Dept. of Computer Science and Engineering, National Sun Yat-sen Univ.

2015 (July) PhD Qualifying Exam. Computer Algorithms

1. Suppose we obtain the following recurrence formula of time complexity for solving a problem:
   $T(n)=b$, if $n \leq 2$
   $T(n)=2T(n/2)+cn^2$, if $n > 2$,
   where n is the input size of the solved problem. Please derive the time complexity and represent it with O notation. (15%)

2. Design an algorithm to find both the *minimum* and the *maximum* of n elements with at most $\lceil 3n/2 \rceil$ comparisons. (15%)

3. Present an algorithm for solving the *minimum spanning tree* problem of a graph. And analyze the time complexity of your algorithm. (15%)

4. In the searching strategy, explain *breadth-first search*, *depth-first search*, *best-first search* and *hill climbing*. (10%)

5. I n the self-organizing sequential search heuristics, what are the *transpose heuristics*, *move-to-front heuristics* and *count* heuristics? (15%)

6. Prove that the *clique* decision problem polynomially reduces to the *node cover* decision problem. (15%)

7. There are 9 rows in the magic triangle, where row i has i cells, shown as follows. The number in each cell is the sum of the two cells below it. For example, 255 is the sum of the two cells in row 2, not shown in the figure. Please calculate all missing numbers and fill in the triangle. Your answer has been written in 9 rows, each row (from left to right) corresponds to one row of the triangle, from top to bottom. Note your answer must include the numbers already in the figure. (15%)