

ECE521A1 Report

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1 Euclidean distance function

Include the snippets of the Python code.

```
def euclidianDist(a, b):  
    x_z = (tf.expand_dims(a,0) - tf.expand_dims(b,1))  
    return tf.transpose(tf.reduce_sum(tf.multiply(x_z, x_z), 2))
```

2 Making Predictions for Regression

2.1 Choosing the nearest neighbours

Include the relevant snippets of your Python code.

```
def pickKNearestNeighboursUnscaled(DistMatrix, k):  
    length = tf.shape(DistMatrix)[1]  
  
    values, indices = tf.nn.top_k(-DistMatrix, k)  
    range = tf.range(length)  
  
    rangeblock = tf.expand_dims(tf.expand_dims(range, 0),0)  
    indexblock = tf.expand_dims(indices, 2)  
  
    truth_matrix = tf.reduce_sum(tf.to_float(tf.equal(rangeblock, indexblock)),1)  
  
    return truth_matrix  
  
def pickKNearestNeighbours(DistMatrix, k):  
    length = tf.shape(DistMatrix)[1]  
  
    values, indices = tf.nn.top_k(-DistMatrix, k)
```

```

range = tf.range(length)

rangeblock = tf.expand_dims(tf.expand_dims(range, 0),0)
indexblock = tf.expand_dims(indices, 2)

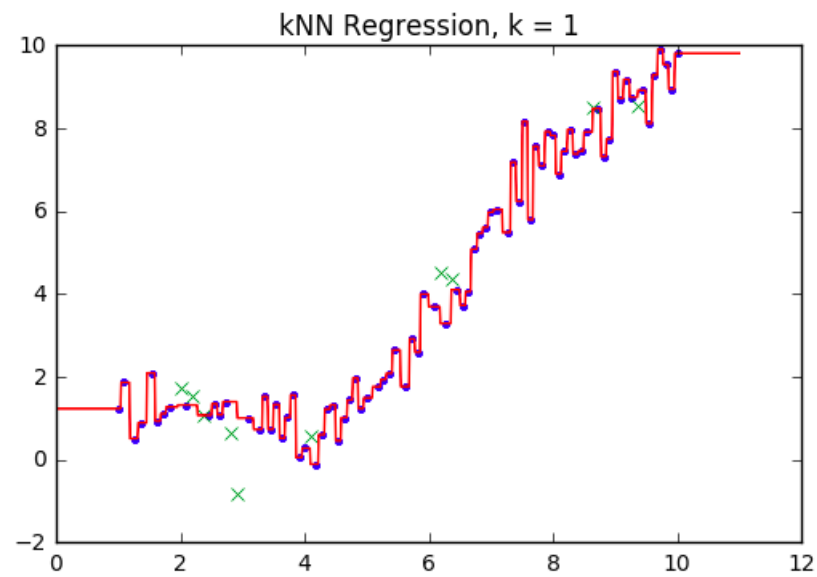
truth_matrix = tf.reduce_sum(tf.to_float(tf.equal(rangeblock, indexblock)),1)

return truth_matrix / tf.to_float(k)

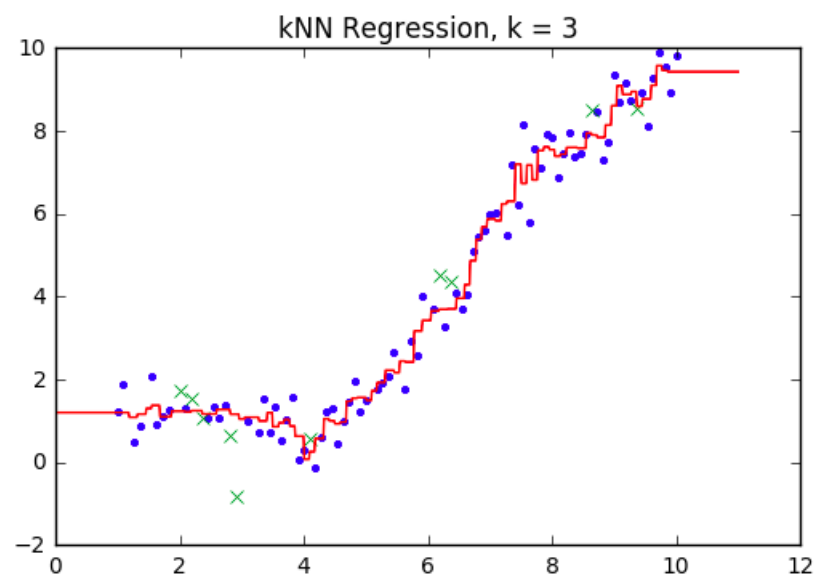
```

2.2 Prediction

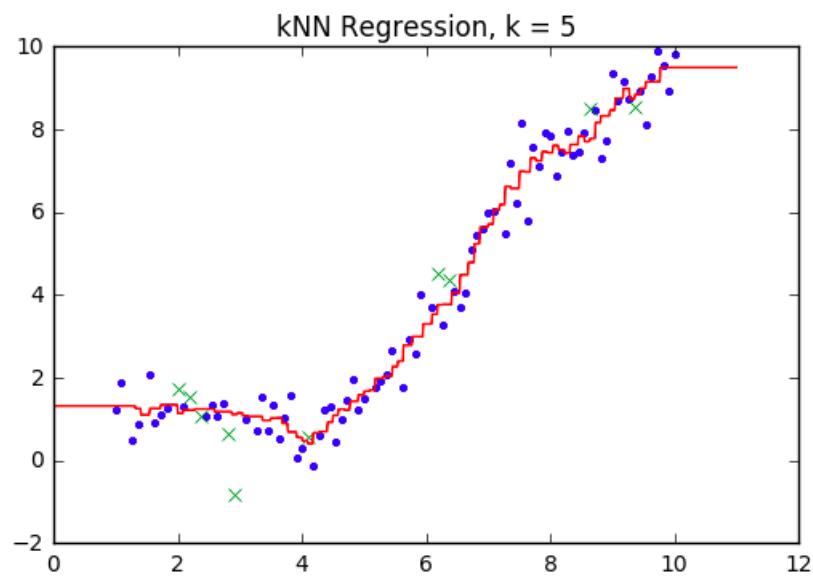
The best k using the validation error is $k=1$, which has the minimum validation MSE loss.



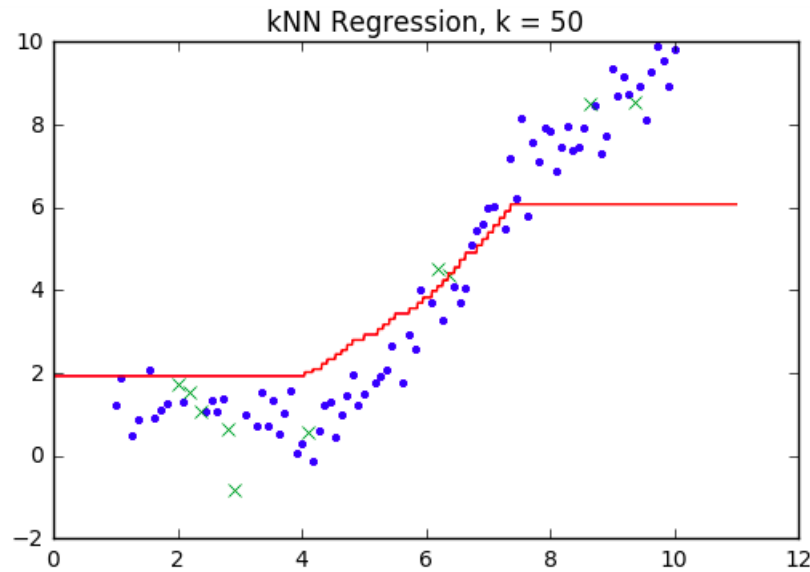
(K = 1) MSE values: Valid = 0.5430993, Test = 0.622008, Train = 0.0



(K = 3) MSE values: Valid = 0.6525566, Test = 0.29018393, Train = 0.21048422



(K = 5) MSE values: Valid = 0.6208772, Test = 0.35665315, Train = 0.23708253



(K = 50) MSE values: Valid = 2.4574032, Test = 1.4138691, Train = 2.4960175
Value of K for lowest MSE in valid data set is 1

The plot shows that for $k=1$, there is an overfitting problem, so the curve has many wiggles, including much noise information. However, if k is too large, such as $k=50$, the difference between predicted y value and true y value is obvious. So in summary, $k = 5$ is the best.

3 Making Predictions for Classification

3.1 Predicting class label

Include the relevant snippet of code for this task.

```
def predictFinalValue(inputX, trainX, trainY, K):
    Knearest = pickKNearestNeighboursUnscaled(euclidianDist(inputX, trainX), K)
    predictionMatrix = tf.multiply(Knearest, trainY + 1)

    outputY = tf.zeros(0)
    for i in range(0, runCount):
        y, idx, count = tf.unique_with_counts(predictionMatrix[i])
        count2 = tf.slice(count, [1], tf.shape(count)-1)
        item_class = tf.expand_dims(y[tf.argmax(count2)+1],0)
        outputY = tf.concat([outputY, item_class],0)

    outputY = outputY - 1
    return tf.to_int32(outputY)
```

Figure 1: Example of a test point that is classified incorrect

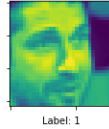
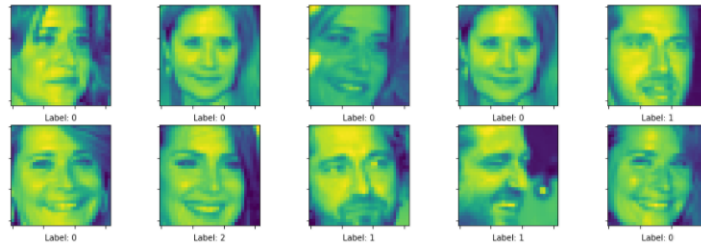


Figure 2: k=10 nearest neighbors that is not the same as true person



3.2 Face recognition using k-NN

For $k = 1$, validation accuracy is 61/92;
 For $k = 5$, validation accuracy is 52/92;
 For $k = 10$, validation accuracy is 51/92;
 For $k = 25$, validation accuracy is 52/92;
 For $k = 50$, validation accuracy is 49/92;
 For $k = 100$, validation accuracy is 43/92;
 For $k = 200$, validation accuracy is 28/92;

The value of k that achieves the best validation accuracy for person is 1

For $k = 1$, test accuracy is 66/93;
 For $k = 5$, test accuracy is 63/93;
 For $k = 10$, test accuracy is 63/93;
 For $k = 25$, test accuracy is 62/93;
 For $k = 50$, test accuracy is 52/93;
 For $k = 100$, test accuracy is 44/93;
 For $k = 200$, test accuracy is 34/93;

3.3 Gender recognition using k-NN

For $K = 1$ validation accuracy is 84/92
 For $K = 5$ validation accuracy is 84/92
 For $K = 10$ validation accuracy is 80/92
 For $K = 25$ validation accuracy is 83/92

For $K = 50$ validation accuracy is 82/92
For $K = 100$ validation accuracy is 78/92
For $K = 200$ validation accuracy is 71/92

The value of k that achieves the best validation accuracy for gender is 1 or 2

For $K = 1$ test accuracy is: 86/93
For $K = 5$ test accuracy is: 84/93
For $K = 10$ test accuracy is: 82/93
For $K = 25$ test accuracy is: 82/93
For $K = 50$ test accuracy is: 80/93
For $K = 100$ test accuracy is: 77/93
For $K = 200$ test accuracy is: 68/93