Final-DSA-final

Data Structure and Algorithms (International University - VNU-HCM)

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Final Examination

Date: 23/06/2022; Duration: 120 minutes

Open-book, only handwritten notes are allowed

SUBJECT: Algorithms & Data Structures (IT013IU)	
Approval by The SCSE Signature Full name: Dr. Nguyen Van Sinh	Lecturer: Signature Full name: Trần Thanh Tùng
Proctor 1 Signature Full name:	Proctor 2 Signature Full name:
STUDENT INFO	
Student name: **Student ID:**	

INSTRUCTIONS: the total point is 100 (equivalent to 40% of the course)

1. *Purpose:*
   - Test your knowledge on data structures and algorithms in the following topics: Binary Tree, Hash Table, Graphs, Advanced graph algorithms
   - Examine your skill in analysis and design algorithms
2. *Requirement:*
   - Write the answers and draw models CLEAN and TIDY

Note: For all calculations in this subject, the following **rounding convention** is used: **7/2 = 4**

0.

Student Name:...
Student ID:.................................

1. **Binary search tree (25pts)**

Given a list of items, take items one by one from left to right.

Table 1 - Items

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
53	20	06	22	13	09	90	65	81	39	37	38	75	70	76	90

1.a. Insert all items into a binary search tree and draw the tree (15pts)

1.b. Delete the root node and redraw the tree (10pts)

2. **Hash table (20pts)**

Given a list of items in table 1 by taking items in the list from left to right

2.a. Insert all items into the hash table of size **27** by using the linear probing algorithm to solve collisions (10pts).

2.b. Change the hash table's size to **31**, redraw it (10pts)

3. **Graph - Elementary Algorithms (30pts)**

3.a Given the graph G_s in Fig. 1, run the DFS algorithm from **A** and redraw the graph with the discovery time and the finishing time for each node. (15pts)

3.b. Find all strongly connected components in G_s and draw the G_s^{-1} with the finishing time for each node(15pts)
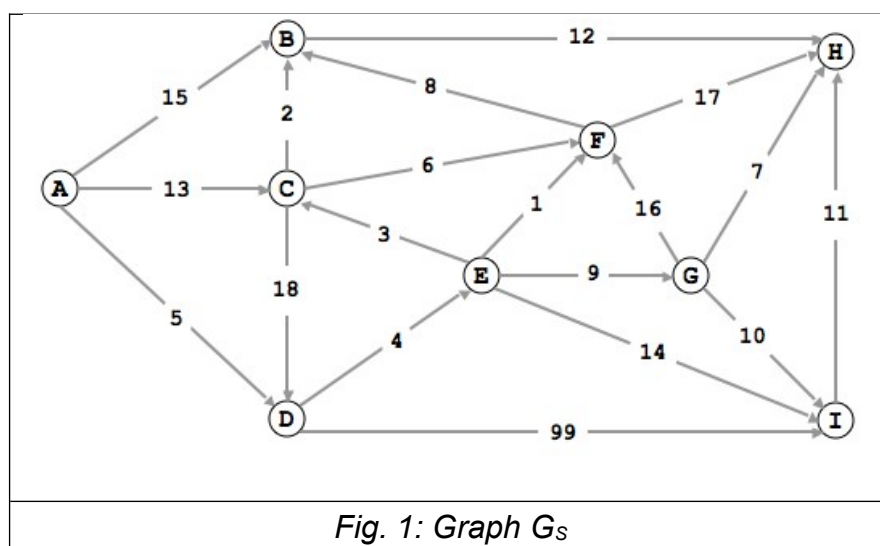
Fig. 1: Graph G_S

4. **Graph – Shortest path algorithm (15pts)**

Run the Dijkstra's algorithm on the graph G_s in Fig.1 **from A**, and fill the following table with corresponding values after each step of the algorithm

Selected nodes	A	B	C	D	E	F	G	H	I
						∞	∞	∞	∞

5. **Algorithm to find cycle (10pts)**

   While traversing a graph using the DFS algorithm, backward edges are edges that link a node to another node in the path from the source node to the node. The backward edges form cycles.

   For example, in the graph below, colored edges are backward edges. A – B – C, and B – C – E are simple cycles.
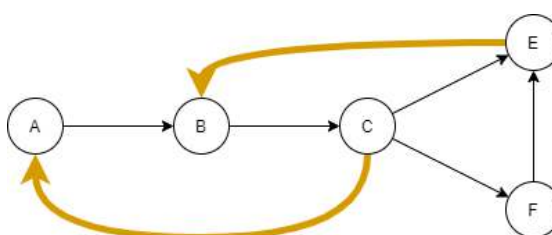
   - (10pts) Propose an algorithm (write a pseudo-code) based on the DFS algorithm to print out all simple cycles of a given graph starting from a source node.

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