C9-R4 : SOFT COMPUTING

NOTE :
1. **Answer question 1 and any FOUR from questions 2 to 7.**
2. **Parts of the same question should be answered together and in the same sequence.**

Time: 3 Hours   Total Marks: 100

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1. (a) Discuss the working principle of Genetic Algorithm. Also draw its flow chart.
    (b) Explain derivative based optimization.
    (c) List out at least four application domains of Fuzzy-Genetic systems?
    (d) Differentiate between statistical randomness and unpredictability.
    (e) Enumerate the advantages of Neuro-Fuzzy approach.
    (f) Explain the basic concept of Hill Climbing.
    (g) Briefly describe the common characteristics of Derivative Free Optimization methods. **(7x4)**

2. (a) Elucidate the main purpose of System Identification? Discuss the two top-down steps required by the system identification?
    (b) "The properties of fuzzy logic help in improvising the generalization capability of neural networks". Do you agree with the statement? Justify your answer. Explain the structure of Neuro-Fuzzy systems.
    (c) Suppose a genetic algorithm uses chromosomes of the form $x = abcdefgh$ with a fixed length of eight genes. Each gene can be any digit between 0 and 9. Let the fitness of individual x be calculated as:
    $f(x) = (a + b) - (c + d) + (e + f) - (g + h)$,
    and let the initial population consist of four individuals with the following chromosomes:
    $x1 = 6\ 5\ 4\ 1\ 3\ 5\ 3\ 2$
    $x2 = 8\ 7\ 1\ 2\ 6\ 6\ 0\ 1$
    $x3 = 2\ 3\ 9\ 2\ 1\ 2\ 8\ 5$
    $x4 = 4\ 1\ 8\ 5\ 2\ 0\ 9\ 4$
    Considering the above statements, answer the following questions
    (1) Evaluate the fitness of each individual, showing all your workings, and arrange them in order with the fittest first and the least fit last.
    (2) Perform the following crossover operations:
       (i) Cross the fittest two individuals using one–point crossover at the middle point.
       (ii) Cross the second and third fittest individuals using a two–point crossover. **(6+6+6)**

3. (a) Explain soft computing. How it is different from hard computing? Identify the situations where Soft Computing is better choice over traditional methods? Explain using proper examples.
    (b) List all the methods of selecting chromosomes for parents to crossover. Explain any two methods in details. **(9+9)**

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4. (a) Elaborate Inverse Learning for the design of Neuro-Fuzzy Controllers.
   (b) Describe the "Random Search Method" as one of the technique of Derivative Free Optimization methods. **(9+9)**

5. (a) Discuss the types of crossover and mutation operations in Genetic Algorithm.
   (b) Explain Cooperative Neuro-Fuzzy Approach. How it is different from Concurrent Neuro-Fuzzy Approach and Hybrid Neuro-Fuzzy Approach **(9+9)**

6. (a) "To construct fuzzy controller, we need to perform knowledge acquisition, which takes human operator's knowledge about how to control a system and generates a set of fuzzy if-then rule." Discuss the two kinds of information that can be obtained from human operator?
   (b) Explain the following Soft Computing (Hybridization) Techniques with their significance and applications:
   (i) Genetic-Fuzzy Systems
   (ii) Neuro-Genetic Systems
   (iii) Genetic-Neuro-fuzzy Systems **(6+12)**

7. (a) What does ANFIS stand for? Draw two-input first order Sugeno model and its corresponding equivalent ANFIS architecture. Explain the layers of ANFIS architecture in detail.
   (b) Explain the purpose of Chinese Remainder Algorithm and write its application in Security Algorithm. **(9+9)**

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