CSE220: Midterm Exam

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Your answers should be brief and to the point. If you think you are having difficulty, don't panic. Move to another problem and do your best. Good luck!

Problem 1: 6 pts Construct a **binary heap** containing the items $10, 2, 9, 16, 8, 6, 1, 3, 12$. Give the final structure only.

Problem 2: 4 pts For each of the following statements state whether it is True or False (You do NOT need to provide any proof).

- $n^2 = O(n^3 - \sqrt{n})$
- $\frac{1}{n} = O(\log n)$
- $n^3 = o(n^2 + n\log n)$
- $\sqrt{n}\log n = o(n)$

Problem 3: 10 pts Let A be an n-element array. Design and analyze a divide-and-conquer algorithm for finding the maximum value in an array A.

Problem 4: 10 pts What is the running time of **insertion sort** on presorted input with all distinct elements? Answer the same question for **quicksort**.

Problem 5: 10 pts You are given a list S of n integers and another integer x. You need to find out whether or not there exist two elements in S whose sum equals x. Design and analyze an efficient algorithm to do this. You can assume that storage is not a problem in this case. For full grade you must give a $O(n)$ algorithm. You can either give a $O(n)$ average case complexity or a $O(n)$ worst case complexity algorithm.

Problem 6: 10 pts Professor Takis claims that he has designed an implementation of a stack S that supports the following operations.

- $Push(S, x)$: usual push
- $Pop(S, x)$: usual pop
- $DeleteMin(S)$: remove from S the minimum element

He further tells you that he uses linked list based insertion, deletion and subsequent comparisons to implement the special stack. He claims that all the operations take $O(1)$ time. Do you believe him? Justify your answer.