CSC 6580 – Design and Analysis of Algorithms

Homework 5

Due date: 04/14/2020 Tuesday (online through Canvas)

Guideline: Please submit your homework as a single PDF file. Include your name in the file name.

Total points: 100

Problem 1 (10+10=20 points)
(i) Write an O(*h*) time procedure for finding the predecessor of a key in a binary search tree of height *h*.
(ii) Prove that a red-black tree with *n* nodes has height of O(log n).

Problem 2 (10+10=20 points)
Prove that **(i)** the fractional knapsack problem has the greedy-choice property, and **(ii)** the 0/1-Knapsack problem does not have the greedy choice property.

Problem 3 (30 points)
Give a dynamic-programming solution to the 0/1-Knapsack problem that runs in O(n.W) time, where *n* is the number of items and W is the maximum weight of items that the thief can put in his knapsack.

Problem 4 (30 points)
Consider simple hash table insertions into a dynamic hash table whose initial size is 1. The size of the table is doubled whenever it becomes full. This is done by allocating memory for a new table whose size is twice the size of the old table, and then by copying the contents of the old table to the new one and by freeing the old table. Use amortized analysis to show that the insertion operation has complexity O(1).