重庆理工大学本科生课程考试试卷

2019 ～ 2020 学年第 2 学期

课程名称 Introduction to algorithms 开课学院 Computer Science 考试时长 120 分钟

班级 6201703L1 考生姓名 学号 卷（A）考核方式 卷（闭卷）

1. (5pts * 5) Solve the following recurrence relation and give a Θ bound for each them.

(1) $T(n) = 2T(n/3) + 1$

(2) $T(n) = 4T(n/2) + n^2$

(3) $T(n) = 8T(n/3) + n^3$

(4) $T(n) = T(n-1) + 2$

(5) $T(n) = 2T(n/3) + nlogn$

2. (25 pts) Suppose you are choosing between the following three algorithms:

Algorithm A solves problems by dividing them into five subproblems of half the size, recursively solving each subproblem, and then combining the solutions in linear time.

Algorithm B solves problems of size n by recursively solving two subproblems of size n - 1 and then combining the solutions in constant time.

Algorithm C solves problems of size n by dividing them into nine subproblems of size n=3, recursively solving each subproblem, and then combining the solutions in $O(n^2)$ time.

What are the running times of each these algorithms(in big-O) notation, and which would you choose?

3. (25pts) Consider the following knapsack problem instance in dynamic programming:

(1) Show the tables for knapsack with repetition and for the knapsack without repetition.

(2) Write the algorithm of knapsack without repetition using dynamic programming.

Item	Weight	Value
1	6	$30
2	3	$14
3	4	$16
4	2	$9

4. (25pts) Palindromic Subsequence. A subsequence is *palindromic* if it is the same whether read left to right or right to left. For instance, the sequence A,C,G,T,G,T,C,A,A,A,A,T,C,G has many palindromic subsequences, including A,C,G,C,A and A,A,A,A (on the other hand, the subsequence A,C,T is *not* palindromic).

(1) Devise an algorithm in a pseudocode that takes a sequence $x[1,\cdots,n]$ and returns the length of the longest palindromic subsequence using a 2-dimensional table. Its running time should be $O(n^2)$.

(2) Show its running time is $O(n^2)$.