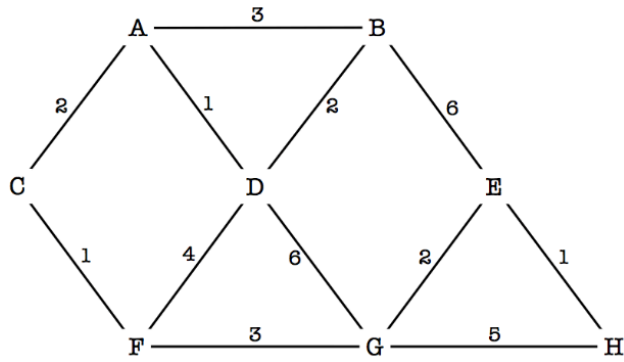
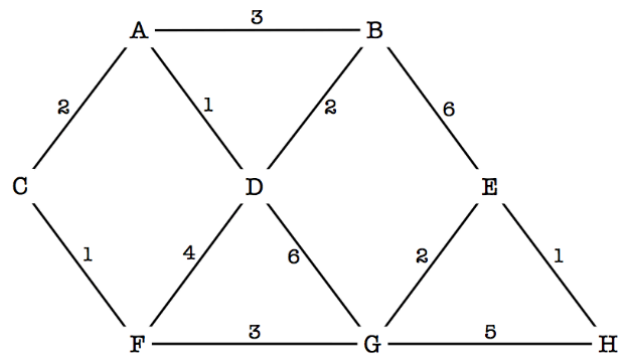


CME 2001 Data Structure and Algorithms
2016 Fall Semester
Sample Final Exam

1) (15 points) Consider the graph below. The vertices are cities and the edges show the distances between the cities. Traverse the graph starting from city A and choosing the smallest distance at each junction. List the cities in visit-order according to Depth-First Search and Breadth-First Search approaches.



2) (15 points) Use the Dijkstra's algorithm to find the shortest path distance of between city A and all the rest of the cities?



3) (15 points) Design a data structure for storing a set of integers. It should support the following operations:

- insert: add an integer to the set
- member: test if a given integer is in the set
- max: return the maximum integer from the set

You may use existing standard data structures as part of your solution – you don't have to start from scratch. Write down the data structure or design you have chosen, plus pseudocode showing how the operations would be implemented. The operations must have the following time complexities:

$O(1)$ for max,

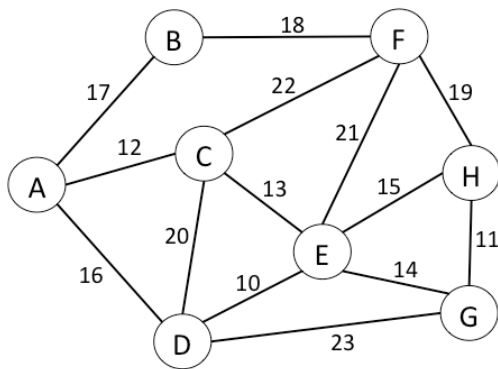
$O(n)$ for member,

$O(\log n)$ for insert,

(where n is the number of elements in the set)

4) (5 points) Give the correct order of the expressions $\log \log n$, $n\sqrt{n}$, n^4 , $n \lg n$, 2^n , \sqrt{n} , $\log n$ in asymptotically ascending order.

5) (10 points) Apply the Kruskal algorithm to find minimum spanning tree (MST) for the given graph. Write down MST edge names for each step of the algorithm. Show the final MST on the graph.



6) (10 points) Consider the array below which contains the numbers and names of some students. Consider the number as the key and name as the satellite data. Sort the array using **counting sort**. Show each step with auxiliary arrays. Show the satellite data at the final array.

Number	5	3	2	3	2	1
Name	Cem	Ali	Ece	Veli	Can	Ege

7) (10 points) Illustrate the operations of inserting the items below to a B-Tree with minimum degree $(t) = 3$. Show each step.

2,38,75,26,32,57,9,49,1,11,4.

8) (15 points) Suppose that you are asked to implement a sorting algorithm to sort some integer values. The program will be used on a real-time system in which the speed is very important and there is no memory limit. Which sorting algorithm you will choose to implement? Explain your reason(s) in detail.

9) (5 points) Which array does represent a binary **heap**? Justify your answer with the heap tree.

- A. [1, 12, 23, 10, 15, 38, 45, 15, 18, 20, 21]
- B. [1, 13, 20, 21, 65, 54, 67, 41, 30, 83, 52]
- C. [1, 8, 27, 10, 45, 83, 91, 31, 12, 52, 51]
- D. [1, 17, 30, 18, 20, 32, 57, 19, 21, 15, 27]