

CSCI 385 Data Structures and Algorithms  
Final Exam  
Fall 2003

- Please answer all questions carefully and thoughtfully.
  - Please number each question.
  - Please place your name on each page.
  - Any answer, other than a definition, should an indication on how you obtained your answer, or a justification for the answer given.
  - Please staple you help-sheet as the last page of the test. I will take off 5% if you fail to do this.
1. (3 pts) State the definition for  $O(f(n))$ , (ie  $f(x) \in O(g(x))$  if ...)
  2. (12 pts) Describe the classes P, NP, NP-COMPLETE, AND NP-HARD, give an example of a problem that is in each of these classes. Draw a venn-diagram that represents one possible arrangement of these classes.
  3. (5 pts) Argue that finding the **convex hull** of a set of points is  $\Omega(n \lg(n))$ .
  4. (15 pts) Red Black Trees
    - (a) What is a red-black tree?
    - (b) Describe what one wishes to achieve when one employs a red-black tree.
    - (c) Give the red-black properties.
    - (d) Describe how each property is used to achieve the goals of a red-black tree.
    - (e) Discuss the performance of a red-black tree.
  5. (5 pts) Describe the difference between a red-black tree and an AVL tree.
  6. (10 pts) Heaps
    - (a) Give the definition of a heap, including the heap order property.
    - (b) Draw a valid heap that includes at least 8 different values according to your definition.
    - (c) Give an algorithm to insert an item into a heap.
  7. (5 pts) Describe heapsort. Discuss it's implementation, data structure and performance. Is it in place?, stable?

8. (10 pts) What is a graph? Give two different data structures which can be used to implement a graph in C/C++. Describe when each should be used.
9. (10 pts) Professor Qulis has asked you to write a program that takes simple combinational circuit and determines if there is an input to the circuit that produces a 1. He estimates that there will be between  $10^3$  and  $10^{10}$  gates in this circuit. He is willing to pay you \$1,000 to write this program, but only if it works in an "reasonable" amount of time. Should you accept this job? If so what conditions do you place on your employment? Your answer should be justified by material studied in this class.