CS106B Instructor: Cynthia Lee

Autumn 2017 Solutions

PRACTICE FINAL EXAM #4 (DRESS REHEARSAL) - SOLUTIONS

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1. MST

AC, CD, AB, DF, AE

2. Linked Lists

```
delete list2->next;
list2->next = list->next;
list->next = NULL;
list2->next->next = list;
list = list2;
```

3. Heaps

(a)

Diagram after inserting 13:

This one is completed for you.

Diagram after inserting 4:

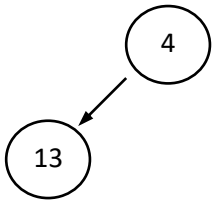


Diagram after inserting 12:

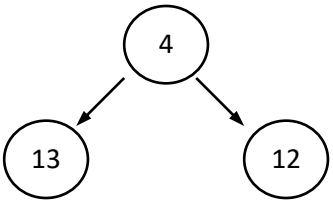


Diagram after inserting 8:

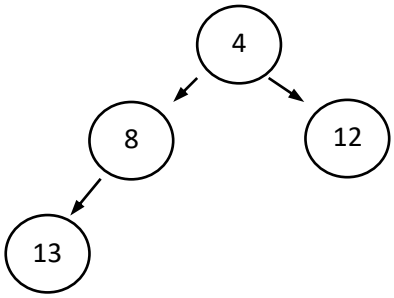
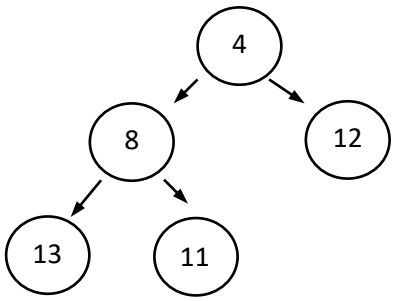
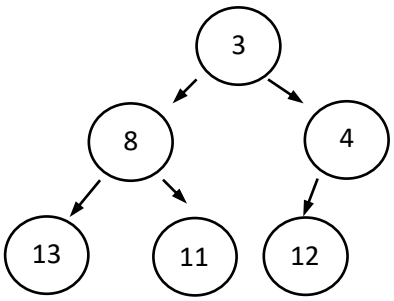


Diagram after inserting 11:	Diagram after inserting 3:
	

(b)

0	1	2	3	4	5	6	7	8	9
3	8	4	13	11	12				

Or:

0	1	2	3	4	5	6	7	8	9
	3	8	4	13	11	12			

(c)

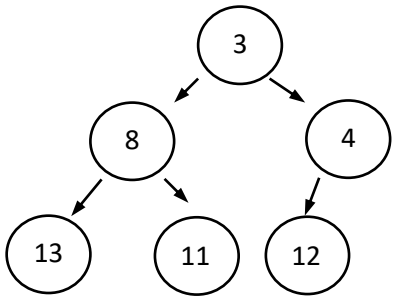
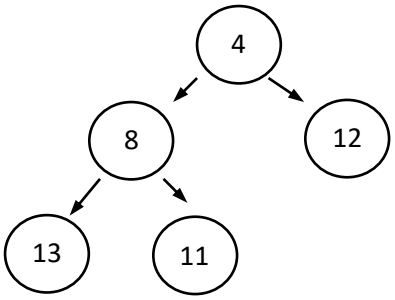
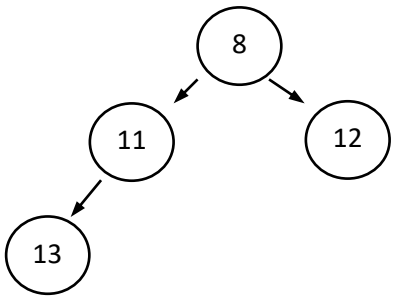
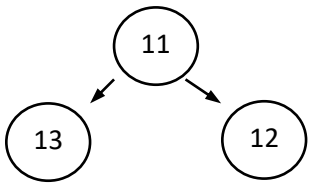
Diagram from above:	Diagram after dequeuer of **3**:
	

Diagram after dequeue of **4**:	Diagram after dequeue of **8**:
	

4. Graphs

```
bool findEulerPathHelper(BasicGraph& graph, Vertex* v, Vector<Vertex*>& path) {
    if (path.size() == graph.getEdgeSet().size() / 2 + 1) {
        return true;   // base case: all the edges have been used (this is
                       // half the total edges because graph is undirected)
    } else {
        // recursive case: for each unused edge: choose, explore, unchoose
        for (Edge* edge : graph.getEdgeSet(v)) {
            if (!edge->visited) {
                // choose
                Edge* partner = graph.getEdge(edge->finish, edge->start);
                edge->visited = true; // mark this edge and its corresponding
                partner->visited = true; // directed edge in the reverse direction
                path.add(edge->finish);

                // explore
                if (findEulerPathHelper(graph, edge->finish, path)) {
                    return true;
                }

                // unchoose
                edge->visited = false;
                partner->visited = false;
                path.remove(path.size() - 1);
            }
        }
        return false;
    }
}

Vector<Vertex*> findEulerPath(BasicGraph& graph) {
    Vector<Vertex*> path;
    if (graph.isEmpty() || graph.getEdgeSet().isEmpty()) {
        return path;   // special case: return empty path
    }
```

```
    for (Vertex* v : graph) {
        graph.resetData();
        path.add(v);
        if (findEulerPathHelper(graph, v, path)) {
            break;
        } else {
            path.clear(); //prepare for next attempt
        }
    }
    return path;
}
```

5. BSTs

```
void partitionTree(BSTnode *tree, Vector<int>& lessThan, Vector<int>& greaterThan){
    bool sawSentinel = false; // false must be stored in a named variable before
                              // passing as arg because it's pass by reference
    partitionTree(tree, lessThan, greaterThan, sawSentinel);
}

// In order traversal; keep track of when we saw sentinel
void partitionTree(BSTnode *tree, Vector<int>& lessThan, Vector<int>& greaterThan,
                   bool& sawSentinel){
    // base case
    if (tree == NULL) {
        return;
    }
    // first traverse left
    partitionTree(tree->left, lessThan, greaterThan, sawSentinel);

    // handle visit of self by adding self key to correct vector (or setting
    // flag if self is the sentinel)
    if (tree->key == -1) {
        sawSentinel = true;
    } else {
        if (sawSentinel) {
            greaterThan.add(tree->key);
        } else {
            lessThan.add(tree->key);
        }
    }

    // then traverse right
    partitionTree(tree->right, lessThan, greaterThan, sawSentinel);
}
```

6. Inheritance

```
var1->m1();          // H1 B3 B1
var1->m2();          // COMPILER ERROR
var2->m2();          // COMPILER ERROR
var3->m1();          // H1 B3 B1
var3->m4();          // COMPILER ERROR
var4->m2();          // G2
var4->m4();          // G4
var4->m1();          // H1 B3 B1
var5->m2();          // G2
var5->m4();          // B3 E4
var5->m1();          // H1 B3 B1

((Hamilton*) var4)->m2();       // COMPILER ERROR
((Eliza*) var4)->m4();          // B3 E4
((Eliza*) var1)->m1();          // H1 B3 B1
((Eliza*) var2)->m2();          // CRASH!
((Hamilton*) var4)->m1();       // H1 B3 B1
((Eliza*) var3)->m4();          // B3 E4
```

7. ADTs

```
// uses inclusion/exclusion pattern of recursive backtracking
bool canSell(Map<string,offer>& customerOffers, int nTix, int minCash,
             Vector<string>& acceptedOffers) {
    if (customerOffers.size() == 0) {
        return false;
    }
    if (nTix <= 0) {
        return false;
    }
    if (minCash <= 0) {
        return true;
    }

    // choose an offer
    string custName;
    for (string s : customerOffers) { custName = s; break; }
    offer cust = customerOffers[custName];
    customerOffers.remove(custName);

    // try for a solution WITH this offer
    acceptedOffers.add(custName);
    if (canSell(customerOffers, nTix - cust.seats, minCash - cust.price,
                acceptedOffers)) {
        return true;
    }
    acceptedOffers.remove(acceptedOffers.size()-1);
```

```
    // try for a solution WITHOUT this offer
    if (canSell(customerOffers, nTix, minCash, acceptedOffers)) {
        return true;
    }

    return false;
}
```
