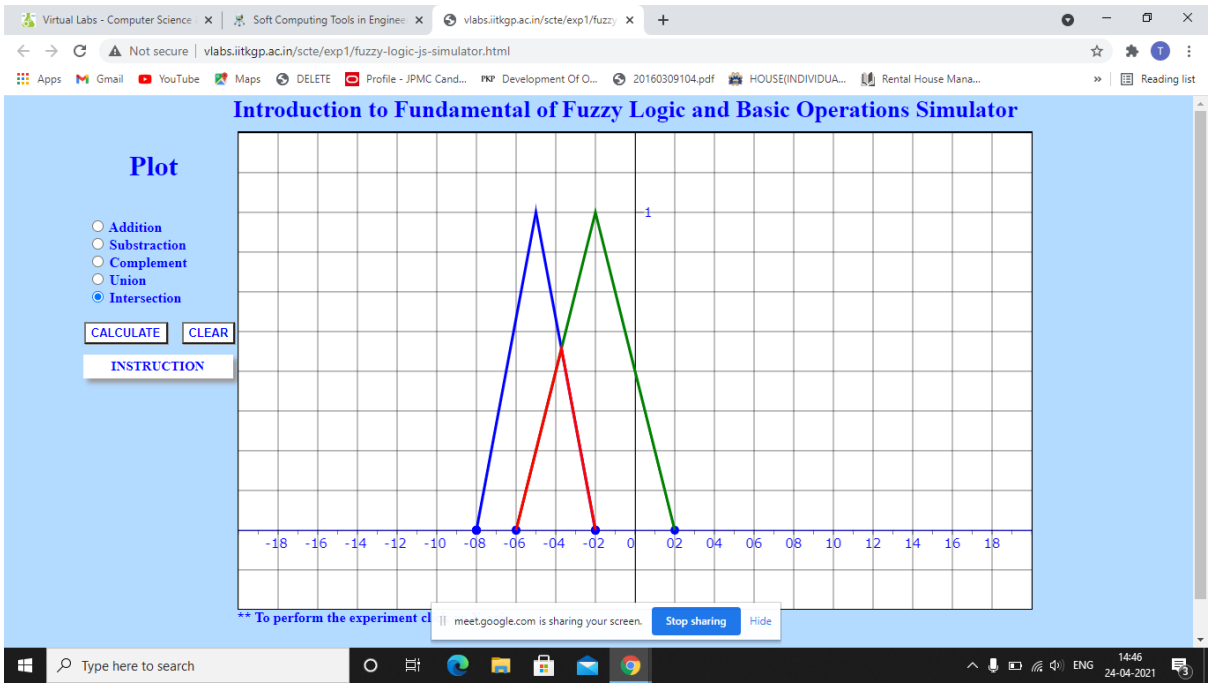
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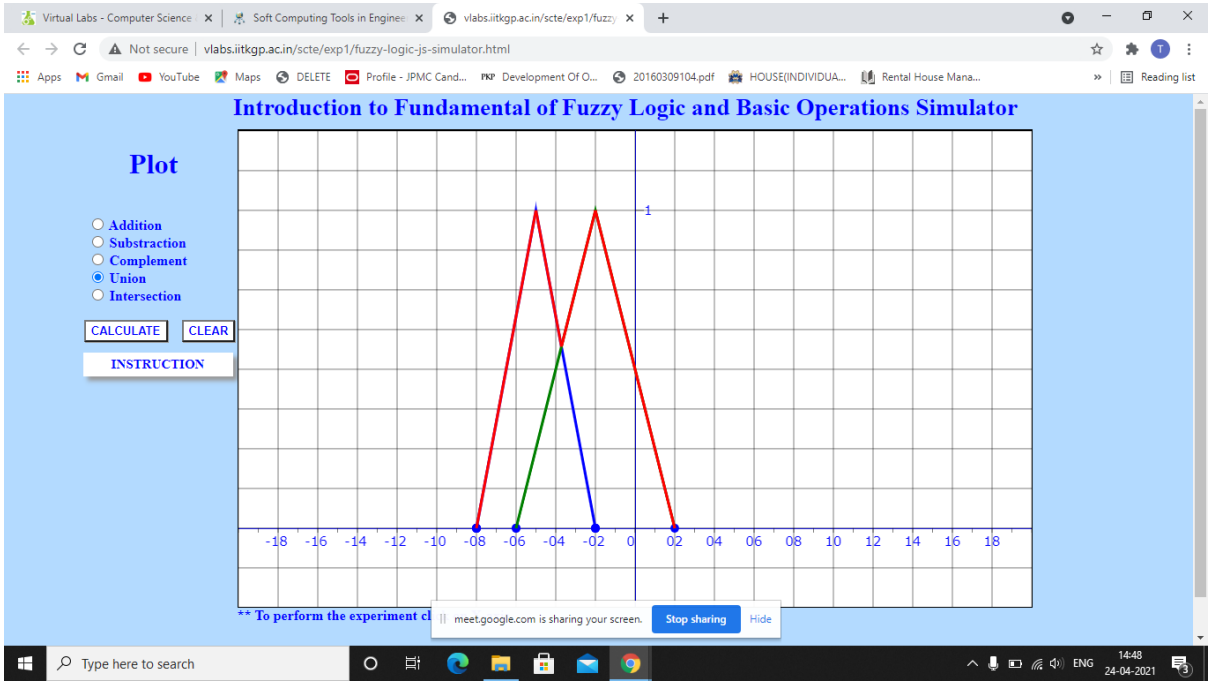
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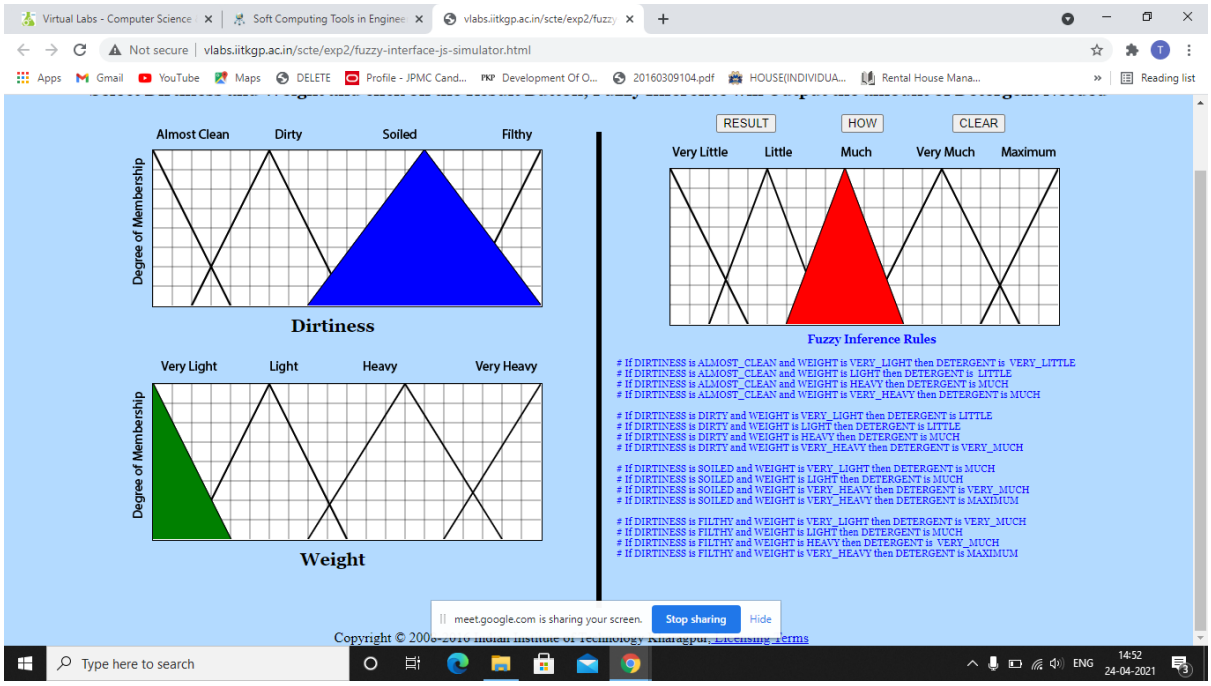
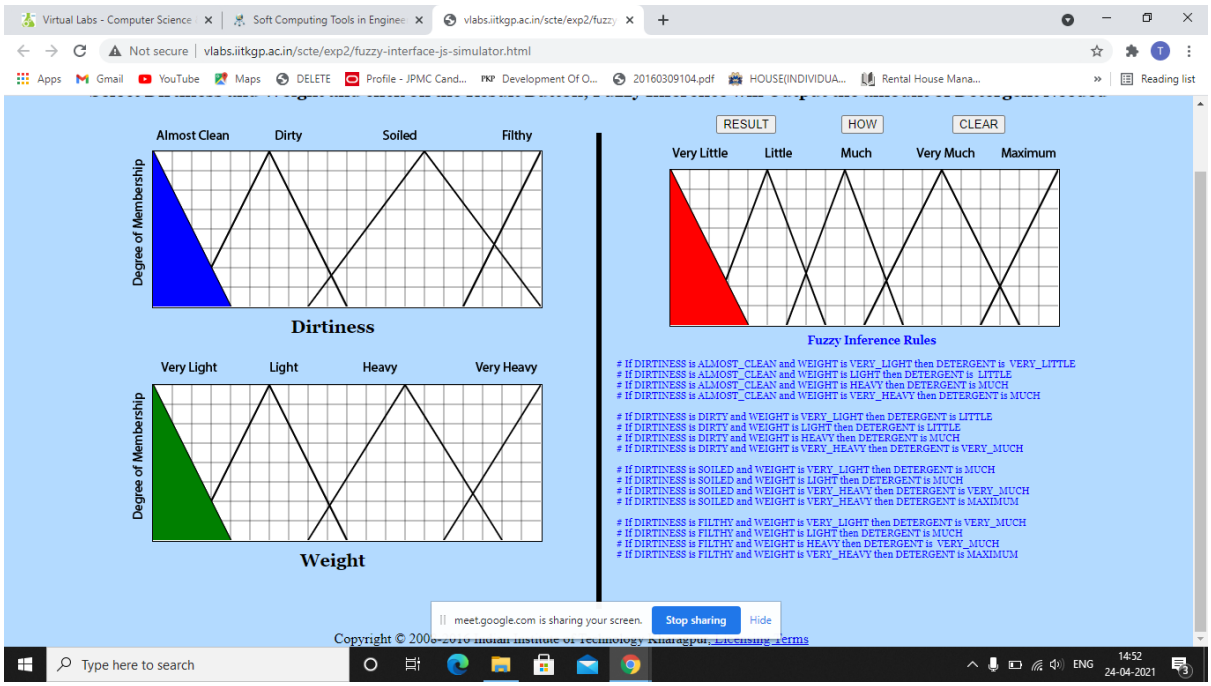
Fuzzy inference is the process of formulating the mapping from a given input to an output using fuzzy logic. The mapping then provides a basis from which decisions can be made, or patterns discerned.

The process of fuzzy inference involves:

- Membership Functions
- Logical Operations
- If-Then Rules.

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Heavy
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Degree of Membership
Weight
RESULT
HOW
CLEAR
Very Little
Little
Much
Very Much
Maximum
Fuzzy Inference Rules
If DIRTINESS is ALMOST_CLEAN and WEIGHT is VERY_LIGHT then DETERGENT is VERY_LITTLE
If DIRTINESS is ALMOST_CLEAN and WEIGHT is LIGHT then DETERGENT is LITTLE
If DIRTINESS is ALMOST_CLEAN and WEIGHT is HEAVY then DETERGENT is MUCH
If DIRTINESS is ALMOST_CLEAN and WEIGHT is VERY_HEAVY then DETERGENT is MUCH
If DIRTINESS is DIRTY and WEIGHT is VERY_LIGHT then DETERGENT is LITTLE
If DIRTINESS is DIRTY and WEIGHT is LIGHT then DETERGENT is LITTLE
If DIRTINESS is DIRTY and WEIGHT is HEAVY then DETERGENT is MUCH
If DIRTINESS is DIRTY and WEIGHT is VERY_HEAVY then DETERGENT is VERY_MUCH
If DIRTINESS is SOILED and WEIGHT is VERY_LIGHT then DETERGENT is MUCH
If DIRTINESS is SOILED and WEIGHT is LIGHT then DETERGENT is MUCH
If DIRTINESS is SOILED and WEIGHT is VERY_HEAVY then DETERGENT is VERY_MUCH
If DIRTINESS is SOILED and WEIGHT is VERY_HEAVY then DETERGENT is MAXIMUM
If DIRTINESS is FILTHY and WEIGHT is VERY_LIGHT then DETERGENT is VERY_MUCH
If DIRTINESS is FILTHY and WEIGHT is LIGHT then DETERGENT is MUCH
If DIRTINESS is FILTHY and WEIGHT is HEAVY then DETERGENT is VERY_MUCH
If DIRTINESS is FILTHY and WEIGHT is VERY_HEAVY then DETERGENT is MAXIMUM
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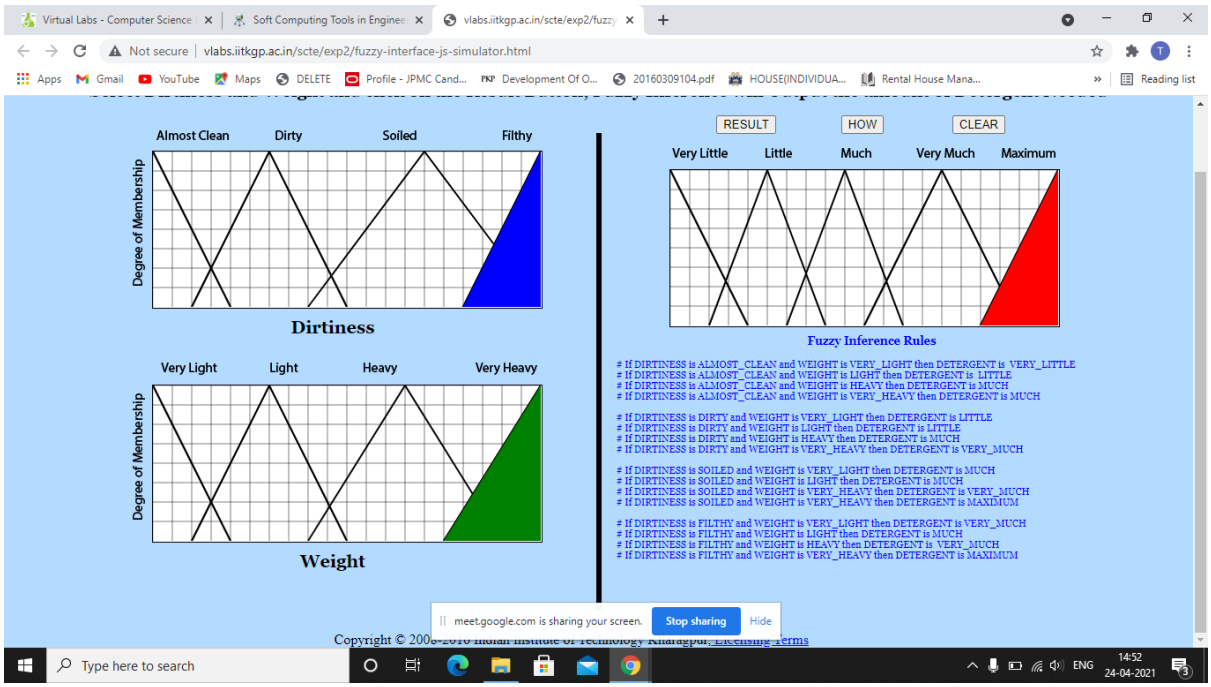
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Fuzzy Inference Rules
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If DIRTINESS is DIRTY and WEIGHT is VERY_LIGHT then DETERGENT is LITTLE
If DIRTINESS is DIRTY and WEIGHT is LIGHT then DETERGENT is LITTLE
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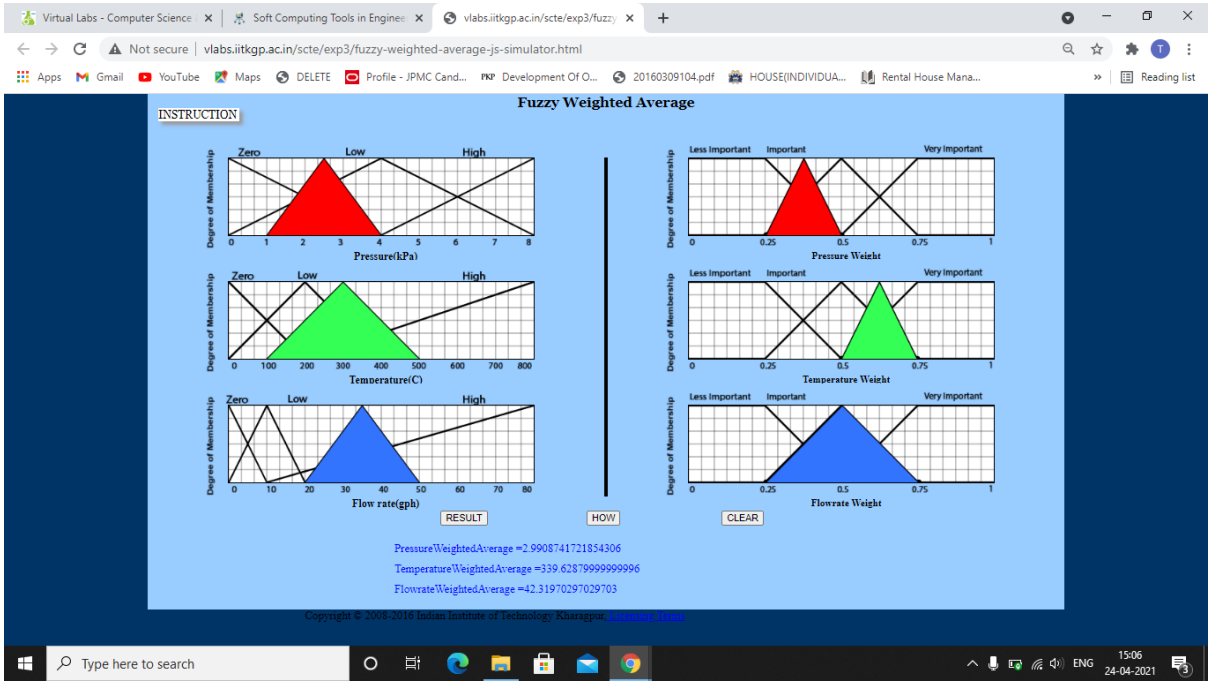
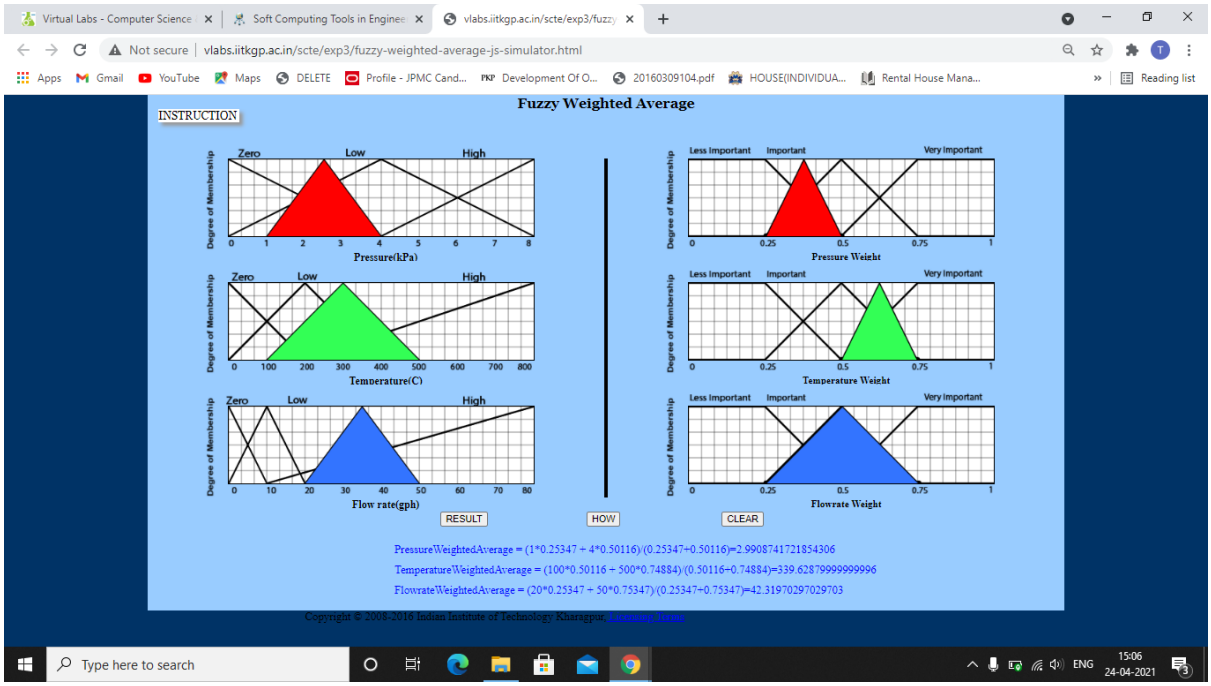
The fuzzy weighted average (FWA), which is a function of fuzzy numbers and is useful as an aggregation method in engineering or management science based on fuzzy sets theory. It provides a discrete approximate solution by α-cuts level representation of fuzzy sets and interval analysis.





Questions

1. Explain about the different fundamentals of soft computing approaches and platforms used in the identified domain? Justify the same?

Soft Computing is an emerging approach to computer like a human mind and to reason and learn in an environment of uncertainty and imprecision. It is the fusion of methodologies designed to model and enable solutions to real world problems.

The Fundamentals of soft computing are:

- Neural Networks
- Fuzzy Logic
- Genetic Algorithms

Neural Network:- Neural network is a interconnected network of large number of processing elements called neurons in an architecture inspired by the brain. It mimic the activities of the brain.

The main characteristics are:

- Mapping Capabilities/Pattern Association.
- Generalization
- Robustness
- Fault Tolerance
- Parallel and high speed information processing

Fuzzy Logic:- Fuzzy Logic set was proposed in 1965 by A.Zadeh.In classical set theory an element either belong to or does not belong to a set and hence such set are termed as crisp set. But in fuzzy set, many degrees of membership (between 0/1) are allowed.

Genetic Algorithm:- Genetic Algorithm is an algorithm which mimic some of the process of natural evolution. These are the stochastic search methods based on the principles of natural genetic system. They perform a search in providing an optimal solution for evaluation function of an optimization problem.

Approach Used

The approach which is used in heart disease prediction is neural network. The neural network model is built to solve the problem of predicting whether a person is likely to have heart disease or not.

This model is built with the following process.

- Data Collection:-This project model is trained with the data set which I form which foundation.
- Feature Extraction:-The data set has several features extracting relevant features required for project and naming them.
- Training Neural Network Model:- using data sets with extracted features neural network model is trained.
- Result:- The neural network model predicts whether a person is likely to have heart diseases or not with relevant input.

2.Discuss the methodology adopted to solve the problem In the domain selected.

The methodology adopted to solve the problem in heart disease prediction are:

- Data Collection:-Data set is the key element in building any models in soft computing. So the data set used in this project is Cleveland clinic Foundation heart disease set.
- Data Preprocessing:- After identifying required dataset the next step is data processing .It involves:
    i. Missing values identification and removing them.
    ii. Feature Extraction
    iii. Splitting training and testing data.
- Building Neural Network Model:-This project uses koras package to build Neural Network Model.It has several dense layers input and output parameters and one hidden layer.
- Training and Testing Data:-After building Neural Network Model the next step is to fit the training data in it.
- Building Classification:-This step is for improving result. Binary classification is used to improve the result. Converting our categorical model which has result of [1,2,3,4] to binary model which has result of [0,1] heart disease or no hear disease.

3.Discuss and analyze the results obtained for the problem selected?

The output/Result of the heart disease prediction is to determine whether the person is likely to have heart disease or not.

The project has two model i.e. categorical model and binary model. Binary model is built so that the accuracy of the model is maximum. Although categorical model results are promising there are large errors. This could be because it is difficult to distinguish the different to distinguish the different security levels of heart disease(1-4).So binary classification model is built which classifies(0-1) heart disease or no heart disease. By data exploration we can know that chest pain type, exercise induced angine,gt depression,slope,thalassemia are directly co-related with heart disease. This results can prove that heart diseases infect the old person and young person but probability of the old person is higher than the young person.

And we see that most people with heart disease have asymptomatic chest pain and usually the people who do not have heart disease have normal electrocardiographic, whereas the people who have heart disease have preferable left ventricular hypertrophy. People who have higher heart rate greater than 150 are more likely to have heart disease.

4. Evaluate the solution obtained

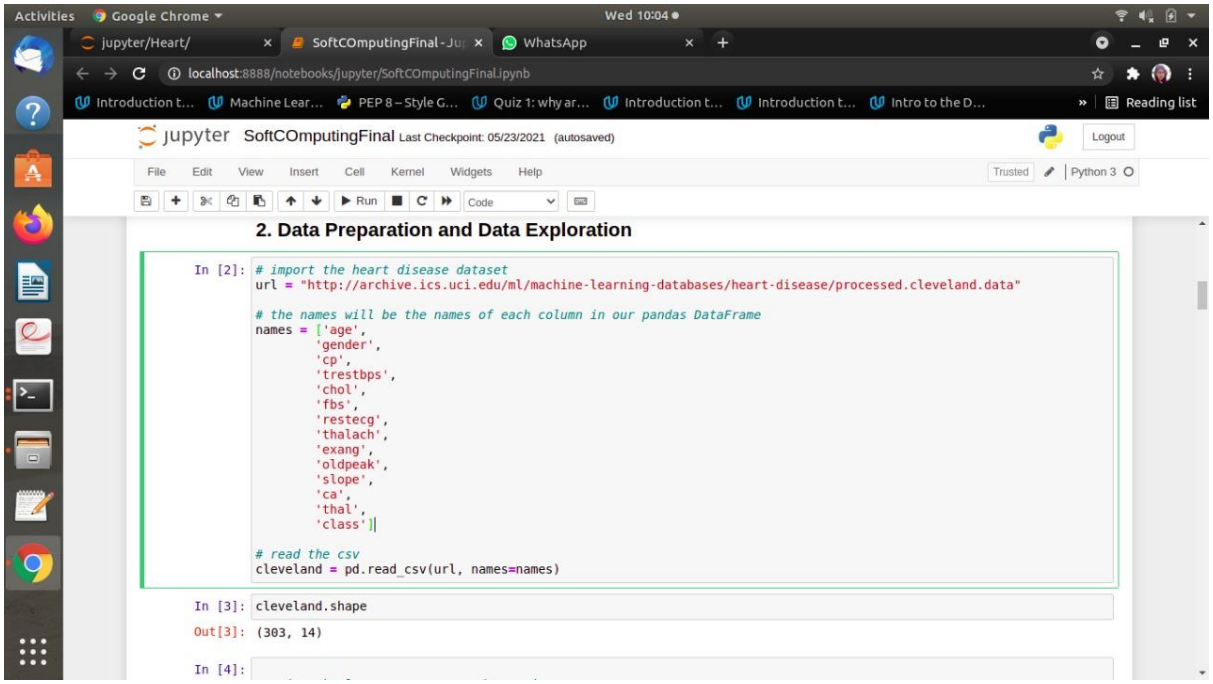
The model is evaluated with accuracy results. Performance metrics is calculated using sklearn model

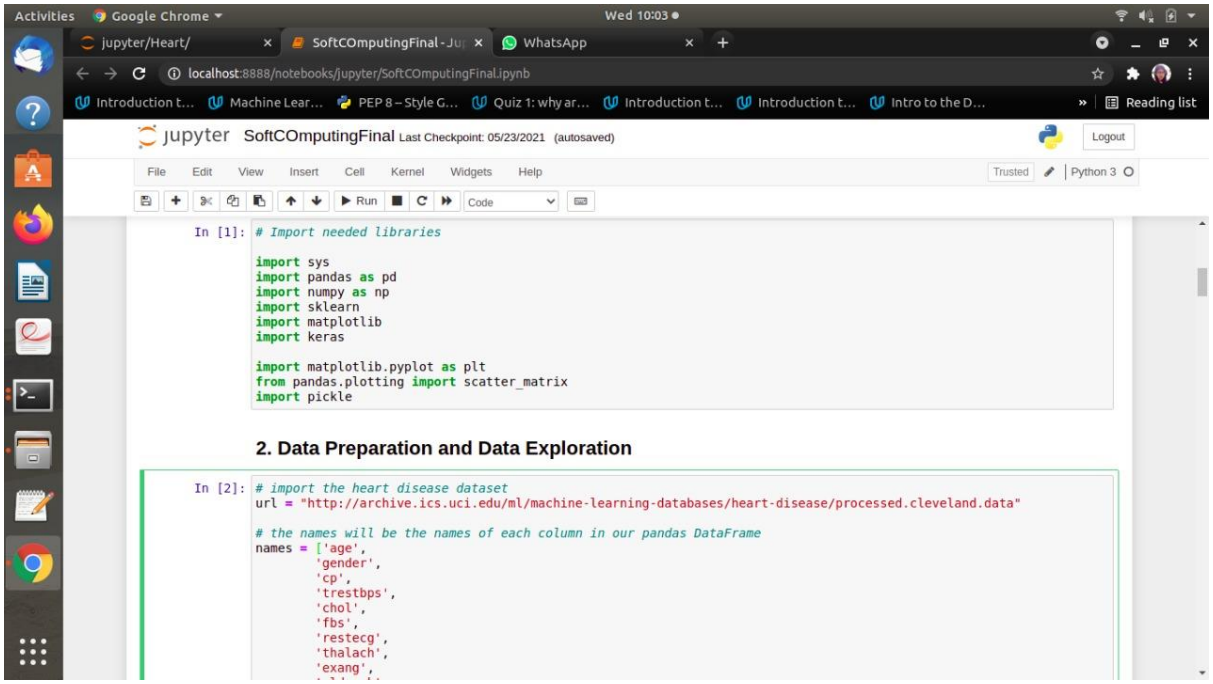
Accuracy score of the project is 0.83 for binary Neural Network model

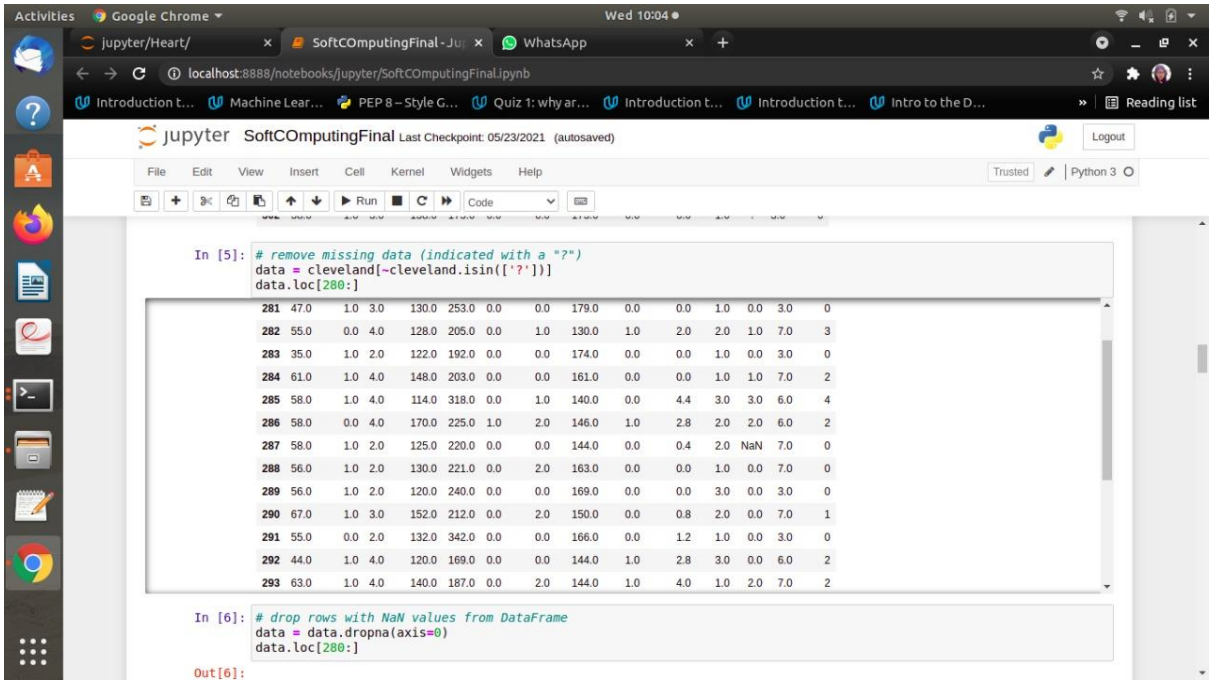
Results for Binary Model
0.8333333333333334

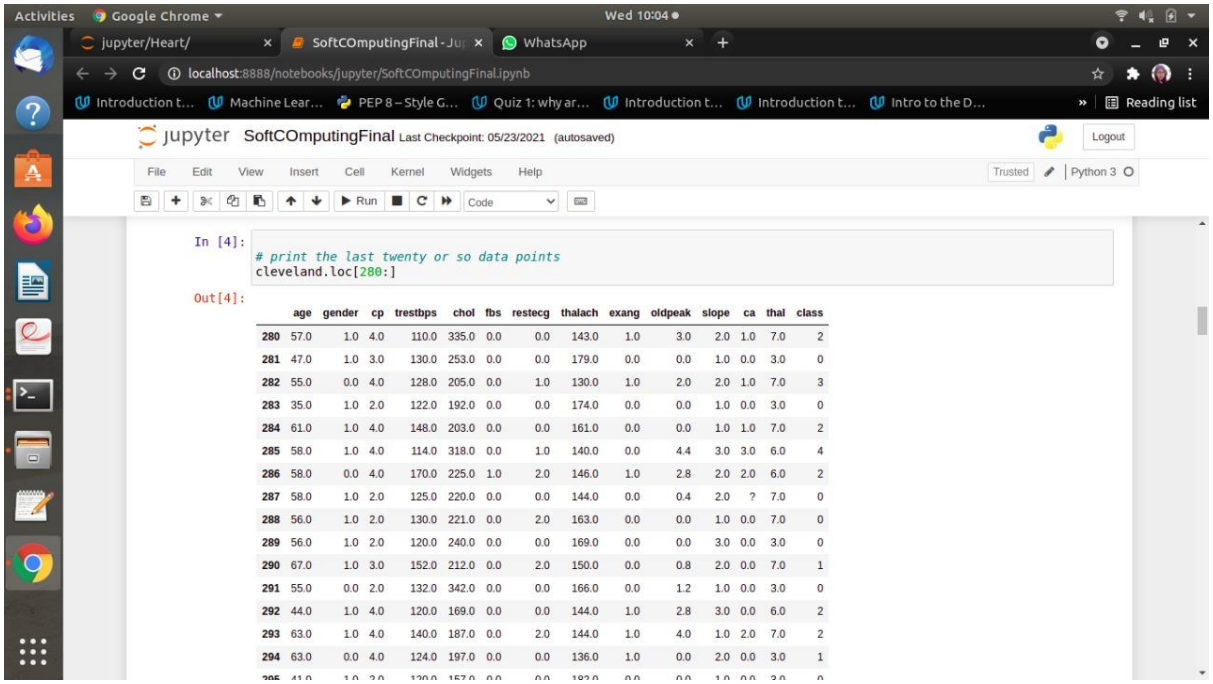
	precision	recall	f1-score	support
0	0.83	0.92	0.88	38
1	0.83	0.68	0.75	22
accuracy			0.83	60
macro avg	0.83	0.80	0.81	60
weighted avg	0.83	0.83	0.83	60

Coding and Screenshots









	age	gender	cp	trestbps	chol	fbs	restecg	thalach	exang	oldpeak	slope	ca	thal	class
280	57.0	1.0	4.0	110.0	335.0	0.0	0.0	143.0	1.0	3.0	2.0	1.0	7.0	2
281	47.0	1.0	3.0	130.0	253.0	0.0	0.0	179.0	0.0	0.0	1.0	0.0	3.0	0
282	55.0	0.0	4.0	128.0	205.0	0.0	1.0	130.0	1.0	2.0	2.0	1.0	7.0	3
283	35.0	1.0	2.0	122.0	192.0	0.0	0.0	174.0	0.0	0.0	1.0	0.0	3.0	0
284	61.0	1.0	4.0	148.0	203.0	0.0	0.0	161.0	0.0	0.0	1.0	1.0	7.0	2
285	58.0	1.0	4.0	114.0	318.0	0.0	1.0	140.0	0.0	4.4	3.0	3.0	6.0	4
286	58.0	0.0	4.0	170.0	225.0	1.0	2.0	146.0	1.0	2.8	2.0	2.0	6.0	2
287	58.0	1.0	2.0	125.0	220.0	0.0	0.0	144.0	0.0	0.4	2.0	?	7.0	0
288	56.0	1.0	2.0	130.0	221.0	0.0	2.0	163.0	0.0	0.0	1.0	0.0	7.0	0
289	56.0	1.0	2.0	120.0	240.0	0.0	0.0	169.0	0.0	0.0	3.0	0.0	3.0	0
290	67.0	1.0	3.0	152.0	212.0	0.0	2.0	150.0	0.0	0.8	2.0	0.0	7.0	1
291	55.0	0.0	2.0	132.0	342.0	0.0	0.0	166.0	0.0	1.2	1.0	0.0	3.0	0
292	44.0	1.0	4.0	120.0	169.0	0.0	0.0	144.0	1.0	2.8	3.0	0.0	6.0	2
293	63.0	1.0	4.0	140.0	187.0	0.0	2.0	144.0	1.0	4.0	1.0	2.0	7.0	2
294	63.0	0.0	4.0	124.0	197.0	0.0	0.0	136.0	1.0	0.0	2.0	0.0	3.0	1

Activities Google Chrome Wed 10:04

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Run Code

In [6]:
```
# drop rows with NaN values from DataFrame
data = data.dropna(axis=0)
data.loc[280:]
```

Out[6]:

	age	gender	cp	trestbps	chol	fbs	restecg	thalach	exang	oldpeak	slope	ca	thal	class
280	57.0	1.0	4.0	110.0	335.0	0.0	0.0	143.0	1.0	3.0	2.0	1.0	7.0	2
281	47.0	1.0	3.0	130.0	253.0	0.0	0.0	179.0	0.0	0.0	1.0	0.0	3.0	0
282	55.0	0.0	4.0	128.0	205.0	0.0	1.0	130.0	1.0	2.0	2.0	1.0	7.0	3
283	35.0	1.0	2.0	122.0	192.0	0.0	0.0	174.0	0.0	0.0	1.0	0.0	3.0	0
284	61.0	1.0	4.0	148.0	203.0	0.0	0.0	161.0	0.0	0.0	1.0	1.0	7.0	2
285	58.0	1.0	4.0	114.0	318.0	0.0	1.0	140.0	0.0	4.4	3.0	3.0	6.0	4
286	58.0	0.0	4.0	170.0	225.0	1.0	2.0	146.0	1.0	2.8	2.0	2.0	6.0	2
288	56.0	1.0	2.0	130.0	221.0	0.0	2.0	163.0	0.0	0.0	1.0	0.0	7.0	0
289	56.0	1.0	2.0	120.0	240.0	0.0	0.0	169.0	0.0	0.0	3.0	0.0	3.0	0
290	67.0	1.0	3.0	152.0	212.0	0.0	2.0	150.0	0.0	0.8	2.0	0.0	7.0	1
291	55.0	0.0	2.0	132.0	342.0	0.0	0.0	166.0	0.0	1.2	1.0	0.0	3.0	0
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294	63.0	0.0	4.0	124.0	197.0	0.0	0.0	136.0	1.0	0.0	2.0	0.0	3.0	1
295	41.0	1.0	2.0	120.0	157.0	0.0	0.0	182.0	0.0	0.0	1.0	0.0	3.0	0
296	59.0	1.0	4.0	164.0	176.0	1.0	2.0	90.0	0.0	1.0	2.0	2.0	6.0	3

Activities Google Chrome Wed 10:04

jupyter/Heart/ | SoftCOmputingFinal - Jup | WhatsApp

localhost:8888/notebooks/jupyter/SoftCOmputingFinal.ipynb

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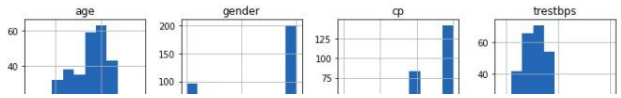
Run Code

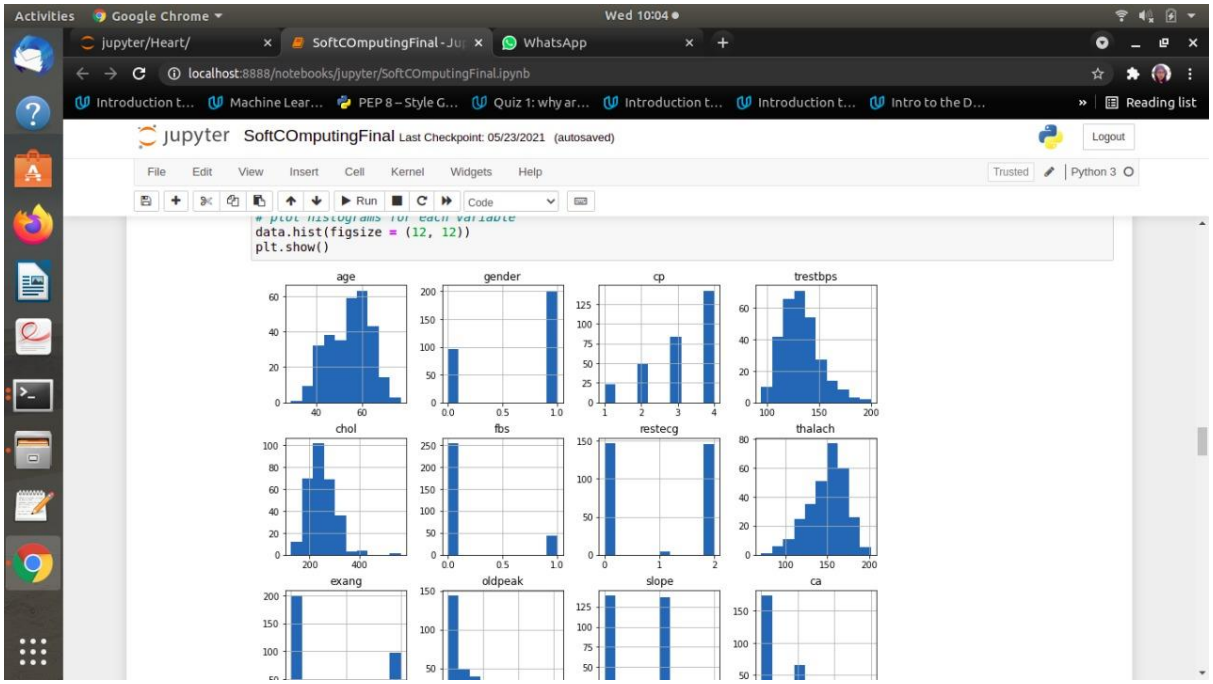
In [8]:
```
# print data characteristics, usings pandas built-in describe() function
data.describe()
```

Out[8]:

	age	gender	cp	trestbps	chol	fbs	restecg	thalach	exang	oldpeak	slope	ca	
count	297.000000	297.000000	297.000000	297.000000	297.000000	297.000000	297.000000	297.000000	297.000000	297.000000	297.000000	297.000000	297
mean	54.542088	0.676768	3.158249	131.693603	247.350168	0.144781	0.996633	149.599327	0.326599	1.055556	1.602694	0.676768	4
std	9.049736	0.468500	0.964859	17.762806	51.997583	0.352474	0.994914	22.941562	0.469761	1.166123	0.618187	0.938965	1
min	29.000000	0.000000	1.000000	94.000000	126.000000	0.000000	0.000000	71.000000	0.000000	0.000000	1.000000	0.000000	3
25%	48.000000	0.000000	3.000000	120.000000	211.000000	0.000000	0.000000	133.000000	0.000000	0.000000	1.000000	0.000000	3
50%	56.000000	1.000000	3.000000	130.000000	243.000000	0.000000	1.000000	153.000000	0.000000	0.800000	2.000000	0.000000	3
75%	61.000000	1.000000	4.000000	140.000000	276.000000	0.000000	2.000000	166.000000	1.000000	1.600000	2.000000	1.000000	7
max	77.000000	1.000000	4.000000	200.000000	564.000000	1.000000	2.000000	202.000000	1.000000	6.200000	3.000000	3.000000	7

In [9]:
```
# plot histograms for each variable
data.hist(figsize = (12, 12))
plt.show()
```

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Code
data.hist(figsize = (12, 12))
plt.show()
age
gender
cp
trestbps
chol
fbs
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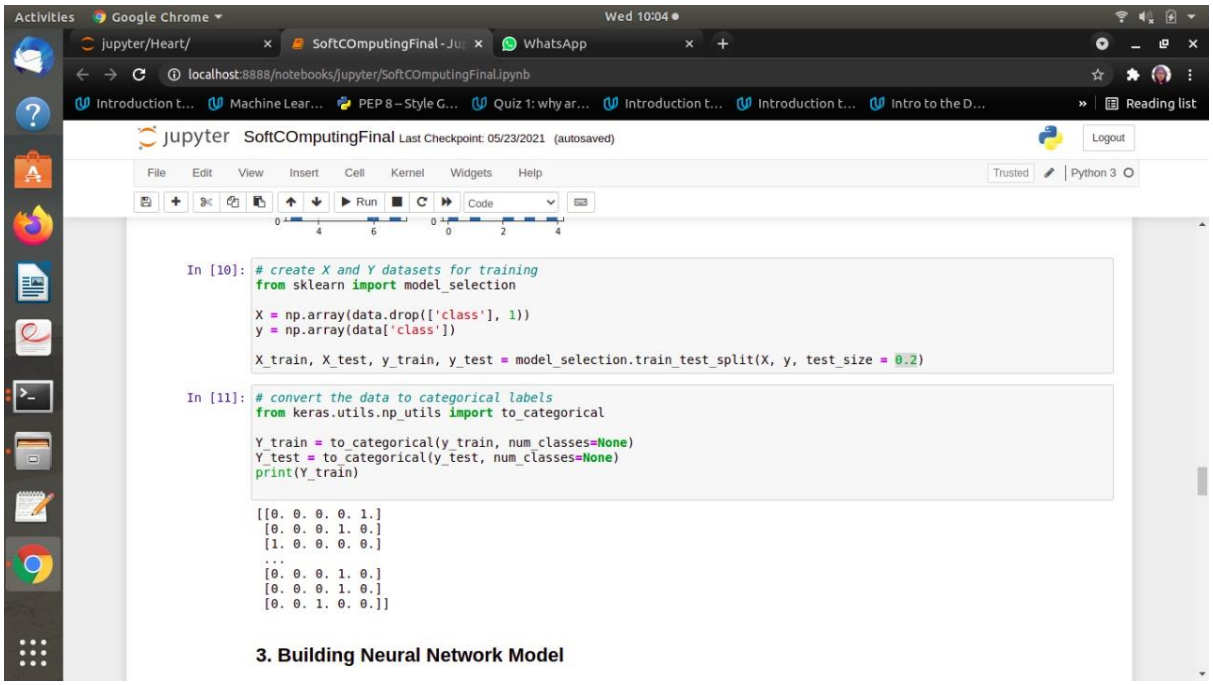
thalach
exang
oldpeak
slope
ca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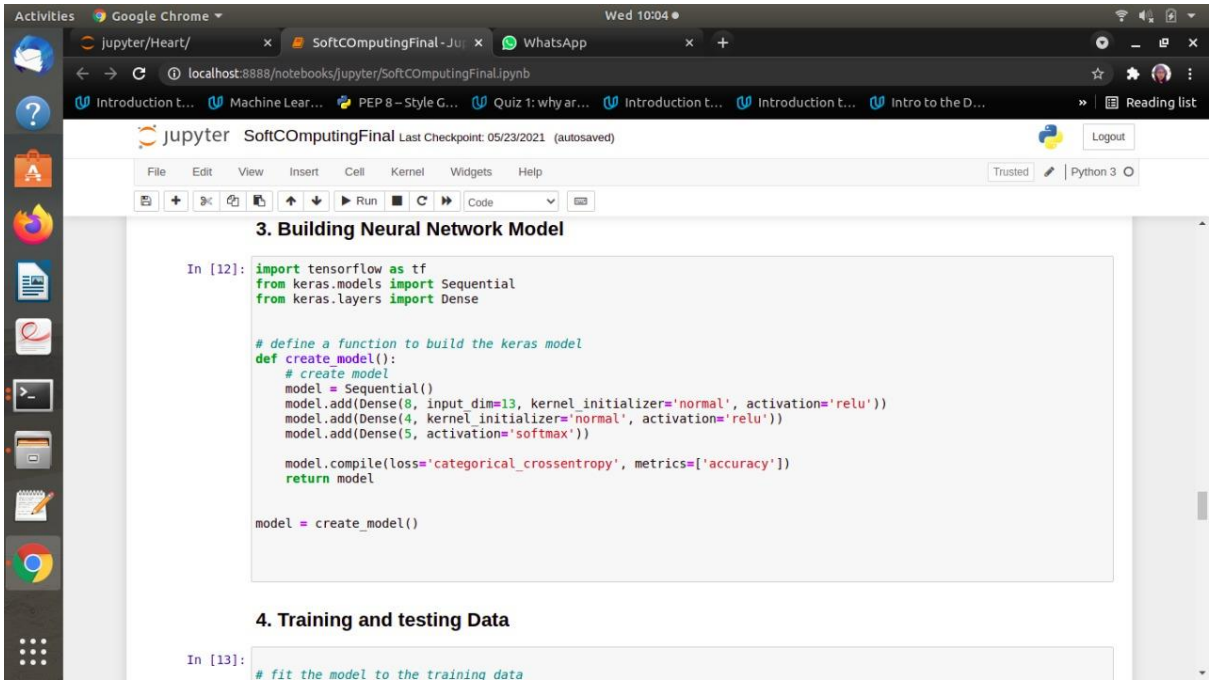
In [10]:
# create X and Y datasets for training
from sklearn import model_selection
X = np.array(data.drop(['class'], 1))
y = np.array(data['class'])
X_train, X_test, y_train, y_test = model_selection.train_test_split(X, y, test_size = 0.2)
In [11]:
# convert the data to categorical labels
from keras.utils.np_utils import to_categorical
Y_train = to_categorical(y_train, num_classes=None)
Y_test = to_categorical(y_test, num_classes=None)
print(Y_train)
[[0. 0. 0. 0. 1.]
[0. 0. 0. 1. 0.]
[1. 0. 0. 0. 0.]
...
[0. 0. 0. 1. 0.]
[0. 0. 0. 1. 0.]
[0. 0. 1. 0. 0.]]
3. Building Neural Network Model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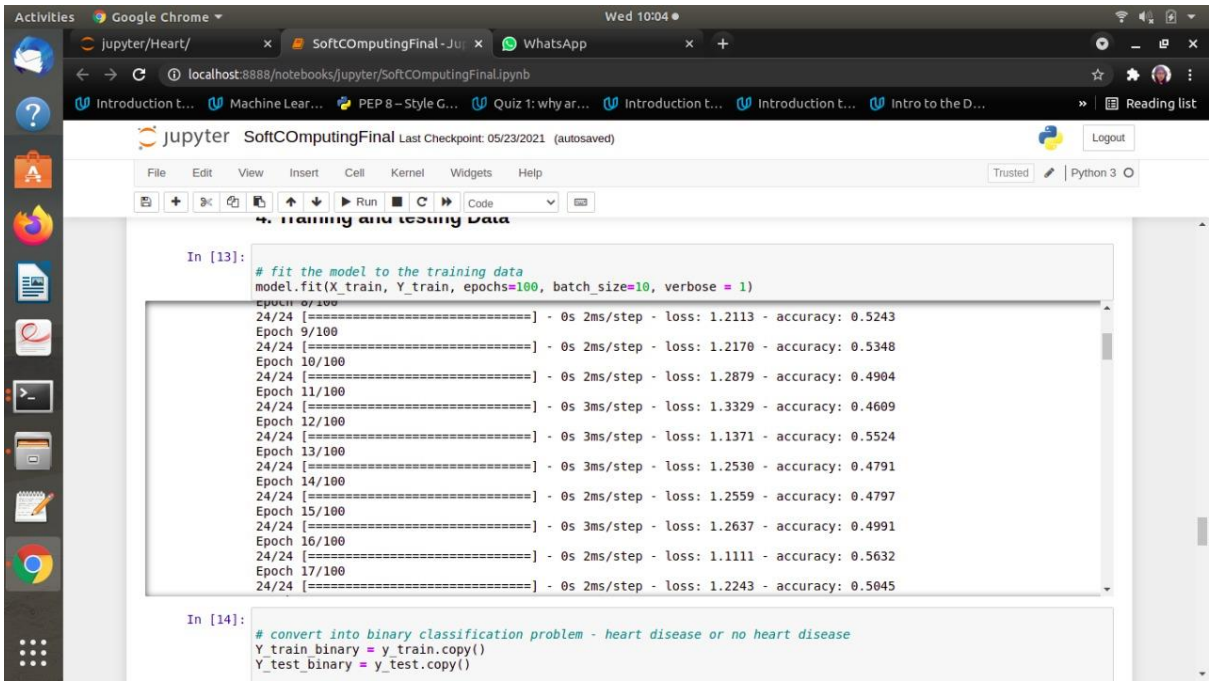
3. Building Neural Network Model
In [12]:
import tensorflow as tf
from keras.models import Sequential
from keras.layers import Dense
# define a function to build the keras model
def create_model():
# create model
model = Sequential()
model.add(Dense(8, input_dim=13, kernel_initializer='normal', activation='relu'))
model.add(Dense(4, kernel_initializer='normal', activation='relu'))
model.add(Dense(5, activation='softmax'))
model.compile(loss='categorical_crossentropy', metrics=['accuracy'])
return model
model = create_model()
4. Training and testing Data
In [13]:
fit the model to the training data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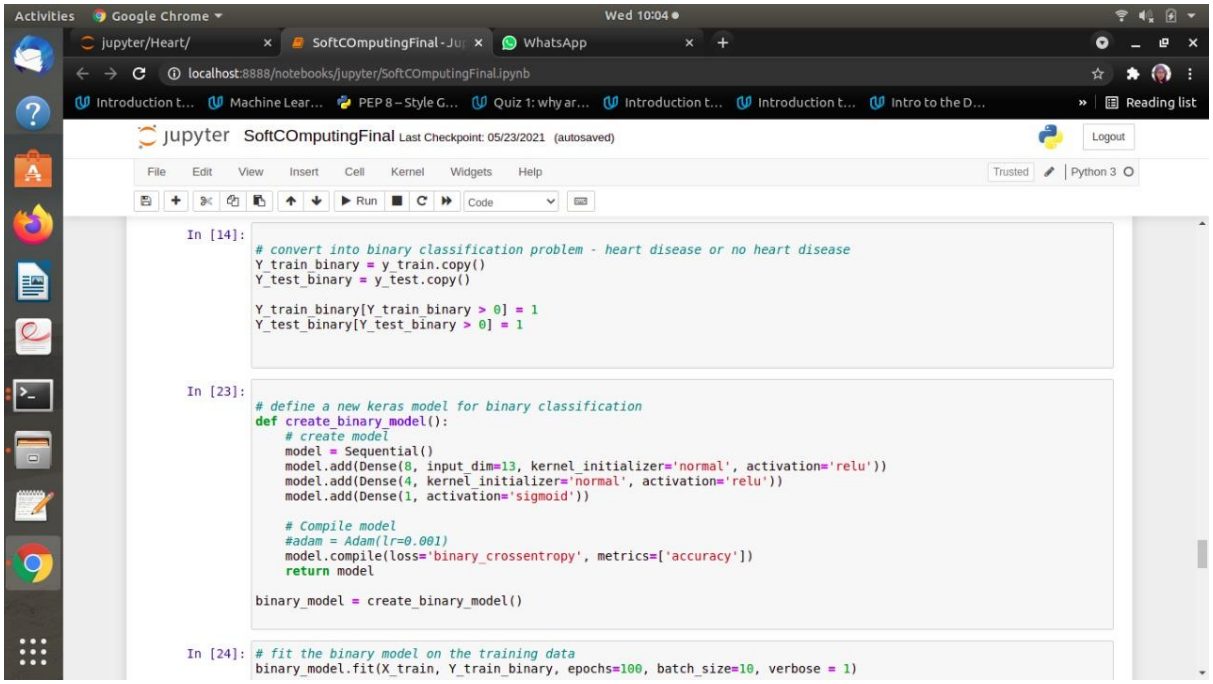
In [13]:
# fit the model to the training data
model.fit(X_train, Y_train, epochs=100, batch_size=10, verbose = 1)
24/24 [==========] - 0s 2ms/step - loss: 1.2113 - accuracy: 0.5243
Epoch 9/100
24/24 [==========] - 0s 2ms/step - loss: 1.2170 - accuracy: 0.5348
Epoch 10/100
24/24 [==========] - 0s 2ms/step - loss: 1.2879 - accuracy: 0.4904
Epoch 11/100
24/24 [==========] - 0s 3ms/step - loss: 1.3329 - accuracy: 0.4609
Epoch 12/100
24/24 [==========] - 0s 3ms/step - loss: 1.1371 - accuracy: 0.5524
Epoch 13/100
24/24 [==========] - 0s 3ms/step - loss: 1.2530 - accuracy: 0.4791
Epoch 14/100
24/24 [==========] - 0s 2ms/step - loss: 1.2559 - accuracy: 0.4797
Epoch 15/100
24/24 [==========] - 0s 3ms/step - loss: 1.2637 - accuracy: 0.4991
Epoch 16/100
24/24 [==========] - 0s 2ms/step - loss: 1.1111 - accuracy: 0.5632
Epoch 17/100
24/24 [==========] - 0s 2ms/step - loss: 1.2243 - accuracy: 0.5045
In [14]:
# convert into binary classification problem - heart disease or no heart disease
Y_train_binary = y_train.copy()
Y_test_binary = y_test.copy()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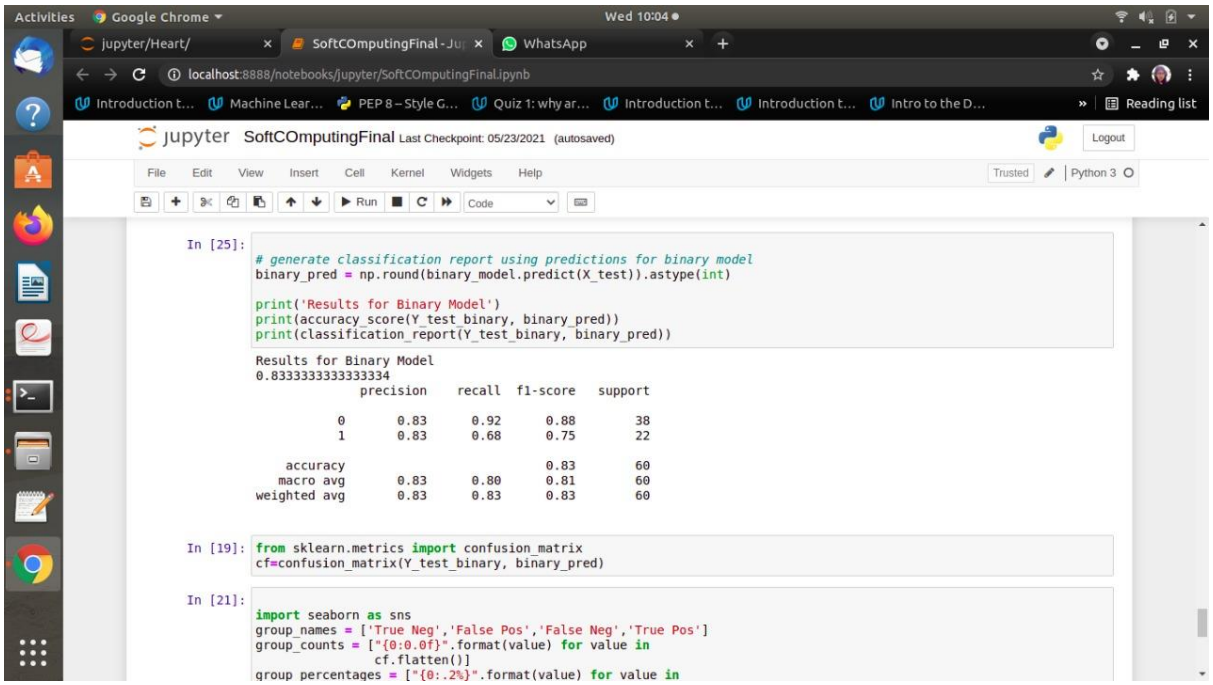
Code
In [14]:
# convert into binary classification problem - heart disease or no heart disease
Y_train_binary = y_train.copy()
Y_test_binary = y_test.copy()
Y_train_binary[Y_train_binary > 0] = 1
Y_test_binary[Y_test_binary > 0] = 1
In [23]:
# define a new keras model for binary classification
def create_binary_model():
# create model
model = Sequential()
model.add(Dense(8, input_dim=13, kernel_initializer='normal', activation='relu'))
model.add(Dense(4, kernel_initializer='normal', activation='relu'))
model.add(Dense(1, activation='sigmoid'))
# Compile model
#adam = Adam(lr=0.001)
model.compile(loss='binary_crossentropy', metrics=['accuracy'])
return model
binary_model = create_binary_model()
In [24]:
# fit the binary model on the training data
binary_model.fit(X_train, Y_train_binary, epochs=100, batch_size=10, verbose = 1)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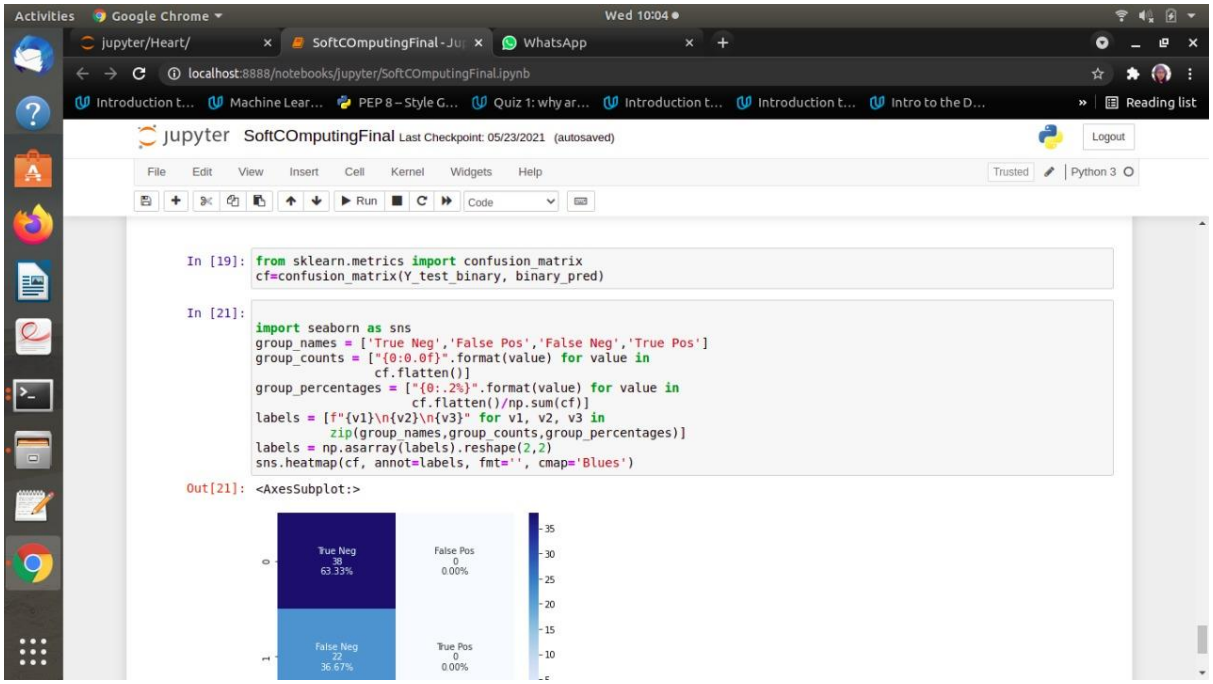
In [25]:
# generate classification report using predictions for binary model
binary_pred = np.round(binary_model.predict(X_test)).astype(int)
print('Results for Binary Model')
print(accuracy_score(Y_test_binary, binary_pred))
print(classification_report(Y_test_binary, binary_pred))
Results for Binary Model
0.8333333333333334
precision recall f1-score support
0 0.83 0.92 0.88 38
1 0.83 0.68 0.75 22
accuracy 0.83 60
macro avg 0.83 0.80 0.81 60
weighted avg 0.83 0.83 0.83 60
In [19]:
from sklearn.metrics import confusion_matrix
cf=confusion_matrix(Y_test_binary, binary_pred)
In [21]:
import seaborn as sns
group_names = ['True Neg','False Pos','False Neg','True Pos']
group_counts = ["{0:0.0f}".format(value) for value in
cf.flatten()]
group_percentages = ["{0:.2%}".format(value) for value in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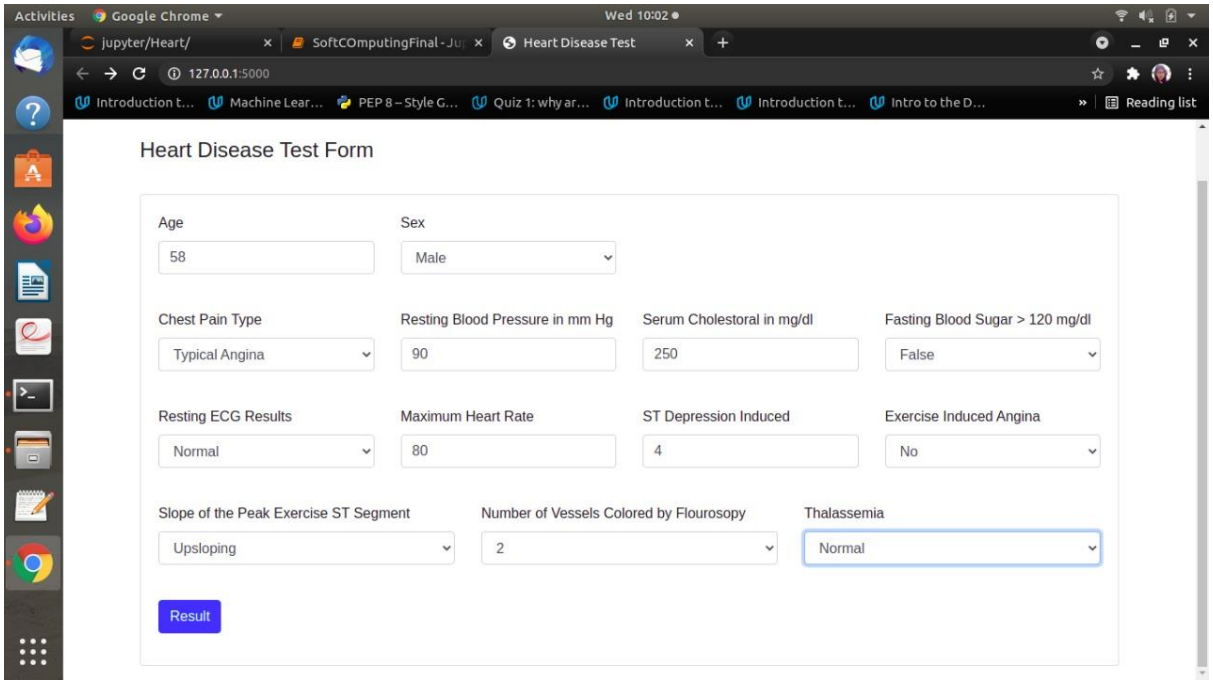
Code
In [19]:
from sklearn.metrics import confusion_matrix
cf=confusion_matrix(Y_test_binary, binary_pred)
In [21]:
import seaborn as sns
group_names = ['True Neg','False Pos','False Neg','True Pos']
group_counts = ["{0:0.0f}".format(value) for value in
cf.flatten()]
group_percentages = ["{0:.2%}".format(value) for value in
cf.flatten()/np.sum(cf)]
labels = [f"{v1}\n{v2}\n{v3}" for v1, v2, v3 in
zip(group_names,group_counts,group_percentages)]
labels = np.asarray(labels).reshape(2,2)
sns.heatmap(cf, annot=labels, fmt='', cmap='Blues')
Out[21]: <AxesSubplot:>
True Neg
38
63.33%
False Pos
0
0.00%
False Neg
22
36.67%
True Pos
0
0.00%
0
1
35
30
25
20
15
10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Introduction t...
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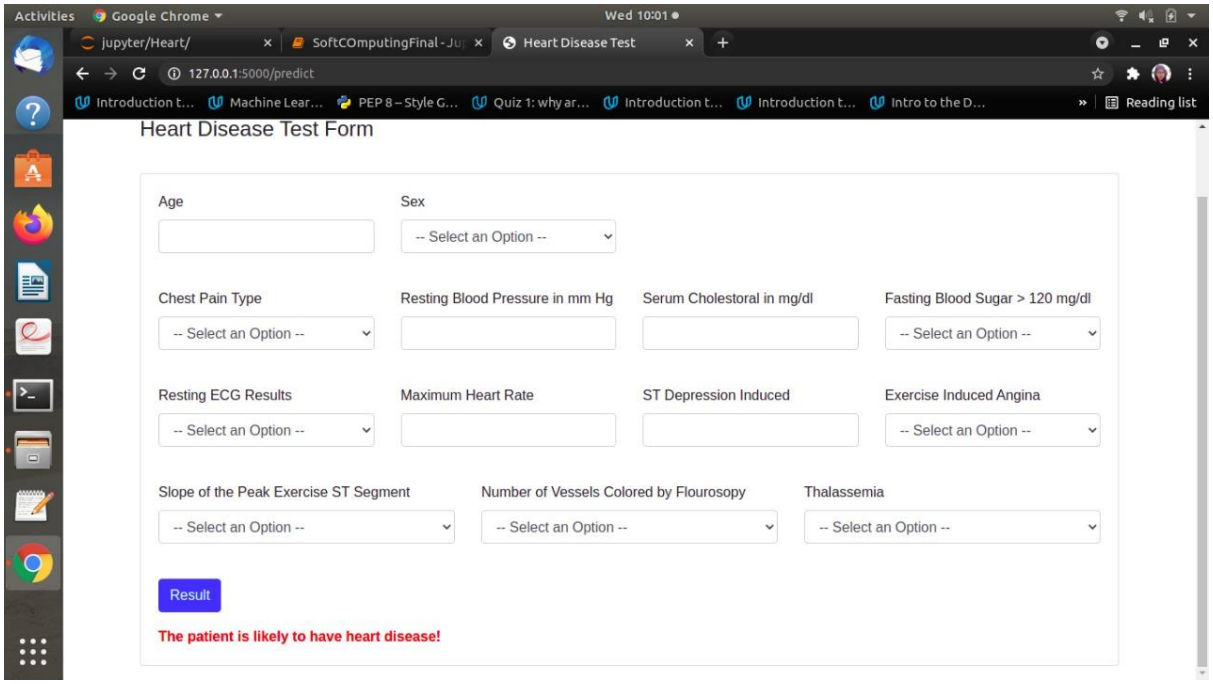
Reading list
Heart Disease Test Form
Age
58
Sex
Male
Chest Pain Type
Typical Angina
Resting Blood Pressure in mm Hg
90
Serum Cholestoral in mg/dl
250
Fasting Blood Sugar > 120 mg/dl
False
Resting ECG Results
Normal
Maximum Heart Rate
80
ST Depression Induced
4
Exercise Induced Angina
No
Slope of the Peak Exercise ST Segment
Upsloping
Number of Vessels Colored by Flourosopy
2
Thalassemia
Normal
Result


Activities
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Heart Disease Test
127.0.0.1:5000/predict
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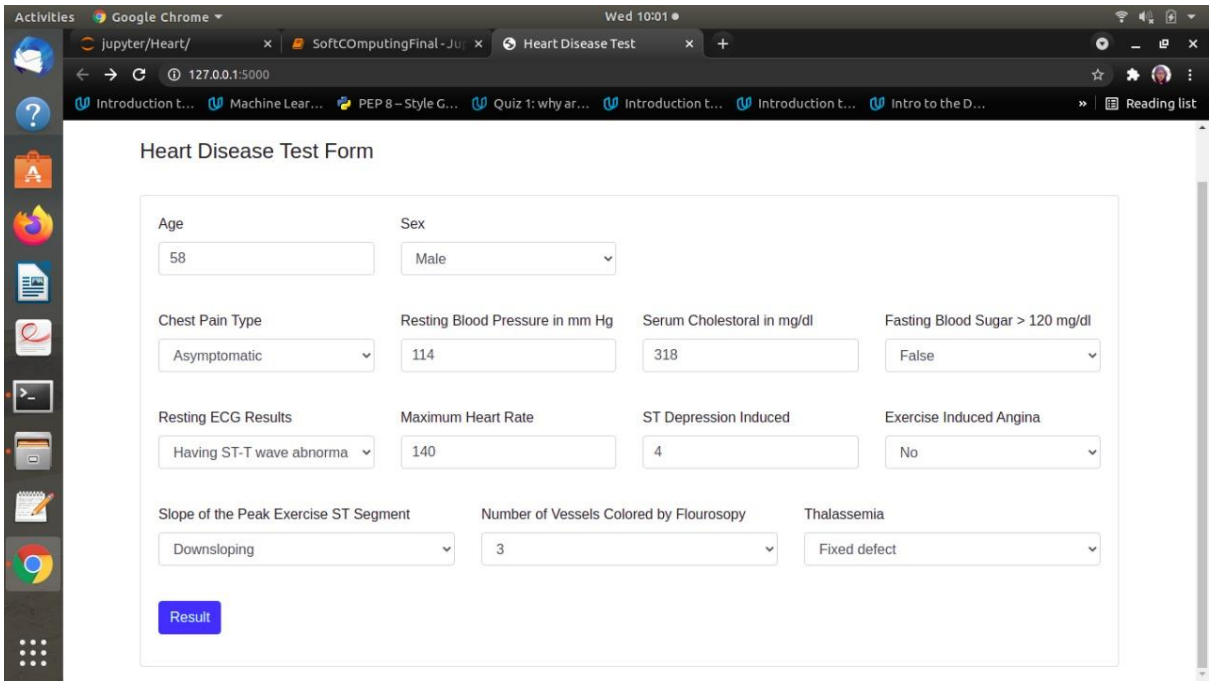
Quiz 1: why ar...
Introduction t...
Introduction t...
Intro to the D...
Reading list
Heart Disease Test Form
Age
Sex
-- Select an Option --
Chest Pain Type
-- Select an Option --
Resting Blood Pressure in mm Hg
Serum Cholestoral in mg/dl
Fasting Blood Sugar > 120 mg/dl
-- Select an Option --
Resting ECG Results
-- Select an Option --
Maximum Heart Rate
ST Depression Induced
Exercise Induced Angina
-- Select an Option --
Slope of the Peak Exercise ST Segment
-- Select an Option --
Number of Vessels Colored by Flourosopy
-- Select an Option --
Thalassemia
-- Select an Option --
Result
The patient is likely to have heart disease!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Heart Disease Test
127.0.0.1:5000
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Machine Lear...
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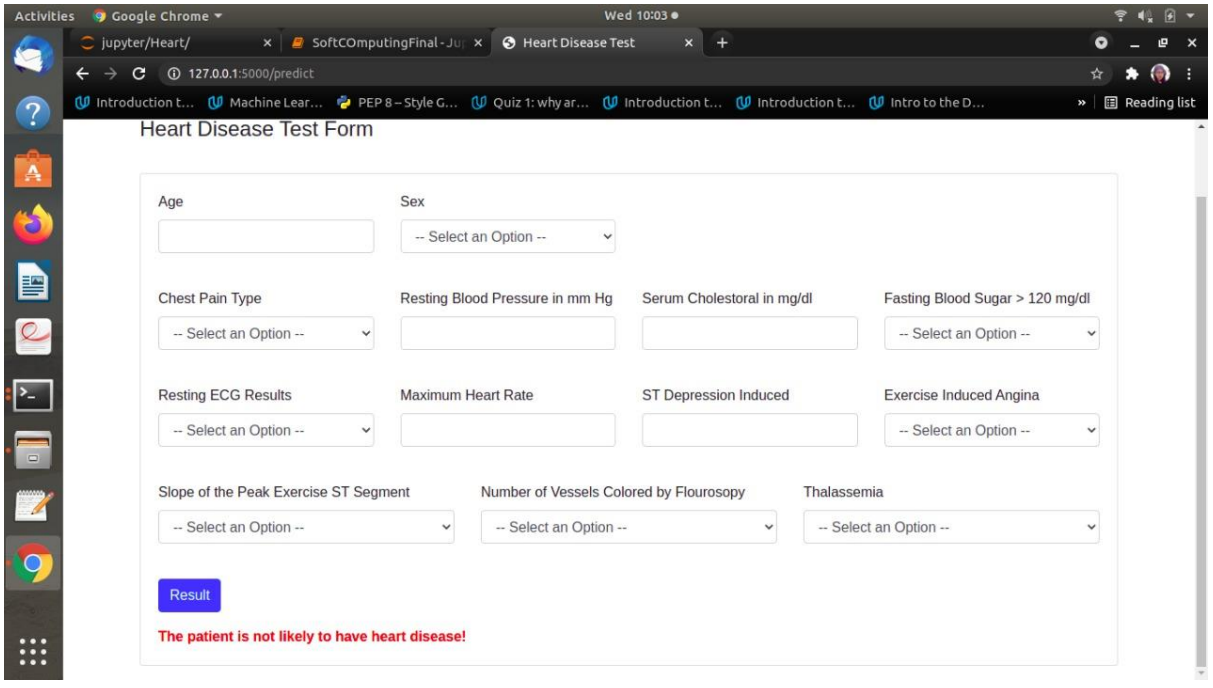
Introduction t...
Intro to the D...
Reading list
Heart Disease Test Form
Age
58
Sex
Male
Chest Pain Type
Asymptomatic
Resting Blood Pressure in mm Hg
114
Serum Cholestoral in mg/dl
318
Fasting Blood Sugar > 120 mg/dl
False
Resting ECG Results
Having ST-T wave abnorma
Maximum Heart Rate
140
ST Depression Induced
4
Exercise Induced Angina
No
Slope of the Peak Exercise ST Segment
Downsloping
Number of Vessels Colored by Flourosopy
3
Thalassemia
Fixed defect
Result


Activities
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127.0.0.1:5000/predict
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Heart Disease Test Form
Age
Sex
-- Select an Option --
Chest Pain Type
-- Select an Option --
Resting Blood Pressure in mm Hg
Serum Cholestoral in mg/dl
Fasting Blood Sugar > 120 mg/dl
-- Select an Option --
Resting ECG Results
-- Select an Option --
Maximum Heart Rate
ST Depression Induced
Exercise Induced Angina
-- Select an Option --
Slope of the Peak Exercise ST Segment
-- Select an Option --
Number of Vessels Colored by Flourosopy
-- Select an Option --
Thalassemia
-- Select an Option --
Result
The patient is not likely to have heart disease!