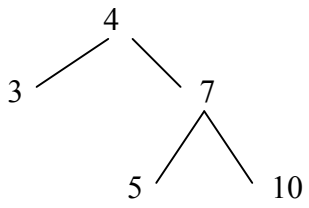
COSC 311 Midterm WI10 Name:_____

Open notes, books, internet.
No contact with another human via any medium.
Return via email on or before 5:00pm, 3/13/10 (this Saturday).

If you have questions or you feel there is a typo -- write down your assumptions that rectify the putative problem, then answer under those assumptions. I reserve the right to decide whether or not your objections and/or assumptions are reasonable.

1. Answer the following questions based on this binary search tree:



1. A. Which of the following represents a postorder traversal of T?

i. 3 4 5 7 10

ii. 4 3 7 5 10

iii. 3 5 10 7 4

iv. 4 3 7 5 10

v. 10 7 5 4 3

1. B. What two nodes could be added to make a perfect binary tree (all leaves at the same depth?

i. 1.5, 2.5 ii. 1.0, 1.5 iii. 1.5, 3.5 iv. 0, 1.0

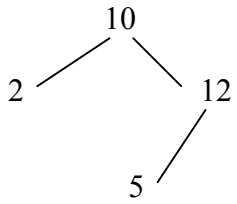
EXTRA CREDIT 1. C. Give pseudocode which will print the nodes in depth (level) order. For the tree pictured, the output would be 4 3 7 5 10. (Hint, use a queue)

EXTRA CREDIT: 1. D. Give the pseudocode which will print the nodes in reverse depth order . The output is 10 5 7 3 4

1. E. What is the output for this pseudocode:

```
void traverse (Node head) {
     if (head == null) return;
     traverse (head.right);
     System.out.println(" " + head.key + " ");
     traverse (head.left);
     }
```

1.F. Give the two possible BSTs after deleting the root?
(if you don't want to draw a picture, then give your answer in labeled depth order, going from right to left. E.g,. for the tree S:



depth 0: 10
depth 1: 2 12
depth 2: 5

2. Here is a slightly modified Ackermann's function definition:

```
B(m, n) = n+2                  if m <= 1
          B(m-1, n-1)          if m>1 and n<=1
          B(B(m-1, n), n-1)    if m>0 and n>0
```

2. A. How many times is B called (including the first) to evaluate B(2, 3)?

2. B. What is the value of B(2, 3)?

3. T(n) is $3 + 0.5\ n^2$

3. A. Which of the following represents the order of growth of T(n) as a function of n?

i. O(n) ii. O (n log n) iii. O (n^2) *iv*. O(n^2 log n) v. O(2^n)

3. B. Call your choice of the function you chose for 4.A. g(n).

Supply <u>three</u> pairs, (c, n_0), such that T(n) <= c * g(n) for all n >= n_0.

i.

ii.

iii.

4. Let T(n) be defined by T(1) = 7 and T(n+1) = 3n + T(n) for all integers n >= 1. Which of the following represents the order of growth of T(n) as a function of n?

i. O(n) ii. O (n log n) iii. O (n^2) *iv*. O(n^2 log n) v. O(2^n)

EXTRA CREDIT 5. A software vendor needs to choose two sorting algorithm implementations I1 and I2. I1 will be used in situations where item exchanges cost nothing but item comparisons remain expensive. Conversely, I2 will be used in situations where item comparisons cost nothing but item exchanges remain expensive.

Suppose the vendor can only use the insertion, selection, or bubble sorts for these implementations, and suppose the vendor only cares about average-case asymptotic algorithmic complexity (i.e. growth).
Which algorithm should the vendor use for each implementation?

A. Insertion sort for I1 and selection sort for I2

B. Insertion sort for I1 and bubble sort for I2

C. Selection sort for I1 and insertion sort for I2

D. Selection sort for I1 and selection sort for I2

E. Bubble sort for I1 and insertion sort for I2

6. Which of the options shown below is an optimal Huffman code for the following distribution?

```
a occurs 10% of the time
b occurs 14% of the time
c occurs 16% of the time
d occurs 18% of the time
e occurs 42% of the time
```

A. `a = 00, b = 01, c = 110, d = 111, e = 10`

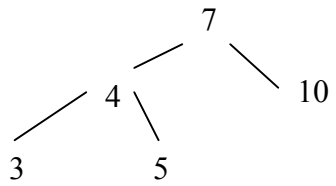
B. `a = 0, b = 100, c = 101, d = 110, e = 111`

C. `a = 000, b = 001, c = 010, d = 011, e = 1`

D. `a = 000, b = 001, c = 1, d = 011, e = 010`

E. `a = 00, b = 10, c = 010, d = 011, e = 11`

7. Give the AVL tree after inserting 1 to this AVL tree.



8. A stack has $O(1)$ behavior to push 1 element. It has $O(n)$ to push n elements. Is that $O(n)$

A. best case

B. average case

C. worst case

D. all of the A - C

E. none of A - C

F. a proper subset of A - C

9. The run time stack is actually implemented as a queue.

TRUE FALSE

10. Show the contents of a circular queue, implemented as a 1D array size 5, after the completing <u>all</u> the following operations to an initially empty circular queue:

insert 1,
insert 2,
insert 3,
insert 4,
insert 5,
remove,
remove,
remove,
insert 6,
insert 7,
remove.