Assignment 6

SFWRENG 2CO3: Data Structures and Algorithms–Winter 2024

Deadline: February 29, 2024

Department of Computing and Software
McMaster University

Please read the *Course Outline* for the general policies related to assignments.

Plagiarism is a *serious academic offense* and will be handled accordingly.
All suspicions will be reported to the *Office of Academic Integrity*
(in accordance with the Academic Integrity Policy).

This assignment is an *individual* assignment: do not submit work of others. All parts of your submission *must* be your own work and be based on your own ideas and conclusions. Only *discuss or share* any parts of your submissions with your TA or instructor. You are *responsible for protecting* your work: you are strongly advised to password-protect and lock your electronic devices (e.g., laptop) and to not share your logins with partners or friends!

If you *submit* work, then you are certifying that you are aware of the *Plagiarism and Academic Dishonesty* policy of this course outlined in this section, that you are aware of the Academic Integrity Policy, and that you have completed the submitted work entirely yourself. Furthermore, by submitting work, you agree to automated and manual plagiarism checking of all submitted work.

Late submission policy. Late submissions will receive a late penalty of 20% on the score per day late (with a five hour grace period on the first day, e.g., to deal with technical issues) and submissions five days (or more) past the due date are not accepted. In case of technical issues while submitting, contact the instructor *before* the deadline.

Problem 1. Consider the sequence of values $S = [3, 42, 39, 86, 49, 89, 99, 20, 88, 51, 64]$.

P1.1. Draw the *left-leaning* red-black tree obtained by adding the values in S in sequence. Show each step.

P1.2. Consider the hash function $h(x) = (x + 7) \bmod 13$ a hash-table of 13 table entries that uses hashing with separate chaining. Draw the hash-table obtained by adding the values in S in sequence. Show each step.

P1.3. Consider the hash function $h(x) = (x + 7) \bmod 13$ a hash-table of 13 table entries that uses hashing with linear probing. Draw the hash-table obtained by adding the values in S in sequence. Show each step.

Do *not* spend time drawing beautiful trees or tables: a clear textual representation is good enough.

Problem 2. Consider a list L of N sorted values. Show how to construct a *valid* left-leaning red-black tree holding the values in L in $\Theta(N)$.

Problem 3. Consider a set of strings S. We want to figure out whether S has duplicates efficiently. We do not want to do so by sorting S and then checking for duplicates: comparing strings can be a lot of work (e.g., they might differ in only a single character).

Assume that you have a hash function h that can compute a suitable hash code for any string $s \in S$ in $O(|s|)$. Show how one can use hashing to find whether S has duplicates without performing many comparisons between strings. Your algorithm should have an expected runtime of $O(|S|)$ in which $|S| = \sum_{s \in S} |s|$ represents the total length of all strings in S.

Assignment Details

Write a report in which you solve each of the above problems. Your submission:

1. must start with your name, student number, and MacID;
2. must be a PDF file;
3. must have clearly labeled solutions to each of the stated problems;
4. must be clearly presented;
5. must *not* be hand-written: prepare your report in LaTeX or in a word processor such as Microsoft Word (that can print or export to PDF).

Submissions that do not follow the above requirements will get a grade of zero.

Grading

Each problem counts equally toward the final grade of this assignment.