```
import time
import numpy as np
import pandas as pd
import seaborn as sns
from sklearn.svm import SVC
from matplotlib import pyplot as plt
from sklearn.ensemble import VotingClassifier
from sklearn.tree import DecisionTreeClassifier
pd.pandas.set_option('display.max_columns', None)
from sklearn.neighbors import KNeighborsClassifier
from sklearn.linear_model import LogisticRegression
from sklearn.inspection import permutation_importance
from sklearn.model_selection import train_test_split, cross_val_score
from sklearn.metrics import accuracy_score, f1_score, recall_score,
r2_score, confusion_matrix, precision_score
```

```
data_set = pd.read_csv('corona_tested_individuals.csv')
```

```
C:\Users\sujith kumar\anaconda3\lib\site-packages\IPython\core\
interactiveshell.py:3012: DtypeWarning: Columns (1,2,3,4,5) have mixed
types.Specify dtype option on import or set low_memory=False.
  has_raised = await self.run_ast_nodes(code_ast.body, cell_name,
```

```
data_set.head()
```

```
    test_date cough fever sore_throat shortness_of_breath head_ache  \
0  2020-04-30     0     0           0                   0         0   
1  2020-04-30     1     0           0                   0         0   
2  2020-04-30     0     1           0                   0         0   
3  2020-04-30     1     0           0                   0         0   
4  2020-04-30     1     0           0                   0         0   

  corona_result age_60_and_above  gender test_indication  
0      negative             None  female           Other  
1      negative             None  female           Other  
2      negative             None    male           Other  
3      negative             None  female           Other  
4      negative             None    male           Other  
```

Data set contains 9 features and one target variable ('Corona result')

- test-date : This features give us a information about when the test is done and result is noted down.
- cough: It reveals whether or not the patient has a cough.
- fever: It tells whether or not the patient has a temperature.
- sore_throat: It reveals whether or not the patient has a sore throat.
- shortness_of_breath: It reveals whether or not the patient is experiencing shortness of breath.
- head_ache: It indicates whether or not the patient is suffering from a headache..
- age_60_and_above: It indicates whether the patient is over the age of 60.

- gender: This characteristic identifies whether the patient is male or female.
- test_indication: This features says whether the covid- 19 is transfer via aboard or confirmed with contact or some other reson.
- corona result: This trait indicates whether or not a person has covid-19.

Data Preprocessing

```
# Droping test_date because it does not effect the output much.

data_set.drop('test_date', inplace=True, axis=1)

data_set['cough'].unique()

array([0, 1, '0', '1', 'None'], dtype=object)

data_set = data_set[data_set['cough']!='None']
data_set = data_set[data_set['fever']!='None']

data_set.replace(['1', '0'], [1, 0], inplace=True)

np.unique(data_set['corona_result'])

array(['negative', 'other', 'positive'], dtype=object)

# lets drop other columns and focus more on negative and positive
results.
data_set = data_set[data_set['corona_result']!='other']

np.unique(data_set['corona_result'])

array(['negative', 'positive'], dtype=object)

data_set['corona_result'].replace(['negative', 'positive'], [0, 1],
inplace=True)

np.unique(data_set['age_60_and_above'])
# lets drop None columns and focus more on No and Yes results.
data_set = data_set[data_set['age_60_and_above']!='None']

data_set['age_60_and_above'].replace(['No', 'Yes'], [0, 1],
inplace=True)

np.unique(data_set['gender'])
data_set = data_set[data_set['gender']!='None']

data_set['gender'].replace(['female', 'male'], [0, 1], inplace=True)

np.unique(data_set['test_indication'])

array(['Abroad', 'Contact with confirmed', 'Other'], dtype=object)
```

```
dummies = pd.get_dummies(data_set['test_indication'])
data_set.drop('test_indication', inplace=True, axis=1)
data_set = pd.concat([data_set, dummies], axis=1)
```

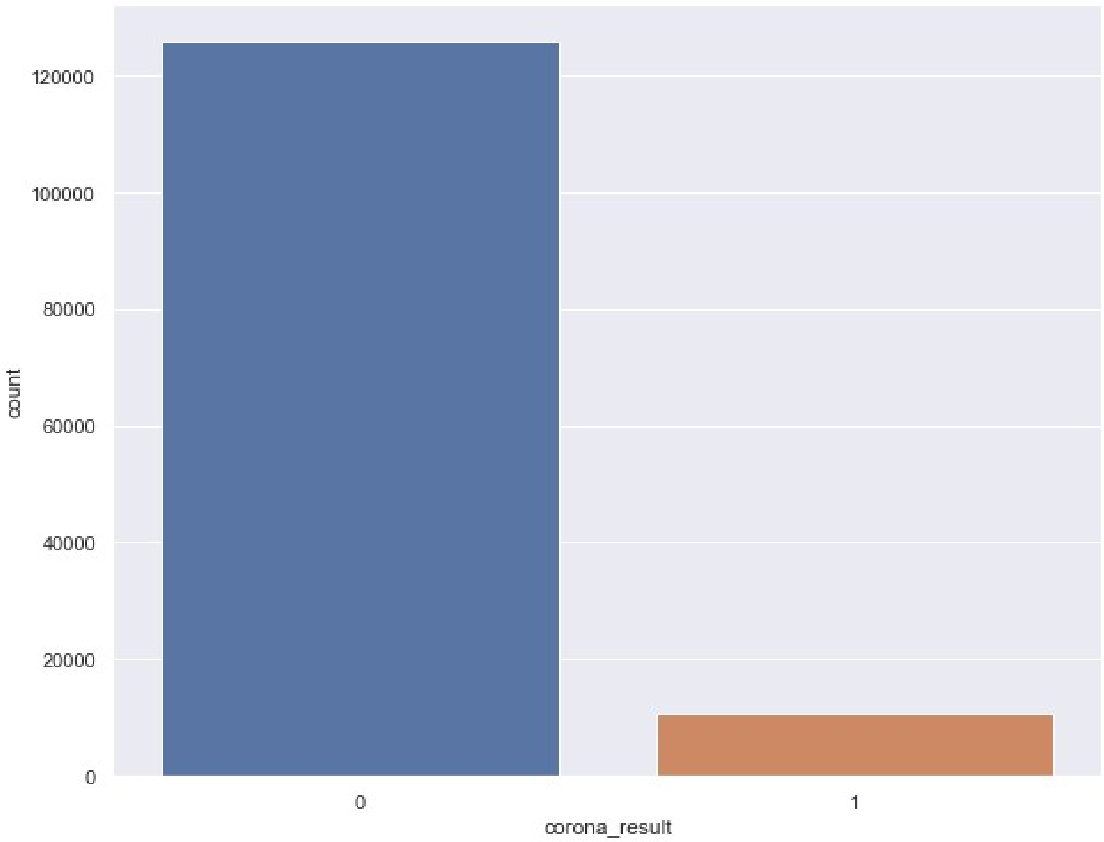
```
data_set.head()
```

```
        cough  fever  sore_throat  shortness_of_breath  head_ache  \
122808      1      0            0                    0          0   
122809      1      0            0                    0          0   
122810      0      0            0                    0          0   
122811      0      1            0                    0          0   
122812      1      0            0                    0          0   

        corona_result  age_60_and_above  gender  Abroad  \
122808              0                 1       1       0   
122809              1                 0       0       0   
122810              0                 0       0       0   
122811              0                 0       0       1   
122812              0                 1       0       0   

        Contact with confirmed  Other  
122808                       0      1  
122809                       0      1  
122810                       0      1  
122811                       0      0  
122812                       0      1  
```

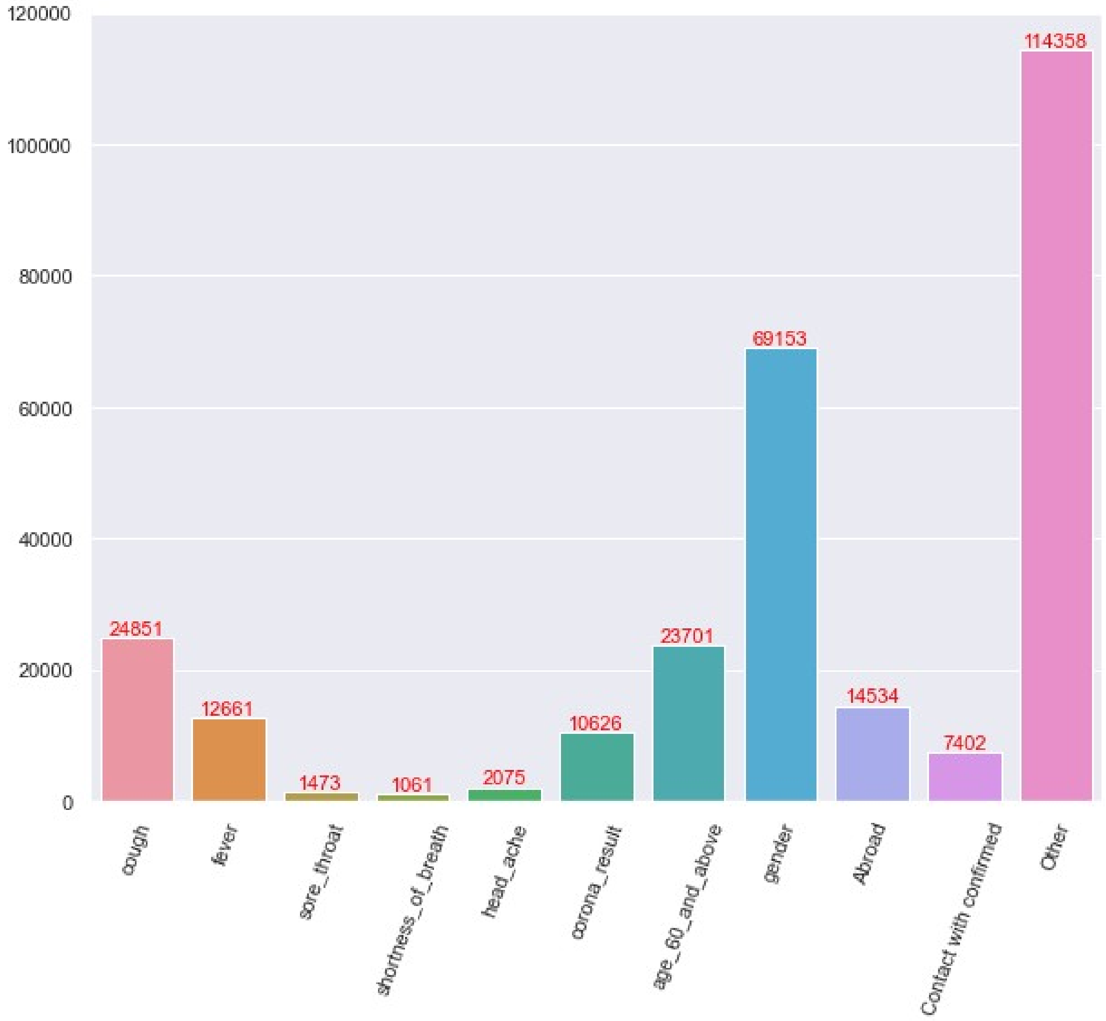
Data Visualization

```
sns.set(rc = {'figure.figsize':(10,8)})
sns.countplot(x=data_set['corona_result'])
```

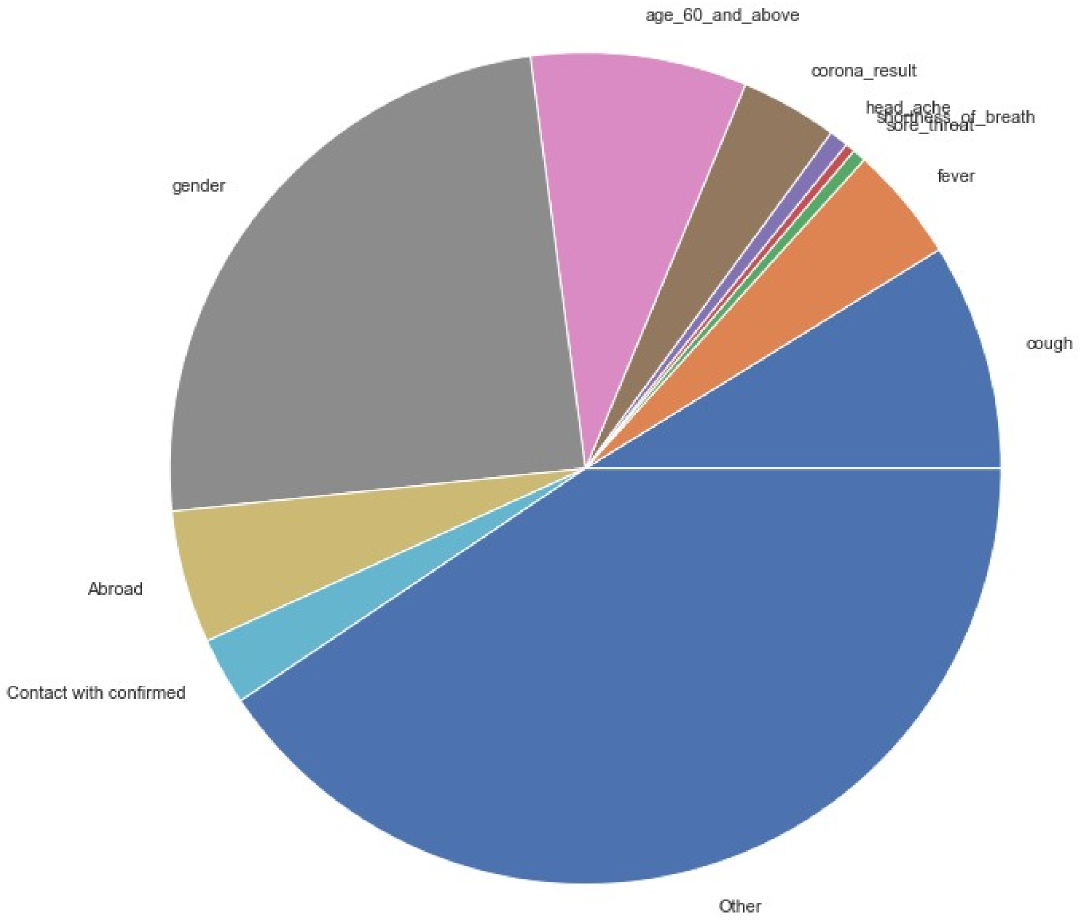
```
<AxesSubplot:xlabel='corona_result', ylabel='count'>
```



```
feature_count = [sum(data_set[unique_characteristic].values) for
unique_characteristic in data_set]

bar_plot = sns.barplot(x = data_set.columns, y = feature_count)
plt.setp(bar_plot.get_xticklabels(), rotation=70)
for i in range(len(feature_count)):
    bar_plot.text(i, feature_count[i]+500, str(feature_count[i]),
fontdict= dict(color='red', fontsize= 11), horizontalalignment =
"center")
```

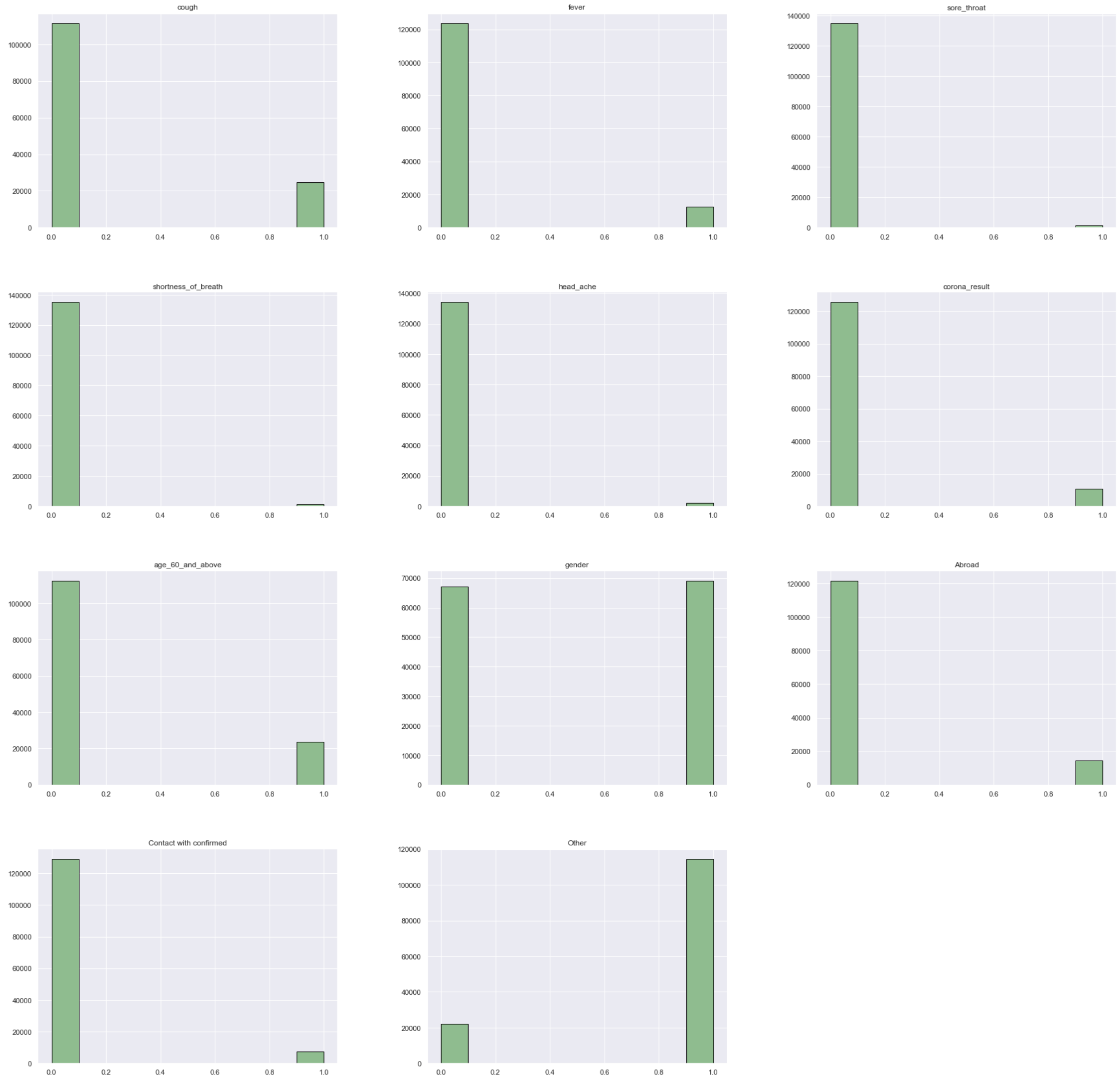


```
plt.figure(figsize = (12 ,12))
pie_plot = plt.pie(data=data_set, x=feature_count,
labels=data_set.columns)
plt.show()
```

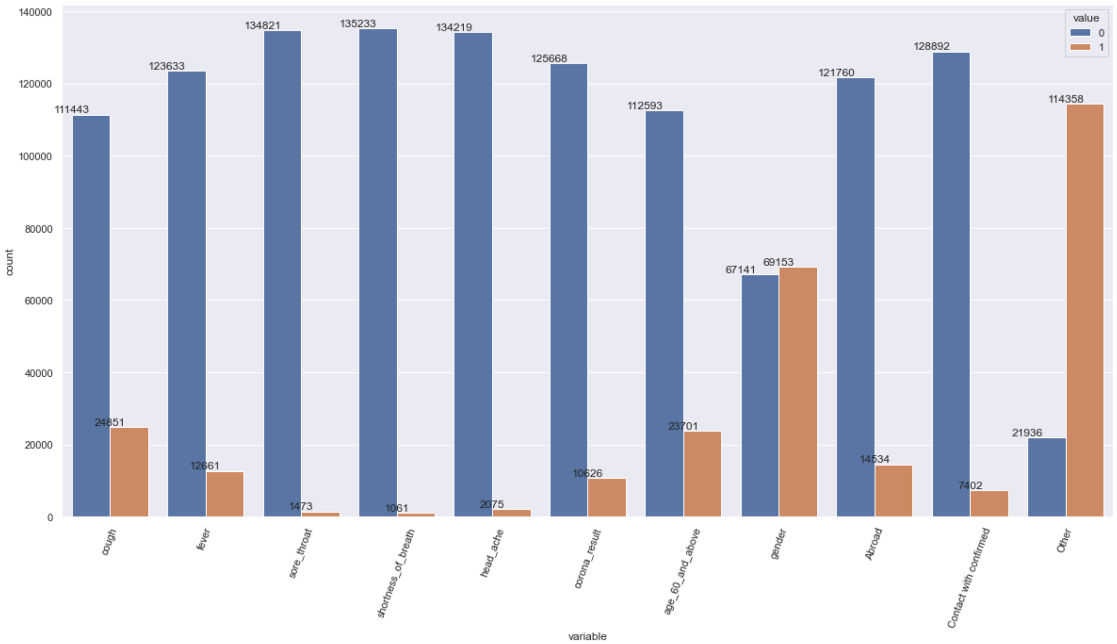


```
data_set.hist(figsize=(30,30), edgecolor='black',
color='darkseagreen')
```

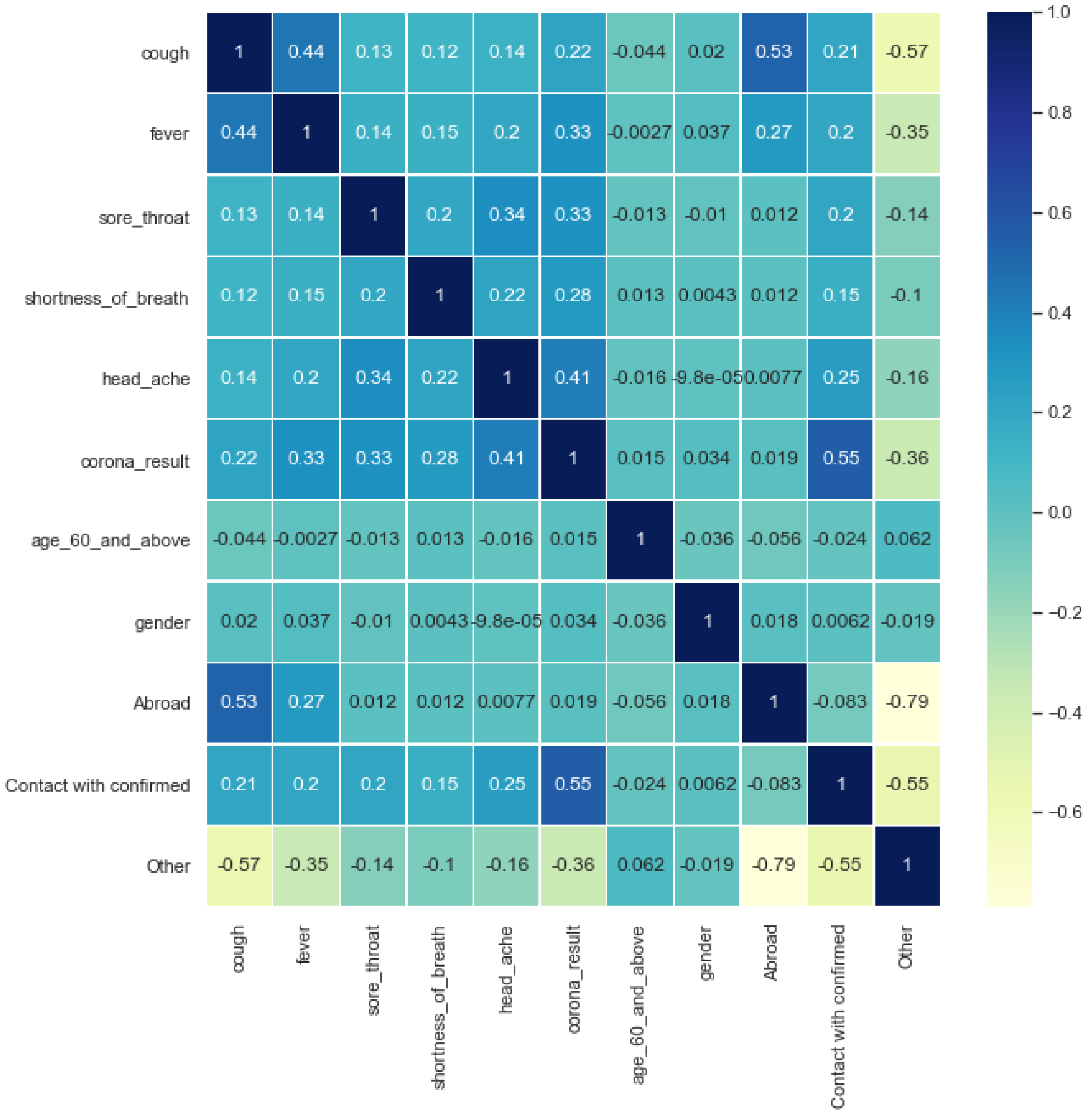
```
array([[<AxesSubplot:title={'center':'cough'}>,
        <AxesSubplot:title={'center':'fever'}>,
        <AxesSubplot:title={'center':'sore_throat'}>],
       [<AxesSubplot:title={'center':'shortness_of_breath'}>,
        <AxesSubplot:title={'center':'head_ache'}>,
        <AxesSubplot:title={'center':'corona_result'}>],
       [<AxesSubplot:title={'center':'age_60_and_above'}>,
        <AxesSubplot:title={'center':'gender'}>,
        <AxesSubplot:title={'center':'Abroad'}>],
       [<AxesSubplot:title={'center':'Contact with confirmed'}>,
        <AxesSubplot:title={'center':'Other'}>, <AxesSubplot:>]],
      dtype=object)
```



```
plt.figure(figsize = (20 ,10))
count_plots = sns.countplot(x="variable", hue="value",
data=pd.melt(data_set))
plt.setp(count_plots.get_xticklabels(), rotation=70)
for p in count_plots.patches:
        count_plots.annotate(int(p.get_height()), (p.get_x(),
p.get_height()+500), horizontalalignment = "center")
plt.show()
```



```
sns.heatmap(data_set.corr(),annot=True,cmap='YlGnBu',linewidths=0.4,
annot_kws={"size": 12})
fig=plt.gcf()
fig.set_size_inches(10,10)
plt.show()
```



Model Training

```
data_set.head()

        cough  fever  sore_throat  shortness_of_breath  head_ache  \
122808      1      0            0                    0          0
122809      1      0            0                    0          0
122810      0      0            0                    0          0
122811      0      1            0                    0          0
122812      1      0            0                    0          0

        corona_result  age_60_and_above  gender  Abroad  \
122808              0                 1       1       0
122809              1                 0       0       0
122810              0                 0       0       0
```

```
122811              0                 0       0       1
122812              0                 1       0       0

        Contact with confirmed  Other
122808                       0      1
122809                       0      1
122810                       0      1
122811                       0      0
122812                       0      1
```

```
display("NULL Values", data_set.isnull().sum())
```

```
'NULL Values'

cough                     0
fever                     0
sore_throat               0
shortness_of_breath       0
head_ache                 0
corona_result             0
age_60_and_above          0
gender                    0
Abroad                    0
Contact with confirmed    0
Other                     0
dtype: int64
```

```
display("Description", data_set.describe())
```

```
'Description'

               cough          fever    sore_throat
shortness_of_breath  \
count  136294.000000  136294.000000  136294.000000
136294.000000
mean        0.182334       0.092895       0.010808
0.007785
std         0.386121       0.290286       0.103396
0.087887
min         0.000000       0.000000       0.000000
0.000000
25%         0.000000       0.000000       0.000000
0.000000
50%         0.000000       0.000000       0.000000
0.000000
75%         0.000000       0.000000       0.000000
0.000000
max         1.000000       1.000000       1.000000
1.000000

           head_ache  corona_result  age_60_and_above
```

```
gender  \
count  136294.000000  136294.000000     136294.000000  136294.000000

mean        0.015224       0.077964          0.173896       0.507381

std         0.122445       0.268116          0.379022       0.499947

min         0.000000       0.000000          0.000000       0.000000

25%         0.000000       0.000000          0.000000       0.000000

50%         0.000000       0.000000          0.000000       1.000000

75%         0.000000       0.000000          0.000000       1.000000

max         1.000000       1.000000          1.000000       1.000000
```

```
              Abroad  Contact with confirmed          Other
count  136294.000000           136294.000000  136294.000000
mean        0.106637                0.054309       0.839054
std         0.308652                0.226627       0.367483
min         0.000000                0.000000       0.000000
25%         0.000000                0.000000       1.000000
50%         0.000000                0.000000       1.000000
75%         0.000000                0.000000       1.000000
max         1.000000                1.000000       1.000000
```

```
data_set.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 136294 entries, 122808 to 265120
Data columns (total 11 columns):
 #   Column                  Non-Null Count   Dtype
---  ------                  --------------   -----
 0   cough                   136294 non-null  int64
 1   fever                   136294 non-null  int64
 2   sore_throat             136294 non-null  int64
 3   shortness_of_breath     136294 non-null  int64
 4   head_ache               136294 non-null  int64
 5   corona_result           136294 non-null  int64
 6   age_60_and_above        136294 non-null  int64
 7   gender                  136294 non-null  int64
 8   Abroad                  136294 non-null  uint8
 9   Contact with confirmed  136294 non-null  uint8
 10  Other                   136294 non-null  uint8
dtypes: int64(8), uint8(3)
memory usage: 14.7 MB
```

```
for i in data_set.columns:
    print("\nColumn Name:", i, "-->", data_set[i].unique(), "-->Unique
Count", len(data_set[i].unique()))
```

```
Column Name: cough --> [1 0] -->Unique Count 2

Column Name: fever --> [0 1] -->Unique Count 2

Column Name: sore_throat --> [0 1] -->Unique Count 2

Column Name: shortness_of_breath --> [0 1] -->Unique Count 2

Column Name: head_ache --> [0 1] -->Unique Count 2

Column Name: corona_result --> [0 1] -->Unique Count 2

Column Name: age_60_and_above --> [1 0] -->Unique Count 2

Column Name: gender --> [1 0] -->Unique Count 2

Column Name: Abroad --> [0 1] -->Unique Count 2

Column Name: Contact with confirmed --> [0 1] -->Unique Count 2

Column Name: Other --> [1 0] -->Unique Count 2
```

```
y = data_set['corona_result']
```

```
data_set.drop('corona_result', axis=1, inplace=True)
```

```
time_taken = list()
```

```
# Split data
X_train, X_test, y_train, y_test = train_test_split(data_set, y,
test_size=0.3, random_state=123, stratify=y)
start = time.time()
print("X_train Shape : ", X_train.shape)
print("X_test Shape : ", X_test.shape)
print("y_train Shape : ", y_train.shape)
print("y_test Shape : ", y_test.shape)

# DecisionTree
DecisionTree = DecisionTreeClassifier(random_state=0)
scores = cross_val_score(DecisionTree, data_set, y, cv=5)


print('DecisionTree scores.mean: ', scores.mean())
DecisionTree = DecisionTree.fit(X_train, y_train)
decission_pred = DecisionTree.predict(X_test)
```

```
print('DecisionTree r2_score: ', r2_score(y_test, decission_pred))
end = time.time()
time_taken.append(end-start)
```

```
X_train Shape :  (95405, 10)
X_test Shape :  (40889, 10)
y_train Shape :  (95405,)
y_test Shape :  (40889,)
DecisionTree scores.mean:  0.9579512325481468
DecisionTree r2_score:  0.41485465591589266
```

Hyper-parameter tunning

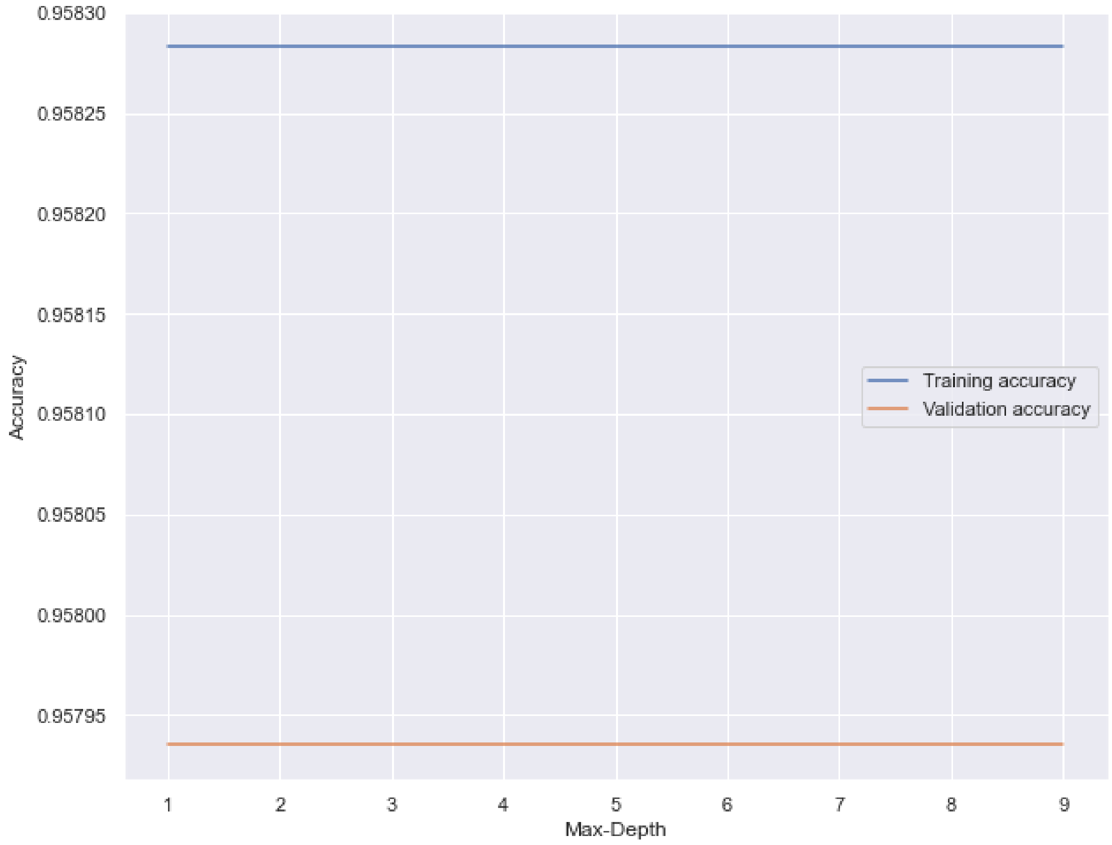
```
# lets tune max_depth to increase the accuracy

training_accuracy = list()
validation_accuracy = list()
for max_d in range(1,10):
    model = DecisionTreeClassifier(max_depth=max_d, random_state=42)
    model.fit(X_train, y_train)
    training_accuracy.append(DecisionTree.score(X_train, y_train))
    validation_accuracy.append(DecisionTree.score(X_test,y_test))
    print('The Training Accuracy for max_depth {} is:'.format(max_d),
DecisionTree.score(X_train, y_train))
    print('The Validation Accuracy for max_depth {}
is:'.format(max_d), DecisionTree.score(X_test,y_test))
    print('')
```

```
The Training Accuracy for max_depth 1 is: 0.9582831088517373
The Validation Accuracy for max_depth 1 is: 0.957934896916041

The Training Accuracy for max_depth 2 is: 0.9582831088517373
The Validation Accuracy for max_depth 2 is: 0.957934896916041

The Training Accuracy for max_depth 3 is: 0.9582831088517373
The Validation Accuracy for max_depth 3 is: 0.957934896916041

The Training Accuracy for max_depth 4 is: 0.9582831088517373
The Validation Accuracy for max_depth 4 is: 0.957934896916041

The Training Accuracy for max_depth 5 is: 0.9582831088517373
The Validation Accuracy for max_depth 5 is: 0.957934896916041

The Training Accuracy for max_depth 6 is: 0.9582831088517373
The Validation Accuracy for max_depth 6 is: 0.957934896916041

The Training Accuracy for max_depth 7 is: 0.9582831088517373
The Validation Accuracy for max_depth 7 is: 0.957934896916041

The Training Accuracy for max_depth 8 is: 0.9582831088517373
The Validation Accuracy for max_depth 8 is: 0.957934896916041

The Training Accuracy for max_depth 9 is: 0.9582831088517373
The Validation Accuracy for max_depth 9 is: 0.957934896916041
```

To understand better, we can plot the resulting accuracies as shown below. You can see the curve where the model begins to overfit.

```
plt.plot(list(range(1,10)), training_accuracy )
plt.plot(list(range(1,10)), validation_accuracy)
plt.xlabel('Max-Depth')
plt.ylabel('Accuracy')
plt.legend(['Training accuracy', 'Validation accuracy'])
```

```
<matplotlib.legend.Legend at 0x2cd3a126f10>
```



We can conclude that taking any depth would result in same output!

```
training_accuracy = list()
validation_accuracy = list()
for max_f in range(2,10):
    model = DecisionTreeClassifier(max_depth=5, max_leaf_nodes=
max_f , random_state=42)
    model.fit(X_train, y_train)
    training_accuracy.append(DecisionTree.score(X_train, y_train))
    validation_accuracy.append(DecisionTree.score(X_test,y_test))
    print('The Training Accuracy for max_leaf_nodes {}
is:'.format(max_f), DecisionTree.score(X_train, y_train))
    print('The Validation Accuracy for max_leaf_nodes {}
is:'.format(max_f), DecisionTree.score(X_test,y_test))
    print('')
```

```
The Training Accuracy for max_leaf_nodes 2 is: 0.9582831088517373
The Validation Accuracy for max_leaf_nodes 2 is: 0.957934896916041

The Training Accuracy for max_leaf_nodes 3 is: 0.9582831088517373
The Validation Accuracy for max_leaf_nodes 3 is: 0.957934896916041

The Training Accuracy for max_leaf_nodes 4 is: 0.9582831088517373
The Validation Accuracy for max_leaf_nodes 4 is: 0.957934896916041

The Training Accuracy for max_leaf_nodes 5 is: 0.9582831088517373
The Validation Accuracy for max_leaf_nodes 5 is: 0.957934896916041

The Training Accuracy for max_leaf_nodes 6 is: 0.9582831088517373
The Validation Accuracy for max_leaf_nodes 6 is: 0.957934896916041

The Training Accuracy for max_leaf_nodes 7 is: 0.9582831088517373
The Validation Accuracy for max_leaf_nodes 7 is: 0.957934896916041

The Training Accuracy for max_leaf_nodes 8 is: 0.9582831088517373
The Validation Accuracy for max_leaf_nodes 8 is: 0.957934896916041

The Training Accuracy for max_leaf_nodes 9 is: 0.9582831088517373
The Validation Accuracy for max_leaf_nodes 9 is: 0.957934896916041
```

```
# lets use inbuilt packages in order to tune the paramters which is
easy way

from scipy.stats import randint
from sklearn.model_selection import RandomizedSearchCV
from sklearn.ensemble import RandomForestClassifier

param_dist = {"max_depth": list(range(1,8)),
             "max_features": randint(0,8),
             "min_samples_leaf": randint(1,8),
             "criterion": ["gini", 'entropy']}
tree_cv = RandomizedSearchCV(DecisionTree, param_dist, cv=5)

tree_cv.fit(data_set, y)
```

```
RandomizedSearchCV(cv=5,
estimator=DecisionTreeClassifier(random_state=0),
                   param_distributions={'criterion': ['gini',
'entropy'],
                                        'max_depth': [1, 2, 3, 4, 5,
6, 7],
                                        'max_features':
<scipy.stats._distn_infrastructure.rv_frozen object at
0x000002CD3A16B280>,
                                        'min_samples_leaf':
<scipy.stats._distn_infrastructure.rv_frozen object at
0x000002CD3A1417F0>})
```

```
tree_cv.best_params_
```

```
{'criterion': 'gini', 'max_depth': 7, 'max_features': 1,
'min_samples_leaf': 2}
```

```
previous_score = tree_cv.best_score_
```

```
# lets drop negatively effecting columns
data_set.corr()
```

```
                           cough     fever  sore_throat
shortness_of_breath  \
cough                   1.000000  0.444898     0.125416
0.116872
fever                   0.444898  1.000000     0.143779
0.145360
sore_throat             0.125416  0.143779     1.000000
0.200670
shortness_of_breath     0.116872  0.145360     0.200670
1.000000
head_ache               0.135117  0.200694     0.337043
0.218756
age_60_and_above       -0.044193 -0.002714    -0.013321
0.013325
gender                  0.020147  0.037465    -0.009988
0.004286
Abroad                  0.526316  0.274075     0.011708
0.012133
Contact with confirmed  0.209147  0.198677     0.204154
0.148594
Other                  -0.571040 -0.352723    -0.135736            -
0.101829


                        head_ache  age_60_and_above    gender
Abroad  \
cough                    0.135117         -0.044193  0.020147
0.526316
fever                    0.200694         -0.002714  0.037465
0.274075
sore_throat              0.337043         -0.013321 -0.009988
0.011708
```

```
shortness_of_breath      0.218756          0.013325  0.004286
0.012133
head_ache                1.000000         -0.016100 -0.000098
0.007713
age_60_and_above        -0.016100          1.000000 -0.035756 -
0.056221
gender                  -0.000098         -0.035756  1.000000
0.017770
Abroad                   0.007713         -0.056221  0.017770
1.000000
Contact with confirmed   0.252326         -0.024359  0.006176 -
0.082795
Other                   -0.162088          0.062243 -0.018734 -
0.788851

                        Contact with confirmed     Other
cough                                 0.209147 -0.571040
fever                                 0.198677 -0.352723
sore_throat                           0.204154 -0.135736
shortness_of_breath                   0.148594 -0.101829
head_ache                             0.252326 -0.162088
age_60_and_above                     -0.024359  0.062243
gender                                0.006176 -0.018734
Abroad                               -0.082795 -0.788851
Contact with confirmed                1.000000 -0.547162
Other                                -0.547162  1.000000
```

```
# lets manually drop "Other" because it is negatively effecting other
features

data_set.drop('Other', axis=1, inplace=True)

tree_cv = RandomizedSearchCV(DecisionTree, param_dist, cv=5)
tree_cv.fit(data_set, y)
```

```
C:\Users\sujith kumar\anaconda3\lib\site-packages\sklearn\
model_selection\_validation.py:548: FitFailedWarning: Estimator fit
failed. The score on this train-test partition for these parameters
will be set to nan. Details:
Traceback (most recent call last):
  File "C:\Users\sujith kumar\anaconda3\lib\site-packages\sklearn\
model_selection\_validation.py", line 531, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
  File "C:\Users\sujith kumar\anaconda3\lib\site-packages\sklearn\
tree\_classes.py", line 890, in fit
    super().fit(
  File "C:\Users\sujith kumar\anaconda3\lib\site-packages\sklearn\
tree\_classes.py", line 279, in fit
    raise ValueError("max_features must be in (0, n_features]")
ValueError: max_features must be in (0, n_features]
  warnings.warn("Estimator fit failed. The score on this train-test"
C:\Users\sujith kumar\anaconda3\lib\site-packages\sklearn\
model_selection\_validation.py:548: FitFailedWarning: Estimator fit
failed. The score on this train-test partition for these parameters
will be set to nan. Details:
Traceback (most recent call last):
  File "C:\Users\sujith kumar\anaconda3\lib\site-packages\sklearn\
model_selection\_validation.py", line 531, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
  File "C:\Users\sujith kumar\anaconda3\lib\site-packages\sklearn\
tree\_classes.py", line 890, in fit
    super().fit(
  File "C:\Users\sujith kumar\anaconda3\lib\site-packages\sklearn\
tree\_classes.py", line 279, in fit
    raise ValueError("max_features must be in (0, n_features]")
ValueError: max_features must be in (0, n_features]

  warnings.warn("Estimator fit failed. The score on this train-test"
C:\Users\sujith kumar\anaconda3\lib\site-packages\sklearn\
model_selection\_validation.py:548: FitFailedWarning: Estimator fit
failed. The score on this train-test partition for these parameters
will be set to nan. Details:
Traceback (most recent call last):
  File "C:\Users\sujith kumar\anaconda3\lib\site-packages\sklearn\
model_selection\_validation.py", line 531, in _fit_and_score
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  File "C:\Users\sujith kumar\anaconda3\lib\site-packages\sklearn\
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C:\Users\sujith kumar\anaconda3\lib\site-packages\sklearn\
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    raise ValueError("max_features must be in (0, n_features]")
ValueError: max_features must be in (0, n_features]

  warnings.warn("Estimator fit failed. The score on this train-test"
```

```
RandomizedSearchCV(cv=5,
estimator=DecisionTreeClassifier(random_state=0),
                   param_distributions={'criterion': ['gini',
'entropy'],
                                        'max_depth': [1, 2, 3, 4, 5,
6, 7],
                                        'max_features':
<scipy.stats._distn_infrastructure.rv_frozen object at
0x000002CD3A16B280>,
                                        'min_samples_leaf':
<scipy.stats._distn_infrastructure.rv_frozen object at
0x000002CD3A1417F0>})
```

```
current_score = tree_cv.best_score_
```

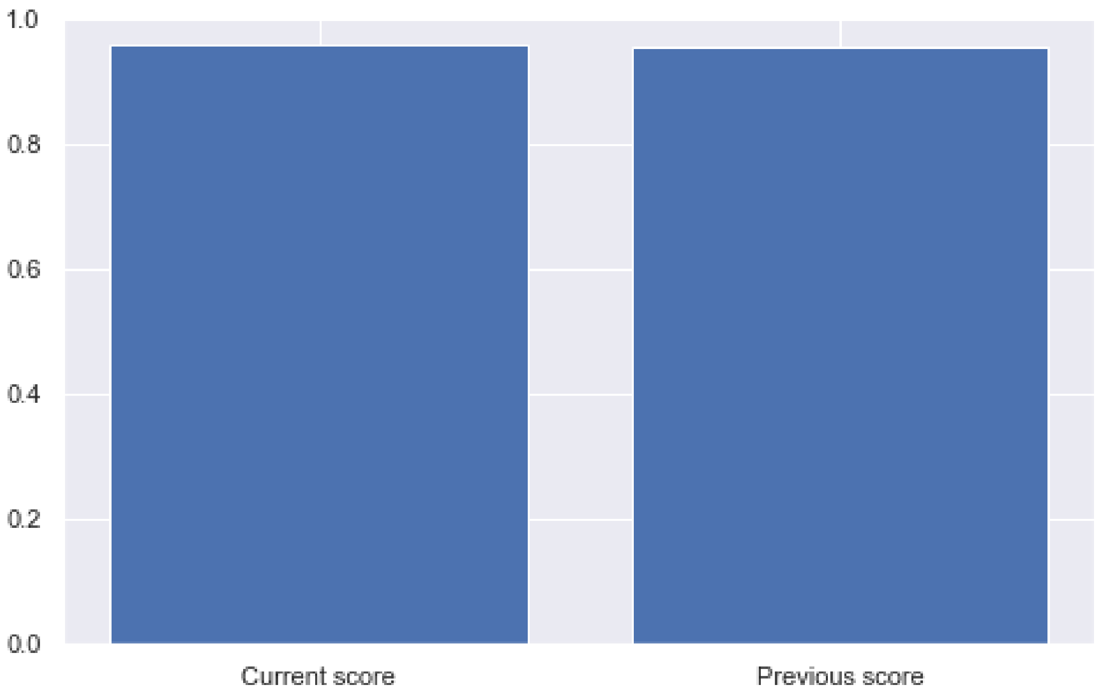
```
print(current_score, previous_score)
```

```
0.9579732438962264 0.9549650442700226
```

```
# plotting previous and current scores
```

```
plt.figure(figsize=(8,5))
plt.bar(['Current score', 'Previous score'], [current_score,
previous_score])
```

```
<BarContainer object of 2 artists>
```



Decision tree reached its saturation point where tunning any more params meter does not later the accuracy. To increase accuracy we either need to add more supporting features or we need more unique records in order to make dataset more robust.

Logistic Regression

```
start = time.time()
print("X_train Shape : ", X_train.shape)
print("X_test Shape : ", X_test.shape)
print("y_train Shape : ", y_train.shape)
print("y_test Shape : ", y_test.shape)
log = LogisticRegression()
scores = cross_val_score(log, data_set, y, cv=5)
print('LogisticRegression scores.mean: ', scores.mean())
log.fit(X_train, y_train)
pred = log.predict(X_test)
print('LogisticRegression r2_score: ', r2_score(y_test, pred))
log_score = scores.mean()
end = time.time()
print("\n"+ str(end-start))
time_taken.append(end-start)
```

```
X_train Shape :  (95405, 10)
X_test Shape :  (40889, 10)
y_train Shape :  (95405,)
y_test Shape :  (40889,)
LogisticRegression scores.mean:  0.9506875668178327
LogisticRegression r2_score:  0.33967028321671366
```

```
1.3885900974273682
```

K Nearest Neigbhours

```
start = time.time()
print("X_train Shape : ", X_train.shape)
print("X_test Shape : ", X_test.shape)
print("y_train Shape : ", y_train.shape)
print("y_test Shape : ", y_test.shape)
Knn = KNeighborsClassifier()
scores = cross_val_score(Knn, data_set, y, cv=5)
print('KNeighborsClassifier scores.mean: ', scores.mean())
Knn.fit(X_train, y_train)
pred = Knn.predict(X_test)
print('KNeighborsClassifier r2_score: ', r2_score(y_test, pred))
knn_score = scores.mean()
end = time.time()
print("\n"+ str(end-start))
time_taken.append(end-start)
```

```
X_train Shape :  (95405, 10)
X_test Shape :  (40889, 10)
y_train Shape :  (95405,)
y_test Shape :  (40889,)
KNeighborsClassifier scores.mean:  0.9518541257372345
KNeighborsClassifier r2_score:  0.3651853418250324

219.38802027702332
```

Support Vector Classifier

```
start = time.time()
print("X_train Shape : ", X_train.shape)
print("X_test Shape : ", X_test.shape)
print("y_train Shape : ", y_train.shape)
print("y_test Shape : ", y_test.shape)
svc = SVC()
scores = cross_val_score(svc, data_set, y, cv=5)
print('SVC scores.mean: ', scores.mean())
svc.fit(X_train, y_train)
pred = svc.predict(X_test)
print('SVC r2_score: ', r2_score(y_test, pred))
svc_score = scores.mean()
end = time.time()
print("\n"+ str(end - start))
time_taken.append(end-start)
```

```
X_train Shape :  (95405, 10)
X_test Shape :  (40889, 10)
```

```
y_train Shape :  (95405,)
y_test Shape :  (40889,)
SVC scores.mean:  0.9580466190043124
SVC r2_score:  0.41859686451177935
```

```
194.00705862045288
```

VotingClassifier

```
vot_clf = VotingClassifier(estimators=[('tree', DecisionTree), ('log', 
log), ('knn', Knn), ('SVC', svc)], voting='hard')
vot_clf.fit(data_set, y)
```

```
VotingClassifier(estimators=[('tree', 
DecisionTreeClassifier(random_state=0)),
                             ('log', LogisticRegression()),
                             ('knn', KNeighborsClassifier()), ('SVC', 
SVC())])
```

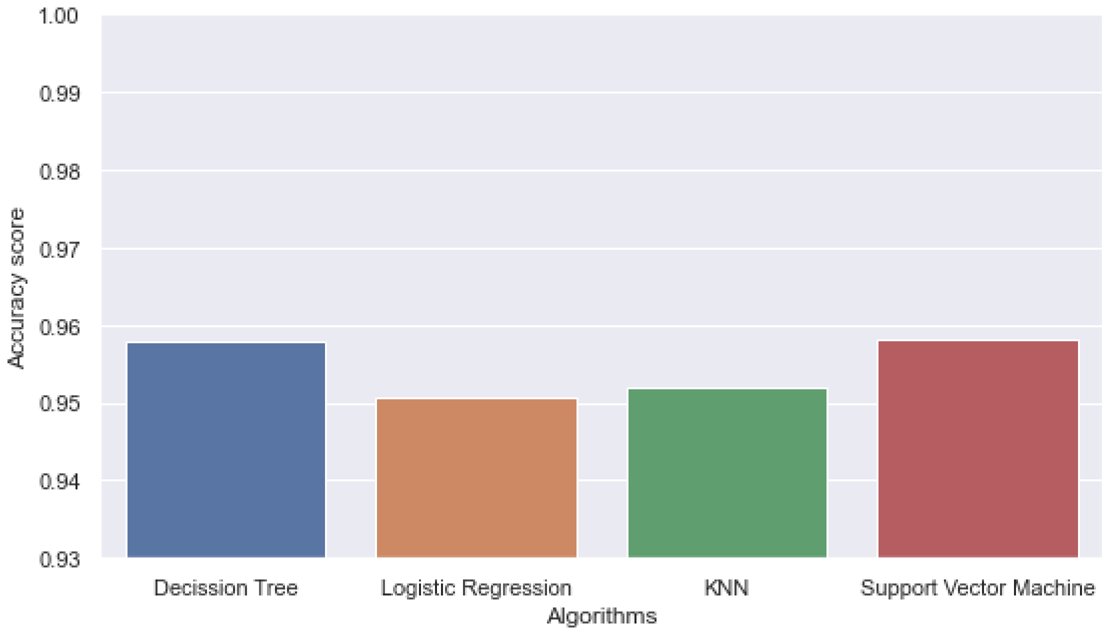
```
vot_pred = vot_clf.predict(data_set)
```

```
vot_clf.score(data_set, y)
```

```
0.958237339868226
```

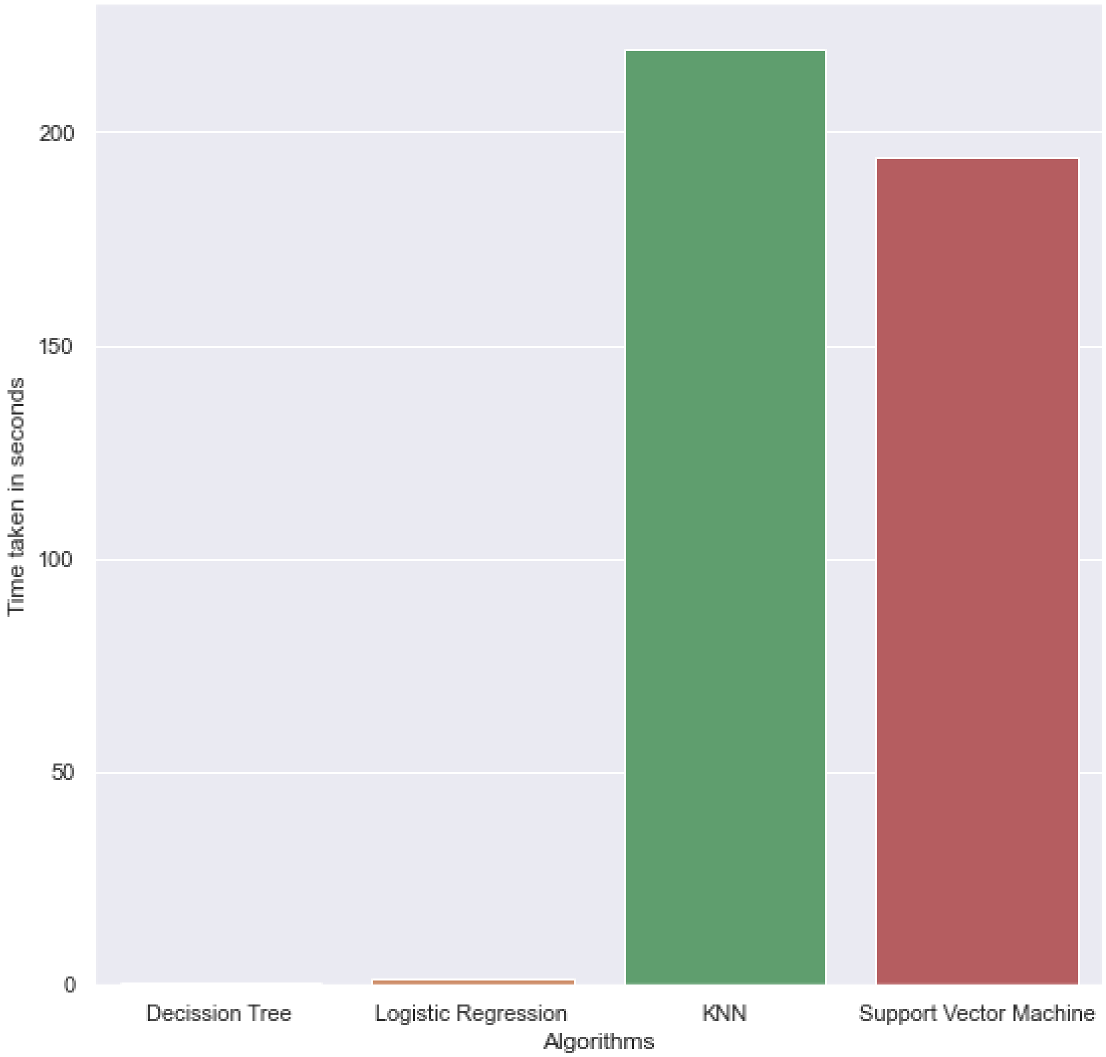
```
with sns.color_palette('muted'):
    algothrim_name = ['Decission Tree', 'Logistic Regression', 'KNN', 
'Support Vector Machine']
    scores = [current_score, log_score, knn_score, svc_score]
    sns.set(rc={'figure.figsize':(9,5)})
    plt.xlabel("Algorithms")
    plt.ylabel("Accuracy score")
    plt.ylim(0.93, 1)
    sns.barplot(algothrim_name, scores)
```

```
C:\Users\sujith kumar\anaconda3\lib\site-packages\seaborn\
_decorators.py:36: FutureWarning: Pass the following variables as 
keyword args: x, y. From version 0.12, the only valid positional 
argument will be `data`, and passing other arguments without an 
explicit keyword will result in an error or misinterpretation.
  warnings.warn(
```



```
with sns.color_palette('muted'):
    algothrim_name = ['Decission Tree', 'Logistic Regression', 'KNN', 
'Support Vector Machine']
    sns.set(rc={'figure.figsize':(9,9)})
    plt.xlabel("Algorithms")
    plt.ylabel("Time taken in seconds")
    sns.barplot(algothrim_name, time_taken)
```

```
C:\Users\sujith kumar\anaconda3\lib\site-packages\seaborn\
_decorators.py:36: FutureWarning: Pass the following variables as 
keyword args: x, y. From version 0.12, the only valid positional 
argument will be `data`, and passing other arguments without an 
explicit keyword will result in an error or misinterpretation.
  warnings.warn(
```



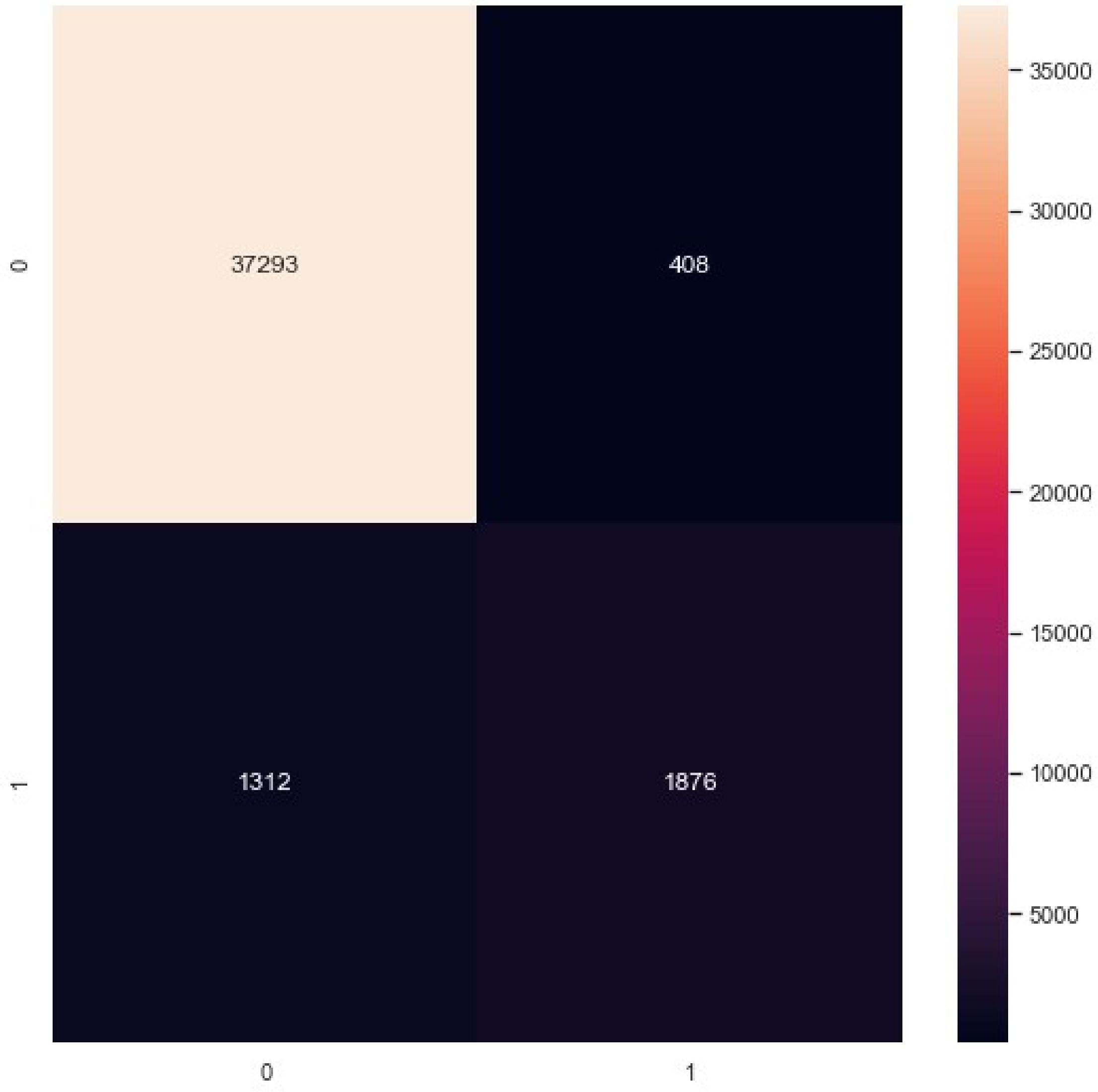
Evaluation metrics

```
# lets consider Decision-tree beccause the time complexity and
accuracy is more for that algorithm
```

Confusion matrix

```
con_mat = confusion_matrix(y_test, decission_pred)

matrix = sns.heatmap(con_mat, annot=True, fmt='.5g')
```



Accuracy is given by :

```
accuracy_score(decission_pred, y_test)
```

```
0.957934896916041
```

In this example, the accuracy is nearly 95%; approximately 3.2 percent of records with Covid-19 are classed as healthy. By using this example, we are attempting to demonstrate that accuracy is not a good metric when the data set is uneven. In such cases, using accuracy might lead to a false interpretation of the findings.

We'll now look for accuracy (positive predictive value) in identifying data instances. The following is how precision is defined:

A good classifier should have a precision of 1 (high). Only when the numerator and denominator are identical, as in TP = TP +FP, can precision become 1. This also implies that FP is zero. The value of the denominator gets bigger than the numerator as FP grows, and the precision value falls (which we do not want).

```
precision_score(y_test, decission_pred)
```

```
0.8213660245183888
```

Recall is given by

As a result, if FN approaches zero, the recal rate approaches one, indicating that the model is doing well.

```
recall_score(y_test, decission_pred)
```

```
0.588456712672522
```

F1 score is given by

Only when accuracy and recall are both 1 does the F1 Score become 1. Only when both accuracy and recall are good can the F1 score rise. The F1 score is a better metric than accuracy since it is the harmonic mean of precision and recall.

```
f1_score(y_test, decission_pred)
```

```
0.6856725146198831
```

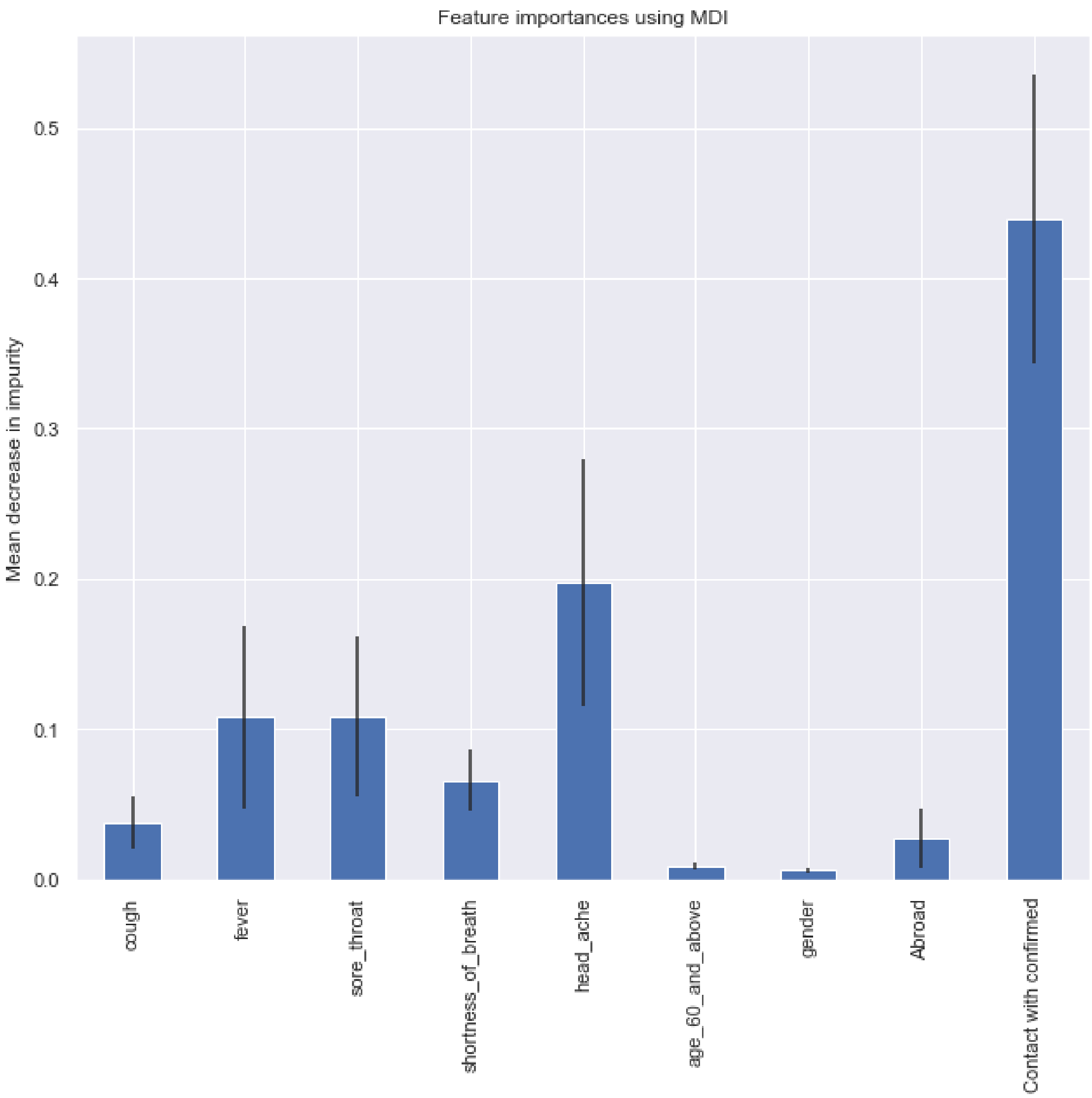
Feature Importance

```
random_forest = RandomForestClassifier()
random_forest.fit(data_set, y)
start_time = time.time()
importances = random_forest.feature_importances_
std = np.std([tree.feature_importances_ for tree in
random_forest.estimators_], axis=0)
elapsed_time = time.time() - start_time

print(f"Time it took to calculate the importances: {elapsed_time:.3f}
seconds")
```

```
Time it took to calculate the importances: 0.010 seconds
```

```
forest_importances = pd.Series(importances, index=data_set.columns)
fig, ax = plt.subplots()
forest_importances.plot.bar(yerr=std, ax=ax)
ax.set_title("Feature importances using MDI")
ax.set_ylabel("Mean decrease in impurity")
fig.tight_layout()
```

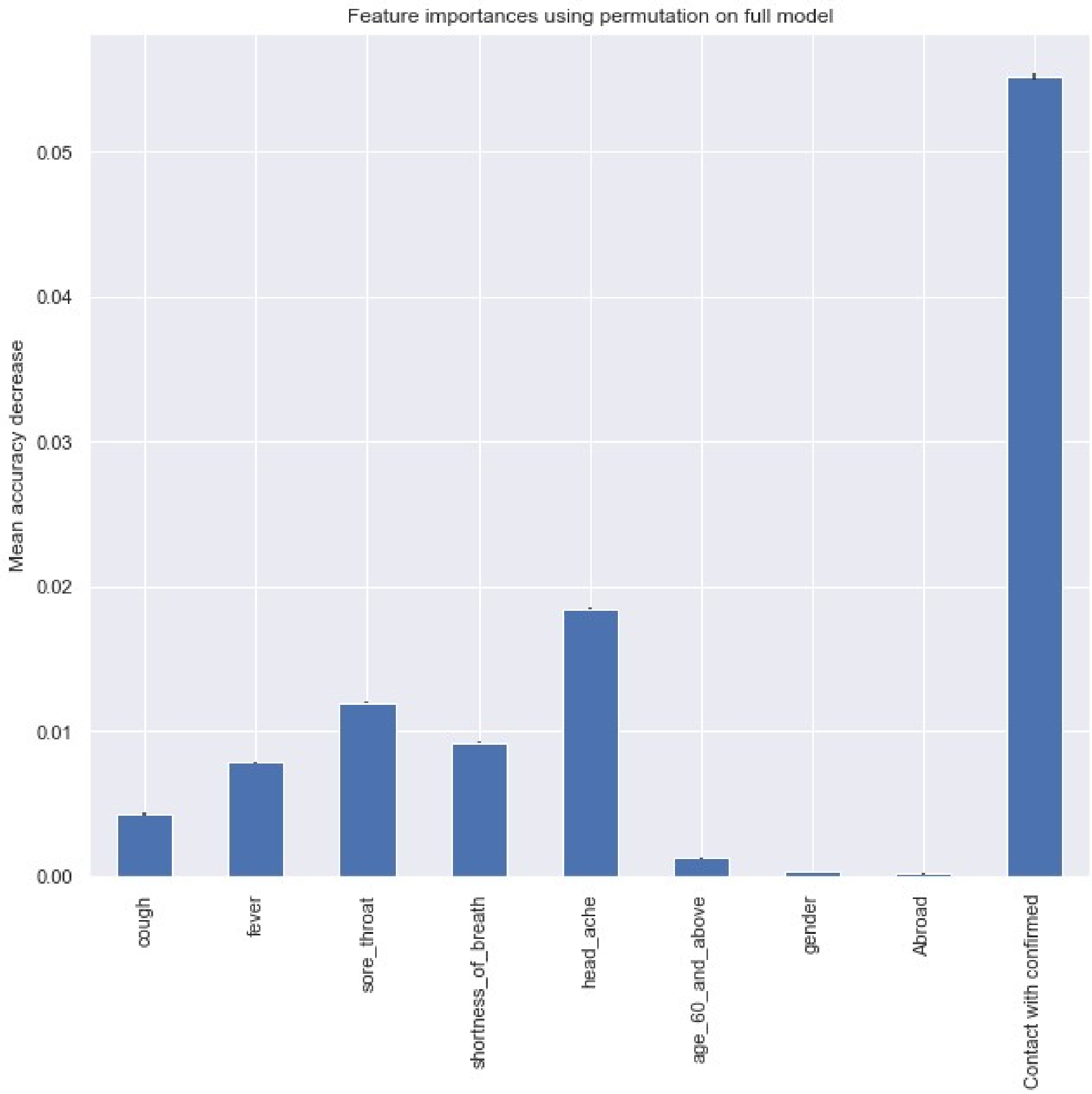


```
start_time = time.time()
result = permutation_importance(
    random_forest, data_set, y, n_repeats=5, random_state=42, n_jobs=-
1
)
elapsed_time = time.time() - start_time
print(f"Elapsed time to compute the importances: {elapsed_time:.3f}
seconds")

forest_importances = pd.Series(result.importances_mean,
index=data_set.columns)
```

```
Elapsed time to compute the importances: 25.913 seconds
```

```
fig, ax = plt.subplots()
forest_importances.plot.bar(yerr=result.importances_std, ax=ax)
ax.set_title("Feature importances using permutation on full model")
ax.set_ylabel("Mean accuracy decrease")
fig.tight_layout()
plt.show()
```



Observation reveals that traits such as `Contact With Confirmed`, `Headache`, and `Sore Throat` are more relevant than others.

CONCLUSION

The final aim is to develop a model that employs the most effective machine learning approach for forecasting COVID-19. Also Our goal is to give efficient and trustworthy prediction with fewer characteristics and testing. In this study, just nine crucial features are taken into account. Four distinct classification techniques were utilized. Some of the approaches employed include support vector machine, K closest neighbors, logistic regression, and decision tree. Before being used in the model, the data was pre-processed.

The support vector machine and decision trees are the strategies that give the best results in this paradigm. However, Decision trees were explored since they have a reduced time complexity. To widen this, other methodologies like as clustering, association rules, and genetic algorithms might be applied. Given the limits of this study, there is a need to develop a more complicated and combination of models to achieve greater accuracy for COVID-19 early prediction.

REFERENCES

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- Gozes O, Frid-Adar M, Greenspan H, et al. Rapid AI Development Cycle for the Coronavirus (COVID-19) Pandemic: Initial Results for Automated Detection & Patient Monitoring using Deep Learning CT Image Analysis. arXiv e-prints. 2020;2003:arXiv:2003.05037. Accessed May 4, 2020. http://adsabs.harvard.edu/abs/2020arXiv200305037G
- Dataset taken from :https://github.com/nshomron/covidpred/tree/master/data
- Feature importance reference: https://scikit-learn.org/stable/auto_examples/ensemble/plot_forest_importances.html
- Dataset for further resarch: https://www.kaggle.com/datasets/imdevskp/corona-virus-report