In [3]:

```python
import sys
import scipy
import numpy
import matplotlib
import pandas
import sklearn
print('Python: {}'.format(sys.version))
print('scipy: {}'.format(scipy.__version__))
print('numpy: {}'.format(numpy.__version__))
print('matplotlib: {}'.format(matplotlib.__version__))
print('pandas: {}'.format(pandas.__version__))
print('sklearn: {}'.format(sklearn.__version__))
```

```
Python: 3.6.5 |Anaconda, Inc.| (default, Apr 26 2018,
08:42:37)
[GCC 4.2.1 Compatible Clang 4.0.1 (tags/RELEASE_401/fi
nal)]
scipy: 1.1.0
numpy: 1.14.3
matplotlib: 2.2.2
pandas: 0.23.0
sklearn: 0.19.1
```

In [4]:

```python
import pandas
from pandas.plotting import scatter_matrix
import matplotlib.pyplot as plt
from sklearn import model_selection
from sklearn.neighbors import KNeighborsClassifier
```

In [6]:

```
names = ['sepal-length', 'sepal-width', 'petal-length', 'petal-widt
h', 'class']
ds = pandas.read_csv('iris.data.txt', names=names)
print(ds)
```

	sepal-length	sepal-width	petal-length	petal-width	class
0	5.1	3.5	1.4	0.2	Iris-setosa
1	4.9	3.0	1.4	0.2	Iris-setosa
2	4.7	3.2	1.3	0.2	Iris-setosa
3	4.6	3.1	1.5	0.2	Iris-setosa
4	5.0	3.6	1.4	0.2	Iris-setosa
5	5.4	3.9	1.7	0.4	Iris-setosa
6	4.6	3.4	1.4	0.3	Iris-setosa
7	5.0	3.4	1.5	0.2	Iris-setosa
8	4.4	2.9	1.4	0.2	Iris-setosa
9	4.9	3.1	1.5	0.1	Iris-setosa
10	5.4	3.7	1.5	0.2	Iris-setosa
11	4.8	3.4	1.6	0.2	Iris-setosa
12	4.8	3.0	1.4	0.1	Iris-setosa
13	4.3	3.0	1.1	0.1	Iris-setosa
14	5.8	4.0	1.2	0.2	Iris-setosa
15	5.7	4.4	1.5	0.4	Iris-setosa
16	5.4	3.9	1.3		

0.4	Iris-setosa		
17	5.1	3.5	1.4
0.3	Iris-setosa		
18	5.7	3.8	1.7
0.3	Iris-setosa		
19	5.1	3.8	1.5
0.3	Iris-setosa		
20	5.4	3.4	1.7
0.2	Iris-setosa		
21	5.1	3.7	1.5
0.4	Iris-setosa		
22	4.6	3.6	1.0
0.2	Iris-setosa		
23	5.1	3.3	1.7
0.5	Iris-setosa		
24	4.8	3.4	1.9
0.2	Iris-setosa		
25	5.0	3.0	1.6
0.2	Iris-setosa		
26	5.0	3.4	1.6
0.4	Iris-setosa		
27	5.2	3.5	1.5
0.2	Iris-setosa		
28	5.2	3.4	1.4
0.2	Iris-setosa		
29	4.7	3.2	1.6
0.2	Iris-setosa		
..	...	...	...
...	...		
120	6.9	3.2	5.7
2.3	Iris-virginica		
121	5.6	2.8	4.9
2.0	Iris-virginica		
122	7.7	2.8	6.7
2.0	Iris-virginica		
123	6.3	2.7	4.9
1.8	Iris-virginica		
124	6.7	3.3	5.7
2.1	Iris-virginica		
125	7.2	3.2	6.0
1.8	Iris-virginica		

126	6.2	2.8	4.8
1.8	Iris-virginica		
127	6.1	3.0	4.9
1.8	Iris-virginica		
128	6.4	2.8	5.6
2.1	Iris-virginica		
129	7.2	3.0	5.8
1.6	Iris-virginica		
130	7.4	2.8	6.1
1.9	Iris-virginica		
131	7.9	3.8	6.4
2.0	Iris-virginica		
132	6.4	2.8	5.6
2.2	Iris-virginica		
133	6.3	2.8	5.1
1.5	Iris-virginica		
134	6.1	2.6	5.6
1.4	Iris-virginica		
135	7.7	3.0	6.1
2.3	Iris-virginica		
136	6.3	3.4	5.6
2.4	Iris-virginica		
137	6.4	3.1	5.5
1.8	Iris-virginica		
138	6.0	3.0	4.8
1.8	Iris-virginica		
139	6.9	3.1	5.4
2.1	Iris-virginica		
140	6.7	3.1	5.6
2.4	Iris-virginica		
141	6.9	3.1	5.1
2.3	Iris-virginica		
142	5.8	2.7	5.1
1.9	Iris-virginica		
143	6.8	3.2	5.9
2.3	Iris-virginica		
144	6.7	3.3	5.7
2.5	Iris-virginica		
145	6.7	3.0	5.2
2.3	Iris-virginica		
146	6.3	2.5	5.0

```
1.9   Iris-virginica
147          6.5           3.0            5.2
2.0   Iris-virginica
148          6.2           3.4            5.4
2.3   Iris-virginica
149          5.9           3.0            5.1
1.8   Iris-virginica

[150 rows x 5 columns]
```

In [7]:

```
print(ds.shape)
print(ds.head(20))
print(ds.describe())
print(ds.groupby('class').size())
```

(150, 5)

	sepal-length	sepal-width	petal-length	petal-width	class
0	5.1	3.5	1.4	0.2	Iris-setosa
1	4.9	3.0	1.4	0.2	Iris-setosa
2	4.7	3.2	1.3	0.2	Iris-setosa
3	4.6	3.1	1.5	0.2	Iris-setosa
4	5.0	3.6	1.4	0.2	Iris-setosa
5	5.4	3.9	1.7	0.4	Iris-setosa
6	4.6	3.4	1.4	0.3	Iris-setosa
7	5.0	3.4	1.5	0.2	Iris-setosa
8	4.4	2.9	1.4	0.2	Iris-setosa
9	4.9	3.1	1.5	0.1	Iris-setosa
10	5.4	3.7	1.5	0.2	Iris-setosa
11	4.8	3.4	1.6	0.2	Iris-setosa
12	4.8	3.0	1.4	0.1	Iris-setosa
13	4.3	3.0	1.1	0.1	Iris-setosa
14	5.8	4.0	1.2	0.2	Iris-setosa
15	5.7	4.4	1.5	0.4	Iris-setosa

```
16            5.4           3.9            1.3
0.4   Iris-setosa
17            5.1           3.5            1.4
0.3   Iris-setosa
18            5.7           3.8            1.7
0.3   Iris-setosa
19            5.1           3.8            1.5
0.3   Iris-setosa
```

|	sepal-length	sepal-width	petal-length	petal-width
count	150.000000	150.000000	150.000000	150.000000
mean	5.843333	3.054000	3.758667	1.198667
std	0.828066	0.433594	1.764420	0.763161
min	4.300000	2.000000	1.000000	0.100000
25%	5.100000	2.800000	1.600000	0.300000
50%	5.800000	3.000000	4.350000	1.300000
75%	6.400000	3.300000	5.100000	1.800000
max	7.900000	4.400000	6.900000	2.500000

```
class
Iris-setosa        50
Iris-versicolor    50
Iris-virginica     50
dtype: int64
```

In [8]:

```
ds.plot(kind='box', subplots=True, layout=(2,2), sharex=False, share
y=False)
plt.show()
```
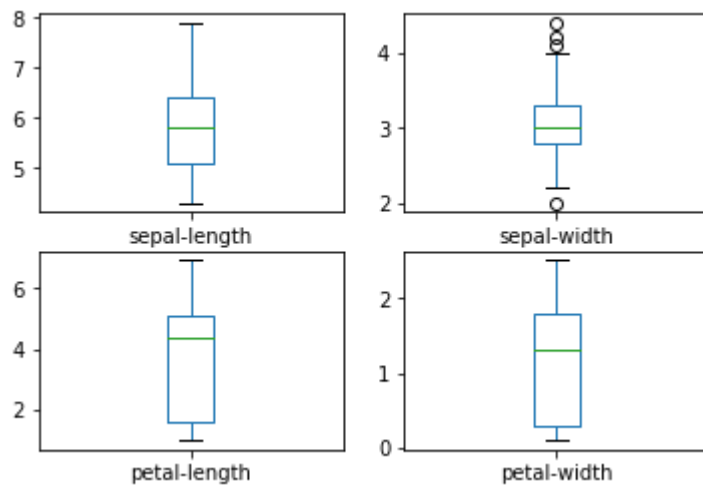
In [9]:

```
array = ds.values
X = array[:,0:4]
Y = array[:,4]
print(X)
print(Y)
```

```
[[5.1 3.5 1.4 0.2]
 [4.9 3.0 1.4 0.2]
 [4.7 3.2 1.3 0.2]
 [4.6 3.1 1.5 0.2]
 [5.0 3.6 1.4 0.2]
 [5.4 3.9 1.7 0.4]
 [4.6 3.4 1.4 0.3]
 [5.0 3.4 1.5 0.2]
 [4.4 2.9 1.4 0.2]
 [4.9 3.1 1.5 0.1]
 [5.4 3.7 1.5 0.2]
 [4.8 3.4 1.6 0.2]
 [4.8 3.0 1.4 0.1]
 [4.3 3.0 1.1 0.1]
 [5.8 4.0 1.2 0.2]
 [5.7 4.4 1.5 0.4]
 [5.4 3.9 1.3 0.4]
 [5.1 3.5 1.4 0.3]
 [5.7 3.8 1.7 0.3]
 [5.1 3.8 1.5 0.3]
 [5.4 3.4 1.7 0.2]
 [5.1 3.7 1.5 0.4]
 [4.6 3.6 1.0 0.2]
 [5.1 3.3 1.7 0.5]
 [4.8 3.4 1.9 0.2]
 [5.0 3.0 1.6 0.2]
 [5.0 3.4 1.6 0.4]
 [5.2 3.5 1.5 0.2]
 [5.2 3.4 1.4 0.2]
 [4.7 3.2 1.6 0.2]
 [4.8 3.1 1.6 0.2]
 [5.4 3.4 1.5 0.4]
 [5.2 4.1 1.5 0.1]
 [5.5 4.2 1.4 0.2]
```

```
[4.9 3.1 1.5 0.1]
[5.0 3.2 1.2 0.2]
[5.5 3.5 1.3 0.2]
[4.9 3.1 1.5 0.1]
[4.4 3.0 1.3 0.2]
[5.1 3.4 1.5 0.2]
[5.0 3.5 1.3 0.3]
[4.5 2.3 1.3 0.3]
[4.4 3.2 1.3 0.2]
[5.0 3.5 1.6 0.6]
[5.1 3.8 1.9 0.4]
[4.8 3.0 1.4 0.3]
[5.1 3.8 1.6 0.2]
[4.6 3.2 1.4 0.2]
[5.3 3.7 1.5 0.2]
[5.0 3.3 1.4 0.2]
[7.0 3.2 4.7 1.4]
[6.4 3.2 4.5 1.5]
[6.9 3.1 4.9 1.5]
[5.5 2.3 4.0 1.3]
[6.5 2.8 4.6 1.5]
[5.7 2.8 4.5 1.3]
[6.3 3.3 4.7 1.6]
[4.9 2.4 3.3 1.0]
[6.6 2.9 4.6 1.3]
[5.2 2.7 3.9 1.4]
[5.0 2.0 3.5 1.0]
[5.9 3.0 4.2 1.5]
[6.0 2.2 4.0 1.0]
[6.1 2.9 4.7 1.4]
[5.6 2.9 3.6 1.3]
[6.7 3.1 4.4 1.4]
[5.6 3.0 4.5 1.5]
[5.8 2.7 4.1 1.0]
[6.2 2.2 4.5 1.5]
[5.6 2.5 3.9 1.1]
[5.9 3.2 4.8 1.8]
[6.1 2.8 4.0 1.3]
[6.3 2.5 4.9 1.5]
[6.1 2.8 4.7 1.2]
[6.4 2.9 4.3 1.3]
```

```
[6.6 3.0 4.4 1.4]
[6.8 2.8 4.8 1.4]
[6.7 3.0 5.0 1.7]
[6.0 2.9 4.5 1.5]
[5.7 2.6 3.5 1.0]
[5.5 2.4 3.8 1.1]
[5.5 2.4 3.7 1.0]
[5.8 2.7 3.9 1.2]
[6.0 2.7 5.1 1.6]
[5.4 3.0 4.5 1.5]
[6.0 3.4 4.5 1.6]
[6.7 3.1 4.7 1.5]
[6.3 2.3 4.4 1.3]
[5.6 3.0 4.1 1.3]
[5.5 2.5 4.0 1.3]
[5.5 2.6 4.4 1.2]
[6.1 3.0 4.6 1.4]
[5.8 2.6 4.0 1.2]
[5.0 2.3 3.3 1.0]
[5.6 2.7 4.2 1.3]
[5.7 3.0 4.2 1.2]
[5.7 2.9 4.2 1.3]
[6.2 2.9 4.3 1.3]
[5.1 2.5 3.0 1.1]
[5.7 2.8 4.1 1.3]
[6.3 3.3 6.0 2.5]
[5.8 2.7 5.1 1.9]
[7.1 3.0 5.9 2.1]
[6.3 2.9 5.6 1.8]
[6.5 3.0 5.8 2.2]
[7.6 3.0 6.6 2.1]
[4.9 2.5 4.5 1.7]
[7.3 2.9 6.3 1.8]
[6.7 2.5 5.8 1.8]
[7.2 3.6 6.1 2.5]
[6.5 3.2 5.1 2.0]
[6.4 2.7 5.3 1.9]
[6.8 3.0 5.5 2.1]
[5.7 2.5 5.0 2.0]
[5.8 2.8 5.1 2.4]
[6.4 3.2 5.3 2.3]
```

```
  [6.5 3.0 5.5 1.8]
  [7.7 3.8 6.7 2.2]
  [7.7 2.6 6.9 2.3]
  [6.0 2.2 5.0 1.5]
  [6.9 3.2 5.7 2.3]
  [5.6 2.8 4.9 2.0]
  [7.7 2.8 6.7 2.0]
  [6.3 2.7 4.9 1.8]
  [6.7 3.3 5.7 2.1]
  [7.2 3.2 6.0 1.8]
  [6.2 2.8 4.8 1.8]
  [6.1 3.0 4.9 1.8]
  [6.4 2.8 5.6 2.1]
  [7.2 3.0 5.8 1.6]
  [7.4 2.8 6.1 1.9]
  [7.9 3.8 6.4 2.0]
  [6.4 2.8 5.6 2.2]
  [6.3 2.8 5.1 1.5]
  [6.1 2.6 5.6 1.4]
  [7.7 3.0 6.1 2.3]
  [6.3 3.4 5.6 2.4]
  [6.4 3.1 5.5 1.8]
  [6.0 3.0 4.8 1.8]
  [6.9 3.1 5.4 2.1]
  [6.7 3.1 5.6 2.4]
  [6.9 3.1 5.1 2.3]
  [5.8 2.7 5.1 1.9]
  [6.8 3.2 5.9 2.3]
  [6.7 3.3 5.7 2.5]
  [6.7 3.0 5.2 2.3]
  [6.3 2.5 5.0 1.9]
  [6.5 3.0 5.2 2.0]
  [6.2 3.4 5.4 2.3]
  [5.9 3.0 5.1 1.8]]
['Iris-setosa' 'Iris-setosa' 'Iris-setosa' 'Iris-setos
a' 'Iris-setosa'
 'Iris-setosa' 'Iris-setosa' 'Iris-setosa' 'Iris-setos
a' 'Iris-setosa'
 'Iris-setosa' 'Iris-setosa' 'Iris-setosa' 'Iris-setos
a' 'Iris-setosa'
 'Iris-setosa' 'Iris-setosa' 'Iris-setosa' 'Iris-setos
```

```
a' 'Iris-setosa'
 'Iris-setosa' 'Iris-setosa' 'Iris-setosa' 'Iris-setos
a' 'Iris-setosa'
 'Iris-setosa' 'Iris-setosa' 'Iris-setosa' 'Iris-setos
a' 'Iris-setosa'
 'Iris-setosa' 'Iris-setosa' 'Iris-setosa' 'Iris-setos
a' 'Iris-setosa'
 'Iris-setosa' 'Iris-setosa' 'Iris-setosa' 'Iris-setos
a' 'Iris-setosa'
 'Iris-setosa' 'Iris-setosa' 'Iris-setosa' 'Iris-setos
a' 'Iris-setosa'
 'Iris-setosa' 'Iris-setosa' 'Iris-setosa' 'Iris-setos
a' 'Iris-setosa'
 'Iris-versicolor' 'Iris-versicolor' 'Iris-versicolor'
'Iris-versicolor'
 'Iris-versicolor' 'Iris-versicolor' 'Iris-versicolor'
'Iris-versicolor'
 'Iris-versicolor' 'Iris-versicolor' 'Iris-versicolor'
'Iris-versicolor'
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'Iris-versicolor'
 'Iris-versicolor' 'Iris-versicolor' 'Iris-versicolor'
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'Iris-versicolor'
 'Iris-versicolor' 'Iris-versicolor' 'Iris-versicolor'
'Iris-versicolor'
 'Iris-versicolor' 'Iris-versicolor' 'Iris-versicolor'
'Iris-versicolor'
 'Iris-versicolor' 'Iris-versicolor' 'Iris-versicolor'
'Iris-versicolor'
 'Iris-versicolor' 'Iris-versicolor' 'Iris-virginica'
'Iris-virginica'
 'Iris-virginica' 'Iris-virginica' 'Iris-virginica' 'I
ris-virginica'
```

```
  'Iris-virginica' 'Iris-virginica' 'Iris-virginica' 'I
ris-virginica'
  'Iris-virginica' 'Iris-virginica' 'Iris-virginica' 'I
ris-virginica'
  'Iris-virginica' 'Iris-virginica' 'Iris-virginica' 'I
ris-virginica'
  'Iris-virginica' 'Iris-virginica' 'Iris-virginica' 'I
ris-virginica'
  'Iris-virginica' 'Iris-virginica' 'Iris-virginica' 'I
ris-virginica'
  'Iris-virginica' 'Iris-virginica' 'Iris-virginica' 'I
ris-virginica'
  'Iris-virginica' 'Iris-virginica' 'Iris-virginica' 'I
ris-virginica'
  'Iris-virginica' 'Iris-virginica' 'Iris-virginica' 'I
ris-virginica'
  'Iris-virginica' 'Iris-virginica' 'Iris-virginica' 'I
ris-virginica'
  'Iris-virginica' 'Iris-virginica' 'Iris-virginica' 'I
ris-virginica'
  'Iris-virginica' 'Iris-virginica' 'Iris-virginica' 'I
ris-virginica']
```

In [33]:

```
test_size = 0.20
seed = 8
X_train, X_test, Y_train, Y_test = model_selection.train_test_split(
X, Y,
test_size=test_size, random_state=seed)
```

In [34]:

```
print(X_train)
print("--------------------")
print(X_test)
print("--------------------")
print(Y_train)
print("--------------------")
print(Y_test)
```

```
[[5.1 3.8 1.9 0.4]
 [4.8 3.0 1.4 0.1]
 [4.6 3.6 1.0 0.2]
 [6.7 3.3 5.7 2.1]
 [5.5 2.6 4.4 1.2]
 [6.8 2.8 4.8 1.4]
 [6.1 2.6 5.6 1.4]
 [5.6 3.0 4.1 1.3]
 [5.5 4.2 1.4 0.2]
 [5.7 2.9 4.2 1.3]
 [5.6 2.5 3.9 1.1]
 [4.5 2.3 1.3 0.3]
 [6.0 2.9 4.5 1.5]
 [6.6 2.9 4.6 1.3]
 [5.9 3.0 5.1 1.8]
 [5.0 3.3 1.4 0.2]
 [5.0 3.5 1.6 0.6]
 [5.0 3.5 1.3 0.3]
 [6.9 3.1 5.4 2.1]
 [6.4 2.7 5.3 1.9]
 [5.7 2.5 5.0 2.0]
 [7.9 3.8 6.4 2.0]
 [5.0 3.0 1.6 0.2]
 [4.4 2.9 1.4 0.2]
 [6.0 2.2 4.0 1.0]
 [5.5 2.4 3.8 1.1]
 [4.9 2.4 3.3 1.0]
 [4.8 3.4 1.6 0.2]
 [5.0 3.2 1.2 0.2]
 [6.7 3.0 5.0 1.7]
 [6.3 3.3 6.0 2.5]
 [5.4 3.9 1.7 0.4]
```

```
[5.7 2.8 4.1 1.3]
[6.0 3.0 4.8 1.8]
[5.7 2.6 3.5 1.0]
[4.8 3.4 1.9 0.2]
[6.7 3.3 5.7 2.5]
[6.3 2.3 4.4 1.3]
[5.7 2.8 4.5 1.3]
[5.4 3.9 1.3 0.4]
[6.6 3.0 4.4 1.4]
[6.8 3.2 5.9 2.3]
[7.7 2.8 6.7 2.0]
[5.1 3.8 1.5 0.3]
[5.6 2.8 4.9 2.0]
[6.5 3.0 5.5 1.8]
[5.6 2.7 4.2 1.3]
[6.1 2.8 4.7 1.2]
[5.2 4.1 1.5 0.1]
[4.6 3.4 1.4 0.3]
[5.1 3.8 1.6 0.2]
[5.1 3.4 1.5 0.2]
[6.5 2.8 4.6 1.5]
[5.8 2.7 5.1 1.9]
[5.8 2.7 3.9 1.2]
[7.7 2.6 6.9 2.3]
[4.9 3.1 1.5 0.1]
[6.2 2.8 4.8 1.8]
[6.7 3.1 5.6 2.4]
[5.5 3.5 1.3 0.2]
[6.3 2.7 4.9 1.8]
[4.4 3.0 1.3 0.2]
[4.7 3.2 1.3 0.2]
[6.3 2.9 5.6 1.8]
[5.0 3.4 1.5 0.2]
[5.6 2.9 3.6 1.3]
[5.4 3.7 1.5 0.2]
[4.6 3.2 1.4 0.2]
[5.7 3.0 4.2 1.2]
[5.2 3.4 1.4 0.2]
[5.8 2.8 5.1 2.4]
[6.3 2.5 4.9 1.5]
[5.1 3.7 1.5 0.4]
```

```
[4.8 3.0 1.4 0.3]
[5.4 3.4 1.7 0.2]
[5.4 3.4 1.5 0.4]
[6.7 3.1 4.7 1.5]
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[7.1 3.0 5.9 2.1]
[5.8 4.0 1.2 0.2]
[5.7 3.8 1.7 0.3]
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[5.0 2.3 3.3 1.0]
[5.9 3.0 4.2 1.5]
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```

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  [6.0 2.7 5.1 1.6]
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 [[5.0 3.6 1.4 0.2]
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  [7.7 3.8 6.7 2.2]]
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 'Iris-setosa' 'Iris-virginica' 'Iris-versicolor' 'Iri
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 'Iris-virginica' 'Iris-virginica' 'Iris-virginica' 'I
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  'Iris-versicolor' 'Iris-setosa' 'Iris-virginica' 'Iri
s-setosa'
  'Iris-setosa' 'Iris-virginica']
```

In [28]:

```
irisML = KNeighborsClassifier(n_neighbors=7)
irisML.fit(X_train, Y_train)
```

Out[28]:

```
KNeighborsClassifier(algorithm='auto', leaf_size=30, m
etric='minkowski',
          metric_params=None, n_jobs=1, n_neighbors=
7, p=2,
          weights='uniform')
```

In [30]:

```
prediction = irisML.predict(X_test)
print(prediction)
```

```
['Iris-virginica' 'Iris-versicolor' 'Iris-setosa' 'Iri
s-versicolor'
 'Iris-versicolor' 'Iris-setosa' 'Iris-versicolor' 'Ir
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'Iris-virginica'
 'Iris-virginica' 'Iris-versicolor' 'Iris-versicolor'
'Iris-versicolor'
 'Iris-virginica' 'Iris-virginica']
```

In [31]:

```
irisML.score(X_test, Y_test)
```

Out[31]:

```
0.8666666666666667
```

In [32]:

```
new_obj1 = [[5.2,4.3,5.6,1.6]]
output1 = irisML.predict(new_obj1)
print(output1)
```

```
[[5.2, 4.3, 5.6, 1.6]]
['Iris-virginica']
```