Chapter_4_Section_2_Logistic_Regression_2D

February 2, 2019

1 Ch 04: Concept 03

1.1 Logistic regression in higher dimensions

Set up the imports and hyper-parameters

```
In [1]: %matplotlib inline
        import numpy as np
        import tensorflow as tf
        import matplotlib.pyplot as plt
        np.random.seed(1234)
        learning_rate = 0.1
        training_epochs = 2000
```

Define positive and negative to classify 2D data points:

```
In [2]: x1_label1 = np.random.normal(3, 1, 1000)
        x2_label1 = np.random.normal(2, 1, 1000)
        x1_label2 = np.random.normal(7, 1, 1000)
        x2_label2 = np.random.normal(6, 1, 1000)
        x1s = np.append(x1_label1, x1_label2)
        x2s = np.append(x2_label1, x2_label2)
        ys = np.asarray([0.] * len(x1_label1) + [1.] * len(x1_label2))
```

Define placeholders, variables, model, and the training op:

```
In [3]: X1 = tf.placeholder(tf.float32, shape=(None,), name="x1")
        X2 = tf.placeholder(tf.float32, shape=(None,), name="x2")
        Y = tf.placeholder(tf.float32, shape=(None,), name="y")
        w = tf.Variable([0., 0., 0.], name="w", trainable=True)

        y_model = tf.sigmoid(-(w[2] * X2 + w[1] * X1 + w[0]))
        cost = tf.reduce_mean(-tf.log(y_model * Y + (1 - y_model) * (1 - Y)))
        train_op = tf.train.GradientDescentOptimizer(learning_rate).minimize(cost)
```

Train the model on the data in a session:

```
In [4]: sess = tf.Session()
        init = tf.global_variables_initializer()
        sess.run(init)

        prev_err = 0
        for epoch in range(training_epochs):
            err, _ = sess.run([cost, train_op], {X1: x1s, X2: x2s, Y: ys})
            if epoch % 100 == 0:
                print(epoch, err)
            if abs(prev_err - err) < 0.0001:
                break
            prev_err = err

        w_val = sess.run(w)
```

```
0 0.6931461
100 0.37416694
200 0.2728377
300 0.2150606
400 0.17839222
500 0.15322778
600 0.1349254
700 0.12101715
```

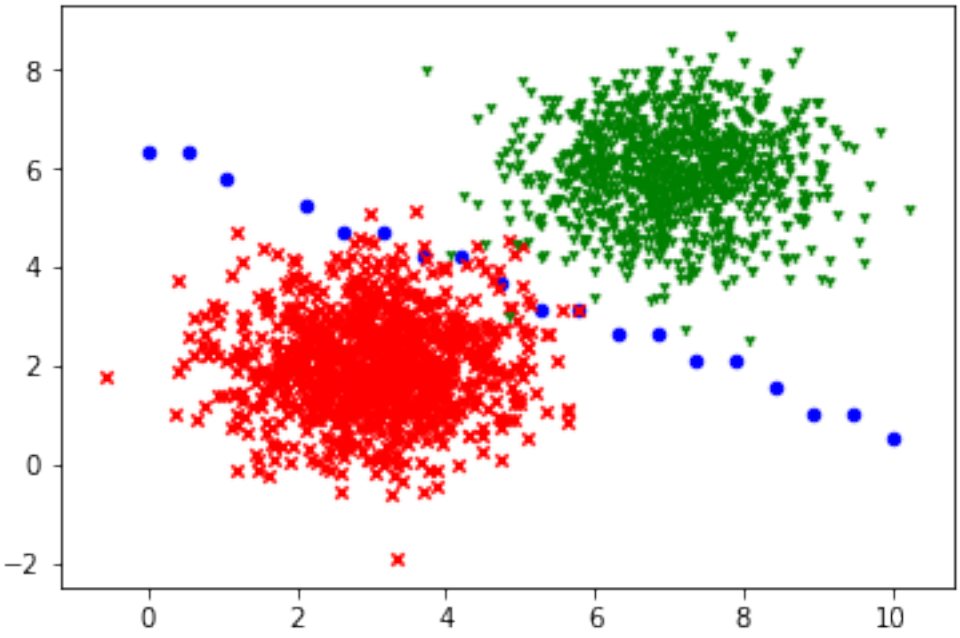
Here's one hacky, but simple, way to figure out the decision boundary of the classifier:

```
In [5]: x1_boundary, x2_boundary = [], []
        for x1_test in np.linspace(0, 10, 20):
            for x2_test in np.linspace(0, 10, 20):
                z = sess.run(tf.sigmoid(-x2_test*w_val[2] - x1_test*w_val[1] - w_val[0]))
                if abs(z - 0.5) < 0.05:
                    x1_boundary.append(x1_test)
                    x2_boundary.append(x2_test)
```

Ok, enough code. Let's see some a pretty plot:

```
In [6]: plt.scatter(x1_boundary, x2_boundary, c='b', marker='o', s=20)
        plt.scatter(x1_label1, x2_label1, c='r', marker='x', s=20)
        plt.scatter(x1_label2, x2_label2, c='g', marker='1', s=20)

        plt.show()
```


8
6
4
2
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10