hw01

September 25, 2017

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```
In [28]: from IPython.display import display, Image, IFrame, Math, Latex
```

```
In [29]: from IPython.core.interactiveshell import InteractiveShell
         # InteractiveShell.ast_node_interactivity = "all"
         %config InlineBackend.figure_format = 'retina'
```

```
In [30]: # %matplotlib inline
         from matplotlib import pyplot as plt
         import numpy as np
```

```
In [31]: # IFrame('hw01.pdf', width=600, height=400)
```

2 Question 1 : Univariate Regression

Train a univariate linear regression model to predict house prices as a function of their floor size, based on the solution to the system with 2 linear equations discussed in class. Use the dataset from the folder hw01/data/univariate. Python3 skeleton code is provided in univariate.py. After training print the parameters and report the RMSE and the objective function values on the training and test data. Plot the training using the default blue circles and test examples using lime green triangles. On the same graph also plot the linear approximation.

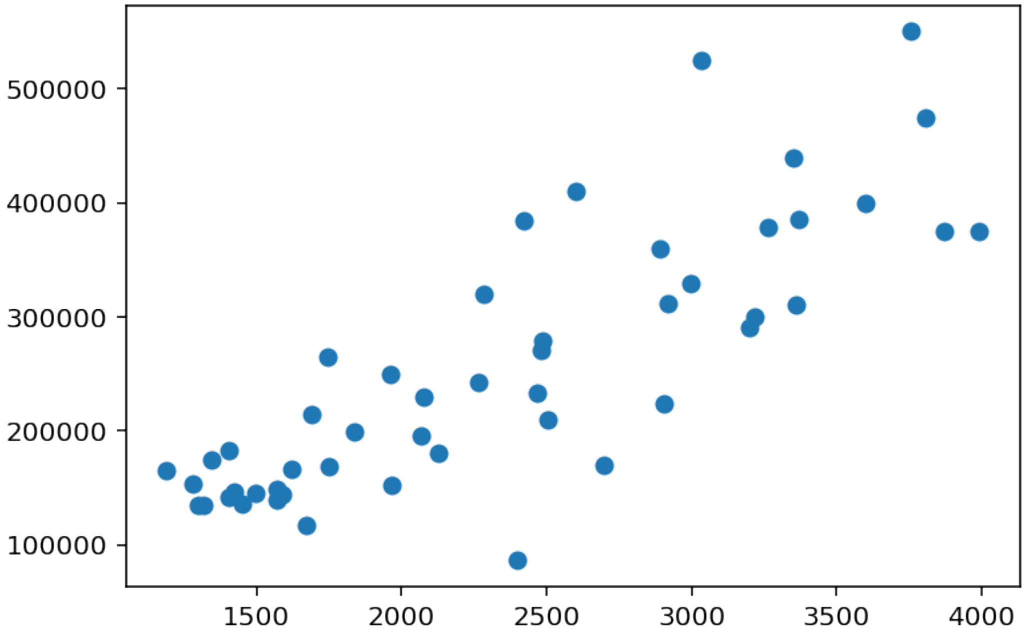
```
In [35]: !ls
```

```
boxBalls             data                 hw01.ipynb           simple_lin_reg(SLR)
code                 dwn                  hw01.pdf
```

```
In [36]: !ls code
```

```
multivariate.py      train-test-line.png  univariate_orig.py
multivariate_orig.py univariate.py
```

```
In [42]: # %load './code/univariate.py'
         #!python
         ############################################################################
         # Author      : Bhishan Poudel; Physics Graduate Student, Ohio University
         # Date        : Sep 12, 2017 Tue
         # Last update :
         ############################################################################
         """
         :Topic: Homework 1 Qn 2.1 Univariate Regression

         :Runtime:

         .. note::

            np.polynomial.polynomial.polyfit returns coefficients [A, B, C] to A + Bx + Cx^2 +
            coeffs = np.polynomial.polynomial.polyfit(x, y, 4)
            print(coeffs)


            # np.polyfit returns: ... + Ax^2 + Bx + C
            coeffs = np.polyfit(x, y, 4)
            print(coeffs)

         """;
         # Imports
         import argparse
         import sys
         import numpy as np
         from matplotlib import pyplot as plt
         import numpy.polynomial.polynomial as poly

Out[42]: '\n:Topic: Homework 1 Qn 2.1 Univariate Regression\n\n:Runtime:\n\n.. note::\n\n   np

In [55]: def read_data(infile):
             data = np.genfromtxt(infile, delimiter=' ',dtype=int)
             X = data[:,0].reshape(len(data),1)
             t = data[:,-1].reshape(len(data),1)
         #     print("X.shape = ", X.shape)
         #     print("t.shape = ", t.shape)
             return [X, t]

In [69]: # Run read_data
         # !ls data/univariate
         X,t = read_data('data/univariate/train_orig.txt')
         # X.shape, t.shape
         plt.scatter(X,t)

Out[69]: <matplotlib.collections.PathCollection at 0x1126a6b38>
```



```
In [57]: def train(X, t):
             """Implement univariate linear regression to compute w = [w0, w1]."""

             # method 1 np.polyfit
             w0,w1 = poly.polyfit(X[0,:], t[0,:],deg=1)
             print('w0 from numpy polynomial polynomial polyfit = {:.5e}'.format(w0))
             print('w1 from numpy polynomial polynomial polyfit = {:.5e}'.format(w1))

             # method 2 np poly poly polyfit
             # X = X - np.mean(X)
             # t = t - np.mean(t)
         #     w0,w1 = poly.polyfit(X[0,:], t[0,:],deg=1)
         #     print('w0 from numpy polynomial polynomial polyfit = {:.5e}'.format(w0))
         #     print('w1 from numpy polynomial polynomial polyfit = {:.5e}'.format(w1))

             # method 3
             # covar = np.cov(X, t, bias=True)[0][1]
             # covar = np.cov(X, t, ddof=0)[0][1]
             # var = np.var(X)
             # w1 = covar/var
             # w0 = np.mean(t) - w1 * np.mean(X)
             # # print(np.cov(X, t, ddof=0))
             # print('w0 from numpy cov = {:.5e}'.format(w0))
             # print('w1 from numpy cov = {:.5e}'.format(w1))

             w = np.array([w0, w1])
```

```
            print("w = ", w)
            return w
```

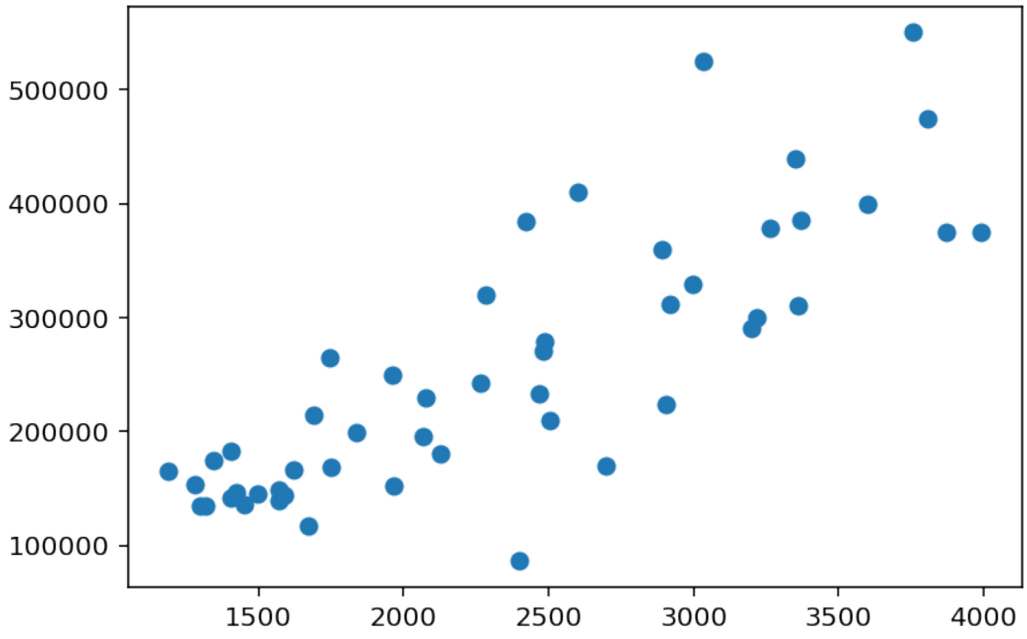
```
In [70]: # Get weights
         Xtrain, ttrain = read_data("data/univariate/train_orig.txt")
         w = train(Xtrain, ttrain)

         Xtrain.shape
         # Print model parameters.
         print('Params: ', w)
         plt.scatter(Xtrain, ttrain)
```

```
w0 from numpy polynomial polynomial polyfit = 2.62500e+05
w1 from numpy polynomial polynomial polyfit = 8.65765e+01
w =  [  2.62500000e+05   8.65765172e+01]


/Users/poudel/anaconda/lib/python3.6/site-packages/ipykernel_launcher.py:7: RankWarning: The fi
  import sys
```

```
Out[70]: (50, 1)
```

```
Params:  [  2.62500000e+05   8.65765172e+01]
```

```
Out[70]: <matplotlib.collections.PathCollection at 0x1124ff7b8>
```



```
In [65]: def compute_rmse(X,t,w):
             """Compute RMSE on dataset (X, t)."""
             X = np.append(np.ones([len(t),1]),X,axis=-1)
             print("X = ", X)
             print("X.shape = ", X.shape)
             print("t = ", t)
             print("t.shape = ", t.shape)
             print("w = ", w)
             print("w.shape = ", w.shape)
             # rmse = np.sqrt(((tpred - t) ** 2).mean())
             rmse = 0

             return rmse
```

```
In [ ]: # Run RMSE
        X
```

```
In [ ]: def compute_cost(X, t, w):
            """Compute objective function on dataset (X, t)."""

            m = len(t)  # number of tranning examples
            J = 0
            J = 1/(2*m) * ((X*w) - t).T * ((X*w) - t)
            return J
```

```
In [ ]: def myplot(data1,data2,data3):
            # matplotlib customization
            plt.style.use('ggplot')
            fig, ax = plt.subplots()

            # data
            X1,X2,X3 = data1[:,0], data2[:,0],data3[:,0]
            t1,t2,t3 = data1[:,-1]/1000, data2[:,-1]/1000, data3[:,-1]/1000

            # plot with label, title
            ax.plot(X1,t1,'bo',label='Train')
            ax.plot(X2,t2,'g^',label='Test')

            # set xlabel and ylabel to AxisObject
            ax.set_xlabel('Floor Size (Square Feet)')
            ax.set_ylabel('House Price (Thousands Dollar)')
            ax.set_title('HW 1 Qn2.1 Univariate Regression')
            ax.legend()
            ax.grid(True)
            plt.savefig('train-test-line.png')
            # plt.show()
```

```
In [ ]: ##=======================================================================
        ## Main Program
```

```
##=======================================================================
def main():
    """Run main function."""
    parser = argparse.ArgumentParser('Univariate Exercise.')
    parser.add_argument('-i', '--input_data_dir',
                        type=str,
                        default='../data/univariate',
                        help='Directory for the univariate houses dataset.')
    FLAGS, unparsed = parser.parse_known_args()

    # Read the training and test data.
    Xtrain, ttrain = read_data(FLAGS.input_data_dir + "/train.txt")
    Xtest, ttest = read_data(FLAGS.input_data_dir + "/test.txt")

    # print("Xtrain = ", Xtrain) # ndarray


    # Train model on training examples.
    # w = train(Xtrain, ttrain)

    # Print model parameters.
    # print('Params: ', w)

    # # Print cost and RMSE on training data.
    # print('Training RMSE: %0.2f.' % compute_rmse(Xtrain, ttrain, w))
    # print('Training cost: %0.2f.' % compute_cost(Xtrain, ttrain, w))
    #
    # # Print cost and RMSE on test data.
    # print('Test RMSE: %0.2f.' % compute_rmse(Xtest, ttest, w))
    # print('Test cost: %0.2f.' % compute_cost(Xtest, ttest, w))

    #  YOUR CODE here: plot the training and test examples with different symbols,
    #                  plot the linear approximation on the same graph.
    #
    #
    w = train(Xtrain, ttrain)
    # print('Params: ', w)
    compute_rmse(Xtrain, ttrain, w)
```

```
In [40]: if __name__ == "__main__":
             import time

             # Beginning time
             program_begin_time = time.time()
             begin_ctime        = time.ctime()

             #  Run the main program
             main()
```

```
    # Print the time taken
    program_end_time = time.time()
    end_ctime        = time.ctime()
    seconds          = program_end_time - program_begin_time
    m, s             = divmod(seconds, 60)
    h, m             = divmod(m, 60)
    d, h             = divmod(h, 24)
    print("\nBegin time: ", begin_ctime)
    print("End   time: ", end_ctime, "\n")
    print("Time taken: {0: .0f} days, {1: .0f} hours, \
      {2: .0f} minutes, {3: f} seconds.".format(d, h, m, s))
```

```
Out[40]: '\n:Topic: Homework 1 Qn 2.1 Univariate Regression\n\n:Runtime:\n\n.. note::\n\n   np
```

```
    ---------------------------------------------------------------------------

    FileNotFoundError                         Traceback (most recent call last)

    <ipython-input-40-6e797df92b95> in <module>()
    168
    169     #  Run the main program
--> 170     main()
    171
    172


    <ipython-input-40-6e797df92b95> in main()
    131
    132     # Read the training and test data.
--> 133     Xtrain, ttrain = read_data(FLAGS.input_data_dir + "/train.txt")
    134     Xtest, ttest = read_data(FLAGS.input_data_dir + "/test.txt")
    135


    <ipython-input-40-6e797df92b95> in read_data(infile)
     33
     34 def read_data(infile):
---> 35     data = np.genfromtxt(infile, delimiter=' ',dtype=int)
     36     X = data[:,0].reshape(len(data),1)
     37     t = data[:,-1].reshape(len(data),1)


    ~/anaconda/lib/python3.6/site-packages/numpy/lib/npyio.py in genfromtxt(fname, dtype, c
   1549                 fhd = iter(np.lib._datasource.open(fname, 'rbU'))
   1550             else:
```

```
-> 1551                    fhd = iter(np.lib._datasource.open(fname, 'rb'))
   1552                own_fhd = True
   1553            else:


    ~/anaconda/lib/python3.6/site-packages/numpy/lib/_datasource.py in open(path, mode, des
    149
    150     ds = DataSource(destpath)
--> 151     return ds.open(path, mode)
    152
    153


    ~/anaconda/lib/python3.6/site-packages/numpy/lib/_datasource.py in open(self, path, moc
    497                if ext == 'bz2':
    498                    mode.replace("+", "")
--> 499                return _file_openers[ext](found, mode=mode)
    500            else:
    501                raise IOError("%s not found." % path)


    FileNotFoundError: [Errno 2] No such file or directory: '../data/univariate/train.txt'
```

```
In [ ]:
```