CIS 3223 MQ 7 | **Name:** Solutions

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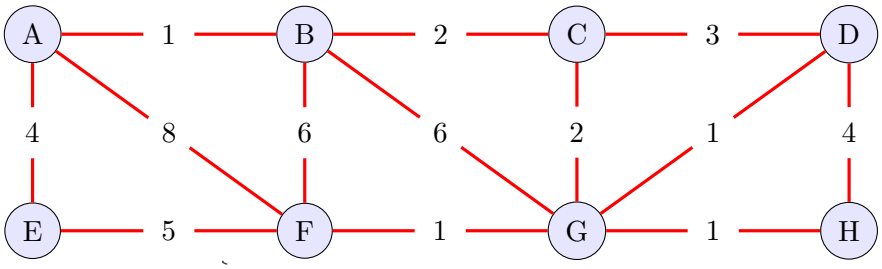
1 (9 pts) For the following graph use Kruskal's algorithm to find a **minimum**-cost spanning tree, and then determine the minimum cost. Use alphabetical ordering.



Construct a hash table using the lengths of the edges to store the edges.

Edge List (Hash Table)

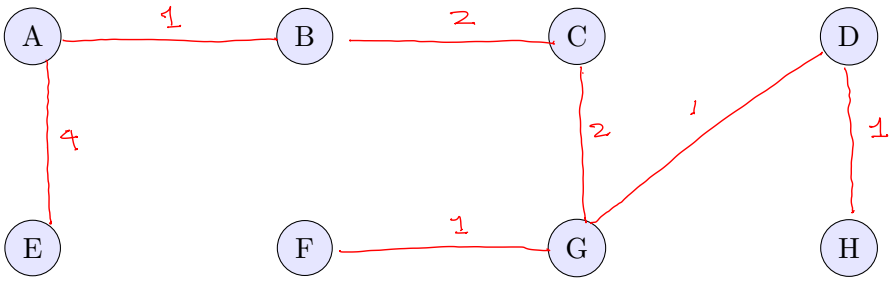
1	AB	DG	FG	GH	
2	BC	CG			
3	CD				
4	AE	DH			
5	EF				
6	BG	BF			
8	AF				

Sorted Edge List

1	AB	DG	FG	GH	
2	BC	CG			
3	~~CD~~				
4	AE	DH			
5	EF				
6	BF	BG			
8	AF				

4
4
4
12

Minimum cost spanning tree



Cost 12

2 (2 pts) If an undirected graph G has n nodes, what is the runtime for the function `find`?

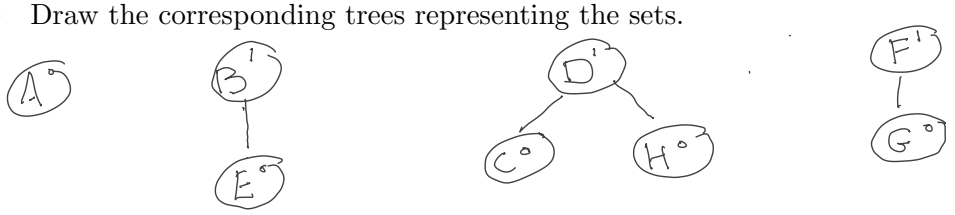
$O(\log n)$ $O(n)$ $O(n \log n)$ $O(n^2)$ $O(2^n)$

3 (9 pts) The current state S of the `union by rank` representation of disjoint subsets of the set of vertices {A, B, C, D, E, F, G, H} is given by

pi	A	B	D	D	B	F	F	D	~~B~~ H
	A	B	C	D	E	F	G	H	~~H~~

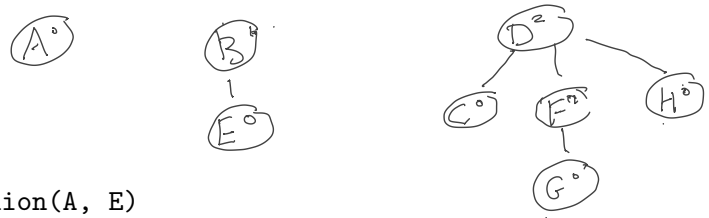
rank	0	1	0	1	0	~~0~~ 1	0	0	~~1~~ 2
	A	B	C	D	E	F	G	H	~~H~~

(a) Draw the corresponding trees representing the sets.

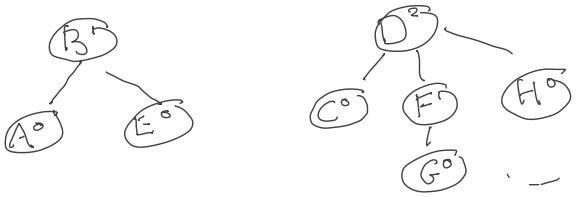


(b) Consider the following **SEQUENCE** of operations. Draw the corresponding trees representing the sets after each of the operations (use alphabetical order):

`union(C, F)` find(c) = D find(F) = F rank(D)=1 rank(F)=1 join F to D rank(D) = 2



`union(A, E)` find(A) = A, find(E) = B rank(A) = 0 rank(B) = 1 join A to B



`union(C, D)` find(C) = D find(D) = D ignore

`union(A, F)` find(A) = B find(F) = D rank(B) = 1 rank(D) = 2 join B to D