Cairo University **Final Exam**
Faculty of Computers & Information **Jan 2009**
Dept of Computer Science (BSc) **Time 2 hrs**

Genetic Algorithms

Solve as much as you can:

Fuzzy Systems

1- Given a stock market system with 2 governing variables:

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

And required to estimate ClosePrice CP:

CP with range 0 to 100 and 5 fuzzy sets VL, L, M, H, VH.

The following fuzzy rules govern the actions of the system:

IF PrevDayPrice =L AND OpenPrice =M THEN CP =VL
IF PrevDayPrice =M AND OpenPrice =L THEN CP =L
IF PrevDayPrice =M OR OpenPrice =M THEN CP =M
IF PrevDayPrice =L AND OpenPrice =H THEN CP =VH

Estimate CP. PrevDayPrice = 30, OpenPrice = 60.
(6 points)

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

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

and D with decisions Malignant: M and Benign: B.
The following decision blocks apply,
DB1:

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

DB2:

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

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.
(6 points)

GeneticAlgorithms

3- Taking the reproductive schema growth equation of schema theory,

$$eta(S, t+1) = eta(S, t).\ eval(S, t)/\ averagePopFitness(t)\ [1-Pc.d(S)/(m-1)-o(S).Pm]$$

assume that $o(S).Pm = 0$ and $d(S) = m-1$, then the equation becomes:

$$eta(S, t+1) = eta(S, t).\ eval(S, t)/\ averagePopFitness(t)\ [1-Pc]$$

Discuss the mechanics of the algorithm when $Pc = 0$ and $Pc = 1$ under the following conditions:
a- low population size
b- high population size
c- Elitism
(6 points)

4- Given a population of PopSize Individuals, which are bit-strings of length L. Let the frequency of allele 1 be 0.3 at position *i*, that is 30% of all individuals contains a 1 and 70% a 0. How does this allele frequency change after performing *k* crossover operations with one-point crossover?
(6 points)

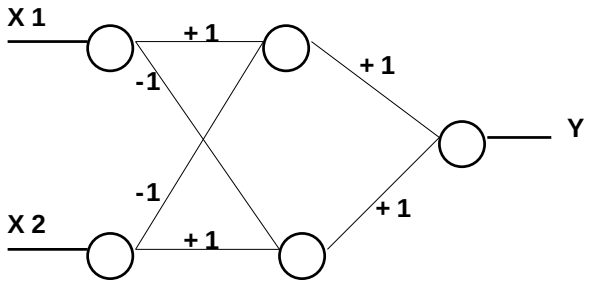
5- Calculate the probability that a binary chromosome with length L will not be changed by applying the usual bit-flip mutation with Pm=1/L.
(6 points)

Neural Networks

6- a-Derive the Generalized Delta Rule for output layer.

b-Discuss the behavior of learning rate and momentum terms on the training process.
(6 points)

7- Given the following feedforward neural network with weights,

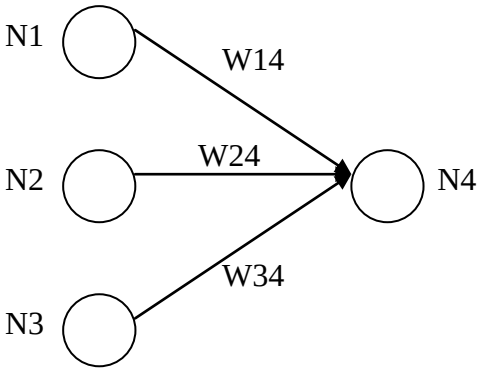


and applying the following activation function,

$$f(x) = \begin{cases} 1 & x > 0 \\ 0 & x \le 0 \end{cases}$$

Compute the outputs Y for inputs (X1, X2) equal to the following,
(0,0), (0,1), (1,0), (1,1).
What function do you think this network emulates.
(6 points)

8- 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 **(6 points)**



9- Differentiate between linear and nonlinear activation functions in the performance of training feedforward neural networks.
(6 points)

Hybrid Systems
10- Show how fuzzy rules that model a particular system can be evolved using genetic algorithms.
(6 points)

11- Show how can genetic algorithms be used for training neural networks.
(6 points)

AMR BADR