CS1102s Data Structures and Algorithms

12/3/2010

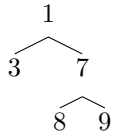
Examination Questions Midterm 2

This examination question booklet has 6 pages, including this cover page, and contains 12 questions.

You have 30 minutes to complete the exam. Use a 2B pencil to fill up the provided MCQ form. Leave Section A blank. Fill up Sections B and C.

Trees

Question 1: Consider the following binary tree:



Which one of the following statements is correct?

1 [A] This tree is a binary search tree.

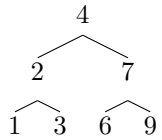
1 [B] This tree is a complete binary tree.

1 [C] This tree is a binary heap.

1 [D] This tree is a tree of height 3.

1 [E] None of the above.

Question 2: Consider the following binary tree:



Which one of the following statements is correct?

2 [A] This tree is a binary search tree.

2 [B] This tree is a binary heap.

2 [C] This tree is a tree of height 3.

2 [D] This tree is a tree of height 7.

2 [E] None of the above.

Question 3: Let N be an arbitrary natural number with $N > 1$. Which one of the following statements is *false*?

3 [A] A binary tree of height N that have $N + 1$ nodes.

3 [B] A binary tree of height N that have N^2 nodes.

3 [C] A binary tree of height N that have 2^N nodes.

3 [D] A binary tree of height N that have $N!$ nodes.

Question 4: We consider log to the base of 2. Thus for $\log N$ to be a natural number, N must be a power of 2.
Let N be an arbitrary number with $N > 1$. Which one of the following statements is *true*?

4 [A] A binary tree of height $\log N$ can have exactly N nodes.

4 [B] A binary tree of height $\log N$ can have exactly $\log N$ nodes.

4 [C] A binary tree of height $\log N$ can have exactly $N \log N$ nodes.

4 [D] A binary tree of height $\log N$ can have exactly N^2 nodes.

4 [E] None of the above.

Sorting

Question 5: Assume a set A of arrays of size N all of which are sorted already. Which one of the following statements it correct?

5 [A] Quicksort on elements of A has a runtime in $\Omega(N^2)$.

5 [B] Mergesort on elements of A has a runtime in $\Omega(N^2)$.

5 [C] Insertion Sort on elements of A has a runtime in $\Omega(N^2)$.

5 [D] Heapsort on elements of A has a runtime in $\Omega(N^2)$.

5 [E] None of the above.

Question 6:
Which statement on Mergesort is correct?

6 [A] There are arrays of varying size N such that Mergesort runs in $\Theta(N^2)$.

6 [B] There are arrays of varying size N such that Mergesort runs in $o(N^2)$.

6 [C] There are arrays of varying size N such that Mergesort runs in $O(N)$.

6 [D] There are arrays of varying size N such that Mergesort runs in $\Omega(N^2)$.

6 [E] None of the above.

Question 7: Which statement on Insertion sort is correct?

7 [A] There are arrays of varying size N such that Insertion Sort runs in $\Theta(N)$.

7 [B] There are arrays of varying size N such that Insertion Sort runs in $\Theta(1)$.

7 [C] There are arrays of varying size N such that Insertion Sort runs in $\Theta(N^3)$.

7 [D] There are arrays of varying size N such that Insertion Sort runs in $\Theta(2^N)$.

7 [E] None of the above.

Question 8: Some sorting algorithms require extra space, apart from the space needed for the original array that needs to be sorted. Which one of the following statements on the space usage of sorting algorithms is correct?

8 [A] Heapsort for sorting an array of size N requires an amount of extra space proportional to N.

8 [B] Insertion Sort for sorting an array of size N requires an amount of extra space proportional to N.

8 [C] Mergesort for sorting an array of size N requires an amount of extra space proportional to N.

8 [D] Quicksort for sorting an array of size N requires an amount of extra space proportional to N.

8 [E] None of the above.

Question 9: The Shellsort algorithm sorts sub-arrays of elements of decreasing distance from each other. These distances are called *increments*. Which statemement on these increments is correct?

9 [A] For every array size N, there is a sequence of increments such that Shellsort runs in $\Theta(N \log N)$.

9 [B] For every array size N, there is a sequence of increments such that Shellsort runs in $\Theta(N)$.

9 [C] For every array size N, there is a sequence of increments such that Shellsort runs in $\Theta(\sqrt{N})$.

9 [D] For every array size N, there is a sequence of increments such that Shellsort runs in $\Theta(N^2)$.

9 [E] None of the above.

Heaps

Question 10: Which statement on the `buildHeap` operation is correct?

10 [A] `buildHeap` calls `percolateUp` only on all internal nodes.

10 [B] `buildHeap` calls `percolateUp` only on all leaf nodes.

10 [C] `buildHeap` calls `percolateUp` only on all nodes with maximal depth.

10 [D] `buildHeap` calls `percolateUp` on all nodes.

10 [E] None of the above.

Question 11: Heaps are usually implemented using arrays. Which of the following statements is correct?
The removal of an element with known array index from an array of size N requires a time in

11 [A] $\Theta(\log N)$

11 [B] $\Theta(N)$

11 [C] $\Theta(1)$

11 [D] $\Theta(N^2)$

11 [E] None of the above.

Hash Tables

Question 12: Consider a hash table using separate chaining for storing integer values in the range from 0 to 9999. Consider a table size (size of the array) of 1000. Which statement about the linked lists of the hash table is correct.

12 [A] One of the linked lists can reach a size of 10, but not more.

12 [B] One of the linked lists can reach a size of 100, but not more.

12 [C] One of the linked lists can reach a size of 1000, but not more.

12 [D] One of the linked lists can reach a size of 10000.

12 [E] None of the above.