Department of Computer Science and Engineering
National Sun Yat-sen University
First Semester of 2022 PhD Qualifying Exam

Subject：Algorithms

1. Explain the following terms: *minimum spanning tree*, *optimal binary search tree*. (10%)
2. Explain the *breadth-first* search, *depth-first* search, and *best-first* search in the tree searching strategies. What data structures are used for them? (15%)
3. Given a set of symbols with their individual occurrence frequencies, please give the *Huffman algorithm* to establish the *Huffman codes* for them. (15%)
4. The *divide-and-conquer* strategy can be used to solve some geometry problems efficiently. Please give the *merging* process in the divide-and-conquer method for solving the *Voronoi diagram* problem. (15%)
5. Prove that the *Hamiltonian cycle* decision problem polynomially reduces to the *travelling salesperson* decision problem. (15%)
6. The *sorting* problem is to organize the order of the given elements so that the sorted sequence is either increasing or decreasing. Please rewrite the sorting problem as an optimization problem. (10%)
7. (a) Please present an approximate algorithm for solving the *node cover* problem of a graph G = (V, E). (10%)

   (b) Please give the *approximation ratio* and prove the ratio. Let N denote the solution (node cover) obtained from your algorithm and C be the size of the optimal solution (node cover). Show that $|N| \leq 2C$. (10%)