

長庚大學 102 學年度第二學期電機系博士班演算法資格考

1. Please write down your student ID and name on the answer sheet.
 2. Please indicate the number of each your answer that is relative to the problem.
 3. Any form of cheating will lead to fail.
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Please select five problems to answer. Total score of this exam is 100. Maximum deduction of 20 points for each problem that you answer.

1. Please describe any algorithm you know that use dynamic programming to solve all pairs shortest paths problem. And please describe the time complexity need for the algorithm you answer.
2. Suppose a data file contains a sequence of 8-bit characters such that all 256 characters are about as common: the maximum character frequency is less than twice the minimum character frequency. Prove that Huffman coding in this case is no more efficient than using an ordinary 8-bit fixed-length code.
3. Please explain what is bucket sort? And please explain the time complexity of bucket sort if we have n integers and m buckets. (The variation of the n integers is m).
4. For a sequence of operations to be performed on a data structure, the i_{th} operation costs i when i is an exact power of 2, costs 1 otherwise. Show that the cost after n operations is $O(n)$. (Amortized Analysis)
5. Describe an algorithm that, given n integers in the range 0 to k , preprocesses its input and then answers any query about how many of the n integers fall into a range $[a..b]$ in $O(1)$ time. Your algorithm should use $\theta(n + k)$ preprocessing time.
6. Please describe any possible modification of insertion sort to let its worst case is $O(n \log n)$, please proof it.
7. In the longest-common-subsequence problem, we are given two sequences $X = \langle x_1, x_2, \dots, x_m \rangle$ and $Y = \langle y_1, y_2, \dots, y_n \rangle$ and try to find a maximum-length common subsequence of X and Y . The LCS problem can be solved efficiently using dynamic programming. Please show the optimal substructure of an LCS and prove its correctness.