

Supervised Learning 2004 — Assignment 2

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Please hand in a print out of any code written for this assignment.

Q1 Optimisation

Write a computer program (preferably Matlab or C) that solves the following optimisation problem:

$$\min_{\mathbf{w}} \frac{1}{n} \sum_{i=1}^n y_i \ln f(\mathbf{x}_i) + (1 - y_i) \ln(1 - f(\mathbf{x}_i)) + \frac{\alpha}{2} \|\mathbf{w}\|^2$$

using conjugate gradient descent and fixed size step, where

$$f(\mathbf{x}) = \frac{1}{1 + \exp(\mathbf{w}^\top \mathbf{x})}$$

(2.5 points)

Q2 Cross-Validation

Propose a dataset for a classification problem with 100 samples in 2 dimension (each $\mathbf{x}_i \in \mathbb{R}^2$ and $y_i \in \{0, 1\}$).

- Solve the classification problem using the proposed computer program in Q1 with $\alpha = 0$.
- Obtain the best α value using cross-validation with 5 folds. Report a table with the mean number of errors for each tested value of α .

(2.5 points)

Q3 Naïve Bayes

Construct a Naïve Bayes classifier using Connect-4 dataset, which is available at <http://www.ics.uci.edu/~mlearn/MLSummary.html>. This dataset has an input vector of dimension 42, each input can take three possible values (b,x,o), and one output value, which can also take 3 different values (win,loss,draw). More information can be found at the connect-4.names file.

- a) Construct a Naïve Bayes classifier. Report the probabilities of winning, loosing or drawing giving the input vector for the data points: 1, 7, 15, 20, 25 and 33.
- b) Group the input in pairs (a1-a2, a3-a4, . . . , g5-g6) to form a 21-dimensional input vector, in which each input can take now 9 different values (bb, bx, bo, xb, . . . , oo). Construct a new Naïve Bayes classifier with this modified input space. Report the probabilities of winning, loosing or drawing giving the input vector for the data points: 1, 7, 15, 20, 25 and 33.
- c) Comment if you believe the Naïve Bayes classifier is a proper approximation to solve this machine learning problem.

(5.0 points)