

Entrance Examination - 2021

Ph.D. in Computer Science

Time: 2 Hours

Max. Marks: 70

Hall Ticket Number:

INSTRUCTIONS

1. Write your Hall Ticket Number in the above box **and** on the OMR Sheet.
2. This test is for **2 hours duration** carrying **70 marks**.
3. Every correct answer gets **1 (one) mark**. There is **NO NEGATIVE MARKING**.
4. This test is objective type and has two parts: Part A contains 35 questions on Research Methodology, and Part B contains 35 questions on Computer Science. Please make sure that all the questions are clearly printed in your paper.
5. All answers should be marked clearly in the OMR answer sheet only.
6. Do not use any other paper, envelope etc. for writing or doing rough work. All the rough work should be done in your question paper or on the sheets provided with the question paper at the end.
7. During the examination, anyone found indulging in copying or have any discussions will be asked to leave the examination hall.
8. Use of non-programmable calculator and log-table are allowed.
9. Use of mobile phone is **strictly prohibited** inside the hall.
10. Submit the OMR sheet to the invigilator before leaving the examination hall.

Part A – Research Methodology

- Train A, running on a track with speed a meters per second is x meters long. Train B running on a parallel track is y meters in length, and running at b meters per second. The time t taken for train A to cross a man sitting in train B:
 - Is indeterminate due to missing information
 - Is $t = \frac{(a+b)}{x}$
 - Is $t = \frac{x}{(a+b)}$
 - Is $t = \frac{(x+y)}{(a+b)}$
- Which of the following is *not* the name of a DNN (deep neural network):
 - VGG16
 - Necocognitron
 - Alexnet
 - Manet
- A non-linear function is required to "saturate" the sum of weighted inputs (here we use variable x) when being used in a unit activation function for DNN. Which of the following activation functions **does not** saturate for all x .
 - $y(x) = \tanh x$
 - $y(x) = a, (x \geq 0)$ or 0 otherwise
 - $y(x) = \frac{1}{1+e^{-x}}$
 - $y(x) = x$
- How many times does the function $f(x) = 2^{x(x-5)} - 5$ cut the X-axis?
 - 0
 - 1
 - 2
 - 5

Answer the questions Q. 5 to Q. 8 by reading the passage given below.

The problem of sorting a mass of items, occupying consecutive locations in the store of a computer, may be reduced to that of sorting two lesser segments of data, provided that it is known that the keys of each of the items held in locations lower than a certain dividing line are less than the keys of all the items held in locations above the dividing line. In this case the two segments may be sorted separately, and as a result the whole mass of data will be sorted.

In practice, the existence of such a dividing line will be rare, but even if it did exist, and its position would be unknown. It is, however, quite easy to rearrange the items in such a way that a dividing line is brought into existence, and its position is known. The method of doing this has been given the name *partition*.

The first step of the partition process is to choose a particular key value which is known to be within the range of keys of the items in the segment which is to be sorted. A simple method of ensuring this is to choose the actual key value of one of the items in the segment. The chosen key value will be called the *bound*. The aim is now to produce a situation in which the keys of all the items above the dividing line are equal to or greater than the bound. Fortunately, we do not need to know the position of the dividing line in advance; its position is determined only at the end of the partition process.

5. What sorting algorithm is described in the passage above?
 - A. Insertion sort
 - B. Quicksort
 - C. Merge sort
 - D. Heap sort
6. What does the method named as *partition* do?
 - A. Rearranges the items such that they are sorted
 - B. Rearranges the items such that a dividing line comes into existence
 - C. Moves all smaller elements to one end of the list
 - D. Moves the dividing line to the end of the list
7. When is the position of the dividing line determined?
 - A. At the beginning of the sorting process
 - B. In the middle of the sorting process
 - C. At the end of the partition process
 - D. It is fixed and is programmed as a parameter
8. By what name is the *bound* more popularly known today?
 - A. Pivot
 - B. Partition
 - C. Min-heap
 - D. Big-Oh
9. The classic book on C language titled, "*The C Programming Language*", is written by
 - A. Kernighan and Ritchie
 - B. Bill Gates
 - C. Yeshwant Kanitkar
 - D. Balaguruswamy
10. Which of the following companies in recent times are referred to as the *Big Four* in the IT industry?

- A. Amazon, Apple, Microsoft, IBM
B. Apple, Microsoft, Google, Facebook
C. Amazon, Google, IBM, Facebook
D. Microsoft, Google, Facebook, IBM.
11. Which of the following is **not** a browser software produced by Microsoft?
A. Internet Explorer
B. Edge
C. Opera
D. All of the above
12. "If we move these items from Set P and place them into Set Q , the average value of both the sets P and Q will increase." Which of the following statements is **false** with regards to the items moved from Set P to Set Q ?
A. The average value of the items is higher than the average value of Set P
B. The average value of the items is lower than the average value of Set P
C. The average value of the items is higher than the average value of Set Q
D. None of the above
13. The monthly expenditure of a household, when analysed, was found to fit a quadratic function $e(x) = ax^2 + bx + c$. Assuming that the monthly expenditure can never be negative (in the past or in the future), what can we say about the roots of $e(x)$?
A. Both are real
B. Both are complex numbers
C. One is real and one is complex
D. One is real and negative, the other is real and positive
14. "In this statement there are exactly _____ three-letter words not more no less." Fill the correct option from below to make the complete sentence **true**.
A. Two
B. Three
C. Four
D. Cannot be correctly filled
15. Which of these computer scientists is credited with the idea of the world wide web of documents using hypertext.
A. Tim BernersLee
B. Vincent Van Gogh
C. Vinton Cerf
D. Dennis Ritchie

16. Dennis Ritchie and his colleague were known for the C language and also Unix operating system. The name of his famous colleague is:
- A. James Gosling
 - B. Steve Jobs
 - C. William Gates
 - D. Kenneth (Ken) Lane Thompson
17. Consider the various display standards like SVGA, VGA, WXGA, XGA and Full HD. Which of these is closest to one mega pixels (approximately 1×10^6 pixels)?
- A. VGA
 - B. 1080p
 - C. WXGA
 - D. 1440p
18. The name best used to describe a graph $G=(V,E)$ which is drawn on a paper without folding it such that no two edges of G intersect at a point other than a vertex:
- A. Bar Graph
 - B. Planar Graph
 - C. All bipartite graphs
 - D. Colored graph
19. A computer scientist wished to share a secret code password on an open sheet of paper by leaving the paper at a public location for his friend. So he wrote this on the paper: "watchout for the odd one. RACECAR, MURDRUM, SAGAS, ATTACK and REPAPER". Then he left the paper at the agreed upon location. The other day his friend looked at the sheet and smiled as he had got the code. Which of the following should be the codeword?
- A. ATTACK
 - B. RACECAR
 - C. MURDRUM
 - D. REPAPER
20. A customer is waiting to be served at a restaurant. The waiting times at this restaurant have an exponential distribution with a mean waiting time of 5 minutes. The probability that a customer will spend more than 10 minutes at restaurant is :
- A. 0
 - B. 1
 - C. e^{-2}
 - D. e^{-10}
21. A function "f" is defined as $f: \{a, b\}^4 \rightarrow \{a, b\}$. If T represents the number of functions from f to the set $\{a, b\}$, then the value of $\log_2(\log_2 T)$ is _____

- A. 2
B. 4
C. 8
D. 16
22. Name the odd one out from the following:
A. Microprocessor
B. Memory
C. Hard disk
D. Laptop
23. The set N represents all-natural numbers and R be the relation on $N \times N$ defined by $(p, q)R(r, s)$ iff $ps(q + r) = qr(p + s)$. The relation R is _____
A. Reflexive and Not Transitive
B. Reflexive, Transitive but not Symmetric
C. Partial Order
D. Equivalence
24. Which of the following are examples of ordinal variables?
A. Rankings, course grades, height
B. ID numbers, eye color, zip codes
C. Calendar dates, temperatures in Celcius, phone numbers
D. Temperature in Kelvin, time, counts
25. Which of the following are examples of data quality problems?
A. Noise and outliers
B. Duplicate data
C. Missing values
D. All of the Above
26. In data standardization assuming a Gaussian distribution, the feature values will be rescaled with parameters
A. Mean 0 and Variance 0
B. Mean 0 and Variance 1
C. Mean 1 and Variance 0
D. Mean 1 and Variance 1
27. Which of the following is a standard approach to handle missing values in the dataset?
A. Delete the observation that contains the missing data

- B. Imputation with mean/median/mode value
C. Taking missing values into a new row or column
D. All of the above
28. Generally, an outlier in a population is far away from the mean of the population. Identify the outlier for the given data? 28, 34, 27, 7, 30, 26, 23, 31, 34
- A. 23
B. 34
C. 7
D. 27
29. In left-skewed data, which of the following is correct
- A. mean < median < mode
B. mode < median < mean
C. mean < mode < median
D. mode < mean < median

Answer the questions Q. 30 to Q. 32 by reading the information in points given below.

- Seven friends B, R, A, V, C, S and W have gathered at the University of Hyderabad main gate.
 - Five of them are scheduled to go to five different places in Hyderabad i.e., Gachibowli, Mehdiapatnam, Banjara Hills, Jubilee Hills, Osmania University.
 - Five of them are academicians, each specializing in Network Science, Pervasive Computing, Pattern Recognition, Image Processing, Rough Sets.
 - C, an academician, is going to Mehdiapatnam and is neither from Network Science nor from Rough Sets.
 - R is an academician and specialized in Pervasive Computing but has come to the main gate to see off her friend.
 - W is specialized in Data Science and is going to Gachibowli. S is an academician but is not going to any of the five places.
 - B is an academician, not from Rough Sets and is flying to one of the destinations but not to Jubilee Hills or Osmania University
 - A is an academician specialized in Pattern Recognition and is not going to Osmania University
30. The one who is going to Mehdiapatnam is
- A. Not an academician
B. From Image Processing
C. V

- D. From Network Science
31. Who among the following specializes in Rough sets?
- A. V
 - B. B
 - C. S
 - D. Data inadequate
32. To which of the following place is R flying?
- A. Jubilee Hills
 - B. Osmania University
 - C. Gachibowli
 - D. Mehdipatnam
33. A partially ordered relation R on a set A is
- (a) Reflexive
 - (b) Symmetric
 - (c) Transitive
 - (d) Anti-symmetric
- A. a, b and c
 - B. a and d
 - C. a, c and d
 - D. c and d
34. Number of values of x that satisfy the equation $(x^2 + 6x + 12)^{(x^2 - 7x + 12)} = 1$ are
- A. 1
 - B. 2
 - C. 4
 - D. infinite
35. The number of subsets of $\{1, 2, 3, \dots, t\}$ of odd cardinality is _____
- A. dependent on the value of t
 - B. 2^{t-1} , if t is odd
 - C. 2^{t-1} , if t is even
 - D. 2^{t-1} , for any value of t.

LOOK TO THE NEXT PAGE FOR PART B →

PART - B: Computer Science

36. Express the solution of the following recurrence relation in Θ notation.

$$T(n) = 3T(n/2) + n, \quad n > 1 \text{ and } n \text{ is power of } 2, \quad T(1) = 1$$

- A. $\Theta(n)$
- B. $\Theta(n^2)$
- C. $\Theta(\log n)$
- D. $\Theta(n \log n)$

37. Solve the recurrence relation completely using the initial conditions.

$$T(n) = \begin{cases} n & \text{if } n = 0 \text{ or } n = 1 \\ 5T(n-1) + 6T(n-2) & \text{Otherwise} \end{cases}$$

- A. $3^n + 2^n$
- B. $4^n + n$
- C. $2n + 3n^2$
- D. $3^n - 2^n$

38. Find the language of the grammar on $\Sigma = \{a, b\}$ given below.

$$S \rightarrow aB \mid bA \mid \epsilon$$

$$A \rightarrow aS$$

$$B \rightarrow bS$$

- A. $(ab + ba)^*$
 - B. $(ab)^* + (ba)^*$
 - C. $b^* + a^*$
 - D. $(aa + ab + ba + bb)^*$
39. What is the length of the smallest string that does NOT get accepted by the Regular Expression $(a + (ba)^*)b^*$.
- A. 1
 - B. 2
 - C. 3
 - D. 4
40. Which of the following Regular Expressions represent the language in $\{0, 1\}^*$ of all strings containing atleast two 0's.

- A. $1^*01^*01^*$
- B. $1^*(01^*0)^+1^*$
- C. $1^*(00)^+1^*$

- D. $(0 + 1)^*0(0 + 1)^*0(0 + 1)^*$
41. Which one of the following languages on $\Sigma = \{a, b\}$ CANNOT be recognized by a Push Down Automaton?
- A. $\{a^m b^n : m < n, m, n \geq 0\}$
 - B. $\{a^i b^j : i \neq j\}$
 - C. $\{a^i b^{2i} : i \geq 0\}$
 - D. $\{a^m b^n a^m b^n, m, n \geq 0\}$
42. Suppose computers A and B have IP addresses 10.105.1.113 and 10.105.1.91 respectively and they both use the same netmask N. Which of the values of N given below should not be used if A and B should belong to the same network?
- A. 255.255.255.0
 - B. 255.255.255.128
 - C. 255.255.255.192
 - D. None of the above
43. The number of tuples in a relation is called as:
- A. Cardinality of that relation
 - B. Degree of that relation
 - C. Domain of an attribute in that relation
 - D. None of the above
44. Suppose you are creating two tables T1 and T2. T1 has a foreign key referencing to one of the attributes of T2. Which table you should create first?
- A. T1
 - B. T2
 - C. Any one of T1, T2
 - D. No such requirement
45. In a database, there are 10 relations. 5 relations are in 4NF, 2 relations are in 3NF and 3 relations are in BCNF. What is the highest normal form satisfied by the database?
- A. 2NF
 - B. 3NF
 - C. BCNF
 - D. 4NF
46. Which of the following properties are desirable during the process of decomposition of a database?
- A. Lossless join property

- B. Dependency preserving property
C. Both A and B above
D. None of the above
47. Select the right `getchar` statement that reads the char `a` from the standard input device of the computer.
- A. `getchar(&a);`
B. `getchar(a)`
C. `a=getchar();`
D. `a=getchar(stdin)`
48. What is the Hamming distance between 110111101101 and 100101000110?
- A. 6
B. 7
C. 8
D. 9
49. Find the protocol which maps a network interface IP address to its hardware address:
- A. RARP
B. ICMP
C. ARP
D. IGMP
50. Consider the following code snippets while assuming all the variables are shared between processes P1 and P2, state which of the following statement(s) is/ are true

```
P1()  
{  
    C=B-1;  
    B=2*C;  
}  
P2()  
{  
    D=2*B;  
    B=D-1;  
}
```

- (a) Process synchronization is required to avoid inconsistency as the variable B is shared by both process P1 and P2.
(b) No process synchronization is required. The processes will be executed concurrently and properly.

- (c) Process synchronization is not required as it will degrade the performance
- (d) Process synchronization will not be able to avoid inconsistency as B will give different values depending on the order of execution of the processes

- A. (b) and (c)
- B. (a) and (d)
- C. (a) only
- D. (c) only

51. In a Linux environment, how many times 'hello' will be printed when the code below is executed?

```
main()
{
fork();
fork();
fork();
fork();
printf("hello");
}
```

- A. 4 times
- B. 8 times
- C. 16 times
- D. Infinite times

52. Which of the following statements are true?

- (a) Cloud computing is a service based virtualisation.
- (b) Virtualisation can exist without cloud computing
- (c) A hypervisor is a type of virtualisation

- A. a, b and c
- B. only a and b
- C. only a and c
- D. only b and c

53. Consider the following recurrence relation: $x_{n+1} = x_n + x_{n-1}$ This recurrence computes which of the following?

- A. $n!$
- B. Taylor series
- C. Geometric series
- D. Fibonacci series

54. If we say that the round robin algorithm's quantum of time is 10ms and the context switch time is 100ms, which of the following statements is TRUE?
- A. The CPU is idle most of the time
 - B. Response time of the process is improved
 - C. CPU is held by the OS most of the time
 - D. None of the above
55. Which of the following scheduling algorithms does NOT lead to starvation?
I. Priority II. SJF III. Round Robin
- A. I only
 - B. III only
 - C. II and III
 - D. All three
56. A process exited. Which of the following statements best defines the *zombie state* for this process
- A. A process whose parent has not yet waited for its termination status
 - B. A process whose parent has died
 - C. A process that lives forever
 - D. None of the above
57. The number of distinct Boolean expressions for 4 variables is
- A. 16
 - B. 256
 - C. 1024
 - D. 65536
58. The size of main memory is 32K x 16 bits. The number of address lines is
- A. 16
 - B. 15
 - C. 14
 - D. 13

Answer the questions 59 -61 based on the following C function. The `funcB()` takes an array `a` and three indices `l`, `m` and `r`. If the sub lists `a[l..m]` and `a[m+1..r]` are sorted (non-decreasing order), the function call `funcB(a, l, m, r)` makes the sub list `a[l..r]` in sorted order in time linear in the length of sublist.

```

void funcA(int n, int a[])
{
    for(int i = 1; i < n; i = i * 2)
    {
        int l = 0, m = l + i - 1, r = m + i;
        while(m < n - 1)
        {
            if (r >= n)
            {
                r = n - 1;
            }
            funcB(a, l, m, r);
            l = l + 2 * i;
            m = m + 2 * i;
            r = r + 2 * i;
        }
    }
}

```

59. If the array is $a = 20, 44, 18, 32, 16, 4, 9, -12, 7, 102$ what is the array after 2 iterations of outer loop indexed by i ?
- 18, 20, 32, 44, -12, 4, 9, 16, 7, 102
 - 18, 20, 32, 44, -12, 4, 7, 9, 16, 102
 - 12, 4, 7, 9, 16, 18, 20, 32, 44, 102
 - 20, 44, 18, 32, 4, 16, -12, 9, 7, 102
60. If the array $a = 16, 12, 8, 32, 102, -20, -40, 64, 72, 102, 112, 115$. What is the array after 3 iterations of the outer for loop indexed by i ?
- 40, -20, 8, 12, 16, 32, 64, 72, 102, 102, 112, 115
 - 40, -20, 8, 12, 16, 32, 64, 102, 72, 102, 112, 115
 - 12, 16, 8, 32, -20, 102, -40, 64, 72, 102, 112, 115
 - None of the above
61. What is the time complexity of the function `funcA()`?
- $O(n)$
 - $O(n \log n)$
 - $O(n^2)$
 - $O(n^2 \log n)$
62. How do you declare a pointer to an array of 10 constant integers?
- `const int (*p) [10]`
 - `int const (*p) [10]`
 - `const int *p [10]`

D. int const *p [10]

63. An user defined data type is created using C structure in the following way. What is (are) the valid names of new data type?

```
struct Student
{
    char rollNo[10];
    char name[20];
    double cgpa;
};
typedef struct Student STD;
```

- A. Only STD
 B. STD and Student
 C. STD and struct Student
 D. Only struct Student

64. Consider the following:

```
#include <stdio.h>
int main()
{
    int i,j;
    j=2;
    scanf("%d",&i);
    while((i%j)!=0)
    { j=j+1; }
    if(j<i) printf("%d",j);
    return 0;
}
```

If $(i \geq 2)$, then the value of j, will be printed only if:

- A. i is prime
 B. j does not divide i
 C. j is odd
 D. i is not prime

65. What will be the value of x after successful execution of the below program.

```
#include <stdio.h>
int main()
{
    int x=5,y=x,i;
    for(i=1;i<5;++i)
    x+=x;
    printf("%d",x);
    return 0;
}
```

- A. Output is 8 times y
- B. Output is 16 times y
- C. Output is 25 times y
- D. Output is 30 times y

66. Given the following pseudocode for the function

```
void greet(int n)
{
    if (n>0)
        {for (i=0;i<=n-1;i++) {printf("hello");}
        greet(n-1);}
    printf("world");
}
```

Which of the following is correct for `greet(4)` ?

- A. hello will be printed four times followed by world five times
- B. hello will be printed 24 times followed by world 5 times
- C. hello will be printed 10 times followed by world five times
- D. hello will be printed 12 times followed by world four times

67. Which of the following is false

- A. Dynamic Programming Algorithm for 0/1 Knapsack problem runs in polynomial time
- B. Fractional Knapsack problem can be solved in polynomial time
- C. 0/1 Knapsack problem can be solved using Branch and Bound method
- D. Backtracking method is used to solve N-Queens problem

68. Which of the following is False about the Vertex Cover Graph Problem (given n is number of vertices)

- A. Vertex Cover Problem is NP-Complete
- B. A solution to Vertex cover problem can be verified in $O(n^2)$ time.
- C. The size of Minimum Vertex cover in complete graph of size n is $n - 1$
- D. Vertex Cover problem can be polynomial reduced to some problem X in P

69. Which of the following statements is FALSE?

- I. `fork()` never returns on error
- II. `exec()` never returns on error
- III. `exec()` never returns on success

- A. I only

- B. II only
 - C. I and III
 - D. III only
70. Runtime binding means the memory locations for loading the process are decided
- A. During compilation
 - B. Dynamically during load time
 - C. Dynamically during the execution of code
 - D. Once and cannot be changed once the process is executing

END

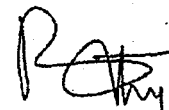
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University of Hyderabad
Entrance Examinations - 2021

School/Department/Centre : SCIS (FINAL KEY)
Course/Subject : **Ph.D. Computer Science**

Q.No.	Answer	Q.No.	Answer	Q.No.	Answer	Q.No.	Answer
1	A	26	B	51	C	76	
2	D	27	B	52	A	77	
3	D	28	C	53	D	78	
4	C	29	A	54	C	79	
5	B	30	B	55	B	80	
6	B	31	C	56	A	81	
7	C	32	X	57	D	82	
8	A	33	C	58	B	83	
9	A	34	B	59	A	84	
10	B	35	D	60	B	85	
11	C	36	C	61	B	86	
12	A	37	D	62	A	87	
13	B	38	A	63	C	88	
14	D	39	B	64	D	89	
15	A	40	D	65	B	90	
16	D	41	D	66	C	91	
17	C	42	C	67	A	92	
18	B	43	A	68	D	93	
19	A	44	B	69	D	94	
20	C	45	B	70	C	95	
21	B	46	C	71		96	
22	D	47	C	72		97	
23	D	48	A	73		98	
24	A	49	C	74		99	
25	D	50	B	75		100	

Note/Remarks : The final key reflects the challenges received.
Q 32 is found incorrect. Please add ONE mark to everyone who attempted it.



Signature of the Head/Dean
School/Department/Centre