Dhirubhai Ambani Institute of Information and Communication Technology

M.Tech (CSE)

Sample Question Paper

1. If a fair dice is rolled twice, what is the probability that an odd number follows an even number?
   (a) 0.25
   (b) 0.5
   (c) 0.75
   (d) 1

2. The probability density function of a random variable X is given by:

   $f_X(x) = \begin{cases} k & a \le x \le b \\ 0 & \text{otherwise} \end{cases}$

   where k is constant. If a = -1 and b=2, then P(|x| <= c) for c = $\frac{1}{2}$ is
   (a) $\frac{1}{4}$
   (b) $\frac{1}{3}$
   (c) $\frac{1}{2}$
   (d) $\frac{3}{4}$

3. A car manufacturing company has two plants A and B. Plant A manufactures 60 percent of the cars and plant B manufactures 40 percent of the cars. 80 percent of the cars at plant A and 90 percent of the cars at plant B are rated of standard quality. A car is chosen at random and is found to be of standard quality. What is the probability that it is manufactured at plant A?
   (a) 2/7
   (b) 4/7
   (c) 3/7
   (d) 1/7

4. The number of observations smaller than _____ is the same as the number of observations larger than it.

   (a) Median
   (b) Mode
   (c) Mean
   (d) None of the above

5. Let $\mathbf{x}$ be a non-zero column vector of size n × 1. The dimension and rank of matrix $\mathbf{A} = \mathbf{x}\,\mathbf{x}^{\mathrm{T}}$, where $\mathbf{x}^{\mathrm{T}}$ denotes the transpose of $\mathbf{x}$, are respectively

   (a) n×n and n
   (b) 1×1 and n^2
   (c) 1×1 and 0
   (d) n×n and 1

6. Consider a differential equation $\frac{d^2y}{dx^2} = -4y$. When x=0, then y=5 and $\frac{dy}{dx} = 0$. The expression of y is

   (a) $y = 4\sin(5x)$
   (b) $y = 10x$
   (c) $y = 5\cos(2x)$
   (d) $y = 2\sin(5x) + 5\cos(2x)$

7. What does the following program print?

```
#include <stdio.h>
  void f1(int a, int b)
  {
     int c;
     c=a; a=b; b=c;
  }
  void f2(int *a, int *b)
  {
     int c;
     c=*a; *a=*b; *b=c;
```

```
}
int main()
{
    int a=3, b=1, c=2;
    f1(a,b);
    f2(&b, &c);
    printf("%d",c+a-b);
}
```

(a) 8
(b) 1
(c) 3
(d) 2

8. What does the following program print?

```
#include <stdio.h>
   int main( )
   {
     int a[ ] = {5, 6, 7, 8, 9};
     int *p[ ] = {a, a+3, a+4, a+1, a+2};
     int **ptr = p;
     ptr++;
     printf("%d",**ptr);
   }
```

(a) 4
(b) 8
(c) 3
(d) 9

9. What will be the output of the following C program?

```
void count(int n)
{
        static int d=1;
        printf("%d ", n);
        printf("%d ", d);
        d++;
        if(n>1) count(n-1);
```

```
        printf("%d ", d);
}
void main()
{
        count(3);
}
```

(a) 3 1 2 2 1 3 4 4 4
(b) 3 1 2 1 1 1 2 2 2
(c) 3 1 2 2 1 3 4
(d) 3 1 2 1 1 1 2

10. Which keyword is used to prevent any changes in the variable within a C program?
(a) immutable
(b) mutable
(c) constant
(d) volatile

11. What will be the output of the following C code snippet?

```
#include <stdio.h>
   int main()
   {
      3 < 4 ? printf("%d", 3) : printf("%d", 4);
   }
```

(a) 3
(b) 4
(c) Compile-time error
(d) Run-time error

12. Which data structure is used for implementing recursion?
a) Stack
b) Queue
c) List
d) Array

13. What does the following code snippet do? Assume that x is positive and less than or equal to the total number of nodes in a single linked list.

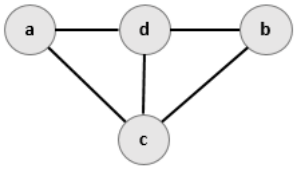
```
ListNode* findNode(ListNode* head, int x) {
        ListNode* front = head;
        int count = 1;
        while(front != NULL) {
                printf("%d  %d", front -> data,  head -> data);
                if(count <= x) {
                        front = front -> next;
                }
                else {
                        head = head -> next;
                        front = front -> next;
                }
                count++;
        }
        return head;
}
```

(a) Find x^{th} node from the beginning of the list
(b) Find x^{th} node from the end of the list
(c) Find $(x-1)^{th}$ node from the beginning of the list
(d) None of the above

14. What will be the postorder traversal of the binary tree if the preorder and inorder traversals are ABCDEF and BADCFE, respectively?
    (a) BDFECA
    (b) BDFEAC
    (c) BDAFEC
    (d) None of the above

15. What is the best case complexity in building a binary heap data structure?
    (a) O(n)
    (b) O(n log n)
    (c) $O(n^2)$
    (d) O(log n)

16. Consider the graph below. How many spanning trees can be found?



(a) 7
(b) 8
(c) 10
(d) 9

17. Which of the following statements is correct?

(a) $|A \cup B| = |A| + |B|$.
(b) $|A \cup B| + |A \cap B| = |A| + |B|$.
(c) $|A \cup B| = |A| + |B| + |A \cap B|$.
(d) $|A \cup B|^2 = |A|^2 + |B|^2 + 2|A| \cdot |B|$

18. In a sport shop, there are T-shirts, shorts, and socks of 5 different colors. How many different uniforms can you compose, assuming that the color of the T-shirt and short should be the same.

(a) 25
(b) 125
(c) 15
(d) 5

19. n boys and n girls go out to dance. In how many ways can they all dance simultaneously? We assume that only couples of different sex dance with each other.

(a) $n!$
(b) n^2
(c) $2n$

(d) n^n

20. Let S = {a, b, c} be a set, and R ⊆ S × S be a relation on it. Which of the following statements is correct?

(a) If R is reflexive, then it has cardinality at least three.

(b) If R is symmetric, then it has cardinality at least two.

(c) If R is transitive, then it has cardinality at least three.

(d) R has cardinality at least one.

21. Given two arbitrary positive integers a and b, which of the following is correct.

(a) GCD(a, b) is always greater than a and b.
(b) LCM (a, b) is always greater than a and b.
(c) LCM (a, b) is 1 when a and b are both prime.
(d) GCD(a, b) × LCM (a, b) = a × b.

22. Consider the function f (n) = n^2 /2− 100n − 5. Which of the following statements is correct?

(a) f (n) is $O(n^2)$, and f (n) is $\Omega(n^2)$.
(b) f (n) is $O(n^2)$, but f (n) is not $\Omega(n^2)$.
(c) f (n) is $\Omega(n^2)$, but f (n) is not $O(n^2)$.
(d) f (n) is neither $O(n^2)$ nor $\Omega(n^2)$.

23. Consider the equation T (n) = c, if n = 1. T (n) = 2T (n/2) + O(n), if n > 1. If c is a constant, then which of the following statements is correct.

(a) $T(n)$ is $O(\log n)$
(b) $T(n)$ is $O(n \log n)$
(c) $T(n)$ is $O(n^2)$
(d) $T(n)$ is $O(n \log^2 n)$

24. Suppose we are given a sorted list of n numbers. How much time is required to find whether the list contains a number k or not.

(a) $O(n \log n)$
(b) $O(n^2)$
(c) $O(\log n)$
(d) $O(n)$

25. Quick sort algorithm is based on which of the following approaches?

(a) Greedy approach.
(b) Divide and conquer.
(c) Amortization.
(d) Dynamic programming.

26. Given a heap of size n, which of the following statements is true.

(a) The height of the heap is $O(n^2)$.
(b) The height of the heap is $O(n)$.
(c) The height of the heap is $O(n \log n)$.
(d) The height of the heap is $O(\log n)$.

27. Let $L = \{0^n 1^n \mid n \geq 1\}$. Which of the following options is correct?

(a) L is context-free but not regular
(b) L is regular but not context-free
(c) L is both context-free and regular
(d) L is neither context-free nor regular

28. Which of the following is correct?

(a) Each finite language is context-free
(b) Each context-free language is finite
(c) Each infinite language is context-free
(d) Each context-free language is infinite

29. Consider a system of simultaneous linear equations in three variables. Then which of the following is impossible:

    (a) The system has no solution
    (b) The system has exactly one solution
    (c) The system has exactly three solutions
    (d) The system has infinitely many solutions

30. Consider a system of linear equations that has no solution. Which of the following changes to the system will possibly allow it to have a solution?

    (a) Remove one equation from the system
    (b) Multiply each equation in the system by -1
    (c) Divide each equation in the system by the largest non-zero scalar multiplier of the different variables
    (d) Rearrange the order of equations in the system

31. Consider a vector space V of Dimension 3 and any 5 of its distinct subspaces $U_1, \ldots, U_5$. Which of the following is true?

    (a) The union of every pair of subspaces from $U_1, \ldots, U_5$ is also a subspace of V
    (b) The union of at least one pair of subspaces from $U_1, \ldots, U_5$ is a subspace of V
    (c) At least two subspaces from $U_1, \ldots, U_5$ have the same dimension
    (d) The intersection of some two distinct subspaces from the list $U_1, \ldots, U_5$ is also in that list of subspaces

32. Consider a list L of non-zero vectors from a vector space V. Which of the following conclusions is correct?

    (a) L is linearly independent implies L spans V
    (b) L spans V implies it is linearly independent

(c) L spans V implies they are pairwise orthogonal

(d) The vectors in L are pairwise orthogonal implies they are linearly independent

33. A TCP sender is transmitting data to a receiver. The initial congestion window size is 2KB and the threshold is 16KB. Maximum segment size is 64KB. Assume that the current RTT estimate is 320ms. The next RTT value measured by the sender is 400ms. Assuming the smoothing parameter (weight given to the sample value) $\alpha = 0.125$, what is the estimated RTT value for the following packet sent?

(a) 360
(b) 380
(c) 350
(d) 330

34. Two stations A and B are connected to each other on a shared Ethernet bus. The protocol in use in 1-persistent CSMA/CD with binary exponential backoff. Assume that both stations have packets waiting to be sent. What is the probability that one of the stations succeed in the third attempt after two collisions?

(a) 1/8
(b) 2/8
(c) 3/8
(d) 4/8

35. A NAT server for an organization has an IP address 128.97.64.120. An internal node with local address 10.100.1.20 has an active TCP HTTP connection at local port 8080 with an external server with IP address 64.125.1.100. Which of the following would be a valid entry in the table at the NAT server?

(a) srcIP=128.97.64.120, srcPort=8080, NATport=8090
(b) srcIP=128.97.64.120, srcPort=80, NATport=8090
(c) srcIP=10.100.1.20, srcPort=80, NATport=8090
(d) srcIP=10.100.1.20, srcPort=8080, NATport=8090

36. For a TCP segment, the following flag combination is not valid:

(a) SYN=1, ACK=1
(b) SYN=1, FIN=1
(c) SYN=1, ACK=0
(d) ACK=1, URG=1

37. Suppose relation R (A, B) has tuples { (1,2), (1,2), (3,4) } and relation S (B, C) has tuples { (2,5), (2,5), (4,6), (7,10) }. Pick up the result of the SQL query:

SELECT * FROM R NATURAL OUTER JOIN S

(a) {(1,2,2,5), (1,2,2,5), (1,2,2,5), (1,2,2,5), (3,4,4,6)}
(b) {(1,2,5), (1,2,5), (1,2,5), (1,2,5), ((3,4,6)}
(c) {(1,2,5), (1,2,5), (3,4,6), (NULL,7,10)}
(d) {(1,2,5), (1,2,5),(1,2,5), (1,2,5), (3,4,6), (NULL,7,10)}

38. The relation R(A,B,C,D,E) and Functional Dependencies F= {A->D, B->E,DE->C} are given. For Fragment set R1(A,B,C) obtained during the schema refinement of R. The Functional Dependencies holding on R1 are:
(a) Only AB->C
(b) A->B, B->C, C->A
(c) Only Trivial dependencies A->A, AB->B, AC->C
(d) None of the above

39. T = {SSN, Employee_name, Parking_ Lot, Rating, Hours_Worked, Hourly_ Wages} and the Functional Dependency FD set F for T is {SSN → T, Rating → Hourly_Wages}. T is decomposed into T1= {SSN, Employee_name, Parking Lot, Rating, Hours_Worked} and T2 = {Rating, Hourly_Wages} by Schema Refinement.

The decomposition of T into T1 and T2 is lossless with respect to set of FDs F because:

(a) T1 ∩ T2 forms a superkey of T1
(b) T1 ∩ T2 forms a superkey of T2
(c) T1 ∩ T2 does not form a superkey of T1 or T2

(d) T1 ∩ T2 forms a superkey of both T1 and T2

40. Transaction T1 adds 500 to the value of the database elements A, B, C. Transaction T2 doubles the value of the database element A, B, C. T3 multiplies the value of the database elements A, B, C by 10. Consider the following interleaved schedule S of committed transactions T1, T2, and T3.

S: R1(A), W1(A), R2(A), W2(A), R2(B), W2(B), R3(C), R2(C), W2(C), W3(C), R1(B), W1(B)

Note: R and W are Read and Write actions of the transactions T1, T2, and T3.

Consider that values of A, B, C equal to 25 each at time t=0. Values of A, B, C at the end of schedule S are:

(a) A=1050, B=1050, C=500
(b) A=500, B=250, C=500
(c) A=1050, B= 550, C=250
(d) Values A, B, and C cannot be calculated because of insufficient information