Name : Kshitij V Darwhekar

Roll No: TETB19

Sub: Soft Computitng

Batch: B2

Experiment 6: Implementation of IOT Solution using Machine Learning

Importing the libraries

```
import sklearn
import numpy as np
import pandas as pd
```

Importing the dataset

```
from google.colab import drive
drive.mount('/content/drive/')
```

```
Drive already mounted at /content/drive/; to attempt to forcibly remount, call drive
```

```
dataset = pd.read_csv("/content/drive/MyDrive/ML/Crop_recommendation.csv")
```

```
X = dataset.iloc[:, :-1].values
y = dataset.iloc[:, -1].values
```

```
dataset.head()
```

	N	P	K	temperature	humidity	ph	rainfall	label
2	60	55	44	23.004459	82.320763	7.840207	263.964248	rice

Data Preprocessing

Taking care of missing data

```
from sklearn.impute import SimpleImputer
imputer = SimpleImputer(missing_values=np.nan, strategy='mean')
imputer.fit(X[:,:])
X[:, :] = imputer.transform(X[:, :])
```

Encoding categorical data

```
from sklearn.preprocessing import LabelEncoder
le = LabelEncoder()
y = le.fit_transform(y)
```

Splitting the dataset into the Training set and Test set

```
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size = 0.25, random_state =
```

```
print(X_train)
```

```
[[134.          56.          18.         ...  83.91902605   6.6912681
   70.97358303]
 [ 29.         122.         196.         ...  81.15595212   5.63832848
   73.06862952]
 [ 25.          68.          19.         ...  64.25510719   7.10845012
   67.47677295]
 ...
 [ 35.          64.          15.         ...  63.53604453   6.50014496
   69.5274407 ]
 [ 39.          65.          23.         ...  69.12613376   7.6859593
   41.02682925]
 [ 14.          22.           9.         ...  91.13772765   6.54319181
  112.5090516 ]]
```

```
print(y_train)
```

```
[ 6  7  2 ...  2 10 16]
```

```
print(X_test)
```

```
[[105.          14.          50.         ...  87.6883982    6.41905219
   59.65590798]
 [ 91.          12.          46.         ...  85.49938185   6.34394252
   48.31219031]
 [ 14.         121.         203.         ...  83.74765639   6.15868941
   74.46411148]
 ...
 [ 84.          27.          29.         ...  53.00366334   7.16709259
  168.2644287 ]
 [ 31.          13.          33.         ...  95.21224392   6.34246371
  148.3003692 ]
 [  5.          24.          40.         ...  93.87030088   6.29790758
  104.6735454 ]]
```

```
print(y_test)
```

```
[21 21  7  3  2 20 13  9 15  1 13  5 10 14 12  0  5 10  5 12  4  2  9  8
  6  5 10 16 13  9 19 20 11 15  4  6 12 12 21 13 11  2 18 21 18 14  9  9
  6 14 13  2  0 15 18  1 17 12 10  6 16 14 21 20 15  0  7  5  0 16  4 19
  9 11  7 13  3 11  8 12 20  2 21 21 15  6 11 10 13 17  2  8 14  7 14 11
  5  8 10  3 16  8 14  1  1 20 21  5 18 15 15 12  5  7 16 19 14 10 11  8
 19 10 16  3  3  2 19 16  3 17 13 13 15 14 11 14  4 19 16  2  2  7  0  5
  3  0  8 12 21 17 16  4 13  1 19  3 21  2  0  8 10 18  8  9  9 15 20 15
  1 16 18  0 13  4  6 14  9 19 17 16 20 17 17 18  9  1  4 18 20 17 11  8
 13 20 11  5 18  4  3 12  4 19 11 13 13 16 15 11 18  1  3  2 18 16 13 14
 12 17 15 19 20 20  2 17  2  5 11  5 16 20 13 14 16  9 19  4 12 14  6 20
  3 14  0 18  2 20 21  2 19 16 11  7  3 18  8 17 19  5 12 13  8 21 19 20
  7  4  8 10  3  5  5 17 19 11 20  3 18 16 19 18  4  9 19 15 13 12 10  1
  2 12  9 12  6 14 17  7  7 18 17  8 20  3 15  5 21 20  8 17  7 15  2 13
 13  3  2 12  1 12 19  8 16 15  3 10  6 17  7  9 10  0 20 15  0 17  2  8
  3 13 10  7  8  9 15 17  7 17 20  5 15 13  1 17 16  9 21 18  0 21 21 18
  9 13  9  8  4  6  9 16  6 18 19  6  6  0  6  0 16 11  7  1  0 13 20  9
  1 20 10  3 19  1  3 15 19  0 10 15 16  2 15 13 12  3 19 12  3  4 15  1
 18 17  8 10  6 20  1  4 20  2 11 16 21 20  0  7 18  7  3 12  8 19 11 12
  7  1 14 18  1  6  2  0  0  8  8 21  3  1 19  1  9  7 11  5 11  8  7  5
 14  2  8 16 18 18 15 13 21 14 21 17 14 14 14 19 16 13  0  5  4 11  4  7
  7  3  3 12  9 17 16 14 17 18  2 17 15  2  1 20  5  6  7  8  3 15  1  7
 21 15 18  8 18  6 21 19  5  4 11 20 14  9 21 14  0  0 21  1 13 14  0 14
  6 20 17  6 17  3  0 19 13 20  2 12 16  8  1 17  5  6 12  5  4 19]
```

Feature Scaling

```
from sklearn.preprocessing import StandardScaler
sc = StandardScaler()
X_train = sc.fit_transform(X_train)
X_test = sc.transform(X_test)
```

```
print(X_train)
```

```
[[ 2.25367108 0.07555744 -0.59141091 ...  0.56115786  0.28639844
  -0.58838147]
 [-0.58434455 2.06834149  2.90385791 ...  0.43651791 -1.09903674
  -0.55053196]
 [-0.69245943  0.43788181 -0.57177457 ... -0.3258651   0.83531751
  -0.65155552]
 ...
 [-0.42217223 0.31710702 -0.65031993 ... -0.35830141  0.03492274
  -0.61450776]
 [-0.31405735 0.34730072 -0.4932292  ... -0.10613716  1.5951916
  -1.12940532]
 [-0.98977536 -0.95102828 -0.76813798 ... 0.88678747  0.09156286
   0.16200634]]
```

```
print(X_test)
```

```
[[ 1.46983819 -1.19257786  0.03695202 ...  0.73119109 -0.07177737
  -0.79284878]
 [ 1.09143611 -1.25296526 -0.04159334 ...  0.63244639 -0.17060505
  -0.99778658]
  [-0.98977536 2.03814779  3.0413123  ...  0.55342752 -0.41435709
  -0.52532091]
 ...
 [ 0.90223507 -0.80005979 -0.37541115 ... -0.83340833  0.91247799
   1.16929376]
 [-0.53028711 -1.22277156 -0.29686578 ...  1.07058549 -0.17255083
   0.8086192 ]
 [-1.23303384 -0.89064089 -0.15941139 ...  1.01005156 -0.23117683
   0.02044856]]
```

Random Forest

Training the Random Forest Classification model on the Training set

```
from sklearn.ensemble import RandomForestClassifier
classifier = RandomForestClassifier(n_estimators = 10, criterion = 'entropy', random_state
classifier.fit(X_train, y_train)
```

```
RandomForestClassifier(criterion='entropy', n_estimators=10, random_state=0)
```

Predicting the Test set results

```
y_pred_RF = classifier.predict(X_test)
print(np.concatenate((y_pred_RF.reshape(len(y_pred_RF),1), y_test.reshape(len(y_test),1)),
```

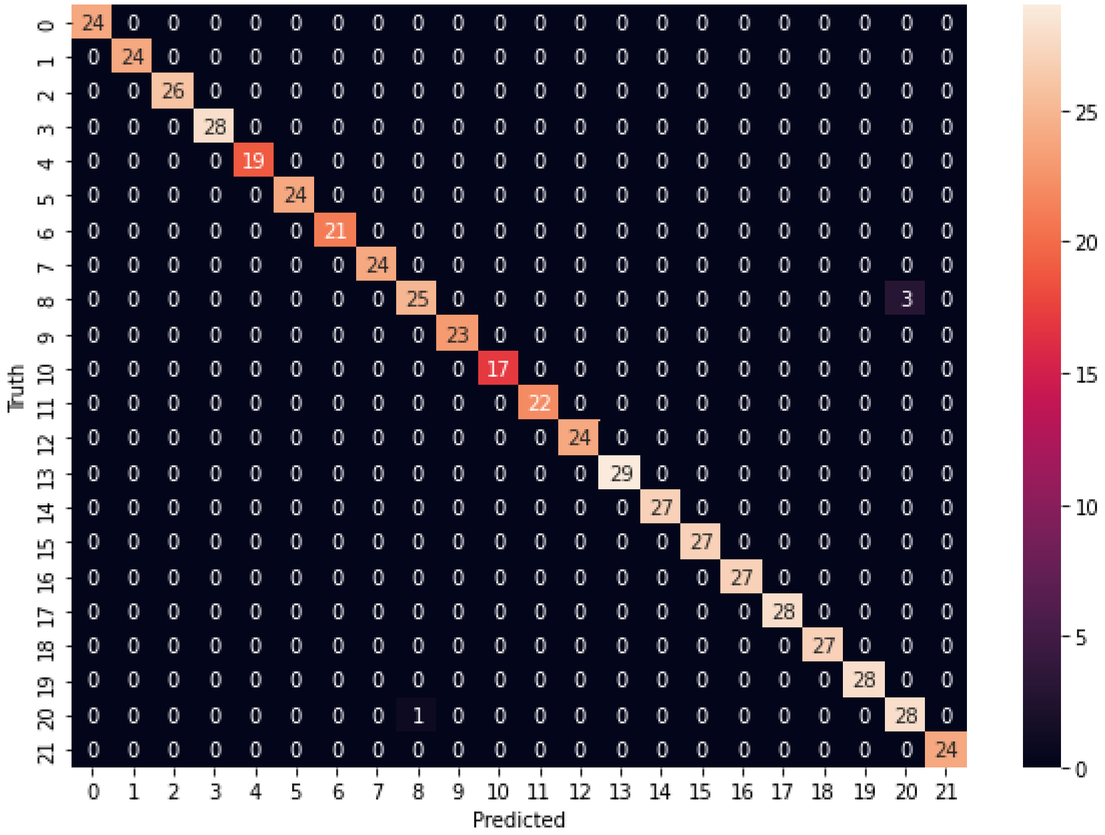
```
[[21 21]
 [21 21]
 [ 7  7]
 ...
 [ 5  5]
 [ 4 4]
 [19 19]]
```

Making the Confusion Matrix

```
from sklearn.metrics import confusion_matrix, accuracy_score
cm = confusion_matrix(y_test, y_pred_RF)
```

```
%matplotlib inline
import matplotlib.pyplot as plt
import seaborn as sn
plt.figure(figsize=(10,7))
sn.heatmap(cm, annot=True)
plt.xlabel('Predicted')
plt.ylabel('Truth')
```

```
Text(69.0, 0.5, 'Truth')
```



```
accuracy_score(y_test, y_pred_RF)
```

```
0.9927272727272727
```

Naive Bayes

Training the Naive Bayes model on the Training set

```
from sklearn.naive_bayes import GaussianNB
classifier = GaussianNB()
classifier.fit(X_train, y_train)
```

```
     GaussianNB()
```

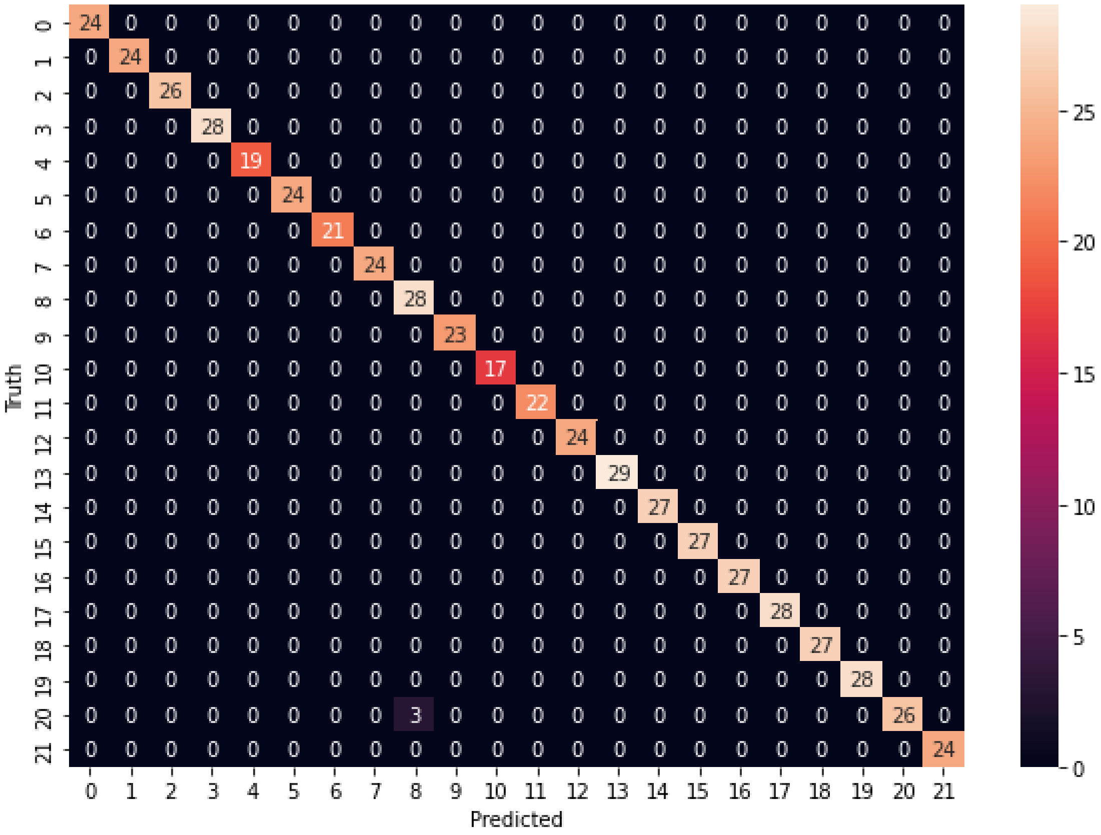
```
y_pred_NV = classifier.predict(X_test)
print(np.concatenate((y_pred_NV.reshape(len(y_pred_NV),1), y_test.reshape(len(y_test),1)),
```

```
     [[21 21]
      [21 21]
      [ 7  7]
      ...
      [ 5  5]
      [ 4  4]
      [19 19]]
```

```
from sklearn.metrics import confusion_matrix, accuracy_score
cm = confusion_matrix(y_test, y_pred_NV)
```

```
%matplotlib inline
import matplotlib.pyplot as plt
import seaborn as sn
plt.figure(figsize=(10,7))
sn.heatmap(cm, annot=True)
plt.xlabel('Predicted')
plt.ylabel('Truth')
```

```
     Text(69.0, 0.5, 'Truth')
```

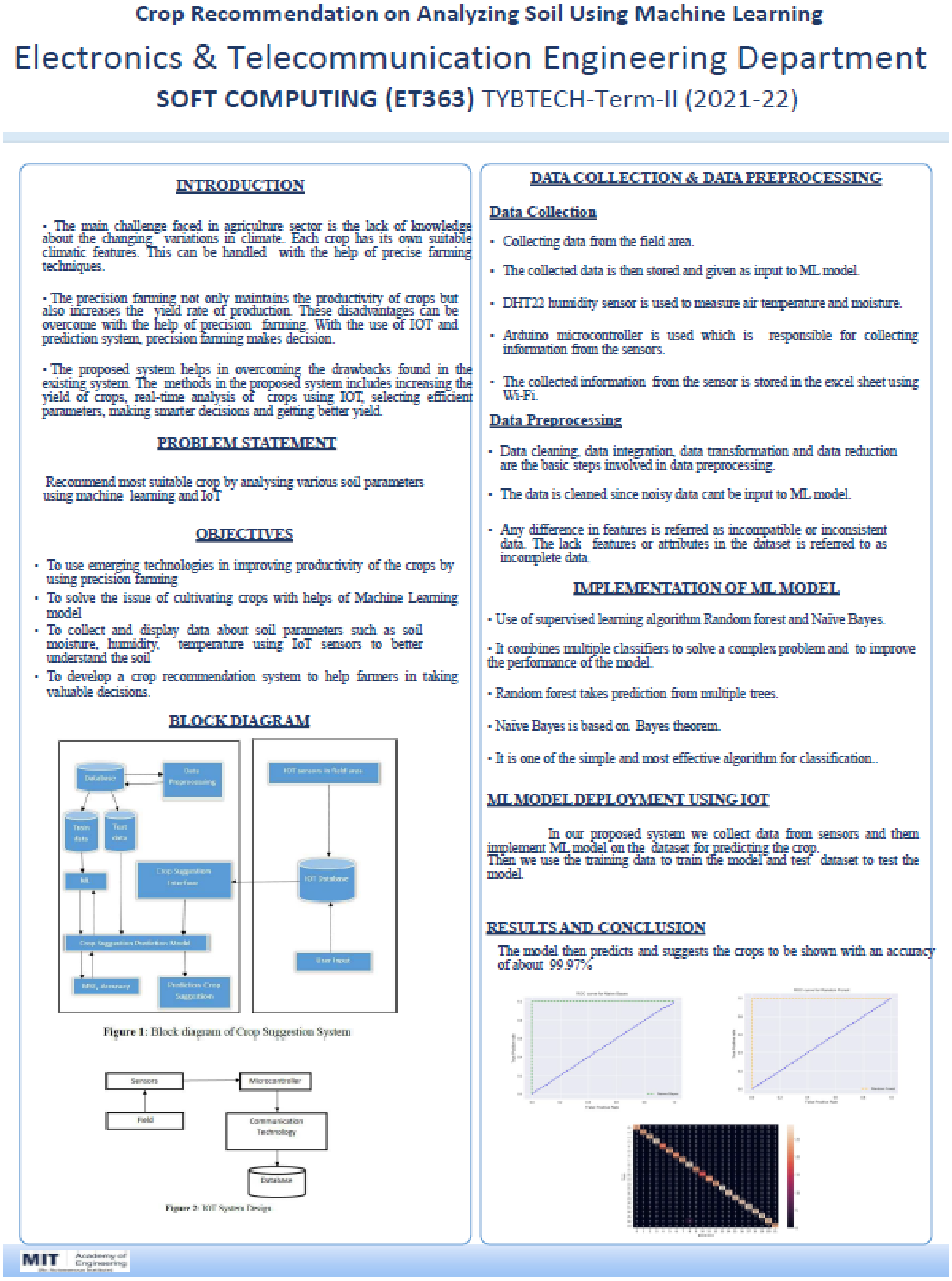


```
accuracy_score(y_test, y_pred_NV)

      0.9945454545454545
```

```
□ 0s   completed at 2:22 PM
```

Poster:



Crop Recommendation on Analyzing Soil Using Machine Learning

Electronics & Telecommunication Engineering Department

SOFT COMPUTING (ET363) TYBTECH-Term-II (2021-22)

INTRODUCTION

• The main challenge faced in agriculture sector is the lack of knowledge about the changing variations in climate. Each crop has its own suitable climatic features. This can be handled with the help of precise farming techniques.

• The precision farming not only maintains the productivity of crops but also increases the yield rate of production. These disadvantages can be overcome with the help of precision farming. With the use of IOT and prediction system, precision farming makes decision.

• The proposed system helps in overcoming the drawbacks found in the existing system. The methods in the proposed system includes increasing the yield of crops, real-time analysis of crops using IOT, selecting efficient parameters, making smarter decisions and getting better yield.

PROBLEM STATEMENT

Recommend most suitable crop by analysing various soil parameters using machine learning and IoT

OBJECTIVES

- To use emerging technologies in improving productivity of the crops by using precision farming
- To solve the issue of cultivating crops with helps of Machine Learning model
- To collect and display data about soil parameters such as soil moisture, humidity, temperature using IoT sensors to better understand the soil
- To develop a crop recommendation system to help farmers in taking valuable decisions.

BLOCK DIAGRAM

Database
Data Preprocessing
Train data
Test data
ML
Crop Suggestion Interface
Crop Suggestion Prediction Model
MSE, Accuracy
Prediction Crop Suggestion
IOT sensors in field area
IOT Database
User Input

Figure 1: Block diagram of Crop Suggestion System

Figure 2: IOT System Design

DATA COLLECTION & DATA PREPROCESSING

Data Collection

- Collecting data from the field area.
- The collected data is then stored and given as input to ML model.
- DHT22 humidity sensor is used to measure air temperature and moisture.
- Arduino microcontroller is used which is responsible for collecting information from the sensors.
- The collected information from the sensor is stored in the excel sheet using Wi-Fi.

Data Preprocessing

- Data cleaning, data integration, data transformation and data reduction are the basic steps involved in data preprocessing.
- The data is cleaned since noisy data cant be input to ML model.
- Any difference in features is referred as incompatible or inconsistent data. The lack features or attributes in the dataset is referred to as incomplete data.

IMPLEMENTATION OF ML MODEL

• Use of supervised learning algorithm Random forest and Naive Bayes.

• It combines multiple classifiers to solve a complex problem and to improve the performance of the model.

• Random forest takes prediction from multiple trees.

• Naive Bayes is based on Bayes theorem.

• It is one of the simple and most effective algorithm for classification..

ML MODEL DEPLOYMENT USING IOT

In our proposed system we collect data from sensors and them implement ML model on the dataset for predicting the crop.
Then we use the training data to train the model and test dataset to test the model.

RESULTS AND CONCLUSION

The model then predicts and suggests the crops to be shown with an accuracy of about 99.97%