UNIVERSITY OF COLOMBO, SRI LANKA

UCSC

UNIVERSITY OF COLOMBO SCHOOL OF COMPUTING

BACHELOR OF SCIENCE IN COMPUTER SCIENCE

Academic Year 2017/2018 – Second Year Examination – Semester I – 2019

SCS2101 – Data Structures and Algorithms III (R1)

TWO (2) HOURS

PART A

To be completed by the candidate

Examination Index No: .....

Important Instructions to candidates:

1. The medium of instruction and question is **English.**
2. If a page or a part of this question paper is not printed, please inform the supervisor immediately.
3. Note that questions appear on both sides of the paper. If a page is not printed, please inform the supervisor immediately.
4. Write your index number on each and every page of the Question paper.
5. This paper has **04** questions across **Part A** and **Part B** in **20** pages.
6. Answer **ALL** questions. All questions carry equal marks (25 marks).
7. **This paper consists of two parts, Part A (Question No 1 and Question No 2) and Part B (Question No 3 and Question No 4).**
8. Any electronic device capable of storing and retrieving text including electronic dictionaries and mobile phones are **not allowed.**
9. **Non-Programmable** calculators are **allowed.**

For Examiner's use only	
Question No	**Marks**
1	
2	
Total	

Index No: .....

1. The pre-processing time of KMP algorithm is considered efficient than that of BM algorithm, it is also considered that the overall running time of KMP is efficient than BM.

   (a) Briefly describe the main differences of KMP algorithm and BM algorithm with regards to *pre-processing* and *text matching*.

   [04 marks]

Pre-processing	Text Matching
KMP:	**KMP:**
BM:	**BM:**

   (b) Following is an example Text and a Pattern where we want to find all the occurrences of the pattern in the text.

   Text: **HERE IS A SIMPLE EXAMPLE**
   Pattern: **EXAMPLE**

   i. Apply the KMP algorithm to find all the occurrences of the given pattern. Show the pre-processing part of the algorithm and the shifts of the pattern against the text. Indicate the number of comparisons made in each shift.

   [10 marks]

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Pre-Processing:

pi= 0 0 0 0 0 0 1

Shifts of the pattern:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	# of comparisons
H	E	R	E		I	S		A		S	I	M	P	L	E		E	X	A	M	P	L	E	
E	X	A	M	P	L	E																		1
	E	X	A	M	P	L	E																	2
		E	X	A	M	P	L	E																1
			E	X	A	M	P	L	E															2
				E	X	A	M	P	L	E														1
					E	X	A	M	P	L	E													1
						E	X	A	M	P	L	E												1
							E	X	A	M	P	L	E											1
								E	X	A	M	P	L	E										1
									E	X	A	M	P	L	E									1
										E	X	A	M	P	L	E								1
											E	X	A	M	P	L	E							1
												E	X	A	M	P	L	E						1
													E	X	A	M	P	L	E					1
														E	X	A	M	P	L	E				2
															E	X	A	M	P	L	E			1
																E	X	A	M	P	L	E		7

Total Number of Comparisons = ...27.....

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ii. Apply the BM algorithm to find all the occurrences of the given pattern. Show the pre-processing part of the algorithm and the shifts of the pattern against the text. Indicate the number of comparisons made in each shift.

[08 marks]

Pre-Processing:

|E|X|A|M|P|L|E|

|E|X|A|M|P|L|#|
|6|5|4|3|2|1|7|

Shifts of the pattern:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	# of comparisons
H	E	R	E		I	S		A		S	I	M	P	L	E		E	X	A	M	P	L	E	
E	X	A	M	P	L	E																		1
							E	X	A	M	P	L	E											1
									E	X	A	M	P	L	E									5
															E	X	A	M	P	L	E			1
																	E	X	A	M	P	L	E	7

Total Number of Comparisons = ..15.....

Index No: .....

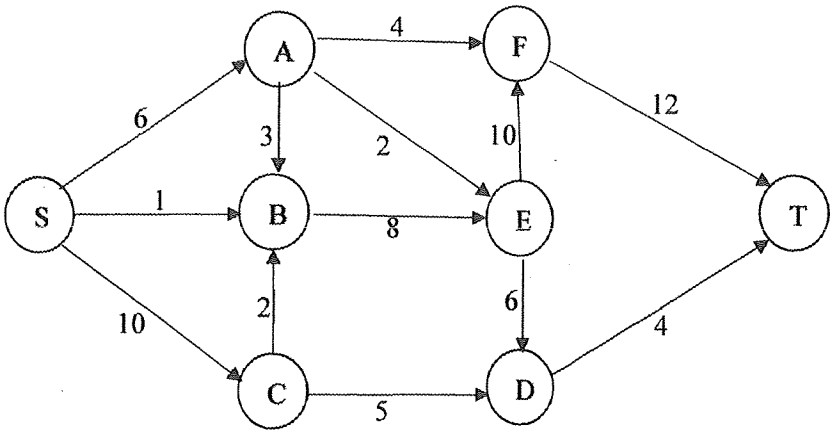
(c) From the above two string-matching algorithms, what is the best algorithm for the given problem. Justify your answer.

[03 marks]

Boyer Moore algorithm

2. In the flow network given below, each directed edge is labeled with its capacity. Consider that Ford-Fulkerson method is used to find the maximum flow from S to T. Consider that the following two augmenting paths were selected (in the given order) as the first two paths.

I. S→B→E→F→T
II. S→A→F→T



Index No: .....

(a) Draw the flow networks and the resultant residual networks after the flow is updated upon the given augmenting paths.

[06 marks]

I. S→B→E→F→T	
Flow Network:	**Residual Network:**
II. S→A→F→T	
Flow Network:	**Residual Network:**

(b) List all the augmenting paths that could be selected for the third augmentation step.

[03 marks]

(c) Calculate the maximum flow of the network by continuing to apply the Ford-Fulkerson algorithm. (Clearly illustrate the flow network and resultant residual network at each selected augmenting path)

[10 marks]

Maximum Flow = ...

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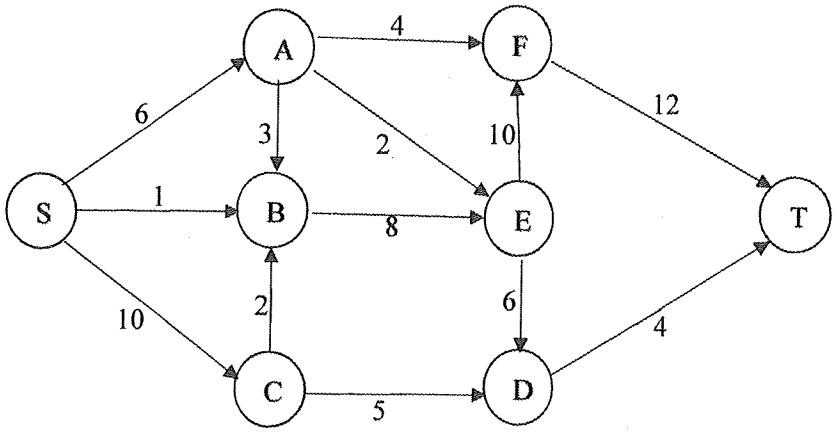
(d) Draw a **dotted line** through the original graph (given below) to represent the minimum cut.

[02 marks]



(e) Consider the following statement.

*For any flow network **G** and any maximum flow on **G**, there is always an edge **e** such that increasing the capacity of **e** increases the maximum flow of the network.*

State whether you agree with the above statement. Justify your answer with a simple example.

[04 marks]

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