Advanced Algorithms (CSE 617)
Mid-Semester Examination 2023
Full Marks - 25
Answer all questions. Each question carries 5 marks.

1 Consider the problem of neatly printing a paragraph with a monospaced font (all characters having the same width). The input text is a sequence of n words of lengths $l_1, l_2, \ldots l_n$, measured in characters, which are to be printed neatly on a number of lines that hold a maximum M characters each. No word exceeds the line length, so that $l_i \leq M$ for $i = 1, 2, \ldots n$. The criterion for "neatnessis as follows. If a given line contains words i through j, where $i \leq j$, and exactly one space appears between words, then the number of extra space characters at the end of the line is, $M - j + i - \Sigma_{k=i}^{j} l_k$, which must be nonnegative so that the words fit on the line. The goal is to minimize the sum, over all the lines except the last, of the cubes of numbers of extra space characters at the end of the lines. Give a dynamic-programming algorithm to print a paragraph of n words neatly. Analyze the running time and space requirements of your algorithm.

2 Recall the greedy coin-changing problem discussed in class. Given certain denominations of coins you have to exchange a sum of rupees with the least number of coin changes. Suppose that the available coins are in denominations that are powers of c: the denominations are $c^0, c^1, \ldots c^k$ for some integers $c > 1$ and $k \geq 1$. Show that the greedy algorithm always yields an optimal solution.

3 Prove the master theorem's case 2 using Arka-Bazzi's method.

4 Professor Diogenes has n supposedly identical integrated-circuit chips that in-principle can test each other. The professor's test jig accommodates two chips at a time. When the jig is loaded, each chip tests the other and reports whether the other chip is good or bad. A good chip always reports accurately whether the other chip is good or bad, but the professor cannot trust the answer of a bad chip. Thus the possible outcomes of a test are as follows:

Chip A says	Chip B says	Conclusion
B is good	A is good	both are good or both are bad
B is good	A is bad	at least one is bad
B is bad	A is good	at least one is bad
B is bad	A is bad	at least one is bad

Design and analyze an algorithm to identify which chips are good and which are bad, assuming more than $n/2$ chips are good.

5 Sort the functions from asymptotically smallest to asymptotically largest, indicating ties if there are any. You do not need to turn in proofs.
$lg(\sqrt{n})!, lg(\sqrt{n!}), \sqrt{lg(n!)}, (lg\sqrt{n})!, (\sqrt{lgn})!, \sqrt{(lgn)!}$. (Hint: Use Stirling's approximation for factorials: $n! \approx n^{(n+1)/2}/e^n$.)

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Q. No. CSE 622/ 81

B.TECH/EVEN
REG/(22-23)

Even Semester Mid-term Examination, 2022-23

SOFT COMPUTING

CSE 622

Full Marks : 25 *Time* : 90 Minutes

The figures in the margin indicate full marks.

Answer any *five* questions.

Question No.	Body of the Question	Marks	Mapped CO

1 (a) Let the optimal solution (chromosome) is 13579246. If the initial population of size 5 is as follows, is it possible to get the optimal solution by Genetic Algorithm (GA) using only Selection and Crossover operator?

x1 = 3 2 6 7 4 1 3 5

x2 = 6 2 1 2 0 1 4 1

x3 = 1 2 5 9 2 2 2 0

x4 = 4 2 8 5 2 0 9 6

(b) A GA is to be used to evolve a binary string of length L containing only 1s. The initial population is a randomly generated set of binary strings of length L. Give a suitable fitness function for this problem:

3+2 CO2 CO5

2. Justify that in GA Selection is exploitive and Mutation is explorative. 5 CO2

3 Design the chromosome for Travelling Salesman Problem (TSP), and correspondingly design a suitable crossover operator. Explain them for a problem of 6 cities. 5 CO5

4. (a) X and Y are two solutions obtained by a multi-objective genetic algorithm (MOGA), and X is dominated by Y. What does it mean?

(b) Are the Pareto front and the first front obtained by executing a MOGA for a given multi-objective problem the same? Explain with suitable figure.

2+3 CO2 CO4 CO5

5. Two different sorting techniques are used in NSGA-II What are they? Distinguish between their purposes for which they are used. 5 CO4 CO5

6. (a)What is crowding distance (CD) and what is the significance of it in NSGA-II?

(b)How it is evaluated explain with suitable figure.

3+2 CO4 CO5

COURSE OUTCOMES

CO1: To familiarize with neural networks and learning methods for neural networks.

CO2: To introduce basics of genetic algorithms and their applications in optimization and planning.

CO3: To introduce the ideas of fuzzy sets, fuzzy logic and fuzzy inference system.

CO4: To introduce students' tools and techniques of Soft Computing.

CO5: To develop skills thorough understanding of the theoretical and practical aspects of Soft Computing.
