COMP3506/7505: Special Exercise Set 7

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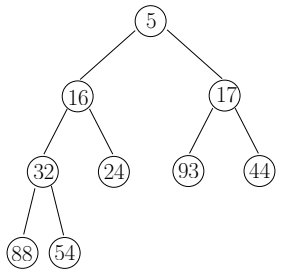
Problem 1. Show the priority queue after inserting the number 3 into the binary heap below:



Problem 2. Show the priority queue after performing a delete-min on the binary heap shown in the above figure.

Problem 3. Suppose that we store the binary heap shown in Problem 1 in an array of length 9. Show the contents of the array.

Problem 4. Consider the following array A of length 9. Suppose that we create a binary heap using the $O(n)$-time algorithm discussed in the class. Show the contents of A at the end of the algorithm.

83	21	66	5	24	76	92	32	43

Problem 5. Show the binary heap after inserting the following integers (in this order): 10, 9, 8, 7, 6, 5, 4, 3, 2, and 1 (you should use the regular insertion algorithm).

Problem 6. Let S be a dynamic set of integers. At the beginning, S is empty. Then, new integers are added to it one by one, but never deleted. Let k be a fixed integer. Describe an algorithm to maintain the k largest integers in S. Your algorithm must use $O(k)$ space at all times, no matter how large $|S|$ is (note that $|S|$ increases continuously, but your space cannot). Furthermore, it must process every integer insertion in $O(\log k)$ time.

For example, suppose that $k = 3$, and that the sequence of integers inserted is 83, 21, 66, 5, 24, 76, 92, 32, 43... Your algorithm must be keeping $\{83, 66, 24\}$ after the insertion of 24, $\{83, 66, 76\}$ after the insertion of 76, and $\{83, 76, 92\}$ after the insertion of 43.