G/E/TX

Reg. No:

# Final Assessment Test – May 2024

Vellore Institute of Technology
(Deemed to be University under section 3 of the UGC Act, 1956)

Course: **BCSE204L - Design and Analysis of Algorithms**

Class NBR(s): **0772/0796/0803/0822/0827/0834/ 0876/0879/0887/0891/0902/0909/0914/0919/ 0924/0926/0928/0930/0932/0934/0935/0937/ 0941/6646**

Slot: **A2+TA2**

Time: **Three Hours**

Max. Marks: **100**

- **KEEPING MOBILE PHONE/ELECTRONIC DEVICES EVEN IN 'OFF' POSITION IS TREATED AS EXAM MALPRACTICE**
- **DON'T WRITE ANYTHING ON THE QUESTION PAPER**

**Answer any TEN Questions**

**(10 X 10 = 100 Marks)**

1. a) Solve the recurrence $T(n) = 4T(\sqrt{n}) + log_2^5 n$ **[4] BL3 CO1**

   b) Write an iterative algorithm to find the sum $\sum_{i=2}^{n} \frac{1}{i(i-1)}$, $n \in Z$. Prove that your algorithm is correct. **[6]**

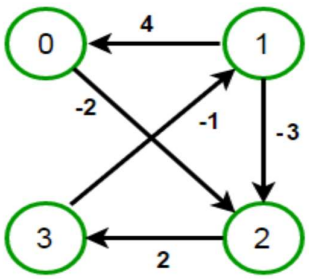
2. You are given two DNA sequences, DNA1 and DNA2, consisting of characters from the alphabet {'A', 'C', 'G', 'T'}. Your task is to find the minimum number of single-character edits (insertions, deletions, or substitutions) required to transform DNA1 into DNA2. For example, given DNA1 = "AGTACG" and DNA2 = "GTCAGT", the minimum number of edits required is 4. One possible sequence of edits results in transforming DNA1 into DNA2 with 4 edits is as follows: **BL4 CO2**

   1. Substitute 'A' in DNA1 with 'G': "GGTACG"
   2. Substitute 'G' in DNA1 with 'T': "GTTACG"
   3. Delete 'A' from DNA1: "GTTCG"
   4. Substitute 'C' in DNA1 with 'A': "GTTAG"

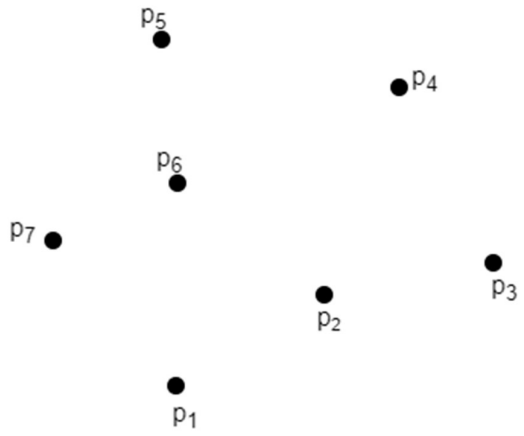
   Develop a DP algorithm that will provide an optimized solution to determine the minimum edit distance between the two DNA sequences.

3. Assume that you have a text $T$ and a pattern $P$. Write an algorithm to report the index of the first occurrence (if any) of $P$ in $T$ from the $\pi$-table of $PT$ where $PT$ is the concatenation of $P$ and $T$. If $P$ does not occur in $T$, then print $-1$. Trace the working of your algorithm with the help of a positive example. **BL4 CO3**

4. Given a directed weighted graph G(V, E) with potentially negative weight edges, check whether the implementation of Bellman-Ford algorithm can find the shortest path between the nodes. How will your algorithm determine the possibility of negative cycles in the graph? Explain the reasoning behind the chosen approach. **BL2 CO3**



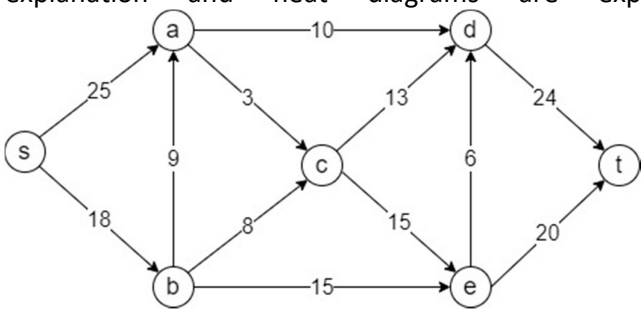
5. Write the pseudocode for Jarvis-march algorithm and trace it for the points provided in the diagram below. **BL3 CO3**




6. Illustrate the need of randomized algorithms. Demonstrate the working of randomized version of quicksort with an appropriate example. **BL1 CO4**

7. Explain the clique decision problem. Show that it is NP complete by performing appropriate reductions. **BL1 CO5**

8. a) Use Ford Fulkerson method (pseudocode/algorithm is NOT expected) to determine the maximum flow possible in the given flow network. Adequate explanation and neat diagrams are expected in each step. **[7] BL3 CO3**




b) Identify an edge $(u, v)$ in the network, in which decreasing its capacity by a positive integer $k$ leads to a reduction of $k$ in the maximum flow. Elucidate the mechanism by which this occurs. **[3]**

9. Define the subset sum problem. Solve it for the set {40, 30, 50, 10, 20} with a target sum of 60. Use backtracking approach. **BL2 CO2**

10. You are attending a workshop with various sessions happening throughout the day. You'd like to attend as many sessions as possible without any conflicts. **BL4 CO2**

| Session | Start Time | End Time |
|---|---|---|
| A | 9:00 | 10:00 |
| B | 9:30 | 11:30 |
| C | 11:00 | 12:00 |
| D | 12:30 | 14:00 |
| E | 13:00 | 14:30 |
| F | 14:30 | 15:00 |

Find a greedy approach to find the maximum number of sessions you can attend without attending any part of two sessions simultaneously. Describe the algorithm and implement it to obtain the solution.

11. Write the pseudocode for Rabin Karp algorithm and trace it for the text T= adbadbacfegba and pattern P = ba. The hash code for the characters is given in the following table. Assume the value of d = 8 and q=13. Demonstration of rolling hashing function is mandatory. Coding scheme: a-1, b-2,…. **BL3 CO3**

12. In the field of robotics, path planning algorithms are crucial for robots to navigate their environment efficiently. Imagine a robot vacuum cleaner that needs to clean the edges of a room. How can the Graham Scan algorithm be used to determine the most efficient cleaning path along the room's perimeter. The coordinates given for this problem are: **BL3 CO3**
{(-3 -4), (2 -3), (4 3), (-4 2), (0 5), (2 -3), (-1 4)}.

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