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Machine Learning for Robotics and Computer Vision
Winter term 2013

Homework Assignment 4
Topic: Boosting
Tutorial December 6th, 2013

Exercise 1: Medusa-Boost

For a model $y_m(x) = y_{m-1}(x) + w_m\phi_m(x)$ consider the following loss function:

$$L(t, y) = \frac{1}{\exp(ty_{m-1})} \log(1 + exp((-tw\phi(x))))$$

where log denotes the natural logarithm. What are the optimal new basis function ϕ_m and its corresponding weight w_n?

Exercise 2: Comitee

Consider a regression problem in which we are trying to predict the value of a single continuous variable. Some training process gives us a set of predictive models $y_m(x)$ where $m = 1, \ldots, M$. A comitee prediction can be obtained via

$$y_{\text{com}} = \sum_{m=1}^{M} \alpha_m y_m(x)$$

Note that although $\alpha_m = \alpha$ being constant seems natural, but implies the assumption, that the individual models are uncorrelated. Still we want to restrict the model to ensure that y_{com} should neither vote less than nor more than all of its members:

$$y_{\min}(x) \leq y_{\text{com}}(x) \leq y_{\max}(x)$$

Show that this is equivalent to

$$\alpha_m \geq 0, \quad \sum_{m=1}^{M} \alpha_m = 1$$

Exercise 3: Programming

Download the file 'ClassCode2.tgz' available at the course's website. Have a look into the file *classification/adaboost.cc* were you find an implementation of the AdaBoost algorithm with decision stumps as weak classifiers.

Compile the project and run *adaboost* with the number of weak classifiers as input parameter. Generate a plot of the classification error with respect to the number of weak classifiers. What do you observe?