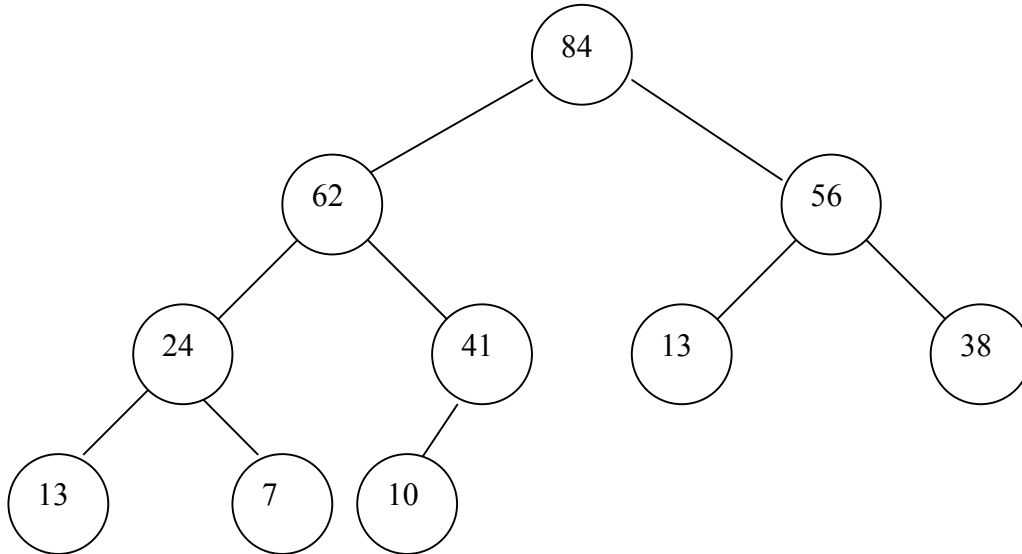


# 15-103 HOMEWORK 3 - Spring 2008

due in class on Sunday, February 3

1. Heaps are often stored in an array since there are some very simple mathematical relationships that can express where the children and parent of a node are located. For example, the heap that we used in class shown below would be stored level by level in the array as shown in the illustration. (The tree is not a BST nor is it a heap.)



1	2	3	4	5	6	7	8	9	10
84	62	56	24	41	13	38	13	7	10

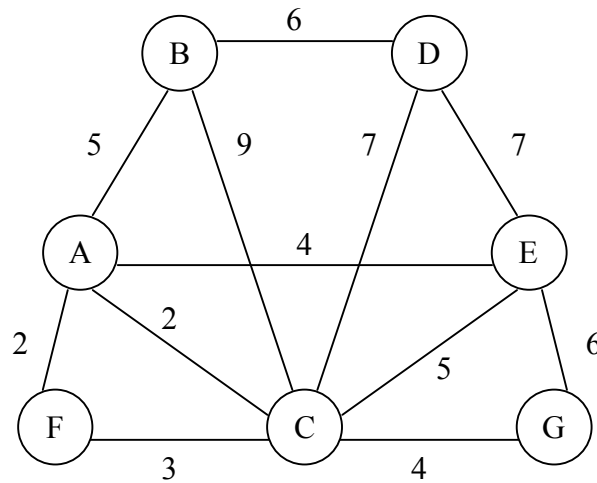
(a) In general, for any node at index  $i$  in a vector representing a binary tree, where would its left child be in the vector if it has a left child?

(b) In general, for any node at index  $i$  in a vector representing a binary tree, where would its right child be in the vector if it has a right child?

(c) In general, for any node at index  $i$  in a vector representing a binary tree (assuming  $i$  is greater than 1), where would its parent be in the vector?

Express  
your  
answers  
in terms  
of  $i$ .

2. Show how the following graph is stored using an adjacency matrix and using adjacency lists.



3. Using the graph shown in problem 2, trace the minimal spanning tree (MST) algorithm discussed **in class**, showing which edges of the graph would be chosen for the MST in the order that they are chosen. Also, give the total cost of the MST.

4. Develop an EBNF for specifying temperature (sample temperatures that you should be able to capture: 39F, -1C, 12°, 105°F).

5. The following questions relate to our discussion of compilers:

(a) Compilers perform what task (i.e., tell me what they take as input and what they produce as output)?

(b) The computer processor can only execute instructions that are in what language?

(c) Can a compiler compile itself? (yes or no is not an acceptable answer – provide some explanation)

(d) When running a Java program, the commands *javac* and *java* are invoked (transparently if you're using an IDE). Explain what *javac* and *java* do in this process.