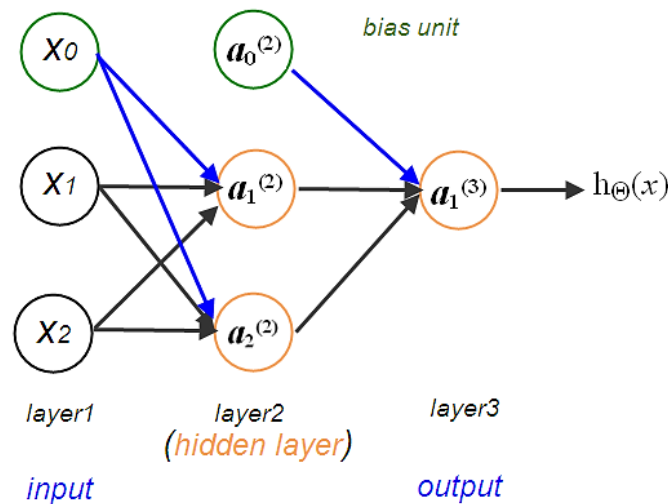


Soft Computing

Homework#02

Due Date: 2021/05/04

https://www.bogotobogo.com/python/python_Neural_Networks_Backpropagation_for_XOR_using_one_hidden_layer.php



In the picture, we used the following definitions for the notations:

1. $a_i^{(j)}$: "activation" of unit i in layer j
2. $\Theta^{(j)}$: matrix of weights controlling function mapping from layer j to layer $j + 1$

Here are the computations represented by the NN picture above:

$$\begin{aligned}a_0^{(2)} &= g(\Theta_{00}^{(1)}x_0 + \Theta_{01}^{(1)}x_1 + \Theta_{02}^{(1)}x_2) = g(\Theta_0^T x) = g(z_0^{(2)}) \\a_1^{(2)} &= g(\Theta_{10}^{(1)}x_0 + \Theta_{11}^{(1)}x_1 + \Theta_{12}^{(1)}x_2) = g(\Theta_1^T x) = g(z_1^{(2)}) \\a_2^{(2)} &= g(\Theta_{20}^{(1)}x_0 + \Theta_{21}^{(1)}x_1 + \Theta_{22}^{(1)}x_2) = g(\Theta_2^T x) = g(z_2^{(2)}) \\h_\Theta(x) &= a_1^{(3)} = g(\Theta_{10}^{(2)}a_0^{(2)} + \Theta_{11}^{(2)}a_1^{(2)} + \Theta_{12}^{(2)}a_2^{(2)})\end{aligned}$$

In the equations, the g is **sigmoid** function that refers to the special case of the **logistic** function and defined by the formula:

$$g(z) = \frac{1}{1 + e^{-z}}$$

使用基因演算法(Genetic Algorithm, GA)找出上圖神經網路的權重值(weights)，輸出結果為 $X_1 \text{ XOR } X_2$

訓練資料：(1, 1: 0), (1, 0: 1), (0, 1: 1), (0, 0: 0)

適應度值：訓練資料誤差的總和 (請註明 L1 或 L2)

繳交報告中：

1. 需說明 (1)染色體(chromosome)編碼方式 (2)所使用的 Crossover 和 Mutation 運算元(Operator)的種類、數目、運作方式和所有使用的參數
2. 需記錄並圖式每次疊代(搜尋)過程中，每一代的最佳適應度值(fitness value)
3. 依據 GA 找出的權重值，測試輸入為(0.8, 0.7)、(0.8, 0.2)與(0.2, 0.3)時，神經網路的輸出值為何？
4. 其它你認為需要的記錄或說明事項