过拟合与欠拟合 与 决策树剪枝

In [1]:

```
import numpy as np
import matplotlib.pyplot as plt
from ML.decision_tree import DecisionTreeClassifier
```

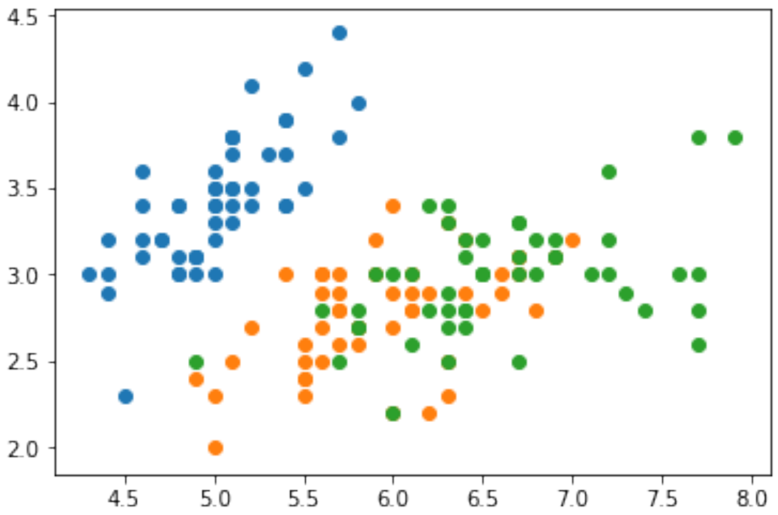
过拟合与欠拟合

In [2]:

```
X = np.loadtxt('x.txt')
X = X[:, :2]
y = np.loadtxt('y.txt')
```

In [3]:

```
plt.scatter(X[y==0, 0], X[y==0, 1])
plt.scatter(X[y==1, 0], X[y==1, 1])
plt.scatter(X[y==2, 0], X[y==2, 1])
plt.show()
```



In [4]:

```
from ML.model_selection import train_test_split
x_train, x_test, y_train, y_test = train_test_split(X, y, seed=100)
```

In [5]:

```
dt_clf = DecisionTreeClassifier(max_depth=999999999)
dt_clf.fit(X, y)
```

Out[5]:

```
d=0, v=4.85, g=0.6571619514368456, l=None
```

In [6]:

```
dt_clf.accuracy_rate(x_train, y_train)
```

Out[6]:

```
0.8938053097345132
```

In [7]:

```
dt_clf.accuracy_rate(x_test, y_test)
```

Out[7]:

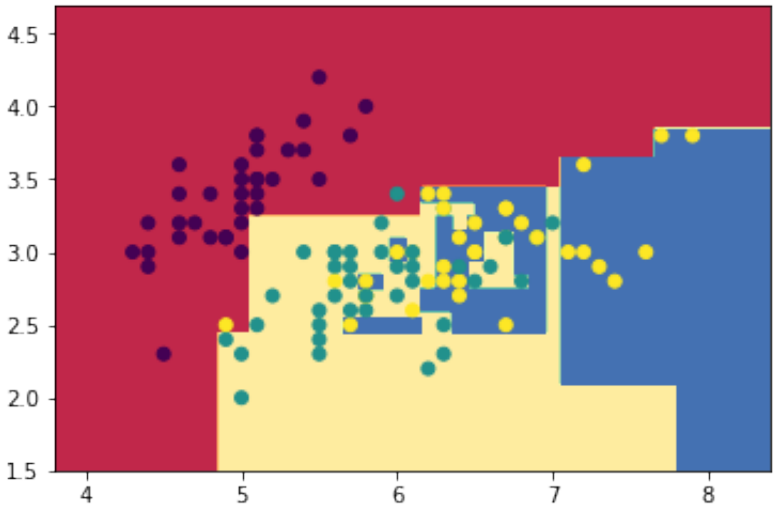
```
0.8648648648648649
```

In [8]:

```
def plot_decision_boundary(X, y, predict_fun, step=0.1):
    x_min = X[:, 0].min() - 0.5
    x_max = X[:, 0].max() + 0.5
    y_min = X[:, 1].min() - 0.5
    y_max = X[:, 1].max() + 0.5

    x_mesh, y_mesh = np.meshgrid(np.arange(x_min, x_max, step), np.arange(y_min, y_max, step))       # 画网格
    labels = predict_fun(np.concatenate([x_mesh.reshape(-1, 1), y_mesh.reshape(-1, 1)], axis = 1))         # 获取预测值
    z = labels.reshape(x_mesh.shape)          # 将预测值转为与x_mesh相同的维度

    plt.contourf(x_mesh, y_mesh, z, cmap = plt.cm.Spectral)
# 画梯度图

    plt.scatter(X[:, 0], X[:, 1], c=y)                     # 绘制散点图
    plt.show()
```

In [9]:

```
plot_decision_boundary(x_train, y_train, lambda x: dt_clf.predict(x), step=0.01)
```



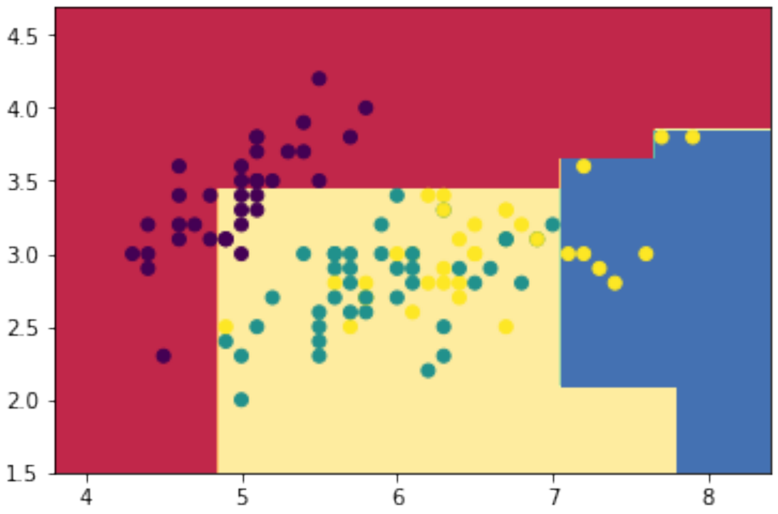
In [10]:

```
dt_clf.show_tree()
```

决策树剪枝

1、设置最大深度
2、设置最小叶片数

```
In [11]: dt_clf = DecisionTreeClassifier(max_depth=10)
         dt_clf.fit(X, y)
         plot_decision_boundary(x_train, y_train, lambda x: dt_clf.predict(x
         ), step=0.01)
```

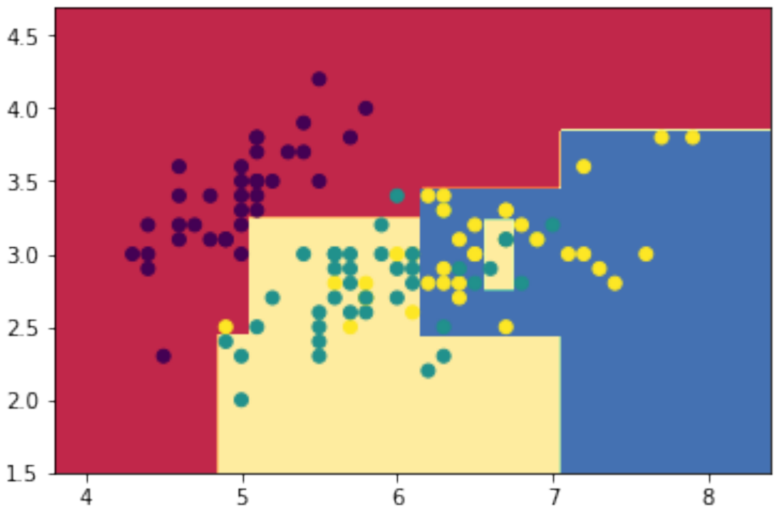


```
In [12]: dt_clf.accuracy_rate(x_train, y_train)

Out[12]: 0.672566371681416
```

```
In [13]: dt_clf.accuracy_rate(x_test, y_test)

Out[13]: 0.5945945945945946
```

以上是 欠拟合

```
In [14]: dt_clf = DecisionTreeClassifier(max_depth=999999999, min_samples_le
         af=5)
         dt_clf.fit(X, y)
         plot_decision_boundary(x_train, y_train, lambda x: dt_clf.predict(x
         ), step=0.01)
```



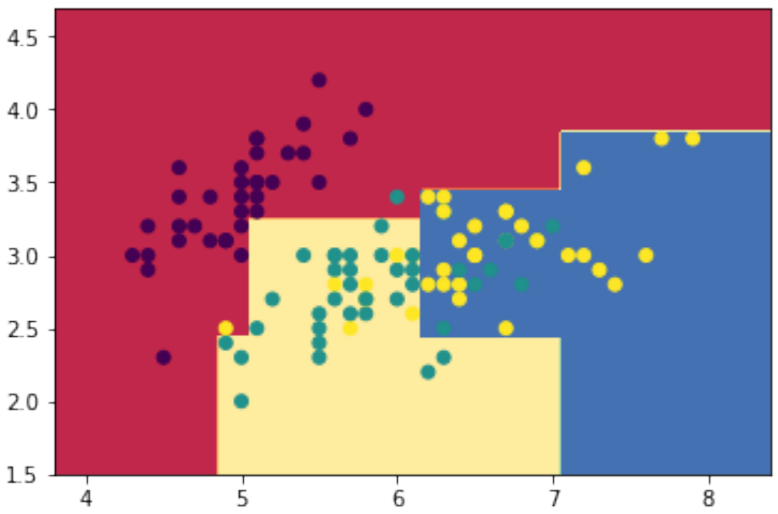
```
In [15]: dt_clf.accuracy_rate(x_train, y_train)
```

```
Out[15]: 0.8407079646017699
```

```
In [16]: dt_clf.accuracy_rate(x_test, y_test)
```

```
Out[16]: 0.8648648648648649
```

```
In [17]: dt_clf = DecisionTreeClassifier(max_depth=10, min_samples_leaf=3)
         dt_clf.fit(X, y)
         plot_decision_boundary(x_train, y_train, lambda x: dt_clf.predict(x
         ), step=0.01)
```



```
In [18]: dt_clf.accuracy_rate(x_train, y_train)
```

```
Out[18]: 0.8230088495575221
```

```
In [19]: dt_clf.accuracy_rate(x_test, y_test)
```

```
Out[19]: 0.8378378378378378
```

In [26]:

```
%%time
train_accuracy = 0
test_accuracy = 0
for i in range(1, 100):
    for j in range(1, 10):
        dt_clf = DecisionTreeClassifier(max_depth=10, min_samples_l
eaf=3)
        dt_clf.fit(X, y)
        train_acc = dt_clf.accuracy_rate(x_train, y_train)
        test_acc = dt_clf.accuracy_rate(x_test, y_test)
        if train_acc > train_accuracy and test_acc > test_accuracy:
            train_accuracy = train_acc
            test_accuracy = test_acc
            best_max_depth = i
            best_min_samples_leaf = j
print("best_max_depth={}, best_min_samples_leaf={}, train_accuracy=
{}, test_accuracy={}".format(best_max_depth, best_min_samples_leaf,
train_accuracy, test_accuracy))
```

```
best_max_depth=1, best_min_samples_leaf=1, train_accuracy=0.823008
8495575221, test_accuracy=0.8378378378378378
CPU times: user 20.4 s, sys: 39.4 ms, total: 20.5 s
Wall time: 20.5 s
```