Algorithms Assignment 4, [17.5 Points]
Due November 29th$^{\text{th}}$, 2020 @ 23:30

Your name goes here

November 9, 2020

I declare that all material in this assessment task is my work except where there is clear acknowledgement or reference to the work of others. I further declare that I have complied and agreed to the CMU Academic Integrity Policy at the University website.

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Submissions that do not include the above academic integrity statements will not be considered.

Student Name: Your name here UID: Your UID here Date: November 9, 2020

Task description

Your assignment should represent your own effort. However, you are not expected to work alone. It is fine to discuss the exercises and try to find solutions together, but each student shall write down and submit his/her solutions separately. Please acknowledge collaborators, so if you worked together with classmates list their names. You must be prepared to present your solution to the class. If you are not able to explain your solution, this will be considered as if you had not done your work at all.

You must write up your answers using a word processing system like LaTeX or other PDF editing tools. Experience shows that Word is in general difficult to use for this kind of task as such no ".doc(x)" will be considered only PDF. For a programming task, your solution must contain:

1. An explanation of your solution to the problem

2. The C++ code, in a form that compiles with g++ or clang command and runs error and warning free

3. Instructions how to run it

4. No blacklist but the fib compute code must be your own not a lib function - the chrono namespace and library is recommended for the timer.

1 Task 1. Q and A - 10 points

1. What does dynamic programming have in common with divide-and-conquer? What is a principal difference between them?

2. Solve the instance 5, 1, 2, 10, 6 of the coin-row problem.

3. Show that the time efficiency of solving the coin-row problem by straightforward application of recurrence (8.3) is exponential.

4. Show that the time efficiency of solving the coin-row problem by exhaustive search is at least exponential.

5. Design a linear-time algorithm that finds a solution to the n-queens problem for any n ≥ 4

6. Apply backtracking to the problem of finding a Hamiltonian circuit in the following graph
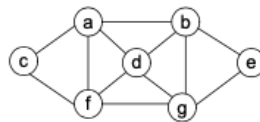
7. Give an example of the best-case input for the branch-and-bound algorithm for the assignment problem.

8. In the best case, how many nodes will be in the state-space tree of the branch-and-bound algorithm for the assignment problem

9. Solve the following instance of the knapsack problem by the branch-and-bound algorithm: item weight value

item	weight	value	
1	10	$100	
2	7	$63	$W = 16$
3	8	$56	
4	4	$12	

10. Apply Horspool's algorithm to search for the pattern BAOBAB in the text BESS KNEW ABOUT BAOBABS

11. Design a greedy algorithm for the assignment problem (see Section 3.4).

    Does your greedy algorithm always yield an optimal solution?

12. Rumor spreading There are n people, each in possession of a different rumor. They want to share all the rumors with each other by sending electronic messages. Assume that a sender includes all the rumors he or she knows at the time the message is sent and that a message may only have one addressee. Design a greedy algorithm that always yields the minimum number of messages they need to send to guarantee that everyone of them gets all the rumors.

2 Task 2 Dynamic Programming. (7.5 Points)

Write a C++ implementation of Fibonacci applying all 3 techniques and comparing running times.

DP Bottom-Up
DP Top-Down
Recursive Non-DP

   Your program is to capture user input as to Fib range (should do sanity checks). Nothing blacklisted however all Fib computation versions must be your own work not library functions.
Code to report running times for all 3 versions and highlight the fastest.

3 Submission

1. PDF file with detailed answers to the questions in Task 1.

2. Source code for task 2 must follow the C++ Style Guide, compile error and warning free on the g++ or clang compiler.

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