

COMP90051 Statistical Machine Learning

Semester 2, 2015

Workshop Week 7: Artificial Neural Networks

Questions

1. In the lecture notes, a worked example of Perceptron learning was introduced. Trace this example. Make sure that you understand how the learning algorithm works.
Now, use the Perceptron learning rule to adapt a single perceptron with two inputs for the Boolean function $y = x_1 \text{ AND } x_2$. Generate a random training set. Use the same initial weights and learning rate from the lecture notes example.
2. Let $s = \sum_{i=0}^n w_i x_i$ be an input function, and $f(s)$ an activation function. Consider three possible choices for the activation function: identity $f(s) = s$, step $f(s) = 1$ if $s \geq 0$, and $f(s) = 0$ otherwise, and $f(s) = \frac{1}{1+e^{-s}}$. Discuss advantages and disadvantages of using each of these functions.
3. Consider a fully connected feed-forward artificial neural network with an input layer with two nodes (x_1 and x_2), a middle layer with two nodes (y_1 and y_2), and an output layer with a single node z . Assume that a sigmoid activation function is used in each node (y_1 , y_2 , and z).
 - (a) How many parameters does this model have? What are these parameters? Draw this network, and clearly label all nodes and weights on your diagram.
 - (b) Initialize the weights with random values. Show the value of all weights in the two-layer network after one training iteration with the back propagation training algorithm. Assume the learning rate is $\eta = 0.2$ and that there is only one training data example $(x_1, x_2, t) = (1, 1, 0)$.
 - (c) Consider a general three-layer network. Derive the update rules for the weights from the input to hidden layer.