CS 32

Exam 2 - Answer Key

March 20, 2015

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), place your scratch papers and the questionnaire inside your blue book.

Questions

Consider the following graph:
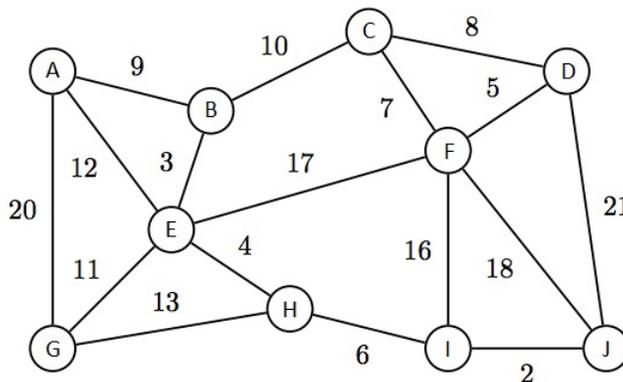
1. Get the shortest path from vertex F to every other vertex in the graph using Dijkstra's algorithm. Show your solutions.
   ANSWER:

   - $F \rightarrow D$ (cost $= 5$)
   - $F \rightarrow C$ (cost $= 7$)
   - $F \rightarrow I$ (cost $= 16$)
   - $F \rightarrow E$ (cost $= 17$)
   - $F \rightarrow C \rightarrow B$ (cost $= 17$)
   - $F \rightarrow J$ (cost $= 18$)
   - $F \rightarrow E \rightarrow H$ (cost $= 21$)
   - $F \rightarrow C \rightarrow B \rightarrow A$ (cost $= 26$)
   - $F \rightarrow E \rightarrow G$ (cost $= 28$)

2. Using *Prim's algorithm*, show the choices made at each step of the method towards getting the minimum spanning tree of the graph. Use vertex A as starting point.
   ANSWER:

   (a) Choose vertex B (edge (A, B) cost = 9)
   (b) Choose vertex E (edge (B, E) cost = 3)
   (c) Choose vertex H (edge (E, H) cost = 4)
   (d) Choose vertex I (edge (H, I) cost = 6)
   (e) Choose vertex J (edge (I, J) cost = 2)
   (f) Choose vertex C (edge (B, C) cost = 10)
   (g) Choose vertex F (edge (C, F) cost = 7)
   (h) Choose vertex D (edge (D, F) cost = 5)
   (i) Choose vertex G (edge (E, G) cost = 11)

3. Perform *breadth first search* on the graph starting from vertex J to generate the corresponding BFS 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.
   ANSWER:
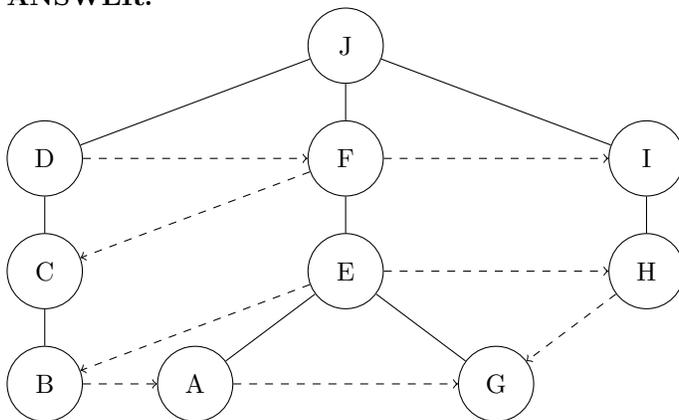
4. Give the sequence of labels when *preorder traversal* is performed on the BFS tree, disregarding the non-tree edges.
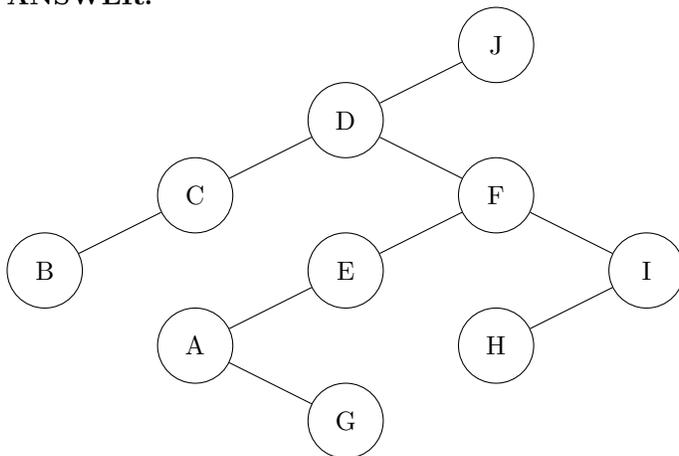   **ANSWER:** J D C B F E A G I H

5. Give the sequence of labels when *postorder traversal* is performed on the BFS tree, disregarding the non-tree edges.
   ANSWER: B C D A G E F H I J

6. Construct the corresponding binary tree representation of the BFS tree, disregarding the non-tree edges.
   ANSWER:

7. Give the sequence of node labels when *inorder traversal* is performed on the corresponding binary tree of the BFS tree.
   ANSWER: B C D A G E F H I J

8. Give the sequence of node labels when *postorder traversal* is performed on the corresponding binary tree of the BFS tree.
   ANSWER: B C G A E H I F D J

2

Scoring Mechanics

1. For Item 1, 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**.

2. For Item 2, a **0.125 point** *deduction* is given for each erroneous vertex that was chosen out of sequence in the execution of the algorithm. Note that **Prim's algorithm chooses vertices and NOT edges**, so **answers that did not show even a hint that a vertex was chosen at each step will not be awarded any points**.

3. For Item 3, 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.

4. For Item 6, a **0.1 point** deduction is given for each erroneous or missing feature in the binary tree based on the one made in Item 3. *If there are incorrect tree edges and/or ancestor-descendant relationships in the tree constructed for Item 3*, then answer to Item 6 will be penalized by **halving the incurred score for Item 6**. For example, if the corresponding binary tree based on Item 3 was correctly constructed, but there are erroneous tree edges and ancestor-descendant relationships in the tree created for Item 3, then the score for Item 6 is 0.5.

5. For Item 4, 5, 7, and 8, 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 Items 3 (for Items 4 and 5) and 6 (for Items 7 and 8).

   (a) *If there are incorrect tree edges and/or ancestor-descendant relationships in the tree constructred for Item 3*, then an additional penalty is imposed for Items 4 and 5 by **halving the accumulated points per Item**. For example, if the postorder traversal of the binary tree in Item 5 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 3, then the score for Item 8 would be 0.5.

   (b) *If the corresponding binary tree in Item 6 was **correctly constructed**, but based on a tree (from Item 3) with erroneous tree edges and ancestor-descendant relationships*, then an additional penalty for Items 7 and 8 is given by **multiplying the accumulated score in each item with a factor of 0.75**.

   (c) *If the corresponding binary tree in Item 6 was **incorrectly constructed**, regardless of the correctness of the answer in Item 3*, then an additional penalty for Items 7 and 8 is given by **halving the accumulated score in each item**.