MACHINE LEARNING
4th Year Students.
Total Marks:
Course Code: 3413

Computer and Syst. Dept.
Time Allowed: 3 Hrs.
15 / 1 / 2013

Question [1]

A can company wants to produce a cylindrical container with a capacity of 1000 cubic centimeters. The top and the bottom of the container must be made of material that costs \$0.05 per square centimeter, while the sides of the container can be made of material costing \$0.03 per square centimeter.

- A. Find the objective function?
- B. What is (are) the constraint?
- C. Find the dimensions that will minimize the total cost of the container

Question [2]

The feedforward network shown in fig. below using **bipolar binary neurons** is mapping the entire plane x_1, x_2 into a binary o value. Find the segment of the x_1, x_2 plane for which $o_4 = 1$ and its complement for which $o_4 = -1$
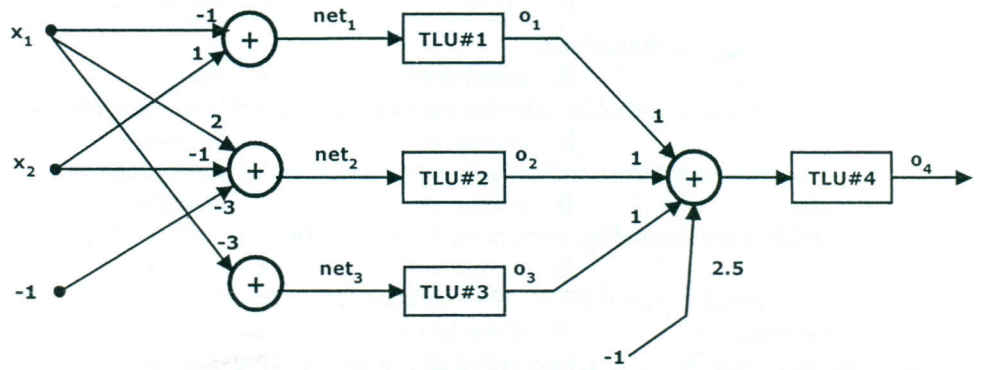
Question [3]

The network shown below uses neurons with bipolar continuous activation function with $\lambda = 1$. The neurons output has been measured as $o_1 = 0.28$ and $o_2 = -0.73$. Find the input vector $x = [x_1 \quad x_2]^t$ that has been applied to the network.
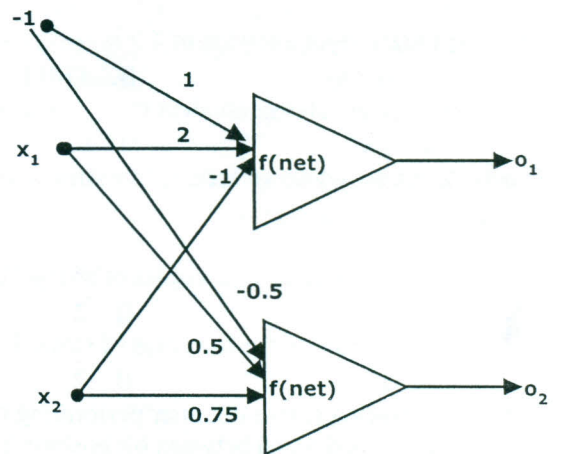
Question [4]

- A. Write down the velocity update formula of particle swarm optimization?
- B. Write down the simple PSO pseudo code

Question [5]

1. Cocerning **MATLAB**, You can convert from binary to decimal value using the function named ------------
   - A. binary
   - B. binary2dec
   - C. binaryToDec
   - D. bin2dec
2. Cocerning **MATLAB**, to start the GUI of Genetic Algorithm / Optimization toolbox you will call --------
   - A. optimtool('ga')
   - B. optimtool( )
   - C. Opti/GA
   - D. GA
3. is a method for solving both constrained and unconstrained optimization problems that is based on natural selection
   - A. GA
   - B. PSO
   - C. SA
   - D. Blind Search
4. The space of all feasible solutions is called ------------- space
   - A. GA
   - B. Search
   - C. time
   - D. frequency
5. ------------ only explores the search space by randomly selecting solutions and evaluates their fitness
   - A. Random search
   - B. GA
   - C. PSO
   - D. Hill Climbing
6. ----------- is search technique to find approximate solutions to optimization and search problems.
   - A. Random search
   - B. GA
   - C. PSO
   - D. all
7. in GA, Each solution is represented through a --------------------
   - A. Chromosome
   - B. Gene
   - C. reproduction
   - D. all
8. ------- is a short length of a chromosome which controls a characteristic of an organism
   - A. Chromosome
   - B. Gene
   - C. reproduction
   - D. all
9. how much the current solution meets the requirements of the objective function is -----------
   - A. fitness
   - B. diversity
   - C. selection pressure
   - D. all
10. --------- : how good the candidate solution is

A. fitness   B. diversity   C. selection pressure   D. all

11. ---------- refers to the average distance between individuals in a population
     A. fitness   B. diversity   C. selection pressure   D. all

12. ---------- is essential to the GA because it enables the algorithm to search a larger region of the space.
     A. fitness   B. diversity   C. selection pressure   D. all

13. The process in which individual strings in the population are selected to contribute to the next generation is called
     A. Roulette wheel   B. Parent selection   C. Tournament   D. all

14. --------- may be considered as one of the weak points of GA
     A. No guarantee for   B. Weak theoretical   C. Need parameter   D. all
        optimality   basis   tuning

15. premature convergence may exist in ------------------
     A. Roulette wheel   B. rank   C. Tournament   D. all

16. if a population contain 4 chromosomes (n = 4), i is the order of the chromosome (i=1 to 4) staring from the fittest. ----
------ equation may be used as way for implementing rank selection
     A. $\frac{n+i+1}{4}$ B. $\frac{n-i+1}{10}$ C. $\frac{n-i+1}{4}$ D. $\frac{n-i-1}{10}$

17. ---------- is an array of individuals
     A. generation   B. population   C. run   D. all

18. ---------- children are created by introducing random changes to a single parent.
     A. elite   B. crossover   C. mutation   D. all

19. --------- children are the best individuals that survive to the next generation
     A. elite   B. crossover   C. mutation   D. all

20. --------- children are created by combining the vectors of a pair of parents.
     A. elite   B. crossover   C. mutation   D. all

21. The genetic algorithm uses the ------------ condition(s) to determine when to stop.
     A. Generations   B. Time Limit   C. Fitness limit   D. all

Assume that each value in [-1.5, 1.5] is encoded as a binary representation with precision to one decimal place.

22. The binary representation of 1.2 is ---------------
     A. 10100   B. 11011   C. 11100   D. 10000

23. The decimal value equivalent to 10100 is ------------
     A. 0.8   B. 0.4   C. 1.3   D. -1.3

Under **Roulette wheel selection**, five strings have the following fitness values: 3, 6, 9, 12, and 15. The mating pool has a constant population size, n=5.

24. The expected number of copies of string 12 is ----------------
     A. 1   B. 2   C. 3   D. 4

25. The expected number of copies of string 15 is ----------------
     A. 1   B. 2   C. 3   D. 4

26. The offspring comes out after performing two-point crossover between **1010001110** and **0011010010** between bit position 4 and 5 and between bit position 8 and 9 is
     A. 1010001110   B. 1010010010   C. 1111000011   D. 1010010010
        0011010010   0011001110   0000111100   0011001110

27. In PSO, to allow particles to oscillate within bounds, we should take ------- into consideration
     A. φ_1, φ_2 B. Speed interval   C. Best position by   D. Best point in the
                                                    particle   neighbor

28. What is generalization?
     A. The ability of a pattern recognition system to approximate the desired output values for pattern vectors which are not in the validation set.
     B. The ability of a pattern recognition system to approximate the desired output values for pattern vectors which are not in the training set.
     C. The ability of a pattern recognition system to extrapolate on pattern vectors which are not in the training set.
     D. The ability of a pattern recognition system to interpolate on pattern vectors which are not in the test set.

29. A neuron with 4 inputs has the weight vector $w = [1, 2, 3, 4]^t$ and a zero bias. The activation function is linear, where the constant of proportionality equals 2 — that is, the activation function is given by $f(net) = 2 \times net$. If the input vector is $x = [4, 8, 5, 6]^t$ then the output of the neuron will be:
     A. 1   B. 56   C. 112   D. 118

30. ------------ learning algorithm is based on the max. activation among all neurons participating in a competition.
     A. Delta   B. Winner takes all   C. Widrow-Hoff   D. a and c

الفرقة الرابعة (نظام قديم)
امتحان مادة: ذكاء اصطناعى
الزمن: ٣ ساعات

جامعة المنصورة
كلية الهندسة
قسم هندسة الحاسبات و النظم

Please answer the following questions:

Q1: Write short notes for the following:
1. What is Computer vision?, Applications of it.
2. What is image processing?, Aspects of it.
3. Types of digital images.
4. Areas of Artificial Intelligence.
5. What is an expert system?
6. Basic Functions of Expert Systems.
7. Expert System Main Components.
8. Advantages of Expert Systems.
9. Considerations for Building Expert Systems.
10. Elements of an Expert System.

Q2: Write the differences between the following:
1. Image Filtering and Processing Line Drawings.
2. Problem Domain vs. Knowledge Domain.
3. DENDRAL and MYCIN systems.
4. Forward chaining and backward chaining.
5. Procedural and Nonprocedural Languages.
6. Strong AI and Weak AI.

Q3: For each of the following image processing/computer vision tasks, explain your steps in details and mention the relevant aspect.
   A. **Figure 1** contains a robot and a number of things. Obtain by an automatic process the robot from the image.
   B. **Figure 2** contains a metallic ring, explain how to extract it from the background.
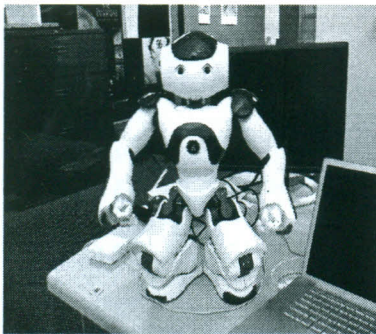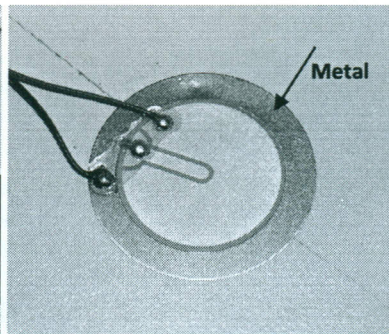   C. **Figure 3** has a problem. State the problem and suggest a solution.
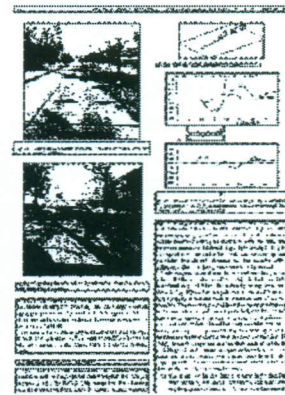

Figure 1   Figure 2   Figure 3

Q4: List two applications of Expert Systems. Explain them in details according to importance and usage.

Good luck.   *Dr. Abdelhameed Fawzy (15/1/2013)*