Homework 04

CS 624, 2024 Spring

1. Problem 16.1-3 on p422.

   Not just any greedy approach to the activity-selection problem produces a maximum-size set of mutually compatible activities.

   (a) Give an example to show that the approach of selecting the activity of least duration from among those that are compatible with previously selected activities does not work.

   (b) Do the same for the approach of always selecting the compatible activity that overlaps the fewest other remaining activities.

   (c) Do the same for the approach of always selecting the compatible remaining activity with the earliest start time.

2. Problem 16.2-5 on p428.

   Describe an efficient algorithm that, given a set $\{x_1, x_2, \ldots, x_n\}$ of points on the real line, determines the smallest set of unit-length closed intervals that contains all of the given points. Argue that your algorithm is correct.

3. Problem 16.3-3 on p436.

   What is an optimal Huffman code for the following set of frequencies, based on the first 8 Fibonacci numbers?

   $$a : 1 \quad b : 1 \quad c : 2 \quad d : 3 \quad e : 5 \quad f : 8 \quad g : 13 \quad h : 21$$

   Can you generalize your answer to find the optimal code when the frequencies are the first n Fibonacci numbers?

4. Problem 17.2-3 (p459)

   Suppose we wish not only to increment a counter but also to reset it to zero (i.e., make all bits in it 0). Counting the time to examine or modify a bit as $\Theta(1)$, show how to implement a counter as an array of bits so that any sequence of n INCREMENT and RESET operations takes time $O(n)$ on an initially zero counter. (Hint: Keep a pointer to the high-order 1.)

5. Problem 17.3.6 (p463)

   Show how to implement a queue with two ordinary stacks (Exercise 10.1-6) so that the amortized cost of each ENQUEUE and each DEQUEUE operation is $O(1)$.