COMP9444 Neural Networks and Deep Learning
Term 3, 2019

Exercises 1: Perceptrons

This page was last updated: 09/29/2019 19:42:58

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1. **Perceptron Learning**

   a. Construct by hand a Perceptron which correctly classifies the following data; use your knowledge of plane geometry to choose appropriate values for the weights w_0, w_1 and w_2.

Training Example	x_1	x_2	Class
a.	0	1	−1
b.	2	0	−1
c.	1	1	+1

   b. Demonstrate the Perceptron Learning Algorithm on the above data, using a learning rate of 1.0 and initial weight values of

   $w_0 = -1.5$
   $w_1 = 0$
   $w_2 = 2$

   In your answer, you should clearly indicate the new weight values at the end of each training step.

2. **XOR Network**

   Construct by hand a Neural Network (or Multi−Layer Perceptron) that computes the XOR function of two inputs. Make sure the connections, weights and biases of your network are clearly visible.

   Challenge: Can you construct a Neural Network to compute XOR which has only one hidden unit, but also includes shortcut connections from the two inputs directly to the (one) output.
   Hint: start with a network that computes the inclusive OR, and then try to think of how it could be modified.

3. **Computing any Logical Function with a 2−layer Network**

   Assuming False=0 and True=1, explain how each of the following could be constructed:

   a. Perceptron to compute the OR function of m inputs
   b. Perceptron to compute the AND function of n inputs

c. 2–layer Neural Network to compute the function (A ∨ B) ∧ (¬ B ∨ C ∨ ¬ D) ∧ (D ∨ ¬ E)
d. 2–Layer Neural Network to compute any (given) logical expression, assuming it is written in Conjunctive Normal Form.

Hint: in each case, first decide on the input–to–output or input–to–hidden weights, then determine the bias.

Make sure you try answering the Exercises yourself, before checking the Sample Solutions