CSE 3500 – Algorithms and Complexity Homework 6

Question 1 (40 points)

Find the solution to the given recurrence. If applicable, make use of the Master Theorem. Present the process step by step.

(a)
$$T(n) = 16T(n/4) + n^2$$

(b)
$$T(n) = 7T(n/2) + n^2$$

(c)
$$T(n) = 4T(n/2) + n^2\sqrt{n}$$

(d)
$$T(n) = T(n-1) + 1$$

Question 2 (20 points)

You are given an array where the values in the array increase up to a certain position p (peak point) and then decrease from position p to the end of the array.

Example:

Input: Array A = [1, 2, 3, 4, 5, 4, 3, 2, 1]

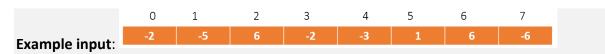
Output: Peak point: 5

Your goal is to write a divide and conquer algorithm to identify the peak point p. Your algorithm should achieve a time complexity better than O(n), where n is the number of elements in the array.

- a. Write a clear divide and conquer algorithm to solve the problem.
- b. Provide the recurrence relation that describes the time complexity of your algorithm.
- c. Analyze the time complexity of your algorithm. If applicable, use the Master Theorem.

Question 3 (40 points)

The maximum sum subarray problem involves finding the contiguous subarray within an array of integers that has the largest sum. Given an array of integers, you need to design a divide and conquer algorithm to find the maximum sum of a subarray.



Output: maximum sum subarray = 8 (from index 2 to index 6)

Task: Research the algorithm and make sure that you fully understand the problem:

- a. Provide a high-level explanation of how the divide and conquer approach is used to tackle this problem.
- b. Write the algorithm.
- c. Provide the recurrence relation that describes the time complexity of your algorithm.
- d. Analyze the time complexity of your algorithm. If applicable, use the Master Theorem.

Additional Guidelines:

- You can assume that the input is a one-dimensional array of integers.
- Your algorithm should divide the problem into smaller subproblems, solve them recursively, and combine their results to find the maximum subarray.
- Pay close attention to the divide and merge steps in your algorithm.
- Explain the key components of your algorithm and how it ensures the correct maximum subarray is found.