

# Correction de l'exo 2.

## Serie 2:

1. les formules mathématiques

$$f_{11} = 1 \cdot w_1 + x \cdot w_2 \quad \text{--- (1)}$$

$$f_{12} = 1 \cdot w_3 + x \cdot w_4 \quad \text{--- (2)} \quad \text{Sig: sigmoïde}$$

$$h_{11} = \frac{1}{1 + e^{-f_{11}}} \quad \text{--- (3)}$$

$$\text{Sig}(x) = \frac{1}{1 + e^{-x}}$$

$$h_{12} = \frac{1}{1 + e^{-f_{12}}} \quad \text{--- (4)}$$

$$f_{21} = h_{11} \cdot w_6 + h_{12} \cdot w_7 + 1 \cdot w_5 \quad \text{--- (5)}$$

$y = f_{21}$  car la fonction d'activation est /  
(i.e.  $f(x) = x$ ).

2. Backpropagation:

on a  $E = (d - y)^2$   
d: sortie désirée.

(E = Erreur  
= sortie désirée -  
sortie obtenue y)

on calcule les dérivées partielles:

$$\frac{\partial E}{\partial w_j} = -2(d - y) \frac{\partial y}{\partial w_j}$$

Mais  $y = h_{11} w_6 + h_{12} w_7 + w_5$  (formule 5).

onc les dérivées sont :

$$\frac{\partial y}{\partial w_5} = 1$$

$$\frac{\partial y}{\partial w_6} = h_{11}$$

$$\frac{\partial y}{\partial w_7} = h_{12}$$

$$\frac{\partial y}{\partial w_1} = \frac{\partial y}{\partial h_{11}} \cdot \frac{\partial h_{11}}{\partial f_{11}} \cdot \frac{\partial f_{11}}{\partial w_1} = w_6 \cdot h_{11} (1-h_{11}) \cdot 1$$

voir formule 1

$$\frac{\partial y}{\partial w_2} = \frac{\partial y}{\partial h_{11}} \cdot \frac{\partial h_{11}}{\partial f_{11}} \cdot \frac{\partial f_{11}}{\partial w_2} = w_6 \cdot h_{11} (1-h_{11}) \cdot x$$

voir formule 2

$$\frac{\partial y}{\partial w_3} = \frac{\partial y}{\partial h_{12}} \cdot \frac{\partial h_{12}}{\partial f_{12}} \cdot \frac{\partial f_{12}}{\partial w_3} = w_7 \cdot h_{12} (1-h_{12})$$

$$\frac{\partial y}{\partial w_4} = \frac{\partial y}{\partial h_{12}} \cdot \frac{\partial h_{12}}{\partial f_{12}} \cdot \frac{\partial f_{12}}{\partial w_4} = w_7 \cdot h_{12} (1-h_{12}) \cdot x$$

la formule de mise à jour des poids est comme suit :

$$\Delta w_j = \alpha (d - y) \cdot \frac{\partial y}{\partial w_j}$$

$j = 1, \dots, 7$

$\alpha$  : paramètre d'apprentissage