AI in Farming

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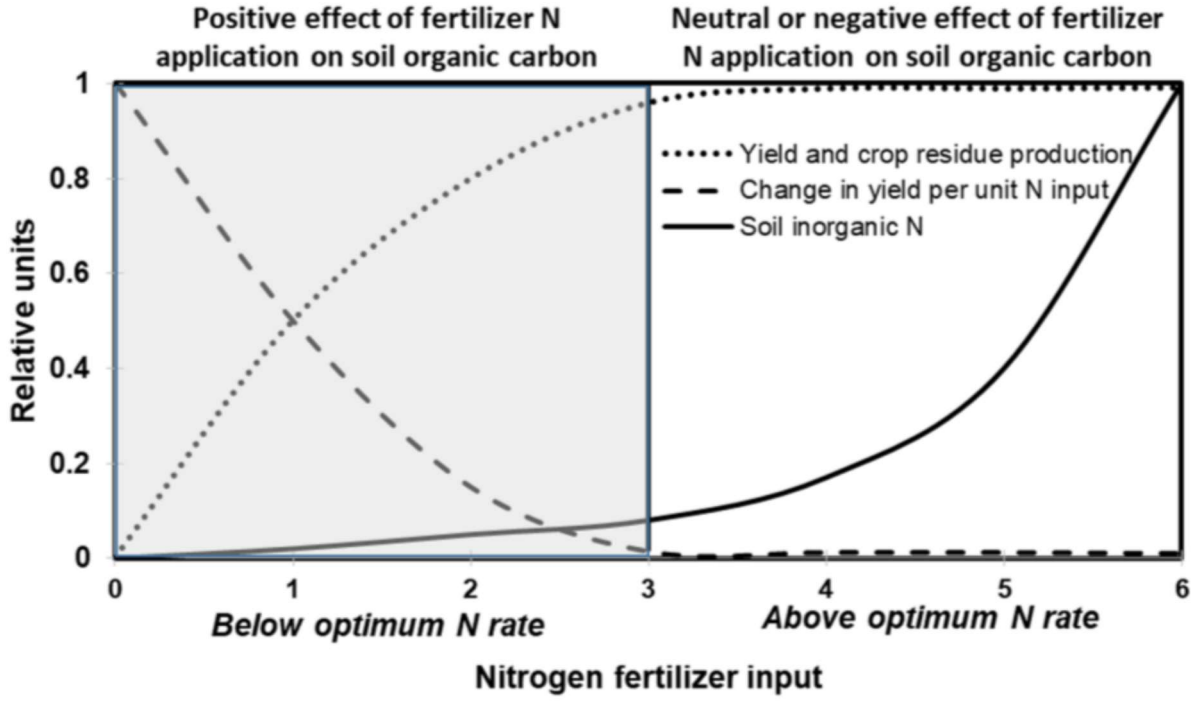
Introduction

As we all know that India is an agricultural country. Almost 60 % of lands are still used for farming. The objective of our work is to help small scale business such as retailers or sellers, by studying the soils content and rainfall of that area and to provide the necessary data, so that they can know the best crop for their business in that area, and we can also optimize the use of the fertilizers at best for that area to provide the maximum yield which would also be helpful to the farmers as well.

Problem Statement

We all know that the most farming community is not literate or that much educated, and so most of them don't know the limitation of using fertilizers, almost half of them over uses them and so it also affects the cultivation of crops and in turn it affects the environment (Eutrophication).
Govt of India and ICMR has released research showing that excessive use of fertilizers deleterious effect on soil health and in turn it affects the cultivation of crops in future.
Also considering we are tropical country our major resource of water is through rainfall, which has a major impact on farming.



Business/Customer Need Assessment

India being second largest population has a big amount of small-scale and medium scale business, which aren't still connected to the modern gird. So, considering all the above parameters a model can be made to help the local sellers understand the requirement of the local farmers, so that they can help and guide the farmers as per their best needs, which would be in turn beneficial for the business as well.
The above research also suggested that proper rotation of the organic and inorganic fertilizers can improve soil quality over time. This will help the business to grow and also help to increase the yield of crops for farmers.

Target Specifications and Characterization

- To give the idea of soil and environment so to better understand the best crop for that area.
- Optimizing the use of fertilizer to prevent soil degradation
- Preventing crop loss by understanding the changing climatic conditions.

External Searches (Information searches):

The Dataset we are using is available on Kaggle Datasets.

	N	P	K	temperature	humidity	ph	rainfall	label
0	90	42	43	20.879744	82.002744	6.502985	202.935536	rice
1	85	58	41	21.770462	80.319644	7.038096	226.655537	rice
2	60	55	44	23.004459	82.320763	7.840207	263.964248	rice
3	74	35	40	26.491096	80.158363	6.980401	242.864034	rice
4	78	42	42	20.130175	81.604873	7.628473	262.717340	rice
...	...	...	...	...	...	...	...	...
2195	107	34	32	26.774637	66.413269	6.780064	177.774507	coffee
2196	99	15	27	27.417112	56.636362	6.086922	127.924610	coffee
2197	118	33	30	24.131797	67.225123	6.362608	173.322839	coffee
2198	117	32	34	26.272418	52.127394	6.758793	127.175293	coffee
2199	104	18	30	23.603016	60.396475	6.779833	140.937041	coffee

Benchmarking Alternative Products

Many of the soil related idea or programs are available. Once such example is of IBM AgroPad.
This "AI on the edge" computing approach uses machine learning and machine vision algorithms to translate the measured colour composition and intensity into concentrations of chemicals in the sample, making it more reliable than tests based on human vision alone.

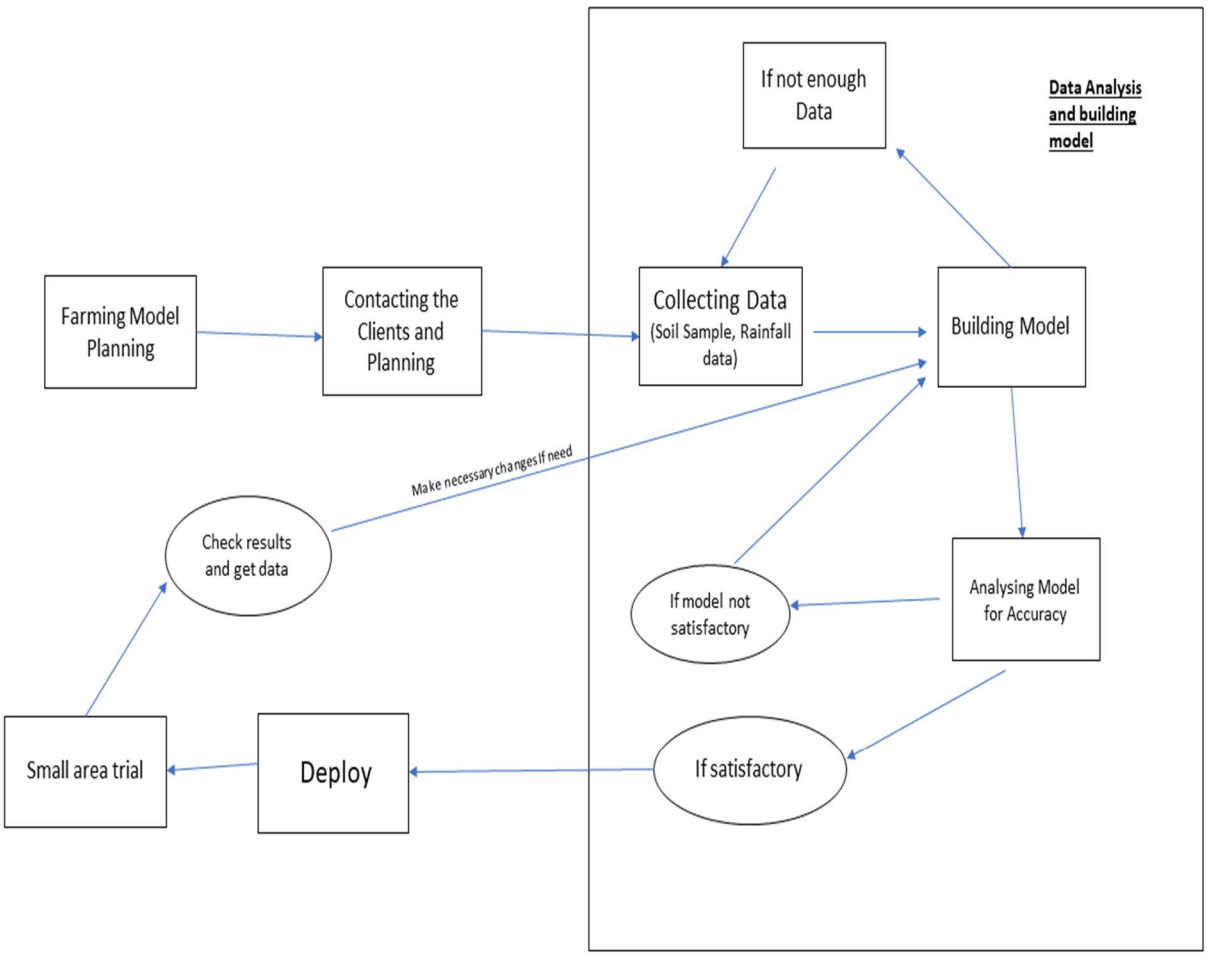
They currently have a five-parameter prototype solution for soil and water testing that measures pH, nitrogen dioxide, aluminium, magnesium and chlorine.

Business Model

Most of the people now days, even educated people now days have agricultural lands which they want to monetize or earn money from it.
Now days "Organics Farming" is taking boom in the market sector.

So, taking into the account, we can help such people in farming by providing them with details of that area and farming.
We can also provide them with the basic of farming, soil and crop knowledge which will be the best for that area.

Prototype



Product Details

1. Data Source –

   https://www.kaggle.com/datasets/atharvaingle/crop-recommendation-dataset

2. Software's.

   Any python IDE with basic libraries for Data Science such as sklearn, pandas and Seaborn.

   Algorithms used here are Classification algorithm. We have used two algorithms Decision Tree and Random Forest.

3. Team required
    1. A data scientist
    2. Business Analyst
    3. A Lab expert
    4. A Ground Team for dealing with sampling (2 People at most)
    5. An Agricultural Expert
    6. Cloud Engineer

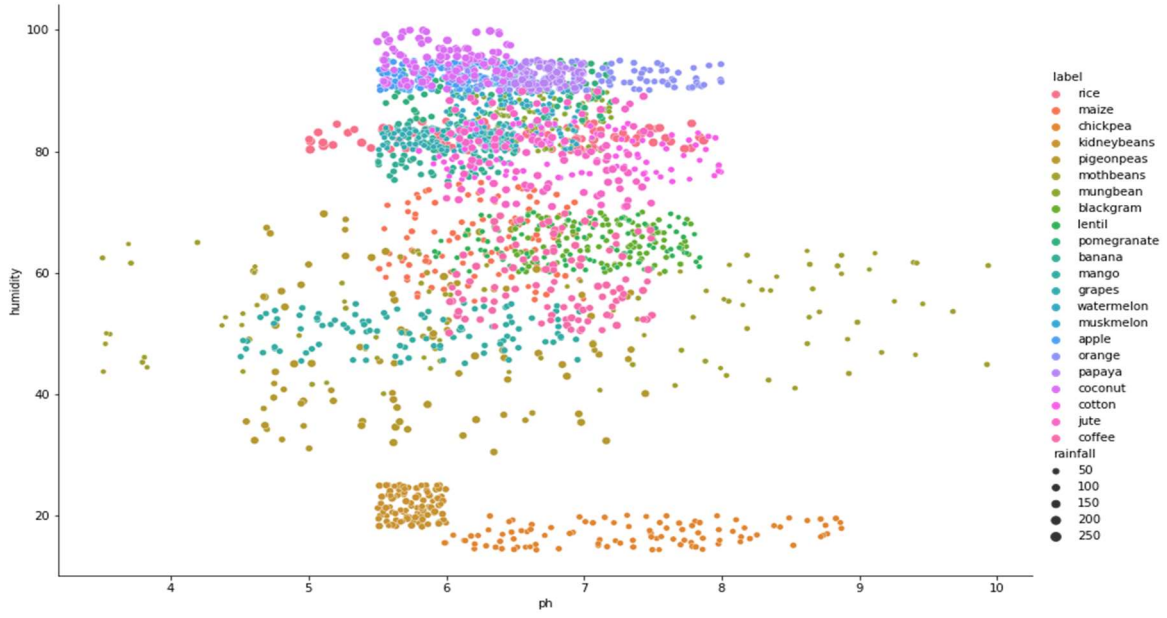
4. Budget

    It would strictly depend on the place for setting up the business. But a medium scale budget would be sufficient to start and implement the project.

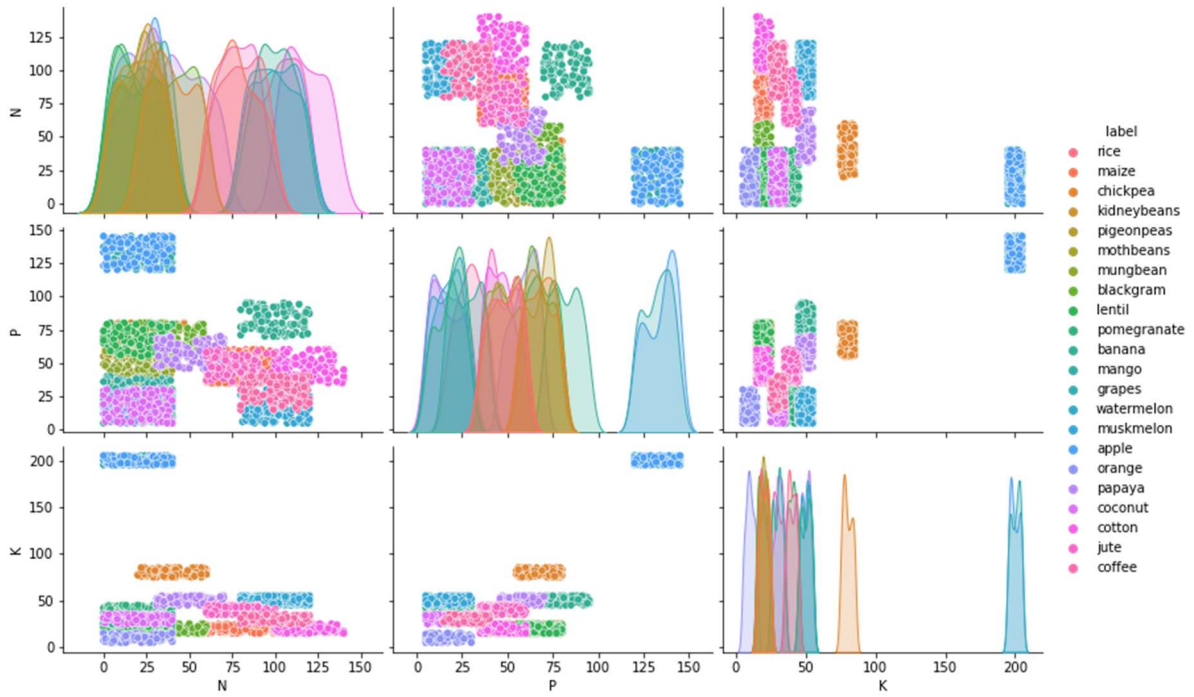
Code Implementation

Building Basic Visualization of the Real-World Data

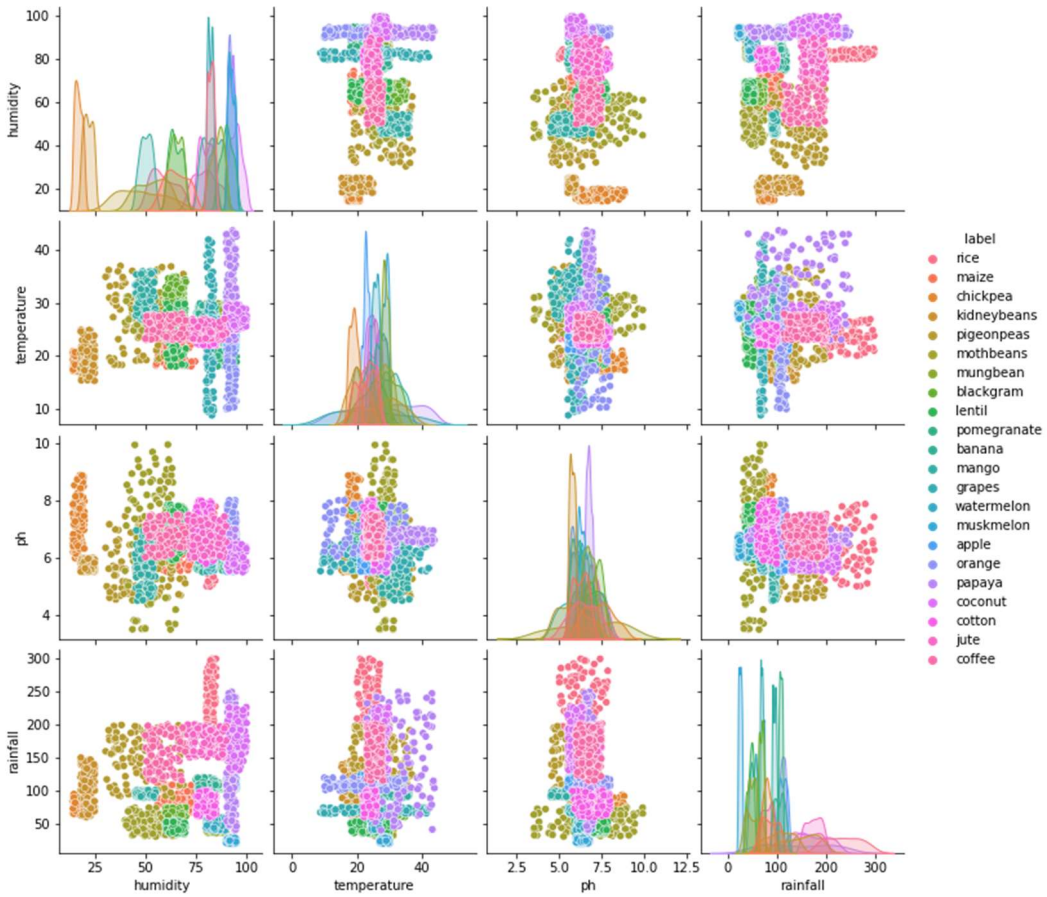
The plot below shows the distribution of the crops on the basis of humidity and ph. by the requirement of rainfall. We can study and inference from the plot that the effect of rainfall on the humidity and ph., and we can see that there are some crops which are concentrated to the particular segment.



Below is a neat pair plot representing the data of the N, P and K, the most commonly used fertilizers for the farming. We can easily figure out the concentrated region of crops with the best suitable range for their requirement.



Details of humidity, ph., rainfall and temperature



ML modelling

Here we are using two Supervised Learning Algorithms Random Forest Classifier and Decision Tree as our target variables is crop, which has different classes.

1. Basic Data Engineering

Checking the data for Null Values

```
In [6]: df.isnull().sum()
```

```
Out[6]: N              0
        P              0
        K              0
        temperature    0
        humidity       0
        ph             0
        rainfall       0
        label          0
        dtype: int64
```

```
In [7]: x = df.drop('label',axis=1)
        y = df['label']
```

Spliting the Data

```
In [8]: from sklearn.model_selection import train_test_split
```

```
In [9]: x_train, x_test, y_train, y_test = train_test_split(x, y, test_size=0.3, random_state=101)
```

Scaling the Data

```
In [10]: from sklearn.preprocessing import StandardScaler
         scaler = StandardScaler()
```

```
In [11]: scaled_x_train = scaler.fit_transform(x_train)
         scaled_x_test = scaler.transform(x_test)
```

2. Fitting Model

Fitting The Model

```
In [29]: from sklearn.tree import DecisionTreeClassifier
```

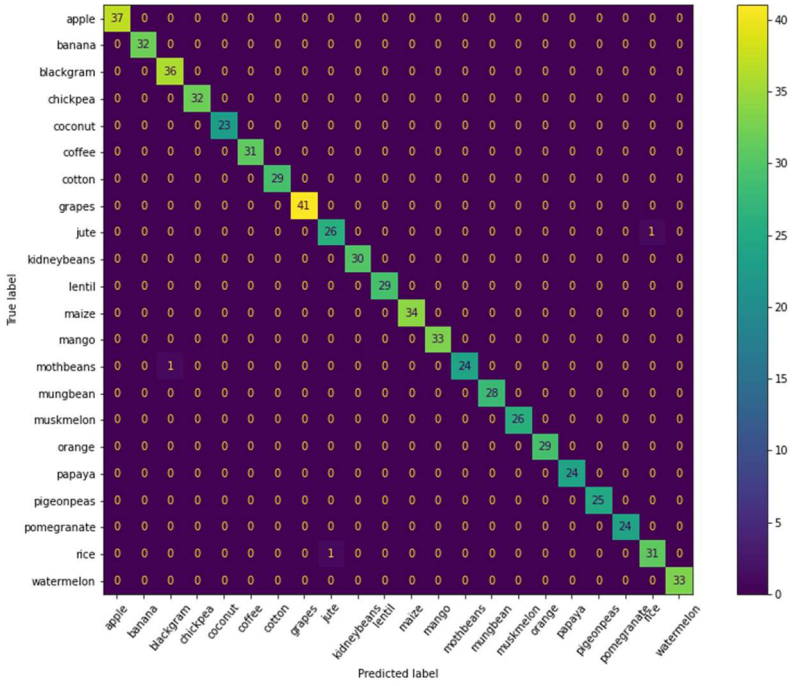
```
In [30]: model = DecisionTreeClassifier()
         model.fit(x_train,y_train)
```

```
Out[30]: DecisionTreeClassifier()
```

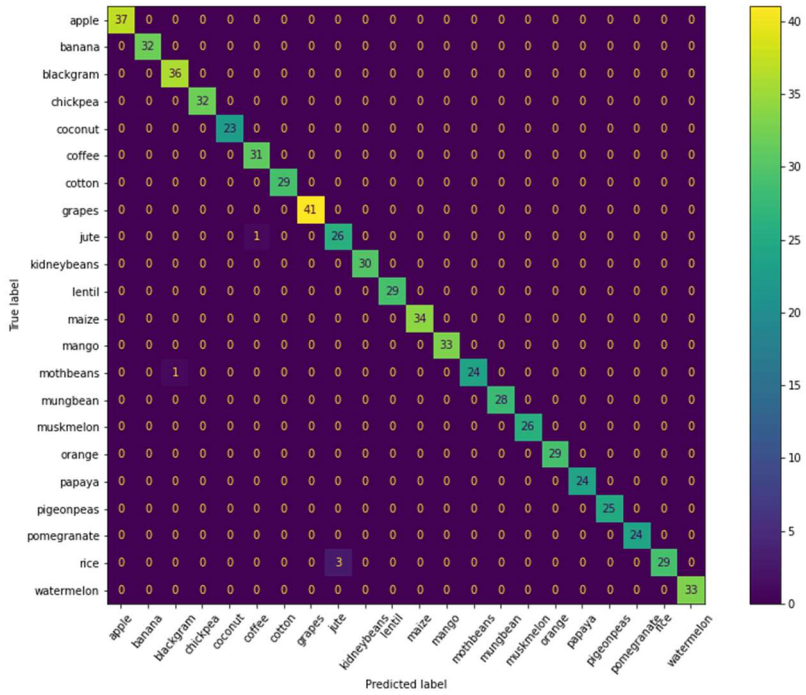
```
In [35]: pred = model.predict(x_test)
```

```
In [32]: from sklearn.metrics import classification_report,plot_confusion_matrix,accuracy_score
```

3. Analysis

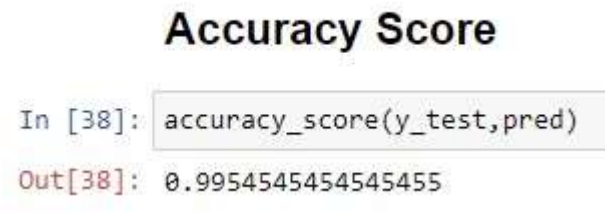


(Decision Tree Plot Confusion Matrix)

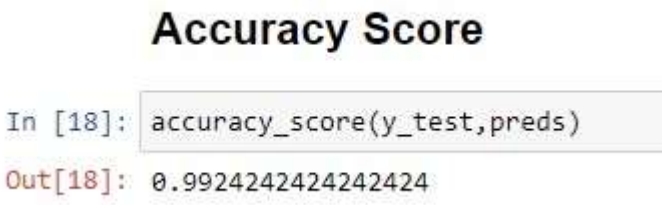


(Random Forest Plot Confusion Matrix)

Accuracy Score



Decision Tree



Random Forest

As per the model accuracy scores, we can inference that our models is almost accurate for the particular datasets.

GitHub Link - https://github.com/rishipatel92/FeynnLabs.git

Conclusion

As per our analysis of the dataset, we can conclude that we have excellent results of our model. Appropriate composition of soil related to N, P and K should be known for our model to work.
Data of the area specially the year around data of the weather should be evaluated and applied.

The Idea of AI related to the farming can help farmers to know which nutrient does the soil is lacking and which is present in more, so that to prevent the over use of fertilizer.

Out model future development can be extended to other nutrient of the soil, like testing for metal ions and can also be used to determine the organic components also like micro-organisms presence, which also plays an important role in the crop cultivation.

References

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