Name: ..... Reg.No: | | | |

Amrita Vishwa Vidyapeetham
Department of Computer Science & Engineering

Quiz #2

Time: 55 minutes CSE330 Design & Analysis of Algorithms Max. Marks: 20

Answer the questions in the spaces provided on the question sheet

1. ½ point The young Hoare invented the ..... algorithm while trying to sort the words of a Russian dictionary for a machine translation project from Russian to English. Says Hoare, *"My first thought on how to do this was bubble sort and, by an amazing stroke of luck, my second thought was ..... . I have been very lucky. What a wonderful way to start a career in Computing, by discovering a new sorting algorithm!"*.

2. 1 point Write the expression for the length LCS in terms of prefixes of strings.

3. ½ point List all possible parenthesization for a matrix chain of length 4.

4. 1 point Define the Edit Distance problem. Give a n instance of this.

5. 1 point Problems that exhibit optimal substructure property can easily be solved using greedy/dynamic programming strategy. Define optimal substructure property.

6. 2 points Solve 0/1 Knapsack: $n = 4$(# of items) , $W = 5$ (max weight) Elements (weight, benefit): (2,3), (3,4), (4,5), (5,6)

7. [2 points] Suppose we want to make change for n paise, using the least number of coins of denominations 1,10, and 25 paisa coins. Consider the following greedy strategy:

```
the amount left to change is m;
take the largest coin that is no more than m;
subtract this coin's value from m, and repeat.
```

Either give a counter example, to prove that this algorithm can output a non-optimal solution, or prove that this algorithm always outputs an optimal solution.

8. [3 points] Suppose you were to drive from Coimbatore to Chennai. Your fuel tank, when full, holds enough fuel to travel m miles, and you have a map that gives distances between fuel filling stations along the route. Let $d_1 < d_2 < \ldots < d_n$ be the locations of all the filling stations along the route where d_i is the distance from Coimbatore to the filling station. You can assume that the distance between neighboring gas stations is at most m miles. Your goal is to make as few filling stops as possible along the way. Give the most efficient algorithm you can find to determine at which filling stations you should stop and prove that your strategy yields an optimal solution. Be sure to give the time complexity of your algorithm as a function of n.

9. [3 points] You are given a sequence of n songs where the i^{th} song is i minutes long. You want to place all of the songs on an ordered series of CDs (e.g. CD1, CD2, CD3... CDk) where each CD can hold m minutes. Furthermore,

   1. The songs must be recorded in the given order, song1, song2,. . . song n.
   2. All songs must be included.
   3. No song may be split across CDs.

Your goal is to determine how to place them on the CDs as to minimize the number of CDs needed. Give the most efficient algorithm for an optimal solution.

10. 3 points You are traveling by a canoe down a river and there are n trading posts along the way. Before starting your journey, you are given for each $1 \leq i < j \leq n$ the fee $f_{i,j}$for renting a canoe from post i to post j. These fees are arbitrary. For example it is possible that $f_{1,3} = 10$ and $f_{1,4} = 5$. You begin at trading post 1 and must end at trading post n using rented canoes.
Your goal is to minimize the rental cost. Give the most efficient algorithm you can find for this problem. Be sure to prove that your algorithm yields an optimal solution and analyze the time complexity.

11. [3 points] For bit strings $X = x_1 \dots x_m$, $Y = y_1 \dots y_n$ and $Z = z_1 \dots z_{m+n}$, we say that Z is an interleaving of X and Y if it can be obtained by interleaving the bits in X and Y in a way that maintains the left-to-right order of the bits in X and Y. For example if $X = 101$ and $Y = 01$ then $x_1x_2y_1x_3y_2 = 10011$ is an interleaving of X and Y, whereas 11010 is not. Give the most efficient algorithm you can find to determine if Z is an interleaving of X and Y . Prove your algorithm is correct and analyze its time complexity as a function $m = |X|$ j and $n = |Y|$

Space for rough work