Homework Assignment No. 3

CSCI 4470/6470 Algorithms, CS@UGA, Fall 2019

Due Monday September 30, 2019

Four questions with total **120** *points.*

Homework submission should be in hardcopy. If for a reason an email submission is necessary, it needs an approval from this instructor. Submission needs to be received by 5:00pm on the due day.

1. (**30 points**) Consider the following decision problem Graph 3-Coloring:

   Input: a graph $G = (V, E)$;
   Output: "**Yes**" iff the vertices in V can be colored with 3 colors,
   i.e., iff there is a mapping function $c : V \to \{B, R, Y\}$ with the constraint:

   $$\forall (u, v) \in E,\ c(u) \neq c(v)$$

   Design an exhaustive search algorithm (either iterative or a recursive) to solve problem Graph 3-Coloring. What is the time complexity upper bound and lower bound *for your algorithm*?

2. (**30 points**) Consider the Assembly Line Scheduling problem (LectureNote3.pdf). Compute the dynamic programming table for the assembly line in Figure 1. For every cell in the table, label it with an arrow to show where its value is calculated from. You can choose to write a program to compute or manually calculate for the table.

3. (**30 points**) Consider the Casino Dice Decoding Problem (ref. Chapter 15, Example-2 in LectureNote3.pdf), which computes the most probable sequence of dice used to roll the input sequence of digits (between 1 and 6). Note that the problem resembles the Assembly Line Scheduling problem.

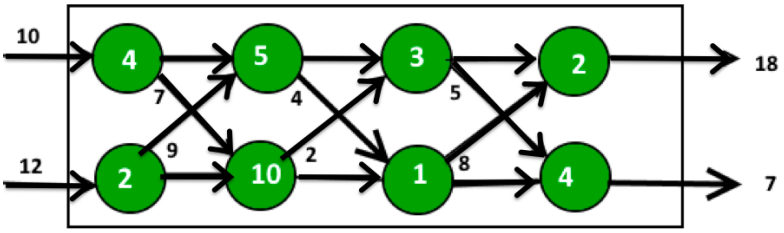

Figure 1: Assembly-line for **Q**2

Let the input sequence of digits be $S = 6662451$, fill out a dynamic programming table that computes functions $p(S, i, F)$ and $p(S, i, L)$ for sequence of digits $S = 6662451$. You can choose to write a program to compute or manually calculate for the table. Label each cell in the table with an arrow to show where its value is calculated from.

What is the most probable sequence of dice used to roll these 7 digits?

4. (**30 points**) Fill out a dynamic programming table that computes for the **0-1 knapsack problem** on the following input data: $B = 6$, $i = 1, 2, 3, 4$. Label each cell in the table with an arrow to show where its value is calculated from.

$$\begin{cases} s_1 = 3, v_1 = 70 \\ s_2 = 3, v_2 = 80 \\ s_3 = 4, v_3 = 100 \\ s_4 = 2, v_4 = 55 \end{cases}$$

The answers must be word-processed or typed. You may substitute formulae and figures with hand-writings. Your submitted algorithms should be in the pseudo-code, not in any specific programming language. Answers deviating from these requirements will be returned without grading.

The answers must be the student's own work. Idea sharing and referencing to others' work (including those online) are not allowed. Plagiarism and other forms of academic dishonesty will be handled within the guidelines of the Student Handbook and reported to the University.