Programming Exercise 8 - Anomaly Detection and Recommender Systems

March 15, 2017

0.1 Programming Exercise 8 - Anomaly Detection and Recommender Systems

- Anomaly Detection
- Recommender Systems

In [1]:
```
# %load ../../../standard_import.txt
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt

from scipy.io import loadmat
from sklearn.svm import OneClassSVM
from sklearn.covariance import EllipticEnvelope

pd.set_option('display.notebook_repr_html', False)
pd.set_option('display.max_columns', None)
pd.set_option('display.max_rows', 150)
pd.set_option('display.max_seq_items', None)

#%config InlineBackend.figure_formats = {'pdf',}
%matplotlib inline

import seaborn as sns
sns.set_context('notebook')
sns.set_style('white')
```

0.1.1 Anomaly Detection

In [2]:
```
data1 = loadmat('data/ex8data1.mat')
data1.keys()
```

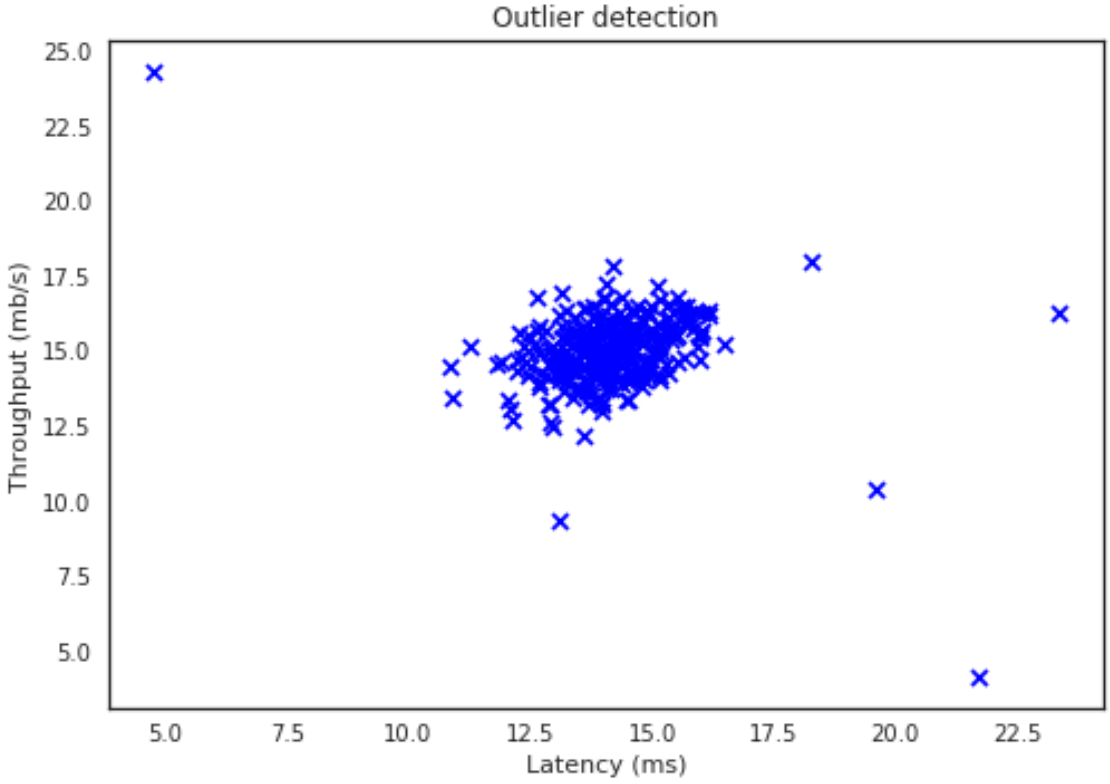
Out[2]:
```
dict_keys(['__header__', '__version__', '__globals__', 'X', 'Xval', 'yval'])
```

In [3]:
```
X1 = data1['X']
print('X1:', X1.shape)
```

```
X1: (307, 2)
```

```
In [4]: plt.scatter(X1[:,0], X1[:,1], c='b', marker='x')
        plt.title("Outlier detection")
        plt.xlabel('Latency (ms)')
        plt.ylabel('Throughput (mb/s)');
```

```
/home/ubuntu/anaconda3/lib/python3.6/site-packages/matplotlib/font_manager.py:1297:
  (prop.get_family(), self.defaultFamily[fontext]))
```



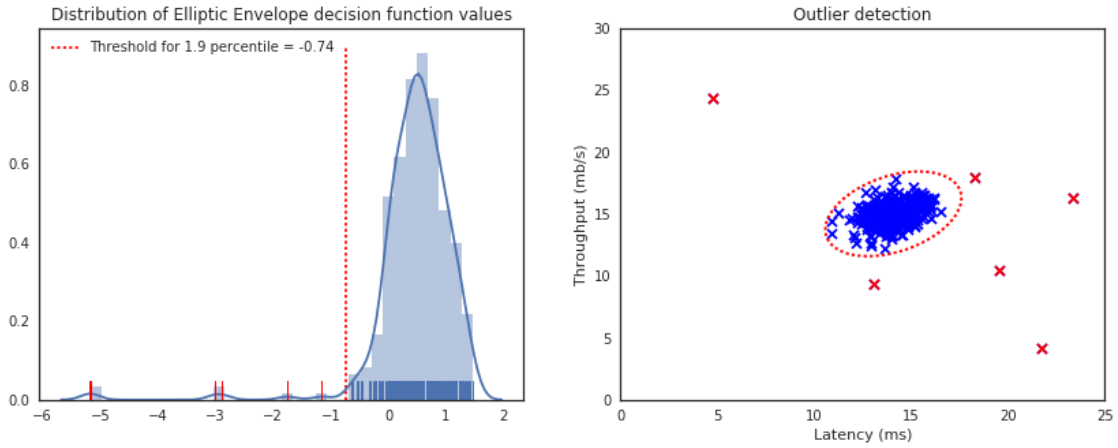

```
In [5]: clf = EllipticEnvelope()
        clf.fit(X1)
```

```
Out[5]: EllipticEnvelope(assume_centered=False, contamination=0.1, random_state=Nor
                store_precision=True, support_fraction=None)
```

```
In [6]: # Create the grid for plotting
        xx, yy = np.meshgrid(np.linspace(0, 25, 200), np.linspace(0, 30, 200))
        Z = clf.decision_function(np.c_[xx.ravel(), yy.ravel()])
        Z = Z.reshape(xx.shape)
```

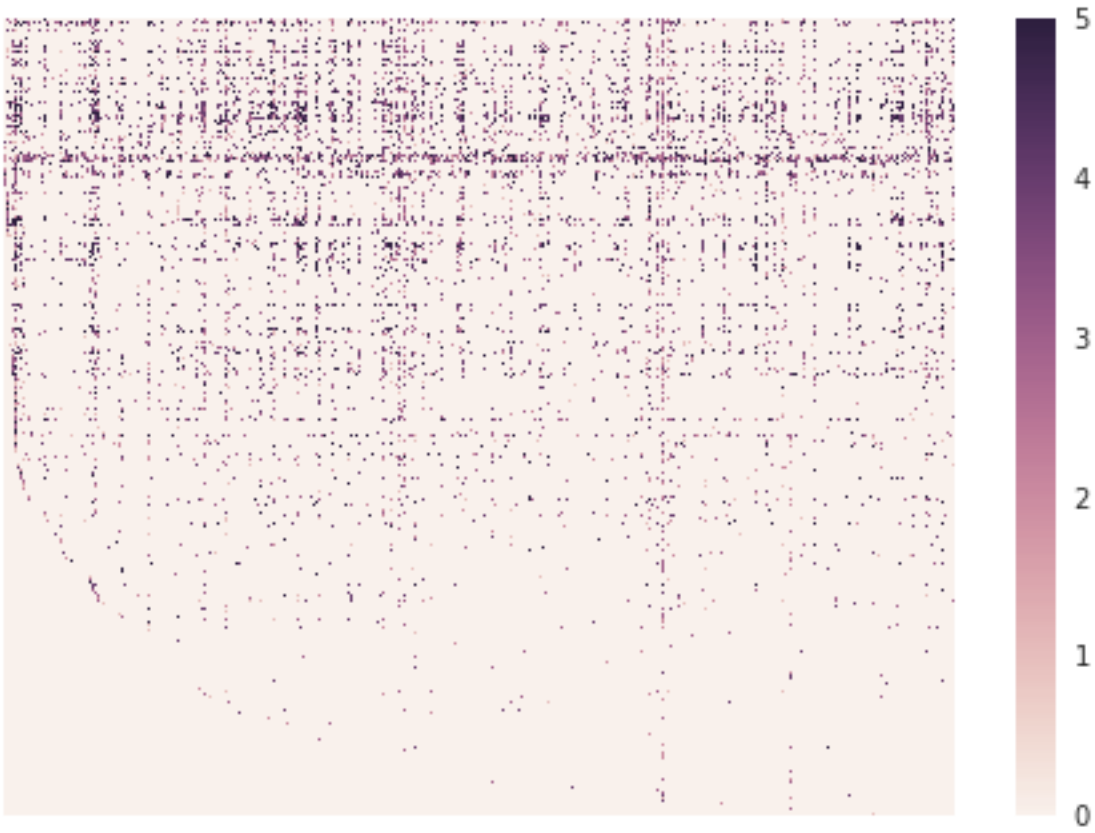
```
        # Calculate the decision function and use threshold to determine outliers
        y_pred = clf.decision_function(X1).ravel()
        percentile = 1.9
        threshold = np.percentile(y_pred, percentile)
        outliers = y_pred < threshold

        fig, (ax1, ax2) = plt.subplots(1,2, figsize=(14,5))

        # Left plot
        # Plot the decision function values
        sns.distplot(y_pred, rug=True, ax=ax1)
        # Plot the decision function values for the outliers in red
        sns.distplot(y_pred[outliers], rug=True, hist=False, kde=False, norm_hist=T
        ax1.vlines(threshold, 0, 0.9, colors='r', linestyles='dotted',
                   label='Threshold for {} percentile = {}'.format(percentile, np.r
        ax1.set_title('Distribution of Elliptic Envelope decision function values')
        ax1.legend(loc='best')

        # Right plot
        # Plot the observations
        ax2.scatter(X1[:,0], X1[:,1], c='b', marker='x')
        # Plot outliers
        ax2.scatter(X1[outliers][:,0], X1[outliers][:,1], c='r', marker='x', linewi
        # Plot decision boundary based on threshold
        ax2.contour(xx, yy, Z, levels=[threshold], linewidths=2, colors='red', line
        ax2.set_title("Outlier detection")
        ax2.set_xlabel('Latency (ms)')
        ax2.set_ylabel('Throughput (mb/s)');
```

```
/home/ubuntu/anaconda3/lib/python3.6/site-packages/statsmodels/nonparametric/kdetoo
  y = X[:m/2+1] + np.r_[0,X[m/2+1:],0]*1j
/home/ubuntu/anaconda3/lib/python3.6/site-packages/matplotlib/font_manager.py:1297:
  (prop.get_family(), self.defaultFamily[fontext]))
```



0.1.2 Recommender Systems

```
In [7]: data2 = loadmat('data/ex8_movies.mat')
        data2.keys()

Out[7]: dict_keys(['__header__', '__version__', '__globals__', 'Y', 'R'])

In [8]: Y = data2['Y']
        R = data2['R']
        print('Y:', Y.shape)
        print('R:', R.shape)

Y: (1682, 943)
R: (1682, 943)


In [9]: Y

Out[9]: array([[5, 4, 0, ..., 5, 0, 0],
               [3, 0, 0, ..., 0, 0, 5],
               [4, 0, 0, ..., 0, 0, 0],
               ...,
               [0, 0, 0, ..., 0, 0, 0],
               [0, 0, 0, ..., 0, 0, 0],
               [0, 0, 0, ..., 0, 0, 0]], dtype=uint8)

In [10]: R

Out[10]: array([[1, 1, 0, ..., 1, 0, 0],
                [1, 0, 0, ..., 0, 0, 1],
                [1, 0, 0, ..., 0, 0, 0],
                ...,
                [0, 0, 0, ..., 0, 0, 0],
                [0, 0, 0, ..., 0, 0, 0],
                [0, 0, 0, ..., 0, 0, 0]], dtype=uint8)

In [11]: sns.heatmap(Y, yticklabels=False, xticklabels=False);

/home/ubuntu/anaconda3/lib/python3.6/site-packages/matplotlib/font_manager.py:1297:
  (prop.get_family(), self.defaultFamily[fontext]))
```


5
4
3
2
1
0