Tutorial 1
(Neural Computing)

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EXERCISE 1

Simple threshold perceptrons cannot compute the XOR function, since they can only represent linearly separable functions. However, a combination of simple perceptrons can solve the xor problem.

(a) Name a set of linearly separable boolean functions f_1, f_2 and f_3, connected as shown in Fig. 1(a) below, such that the combined network computes the XOR function.

(b) Find a weight vector for the network in Fig. 1(b) below such that the XOR function is computed.

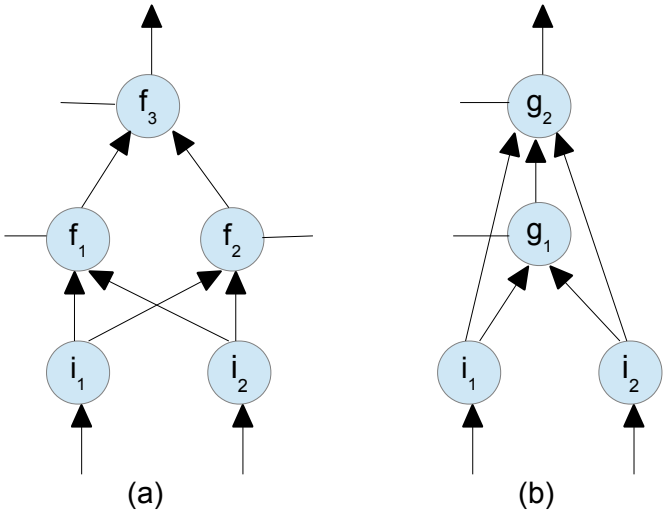

Figure 1: Multilayer perceptrons

EXERCISE 2

We shall use the MatLab Neural Network Toolbox to design and build neural networks.

(a) Open MatLab and type "nnstart" <enter> in the command window;

Click on "More Information" in the "Neural Network Start" window;

Explore the "getting started documentation", "demonstrations" and "datasets";

Click on "Getting started wizards" in the "Neural Network Start" window;

Try the "fitting tool" for input-output curve fitting and the "pattern recognition tool"

(b) Familiarise yourself with the MatLab Neural Network environment. Use it to create the neural network of Fig. 1(a) above.

(p.t.o.)

EXERCISE 3

(a) Set the weights of a threshold perceptron that implements exactly the classification given in Figure 2.

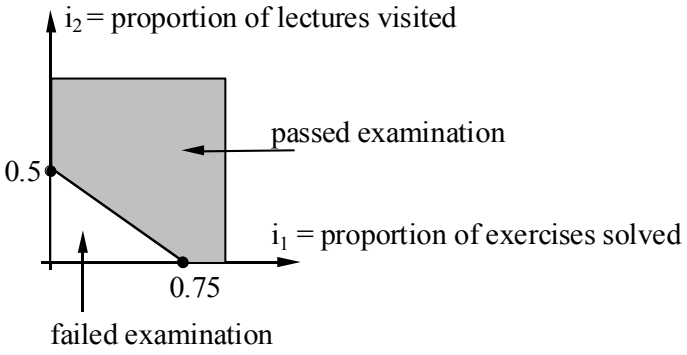

Figure 2: Classification task in the unit square $[0,1]^2$

(b) Assume you have been given training data $\{(i_1, i_2)\}$ where $(0.7, 0.3)$, $(0.4, 0.5)$ and $(0.6, 0.9)$ have passed the examination (i.e. have target output 1) and $(0.2, 0.2)$ has failed the examination (i.e. has target output 0). Train a perceptron on this data using $\eta = 0.1$ and initial weight vector $(\theta, W_{i_1}, W_{i_2}) = (-0.5, 0.3, -0.2)$.

(c) Compute the generalisation error of the perceptron trained in 3(b) w.r.t. the ideal classification given in Figure 2, i.e. draw the classification boundary for the trained perceptron and compare it with that of the figure.