

CS2223: Algorithms

D-Term, 2013

Assignment 3

Teams: To be done individually

Release date: 04/04/2013

Due date: 04/11/2013 (11:59 PM)

Submission: Electronic submission only

General Instructions

- ***Executable vs. Pseudocode:*** Each question will explicitly state whether the deliverable is pseudocode or an executable program that the TA will run to give you a grade.
- ***Programming Language:*** If a question asks you to write an executable program, then choose a language of your choice, but make it clear in your report:
 - How to compile your program
 - How to execute it and with what arguments
- ***Submissions:*** The submission of Assignment 3 must be done electronically through blackboard system. All programs plus your report (.doc, .docx, or .pdf) should be zipped into a single file and that is the file to submit.

Question 1 [10 Points]

Given an array of unsorted positive and negative values of size N . For example $[10, 20, -5, -15, 11, -4, -30, 25, \dots]$. We need to find the two indexes i , and j where the sum of the values between these two indexes (inclusive) is the largest.

That is, denote by $\text{Sum}[i,j]$ the sum of the values between i, j (inclusive), and we want the indexes where there “ $\text{Sum}[]$ ” is the largest.

Write a pseudocode for an algorithm to solve the problem above in $O(N)$. In this question, you only need to sketch the algorithm and analyze it to show it is $O(N)$ time complexity.

Question 2 [25 Points]

2.1) [5 Points] Solve Problem 12.2-1 in your textbook (Page 293). In your report indicate the reason for your choice.

2.2) [10 Points] Assume a binary tree where each node has two fields, a unique ID, and a Value (positive or negative). We need to find the node X where the sum of all values in its subtree (including X) is the maximum.

- a) You are asked in this question to sketch a pseudocode for a recursive algorithm that reports the ID of node X .
- b) Analyze your algorithm and state its time complexity.

2.3) [10 Points] Related to binary trees:

- a) **True or False: Given any two distinct traversal types (In-, Pre-, Post-)Orders of a binary tree, we can construct the binary tree?**
- b) **Given the following Pre-Order and In-Order traversals of a tree, construct the tree (draw it in your report). If you think it cannot be done, then state so.**

Pre-Order: 10, 3, 5, 4, 15, 7, 8, 2, 9, 20

In-Order: 4, 5, 3, 15, 10, 2, 8, 7, 9, 20

Question 3 [20 Points]

3.1) [5 Points] What is optimal Huffman coding for the following characters, given their frequencies as follows:

a: 3, b: 20, c: 100, d: 50, e: 10, f: 20, g: 5, h: 8

Show in your report the Huffman tree and the final encoding of each character.

3.2) [15 Points] Write an executable code that implements Huffman Code algorithm given in class (also in Book 16.3). The program has two modes “encoding” (compressing) and “decoding” (decompressing).

Encoding Mode:

- Your program should accept three input parameters, e.g.,
> ExecMyProgram Encode <input_file_path_to_compress> <path_of_output_file>
- Your code should compress the file and produce the output to the given <path_of_output_file> location
- For this mode, the TA will check the size of the compressed file to check if it matches the expected compressed size.

Decoding Mode:

- Your program should accept three input parameters, e.g.,
> ExecMyProgram Decode <input_file_path_to_decompress> <path_of_output_file>
- Your code should decompress the input file and produce the output to the given <path_of_output_file> location.
- For this mode, the TA will apply a diff command to compare the original file with the output file (they should match)..

Note: You can keep the coding table (Huffman Tree) in memory between the encoding and the decoding, or you can write it to disk a place known to your program.

Question 4 [10 Points]

Solve Problems 16.1-2 and 16.1-3 in your textbook (Page 422).