Assignment 3

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**Due Date:** Tuesday 25 October, right before midnight (in the middle of Reading Week).

Please type your answers or handwrite them neatly on a piece of paper. You can submit a doc or pdf file. Some of these questions could’ve been in the test, but I think it is more humane if you do them as homework instead.

(1) A model has a 3% training error and a 10% dev error when compared to humans.

1. Compute the bias in the model.

Solution:

Because training set error == bias == 3%

Then, we know the bias is 3%

1. Compute the variance in the model.

Solution:

Firstly, we will compute the dev set error,

Dse = bias + variance = 10%

Variance = 10% - 3% = 7%

We know the variance is 7%.

1. Is the model overfitting or underfitting?

Solution:

Because the model has high variance, the model is overfitting.

1. List 4 different ways to improve the model.

Solution:

* Using smaller sets of features
* Increasing regularization parameters
* Using Cross-validation
* Get more data in training dataset

(2) Now suppose another model has 7% training error and 10% dev error when compared to humans.

1. Compute the bias in this model.

Solution:

Because training set error == bias == 7%

We know the bias is 7%

1. Compute the variance in this model.

Solution:

Firstly, we will compute the dev set error,

Dse = bias + variance = 10%

Variance = 10% - 7% = 3%

We know the variance is 3%.

1. Is this model overfitting or underfitting?

Solution:

Because the model’s bias is high, the model is underfitting.

1. How should we improve this model?

Solution:

* We can get more polynomial features
* We can decrease regularization parameters
* We can get more additional features

(3) In SoftMax classification, we have = for class 0, 1 and 2. (Value 1 is for class 0.)

(a) To which class does the input image most likely belong?

(b) Compute the probability of the input image for each class. Give your answer in 3 decimal digits to the right of the decimal point. (I.e., use 4 digits right of the decimal points in your calculation, and then round off to 3 digits in the final answer.) State your answer as the probability between 0 and 1.

Solution:

According to the question, we get,

= and we know,

Then we can get t =

Then,

We can compute the

Finally, we get the probability of the input image for class 0 is 25.9%, class 1 is 70.5%, class 2 is 3.5%

We get the input image is most likely belong to class 1.