Lab session 5 : exercises

1 Perceptron algorithm

1.1 Perceptron for binary classification (with integrated bias)

Suppose we have a set X of T training examples, and the perceptron runs for E epochs.
Let us note :

- **i** an iteration id, corresponding to handling a certain example, at a certain epoch
- **L** the total number of iterations ($L \leq E*T$ if the algo may stop when no updates were done for the current epoch, otherwise $L = E*T$)
- and $w^{(i)}$ the weight vector learnt after i iterations

Let's consider a toy example, with

- T=3, E = 2 and L= E*T=6
- and $X = \{ (x^{(1)}, +1) , (x^{(2)}, +1) , (x^{(3)}, -1) \}$, with :
  $x^{(1)} = (1,-1,-1, 1)$ $x^{(2)} = (1, 1, 0, 10)$ $x^{(3)} = (1, -2, 1, 0)$
  (first component is for the bias)

Manually run the perceptron algo, and **express** the values of the weights after initialization ($w^{(0)}$) and after each iteration ($w^{(1)}, \dots w^{(6)}$).

1.2 Multiclass perceptron (with integrated bias)

Suppose the problem has C classes, numbered 1, 2, …, C.

Let $W^{(i)}$ be the weight matrix after i iterations of the perceptron algorithm.

We take again a toy example with T = 3, E = 2 et L = ET = 6
and a training set $X = \{ (x^{(1)}, c1) , (x^{(2)}, c1) , (x^{(3)}, c3) \}$

NB : contrary to question 1.1, we don't provide here the precise values for the $x^{(t)}$ vectors.

Suppose that when running the algo, updates are made at iterations 1, 3 and 4 (and predicted classes for these iterations were c2, c1 and c2 respectively).

- **run** the algorithm and **express** $W^{(6)}$ as a function of the $x^{(t)}$