CS2223: Algorithms
D-Term, 2013

Assignment 4

Teams: To be done individually

Release date: 04/19/2013

Due date: 04/26/2013 (11:59 PM)

Submission: Electronic submission only

General Instructions

- ***Executable vs. Pseudocode:*** Each question will explicitly state whether the deliverable is pseudocode or an executable program that the TA will run to give you a grade.

- ***Programming Language:*** If a question asks you to write an executable program, then choose a language of your choice, but make it clear in your report:
  - How to compile your program
  - How to execute it and with what arguments

- ***Submissions:*** The submission of Assignment 4 must be done electronically through blackboard system. All programs plus your report (.doc, .docx, or .pdf) should be zipped into a single file and that is the file to submit.

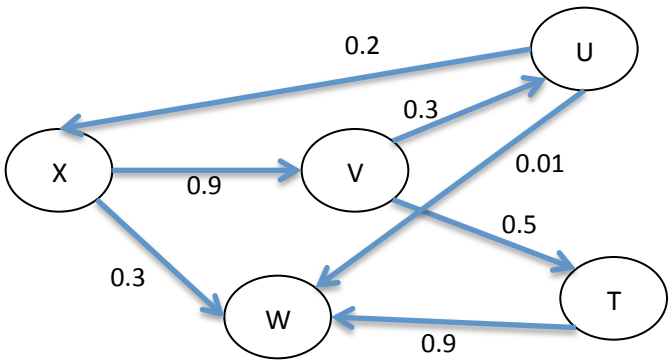
Question 1 [15 Points]

Solve Problem 24.3-6 in the textbook page 663. You are required to do the following:

(a) [5 Points] Write a pseudocode for an algorithm that solves the problem from a given source node to all destination nodes.

(b) [5 Points] Analyze the algorithm and provide the time complexity

(c) [5 Points] Apply your algorithm on the following graph assuming the source node is U. Show the most reliable path to each other node and its reliability value.



Question 2 [15 Points]

(a) [5 Points] Solve Problem 11.2-2 in your textbook Page 261. Draw the hash table and show its content.

(b) [7 Points] Assume we have a list of size n of distinct string values (each value is a long string). We search this list frequently and each search costs O(nx), where x is the average length of each value. We need to make the searching process more efficient and be done in O(Log n). Develop an algorithm (pseudocode) that will achieve such searching complexity.

Hint: You can have a pre-processing phase that is done once over the data. The complexity of this phase is not part of the O(Log n) target. Also, think of avoiding string comparisons as much as possible.

(c) [3 Points] Analyze the algorithm you developed in (b), if you have any pre-processing phase, then analyze its time and space complexity. Also show that the search is on average takes O(Log n).

Question 3 [15 Points]

Alex decided to take her son Mark to Disney Land. They found many rides that they can take. Each ride has a start time, end time, and credit points (points that they earn when they take the ride). To be more formal, each ride R_i is described as Ri (S_i, E_i, C_i) triplet that denotes the start time (S_i), end time (E_i) and the number of earned pointed (C_i)

Alex and Mark have different objective functions, Alex wants to maximize the number of rides they take while Mark wants to maximize the number of credit points they collect.

(a) [5 Points] Assume that we will follow Alex's objective function, write a pseudocode that arranges the rides to achieve Alex's objective. Also, analyze the algorithm and state its time and space complexity.

(b) [5 Points] Give a counterexample showing that the solution in (a) will not meet Mark's objective function.

(c) [5 Points] Assume that we will follow Mark's objective function, write a pseudocode that arranges the rides to achieve Mark's objective. Also, analyze the algorithm and state its time and space complexity.

Question 4 [15 Points]

Given the following two strings

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S1:   GTAATCATTTAA
S2:   GATTACTGATA
```

Show the dynamic programming matrix that computes the optimal edit distance between them (Convert S1 to S2). Assume that the allowed operations are:

Insert → will cost 2

Delete → will cost 2

align(a, b) →

will cost 0	if a = b
will cost 1	if a and b are (G, C) or (C, G)
will cost 2	otherwise

State the final optimal cost, and also indicate the exact sequence of edit operations to be done on S1 to convert it to S2.