In [1]:

```
#imports
import pandas as pd
#use
pd.set_option('display.max_columns', None)
import numpy as np
```

In [2]:

```
#alias fun
true = True
false = False
```

In [3]:

```
#read in data
#p = pd.read_csv("../src/test/resources/CelticsTrain.csv")
p = pd.read_csv("fifa_18_train_data.csv")
p = p[:64] #need only the first half of the data
p["1st Goal"] = p["1st Goal"].fillna(0)
p
```

Out[3]:

	Date	Team	Opponent	Goal Scored	G>=3	Ball Possession %	Attempts	On-Target	Off-Target	Blocked
0	14-06-2018	Russia	Saudi Arabia	5	>=3	40	13	7	3	3
1	14-06-2018	Saudi Arabia	Russia	0	<3	60	6	0	3	3
2	15-06-2018	Egypt	Uruguay	0	<3	43	8	3	3	2
3	15-06-2018	Uruguay	Egypt	1	<3	57	14	4	6	4
4	15-06-2018	Morocco	Iran	0	<3	64	13	3	6	4
...	...	...	...	...	...	...	...	...	...	...
59	24-06-2018	Panama	England	1	<3	42	8	2	5	1
60	24-06-2018	Japan	Senegal	2	<3	54	7	3	2	2
61	24-06-2018	Senegal	Japan	2	<3	46	14	7	5	2
62	24-06-2018	Poland	Colombia	0	<3	45	9	2	3	4
63	24-06-2018	Colombia	Poland	3	>=3	55	13	3	5	5

64 rows × 28 columns

In [4]:

```
#dependent variables (needed for sorting output later)
labels = p['G>=3']
labels
```

Out[4]:

```
0      >=3
1       <3
2       <3
3       <3
4       <3
     ...
59      <3
60      <3
61      <3
62      <3
63     >=3
Name: G>=3, Length: 64, dtype: object
```

In [5]:

```
#features/independent variables
features = ["Ball Possession %","Attempts","On-Target","Off-Target","Blocked",
features
```

Out[5]:

```
['Ball Possession %',
 'Attempts',
 'On-Target',
 'Off-Target',
 'Blocked',
 'Corners',
 'Offsides',
 'Free Kicks',
 'Saves',
 'Pass Accuracy %',
 'Passes',
 'Distance Covered (Kms)',
 '1st Goal']
```

In [6]:

```
#get dataframe of just features
#get all rows and just the columns that match our features
X = p.loc[:,features]
#p.loc[[0]]
X
```

Out[6]:

	Ball Possession %	Attempts	On-Target	Off-Target	Blocked	Corners	Offsides	Free Kicks	Saves	Pass Accuracy %	Passes
0	40	13	7	3	3	6	3	11	0	78	306
1	60	6	0	3	3	2	1	25	2	86	511
2	43	8	3	3	2	0	1	7	3	78	395
3	57	14	4	6	4	5	1	13	3	86	589
4	64	13	3	6	4	5	0	14	2	86	433
...	...	...	...	...	...	...	...	...	...	...	..
59	42	8	2	5	1	2	0	17	1	88	398
60	54	7	3	2	2	2	2	18	5	84	449
61	46	14	7	5	2	5	4	10	1	79	338
62	45	9	2	3	4	7	1	11	0	79	424
63	55	13	3	5	5	5	1	16	2	82	514

64 rows × 13 columns

In [7]:

```
#setup plot for the confusion matrix and decision tree
import matplotlib.pyplot as plt
print(plt.rcParams.get('figure.figsize'))
```

```
[6.0, 4.0]
```

In [8]:

```
#setup figure size
fig_size = plt.rcParams["figure.figsize"]
fig_size[0] = 20
fig_size[1] = 20
plt.rcParams["figure.figsize"] = fig_size
```

In [9]:

```
#output/labels once more for naming
Y = p["G>=3"]
Y
```

Out[9]:

```
0     >=3
1      <3
2      <3
3      <3
4      <3
     ...
59     <3
60     <3
61     <3
62     <3
63    >=3
Name: G>=3, Length: 64, dtype: object
```

In [10]:

```
#some system checks for versions
from platform import python_version
print(python_version())
import sklearn
```

```
3.6.9
```

In [11]:

```
#import decision tree
print('The scikit-learn version is {}.'.format(sklearn.__version__))
from sklearn import tree

clf = tree.DecisionTreeClassifier(random_state=0)
clf = clf.fit(X, Y)
```

```
The scikit-learn version is 0.23.2.
```

In [12]:

```
#get sorted labels for plot
import numpy as np
sorted = labels.unique()
sorted = np.sort(sorted)
sorted = list(map(str, sorted))
sorted
```

Out[12]:

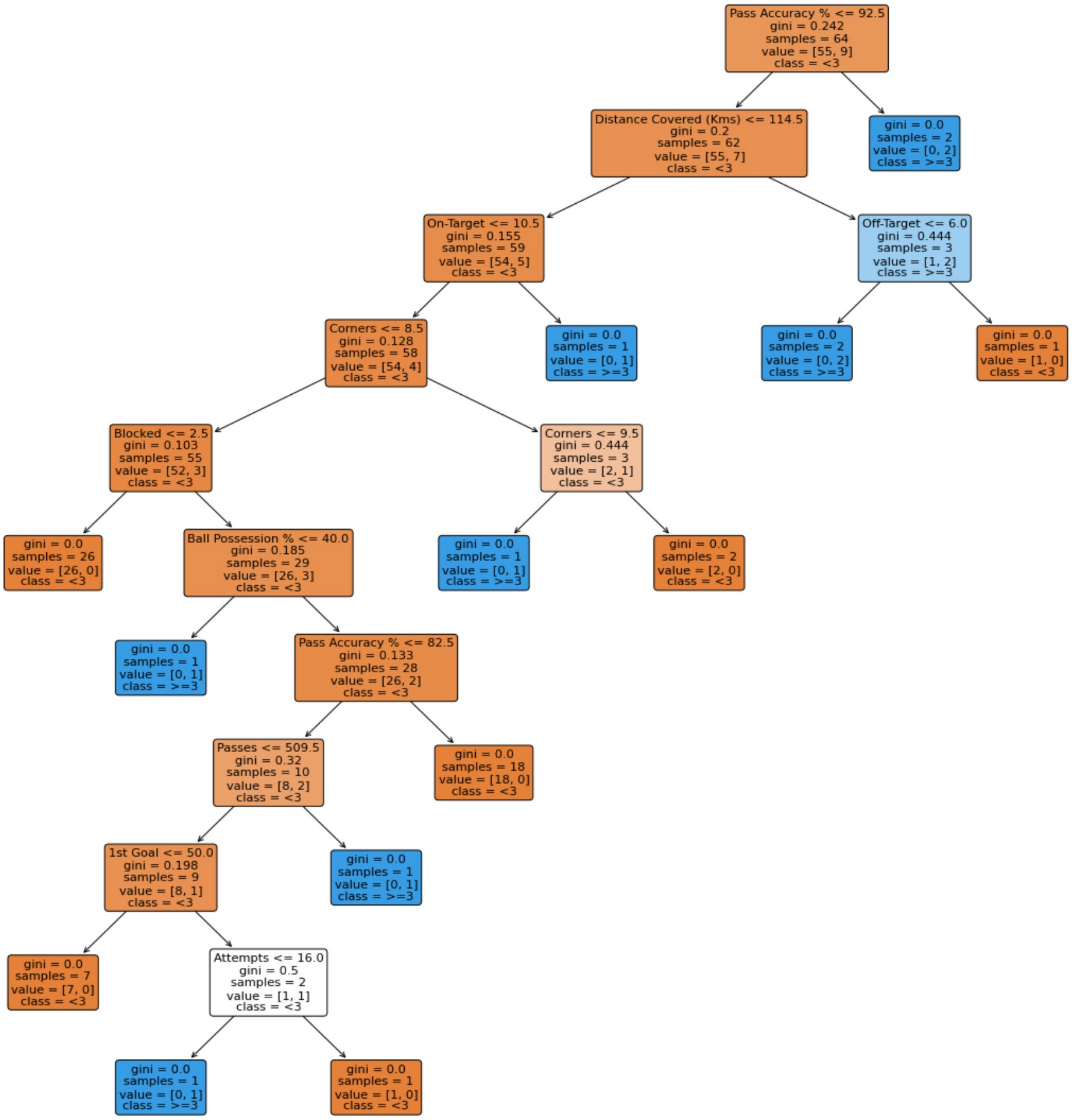
```
['<3', '>=3']
```

In [13]:

```
from pandas.plotting import scatter_matrix
```

In [14]:

```
#x = tree.plot_tree(clf,feature_names=features,class_names=labels.astype(str)
x = tree.plot_tree(clf,rounded=True,filled=True,class_names=sorted,feature_nar
```



In [15]:

```
#testData = pd.read_csv("../src/test/resources/CelticsTest.csv")
testData = pd.read_csv("fifa_18_test_data.csv")
testData["1st Goal"] = testData["1st Goal"].fillna(0)
testData
```

Out[15]:

	Date	Team	Opponent	Goal Scored	G>=3	Ball Possession %	Attempts	On-Target	Off-Target	Blocked
0	25-06-2018	Uruguay	Russia	3	>=3	56	17	7	6	4
1	25-06-2018	Russia	Uruguay	0	<3	44	3	1	1	1
2	25-06-2018	Saudi Arabia	Egypt	2	<3	61	22	7	10	5
3	25-06-2018	Egypt	Saudi Arabia	1	<3	39	8	1	6	1

	Date	Team	Opponent	Goal Scored	G>=3	Ball Possession %	Attempts	On-Target	Off-Target	Blocked
4	25-06-2018	Spain	Morocco	2	<3	68	16	4	11	1
...	...	...	...	...	...	...	...	...	...	...
59	11/7/2018	England	Croatia	1	<3	46	11	1	6	4
60	14-07-2018	Belgium	England	2	<3	43	12	4	3	5
61	14-07-2018	England	Belgium	0	<3	57	15	5	7	3
62	15-07-2018	France	Croatia	4	>=3	39	8	6	1	1

In [16]:

```
#get X features
XTest = testData.loc[:,features]
XTest
```

Out[16]:

	Ball Possession %	Attempts	On-Target	Off-Target	Blocked	Corners	Offsides	Free Kicks	Saves	Pass Accuracy %	Passes
0	56	17	7	6	4	4	0	20	1	88	492
1	44	3	1	1	1	2	2	17	5	83	355
2	61	22	7	10	5	7	1	19	0	90	655
3	39	8	1	6	1	2	3	8	5	82	357
4	68	16	4	11	1	7	1	18	1	91	762
...	...	...	...	...	...	...	...	...	...	...	..
59	46	11	1	6	4	4	3	24	5	79	479
60	43	12	4	3	5	4	1	5	5	88	510
61	57	15	5	7	3	5	0	12	2	92	698
62	39	8	6	1	1	2	1	14	1	75	271
63	61	15	3	8	4	6	1	15	3	83	547

64 rows × 13 columns

In [17]:

```
YTest = testData["G>=3"]
YTest
```

Out[17]:

```
0      >=3
1       <3
2       <3
3       <3
4       <3
      ...
59      <3
60      <3
```

```
61     <3
62    >=3
63     <3
Name: G>=3, Length: 64, dtype: object
```

In [18]:

```
#make predictions on test data
YPredicted = clf.predict(XTest)
YPredicted
```

Out[18]:

```
array(['<3', '<3', '<3', '<3', '<3', '<3', '<3', '<3', '<3', '<3', '<3',
       '<3', '<3', '<3', '<3', '<3', '>=3', '<3', '<3', '<3', '<3', '>=3',
       '<3', '<3', '<3', '<3', '<3', '<3', '<3', '<3', '<3', '<3', '<3',
       '<3', '<3', '<3', '>=3', '>=3', '<3', '<3', '<3', '<3', '<3', '<3',
       '>=3', '<3', '<3', '<3', '<3', '<3', '<3', '<3', '<3', '>=3',
       '>=3', '<3', '>=3', '<3', '<3', '>=3', '<3', '<3', '<3', '<3'],
      dtype=object)
```

In [19]:

```
#YTest
```

In [20]:

```
#calculate accuracy
from sklearn import metrics
accuracy = metrics.accuracy_score(YTest,YPredicted)
accuracy
```

Out[20]:

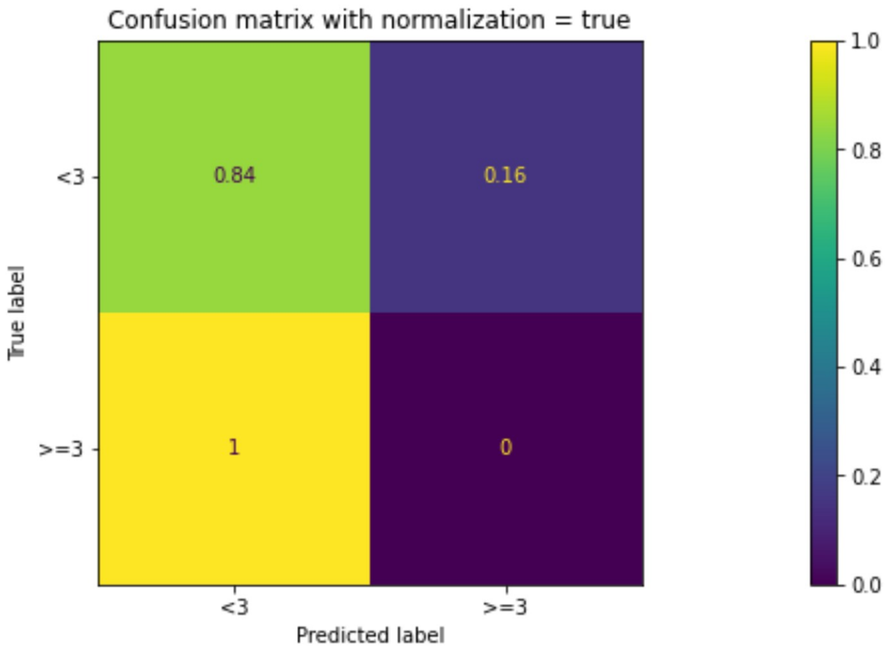
```
0.765625
```

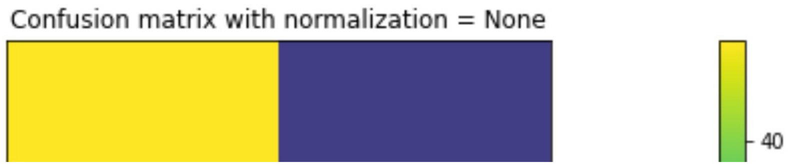
In [21]:

```
#setup plots for confusion matrix
from sklearn.metrics import plot_confusion_matrix as matrix
figSize = plt.rcParams["figure.figsize"]
figSize[0] = 30
figSize[1] = 5
plt.rcParams["figure.figsize"]=figSize
print(plt.rcParams.get('figure.figsize'))

#plot the confusion matrices 1 for normalzied the other un-normalized
values = ['true',None]
#cmap='cividis'
for x in values:
    disp = matrix(clf,XTest,YTest,display_labels=sorted,normalize=x)
    disp.ax_.set_title("Confusion matrix with normalization = "+str(x))
print(disp.confusion_matrix)
```

```
[30.0, 5.0]
[[49  9]
 [ 6  0]]
```





In [22]:

```
#get false positives
#pd.set_option('display.max_rows',100)
testData[(YTest!=YPredicted)&(YPredicted==">=3")]
```

Out[22]:

	Date	Team	Opponent	Goal Scored	G>=3	Ball Possession %	Attempts	On-Target	Off-Target	Blocked
16	27-06-2018	Korea Republic	Germany	2	<3	30	11	5	5	1
21	27-06-2018	Brazil	Serbia	2	<3	56	13	6	3	4
36	1/7/2018	Spain	Russia	1	<3	75	25	9	6	10
37	1/7/2018	Russia	Spain	1	<3	25	6	1	3	2
44	3/7/2018	Sweden	Switzerland	1	<3	37	12	3	6	3
53	7/7/2018	England	Sweden	2	<3	57	12	2	4	6
54	7/7/2018	Russia	Croatia	2	<3	38	13	7	4	2
56	10/7/2018	France	Belgium	1	<3	40	19	5	8	6
59	11/7/2018	England	Croatia	1	<3	46	11	1	6	4

In [23]:

```
#get false negative
#pd.set_option('display.max_rows',100)
testData[(YTest!=YPredicted)&(YPredicted=="<3")]
```

Out[23]:

	Date	Team	Opponent	Goal Scored	G>=3	Ball Possession %	Attempts	On-Target	Off-Target	Blocked
0	25-06-2018	Uruguay	Russia	3	>=3	56	17	7	6	4
19	27-06-2018	Sweden	Mexico	3	>=3	35	13	5	7	1
32	30-06-2018	France	Argentina	4	>=3	41	9	4	4	1
33	30-06-2018	Argentina	France	3	>=3	59	9	4	1	4
42	2/7/2018	Belgium	Japan	3	>=3	56	24	8	10	6
62	15-07-2018	France	Croatia	4	>=3	39	8	6	1	1

In [ ]:

In [ ]: