CIS 32 Homework 1

1. Classify each of the following environments

   (a) WWW server;

   (b) office cleaning robot;

   as

   - Accessible *vs* inaccessible
   - Deterministic *vs* non-deterministic
   - Episodic *vs* non-episodic
   - Static *vs* dynamic
   - Discrete *vs* continuous

   As part of your answer, you should explain *why* you classify each environment in the way you do.

   (20 points)

2. Design by hand a neural network to implement the exclusive-or function of two inputs x_1 and x_2. This means decide the connections between TLUs (you will need more than one) and the weights on inputs and on connections.

   Your network should have a *hidden* layer of TLUs (that is a set of TLUs that are not connected to the output) which each have inputs x_1 and x_2, and an output TLU with inputs from the output of the hidden layer (and no direct input from x_1 or x_2).

   (20 points)

3. The following training set is linearly separable:

 | input | output |
   | --- | --- |
   | 1 0 0 | 1 |
   | 0 1 1 | 0 |
   | 1 1 0 | 1 |
   | 1 1 1 | 0 |
   | 0 0 1 | 0 |
   | 1 0 1 | 1 |

By hand, train a TLU using this training set.

(a) Using the Widrow Hoff procedure

(b) Using the error-correction procedure.

You will need to have four inputs (including the one which implements the threshold). Start training with all weights equal to 0 and $c = 0.5$, and train once on each example in the training set.

Show the set of weights after each example.

(40 points)

4. Consider the TLU given in:

$$\mathbf{X} \cdot \mathbf{W} \longrightarrow \boxed{\int} \longrightarrow f(\mathbf{X})$$
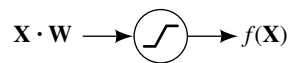
$f(\mathbf{X}) = 0$ if $\mathbf{X} \cdot \mathbf{W} < -b$
$\qquad = 1$ if $\mathbf{X} \cdot \mathbf{W} > b$
$\qquad = (1/2b)(\mathbf{X} \cdot \mathbf{W} + b)$ otherwise

This has a ramp function rather than a sigmoid or a threshold function.

(a) Derive the weight adjusting rule for the weight vector $\mathbf{W}$ which will give gradient descent to minimize the squared error ϵ between the actual output f and the desired output d.

(b) Comment on your result.

(20 points)

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