Lecture Two

February 18, 2016

1 Grading

Homework: 40% weekly, Midterm: 30% - Take home 17.3, Final(project): 30%

- Read chapter 1 this week!!
- Chapter 2: 2.1-2.3, 2.5
- Chapter 3: 3.1-3.5
- Chapter 4: 4.3 4.4, 4.5
- Chapter 7: 7.3
- Chapter 8: 8.2
- Chapter 10: 10.1 Boosting
- Chapter 11: Neural Networks
- Chapter 12: SVM

2 Linear Regression

Parametric Model represents a linear regression. K-NN is a non-parametric model. In the case of a linear regression representing a line a $\mathbb{R}^2$ you would have two parameters: $y = ax + b$. In $\mathbb{R}^3$ you would have 3 parameters that would represent a plane. This is the plane that is used to segment the space into the two classified spaces.

$$y = a_0 + a_1 x_1^i + \cdots + a_n x_n^i \tag{1}$$

$$y = \begin{bmatrix} 1 & x_1^i & x_2^i & \dots & x_n^i \end{bmatrix} * \begin{bmatrix} a_0 \\ a_1 \\ \vdots \\ a_n \end{bmatrix} \tag{2}$$

$$\vec{y} = \begin{bmatrix} 1 & x_1^1 & x_2^1 & \dots & x_n^1 \\ 1 & x_1^2 & x_2^2 & \dots & x_n^2 \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ 1 & x_1^n & x_2^n & \dots & x_n^n \end{bmatrix} * \begin{bmatrix} a_0 \\ a_1 \\ \vdots \\ a_n \end{bmatrix} + \begin{bmatrix} e_1 \\ e_2 \\ \vdots \\ e_n \end{bmatrix} \tag{3}$$

$$\vec{y} = X\vec{a} \tag{4}$$

2.1 Derivative properties with matrices

2.2 Classification

1. Build X and y Where X is your features and y is your classification result
2. Compute $a = (X^T X)^{-1} X^T y$
3. Apply Classifier: New data is given $\leftarrow$ ($z^T = [z_1, z_2, \dots, z_n]$ Compute : $f(z)$
4. if $f(z) \geq 0, z \in P$
   if $f(z) < 0, z \in N$

3 Weekly Homework

Build a K-NN classifier for digits

- classes: 0-9
- features: a matrix of features with the last column being the classification of the feature

produce an estimate of the error rate to compare a K-NNS classifier to a LSE Linear regression classifier. Determine the difference in error rate for difference K's in the K-NNS classifier.

3.1 Due Date

The homework is due the following Thursday!