Cairo University
Faculty of Computers & Information
Dept of Computer Science (BSc)

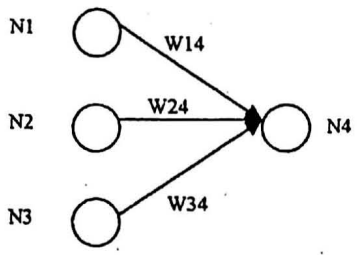
Final Exam
Jan 2010
Time 2 hrs

Genetic Algorithms

Solve as much as you can:

Neural Networks.

1- A fragment of a NN comprising 4 neurons is shown below. N1, N2 and N3 are on the hidden layer and N4 is on the output layer. I(N1)=0.9 and o(N4)=0.5, error e at N4=0.3. weights w14=0.6, w24=0.4 and w34=0.7 and learning rate = 0.03. Update the value of w14 by backpropagation algorithm. Also compute the back-propagated error at neuron N1. Apply sigmoidal activation function.



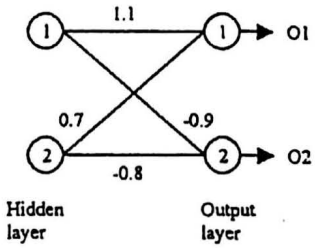
(5.5 points)

2- Given the following weights of feedforward neural network

$$[W^h]=\begin{bmatrix} -0.2 & 1.1 & 0.4 \\ 0.8 & -1.3 & 0.9 \end{bmatrix} \quad [W^o]=\begin{bmatrix} 1.5 & 2.6 \\ 5.1 & 3.2 \end{bmatrix} \quad \text{and } [X]=\begin{bmatrix} 0.5 \\ 0.85 \\ -0.4 \end{bmatrix}$$

and sigmoidal activation function on both output and hidden layers. Compute y1 and y2.
(5.5 points)

3- Given the following segment of a FFNN with two output neurons and two hidden neurons with weights,



where outputs on output layer o1=0.6 and o2=0.85. The errors on output layer are e1=y1-o1=0.1 and e2=y2-o2=-0.15. The outputs of the hidden layer are I1=0.9 and I2=0.65. The learning rate=0.4. It is required to update the weight w11. Compute the error backpropagated at neuron 1 in the hidden layer. Apply sigmoidal activation function.
(5.5 points)

4- Construct an autoassociative Bi-directional associative memory (BAM) using the following training vectors: X1=[1, -1, -1, 1, -1, 1] and X2=[1, 1, 1, -1, -1, -1]
It is required:

a- Compute the weight matrix. **(1 point)**
b- Recall BAM for X=[1, 1, 1, 1, -1, 1]. Comment on the result. **(1 point)**
c- Recall BAM for X=[-1, 1, 1, -1, 1, -1]. Comment on the result. **(1 point)**
d- Compute the minimum bound of energy according to Lyapunov energy function. **(1 point)**
e- Compute the resonance energy. Compare with (d) and comment. **(1.5 point)**

(5.5 points)

Fuzzy Systems

5- Given a financial company system with 2 products:

P1 with range 0 to 100 and 3 fuzzy sets L, M, H.

P2 with range 0 to 100 and 3 fuzzy sets L, M, H.

And required to estimate profit PR:

PR with range -50 to 50 and 5 fuzzy sets VL, L, ZE, H, VH.

The following fuzzy rules govern the actions of the system:

IF P1=L OR P2=L THEN PR=VL

IF P1=M AND P2=M THEN PR=L

IF P1=M AND P2=M THEN PR=ZE

IF P1=H OR P2=not H THEN PR=VH

Estimate PR. P1 = 70, P2 = 40.

(5.5 points)

6- Given a stock market information system with governing variables x1, x2 and x3. It is required to infer the decision D. The following information is provided,

x1, x2, x3: range 0..100 with fuzzy sets L, M, H.

and D with decisions Sell:S and Buy: B and Hold:H

The following decision blocks apply,

DB1: IF x1=L AND x2=L THEN y=L

IF x1=M AND x2=H THEN y=H

IF x1=H AND x2=M THEN y=M

DB2: IF x3=L AND y=L THEN D=B

IF x3=M AND y=H THEN D=S

IF x3 =H AND y=M THEN D=H

Intermediate variable y is y range 0..100 with fuzzy sets VL, L, M, H, VH

determine the decision D for x1= 30, x2=70 and x3=30.

(5.5 points)

7- Given a car brake system with [inputs] = SPEED: fuzzy sets slow, medium, quick and fast

DISTANCE: fuzzy sets very near, near, medium and far

[output] = BRAKE: fuzzy sets slight, medium, full and extreme

It is required to draw the fuzzy sets for inputs and output. Design a set of 5 fuzzy rules that control the system.

(5.5 points)

Genetic Algorithms.

8-Are there any cases in which a population of n l-bit strings contains *exactly* n x 2^l different schemas?

(5.5 points)

9- Discuss whether there is survival of the fittest in a generational GA.

(5.5 points)

10- For $f = x^2$, $0<=x<=127$, what is the average fitness of 1******, 0****** and 11*****?

(5.5 points)

Hybrid Systems.

11- Show how fuzzy rules that model a particular system can be evolved using genetic algorithms.

(5.5 points)

12- Show how can genetic algorithms be used for training neural networks.

(5.5 points)

AMR BADR