PadhAI: Activation Functions & Initialization Methods

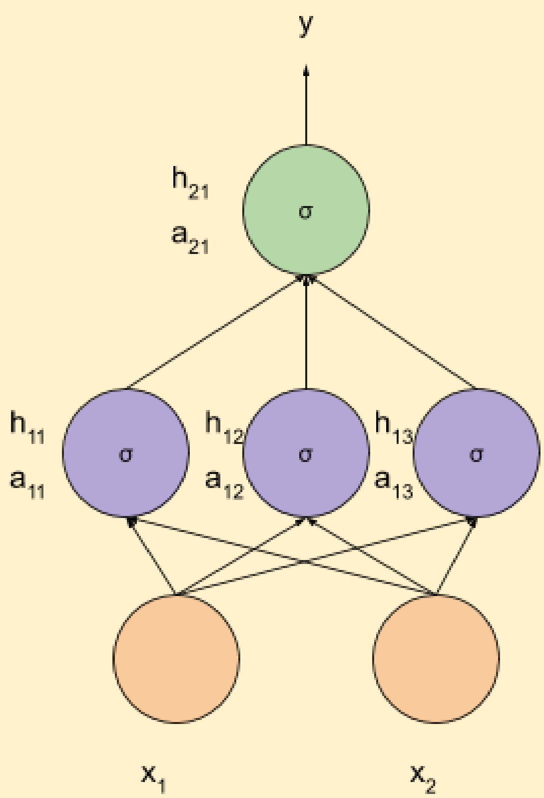
One Fourth Labs

Initialization Methods

Symmetry Breaking Problem

Why not simply initialise all weights to 0?

1. Consider the following neural network that uses the logistic activation function



   a. $a_{11} = w_{11}x_1 + w_{12}x_2$
   b. $a_{12} = w_{21}x_1 + w_{22}x_2$
   c. Let us initialise all the weights to 0
   d. $a_{11} = a_{12} = 0$
   e. $h_{11} = h_{12}$
   f. $\nabla w_{11} = \frac{\partial L(w)}{\partial y} . \frac{\partial y}{\partial h_{11}} . \frac{\partial h_{11}}{\partial a_{11}} . x_1$
   g. $\nabla w_{21} = \frac{\partial L(w)}{\partial y} . \frac{\partial y}{\partial h_{12}} . \frac{\partial h_{12}}{\partial a_{12}} . x_2$
   h. But $h_{11} = h_{12}$ and $a_{11} = a_{12}$
   i. Therefore $\nabla w_{11} = \nabla w_{21}$
   j. We can see that if we initialise the weights to equal values, then the equality carries through to the gradients associated with these weights, thereby keeping the weights equal throughout the training.
   k. This is known as the Symmetry Breaking Problem, where if you start with equal initialised weights, they remain equal through the training.
   l. Hence weights connected to the same neuron should never be initialised to the same value?
2. Some conclusions we can make are as follows
   a. Never initialise all weights to 0
   b. Never initialise all weights to the same value