-Najah National University
iculty of Engineering

جامعة النجاح الوطنية
كلية الهندسة

Computer Engineering Department
Algorithms and Computational Complexity(66314)
Final Exam

Instructor Name: Samer Arandi

Student Name:.....

Academic Year:2021/2022
Semester: Fall
Credit Hours: 3
Date: Thursday, Dec,24, 2022
Exam Duration: 120 minutes

Registration Number:.....

Section: .....
Total Exam Mark: 100
Exam Weight: 30

Exam Notes:

Question	Points	ILO's	ILO's %	Question Grade	Required Time
Q1	41	i	100%		20 minutes
Q2	15	iv	100%		35 minuets
Q3	44	iii	100%		
Student Grade					

1- Close Books & Notes.
2- Read each problem carefully before attempting to solve it.
3- Write all work on this exam paper.

Q1) (**41 pts**) Answer the following questions:

1- The asymptotic best case running time for Quicksort is: NLgN.

2- The solution for the recurrence: T(n) = T(n/4) is: NLgN.

3- The fastest algorithm for calculating Fibonacci numbers has an asymptotic running time of: Lgn(not sure)

4- It is possible to create a fully-functional Skiplist using unordered linked lists. T/F: F.

5 –Any BSTree operation also works correctly on a RBTree. T/F: F (90%)

6- Name one operation in which a SkipList is asymptotically faster than a RBTree: getMin

7- Name one operation in which a Sorted LList is asymptotically faster than a well-designed hash: getMin

8- Name one operation in which a well-designed hash is asymptotically faster than a RBTree: search

9- The asymptotic worst-case cost for an insertion operation in a RB-Tree is the same as in a BSTree .
T/F: F

10- Dijikstra is a type of greedy algorithms. T/F: T

11- Given a graph in which all the edge weights are different (i.e. no two edges have the same weight). Such graph will always have a unique MST (one MST only). T/F: T

12-If a certain graph has E edges. Two of the edges 2 have the same weight. If we use Kruskal's algorithm to compute the MST for that graph, then there will be at least two MSTs. T/F:(F 70%)

13- Given a school bus full of students leaving school after along day. The bus is required to pass by N bus stops. At each bus stop a number of the students are dropped off. The bus starting point is the school building and the ending point is at the driver's house where the bus is parked. The bus driver would like to finish his job (drop off all the students by passing by all the stations) with the shortest possible time. Knowing that the school building is located at the far edge of the city and the driver's house is at the other edge. Assume you are given as input the locations of all the bus stops in addition to the location of the school building and driver's house. Would you use MST or Shortest Path algorithms to solve this problem?

MST.

14- Given a certain undirected graph G. We don't know whether the graph is dense or sparse and we don't know if the graph is connected or disconnected. You are asked to write code that finds the summation of all the values/keys in the graph nodes. Would you use DFS or BFS? DFS.

15- Given a graph that has some negative weights. The minimum weight (the most negative weight) is found to be **-w**. Supposed that we go and add **+w** to all the edges of the graph so that we get rid of all the negative weights. Can we now use Dijikstra's algorithm to find the correct shortest path in the graph? Yes/No: Yes

16- The amortized cost for a search operation on an unsorted linked list is less than the amortized cost for that operation on a sorted linked-list. True/False: _____.

17- If a certain operations has two implementations, one of them is 4-competitive and the other 8-competitive. Which one of them is faster ? 4-competitive

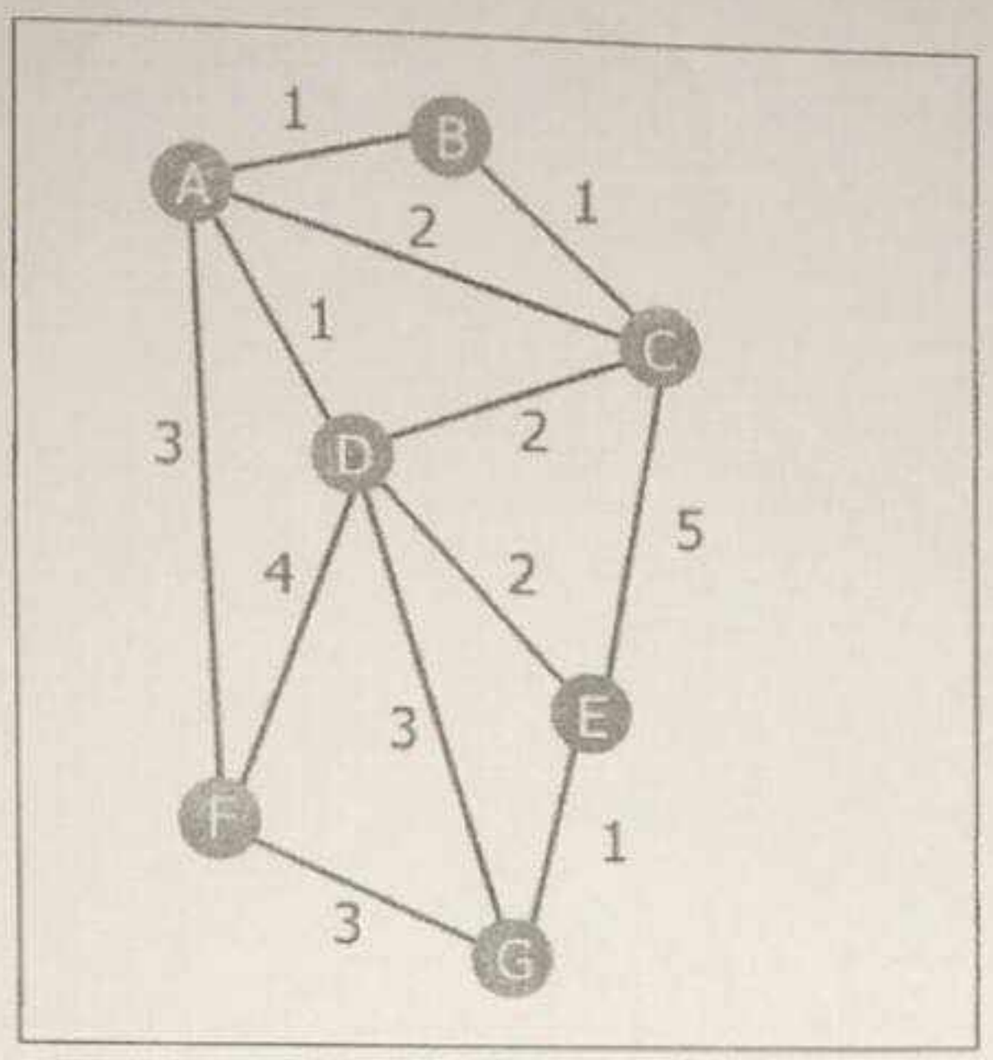
Q2 (**15 pts**) Given a sum of money V, we want to reach this sum using the minimum number of coins. Assume you have an infinite number of coins for each value. Describe an algorithm to achieve your goal. As an example, image the currency system you are dealing with has coins with values: {1, 2, 5, 10, 20, 50, 100, 500, 1000} and you are asked to provide the value 70 and the value 121.

Example 1: if V=70, then your algorithm should reach this sum of money with 2 coins only: 50 and 20

Example 2: if V=121, then your algorithm should reach this sum of money using 3 coins only: 100, 20 and 1.

using greedy algorithm

Q3 (**44 pts**) a) (**20 pts**) 1-(8 pts) 1- Show the MST for the following graph.



Node	Shortest Path	Length
A (start)		
B		
C		
D		
E		
F		
G		

2- (8 pts) Write the code for Dijkstra's algorithm below.

Slide number 15
Shortest path slide part 1

3- (2 pts) The running time for Dijkstra's algorithm assuming we use a Fibonacci heap array is: O(E+vLgv

4-(2 pts) Using a binary heap is always better than using an unsorted array in Dijikstra: T/F: F

array -> V^2
heap - > ELgV

idk if spars yes if dense no
so he said "always" so its
false

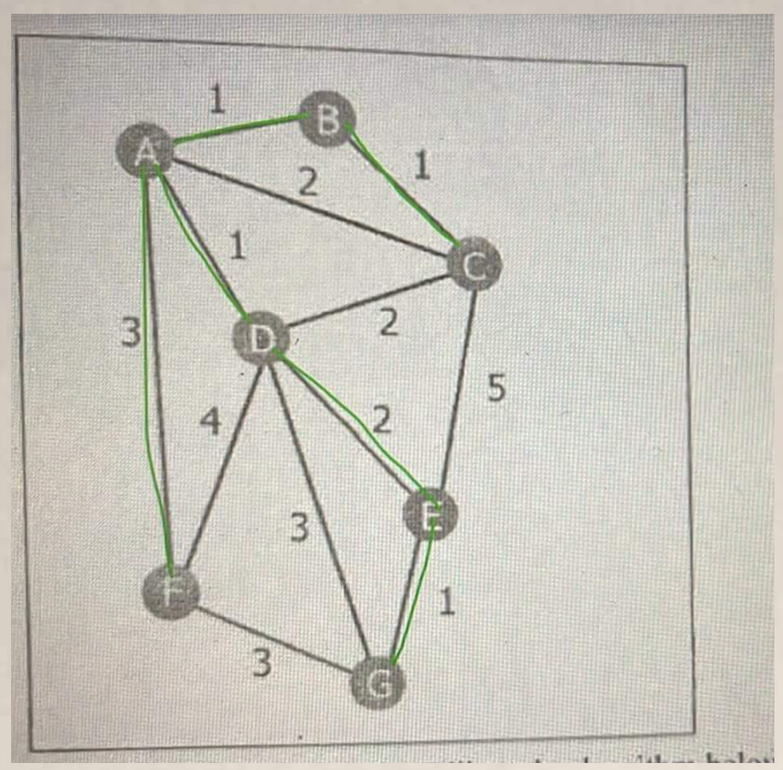
spars->V=E
dense ->E=v^2

2- (6 pts) Write the code of the algorithm you used: 5

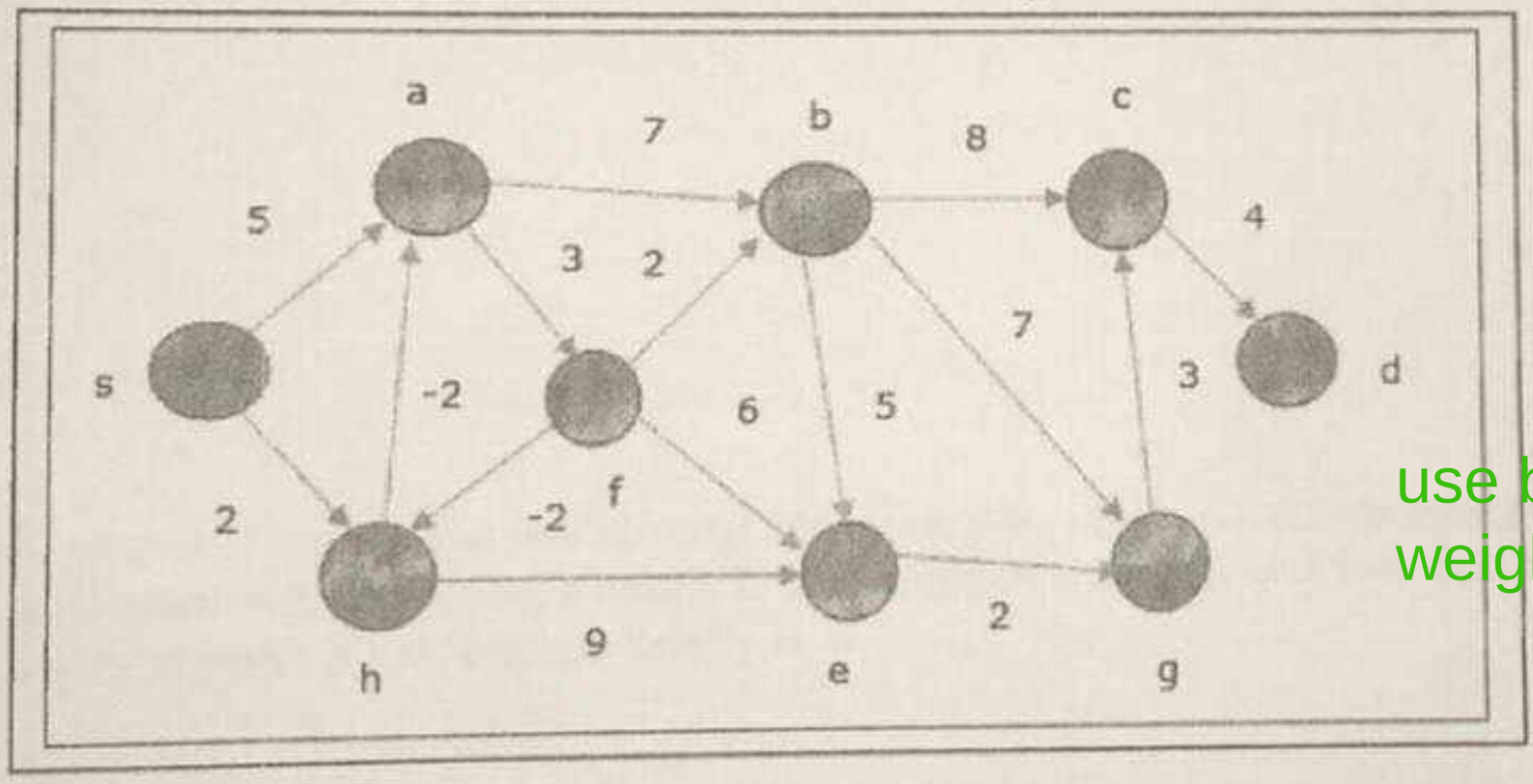
kruskal algorithm or prim
kruskal slide 9
prim slide 29

d- (4 pts) If we assume that the cost for solving the single-source shortest path problem using Dijikstra's algorithm is E.lgV (using a heap). Is it possible to achieve a cost less than V*(E.lgV) for the multi-source shortest path? If yes, explain briefly how.

b) (**8 pts**) Draw below the minimum spanning tree of the graph in branch (a).



c - **(16 pts)** 1- (10 pts) Show the Shortest Path for each of the nodes in the following graph questions using an algorithm of your choice. Assume the starting node is node **s**.



use bellman bcs negative weights

Node	Shortest Path	Length
A(start)		
B		
C		
D		
E		
F		
G		
H		

no solution theres negative weight cycle
h-a-f 3+ -2 + -2=-1