J-55

Entrance Examination (2015)

Ph.D. in Computer Science

Time: 2 Hrs. **Max. Marks: 75**

Hall Ticket Number:

INSTRUCTIONS

1. Write your hall ticket number in the box above **and** on the OMR sheet.
2. This test is for **2 hours duration** carrying 75 marks.
3. All answers should be marked clearly in the OMR sheet.
4. Every correct answer gets **1(ONE) mark. There is negative marking of 0.33 marks for every wrong answer.**
5. Do all the rough work only in the pages provided in the question booklet, **nowhere else.**
6. Use of non-programmable calculator and log table is allowed.
7. Handover the OMR answer sheet to the Invigilator before leaving the examination hall.
8. **The use of cellphone is strictly prohibited in the examination hall. All**

1. When the most significant byte of a word is at the smallest address, the architecture is called

   A. Big Indian

   B. Little Endian

   C. Big Endian

   D. Little Indian

2. Polymorphism means

   A. that data fields should be declared private

   B. that a class can extend another class

   C. that a class can contain another class

   D. that a variable of supertype can refer to a subtype object

3. A computer system has a RAM of 4 GB and a cache of 512MB. Assuming that the least significant bit is b_0, the cache location using *direct mapping* is given by

   A. the bits $b_{31} \dots b_4$

   B. the bits $b_2 \dots b_0$

   C. the bits $b_{31} \dots b_{29}$

   D. the bits $b_{28} \dots b_0$

4. Which of the following is TRUE about *vectored*interrupts?

   A. the interrupt service routine is determined by the interrupt-generating device

   B. the interrupt service routine polls the devices to find the device that generated the interrupt

   C. the interrupt is generated not by one device but byseveral devices simultaneously

   D. None of the above

5. The maximum number of items in a B-tree of order m and height h is

   A. $m^h - 1$

   B. $m^{h-1} + 1$

   C. $m^{h+1} - 1$

   D. $m^h + 1$

6. Each B-tree node can have *at-most* p tree pointers, $p - 1$ data pointers and $p - 1$ search key field values. These must fit into a single disk block if each B-tree node is to correspond to a disk block. Suppose the search field is $V = 9$ bytes long, the disk block size is $B = 512$ bytes, record (data) pointer is $P_r = 7$ bytes and a block pointer is $P = 6$ bytes. What is the value of p?

   A. 22

   B. 23

C. 24

D. 25

7. What is the order p of a B^+ tree given that the search key field is $V = 9$ bytes long, the block size is $B = 512$ bytes, record pointer is $P_r = 7$ bytes and a block pointer is $P = 6$ bytes.

   A. 32

   B. 33

   C. 34

   D. 24

8. Consider a schema R(A, B, C, D, E) with functional dependencies $A \rightarrow B$, $B \rightarrow C$, $BC \rightarrow A$,$A \rightarrow D$,$E \rightarrow A$,$D \rightarrow E$. Which of the following is not a key?

   A. A

   B. E

   C. B,C

   D. D

9. The tuples in relation `R(A,B)` are `{(1,2),(1,3),(3,4)}` and the tuples in relation `S(B,C)` are `{(2,5),(4,6),(7,8)}`. The number of tuples in the result of the following SQL query are:
   *Select * From R Natural Outer Join S;*

   A. 2

   B. 4

   C. 6

   D. None of the above

10. A unit of storage that can store one or more records in a hash file organization is denoted as

    A. Buckets

    B. Disk Pages

    C. Blocks

    D. Nodes

11. Which of the following will undo all statements upto `commit`?

    A. Transaction

    B. Flashback

    C. Rollback

    D. Abort

12. If a system has a 32-bit processor, what are the number of page table entries if the page size is 16KB?

A. 16K entries
B. 256K entries
C. 8K entries
D. 64K entries

13. Zombie process is a process

A. that lives forever in all situations
B. has terminated and is waiting for its parent to check its status
C. whose parent has died
D. None of the above

14. Wireless LANs do not use CSMA/CD because

A. CSMA/CD is not efficient
B. CSMA/CD requires duplex operation
C. Wireless networks have a high BER
D. Wireless networks are not secure

15. If a host has an IP address `201.40.67.31/25`, what are the network ID and broadcast address of the network to which this host belongs:

A. 201.40.67.31, 201.40.67.63
B. 201.40.67.0, 201.40.67.255
C. 201.40.67.0, 201.40.67.63
D. 201.40.67.31, 201.40.67.255

16. If the MF bit=0, Fragment Offset = 1480 and Total Lenght = 520 in an IP datagram, then the lenght of datagram is

A. 520
B. 1480
C. 1500
D. 2000

17. When the TTL of a datagram sent from a host H1 is 1, the data can reach a host which is

A. within the same network
B. any host in the world
C. within the same network and the network reached through one router
D. no host at all

18. Five segements of data of sizes 100B, 400B, 200B, 300B and 50B are sent using TCP and PSH bit is set on each of the segements. There are no retransmission timeouts. The acks received are 101, 101, 701, 701 and 1051. In which order are the segements received

A. 100B, 200B, 400B, 300B, 50B

B. 100B, 400B, 200B, 50B, 300B

C. 100B, 400B, 200B, 300B, 50B

D. 100B, 200B, 400B, 50B, 300B

19. One major difference between RIPv1 and RIPv2 are:

A. RIPv1 is an IGP whereas RIPv2 is an EGP

B. RIPv1 uses UDP whereas RIPv2 uses TCP

C. RIPv1 supports Classful networks only whereas RIPv2 supports CIDR

D. None of the above

20. The Memory Buffer Register(MBR) is best understood by which of the following descriptions

A. is a hardware memory device which denotes the location of the current instruction being executed

B. is a group of electrical circuits (hardware) that performs the intent of instructions fetched from memory

C. contains the address of the memory location that is to be read from or stored into

D. contains a copy of designated memory location specified by the MAR after a "read" or the new contents of the memory prior to "write"

21. A Program that allows multiple operating systems to share a single hardware processor, in current terminology is called as

A. Loader

B. Boot strap controller

C. Hypervisor

D. Cross compiler

22. Which type of operating system would be needed to allow the students in a class to read a file that the teacher also had open?

A. Batch processing

B. Multi-user

C. Multitasking

D. None of the above

Read the passage below and then answer the questions (23 – 26).

I thank the ACM for this award. I can't help but feel that I am receiving this honor for timing and serendipity as much as technical merit. UNIX swept into popularity with an industry-wide change from central main frames to autonomous minis. There is an old adage, "Dance with the one that brought you," which means that I should talk about UNIX. I have not worked on mainstream UNIX in many years, yet I

continue to get undeserved credit for the work of others. Therefore, I am not going to talk about UNIX, but I want to thank everyone who has contributed. That brings me to Dennis Ritchie. Our collaboration has been a thing of beauty. In the ten years that we have worked together, I can recall only one case of miscoordination of work. On that occasion, I discovered that we both had written the same 20-line assembly language program. I compared the sources and was astounded to find that they matched character-for-character. The result of our work together has been far greater than the work that we each contributed.

23. Whom did the speaker of the above paragraph work with for 10 years?

    A. Brian Kernighan

    B. Dennis Ritchie

    C. Steve Jobs

    D. None of the above

24. Who or what is the speaker **NOT** going to talk about?

    A. UNIX

    B. Dennis Ritchie

    C. Assembly Language Programming

    D. None of the above

25. What *astounded* the speaker?

    A. His ability to dance

    B. The success of UNIX

    C. Industry-wide change from mainframes to minis

    D. Writing the same 20-line program as Dennis Ritchie

26. "I thank the ACM for this award." What award can it be?

    A. Fields Medal

    B. Nobel Prize

    C. Computer Scientist of the Year

    D. Turing Award

27. It is not possible to construct a graph having

    A. Even number of nodes with even degree

    B. Even number of nodes with odd degree

    C. Odd number of nodes with even degree

    D. Odd number of nodes with odd degree

28. $f : N \times N \rightarrow N$ is a function where $f(m, n) = 2^m.3^n$. Then f is

    A. Only 1-1

B. Only Onto

C. both 1-1 and onto

D. neither 1-1 nor onto

29. The time complexity of the following code segement is NOT of the order
while $(n \neq 1)$
{
$n = n/2;$
}

A. $O(n)$

B. $\Omega(1)$

C. $\theta(logn)$

D. $\theta(n)$

30. Two algorithms A and B are being compared for their efficiencey on an input of size n. The running time of A is n^3 seconds and the running time of B is n^2 hours. Find the smallest n for which B is faster than A.

A. 61

B. 121

C. 3601

D. 72

31. Let $(a_1, a_2, a_3, ..., a_{n-1}, a_n)$be a list of numbers in ascending order except for a_n, where $a_n < a_1$. Then the time taken by insertion sort and bubble sort algorithms respectively to sort the list are

A. O(n),O(n)

B. O(n),O(n^2)

C. O(n^2),O(n)

D. O(1),O(n)

32. A Regular Expression for the language L over the alphabet $\Sigma = \{a, b\}^*$ consisting of strings with exactly 2b's is

A. $a^*ba^*ba^*$

B. a^*bba^*

C. bba^*

D. a^*bb

33. Which of the following generates the same language as L, Where L = $\{x^n y^n \mid n \geq 1\}$
I : $E \rightarrow xEy \mid xy$
II : $xy \mid (x^+xyy^+)$
III: x^+y^+

A. I only

B. I and II

C. II and III

D. II only

34. How many new processes will be created in case a process executes the following code:

```
fork();
fork();
fork();
```

A. 9

B. 7

C. 6

D. 8

35. As $n \to \infty$, the function $2^{\sqrt{n}}$ grows faster than

A. $\sqrt{n}$ but slower than n

B. n but slower than n^2

C. n^2 but slower than $\sqrt{2^n}$

D. $\sqrt{2^n}$, but slower than 2^n

36. Which of the folllowing holds under the assumption that $P \neq NP$

A. $P \cap NP - Complete = \emptyset$

B. $NP - Hard = NP - Complete$

C. $NP = NP - Complete \cup P$

D. None of the above

37. Let `G` be a connected graph with `"v"` nodes and `"e"` edges. The number of edges to be dropped to form a tree are

A. $e - v + 1$ where $e < v$

B. $e - v + 1$ where $e >= v$

C. $v - e + 1$ where $e < v$

D. $v - e + 1$ where $e >= v$

38. Let G be a Eulerian weighted graph with sum of the weights of edges as 1000. What is the weight of Eulerian circuit of G

A. Eulerian circuit need not exist

B. Eulerian circuit exist with weight greater than 1000

C. Eulerian circuit exist with weight less than 1000

D. Eulerian circuit exist with weight equal to 1000

39. Let L be a bounded, distributive, complimented Lattice and a,b,c be the elements of L, then which of the following is valid

    A. $a * b = a$

    B. $aVb = a$

    C. $a * (bVc) = (a * b)Vc$

    D. $a * (bVc) \leq (a * b)V(a * c)$

40. Convert FEDCBA into octal number

    A. 77556272

    B. 77565271

    C. 76556272

    D. 77565472

41. Thrashing can be reduced by

    A. increasing the CPU power

    B. increasing degree of multiprogramming

    C. increasing memory

    D. increasing the swap space

42. Let m and n be the natural numbers and let `prime(n)` be true if n is a prime. Which of the following expression says that there are infinite number of primes

    A. $(\forall m)(\exists n)(n > m) \Rightarrow prime(n)$

    B. $(\exists n)(\forall m)(n > m) \Rightarrow prime(n)$

    C. $(\forall m)(\exists n)(n > m) \wedge prime(n)$

    D. $(\exists n)(\forall m)(n > m) \wedge prime(n)$

43. A disadvantage of an inverted page table as compared to a normal page table is

    A. It is very large in size

    B. It cannot support large virtual memory

    C. It is inefficient in translation of logical to physical address

    D. None of the above

44. Consider the following two Statements:
    (A) There are infinitely many interesting whole numbers
    (B) There are finitely many uninteresting whole numbers
    Which of the following is TRUE

    A. A and B are equivalent

    B. B implies A

    C. A implies B

    D. None of the above

45. A simple graph on 8 vertices is given such that there is a vertex of degree 1, a vertex of degree 2, a vertex of degree 3, a vertex of degree 4, a vertex of degree 5, a vertex of degree 6 and a vertex of degree 7. Which of the following can be degree of the last vertex

    A. 3

    B. 0

    C. 5

    D. 4

46. Consider the set of all 2x2 matrices whose entries are either 0 or 1. A matrix is randomly chosen from that set. What is the probability that the determinant of the chosen matrix is -ve

    A. 3/16

    B. 13/10

    C. 10/16

    D. 1

47. The Program counter contains the number 9ABC and the address part of instruction contains 134. If relative mode if addressing is used, find the effective address.

    A. 9BF0

    B. 9ABD

    C. 9ABC

    D. 9BF1

48. The function below has a flaw. Which one of the following describes the deficiency?

```
int fibonacci(int n)
{
 if(n>0)
  {
    switch(n)
     {
default: return (fibonacci(n-1) + fibonacci(n-2);
case 1:
case 2: return 1;
     }
   }
  return -1;
}
```

    A. Since the default case is given first,it will be executed before any case matching n

    B. A break statement should be inserted after each case.Fall through is not desirable here

C. For some values of n, the environment will almost certainly exhaust its stack space before the calculation completes

D. An error in the algorithm causes unbounded recursion for all values of n

49. What is the output of the following code?

```
public class Test1{
     public static void main(String[] args){
ChildClass c = new ChildClass();
c.print();
}
     }
class ParentClass{
int id=1;
void print() {
System.out.println(id);
}
   }
class ChildClass extends ParentClass{
int id=2;
}
```

A. 0

B. 1

C. 2

D. Nothing appears in output

50. Let A = {1,2,3,4,5,6,7,8,9,10} A1= {1,2,3,4}, A2= {5,6,7}, A3= {4,5,7,9}, A4={4,8,10}, A5={8,9,10}, A6={1,2,3,6,8,10}. Which of the following are partitions of A

A. (A1,A3,A5)

B. (A1,A2,A5)

C. (A2,A3,A4)

D. (A1,A4)

51. The main memory can store 32K words of 12 bits each. If direct cache mapping is used with a cache capability of 512 words, what is the size of each cache location.

A. 18

B. 36

C. 9

D. 27

52. Let R ={(1,2), (2,3), (3,4) } be a relation on {1,2,3,4}. Which one of the following is transitive closure of R?

A. {(1,2),(2,3),(3,4),(2,1),(3,2),(4,3)}

B. {(1,2),(2,3),(3,4),(1,3),(2,4)

C. {(1,2),(2,3),(3,4),(1,3),(2,4),(1,4)}

D. {(1,2),(2,3),(3,4),(1,4)}

53. If G is a polyhedral graph with 12 vertices and 30 edges then

A. Degree of each region is greater than 3

B. Degree of each region is equal to 3

C. Degree of each region is greater than 2

D. Degree of each region is equal to 2

54. How many queues are needed to implement a priority queue

A. 1

B. 2

C. 3

D. 0

55. What is the most suitable data structure to store permutation of a given set of alphabets in terms of search complexity

A. Tree

B. Stack

C. Queue

D. Adjacency list

56. Comment on the output of the given C code

```
#include<stdio.h>
struct temp
{
int a;
int b;
int c;
};
main()
{
struct temp p[]={1, 2, 3, 4, 5, 6, 7, 8, 9};
printf("%d", p[0].a)
}
```

A. No compile time error, generates an array of structure of size 3

B. No compile time error, generates an array of structure of size 9

C. Run time error, in accessing the members of p[0]

D. Compile time error, illegal assignment to members of structure

57. What is the search complexity of finding nearest neighbors in a huge data set of size n

    A. $O(n^2)$

    B. $O(nlogn)$

    C. $O(n)$

    D. $O(1)$

58. A min-max heap is defined as follows: *Each node at an even level in the tree is less than all of its descendants, while each node at an odd level in the tree is greater than all of its descendents*
    If the values are inserted in the order (3,6,9,19,27,48,50,66) in the min-max heap, what value would be found at position 5 in min-max heap (root is counted as position 1)

    A. 6

    B. 27

    C. 48

    D. 50

59. Which is the suitable data structure that finds duplicate in a list of numbers whose range is small

    A. Hash

    B. Binary Search tree

    C. Linear queue

    D. Linked list

60. If two function declarations were made as follows:
    f(int arr[])
    pf(int *arr)
    Which of the following statement is TRUE?

    A. arguments to f and pf takes arrays starting at different addresses

    B. arguments of f and Pf take array starting at the same address

    C. both can have different ending addresses

    D. arr size in both statements is different

61. What is the output of the following Java code

```
int count=1;
int num=25;
while (count<25)
{
      num= num-1;
      count++;
}
System.out.println(count +" "+num);
```

A. 24 0

B. 24 1

C. 25 0

D. 25 1

62. An example of NP-Hard decision problem which is not NP-Complete.

A. Satisfiability problem

B. Halting problem

C. Travelling Salespersons problem

D. None of the above

63. Which algorithm can be used for the solution of Single Source Shortest Path problem when the edges are of negative lengths:

A. Prims algorithm

B. Dijkstras algorithm

C. Bellman-Ford algorithm

D. None of the above

64. If a complete binary tree with n nodes is represented sequentially using array then for any node with index i, $1 \leq i \leq n$ we have:

A. Right-CHILD(i) is at $2i + 1$, if $2i + 1 \leq n$

B. Right-CHILD(i) is at $2i$, if $2i \leq n$

C. Right-CHILD(i) is at $2i - 1$, if $2i - 1 \leq n$

D. None of the above

65. If X = ABCB, Y = BDCAB, the Longest Common Subsequence (LCS) of X and Y is

A. ABC

B. BCB

C. BB

D. None of the above

66. Consider the following C++ program (Assume no syntax errors)

```
#include <iostream>
#include <stdio.h>
#include <math.h>
using namespace std;
int main()
{cout << Enter the number n : ;
 int n;
 cin >> n;
```

```
int sum = 0;
for (int i=1; i<=n ; i++)
  for (int j=1; j<=i ; j++)
    for (int k=1; k<=j ; k++)
{
            cout << "\n  UoH  ";}
}
```

Asymptotic running time of the segment is

A. $nlog_2n$

B. n^3

C. $O(nlog_2n * n^3)$

D. None of the above

67. How many times "UoH" will be printed for the value of n=8 for the c++ code of question number 66

A. 240

B. 60

C. 120

D. None of the above

68. The relationship between time slice of a round-robin scheduler and the context switch time is as follows:

A. They are independent of each other

B. Time slice must be smaller than the context switch time

C. Time slice must be equal to the context switch time

D. Time slice must be much higher than the context switch time

69. In an operating system, a process refers to 5 pages, A, B, C, D, E in the order : A, B, C, D, A, B, E, A, B, C, D, E. If the page replacement algorithm is FIFO, the number of page transfers with an empty internal store of 3 frames is :

A. 8

B. 10

C. 9

D. 7

70. An operating system supports multi-threading system. In Many to Many model when a thread performs a blocking system call :

A. other threads are allowed to run

B. other threads are strictly prohibited from running

C. other threads only from other processes are allowed to run

D. None of the above

71. Consider a disk where blocks 2,3,4,5,8,9,10,11,12,13,17,18,25,26 and 27 are free and the rest of the blocks are allocated. If the block numbering starts from 0, then the free space bit map would be :

A. 10000110000001110011111100011111

B. 11000011000000111001111100011111

C. 01111001111110001100000011100000

D. 00111100111111000110000011100000

72. A system with 5 processes P0 through P4 and three resource types A, B, C has A with 10 instances, B with 5 instances, and C with 7 instances. At time t_0, $the following snapshot ha$
$Process(P0, P1, P2, P3, P4)$
$Allocation(process - wise : P0 through P4 top to bottom)$

A	B	C
0	1	0
2	0	0
3	0	2
2	1	1
0	0	2

Max (process-wise : P0 through P4 top to bottom)

A	B	C
7	5	3
3	2	2
9	0	2
2	2	2
4	3	3

Available

A	B	C
3	3	2

The sequence leads the system to :

A. unsafe state

B. a safe state

C. a protected state

D. a deadlock

73. A disadvantage of an inverted page table as compared to a normal page table is

A. It is very large in size

B. It cannot support large virtual memory

C. It is inefficient in translation of logical to physical address

D. None of the above

74. In how many ways can nine students be partitioned into three teams containing four, three and two students respectively

A. 9!

B. 630

C. 315

D. None of the above

75. A connected planar graph with 15 vertices divides the plane into 12 regions. How many edges does the graph have

A. 15

B. 24

C. 25

D. Insufficient data