Decision Trees

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1 Decisions Trees

1.0.1 Example for reference

```
In [46]: from sklearn import tree
         X = [[0, 0], [1, 1]]
         Y = [0, 1]
         clf = tree.DecisionTreeClassifier()
         clf = clf.fit(X, Y)

         pred = clf.predict([[2., 2.]])
         print(pred)
```

```
[1]
```

1.0.2 Using Decision trees to classifiy iris data

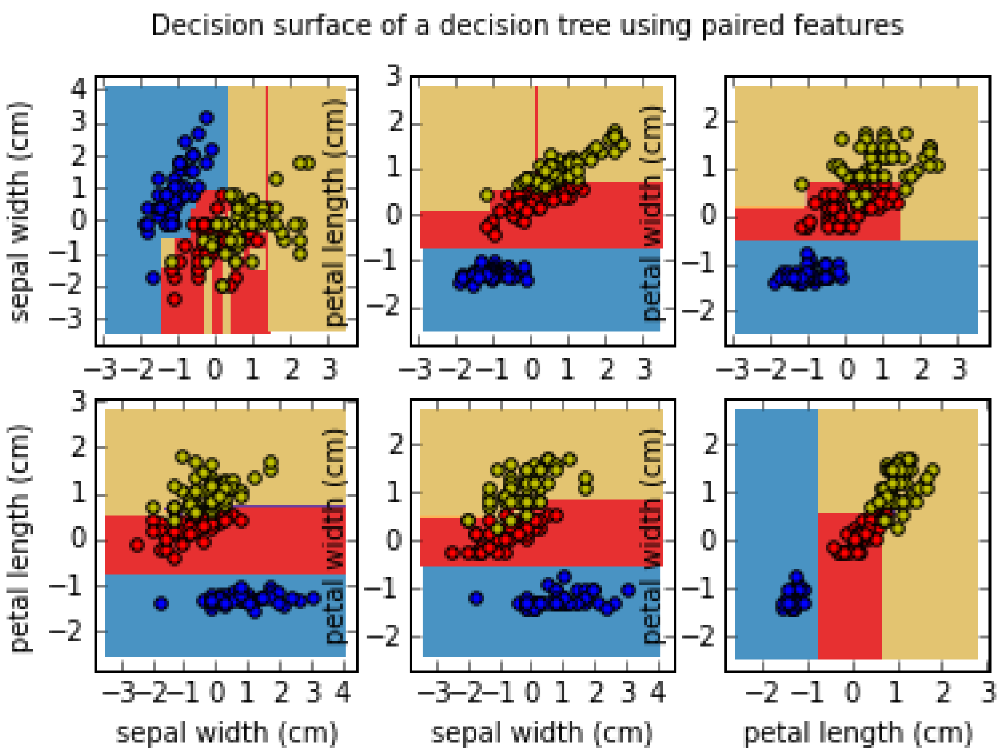
```
In [1]: from sklearn.datasets import load_iris
        from sklearn import tree
        from sklearn.metrics import accuracy_score
        import numpy as np
        import matplotlib.pyplot as plt

        #Plotting gives unwanted warning message
        import warnings
        warnings.filterwarnings('ignore')
```

1.0.3 The graphing function

Here we crate different visuals for the decision tree, but in order to do that in 2 dimension we have to split the grpahs up and create multiple classifiers.

```
In [3]: %matplotlib inline
        # Load Data
        iris = load_iris()

        # Parameters
        n_classes = 3
        plot_colors = "bry"
        plot_step = 0.02

        for pairidx, pair in enumerate([[0, 1], [0, 2], [0, 3],
                                        [1, 2], [1, 3], [2, 3]]):
```

```python
    # We only take the two corresponding features
    X = iris.data[:, pair]
    y = iris.target

    # Shuffle
    idx = np.arange(X.shape[0])
    np.random.seed(13)
    np.random.shuffle(idx)
    X = X[idx]
    y = y[idx]

    # Standardize
    mean = X.mean(axis=0)
    std = X.std(axis=0)
    X = (X - mean) / std

    # Train
    clf = tree.DecisionTreeClassifier().fit(X, y)

    # Plot the decision boundary
    plt.subplot(2, 3, pairidx + 1)

    x_min, x_max = X[:, 0].min() - 1, X[:, 0].max() + 1
    y_min, y_max = X[:, 1].min() - 1, X[:, 1].max() + 1
    xx, yy = np.meshgrid(np.arange(x_min, x_max, plot_step),
                         np.arange(y_min, y_max, plot_step))

    Z = clf.predict(np.c_[xx.ravel(), yy.ravel()])
    Z = Z.reshape(xx.shape)
    cs = plt.contourf(xx, yy, Z, cmap=plt.cm.Paired)

    plt.xlabel(iris.feature_names[pair[0]])
    plt.ylabel(iris.feature_names[pair[1]])
    plt.axis("tight")

    # Plot the training points
    for i, color in zip(range(n_classes), plot_colors):
        idx = np.where(y == i)
        plt.scatter(X[idx, 0], X[idx, 1], c=color, label=iris.target_names[i],
                    cmap=plt.cm.Paired)

    plt.axis("tight")

plt.suptitle("Decision surface of a decision tree using paired features")
plt.show()
```



1.0.4 Training our classifier

Here we train our classifier and then plot it. The training data has 4 features with 150 data points and 3 labels for the three different types of iris. We split our data with an 80/20 for training and testing.

```
In [6]: # We have a small amount of data lets split our data 80%~ training 20%~ testing
        # Usually I would go for a 75%/25% split

        X_train = iris.data[:125]
        y_train = iris.target[:125]
        X_test = iris.data[125:]
        y_test = iris.target[125:]

        # Create a Decision Tree Calssifier and fit our training data
        clf = tree.DecisionTreeClassifier()
        clf.fit(X_train, y_train)

        # Predict using our testing data and score our model
        pred = clf.predict(X_test)
        score = accuracy_score(y_test, pred)
        print('Accuracy: {:.2%}'.format(score))
```

```
Accuracy: 88.00%
```

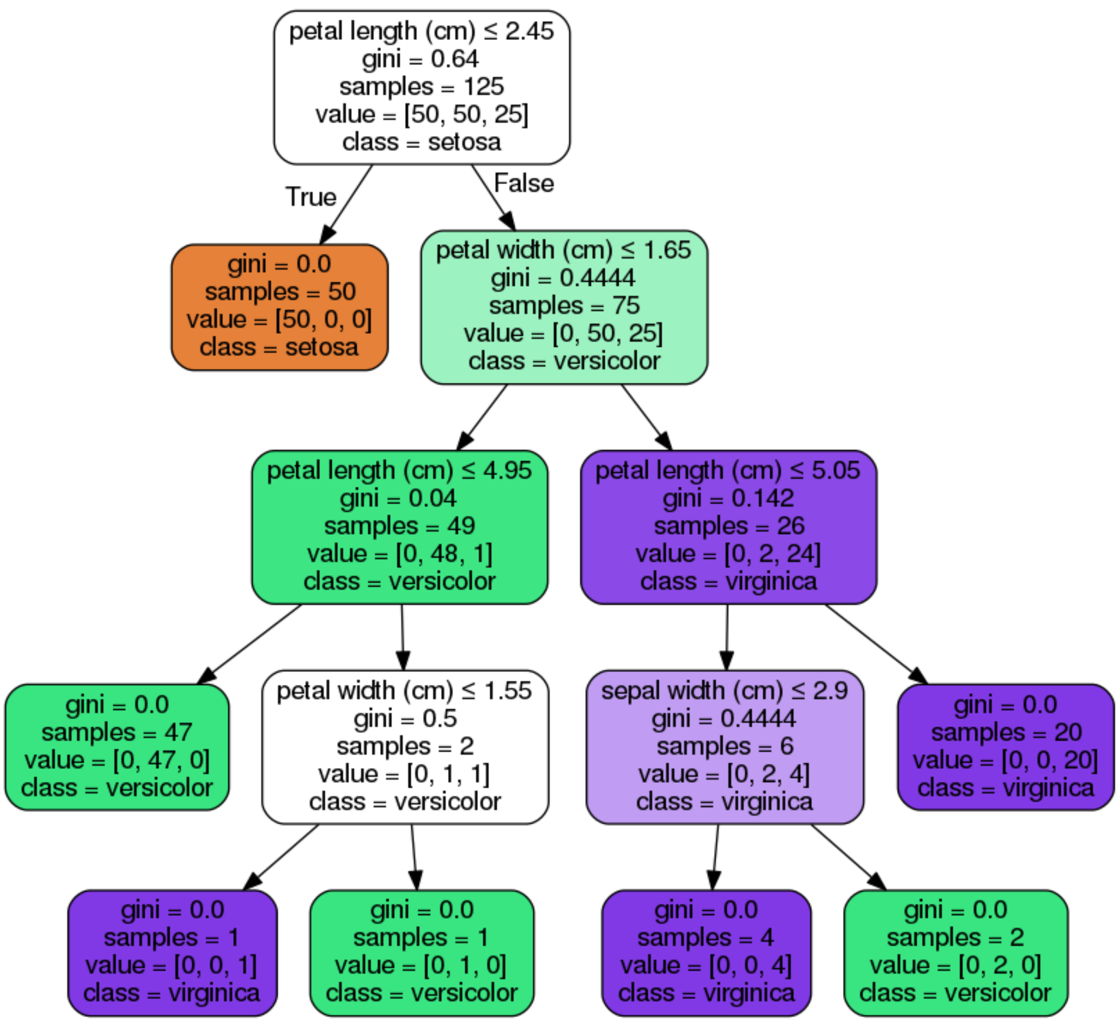
Here the classifier is looking at all 4 features at once, or looking at the whole dataset and trying to make a tree that can work with the data as a whole. Now lets write our classifier to a file in dot notation and create a tree graphic with graphviz.

Note convert the dot file to a png with this command:

```
dot -Tpng iris.dot -o iris.png
```

In [7]:
```python
from IPython.display import Image
import pydot

# Write our dot file
dot_data = tree.export_graphviz(clf, out_file='iris.dot',
                                feature_names=iris.feature_names,
                                class_names=iris.target_names,
                                filled=True, rounded=True,
                                special_characters=True)

# Load our converted dot file
Image('iris.png')
```

Out[7]:



Now we have generated a beautiful and fairly complex desicion tree, all automatically!

1.0.5 Conculsion

Decision tree are a ver powerfull idea, when it comes to dependent events/probablity and can also make very good a very good calssifier for data, however the they are prone to overfitting if they are not tuned properly. The real beauty of this is that it can all be done by a machine very quickly! Just image generating a decision tree by hand to do somthing similar, it can be vary laborious.

1.0.6 Reference

sklearn: http://scikit-learn.org/stable/modules/tree.html
udacity: https://www.udacity.com/wiki/ud120