

# HOMEWORK 3 CMPS242 - FALL 2015

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## 1 Problem 1

a) After saving the file in an aff file, we run the linear regression algorithm on the data and get the following values for the parameters:

$w = [-0.1343, 1.8477, -0.8966]^T$  and  $b = 4.3608$  where  $\hat{y} = w^T \mathbf{x} + b$

The root mean squared error on the training set is: 0.1897

b) The prediction for the new instance  $\mathbf{x} = [3, 3, 5]$ :  $\hat{t} = 5.0180$

c) Now, we set the regularizer  $\lambda = 0.2$  and run the first two parts again to get:  
 $w = [-0.1527, 2.0598, -0.6439]^T$  and  $b = 1.9483$

As can be seen, the weights become smaller, compared to (a), as we expected.

The root mean squared error on the training set becomes: 0.4614

d) By doing the calculations by hand, we find the following weights:

$w = [-0.1343, 1.8477, -0.8966]^T$  and  $b = 4.3608$  and error = 0.1897, which is almost the same as part (a), because Weka uses a very small regularizer parameter by default ( $1e-8$ ).

e) The least squared error solution does not depend on the order of the examples because what we are trying to minimize is the sum of the squared errors.

## 2 Problem Two

### 2.1 Part a

Select the Use training set test option and run the three classifiers. Report their results (accuracies). Which algorithm is best and why?

	Nearest Neighbor	Naive Bayes	Logistic Regression
Accuracy Training Set	100%	76.3021%	78.2552%
Accuracy 66% Split	72.7969 %	77.0115 %	80.0766 %

At first glance it may appear that 1 Nearest Neighbor is the best. However it's performance is so nice on the training set that one is agitated by a fear of the model having overfitted the data. Indeed that seems to be the case, when we perform a 66% split training, testing, we see that the 1 Nearest Neighbor is the least impressive of the lot.

## 2.2 Part b

From weka we have that the coefficients are:

preg	-0.1232
plas	-0.0352
pres	0.0133
skin	-0.0006
insu	0.0012
mass	-0.0897
pedi	-0.9452
age	-0.0149
Intercept	8.4047

We chose point 643, and got the result was -0.004295 Which we confirm is close to 0. Rerunning a sanity chance of  $P(x) = 1/(1+e^x) = .5$ .

## 2.3 Part c

	Nearest Neighbor	Naive Bayes	Logistic Regression
Accuracy Training Set	100%	76.3021%	78.2552%
Accuracy 66% Split	72.7969 %	77.0115 %	80.0766 %

## 3 Problem 4

Note that

$$\frac{d\sigma(a)}{da} = \frac{\exp(-a)}{(1 + \exp(-a))^2} = \sigma(-a)(1 - \sigma(-a))$$

and

$$\frac{dy_n}{d\mathbf{w}} = \sigma(-a)(1 - \sigma(-a))\mathbf{x}_n = y_n(1 - y_n)\mathbf{x}_n$$

Taking the derivative of  $E(\mathbf{w})$  w.r.t.  $\mathbf{w}$  and substituting for these  $\frac{dy_n}{d\mathbf{w}}$  from above, we have:

$$\nabla E(\mathbf{w}) = \sum_{n=1}^N \left( \frac{t_n}{y_n} - \frac{(1-t_n)}{(1-y_n)} \right) \frac{dy_n}{d\mathbf{w}} = \sum_{n=1}^N (t_n(1-y_n) - (1-t_n)y_n)\mathbf{x}_n = \sum_{n=1}^N (t_n - y_n)\mathbf{x}_n$$