CS 32

Exam 2 - Answer Key

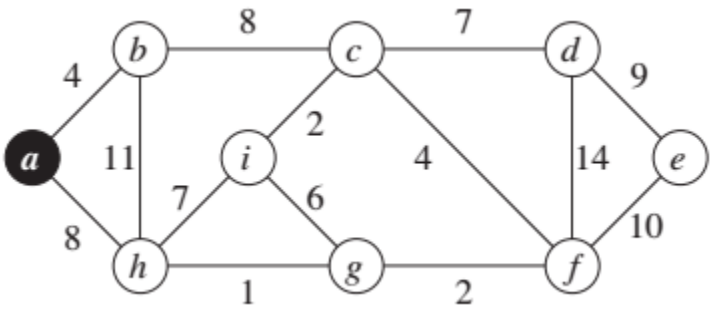
09 March 2017

General Instructions

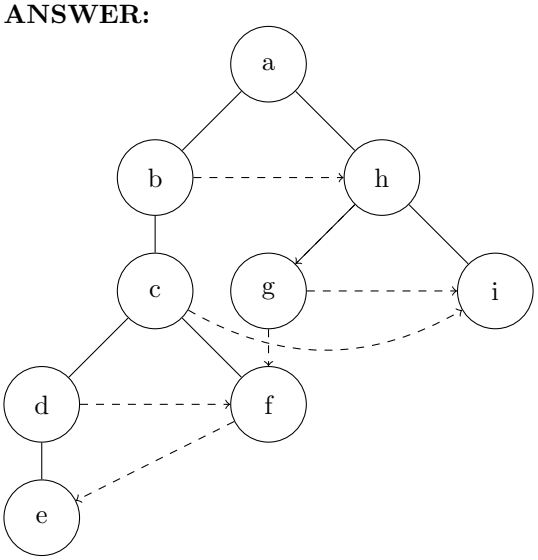
- Answer the items completely. Show your solutions/justifications when asked.
- Write as legibly as possible. Illegible or unreadable answers and solutions may not merit any points.
- Refrain from making unnecessary motions and sounds during the exam. Any suspicious behavior will be dealt with accordingly.
- Direct all questions to the proctor.
- If you need to go to the CR, hand your questionnaire, answer sheet, and scratch paper to the proctor before heading out. Only one person at any given time is allowed to go out.
- Once you're done with the exam (one way or the other), submit your the questionnaire-answer sheet together with scratch papers.

Questions

Consider the following graph:



1. Perform *breadth first search* on the graph starting from vertex a to generate the corresponding DFS tree. As a rule of thumb, *prioritize traversal of a vertex whose label comes first in the alphabetical order* if given several vertices to go to next. Also, make sure that the sons of a vertex, if any, are listed from *left to right in alphabetical order. (1 point)*
ANSWER:



2. Give the sequence of labels when *preorder traversal* is performed on the BFS tree, disregarding the non-tree edges. *(1 point)*
ANSWER: a b c d e f h g i

3. Give the sequence of labels when *inorder traversal* is performed on the BFS tree, disregarding the non-tree edges. *(1 point)*
ANSWER: e d c f b a g h i

4. Give the sequence of labels when *postorder traversal* is performed on the BFS tree, disregarding the non-tree edges. *(1 point)*
ANSWER: e d f c b g i h a

5. Using *Kruskal's algorithm*, show *each step* of the method towards getting the minimum spanning tree of the graph. *(1 point)*
ANSWER:

   (a) Choose edge (g, h) (cost = 1)
   (b) Choose edge (c, i) (cost = 2)
   (c) Choose edge (f, g) (cost = 2)
   (d) Choose edge (a, b) (cost = 4)
   (e) Choose edge (c, f) (cost = 4)
   (f) Choose edge (g, i) (cost = 6), but reject
   (g) Choose edge (c, d) (cost = 7)
   (h) Choose edge (h, i) (cost = 7), but reject
   (i) Choose edge (b, c) (cost = 8)
   (j) Choose edge (a, h) (cost = 8), but reject
   (k) Choose edge (d, e) (cost = 9)

   NOTE: The following steps are interchangeable: steps (b) and (c), steps (d) and (e), steps (g) and (h), steps (i) and (j).

6. Get the shortest path from vertex a to every other vertex (and the corresponding path cost) in the graph using Dijkstra's algorithm. Show your solutions. *(1 point)*
ANSWER:

   - $a \rightarrow b$ (cost = 4)
   - $a \rightarrow b \rightarrow c$ (cost = 12)

- $a \to b \to c \to d$ (cost = 19)
- $a \to h \to g \to f \to e$ (cost = 21)
- $a \to h \to g \to f$ (cost = 11)
- $a \to h \to g$ (cost = 9)
- $a \to h$ (cost = 8)
- $a \to b \to c \to i$ (cost = 14)

Scoring Mechanics

1. For Item 1, a **0.1 point** deduction is given for each erroneous or missing feature (i.e. ancestor-descendant relationship, tree and cross edges) in the tree.

2. For Items 2, 3, and 4, a **0.1 point** deduction is given for each letter that is missing or out of place in the sequence based on the tree constructed in Item 1. *If there are incorrect tree edges and/or ancestor-descendant relationships in the tree constructred for Item 1*, then an additional penalty is imposed for Items 2, 3 and 4 by **halving the accumulated points per Item**. For example, if the postorder traversal of the binary tree in Item 4 was correctly done (which means no 0.1 point deductions incurred), but there are erroneous tree edges and ancestor-descendant relationships in the tree created for Item 1, then the score for Item 4 would be 0.5.

3. For Item 5, a **0.1 point *deduction*** is given for each erroneous edge that was chosen out of sequence in the execution of the algorithm. Note that **Kruskal's algorithm chooses edges and NOT vertices**, so **answers that did not show even a hint that an edge was chosen at each step will not be awarded any points**.

4. For Item 6, a **0.125 point *deduction*** is given for each erroneous shortest path answered. Note that the item requires that the solution is shown, and hence **no points are awarded if no solution is provided with the answers**.

5. The perfect score for this exam is **5 points**. Any points accumulated exceeding 5 points are considered bonus points and will still be counted towards the computation of your grade. For example, if you get 5.5 points, that is equivalent to getting 110% for the exam.