

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

Subject : Algorithms

1. Explain each of the following terms: *NP-complete*, *2-D ranking* problem, *0/1 knapsack* problem. (15%)
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. (a) Explain the *longest common subsequence* (LCS) problem with an example. (10%)
(b) Present the *dynamic programming* method for calculate the LCS length and analyze the time complexity. (10%)
4. Prove that the *sum of subset decision* problem polynomially reduces to the *partition* problem. (15%)
5. The *quadratic selection sort* is described as follows: Divide the n input elements into k groups of k elements each, where $k = \sqrt{n}$. Find the largest element of each group and insert it into an auxiliary array a . Find the largest of the elements in a . This is the largest element of the file. Then replace this largest element in a by the next largest element of the group from which it came. Again, find the largest element in a . This is the second largest element of the file. Repeat the process until the file has been sorted. Use the following 16 elements to explain how this algorithm works: 14, 5, 3, 8, 13, 15, 2, 9, 10, 4, 1, 6, 16, 7, 11, 12. (15%)
6. (a) The *first-fit* algorithm is a simple approximation algorithm for solving the *bin packing* problem. Please present the first-fit algorithm. (10%)
(b) Show that the number of bins resulting from the *first-fit* algorithm is no more than twice the number of bins required in an optimal solution. (10%)