Random Forest - kyphosis Classification Project

Nawal Obaid

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PROBLEM STATEMENT

- Kyphosis is an abnormally excessive convex curvature of the spine. The kyphosis data frame has 81 rows and 4 columns. representing data on children who have had corrective spinal surgery. Dataset contains 3 inputs and 1 output

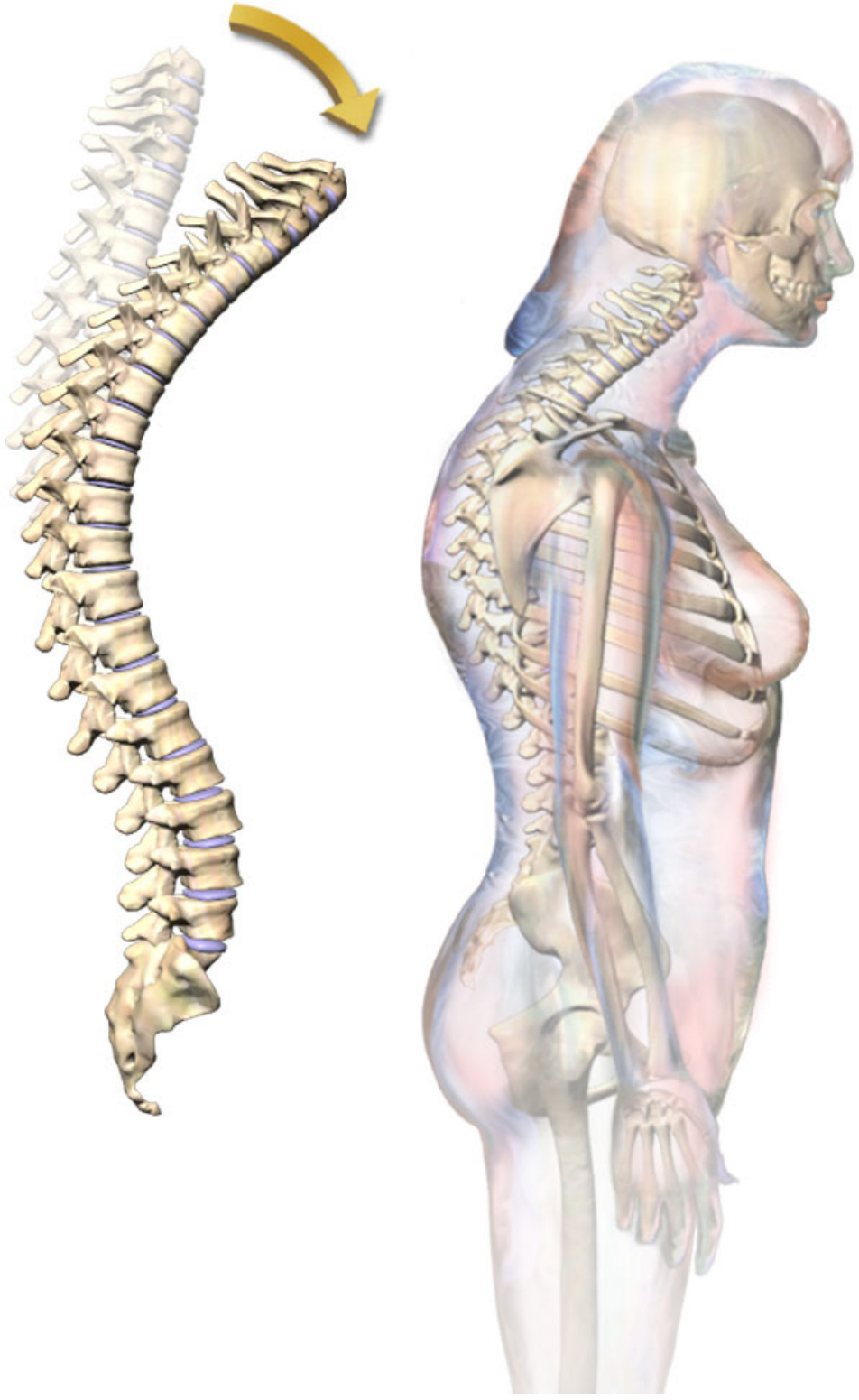
INPUTS:

- Age: in months
- Number: the number of vertebrae involved
- Start: the number of the first (topmost) vertebra operated on.

OUTPUTS:

- Kyphosis: a factor with levels absent present indicating if a kyphosis (a type of deformation) was present after the operation.

- Link to the dataset: https://www.kaggle.com/abbasit/kyphosis-dataset (https://www.kaggle.com/abbasit/kyphosis-dataset)
- Source: John M. Chambers and Trevor J. Hastie eds. (1992) Statistical Models in S, Wadsworth and Brooks/Cole, Pacific Grove, CA.



STEP #0: LIBRARIES IMPORT

In [1]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
%matplotlib inline
```

STEP #1: IMPORT DATASET

In [2]:
```
Kyphosis_df = pd.read_csv("kyphosis.csv")
```

In [3]:
```
Kyphosis_df.head(10)
```

Out[3]:

	Kyphosis	Age	Number	Start
0	absent	71	3	5
1	absent	158	3	14
2	present	128	4	5
3	absent	2	5	1
4	absent	1	4	15
5	absent	1	2	16
6	absent	61	2	17
7	absent	37	3	16
8	absent	113	2	16
9	present	59	6	12

In [4]:
```
Kyphosis_df.tail()
```

Out[4]:

	Kyphosis	Age	Number	Start
76	present	157	3	13
77	absent	26	7	13
78	absent	120	2	13
79	present	42	7	6
80	absent	36	4	13

In [5]:
```
Kyphosis_df.describe()
```

Out[5]:

	Age	Number	Start
count	81.000000	81.000000	81.000000
mean	83.654321	4.049383	11.493827
std	58.104251	1.619423	4.883962
min	1.000000	2.000000	1.000000
25%	26.000000	3.000000	9.000000
50%	87.000000	4.000000	13.000000
75%	130.000000	5.000000	16.000000
max	206.000000	10.000000	18.000000

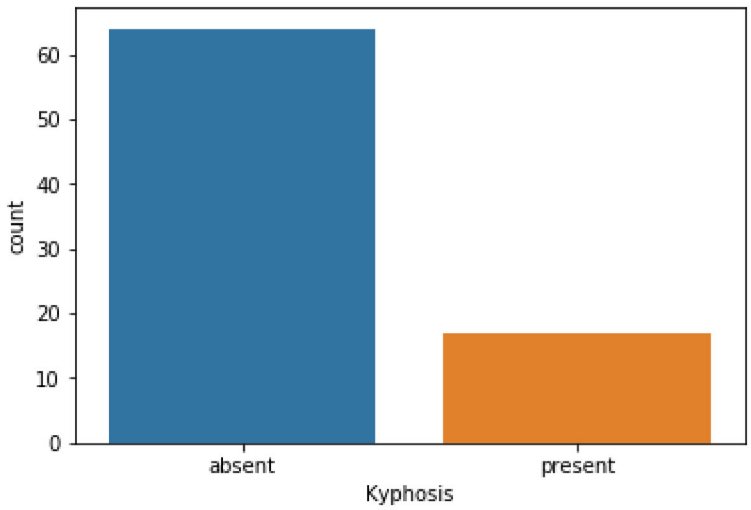
In [6]:
```
Kyphosis_df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 81 entries, 0 to 80
Data columns (total 4 columns):
Kyphosis    81 non-null object
Age         81 non-null int64
Number      81 non-null int64
Start       81 non-null int64
dtypes: int64(3), object(1)
memory usage: 2.6+ KB
```

STEP #2: VISUALIZE DATASET

In [7]:
```
sns.countplot(Kyphosis_df['Kyphosis'], label = "Count")
```

Out[7]: `<matplotlib.axes._subplots.AxesSubplot at 0x20ec0a550f0>`



In [8]:
```
from sklearn.preprocessing import LabelEncoder, OneHotEncoder
LabelEncoder_y = LabelEncoder()
Kyphosis_df['Kyphosis'] = LabelEncoder_y.fit_transform(Kyphosis_df['Kyphosis'])
```

In [9]:
```
Kyphosis_df
```

Out[9]:

	Kyphosis	Age	Number	Start
0	0	71	3	5
1	0	158	3	14
2	1	128	4	5
3	0	2	5	1
4	0	1	4	15
5	0	1	2	16
6	0	61	2	17
7	0	37	3	16
8	0	113	2	16
9	1	59	6	12
10	1	82	5	14
11	0	148	3	16
12	0	18	5	2
13	0	1	4	12
14	0	168	3	18
15	0	1	3	16
16	0	78	6	15
17	0	175	5	13
18	0	80	5	16
19	0	27	4	9
20	0	22	2	16
21	1	105	6	5
22	1	96	3	12
23	0	131	2	3
24	1	15	7	2
25	0	9	5	13
26	0	8	3	6
27	0	100	3	14
28	0	4	3	16
29	0	151	2	16
...	...	...	...	...
51	0	9	2	17
52	1	139	10	6
53	0	2	2	17
54	0	140	4	15

	Kyphosis	Age	Number	Start
55	0	72	5	15
56	0	2	3	13
57	1	120	5	8
58	0	51	7	9
59	0	102	3	13
60	1	130	4	1
61	1	114	7	8
62	0	81	4	1
63	0	118	3	16
64	0	118	4	16
65	0	17	4	10
66	0	195	2	17
67	0	159	4	13
68	0	18	4	11
69	0	15	5	16
70	0	158	5	14
71	0	127	4	12
72	0	87	4	16
73	0	206	4	10
74	0	11	3	15
75	0	178	4	15
76	1	157	3	13
77	0	26	7	13
78	0	120	2	13
79	1	42	7	6
80	0	36	4	13

81 rows × 4 columns

In [10]:
```
Kyphosis_True = Kyphosis_df[Kyphosis_df['Kyphosis']==1]
```

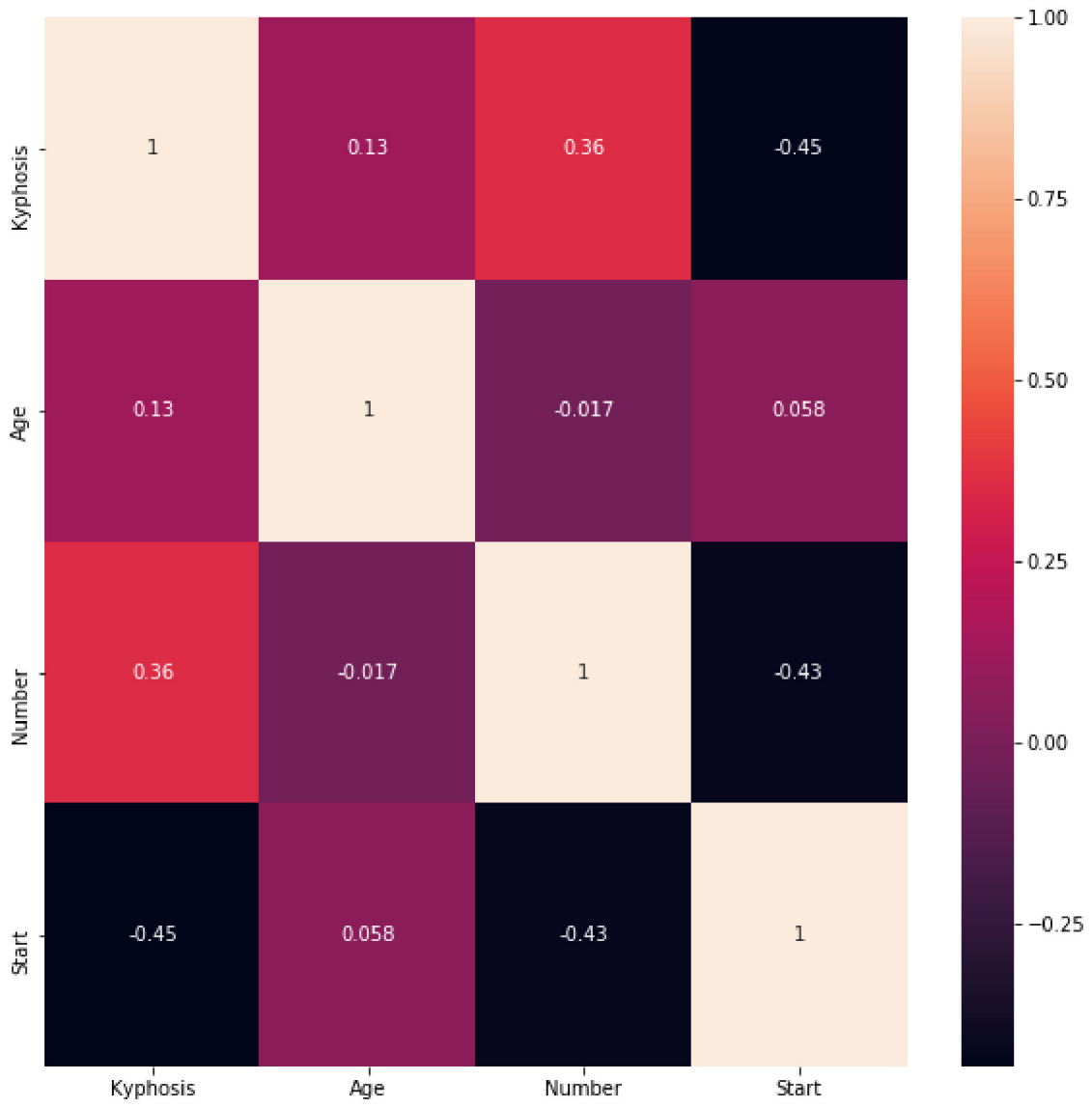
In [11]:
```
Kyphosis_False = Kyphosis_df[Kyphosis_df['Kyphosis']==0]
```

In [12]:
```
print( 'Disease present after operation percentage =', (len(Kyphosis_True) / len(
```

```
Disease present after operation percentage = 20.98765432098765 %
```

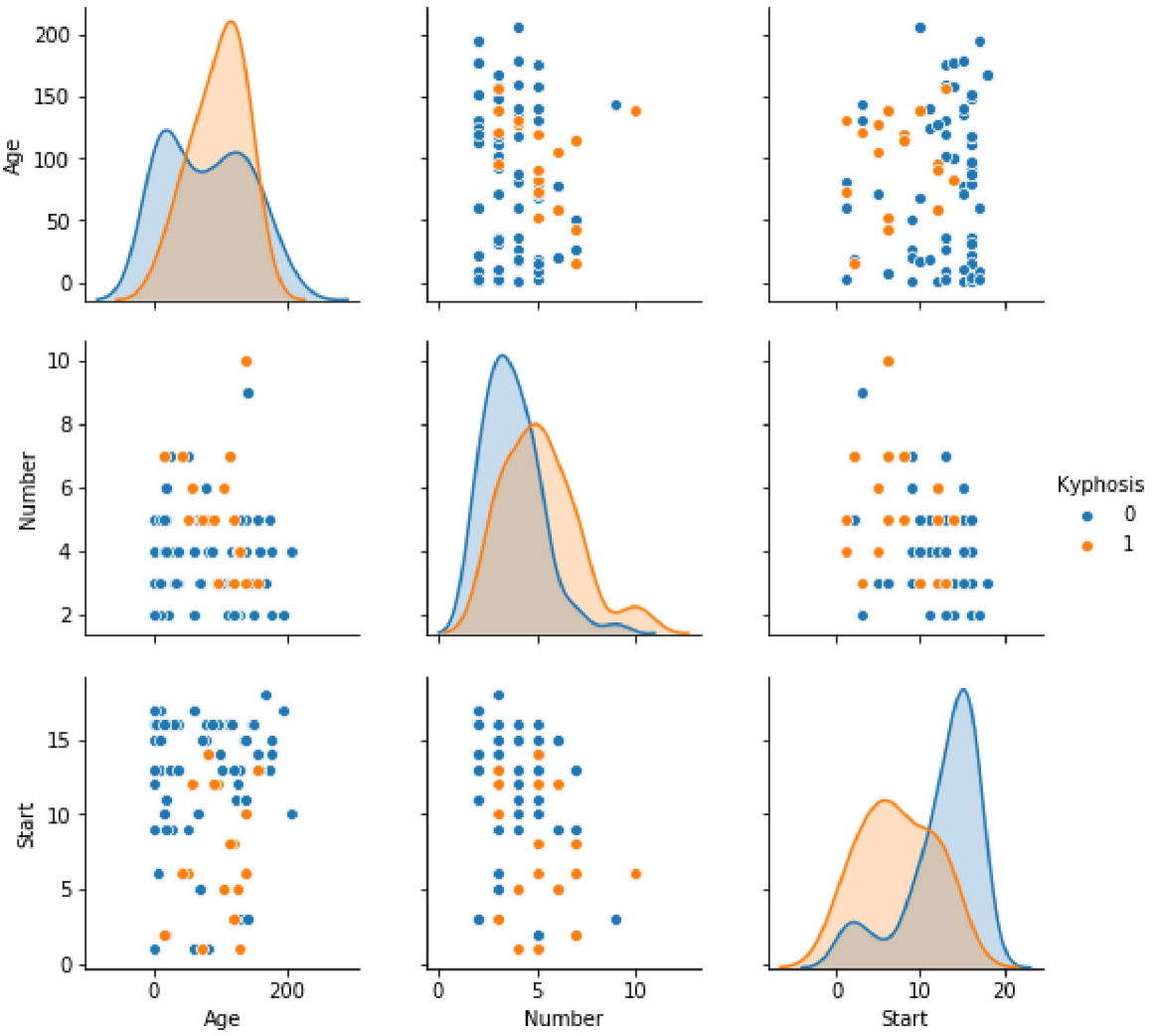
In [13]:
```
plt.figure(figsize=(10,10))
sns.heatmap(Kyphosis_df.corr(), annot=True)
```

Out[13]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x20ec1c3e748>
```



```
In [14]: sns.pairplot(Kyphosis_df, hue='Kyphosis', vars = ['Age', 'Number', 'Start'])
```

```
Out[14]: <seaborn.axisgrid.PairGrid at 0x20ec1d3c630>
```



STEP #3: CREATE TESTING AND TRAINING DATASET/DATA CLEANING

In [15]:
```
# Let's drop the target label coloumns
X = Kyphosis_df.drop(['Kyphosis'],axis=1)
y = Kyphosis_df['Kyphosis']
```

In [16]:
```
X
```

Out[16]:

	Age	Number	Start
0	71	3	5
1	158	3	14
2	128	4	5
3	2	5	1
4	1	4	15
5	1	2	16
6	61	2	17
7	37	3	16
8	113	2	16
9	59	6	12
10	82	5	14
11	148	3	16
12	18	5	2
13	1	4	12
14	168	3	18
15	1	3	16
16	78	6	15
17	175	5	13
18	80	5	16
19	27	4	9
20	22	2	16
21	105	6	5
22	96	3	12
23	131	2	3
24	15	7	2
25	9	5	13
26	8	3	6
27	100	3	14
28	4	3	16
29	151	2	16
...	...	...	...
51	9	2	17
52	139	10	6
53	2	2	17
54	140	4	15

	Age	Number	Start
55	72	5	15
56	2	3	13
57	120	5	8
58	51	7	9
59	102	3	13
60	130	4	1
61	114	7	8
62	81	4	1
63	118	3	16
64	118	4	16
65	17	4	10
66	195	2	17
67	159	4	13
68	18	4	11
69	15	5	16
70	158	5	14
71	127	4	12
72	87	4	16
73	206	4	10
74	11	3	15
75	178	4	15
76	157	3	13
77	26	7	13
78	120	2	13
79	42	7	6
80	36	4	13

81 rows × 3 columns

In [17]:
```
y
```

Out[17]:
```
0     0
1     0
2     1
3     0
4     0
5     0
6     0
7     0
8     0
9     1
10    1
11    0
12    0
13    0
14    0
15    0
16    0
17    0
18    0
19    0
20    0
21    1
22    1
23    0
24    1
25    0
26    0
27    0
28    0
29    0
     ..
51    0
52    1
53    0
54    0
55    0
56    0
57    1
58    0
59    0
60    1
61    1
62    0
63    0
64    0
65    0
66    0
67    0
68    0
69    0
70    0
71    0
72    0
73    0
74    0
```

```
75    0
76    1
77    0
78    0
79    1
80    0
Name: Kyphosis, Length: 81, dtype: int64
```

In [18]:
```
from sklearn.model_selection import train_test_split
```

In [19]:
```
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3)
```

In [20]:
```
# from sklearn.preprocessing import StandardScaler
# sc = StandardScaler()
# X_train = sc.fit_transform(X_train)
# X_test = sc.transform(X_test)
```

STEP#4: TRAINING THE MODEL

In [21]:
```
X_train.shape
```

Out[21]:
```
(56, 3)
```

In [22]:
```
y_train.shape
```

Out[22]:
```
(56,)
```

In [23]:
```
X_test.shape
```

Out[23]:
```
(25, 3)
```

In [24]:
```
y_test.shape
```

Out[24]:
```
(25,)
```

In [25]:
```
from sklearn.tree import DecisionTreeClassifier
decision_tree = DecisionTreeClassifier()
decision_tree.fit(X_train,y_train)
```

Out[25]:
```
DecisionTreeClassifier(class_weight=None, criterion='gini', max_depth=None,
            max_features=None, max_leaf_nodes=None,
            min_impurity_decrease=0.0, min_impurity_split=None,
            min_samples_leaf=1, min_samples_split=2,
            min_weight_fraction_leaf=0.0, presort=False, random_state=None,
            splitter='best')
```

In [26]:
```
feature_importances = pd.DataFrame(decision_tree.feature_importances_,
                                   index = X_train.columns,
                                    columns=['importance']).sort_values('importar
```

In [27]:
```
feature_importances
```

Out[27]:

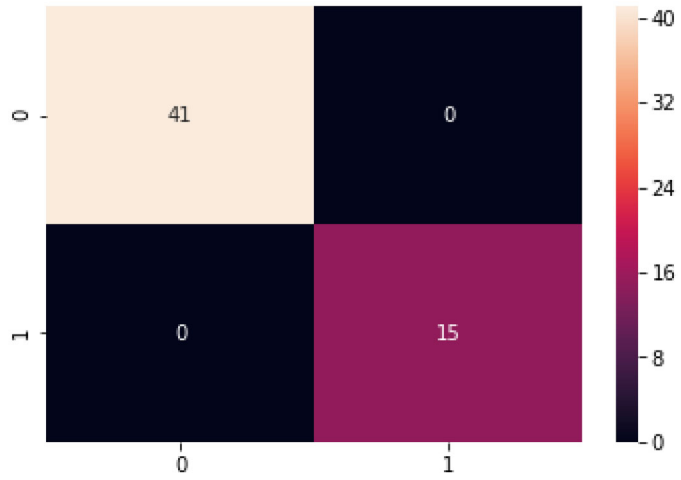
	importance
Start	0.523935
Age	0.337200
Number	0.138866

STEP#5: EVALUATING THE MODEL

In [28]:
```
from sklearn.metrics import classification_report, confusion_matrix
```

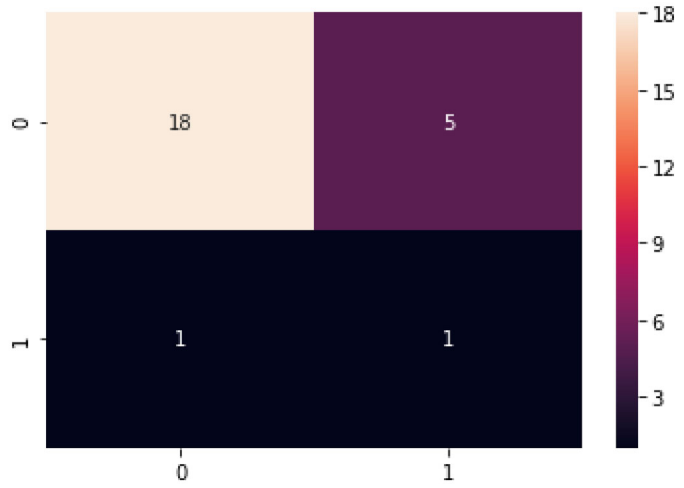
In [29]:
```
y_predict_train = decision_tree.predict(X_train)
y_predict_train
cm = confusion_matrix(y_train, y_predict_train)
sns.heatmap(cm, annot=True)
```

Out[29]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x20ec291de10>
```



In [30]:
```
# Predicting the Test set results
y_predict_test = decision_tree.predict(X_test)
cm = confusion_matrix(y_test, y_predict_test)
sns.heatmap(cm, annot=True)
```

Out[30]: <matplotlib.axes._subplots.AxesSubplot at 0x20ec2ac9cc0>



In [31]:
```
print(classification_report(y_test, y_predict_test))
```

```
             precision    recall  f1-score   support

          0       0.95      0.78      0.86        23
          1       0.17      0.50      0.25         2

avg / total       0.88      0.76      0.81        25
```

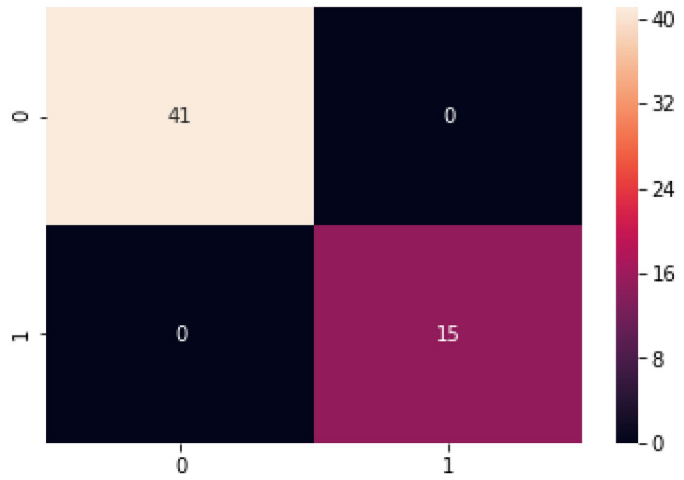
STEP#6: IMPROVING THE MODEL

In [32]:
```
from sklearn.ensemble import RandomForestClassifier
RandomForest = RandomForestClassifier(n_estimators=150)
RandomForest.fit(X_train, y_train)
```

Out[32]:
```
RandomForestClassifier(bootstrap=True, class_weight=None, criterion='gini',
            max_depth=None, max_features='auto', max_leaf_nodes=None,
            min_impurity_decrease=0.0, min_impurity_split=None,
            min_samples_leaf=1, min_samples_split=2,
            min_weight_fraction_leaf=0.0, n_estimators=150, n_jobs=1,
            oob_score=False, random_state=None, verbose=0,
            warm_start=False)
```

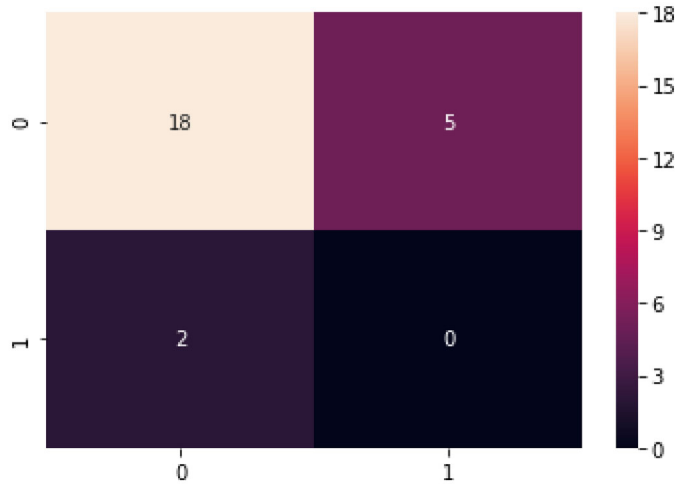
In [33]:
```
y_predict_train = RandomForest.predict(X_train)
y_predict_train
cm = confusion_matrix(y_train, y_predict_train)
sns.heatmap(cm, annot=True)
```

Out[33]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x20ec2bf4128>
```



In [34]:
```
# Predicting the Test set results
y_predict_test = RandomForest.predict(X_test)
cm = confusion_matrix(y_test, y_predict_test)
sns.heatmap(cm, annot=True)
```

Out[34]: <matplotlib.axes._subplots.AxesSubplot at 0x20ec2c68780>



In [35]:
```
print(classification_report(y_test, y_predict_test))
```

```
             precision    recall  f1-score   support

          0       0.90      0.78      0.84        23
          1       0.00      0.00      0.00         2

avg / total       0.83      0.72      0.77        25
```