Homework Assignment N°2

BML36
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Contents

1 Exercise 2: Logistic classification & discrimination

1.1 Part a

Initialize w_0 ?

1. Some fixed w_0 like $\begin{bmatrix}0 & 0 & \cdots & 1\end{bmatrix}$
2. Some computation around the dataset like the mean: $w_0 = \frac{1}{N}\sum_{i=1}^{N} x_i$, concatenated with a constant.
3. Some random vector

How to learn: for batch learning use this equation at each step

$$w_{n+1} = w_n - \eta \nabla E(w_n) = w_n - \eta \sum_{n=1}^{N} (y(n) - t_n)\, x_n$$

How to stop the iterative process ?

1. Stop when the norm of the difference vector is low: $\Delta_n = \frac{\|w_{n+1} - w_n\|}{\|w_n\|} < \epsilon$
   This is a commonly used criterion that stops the process when the steps we take are getting small compared to our current result.
2. Stop after fixed number of iteration
   This ensures we won't enter in a infinite non-convergent process.
3. Stop when a threshold error is reached: $E(w_n) < \epsilon$
   This is actually a bad idea because most of the time we can't be certain it is possible to reach such threshold on the error. It would result in an infinite process.

Our algorithm goes as follows:

1. Chose ϵ, N and η respectivelly for precision, maximum number of iterations and speed convergency.
2. Set current error Δ to $+\infty$ and n to 0
3. Chose the initial discriminant: $w_{current}$. WE NEED TO CHOSE THE METHOD !
4. While $\Delta > \epsilon \wedge n < N$ do
   (a) Compute and store next discriminant w_{next}:

$$w_{next} = w_{current} - \eta \sum_{n=1}^{N} \left(\sigma({w_{current}}^{\top} x_n) - t_n\right) x_n$$

   (b) Compute and store the new error Δ:

$$\Delta = \frac{\|w_{next} - w_{current}\|}{\|w_{current}\|}$$

(c) Prepare for next iteration: store w_{next} in place of $w_{current}$ and increment n

5. If $\Delta > \epsilon$, it means we have not converged enough towards the limit. We should consider increasing N OR using another algorithm for convergence (eg. Newton-Raphson)

6. Result is stored in $w_{current}$, number of steps in n.