CS106X Instructor: Cynthia Lee

Autumn 2015 Solutions

PRACTICE FINAL EXAM 2 - SOLUTIONS

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1. Sorting

5	6	8	4	2	8	3	7	1
1	6	8	4	2	8	3	7	5
1	2	8	4	6	8	3	7	5
1	2	3	4	6	8	8	7	5
1	2	3	4	6	8	8	7	5
1	2	3	4	5	8	8	7	6
1	2	3	4	5	6	8	7	8
1	2	3	4	5	6	7	8	8
1	2	3	4	5	6	7	8	8
1	2	3	4	5	6	7	8	8

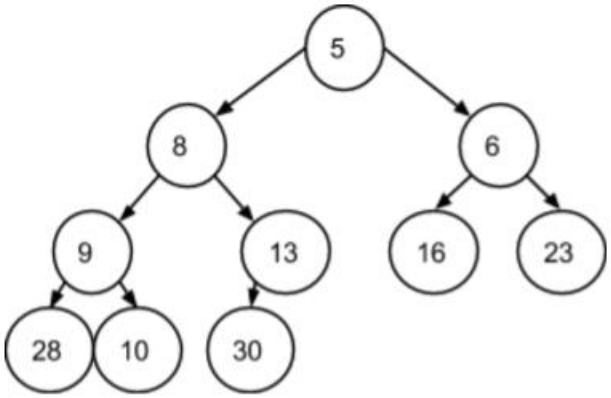
2. BFS/DFS

BFS: All possible full credit solutions:
A, C, D, B, E, H, G, J, F
A, C, D, B, E, H, J, G, F
A, C, D, E, B, H, G, J, F
A, C, D, E, B, H, J, G, F
A, D, C, B, H, E, G, J, F
A, D, C, B, H, E, J, G, F
A, D, C, H, B, E, G, J, F
A, D, C, H, B, E, J, G, F

DFS: All possible full credit solutions:
A, C, B, E, D, H, J, G, F
A, C, B, E, D, H, G, F, J

A, C, E, B, D, H, J, G, F
A, C, E, B, D, H, G, F, J
A, D, H, J, G, F, C, E, B
A, D, H, J, G, F, C, B, E
A, D, H, G, F, J, C, E, B
A, D, H, G, F, J, C, B, E

3. Heap



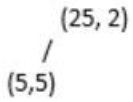
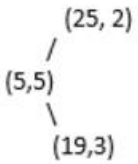
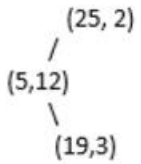
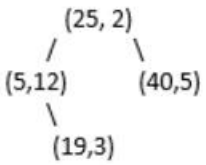
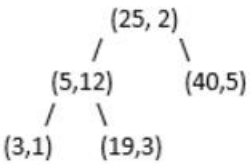
Circle: YES

4. MST

(order in list does not matter)

MST #1:	AC	BC	BE	CE	BD	DE	DF
MST #2:	AC	BC	BE	CE	BD	DE	DF
MST #3:	AC	BC	BE	CE	BD	DE	DF
MST #4:	AC	BC	BE	CE	BD	DE	DF
MST #5:	AC	BC	BE	CE	BD	DE	DF

5. BST

Diagram after inserting (25,2):  *This one is completed for you as a node formatting example.*	Diagram after inserting (5,5): 
Diagram after inserting (19,3):  	Diagram after inserting (5,12):  2/2 pts if they update value of 5 regardless of 5's location in the tree
Diagram after inserting (40,5):  	Diagram after inserting (3,1): 

6. ADTs

```
void moveLeft(Grid<int> &board) {
   // For each [row][col], we consider if something from the right
   // should move into this place, and there are two cases of this:
   // (1) if we are non-zero, see if a matching number merges into us
   // (2) if we are blank, see if a number moves into this space
   for (int row = 0; row < board.numRows(); row++) {
      for (int col = 0; col<board.numCols(); col++) {
         // (1) if we are non-zero, see if a matching number merges
         if (board[row][col] != 0) {
            for (int i = col + 1; i < board.numCols(); i++) {
               //matching number: merge
               if (board[row][i] == board[row][col]) {
                  board[row][col] *= 2;
                  board[row][i] = 0;
                  break;
               //non-matching number: end search
```

```
            } else if (board[row][i] != 0){
               break;
            }
         }
      }
      // (2) if we are blank, see if a number moves into this space
      else {
         for (int i = col + 1; i < board.numCols(); i++){
            if (board[row][i] != 0){
               board[row][col] = board[row][i];
               board[row][i] = 0;
               col--;
               break;
            }
         }
      }
   }
}
```

7. Graphs

```
// This solution uses a DFS helper that is shared between parts (a) and (b). It
// finds all itineraries and then parts (a) and (b) examine the output to answer
// their specific questions about them (number of different ones, and longest one).
// It is also possible to write custom DFS for each part, with no shared code. That
// gives two simpler functions, but less reuse.

// Shared DFS is in two functions: start is a wrapper and go is the actual recursive
// function.
void startDFS(BasicGraph &map, Vertex *dorm,
              Vector<Vector<Vertex*> > &itineraries) {
    Vector<Vertex*> currentItinerary;
    currentItinerary.add(dorm);
    for (Vertex *neighbor : map.getNeighbors(dorm)) {
        if (!neighbor->visited) {
            neighbor->visited = true;
            goDFS(map, neighbor, dorm, currentItinerary, itineraries);
            neighbor->visited = false;
        }
    }
}

void goDFS(BasicGraph &map, Vertex *current, Vertex *dorm,
              Vector<Vertex*> currentItinerary,
              Vector<Vector<Vertex*> > &itineraries) {
    currentItinerary.add(current);
    if (current == dorm) {
        itineraries.add(currentItinerary);
        return;
    }
    for (Vertex *neighbor : map.getNeighbors(current)) {
```

```
        if (!neighbor->visited) {
            neighbor->visited = true;
            goDFS(map, neighbor, dorm, currentItinerary, itineraries);
            neighbor->visited = false;
        }
    }
}

// this is the required function for (a), relies on two DFS helpers above
int countItineraries(BasicGraph &map, Vertex *dorm) {
    if (dorm == NULL) error("Dorm is null!");
    Vector<Vector<Vertex*> > itineraries;
    startDFS(map, dorm, itineraries);
    return itineraries.size();
}

// this is the required function for (b), relies on two DFS helpers above
int longestItinerary(BasicGraph &map, Vertex *dorm) {
    if (dorm == NULL) error("Dorm is null!");
    Vector<Vector<Vertex*> > itineraries;
    startDFS(map, dorm, itineraries);
    int longest = -1;
    for (Vector<Vertex*> itinerary : itineraries) {
        if (itinerary.size() > longest) {
            longest = itinerary.size();
        }
    }
    return longest;
}
```

8. Trees

```
bool isSubtree(Node *tree1, Node *tree2) {
   if (isSame(tree1, tree2)) return true;
   if (tree1 == NULL) return false;
   if (isSubtree(tree1->left, tree2)) return true;
   if (isSubtree(tree1->right, tree2)) return true;
   return false;
}

bool isSame(Node *tree1, Node *tree2) {
   if (tree1 == NULL && tree2 == NULL) return true;
   if (tree1 == NULL || tree2 == NULL) return false;
   if (tree1->value != tree2->value) return false;
   return isSame(tree1->left, tree2->left) && isSame(tree1->right, tree2->right);
}
```