

Department of Computer Science and Engineering
National Sun Yat-sen University
Second Semester of 2025 PhD Qualifying Exam

Subject : Algorithms

1. Explain each of the following terms: *NP-complete*, *Hamiltonian cycle of a graph*, *2-D ranking problem*, *0/1 knapsack problem*, *branch-and-bound*. (25%)
2. (a) Explain the *topological ordering* problem in a graph, and provide an example to illustrate your answer. (5%)
(b) Present an algorithm for solving the above problem. Analyze the time complexity of your algorithm. (10%)
3. (a) Explain the *longest common subsequence* problem, and provide an example to illustrate your answer. (5%)
(b) Give the *dynamic programming* approach for solving the above problem. Be sure to include the boundary conditions in your algorithm. (10%)
4. (a) Describe the *first-fit* approximation algorithm for solving the *bin packing* problem. (5%)
(b) Prove that the number of bins used in the first-fit algorithm is at most twice the number required by an optimal solution. (10%)
5. (a) Explain the three heuristics of self-organizing sequential search: *transpose*, *move to front*, *count*. (9%)
(b) What is the *pair-wise independent* property in *move to front*? (6%)
6. Prove that the *clique* decision problem in a graph polynomially reduces to the *node cover* decision problem. (15%)