clf-1

April 18, 2021

0.1 . - 402

[ ]:
```python
import graphviz
import numpy as np
import pandas as pd
from sklearn import tree
from sklearn import preprocessing
from sklearn.model_selection import GridSearchCV
from sklearn.model_selection import train_test_split
from yellowbrick.classifier import ClassificationReport

import warnings
warnings.filterwarnings('ignore')
```

[2]:
```python
data = pd.read_csv('grades.csv')
```

[3]:
```python
data.head()
```

[3]:
```
  PUPIL_SEX PUPIL_CLASS  TEACHER_RIGHT  TEACHER_CHK  TEACHER_QUEST  \
0         F          8A             65            0              4
1         F          8A             70            4              0
2         F          8A             85            0              0
3         M          8A             55            0              0
4         M          8A             40            1              2

   TEACHER_CORR  PUPIL_CORR  PUPIL_STRIP GRADE
0             2           1            6    4-
1             4           0            4     3
2             4           3            5     4
3             1           8            3     3
4             0           3            4     2
```

[4]:
```python
data.isnull().sum().sort_values(ascending=False)
```

[4]:
```
PUPIL_SEX        0
PUPIL_CLASS      0
```

```
TEACHER_RIGHT    0
TEACHER_CHK      0
TEACHER_QUEST    0
TEACHER_CORR     0
PUPIL_CORR       0
PUPIL_STRIP      0
GRADE            0
dtype: int64
```

[5]:
```
X = data[['PUPIL_SEX',
          'PUPIL_CLASS',
          'TEACHER_RIGHT',
          'TEACHER_CHK',
          'TEACHER_QUEST',
          'TEACHER_CORR',
          'PUPIL_CORR',
          'PUPIL_STRIP']]

y = data['GRADE']
```

[6]:
```
le = preprocessing.LabelEncoder()

X['PUPIL_SEX'] = le.fit_transform(data['PUPIL_SEX'])
print({sex: i for i, sex in enumerate(le.inverse_transform([0, 1]))})

X['PUPIL_CLASS'] = le.fit_transform(data['PUPIL_CLASS'])
print({cl: i for i, cl in enumerate(le.inverse_transform([0, 1]))})

y = le.fit_transform(data['GRADE'])
print({grade: i for i, grade in enumerate(le.inverse_transform([0, 1, 2, 3, 4,␣
 ↪5, 6]))})
```

```
{'F': 0, 'M': 1}
{'8A': 0, '8B': 1}
{'2': 0, '3': 1, '3-': 2, '4': 3, '4-': 4, '5': 5, '5-': 6}
```

,

[7]:
```
tree_clf = tree.DecisionTreeClassifier()
tree_clf = tree_clf.fit(X, y)
```

[8]:
```
dot_data = tree.export_graphviz(tree_clf, out_file=None,
                                feature_names=data.columns.values[:-1],
                                class_names=le.inverse_transform([0, 1, 2, 3,␣
 ↪4, 5, 6]),
                                filled=True, rounded=True,
                                special_characters=True)
graph = graphviz.Source(dot_data)
graph.render("grades-100")
```

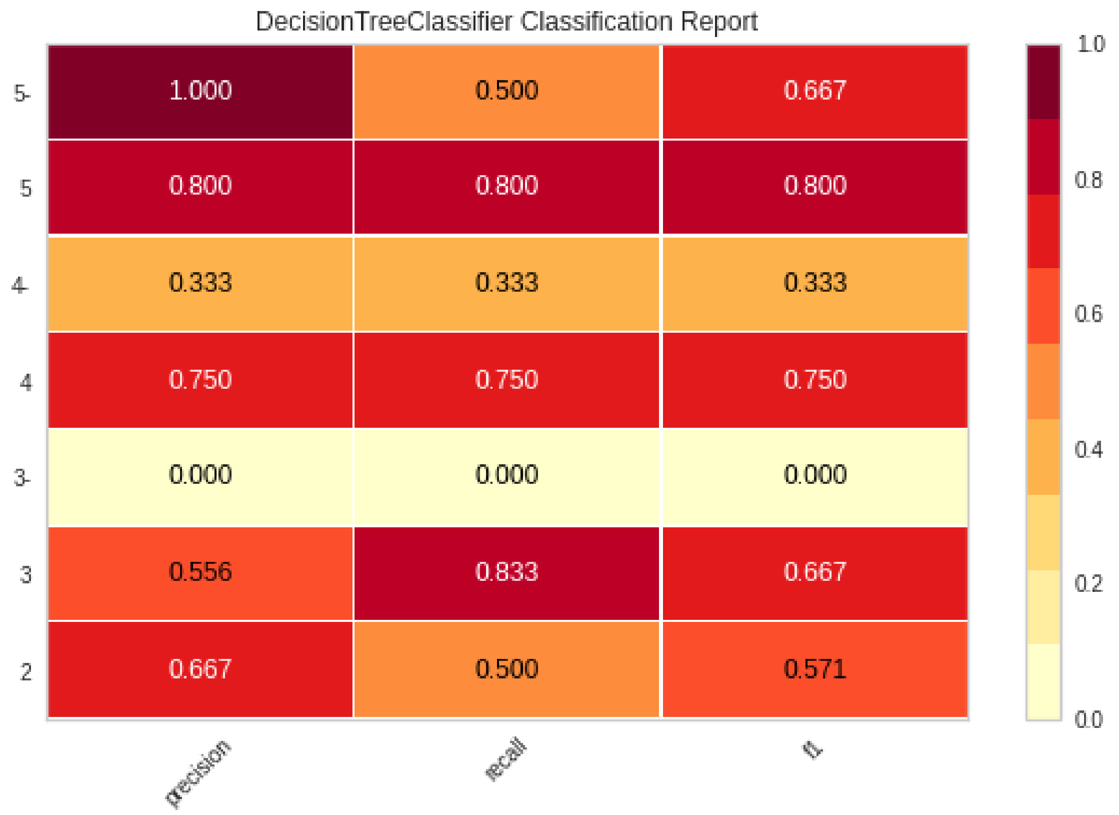
[8]: 'grades-100.pdf'

[9]:
```
def build_tree(X, y, test_size, criterion):
    class_names = le.inverse_transform([0, 1, 2, 3, 4, 5, 6])

    X_train, X_test, y_train, y_test = train_test_split(X, y,␣
 ↪test_size=test_size, random_state=5)

    print(y_train.shape, y_test.shape)

    param_grid = [{
             'max_depth':[1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 15],
             'min_samples_leaf':[1, 2, 3, 4, 5, 6, 7, 8, 9, 10],
            }]

    tree_clf = tree.DecisionTreeClassifier(criterion=criterion, random_state=1)

    grid_search = GridSearchCV(tree_clf, param_grid, cv=2, n_jobs=12)
    grid_search.fit(X_train, y_train)

    max_depth = grid_search.best_params_['max_depth']
    min_samples_leaf = grid_search.best_params_['min_samples_leaf']
    tree_clf_unf = tree.DecisionTreeClassifier(criterion=criterion,␣
 ↪max_depth=max_depth,
                                           min_samples_leaf=min_samples_leaf,
                                           random_state=1)
    tree_clf = tree_clf_unf.fit(X_train, y_train)

    dot_data = tree.export_graphviz(tree_clf, out_file=None,
                                feature_names=data.columns.values[:-1],
                                class_names=class_names,
                                filled=True, rounded=True,
                                special_characters=True)
    graph = graphviz.Source(dot_data)
    graph.render(f"grades-{int(100 * (1 - test_size))}:{int(100 *␣
 ↪test_size)}-{criterion}")


    vis = ClassificationReport(tree_clf_unf, classes=class_names)

    vis.fit(X_train, y_train)
    acc = vis.score(X_test, y_test)
    print(f'Accuracy {round(acc, 5)} with split = {int(100 * (1 - test_size))}:
↪{int(100 * test_size)} and criterion = {criterion}')
    vis.show()
    print('-----------------------------------------------------------------')
```

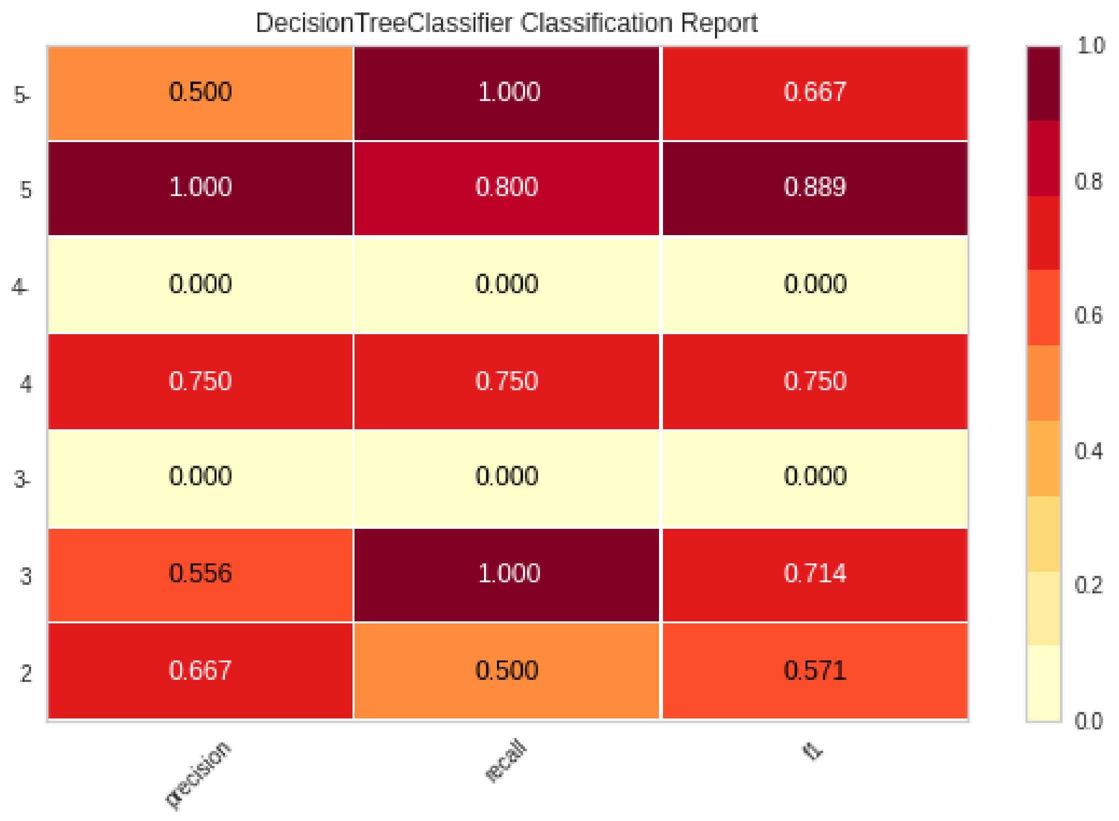
(**entropy)** , 70 30 (70 - , 30 -), (accuracy) 68%. - (80% - 90%) ,

```
[10]: for spl in range(4, 0, -1):
          build_tree(X, y, round(spl * 0.1, 1), 'entropy')
```

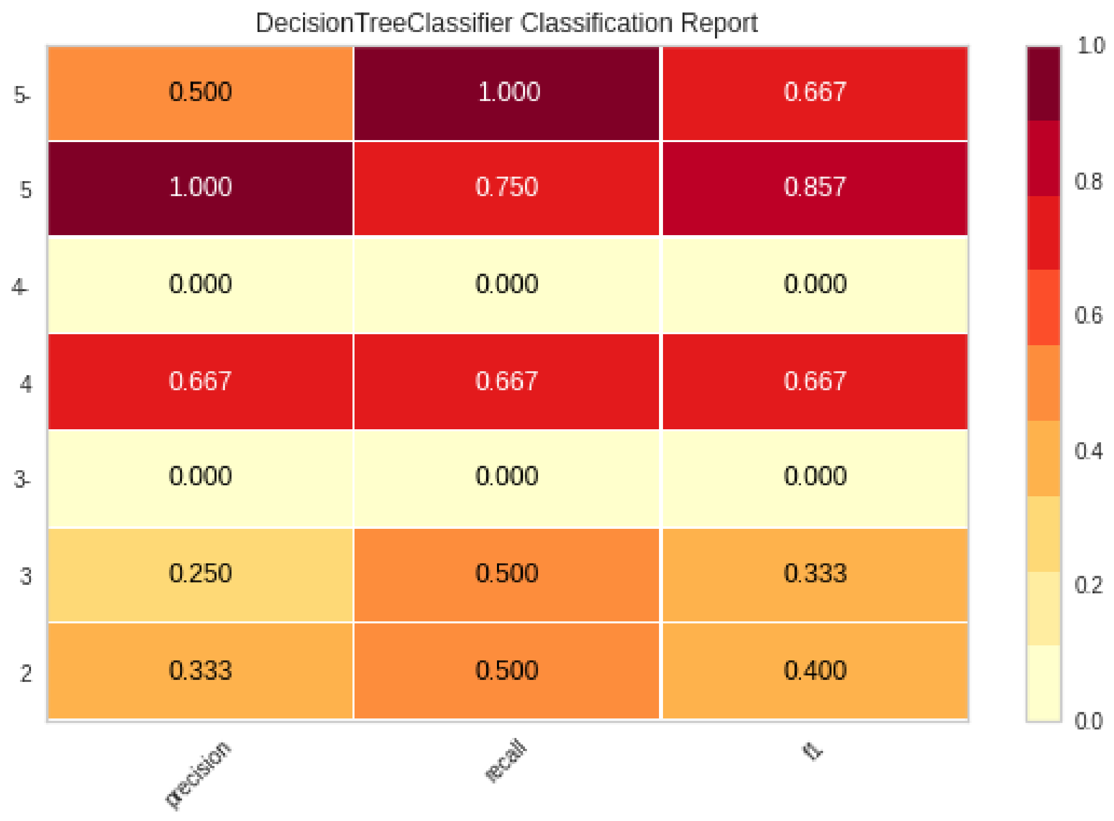
```
(43,) (29,)
Accuracy 0.65517 with split = 60:40 and criterion = entropy
```



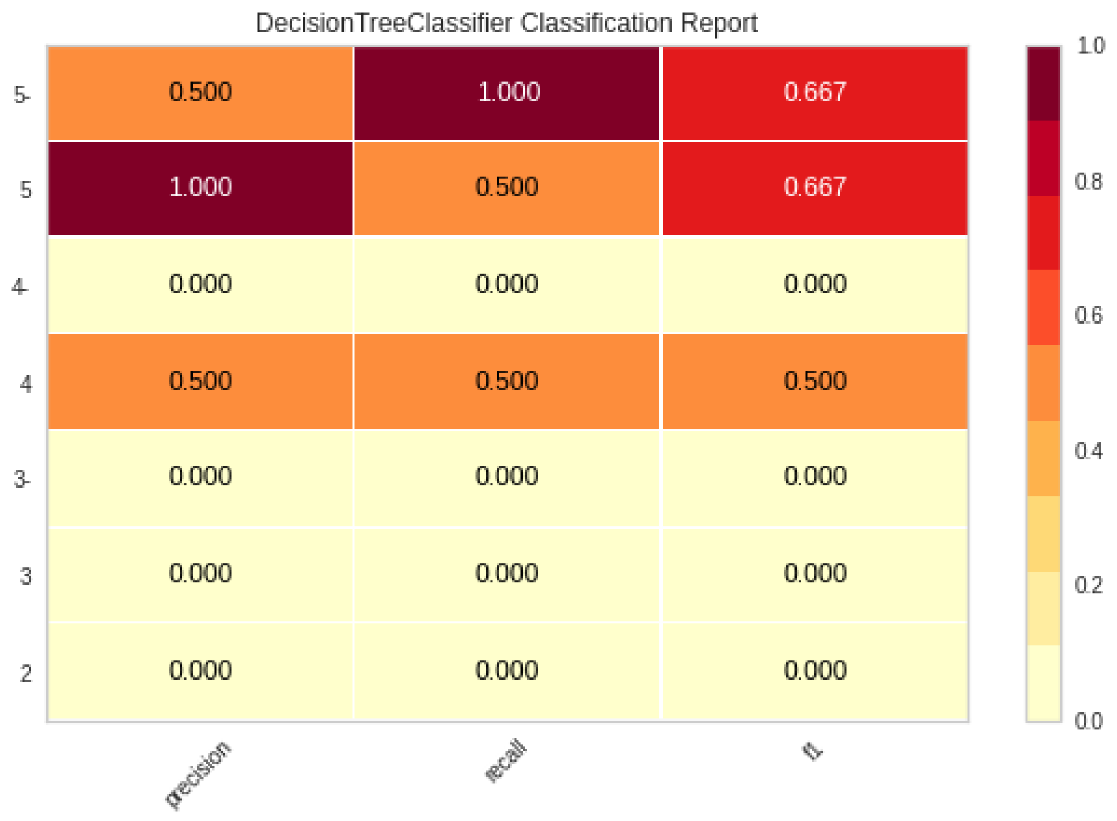
```
-----------------------------------------------------------------
(50,) (22,)
Accuracy 0.68182 with split = 70:30 and criterion = entropy
```



```
-----------------------------------------------------------------
(57,) (15,)
Accuracy 0.53333 with split = 80:20 and criterion = entropy
```



```
-----------------------------------------------------------------
(64,) (8,)
Accuracy 0.375 with split = 90:10 and criterion = entropy
```

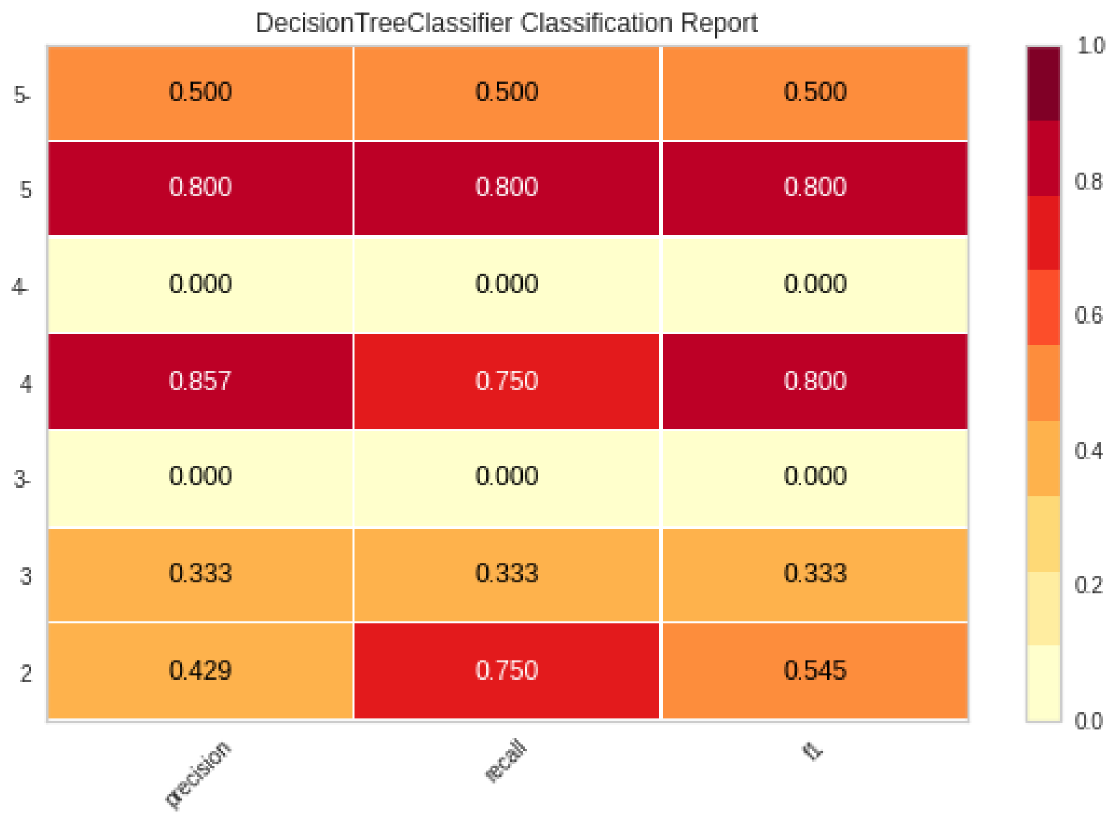


```
----------------------------------------------------------------
```

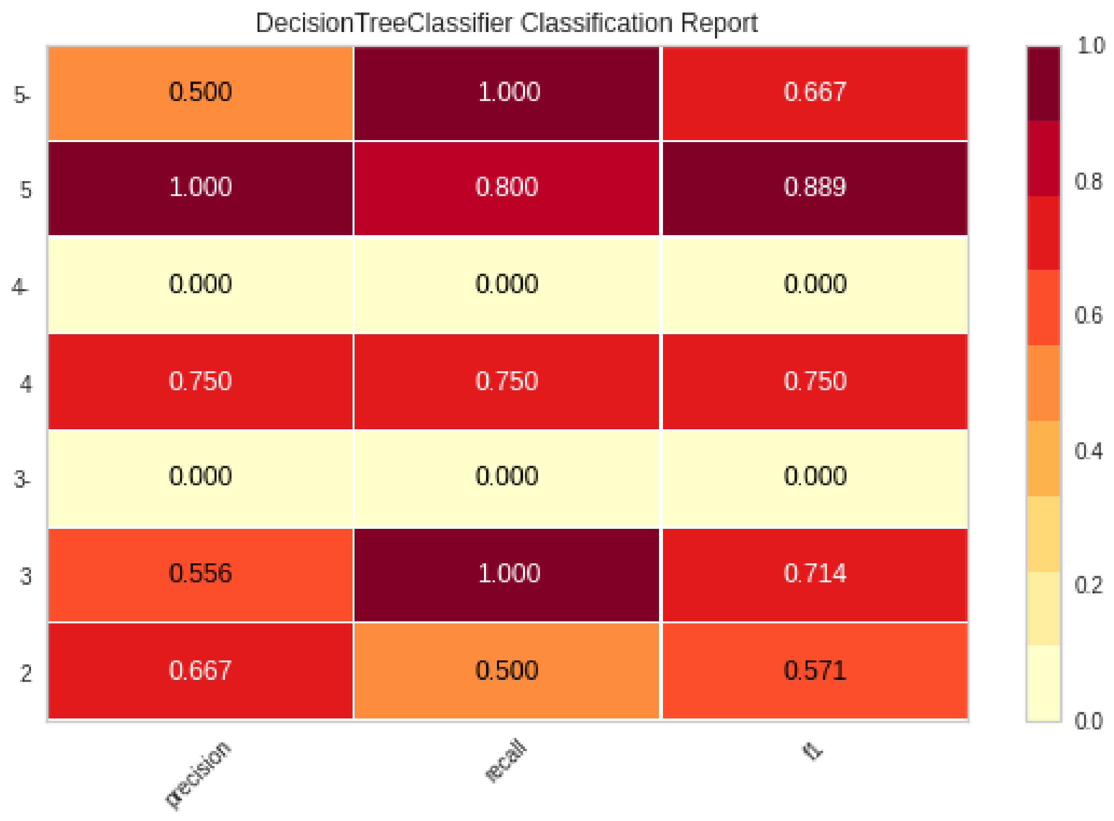
(gini) “gini”

```
[11]: for spl in range(4, 0, -1):
          build_tree(X, y, round(spl * 0.1, 1), 'gini')
```

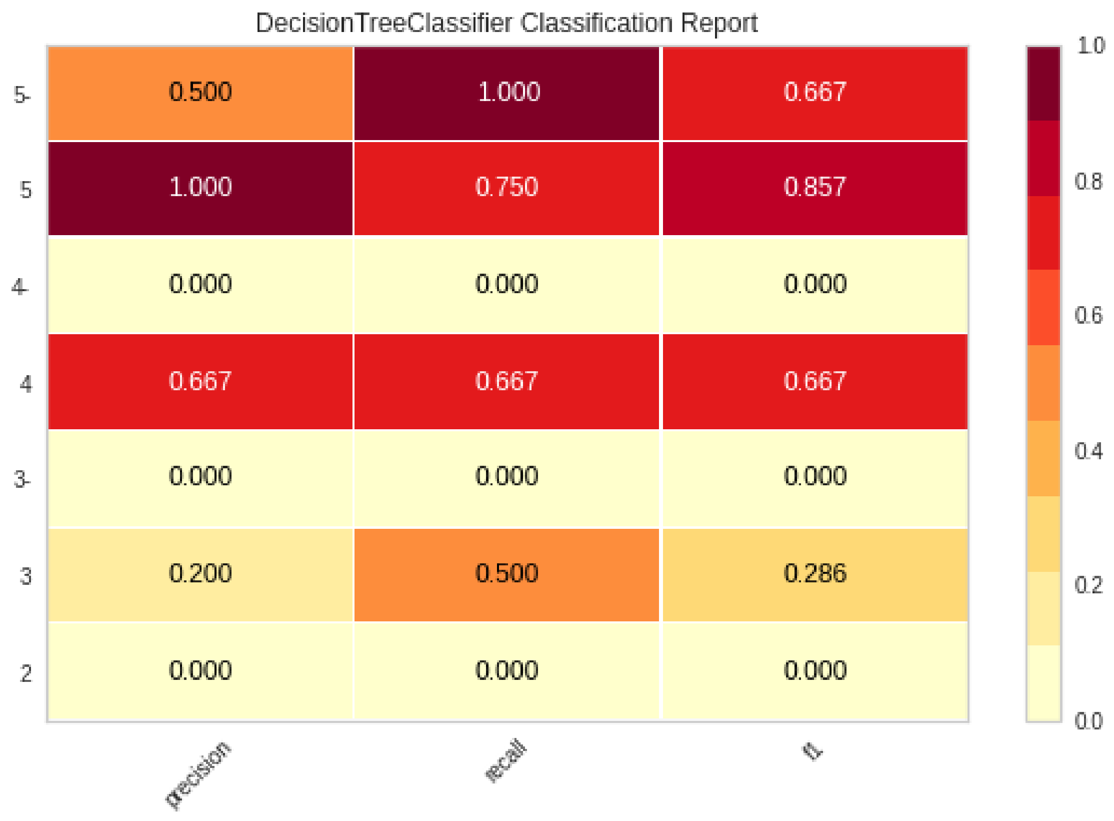
```
(43,) (29,)
Accuracy 0.55172 with split = 60:40 and criterion = gini
```



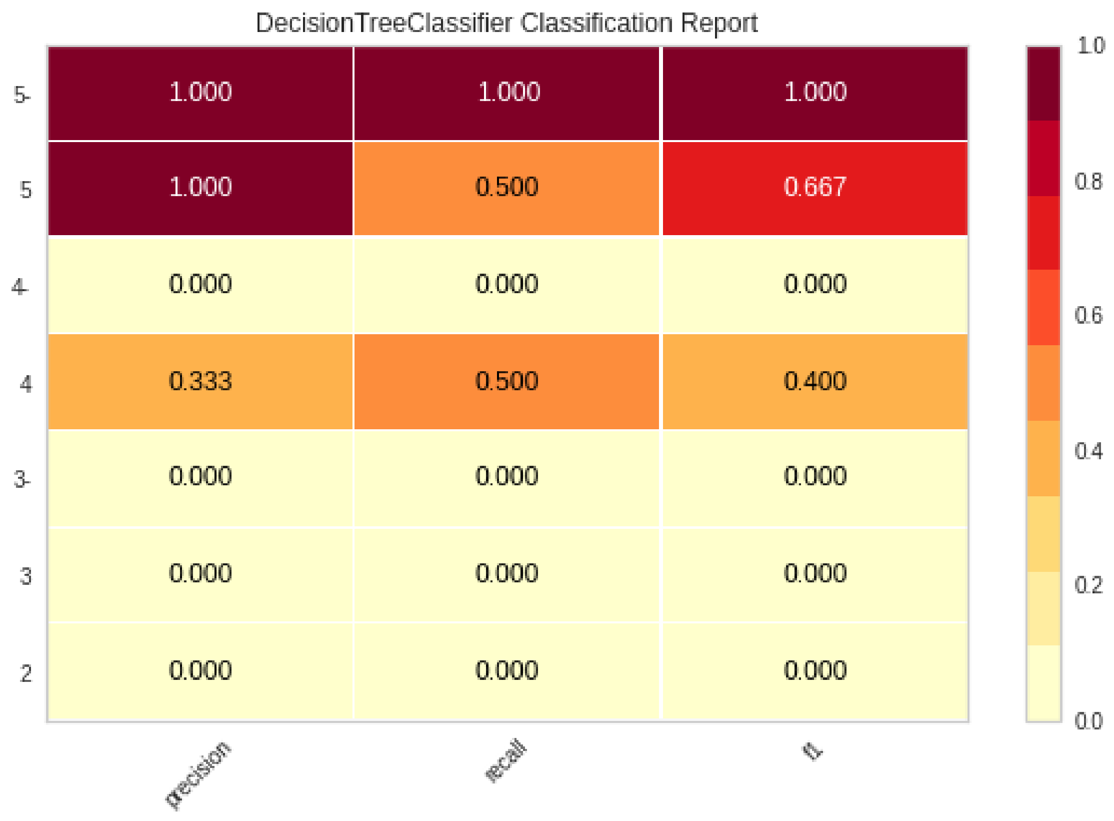
```
-----------------------------------------------------------------
(50,) (22,)
Accuracy 0.68182 with split = 70:30 and criterion = gini
```



```
-----------------------------------------------------------------
(57,) (15,)
Accuracy 0.46667 with split = 80:20 and criterion = gini
```



```
-----------------------------------------------------------------
(64,) (8,)
Accuracy 0.375 with split = 90:10 and criterion = gini
```


DecisionTreeClassifier Classification Report
5-
5
4-
4
3-
3
2
1.000
1.000
1.000
1.000
0.500
0.667
0.000
0.000
0.000
0.333
0.500
0.400
0.000
0.000
0.000
0.000
0.000
0.000
0.000
0.000
0.000
precision
recall
f1
1.0
0.8
0.6
0.4
0.2
0.0

```
[ ]:
```

```
[ ]:
```