Computer Sciences 367  
Midterm Exam 2  Information and Sample Questions

The following information and questions are meant to familiarize you with the CS 367 exam instructions and give you a few examples of midterm exam 2 questions. This sample does not represent the length or difficulty of an actual midterm 2 exam. The actual exam will have more questions and cover a broader range of topics than what is shown here. For a list of topics for the exam and more information about CS 367 exams, see the course website.

Solutions to these sample questions will be covered during the lecture before the exam. You are welcome to discuss these questions with classmates, but don’t post solutions on Piazza since that can discourage some of your classmates from trying (some cannot resist the temptation to see the answers even when we know we should do the questions first).

Cover Sheet Information

1. Print your Last (Family) Name: _____________________ First (Given) Name: _____________

2. Circle your Lecture:
   (Deb) Lec 001 11:00 TR  (Deb) Lec 002 1:00 TR  (Alexi) Lec 003 2:30 TR

3. Fill in these fields and their bubbles on the scantron form (use #2 pencil).
   (a) LAST NAME - write in your last (family) name starting at left column.
   (b) FIRST NAME - write the first five letters of your first (given) name.
   (c) IDENTIFICATION NUMBER - write your UW Student ID number.
   (d) Under ABC of SPECIAL CODES, write your lecture number as a three digit value 001, 002, or 003.
   (e) Under F of SPECIAL CODES, write the letter P and fill in the number (1) bubble.

4. DOUBLE-CHECK THAT BUBBLES ARE FILLED IN FOR EACH OF ABOVE FIELDS.

5. Read, agree to, and sign this ACADEMIC CONDUCT STATEMENT.
   I will keep my answers covered so that they may not be viewed by another student during the exam or prior to completion of their exam. I will not view or in any way use another’s work or any unauthorized devices. I understand that I may not make any type of copy of any portion of this exam. I understand that being caught doing any of these or other actions that permit me or another student to submit work that is not our own will result in automatic failure of the course. All such penalties are reported to the Deans Office for all involved.

   Signature: ________________________________

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Turn off and put away all electronic devices and wait for the proctor to signal the start of the exam.
Part I: Simple Choice (5 Questions 1 points each)

Unless otherwise specified, assume the ADTs, interfaces, and algorithms mentioned are those discussed in lecture and in the readings.

1. Which one of the following list of array elements could represent a min heap?

2. A recursive method typically uses ___________ memory than a corresponding iterative method.
   A. more  B. less

For questions 3-4, consider this general tree with character labels:

3. The tree has  A. 6    B. 7 leaf nodes.

4. The length of the path from the root to the node labeled G is  A. 2    B. 3

5. Which one of the following is a valid BST?  A. 

6. ___________ traversal is not meaningful for general trees.
   A. A level order   B. An inorder
Part II: Multiple Choice (15 Questions 3 points each)
Choose the one best answer of the available choices.

The next two questions refer to the following recursive method:

```java
public static int compute (int x, int y) {
    if (x == y) return x;
    return compute(x+1, y-1);
}
```

7. What is returned by the call `compute(1,5)`?
   A. 2
   B. 3
   C. 4
   D. 5
   E. No value is returned because an infinite recursion occurs.

8. Which of the following calls leads to infinite recursion?
   i  compute(2, 5)
   ii compute(2, 8)
   iii compute(8, 2)
   A. ii only
   B. iii only
   C. i and iii only
   D. ii and iii only
   E. i, ii, iii

9. Consider the following recursive method that determines if two chains of nodes are equal, that is, they have the same objects in the same order. Note by definition two empty chains of nodes are equal.

```java
public static boolean isEqual( Listnode<E> L1, Listnode<E> L2) {
    if (L1 == null && L2 == null) return true;
    return L1.getData().equals( L2.getData() )
        && isEqual( L1.getNext() , L2.getNext() );
}
```

Which one of the following statements is true?
   A. It always works correctly.
   B. It works correctly only if the two chains of nodes are the same size.
   C. It fails to work correctly when both chains of nodes are empty.
   D. It fails to work correctly when both chains of nodes have the same items in the same order.
   E. It always fails to work correctly.
10. Consider the following method that returns true if and only if a chain of nodes contains duplicates. Assume hasDups is initially called by passing it the first node in the chain (asume no header node):

```java
private boolean hasDups( Listnode<E> L ) {
    if ( L == null ) return false;
    return contains( L.getNext() , L.getData() ) ||
            hasDups( L.getNext() );
}
```

// assume contains() returns true iff obj is in L
public boolean contains ( Listnode<E> L , E obj ) {
    // assume this method takes time O(N), where N is the
    size of the List L
}

Which one of the following pairs of recurrence equations correctly characterizes the hasDups method?

A. $T(0) = 1, T(N) = 1 + T(N/2)$
B. $T(0) = 1, T(N) = 1 + T(N - 1)$
C. $T(0) = 1, T(N) = N + T(N - 1)$
D. $T(1) = 1, T(N) = N + T(N - 1)$
E. $T(1) = 1, T(N) = 1 + T(N + 1)$

11. You are given an array of size 100 where the value at each index $k$ is $k$, e.g., $A[0]=0$, $A[1]=1$, etc. You perform a search for every value in the array, e.g., first you find 0, then 1, etc. Which one of the statements below is true?

A. Binary search is not applicable to the problem.
B. Sequential search is not applicable to the problem.
C. Sequential search is always faster than binary search for every one of the 100 values searched.
D. Sequential search is always slower than binary search for every one of the 100 values searched.
E. Sequential search is sometimes faster, sometimes slower than binary search depending on the which of the 100 values is being searched.

12. Consider the binary tree (shown below) with character labels: Which one of the choices shows the order that nodes are visited during a pre-order traversal?

```

```
13. Consider the following binary search tree that stores integers:

Which one best describes the ranges of possible values for X and Y if duplicates are not allowed?

A. $X < 44$ and $Y > 44$
B. $X > 22$ and $Y > 77$
C. $22 < X < 44$ and $Y < 77$
D. $22 < X < 44$ and $Y > 77$
E. $22 < X < 44$ and $44 < Y < 77$

14. Assume general trees are implemented using a generic `Treenode` class that includes the following field and method:

```java
private List<Treenode<T>> children;
private List<Treenode<T>> getChildren() { return children; }
```

and that the following class is used to represent general trees and it contains two mystery methods:

```java
private Treenode<T> root;
public int mystery() { return mystery(root); }
private int mystery(Treenode<T> n) {
    if (n == null || n.getChildren().isEmpty())
        return 0;
    int total = 1;
    Iterator<Treenode<T>> itr = n.getChildren().iterator();
    while (itr.hasNext())
        total += mystery(itr.next());
    return total;
}
```

Which of the following best describes what the method `mystery` does?

A. Always returns 0.
B. Returns the number of nodes in the tree.
C. Returns the number of leaves in the tree.
D. Returns the number of non-leaves in the tree.
E. Returns the height of the tree.