

Dept. of Computer Science and Engineering, National Sun Yat-sen Univ.
2015 (January) PhD Qualifying Exam. Computer Algorithms

1. [30%] Use Quick Sort to sort the ten integers (12, 4, 21, 3, 29, 7, 9, 25, 10, 17). You should show the detailed steps of the sorting process or get no credit.
2. [30%] The number of comparisons required for the linear two-way merge algorithm is not greater than t_1+t_2-1 where t_1 and t_2 are the lengths of two sorted lists, respectively. The problem: There are eight sorted lists of lengths 7, 12, 5, 20, 10, 8, 4, and 13, respectively. What is the optimal sequence of merging process to merge these eight lists into one sorted list?
3. [20%] Let p be a k -bit prime shared by A and B , and they keep p confidential. Please design a randomized algorithm for interactive proofs based on quadratic residues (QR) such that B can be convinced that A is the real A with probability $1-2^{-k}$ after performing the interactive algorithm successfully.
4. [20%] Let A be a machine that can solve $f(x) = 0$, i.e., A can output all possible values of x such that $f(x) = 0$. Assume that A can solve $f(x) = 0$ for any polynomial $f(x)$ with degree less than n , but cannot solve $f(x) = 0$ if $f(x)$ is with degree not less than n , where n is an integer greater than 3. Please construct a machine B using A such that B can solve $(x^2-1)(g(x)h(x)-(x^2-1)g(x)) = 0$ where $g(x)$ and $h(x)$ are two polynomials with degrees $n-1$ and $n-2$, respectively.