```
import seaborn as sns  # for data visualization
import matplotlib.pyplot as plt
import numpy as np  # for operations on data
import pandas as pd  # for loading dataset
from sklearn.impute import SimpleImputer  # for preprocessing
from sklearn.preprocessing import LabelEncoder, OneHotEncoder, StandardScaler, MinMaxScaler
from sklearn.model_selection import train_test_split  # for splitting dataset
from sklearn.decomposition import PCA
from sklearn.linear_model import LogisticRegression
from sklearn.metrics import accuracy_score, classification_report, precision_score, f1_score
from sklearn.svm import SVC
from sklearn.tree import DecisionTreeClassifier
from sklearn.metrics import confusion_matrix
```

```
df=pd.read_csv("/content/Crop_recommendation.csv")
```

```
df1=df.copy(deep=True)
```

```
df.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

Next steps: View recommended plots

```
df.tail()
```

	N	P	K	temperature	humidity	ph	rainfall	label
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

```
df.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
```

```
df.describe()
```

	N	P	K	temperature	humidity	ph	rainfall
count	2200.000000	2200.000000	2200.000000	2200.000000	2200.000000	2200.000000	2200.000000
mean	50.551818	53.362727	48.149091	25.616244	71.481779	6.469480	103.463655
std	36.917334	32.985883	50.647931	5.063749	22.263812	0.773938	54.958389
min	0.000000	5.000000	5.000000	8.825675	14.258040	3.504752	20.211267
25%	21.000000	28.000000	20.000000	22.769375	60.261953	5.971693	64.551686
50%	37.000000	51.000000	32.000000	25.598693	80.473146	6.425045	94.867624
75%	84.250000	68.000000	49.000000	28.561654	89.948771	6.923643	124.267508
max	140.000000	145.000000	205.000000	43.675493	99.981876	9.935091	298.560117

```
crop={}
temp=set()
for i in df["label"]:
  temp.add(i)
index=0
for k in sorted(list(temp)):
  if k not in dict:
    crop[index]=k
    index+=1
```

```
print(crop)
```

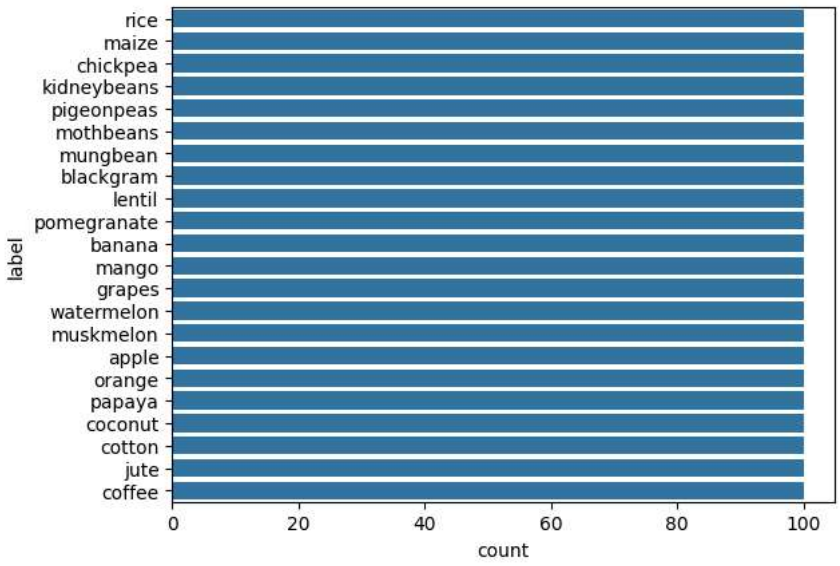
```
{0: 'apple', 1: 'banana', 2: 'blackgram', 3: 'chickpea', 4: 'coconut', 5: 'coffee', 6: 'cotton', 7: 'grapes', 8: 'jute', 9: 'kidneybean
```

```
df.isnull().sum()
```

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

```
num_cols = df[["N","K","P","ph","humidity","rainfall","temperature"]]
cat_cols = df[["label"]]
```

```
sb.countplot(y="label", data=df)
plt.show()
```



```
#Categorical Values
print(df['label'])
```

```
0         rice
1         rice
2         rice
3         rice
4         rice
         ...
2195    coffee
2196    coffee
2197    coffee
2198    coffee
2199    coffee
Name: label, Length: 2200, dtype: object
```

```
le = LabelEncoder()
df['label'] = le.fit_transform(df['label'])
```

```
#Numerical Values
print(df['label'])
```

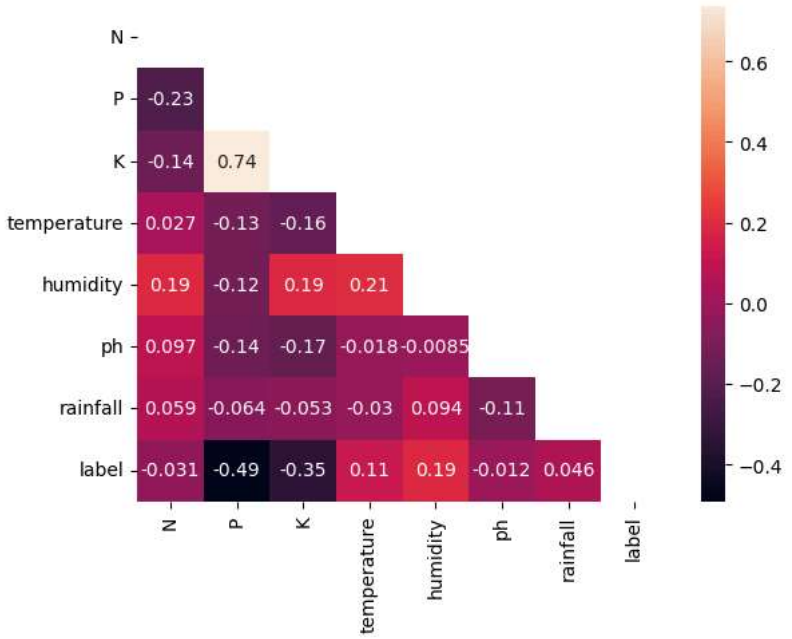
```
0       20
1       20
2       20
3       20
4       20
        ..
2195     5
2196     5
2197     5
2198     5
2199     5
Name: label, Length: 2200, dtype: int64
```

```
a=df.corr()
a.style.background_gradient()
```

	N	P	K	temperature	humidity	ph	rainfall	label
N	1.000000	-0.231460	-0.140512	0.026504	0.190688	0.096683	0.059020	-0.031130
P	-0.231460	1.000000	0.736232	-0.127541	-0.118734	-0.138019	-0.063839	-0.491006
K	-0.140512	0.736232	1.000000	-0.160387	0.190859	-0.169503	-0.053461	-0.346417
temperature	0.026504	-0.127541	-0.160387	1.000000	0.205320	-0.017795	-0.030084	0.113606
humidity	0.190688	-0.118734	0.190859	0.205320	1.000000	-0.008483	0.094423	0.193911
ph	0.096683	-0.138019	-0.169503	-0.017795	-0.008483	1.000000	-0.109069	-0.012253
rainfall	0.059020	-0.063839	-0.053461	-0.030084	0.094423	-0.109069	1.000000	0.045611
label	-0.031130	-0.491006	-0.346417	0.113606	0.193911	-0.012253	0.045611	1.000000

```
sb.heatmap(a,annot=True,mask=np.triu(a))
```

```
<Axes: >
```




```
def outlier_analysis(f_q, t_q):
    shape_first = num_cols.shape[0] # get initial no. of rows (row size,col size)
    col='ph'
    Q1 = num_cols[col].quantile(f_q) # First Quartile
    Q3 = num_cols[col].quantile(t_q) # Third Quartile
    IQR = Q3 - Q1 # interquartile range
    min_ = Q1 - 1.5 * IQR # for non-outliers Q1-1.5IQR<=X<=Q3+1.5IQR
    max_ = Q3 + 1.5 * IQR
    filter_ = (num_cols[col] < min_) | (num_cols[col] > max_) # get col withb corresponding bool
    if num_cols.loc[filter_].any(axis = None): # check for outlier in any row
        cat_cols.drop(num_cols.loc[filter_].index, inplace=True) # .index retrieves row no.
        num_cols.drop(num_cols.loc[filter_].index, inplace=True) # separately drop then combine
    else:
        print(f"There is no outlier for {col} column.")
    shape_last = num_cols.shape[0]
    outlier_percentage = ((shape_first - shape_last) / shape_first) * 100
    print("{:.2f}% observations have been dropped as outlier.".format(outlier_percentage))
outlier_analysis(0.2, 0.8) # we can customize the definition for quartiles
df = pd.concat([num_cols,cat_cols], axis=1)
```

```
 1.36% observations have been dropped as outlier.
 <ipython-input-88-09e70c8967a0>:11: SettingWithCopyWarning:
 A value is trying to be set on a copy of a slice from a DataFrame

 See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-c
   cat_cols.drop(num_cols.loc[filter_].index, inplace=True) # .index retrieves row no.
 <ipython-input-88-09e70c8967a0>:12: SettingWithCopyWarning:
 A value is trying to be set on a copy of a slice from a DataFrame

 See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-c
   num_cols.drop(num_cols.loc[filter_].index, inplace=True) # separately drop then combine
```

```
le = LabelEncoder() #Create object for class to access its functions
df['label'] = le.fit_transform(df['label'])
df.tail(5)
```

	N	K	P	ph	humidity	rainfall	temperature	label
2195	107	32	34	6.780064	66.413269	177.774507	26.774637	5
2196	99	27	15	6.086922	56.636362	127.924610	27.417112	5
2197	118	30	33	6.362608	67.225123	173.322839	24.131797	5
2198	117	34	32	6.758793	52.127394	127.175293	26.272418	5
2199	104	30	18	6.779833	60.396475	140.937041	23.603016	5

```
x= df.iloc[:, [0,1,2,3,4,5,6]].values
y= df["label"].values
x_train, x_test, y_train, y_test= train_test_split(x, y, test_size= 0.20, random_state=100) # 20% test
st_x= StandardScaler() #create object
y_t=y_train
x_train= st_x.fit_transform(x_train) #standardize by shifting mean and scaling SD
x_test= st_x.transform(x_test)
x_test
```

```
array([[ 1.86507501,  0.07582936,  1.0267091 , ...,  0.17865519,
         0.26445285,  0.48678633],
       [-0.62789371,  3.01838878,  2.51178762, ...,  0.91908547,
         0.18794326, -0.49980808],
       [-1.11564846,  2.93886015,  2.17840265, ...,  0.81216092,
         0.15787709, -0.64727523],
       ...,
       [-0.57369874, -0.46098891,  0.6630164 , ..., -1.34852847,
         0.809744  ,  0.93072228],
       [ 1.29602781, -0.22240301,  0.02655418, ...,  0.37258768,
         1.69806053, -0.87729065],
       [-0.54660125,  2.93886015,  2.54209534, ...,  0.98389417,
         0.29393655, -0.68030905]])
```

```
y_t
```

```
array([19,  3,  9, ..., 20,  4,  0])
```

```
pca=PCA()
pca.fit(x_train)
```

```
PCA()
```

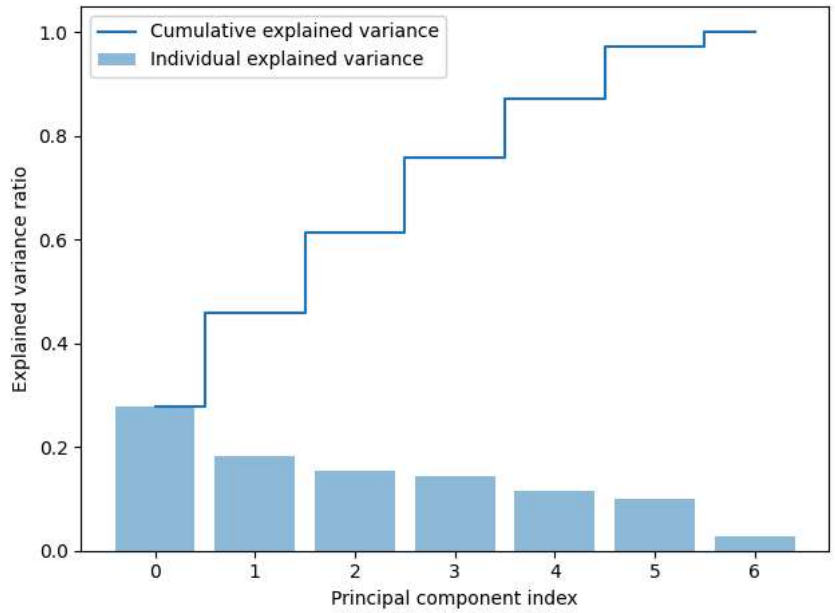
```
x_pca=pca.transform(x_train)
x_t_pca=pca.transform(x_test)
x_test
```

```
array([[ 1.86507501,  0.07582936,  1.0267091 , ...,  0.17865519,
         0.26445285,  0.48678633],
       [-0.62789371,  3.01838878,  2.51178762, ...,  0.91908547,
         0.18794326, -0.49980808],
       [-1.11564846,  2.93886015,  2.17840265, ...,  0.81216092,
         0.15787709, -0.64727523],
       ...,
       [-0.57369874, -0.46098891,  0.6630164 , ..., -1.34852847,
         0.809744  ,  0.93072228],
       [ 1.29602781, -0.22240301,  0.02655418, ...,  0.37258768,
         1.69806053, -0.87729065],
       [-0.54660125,  2.93886015,  2.54209534, ...,  0.98389417,
         0.29393655, -0.68030905]])
```

```
x_pca.shape
```

```
(1736, 7)
```

```
exp_var_pca = pca.explained_variance_ratio_
# Cumulative sum of eigenvalues; This will be used to create step plot
# for visualizing the variance explained by each principal component.
cum_sum_eigenvalues = np.cumsum(exp_var_pca)
# Create the visualization plot
plt.bar(range(0,len(exp_var_pca)), exp_var_pca, alpha=0.5, align='center', label='Individual explained variance')
plt.step(range(0,len(cum_sum_eigenvalues)), cum_sum_eigenvalues, where='mid',label='Cumulative explained variance')
plt.ylabel('Explained variance ratio')
plt.xlabel('Principal component index')
plt.legend(loc='best')
plt.tight_layout()
plt.show()
```




```
def model_train(model):
    model.fit(x_pca, y_train)
    y_pred = model.predict(x_t_pca)
    score = model.score(x_t_pca, y_test)
    print("accuracy ", score)
    print(classification_report(y_test, y_pred))
    print(confusion_matrix(y_test, y_pred))  # Corrected this line
    print("precision ", precision_score(y_test, y_pred, average=None))
    print("f_score ", f1_score(y_test, y_pred, average=None))


model_train(LogisticRegression())
```

```
                8       1.00      0.93      0.97        15
                9       1.00      1.00      1.00        22
               10       0.91      1.00      0.95        21
               11       1.00      1.00      1.00        20
               12       0.96      1.00      0.98        22
               13       1.00      0.83      0.91        12
               14       1.00      1.00      1.00        20
               15       1.00      1.00      1.00        17
               16       1.00      0.94      0.97        16
               17       1.00      0.89      0.94        19
               18       1.00      1.00      1.00        19
               19       1.00      1.00      1.00        17
               20       0.88      1.00      0.94        15
               21       1.00      1.00      1.00        14

         accuracy                           0.98       434
        macro avg       0.99      0.98      0.98       434
     weighted avg       0.99      0.98      0.98       434

    [[20  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
     [ 0 18  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
     [ 0  0 23  0  0  0  0  0  0  0  1  0  0  0  0  0  0  0  0  0  0  0]
     [ 0  0  0 23  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
     [ 0  0  0  0 24  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
     [ 0  0  0  0  0 27  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
     [ 0  0  0  0  0  0 25  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
     [ 0  0  0  0  0  0  0 24  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
     [ 0  0  0  0  0  1  0  0 14  0  0  0  0  0  0  0  0  0  0  0  0  0]
     [ 0  0  0  0  0  0  0  0  0 22  0  0  0  0  0  0  0  0  0  0  0  0]
     [ 0  0  0  0  0  0  0  0  0  0 21  0  0  0  0  0  0  0  0  0  0  0]
```

```
precision  [1.         1.         1.         1.         0.90       0.96428571
 1.         1.         1.         1.         0.91304348 1.
 0.95652174 1.         1.         1.         1.         1.
 1.         1.         0.88235294 1.        ]
f_score  [1.         1.         0.9787234  1.         0.97959184 0.98181818
 1.         1.         0.96551724 1.         0.95454545 1.
 0.97777778 0.90909091 1.         1.         0.96774194 0.94444444
 1.         1.         0.9375     1.        ]
/usr/local/lib/python3.10/dist-packages/sklearn/linear_model/_logistic.py:458: ConvergenceWarning: lbfgs failed to converge (status=1
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
```

```
model_train(SVC(kernel = 'linear'))
```

```
accuracy  0.9976958525345622
              precision    recall  f1-score   support

           0       1.00      1.00      1.00        20
           1       1.00      1.00      1.00        18
           2       1.00      1.00      1.00        24
           3       1.00      1.00      1.00        23
           4       1.00      1.00      1.00        24
           5       1.00      1.00      1.00        27
           6       1.00      1.00      1.00        25
           7       1.00      1.00      1.00        24
           8       1.00      1.00      1.00        15
           9       1.00      1.00      1.00        22
          10       0.95      1.00      0.98        21
          11       1.00      1.00      1.00        20
          12       1.00      1.00      1.00        22
          13       1.00      0.92      0.96        12
          14       1.00      1.00      1.00        20
          15       1.00      1.00      1.00        17
          16       1.00      1.00      1.00        16
          17       1.00      1.00      1.00        19
          18       1.00      1.00      1.00        19
          19       1.00      1.00      1.00        17
          20       1.00      1.00      1.00        15
          21       1.00      1.00      1.00        14

    accuracy                           1.00       434
   macro avg       1.00      1.00      1.00       434
weighted avg       1.00      1.00      1.00       434

[[20  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
 [ 0 18  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
 [ 0  0 24  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
 [ 0  0  0 23  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  0 24  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  0  0 27  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  0  0  0 25  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  0  0  0  0 24  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  0  0  0  0  0 15  0  0  0  0  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  0  0  0  0  0  0 22  0  0  0  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  0  0  0  0  0  0  0 21  0  0  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  0  0  0  0  0  0  0  0 20  0  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  0  0  0  0  0  0  0  0  0 22  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  0  0  0  0  0  0  0  0  1  0  0 11  0  0  0  0  0  0  0]
 [ 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0 20  0  0  0  0  0  0]
 [ 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0 17  0  0  0  0  0]
 [ 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0 16  0  0  0  0]
 [ 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0 19  0  0  0]
 [ 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0 19  0  0]
 [ 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0 17  0]
 [ 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0 15]
 [ 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0 14]]
precision  [1.         1.         1.         1.         1.         1.
 1.         1.         1.         1.         0.95454545 1.
 1.         1.         1.         1.         1.         1.
 1.         1.         1.         1.        ]
f_score  [1.         1.         1.         1.         1.         1.
 1.         1.         1.         1.         0.97674419 1.
```

```
model_train(DecisionTreeClassifier(random_state=42))
```

```
                2       0.92      0.96      0.94        24
                3       1.00      1.00      1.00        23
                4       0.92      0.96      0.94        24
                5       1.00      1.00      1.00        27
                6       0.83      0.96      0.89        25
                7       1.00      1.00      1.00        24
                8       0.82      0.93      0.87        15
                9       1.00      1.00      1.00        22
               10       0.80      0.95      0.87        21
               11       1.00      0.70      0.82        20
               12       1.00      1.00      1.00        22
               13       0.62      0.83      0.71        12
               14       1.00      0.85      0.92        20
               15       1.00      1.00      1.00        17
               16       1.00      0.88      0.93        16
               17       0.94      0.89      0.92        19
               18       0.89      0.84      0.86        19
               19       1.00      0.88      0.94        17
               20       1.00      0.87      0.93        15
               21       0.88      1.00      0.93        14

    accuracy                           0.94       434
   macro avg       0.94      0.93      0.93       434
weighted avg       0.94      0.94      0.94       434

[[20  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
 [ 0 17  0  0  0  0  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
 [ 0  0 23  0  0  0  0  0  0  0  1  0  0  0  0  0  0  0  0  0  0  0]
 [ 0  0  0 23  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  0 23  0  0  0  0  0  0  0  0  0  0  0  0  1  0  0  0  0]
 [ 0  0  0  0  0 27  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  0  0  0 24  0  0  0  0  0  0  0  0  0  0  0  0  0  0  1]
 [ 0  0  0  0  0  0  0 24  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  0  0  0  0  0 14  0  0  0  0  0  0  0  0  1  0  0  0  0]
 [ 0  0  0  0  0  0  0  0  0 22  0  0  0  0  0  0  0  0  0  0  0  0]
 [ 0  0  1  0  0  0  0  0  0  0 20  0  0  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  0  0  0  3  0  0  0  3 14  0  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  0  0  0  0  0  0  0  0  0 22  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  0  0  0  0  0  0  0  1  0  0 10  0  0  0  0  1  0  0  0]
 [ 0  0  1  0  0  0  0  0  0  0  0  0  0  2 17  0  0  0  0  0  0  0]
 [ 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0 17  0  0  0  0  0  0]
 [ 0  0  0  0  1  0  0  0  0  0  0  0  0  1  0  0 14  0  0  0  0  0]
 [ 0  0  0  0  0  0  0  0  2  0  0  0  0  0  0  0  0 17  0  0  0  0]
 [ 0  0  0  0  0  0  0  0  0  0  0  0  0  3  0  0  0  0 16  0  0  0]
 [ 0  0  0  0  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0 15  0  1]
 [ 0  0  0  0  0  0  1  0  1  0  0  0  0  0  0  0  0  0  0  0 13  0]
 [ 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0 14]]
precision  [1.         1.         0.92       1.         0.92       1.
 0.82758621 1.         0.82352941 1.         0.8        1.
 1.         0.625      1.         1.         1.         0.94444444
 0.88888889 1.         1.         0.875     ]
f_score  [1.         0.97142857 0.93877551 1.         0.93877551 1.
 0.88888889 1.         0.875      1.         0.86956522 0.82352941
 1.         0.71428571 0.91891892 1.         0.93333333 0.91891892
 0.86486486 0.9375     0.92857143 0.93333333]
```

```
model_train(SVC(kernel = 'rbf'))
```

```
accuracy  0.9930875576036866
              precision    recall  f1-score   support

           0       1.00      1.00      1.00        20
           1       1.00      1.00      1.00        18
           2       1.00      1.00      1.00        24
           3       1.00      1.00      1.00        23
           4       1.00      1.00      1.00        24
           5       1.00      1.00      1.00        27
           6       1.00      1.00      1.00        25
           7       1.00      1.00      1.00        24
           8       0.94      1.00      0.97        15
           9       1.00      1.00      1.00        22
          10       0.91      1.00      0.95        21
          11       1.00      1.00      1.00        20
          12       1.00      1.00      1.00        22
          13       1.00      0.83      0.91        12
          14       1.00      1.00      1.00        20
          15       1.00      1.00      1.00        17
          16       1.00      1.00      1.00        16
          17       1.00      1.00      1.00        19
          18       1.00      1.00      1.00        19
          19       1.00      1.00      1.00        17
          20       1.00      0.93      0.97        15
          21       1.00      1.00      1.00        14
```

```
    accuracy                           0.99       434
   macro avg       0.99      0.99      0.99       434
weighted avg       0.99      0.99      0.99       434

[[20  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
 [ 0 18  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
 [ 0  0 24  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
 [ 0  0  0 23  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  0 24  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  0  0 27  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  0  0  0 25  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  0  0  0  0 24  0  0  0  0  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  0  0  0  0  0 15  0  0  0  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  0  0  0  0  0  0 22  0  0  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  0  0  0  0  0  0  0 21  0  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  0  0  0  0  0  0  0  0 20  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  0  0  0  0  0  0  0  0  0 22  0  0  0  0  0  0  0  0]
 [ 0  0  0  0  0  0  0  0  0  0  2  0  0 10  0  0  0  0  0  0  0]
 [ 0  0  0  0  0  0  0  0  0  0  0  0  0  0 20  0  0  0  0  0  0]
 [ 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0 17  0  0  0  0  0]
 [ 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0 16  0  0  0  0]
 [ 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0 19  0  0  0]
 [ 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0 19  0  0]
 [ 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0 17  0]
 [ 0  0  0  0  0  0  0  0  1  0  0  0  0  0  0  0  0  0  0  0 14]
 [ 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0 14]]
precision  [1.         1.         1.         1.         1.         1.
 1.         1.         0.9375     1.         0.91304348 1.
 1.         1.         1.         1.         1.
 1.         1.         1.         1.        ]
f_score  [1.         1.         1.         1.         1.         1.
 1.         1.         0.96774194 1.         0.95454545 1.
```

```
model_train(SVC(kernel = 'poly'))
```

```
accuracy  0.9331797235023042
              precision    recall  f1-score   support

           0       1.00      1.00      1.00        20
           1       1.00      0.94      0.97        18
           2       1.00      0.88      0.93        24
           3       1.00      1.00      1.00        23
           4       0.96      1.00      0.98        24
           5       1.00      0.85      0.92        27
           6       1.00      0.92      0.96        25
           7       1.00      1.00      1.00        24
           8       0.67      0.80      0.73        15
           9       1.00      1.00      1.00        22
          10       0.88      1.00      0.93        21
          11       0.53      1.00      0.69        20
          12       1.00      0.95      0.98        22
          13       1.00      0.75      0.86        12
          14       1.00      1.00      1.00        20
          15       1.00      1.00      1.00        17
          16       1.00      0.88      0.93        16
          17       1.00      0.74      0.85        19
          18       1.00      0.84      0.91        19
          19       0.94      1.00      0.97        17
          20       1.00      0.87      0.93        15
          21       1.00      1.00      1.00        14

    accuracy                           0.93       434
   macro avg       0.95      0.93      0.93       434
weighted avg       0.96      0.93      0.94       434

[[20  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
 [ 0 17  0  0  0  0  0  0  0  0  0  1  0  0  0  0  0  0  0  0  0]
 [ 0  0 21  0  0  0  0  0  0  0  0  3  0  0  0  0  0  0  0  0  0]
 [ 0  0  0 23  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  0 24  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  0  0 23  0  0  1  0  0  3  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  0  0  0 23  0  0  0  0  2  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  0  0  0  0 24  0  0  0  0  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  0  0  0  0  0 12  0  0  3  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  0  0  0  0  0  0 22  0  0  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  0  0  0  0  0  0  0 21  0  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  0  0  0  0  0  0  0  0 20  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  0  0  0  0  0  0  0  0  1 21  0  0  0  0  0  0  0  0]
 [ 0  0  0  0  0  0  0  0  0  0  3  0  0  9  0  0  0  0  0  0  0]
 [ 0  0  0  0  0  0  0  0  0  0  0  0  0  0 20  0  0  0  0  0  0]
 [ 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0 17  0  0  0  0  0]
 [ 0  0  0  0  1  0  0  0  0  0  0  0  0  0  0  0 14  0  0  1  0]
 [ 0  0  0  0  0  0  0  0  3  0  0  2  0  0  0  0  0 14  0  0  0]
 [ 0  0  0  0  0  0  0  0  0  0  0  3  0  0  0  0  0  0 16  0  0]
```

```
 [ 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0 17  0  0]
 [ 0  0  0  0  0  0  0  0  2  0  0  0  0  0  0  0  0  0 13  0]
 [ 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0 14]]
precision  [1.         1.         1.         1.         0.96       1.
 1.         1.         0.66666667 1.         0.875      0.52631579
 1.         1.         1.         1.         1.         1.
 1.         0.94444444 1.         1.        ]
f_score  [1.         0.97142857 0.93333333 1.         0.97959184 0.92
 0.95833333 1.         0.72727273 1.         0.93333333 0.68965517
```

```
print("Enter N K P PH humidity rainfall temparature accordingly")
arr=[float(input()) for i in range(7)]
```

```
Enter N K P PH humidity rainfall temparature accordingly
100
23
45
56
4.5
4.7
3.6
```

```
arr=np.array([arr])
arr
```

```
array([[100. ,  23. ,  45. ,  56. ,   4.5,   4.7,   3.6]])
```

```
x_i=st_x.transform(arr)
x_i=pca.transform(x_i)
x_i
```

```
array([[-17.64039512,  12.63422887, -40.88957981, -27.21390004,
```