

CIS 716 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

(20 points)

2. Design by hand a neural network to implement the exclusive-or function of two inputs x_1 and x_2 . Your network should have a *hidden* layer of standard TLUs with inputs x_1 and x_2 and a final 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:

<u>input</u>	<u>output</u>
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. You will need to have four inputs (including the one which implements the threshold). Start

training with all weights equal to 0, and use the error correction procedure until it converges on a solution.

Show the set of weights at each pass through the training cycle.

(30 points)

4. Consider the TLU given in:



$$\begin{aligned} f(\mathbf{X}) &= 0 \text{ if } \mathbf{X} \cdot \mathbf{W} < -b \\ &= 1 \text{ if } \mathbf{X} \cdot \mathbf{W} > b \\ &= (1/2b)(\mathbf{X} \cdot \mathbf{W} + b) \text{ otherwise} \end{aligned}$$

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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.

(30 points)