

School of Computer Science and Engineering  
Winter Semester 2023-2024

Continuous Assessment Test – II  
SLOT: A2+TA2

Programme Name & Branch : B.Tech (BCB/BCE/BCI/BCT/BDS/BKT)

Course Name & code: Design and Analysis of Algorithms, BCSE204L

Class Number (s): ALL

Faculty Name (s): ALL

Exam Duration: 90 Min.

Maximum Marks: 50

Answer All

Q.No.	Question	Max Marks															
1.	<p>A bank has 14 million dollars, which can be invested into stocks of four companies (1, 2, 3, and 4). The following table shows the net revenue of each company and the amount that must be invested into each company.</p> <table border="1"> <thead> <tr> <th>Company</th> <th>1</th> <th>2</th> <th>3</th> <th>4</th> </tr> </thead> <tbody> <tr> <td>Revenue (Million \$)</td> <td>16</td> <td>22</td> <td>12</td> <td>8</td> </tr> <tr> <td>Investment Amount (Million \$)</td> <td>5</td> <td>7</td> <td>4</td> <td>3</td> </tr> </tbody> </table> <p>The objective for the bank is to select a set of companies for investment, so as to maximize the total revenue with the condition that no partial investment can be done i.e., for each company we can either invest into it or not. Solve the problem with the algorithm whose exponential worst-case time complexity can be improved by employing better techniques for efficient pruning.</p>	Company	1	2	3	4	Revenue (Million \$)	16	22	12	8	Investment Amount (Million \$)	5	7	4	3	10
Company	1	2	3	4													
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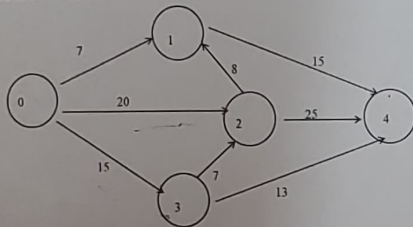
2.	<p>i) Find out the longest proper prefix that is also the proper suffix for the pattern "ababa".</p> <p>ii) Calculate the LPS table of the pattern "ababaa".</p> <p>Using the table constructed in (ii), answer the following.</p> <p>iii) What is the LPS value for the 4<sup>th</sup> character 'b'? What does that value infer?</p> <p>iv) Let 'i' and 'j' be used to denote the index of the characters to be compared in text and pattern respectively. For the text "ababaababaabb", if the comparison starts from the beginning of the text and if all the characters of the pattern matched with those of the text, what will be the new values of <i>i</i> and <i>j</i>, to proceed with the next comparison?</p> <p>v) For the text "ababababaabb", if all the characters of the pattern except the last, matched with those of the text, what will be the new values of <i>i</i> and <i>j</i>, to proceed with the next comparison?</p>	10
3.	<p>A)</p> <pre> RELAX(<i>u, v, w</i>) 1  if <i>v.d &gt; u.d + w(u, v)</i> 2     <i>v.d = u.d + w(u, v)</i>  BELLMAN-FORD(<i>G, w, s</i>) 1  INITIALIZE-SINGLE-SOURCE(<i>G, s</i>) 2  for <i>i = 1 to  G.V  - 1</i> 3     for each edge (<i>u, v</i>) ∈ <i>G.E</i> 4         RELAX(<i>u, v, w</i>) 5  for each edge (<i>u, v</i>) ∈ <i>G.E</i> 6     if <i>v.d &gt; u.d + w(u, v)</i> 7         return FALSE 8  return TRUE </pre> <p>In the above Bellman-Ford algorithm, make the required modifications to merge the two loops in line numbers 2 and 5 into a single loop and to implement early termination of the loop, if no edges are relaxed in a particular iteration.</p> <p>B) The capacity matrix for a flow network is given below. The first augmenting path found using Edmonds-Karp algorithm for the graph is 0-1-2-4-5. Is this correct or not? Justify your answer.</p>	5

*p = b*  
*m = b*  
*i - m = b - b = 0*

	0	1	2	3	4	5
0	0	16	13	0	0	0
1	0	0	0	12	0	0
2	0	0	0	0	14	0
3	0	0	9	0	0	20
4	0	0	0	7	0	4
5	0	0	0	0	0	0

5

4. Apply Push-Relabel algorithm for the flow network given below to find the maximum flow that can pass from the source to sink.



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5. Two line-segments intersect if and only if either (or both) of the following conditions holds:  
 1. Each segment straddles the line containing the other.  
 2. An endpoint of one segment lies on the other segment.  
 (This condition comes from the boundary case.)

```

SEGMENTS-INTERSECT( $p_1, p_2, p_3, p_4$ )
1   $d_1 = \text{DIRECTION}(p_2, p_4, p_1)$ 
2   $d_2 = \text{DIRECTION}(p_3, p_4, p_2)$ 
3   $d_3 = \text{DIRECTION}(p_1, p_2, p_3)$ 
4   $d_4 = \text{DIRECTION}(p_1, p_2, p_4)$ 
5  If  $((d_1 > 0 \text{ and } d_2 < 0) \text{ or } (d_1 < 0 \text{ and } d_2 > 0))$  and
    $((d_3 > 0 \text{ and } d_4 < 0) \text{ or } (d_3 < 0 \text{ and } d_4 > 0))$ 
6    return TRUE
7  elseif  $d_1 = 0$  and ON-SEGMENT( $p_3, p_4, p_1$ )
8    return TRUE
9  elseif  $d_2 = 0$  and ON-SEGMENT( $p_3, p_4, p_2$ )
10   return TRUE
11 elseif  $d_3 = 0$  and ON-SEGMENT( $p_1, p_2, p_3$ )
12   return TRUE
13 elseif  $d_4 = 0$  and ON-SEGMENT( $p_1, p_2, p_4$ )
14   return TRUE
15 else return FALSE

```

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DIRECTION( $p_1, p_2, p_3$ )
1  return  $(p_2 - p_1) \times (p_3 - p_1)$ 

```

```

ON-SEGMENT( $p_1, p_2, p_3$ )
1  If  $\min(x_1, x_2) \leq x_3 \leq \max(x_1, x_2)$  and  $\min(y_1, y_2) \leq y_3 \leq \max(y_1, y_2)$ 
2    return TRUE
3  else return FALSE

```

Given a line-segment L1 with two end-points (2,1) and (6,5), select the other appropriate line-segment among the following to justify your answer for the statements (A), (B) and (C) given below.

L2 with two end-points (3,5) and (5,2)

L3 with two end-points (3,5) and (4,4)

L4 with two end-points (7,6) and (8,7)

L5 with two end-points (7,6) and (5,8)

L6 with two end-points (5,4) and (7,3)

**Statement A:**

The condition in line number 5 of the algorithm is "if  $((d_1 > 0 \text{ and } d_2 < 0) \text{ or } (d_1 < 0 \text{ and } d_2 > 0))$  and  $((d_3 > 0 \text{ and } d_4 < 0) \text{ or } (d_3 < 0 \text{ and } d_4 > 0))$ "

return TRUE"  
 Can the "and" operator which is underlined and highlighted in bold, be replaced with "or" operator to prove that one segment straddles the line containing the other?

**Statement B:**

To prove intersection, is it a must to check the condition "ON\_SEGMENT( $P_i, P_j, P_k$ )" in line numbers 7 to 14 of the algorithm?

**Statement C:**

The else-if conditions in line numbers 7 to 14 of the algorithm show that any one of the directions  $d_1, d_2, d_3, d_4$  can be zero to prove intersection. Is there any line-segment in the list for which only one direction is zero and does not intersect with L1? Is there any line-segment in the list for which more than one direction is zero and still does not intersect with L1?

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3

4