In [1]:
```
from sklearn.datasets import load_iris
import numpy as np
import matplotlib.pyplot as plt
from sklearn.model_selection import train_test_split, KFold, cross_val_score
from sklearn.tree import DecisionTreeClassifier, plot_tree
from sklearn.metrics import confusion_matrix, classification_report, accurac
```

In [2]:
```
# Importing done here
dataset = load_iris()
X = dataset.data
y = dataset.target
```

In [3]:
```
# Trained and split 20% of data for testing
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3, ran
```

In [4]:
```
kf = KFold(n_splits=int(X.size/10), random_state=42, shuffle=True)
```

In [5]:
```
'''
Decision trees is a classification method that is used to perform multi-clas


For training vectors x[i] which are real numbers and y is a vector of size o
A decision tree recursively partitions the feature space such that the sampl
with the same labels or similar target values are grouped together.

Let the data at node m be represented by Qm with Nm samples where N is the s
split Theta = (j, tm) consisting of feature j and the threshold tm partition

Where
Qm^left = The data at m is a tuple of (x, y) for x for feature j <= threshol
Qm^right =
'''
# Visualizing the tree
clf = DecisionTreeClassifier(random_state=0)
clf = clf.fit(X_train, y_train)
plot_tree(clf, filled=True)
```

Out[5]:
```
[Text(0.3076923076923077, 0.9285714285714286, 'x[3] <= 0.8\ngini = 0.664\nsa
mples = 105\nvalue = [31, 37, 37]'),
 Text(0.23076923076923078, 0.7857142857142857, 'gini = 0.0\nsamples = 31\nva
lue = [31, 0, 0]'),
 Text(0.38461538461538464, 0.7857142857142857, 'x[2] <= 4.75\ngini = 0.5\nsa
mples = 74\nvalue = [0, 37, 37]'),
 Text(0.15384615384615385, 0.6428571428571429, 'x[3] <= 1.6\ngini = 0.059\ns
amples = 33\nvalue = [0, 32, 1]'),
 Text(0.07692307692307693, 0.5, 'gini = 0.0\nsamples = 32\nvalue = [0, 32,
0]'),
 Text(0.23076923076923078, 0.5, 'gini = 0.0\nsamples = 1\nvalue = [0, 0,
1]'),
 Text(0.6153846153846154, 0.6428571428571429, 'x[3] <= 1.75\ngini = 0.214\ns
amples = 41\nvalue = [0, 5, 36]'),
 Text(0.38461538461538464, 0.5, 'x[2] <= 4.95\ngini = 0.5\nsamples = 8\nvalu
e = [0, 4, 4]'),
 Text(0.3076923076923077, 0.35714285714285715, 'gini = 0.0\nsamples = 2\nval
ue = [0, 2, 0]'),
 Text(0.46153846153846156, 0.35714285714285715, 'x[3] <= 1.55\ngini = 0.444
\nsamples = 6\nvalue = [0, 2, 4]'),
 Text(0.38461538461538464, 0.21428571428571427, 'gini = 0.0\nsamples = 3\nva
lue = [0, 0, 3]'),
 Text(0.5384615384615384, 0.21428571428571427, 'x[2] <= 5.45\ngini = 0.444\n
samples = 3\nvalue = [0, 2, 1]'),
 Text(0.46153846153846156, 0.07142857142857142, 'gini = 0.0\nsamples = 2\nva
lue = [0, 2, 0]'),
 Text(0.6153846153846154, 0.07142857142857142, 'gini = 0.0\nsamples = 1\nval
ue = [0, 0, 1]'),
 Text(0.8461538461538461, 0.5, 'x[2] <= 4.85\ngini = 0.059\nsamples = 33\nva
lue = [0, 1, 32]'),
 Text(0.7692307692307693, 0.35714285714285715, 'x[1] <= 3.1\ngini = 0.444\ns
amples = 3\nvalue = [0, 1, 2]'),
 Text(0.6923076923076923, 0.21428571428571427, 'gini = 0.0\nsamples = 2\nval
ue = [0, 0, 2]'),
 Text(0.8461538461538461, 0.21428571428571427, 'gini = 0.0\nsamples = 1\nval
ue = [0, 1, 0]'),
 Text(0.9230769230769231, 0.35714285714285715, 'gini = 0.0\nsamples = 30\nva
lue = [0, 0, 30]')]
```

In [6]:
```
cv_scores = cross_val_score(clf, X, y, cv=kf)
print(cv_scores)
```

```
[1.         1.         1.         1.         1.         1.
 1.         1.         1.         1.         1.         1.
 1.         1.         1.         1.         1.         1.
 1.         1.         1.         1.         1.         1.
 1.         1.         1.         1.         0.66666667 0.66666667
 1.         0.5        1.         1.         0.5        1.
 1.         1.         1.         1.         1.         1.
 1.         1.         1.         1.         1.         1.
 1.         0.5        0.5        1.         1.         1.
 1.         1.         1.         1.         0.5        1.        ]
```

In [7]:
```
'''
Let C ∈ R^m,n
for C[i,j] = Observations of group i, predicted to be in group j
'''
```

Out[7]:
```
'\nLet C ∈ R^m,n\nfor C[i,j] = Observations of group i, predicted to be in g
roup j\n'
```

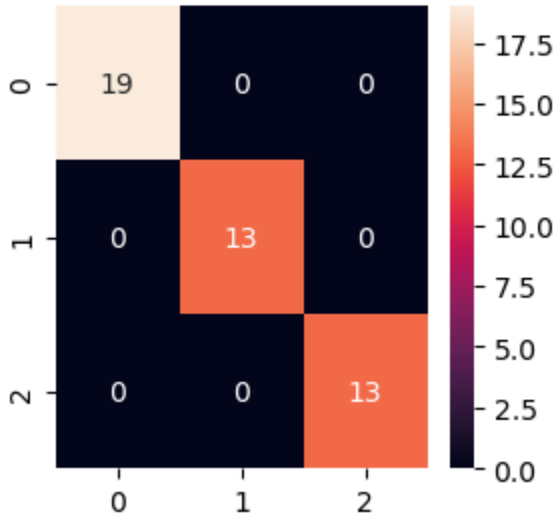
In [8]:
```
hypothesis = clf.predict(X_test)
print(accuracy_score(y_test, hypothesis))
```

```
1.0
```

In [9]:
```
confusion_mat = confusion_matrix(y_test, hypothesis)
```

In [10]:
```
import seaborn as sb
```

In [11]:
```
fig, ax = plt.subplots(figsize=(3,3))
sb.heatmap(confusion_mat, annot=True)
plt.show()
```



In [12]:
```
print(classification_report(hypothesis, y_test))
```

```
              precision    recall  f1-score   support

           0       1.00      1.00      1.00        19
           1       1.00      1.00      1.00        13
           2       1.00      1.00      1.00        13

    accuracy                           1.00        45
   macro avg       1.00      1.00      1.00        45
weighted avg       1.00      1.00      1.00        45
```