The LNM Institute of Information Technology, Jaipur

CS325 Design and Analysis of Algorithm

Quiz-I **Tuesday, Feb 13, 2018**

Time: 45 Minutes Maximum Marks: 40

Name: _____ Roll No:_____

Read the Instructions Carefully:
All are objective questions with 4 choices. There may be more than one correct answers. Each question carry three marks. You need to select all the correct answers to get full marks. For example, if a question has 2 correct choices and you did only one correctly you will get 1 mark. If out of your choices even one choice is wrong then there won't be any marks given (even if there are correct choices that you have made). So be careful when you are finding and marking the correct choices. **Encircle all the correct answer/s. Any other marking will be considered as invalid**. Do not write anything in the answer sheet except the answer. No justification is required. **There is no negative marking for wrong answer/s.**

1. There are two functions f and g defined by $f(n) = 2^{2n}$ and $g(n) = 2^n$. Pick the correct answer(s) from the following:
   (a) $f(n) = \mathcal{O}(g(n))$
   (b) $f(n) = \Theta(g(n))$
   (c) $f(n) = \Omega(g(n))$
   (d) None of the above
2. Which is the correct order of the following algorithms with respect to their time complexity in the best case ?
   (a) Merge sort > Quick sort > Insertion sort > selection sort
   (b) insertion sort < Quick sort < Merge sort < selection sort
   (c) Merge sort > selection sort > quick sort > insertion sort
   (d) Merge sort > Quick sort > selection sort > insertion sort
3. When RANDOMIZED-QUICKSORT runs, how many calls are made to the random number generator RANDOM in the best case?
   (a) $\Theta(n)$
   (b) $\Theta(n \log n)$
   (c) $\mathcal{O}(n^2)$
   (d) $\Theta(\log n)$
4. Suppose we are sorting an array of eight integers using quicksort, and we have just finished the first partitioning with the array looking like this:

   $$2, 5, 1, 7, 9, 10, 12, 11$$

   Which statement(s) is (are) correct and how?
   (a) The pivot could be 7
   (b) The pivot could be 9
   (c) The pivot could be 10
   (d) This situation cannot arise

5. Consider the following recurrence equation:

$$T(n) = 2T(n-1) + 1$$

What is $T(n)$?

(a) 2^n

(b) 2^{2^n}

(c) n^2

(d) $\log n$

6. Donald Knuth conducts a quiz for his DAA students of strength 100. Quiz is for total marks of 15. He has the list of marks together with the names of the students listed in alphabetical order. He would like to do a sorting on the basis of the marks scored. Which sorting is best suited for this purpose?

(a) Insertion Sort

(b) Quicksort

(c) Heapsort

(d) Counting Sort

7. What is the best case complexity of heapsort algorithm?

(a) $\mathcal{O}(n)$

(b) $\mathcal{O}(n \log n)$

(c) $\mathcal{O}(\log n)$

(d) $\mathcal{O}(n^2)$

8. What is the worst-case running time complexity of bucket sort?

(a) $\mathcal{O}(n \log n)$

(b) $\mathcal{O}(n)$

(c) $\mathcal{O}(n^2)$

(d) $\mathcal{O}(n^2 \log n)$

9. Multiplication algorithm that we had studied for multiplying two n-bit numbers is called as Karatsuba's algorithm. Which of the following statement(s) is (are) NOT true about Karatsuba's algorithm?

(a) It can only be applied to two integers of same size

(b) It can be only applied to integers of size n where $n = 2^k$

(c) It can be only applied to integers of same size and the size is of the form $n = 2^k$

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10. Consider the following recurrence equation:

$$T(n) = 2T((n/2) + 17) + n$$

What is $T(n)$?

(a) $\mathcal{O}(n \log n)$

(b) $\log n$

(c) n^2

(d) $\log^2 n$

11. What is the maximum number of nodes at height h in any n-element heap?
    (a) $n/2^h$
    (b) $n/2^{h+1}$
    (c) $n/2^{h-1}$
    (d) $n/2^{2^h}$

12. An Airline stores the PNR of its passengers as a five letter English alphabet. It has already stored this information in its database. Now it intends to sort it with respect to the PNR. What sorting method would be ideal for this situation?
    (a) Bucket Sort
    (b) Counting Sort
    (c) Radix Sort
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13. Which of the following sorting algorithms are stable: insertion sort, merge sort, heapsort, and quicksort?
    (a) Only insertion sort is stable
    (b) insertion sort and heapsort are both stable but not others
    (c) insertion sort and quicksort are both stable but not others
    (d) insertion sort and merge sort are both stable but not others

14. Which is asymptotically larger: $f(n) = \log(\log^* n)$ or $g(n) = \log^*(\log n)$?
    (a) $f(n)$
    (b) $g(n)$
    (c) Both are growing almost at the same pace
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15. Strassen's multiplication algorithm works for two square matrices of size $n \times n$. How about multiplying two non-square matrices? Pick the correct choice in the following:
    (a) For non-square matrices it won't work
    (b) Make it as square matrices by padding with extra zeroes and then apply Strassen's method
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16. There are two functions f and g defined by $f(n) = 2^{n+1}$ and $g(n) = 2^n$. Pick the correct answer(s) from the following:
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17. In Heapsort algorithm if instead of using BUILD-MAX-HEAP algorithm we use MAX-HEAP-INSERT algorithm to build the heap what will be the resulting complexity of the Heapsort algorithm?

    (a) $\mathcal{O}(n \log n)$

    (b) $\mathcal{O}(n^2 \log n)$

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18. When RANDOMIZED-QUICKSORT runs, how many calls are made to the random number generator RANDOM in the worst case?

    (a) $\Theta(n)$

    (b) $\Theta(n \log n)$

    (c) $\mathcal{O}(n^2)$

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19. What is the maximum number of counting inversions possible in a given sequence of n numbers?

    (a) n

    (b) $n(n-1)/2$

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Answer Key for Exam A

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Answer Key for Exam B

1. Which is the correct order of the following algorithms with respect to their time complexity in the best case ?

   (a) Merge sort > Quick sort > Insertion sort > selection sort

   (b) insertion sort < Quick sort < Merge sort < selection sort

   (c) Merge sort > selection sort > quick sort > insertion sort

   (d) Merge sort > Quick sort > selection sort > insertion sort

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