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

Importing Data

```
crop = pd.read_csv("Crop_recommendation.csv")
crop.head()
```

	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

Start coding or generate with AI.

```
crop.shape
```

```
(2200, 8)
```

```
crop.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 2200 entries, 0 to 2199
Data columns (total 8 columns):
 #   Column       Non-Null Count  Dtype  
---  ------       --------------  -----  
 0   N            2200 non-null   int64  
 1   P            2200 non-null   int64  
 2   K            2200 non-null   int64  
 3   temperature  2200 non-null   float64
 4   humidity     2200 non-null   float64
 5   ph           2200 non-null   float64
 6   rainfall     2200 non-null   float64
 7   label        2200 non-null   object 
dtypes: float64(4), int64(3), object(1)
memory usage: 137.6+ KB
```

```
crop.isnull().sum()
```

```
N              0
P              0
K              0
temperature    0
humidity       0
ph             0
rainfall       0
label          0
dtype: int64
```

```
crop.duplicated().sum()
```

```
0
```

```
crop.describe()
```

	N	P	K	temperature	humidity	ph	ra
count	2200.000000	2200.000000	2200.000000	2200.000000	2200.000000	2200.000000	2200.
mean	50.551818	53.362727	48.149091	25.616244	71.481779	6.469480	103.
std	36.917334	32.985883	50.647931	5.063749	22.263812	0.773938	54.
min	0.000000	5.000000	5.000000	8.825675	14.258040	3.504752	20.
25%	21.000000	28.000000	20.000000	22.769375	60.261953	5.971693	64.
50%	37.000000	51.000000	32.000000	25.598693	80.473146	6.425045	94.
75%	84.250000	68.000000	49.000000	28.561654	89.948771	6.923643	124.
max	140.000000	145.000000	205.000000	43.675493	99.981876	9.935091	298

Exploring Data

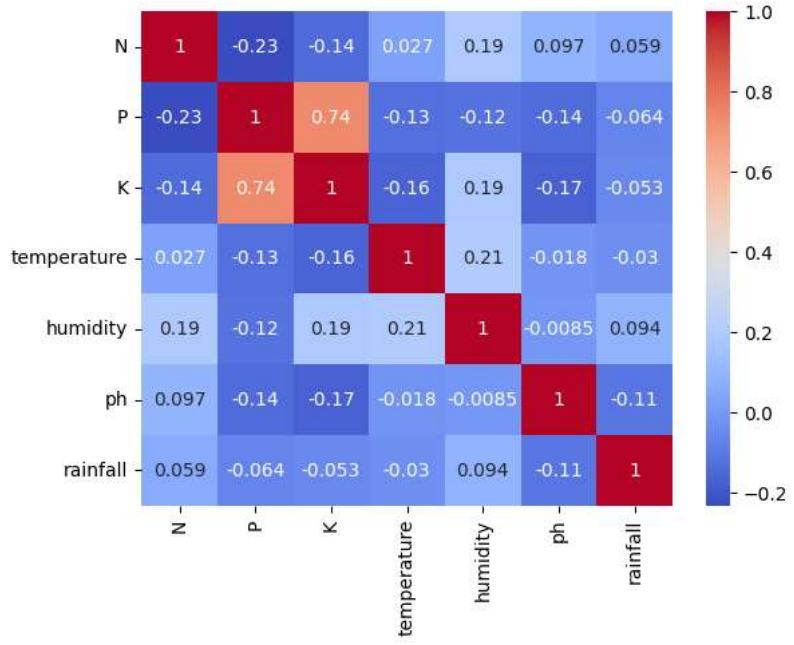
```
corr = crop.corr()
corr
```

```
<ipython-input-16-1dcd70030872>:1: FutureWarning: The default value of numeric_only in D
  corr = crop.corr()
```

	N	P	K	temperature	humidity	ph	rainfall
N	1.000000	-0.231460	-0.140512	0.026504	0.190688	0.096683	0.059020
P	-0.231460	1.000000	0.736232	-0.127541	-0.118734	-0.138019	-0.063839
K	-0.140512	0.736232	1.000000	-0.160387	0.190859	-0.169503	-0.053461
temperature	0.026504	-0.127541	-0.160387	1.000000	0.205320	-0.017795	-0.030084
humidity	0.190688	-0.118734	0.190859	0.205320	1.000000	-0.008483	0.094423
ph	0.096683	-0.138019	-0.169503	-0.017795	-0.008483	1.000000	-0.109069
rainfall	0.059020	-0.063839	-0.053461	-0.030084	0.094423	-0.109069	1.000000

```
import seaborn as sns
sns.heatmap(corr,annot=True,cbar=True,cmap='coolwarm')
```

```
<Axes: >
```




```
crop['label'].value_counts()
```

```
rice           100
maize          100
jute           100
cotton         100
coconut        100
papaya         100
orange         100
apple          100
muskmelon      100
watermelon     100
grapes         100
mango          100
banana         100
pomegranate    100
lentil         100
blackgram      100
mungbean       100
mothbeans      100
pigeonpeas     100
kidneybeans    100
chickpea       100
coffee         100
Name: label, dtype: int64
```

```
crop['label'].isnull().sum()
```

```
0
```

```
import matplotlib.pyplot as plt
sns.distplot(crop["N"])
plt.show()
```

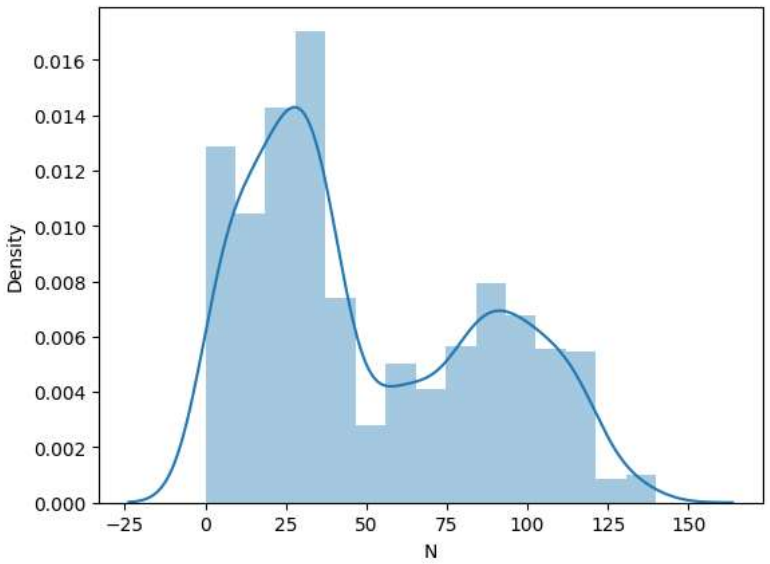
```
<ipython-input-93-c29d4605fd08>:2: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(crop["N"])
```



Encoding

```
crop_dict = {
    'rice': 1,
    'maize': 2,
    'jute': 3,
    'cotton': 4,
    'coconut': 5,
    'papaya': 6,
    'orange': 7,
    'apple': 8,
    'muskmelon': 9,
    'watermelon': 10,
    'grapes': 11,
    'mango': 12,
    'banana': 13,
    'pomegranate': 14,
    'lentil': 15,
    'blackgram': 16,
    'mungbean': 17,
    'mothbeans': 18,
    'pigeonpeas': 19,
    'kidneybeans': 20,
    'chickpea': 21,
    'coffee': 22
}
crop['crop_num']  = crop['label'].map(crop_dict)
```

```
crop['crop_num'].value_counts()
```

```
1     100
2     100
3     100
4     100
5     100
6     100
7     100
8     100
9     100
10    100
11    100
12    100
13    100
14    100
15    100
16    100
17    100
18    100
19    100
20    100
21    100
22    100
Name: crop_num, dtype: int64
```

```
#crop.drop('label',axis=1,inplace=True)
crop.head()
```

	N	P	K	temperature	humidity	ph	rainfall	label	crop_num
0	90	42	43	20.879744	82.002744	6.502985	202.935536	rice	1
1	85	58	41	21.770462	80.319644	7.038096	226.655537	rice	1
2	60	55	44	23.004459	82.320763	7.840207	263.964248	rice	1
3	74	35	40	26.491096	80.158363	6.980401	242.864034	rice	1
4	78	42	42	20.130175	81.604873	7.628473	262.717340	rice	1

Train Test Split

```
X= crop.drop(['crop_num', 'label'],axis=1)
y =crop['crop_num']
```

```
X.shape
```

```
(2200, 7)
```

```
y.shape
```

```
(2200,)
```

```
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=42)

X_train.shape
```

```
(1760, 7)
```

```
X_test.shape
```

```
(440, 7)
```

Scale the features using MinMaxScaler

```
from sklearn.preprocessing import MinMaxScaler
ms = MinMaxScaler()



ms.fit(X_train)
X_train= ms.transform(X_train)
X_test = ms.transform(X_test)

X_train
```

```
array([[0.12142857, 0.07857143, 0.045     , ..., 0.9089898 , 0.48532225,
        0.29685161],
       [0.26428571, 0.52857143, 0.07      , ..., 0.64257946, 0.56594073,
        0.17630752],
       [0.05      , 0.48571429, 0.1       , ..., 0.57005802, 0.58835229,
        0.08931844],
       ...,
       [0.07857143, 0.22142857, 0.13      , ..., 0.43760347, 0.46198144,
        0.28719815],
       [0.07857143, 0.85      , 0.995     , ..., 0.76763665, 0.44420505,
        0.18346657],
       [0.22857143, 0.52142857, 0.085     , ..., 0.56099735, 0.54465022,
        0.11879596]])
```

```
y_train.isnull().sum()
```

```
0
```

Standarization

```
from sklearn.preprocessing import StandardScaler
sc = StandardScaler()



sc.fit(X_train)
X_train= sc.transform(X_train)
X_test = sc.transform(X_test)

X_train
```

```
array([[-9.03426596e-01, -1.12616170e+00, -6.68506601e-01, ...,
         9.36586183e-01,  1.93473784e-01,  5.14970176e-03],
       [-3.67051340e-01,  7.70358846e-01, -5.70589522e-01, ...,
        -1.00470485e-01,  8.63917548e-01, -6.05290566e-01],
```

```
            [-1.17161422e+00,  5.89737842e-01, -4.53089028e-01, ...,
             -3.82774991e-01,  1.05029771e+00, -1.04580687e+00],
            ...,
            [-1.06433917e+00, -5.24091685e-01, -3.35588533e-01, ...,
             -8.98381379e-01, -6.34357580e-04, -4.37358211e-02],
            [-1.06433917e+00,  2.12501638e+00,  3.05234239e+00, ...,
              3.86340190e-01, -1.48467347e-01, -5.69036842e-01],
            [-5.01145154e-01,  7.40255346e-01, -5.11839275e-01, ...,
             -4.18045489e-01,  6.86860180e-01, -8.96531475e-01]])
```

Training Models

```
from sklearn.linear_model import LogisticRegression
from sklearn.naive_bayes import GaussianNB
from sklearn.svm import SVC
from sklearn.neighbors import KNeighborsClassifier
from sklearn.tree import DecisionTreeClassifier
from sklearn.tree import ExtraTreeClassifier
from sklearn.ensemble import RandomForestClassifier
from sklearn.ensemble import BaggingClassifier
from sklearn.ensemble import GradientBoostingClassifier
from sklearn.ensemble import AdaBoostClassifier
from sklearn.metrics import accuracy_score

# create instances of all models
models = {
    'Logistic Regression': LogisticRegression(),
    'Naive Bayes': GaussianNB(),
    'Support Vector Machine': SVC(),
    'K-Nearest Neighbors': KNeighborsClassifier(),
    'Decision Tree': DecisionTreeClassifier(),
    'Random Forest': RandomForestClassifier(),
    'Bagging': BaggingClassifier(),
    'AdaBoost': AdaBoostClassifier(),
    'Gradient Boosting': GradientBoostingClassifier(),
    'Extra Trees': ExtraTreeClassifier(),
}


for name, md in models.items():
    md.fit(X_train,y_train)
    ypred = md.predict(X_test)

    print(f"{name}  with accuracy : {accuracy_score(y_test,ypred)}")
```

```
     Logistic Regression  with accuracy : 0.9636363636363636
     Naive Bayes  with accuracy : 0.9954545454545455
     Support Vector Machine  with accuracy : 0.9681818181818181
     K-Nearest Neighbors  with accuracy : 0.9590909090909091
     Decision Tree  with accuracy : 0.9818181818181818
     Random Forest  with accuracy : 0.9931818181818182
     Bagging  with accuracy : 0.9886363636363636
     AdaBoost  with accuracy : 0.1409090909090909
     Gradient Boosting  with accuracy : 0.9818181818181818
     Extra Trees  with accuracy : 0.9340909090909091
```

```
rfc =RandomForestClassifier()
rfc.fit(X_train,y_train)
ypred = rfc.predict(X_test)
accuracy_score(y_test,ypred)
```

```
     0.9931818181818182
```

Predictive System

```
def recommendation(N,P,k,temperature,humidity,ph,rainfall):
 features = np.array([[N,P,k,temperature,humidity,ph,rainfall]])
 prediction = rfc.predict(features).reshape(1,-1)


 return prediction[0]
```

```
N=50
P=60
k=50
temperature=30.0
humidity=20
ph=100
rainfall=100


predict=recommendation(N,P,k,temperature,humidity,ph,rainfall)

crop_dict ={1: "Rice", 2: "Maize", 3: "Jute", 4: "Cotton", 5: "Coconut", 6: "Papaya", 7: "Orange",
                 8: "Apple", 9: "Muskmelon", 10: "Watermelon", 11: "Grapes", 12: "Mango", 13: "Banana",
                 14: "Pomegranate", 15: "Lentil", 16: "Blackgram", 17: "Mungbean", 18: "Mothbeans",
                 19: "Pigeonpeas", 20: "Kidneybeans", 21: "Chickpea", 22: "Coffee"}

if predict[0] in crop_dict:
    crop = crop_dict[predict[0]]
    print("{} is a best crop to be cultivated ".format(crop))
else:
    print("Sorry we are not able to recommend a proper crop for this environment")

 Apple is a best crop to be cultivated


import pickle
pickle.dump(rfc,open('model.pkl','wb'))


crop['label'].value_
```