Module 1

April 1, 2020

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*You are currently looking at **version 1.0** of this notebook. To download notebooks and datafiles, as well as get help on Jupyter notebooks in the Coursera platform, visit the [Jupyter Notebook FAQ](#) course resource.*

0.1 Applied Machine Learning, Module 1: A simple classification task

0.1.1 Import required modules and load data file

```
In [2]: %matplotlib notebook
        import numpy as np
        import matplotlib.pyplot as plt
        import pandas as pd
        from sklearn.model_selection import train_test_split

        fruits = pd.read_table('readonly/fruit_data_with_colors.txt')
```

```
In [3]: fruits.head()
```

```
Out[3]:    fruit_label fruit_name fruit_subtype  mass  width  height  color_score
        0            1      apple  granny_smith   192    8.4     7.3         0.55
        1            1      apple  granny_smith   180    8.0     6.8         0.59
        2            1      apple  granny_smith   176    7.4     7.2         0.60
        3            2   mandarin      mandarin    86    6.2     4.7         0.80
        4            2   mandarin      mandarin    84    6.0     4.6         0.79
```

```
In [4]: # create a mapping from fruit label value to fruit name to make results eas
        lookup_fruit_name = dict(zip(fruits.fruit_label.unique(), fruits.fruit_name
        lookup_fruit_name
```

```
Out[4]: {1: 'apple', 2: 'mandarin', 3: 'orange', 4: 'lemon'}
```

The file contains the mass, height, and width of a selection of oranges, lemons and apples. The heights were measured along the core of the fruit. The widths were the widest width perpendicular to the height.

0.1.2 Examining the data

```
In [7]: # plotting a scatter matrix
        from matplotlib import cm

        X = fruits[['height','width','mass','color_score']]
        y = fruits['fruit_label']
        X_train,X_test,y_train,y_test = train_test_split(X, y, random_state=0)

        cmap = cm.get_cmap('gnuplot')
        scatter = pd.scatter_matrix(X_train, c= y_train, marker = 'o', s=40, hist_k
```

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```
In [8]: # plotting a 3D scatter plot
        from mpl_toolkits.mplot3d import Axes3D

        fig = plt.figure()
        ax = fig.add_subplot(111, projection = '3d')
        ax.scatter(X_train['width'], X_train['height'], X_train['color_score'], c =
        ax.set_xlabel('width')
        ax.set_ylabel('height')
        ax.set_zlabel('color_score')
        plt.show()
```

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```

0.1.3 Create train-test split

```
In [9]: # For this example, we use the mass, width, and height features of each fru
        X = fruits[['mass', 'width', 'height']]
        y = fruits['fruit_label']

        # default is 75% / 25% train-test split
        X_train, X_test, y_train, y_test = train_test_split(X, y, random_state=0)
```

0.1.4 Create classifier object

```
In [10]: from sklearn.neighbors import KNeighborsClassifier

         knn = KNeighborsClassifier(n_neighbors = 4)
```

0.1.5 Train the classifier (fit the estimator) using the training data

```
In [11]: knn.fit(X_train, y_train)
```

```
Out[11]: KNeighborsClassifier(algorithm='auto', leaf_size=30, metric='minkowski',
                    metric_params=None, n_jobs=1, n_neighbors=4, p=2,
                    weights='uniform')
```

0.1.6 Estimate the accuracy of the classifier on future data, using the test data

```
In [12]: knn.score(X_test, y_test)
```

```
Out[12]: 0.5333333333333333
```

0.1.7 Use the trained k-NN classifier model to classify new, previously unseen objects

```
In [13]: # first example: a small fruit with mass 20g, width 4.3 cm, height 5.5 cm
         fruit_prediction = knn.predict([[20, 4.3, 5.5]])
         lookup_fruit_name[fruit_prediction[0]]
```

```
Out[13]: 'mandarin'
```

```
In [14]: # second example: a larger, elongated fruit with mass 100g, width 6.3 cm,
         fruit_prediction = knn.predict([[100, 6.3, 8.5]])
         lookup_fruit_name[fruit_prediction[0]]
```

```
Out[14]: 'lemon'
```

0.1.8 Plot the decision boundaries of the k-NN classifier

```
In [15]: from adspy_shared_utilities import plot_fruit_knn

         plot_fruit_knn(X_train, y_train, 5, 'uniform')   # we choose 5 nearest ne
```

```
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```

```
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```

0.1.9 How sensitive is k-NN classification accuracy to the choice of the 'k' parameter?

```
In [16]: k_range = range(1,20)
         scores = []

         for k in k_range:
             knn = KNeighborsClassifier(n_neighbors = k)
             knn.fit(X_train, y_train)
             scores.append(knn.score(X_test, y_test))
```

```
plt.figure()
plt.xlabel('k')
plt.ylabel('accuracy')
plt.scatter(k_range, scores)
plt.xticks([0,5,10,15,20]);
```

```
<IPython.core.display.Javascript object>


<IPython.core.display.HTML object>
```

0.1.10 How sensitive is k-NN classification accuracy to the train/test split proportion?

```
In [17]: t = [0.8, 0.7, 0.6, 0.5, 0.4, 0.3, 0.2]

         knn = KNeighborsClassifier(n_neighbors = 5)

         plt.figure()

         for s in t:

             scores = []
             for i in range(1,1000):
                 X_train, X_test, y_train, y_test = train_test_split(X, y, test_siz
                 knn.fit(X_train, y_train)
                 scores.append(knn.score(X_test, y_test))
             plt.plot(s, np.mean(scores), 'bo')

         plt.xlabel('Training set proportion (%)')
         plt.ylabel('accuracy');
```

```
<IPython.core.display.Javascript object>


<IPython.core.display.HTML object>
```

```
In [ ]:
```