ENTRANCE TEST FOR MSc Computer Science

Date: 8 June 2019   *Max Marks: 105*
*Student's Name (in block letters):*   Time: 2 hrs
Signature:

1. How many distinct squares can you count on an 8 x 8 chessboard?

   a. $\binom{64}{4}$ b. $\binom{64}{8}$ c. $\sum_k = 1^8 k^3$ d. $\sum_k = 1^8 k^2$ e. 64

2. A graph G is a tree, ie., it has no cycles. Let G has n vertices and m edges. Which of the following statements are true?

   a. All the trees on n vertices have same number of edges

   b. m depends on number of root vertices.

   c. m depends on number of leaf vertices.

   d. There is no relation between n and m.

   e. m is always less than n.

3. Let H be a tree on $2n$ vertices. Construct G by connecting all one degree vertices of H to form a cycle. What is the maximum number of edges in the resulting graph?

   a. $4n$ b. $2(2n - 1)$ c. $3n - 1$ d. $4n - 1$ e. $3n$

4. How many bit-string of length 4 are possible where each contains 2 ones and 2 zeroes in any order?

   a. 2   b. 4   c. 6   d. 8   e. 12

5. If a set contains 3 elements then the number of subsets is

   a. 3   b. 6   c. 8   d. 9   e. 4

6. Given the recurrence relation $T(n) = 2T(\lceil n/2 \rceil) + c$, what is the order of time taken to compute $T(n)$?

   a. $n(n - 1)/2$ b. $n + \log n$ c. $2n$ d. 2^n e. $n \log(n)$

7. In a k-regular graph G every vertex has degree k. Delete $r + 1$ vertices from G to form graph H, such that $r + 1 < k$. The maximum degree sum for graph H is $nk/2 - x$. What is x? Assume G has n vertices. *Hint: maximize the edges among the $r + 1$ vertices.*

   a. $(r + 1)(2k - r)/2$ b. $r(r + 1)/2$ c. $k(r + 1)/2$ d. $k(r + 1)$ e. $\binom{k-r-1}{2}$

8. Let A be set of all prime numbers, B be the set of all even prime numbers, C be the set of all odd prime numbers, then which of the following is true?

   a. $A \equiv B \cup C$ b. B is a singleton set.   c. $A \equiv C \cup \{2\}$ d. All of the mentioned.
   e. None of the mentioned

9. An object code $\mathcal{O}$ consists of approximately 25% loads, 10% stores, 13% branches, and 52% data-processing instructions. In an ideal condition each instruction executes without delay in one clock cycle time, that is cycles per instruction (CPI) is 1. Now, in $\mathcal{O}$ assume that 40% of the loads incur one cycle delay, 50% of the branches incur two cycles delay. 25% of stores incur on the whole 20 cycles delay, and the data processing instructions execute without delay. What is the average CPI for this object code?

a. 1.45   b. 1.33   c. 1.43   d. 1.25

e. none of the mentioned

10. A 4×4 black and white check board as in image is given. Also given a 2×2 full black check board called the stencil. Now the stencil is drawn at the center of the image by performing two times XOR operation of the stencil pixel with the corresponding image pixel. The resulting image is

image   (a)   (b)   (c)   (d)   (e) None of the mentioned
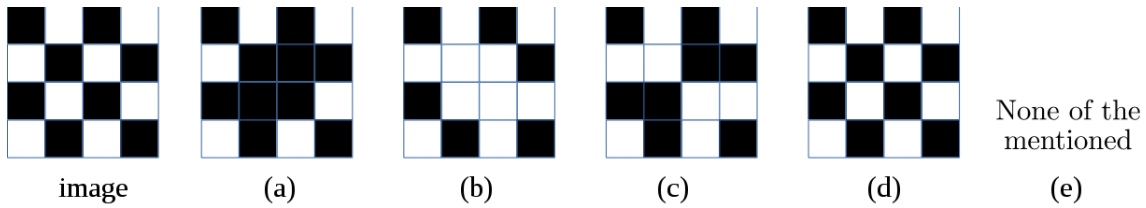
11. Electronic mails are sent over computer network through

    a. File Transfer Protocol (FTP)

    b. Internet Control Message Protocol (ICMP)

    c. Transmission Control Protocol/Internet Protocol (TCP/IP)

    d. Hypertext Transmission Protocol (HTTP)

    e. Secured Hypertext Transmission Protocol (HTTPS)

12. Given that `#define f(a,b) a*b` what does `f(f(5-2,3), 6-4)` evaluate to?

    a. 18   b. 50   c. -35

    d. -2   e. illegal nested function call

13.
```
uint i = -1;
int j = -10;
while( --i > j)  cout << "In Loop" << endl;
cout << "Loop ended" << endl;
```
For the above snippet of C++/ code which of the following statements are true?

    a. `In Loop` will be printed 10 times   b. `In Loop` will be printed 9 times

    c. `In Loop` will be printed 8 times   d. `Loop ended` will be printed once

    e. `In Loop` will be printed infinitely

14. What does the following function print for `n = 25`?
```
void fun(int n) {
if (n == 0) return;
printf("%d", n%2);
fun(n/2);
}
```
    a. 11001   b. 10011   c. 11111   d. 00000

    e. None of the mentioned

15. For an 8 bit adder what is output of adding `0xFF + 0x01`

    a. `0xFG`   b. `0xFE`   c. `0x100`   d. `0x00`   e. `0x01`

16. In logic, a functionally complete set of logical connectives or Boolean operators is one which can be used to express all possible truth tables by combining members of the set into a Boolean expression. Which two of the following are not functionally complete?

    a. {AND,NOT}   b. NAND   c. NOR   d. {AND, OR}   e. XOR

17. Communication offered by TCP is

    a. Full-duplex   b. Half-duplex   c. Semi-duplex   d. Byte by byte
    e. None of the mentioned

18. How many computers at the maximum can stay connected in a Class A network?

    a. 63   b. 127   c. 255   d. 1023   e. 65535

19. To achieve reliable transport in TCP, what is used to check the safe and sound arrival of data?

    a. Buffer   b. Segment   c. Packet   d. Frame   e. Acknowledgement

20. Bluetooth is an example of

    a. personal area network   b. local area network   c. wide area network   d. virtual private network
    e. none of the mentioned

21. Which one of the following event is not possible in wireless LAN.

    a. collision avoidance   b. collision detection
    c. acknowledgement of data frames   d. multi-mode data transmission
    e. none of the mentioned

22. In RDBMS, the term relation refers to,

    a. Fields   b. Tuples   c. Entities   d. Relationship   e. Records

23. A missing foreign key is an instance of violation of

    a. domain constraint   b. key constraint   c. referential integrity constraint
    d. entity integrity constraint   e. normalization

24. In which normal form, a composite attribute is converted to individual attributes?

    a. 1NF   b. 2NF   c. 3NF   d. BCNF   e. 4NF

25. In the following ER diagram what is the best way to describe relationship R as?
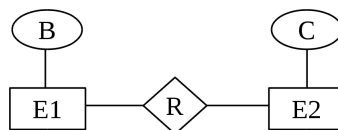
    a. One to One   b. One to Many   c. Many to One   d. Many to Many
    e. R cannot be described

26. Which one of the following statements about normal forms is FALSE?

    a. BCNF is stricter than 3 NF

    b. Loss less, dependency -preserving decomposition into 3 NF is always possible

    c. Loss less, dependency -preserving decomposition into BCNF is always possible

    d. Any relation with two attributes is BCNF

    e. No non-prime (non-key) attribute in a 3NF relation is transitively dependent of any key.

27. Mutual exclusion is implemented using

    a. pipes   b. messages   c. monitors   d. signals   e. semaphores

28. In the famous Dining Philosopher problem if every philosopher has one knife with him, then such a state of the problem is best described as

    a. Idle   b. Deadlock   c. Waiting   d. Ready   e. Steady state

29. Which two of the statements regarding Linux are false?

    a. Everything, namely processes, files, directories, sockets, pipes etc, is a file.

    b. VFS enables programmers to build custom file systems.

    c. Users can write custom device drivers.

    d. As Linux is open source, programs written for other OS can also run on Linux.

    e. Linux computers cannot be virus infected.

30. What is not true about a circular linked list CL?

    a. given an element it takes constant time to delete itself

    b. given an element it takes constant time to delete the previous element

    c. given an element it takes constant time to delete the next element

    d. an iterator on CL may end up in an infinite loop

    e. size of CL impacts the performance of the algorithm

31. A hash function h defined `h(key)=key mod 7`, with linear probing, is used to insert the keys 44, 45, 79, 55, 91, 18, 63 into a table indexed from 0 to 6. What will be the location of key 18?

    a. 3   b. 6   c. 4   d. 5   e. 0

32. The following numbers are inserted into an empty binary search tree in the given order: 10, 1, 3, 5, 15, 12, 16. What is the height of the binary search tree (the height is the maximum distance of a leaf node from the root)?

```
            10
           /      \
          1        15
           \      /  \
            3    12   16
             \
              5
```
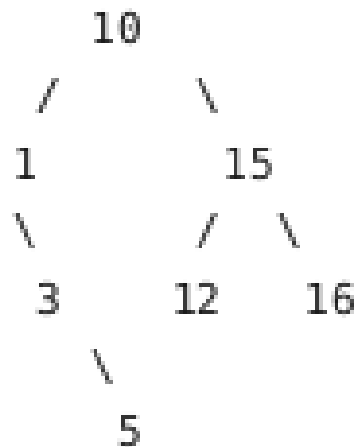
    a. 4   b. 2   c. 3   d. 5   e. 6

33. Consider a situation where swap operation is very costly. Which of the following sorting algorithms should be preferred so that the number of swap operations is minimized in general?

    a. Insertion Sort   b. Merge Sort   c. Selection Sort   d. Bubble Sort   e. Heap Sort

34. Quicksort is run on two inputs shown below to sort in ascending order taking first element as pivot.
i) $1, 2, 3, \cdots, n$ ii) $n, n-1, n-2, \cdots, 2, 1$
Let C_1 and C_2 be the number of comparisons made for the inputs (i) and (ii) respectively. Then,

a. $C_1 > C_2$ b. $C_1 < C_2$ c. $C_1 = \frac{1}{2}C_2$ d. $C_1 = C_2$

e. None of the mentioned

35. Which sorting algorithm will take least time when all elements of input array are identical? Consider typical implementations of sorting algorithms.

    a. Insertion Sort   b. Selection Sort   c. Quick Sort   d. Heap Sort   e. Merge Sort