MAHARAJA RANJIT SINGH PUNJAB TECHNICAL UNIVERSITY, BATHINDA

Ph.D. Entrance Examination of COMPUTER SCIENCE AND ENGINEERING

1. The equivalence $\neg(P \vee Q) = \neg P \wedge \neg Q$ is known as:
   A) De Morgan's Law
   B) Commutative Law
   C) Associative Law
   D) Absorption Law

2. If $P(A \cap B) = 0.2$ and $P(A) = 0.5$, what is $P(B \mid A)$?
   A) 0.4
   B) 0.3
   C) 0.5
   D) 0.2

3. A lattice is a:
   A) Group
   B) Partially ordered set
   C) Linear order
   D) Total order

4. The recurrence relation for Fibonacci numbers is:
   A) $F(n) = F(n-1) + F(n-2)$
   B) $F(n) = n + F(n-1)$
   C) $F(n) = n \cdot F(n-1)$
   D) $F(n) = F(n-1) - F(n-2)$

5. In a normal distribution, approximately what percentage of data lies within one standard deviation from the mean?
   A) 68%
   B) 95%
   C) 99.7%
   D) 50%

6. A dice is rolled twice. What is the probability that the sum of the outcomes is 7?
   A) 1
   B) 4
   C) 6
   D) 10

7. A graph is said to be connected if:
   A) It has no isolated vertices.
   B) There is a path between every pair of vertices.
   C) It contains at least one cycle.
   D) It has the minimum number of edges.

8. How many ways can 5 different books be arranged on a shelf?
   A) 60
   B) 120
   C) 240
   D) 720

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9. Which of the following is a group under usual matrix multiplication?
   A) Set of all 2×2 matrices.
   B) Set of all invertible 2×2 matrices.
   C) Set of all 2×2 matrices with determinant zero.
   D) Set of all diagonal 2×2 matrices.

10. In pipelined CPU architecture, a situation where an instruction depends on the result of a previous instruction is called:
   A) Data hazard
   B) Control hazard
   C) Structural hazard
   D) Resource hazard

11. Which number representation method is commonly used for floating-point arithmetic in computers?
   A) Sign-magnitude
   B) 1's complement
   C) 2's complement
   D) IEEE 754 standard

12. Which of the following circuits is used to store a single bit of data?
   A) Multiplexer
   B) Flip-Flop
   C) Decoder
   D) Encoder

13. Which cache mapping technique allows a block of main memory to be mapped to any line of the cache?
   A) Direct mapping
   B) Associative mapping
   C) Set-associative mapping
   D) None of the above

14. In pipelined CPU architecture, a situation where an instruction depends on the result of a previous instruction is called:
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   B) Control hazard
   C) Structural hazard
   D) Resource hazard

15. In C programming, what is the output of the following code snippet?

```
#include <stdio.h>
void func(int *x) {
   *x = 20;
}
int main() {
   int a = 10;
   func(&a);
   printf("%d\n", a);
   return 0;  }
```

   A) 10
   B) 20
   C) Compilation error
   D) Undefined behavior

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16. In a binary heap used to implement a priority queue, what is the time complexity of inserting a new element?
A) O(1)
B) O(log n)
C) O(n)
D) O(n log n)

17. Which of the following is true about parameter passing in C?
A) C supports both pass-by-value and pass-by-reference.
B) C supports only pass-by-reference.
C) C supports only pass-by-value.
D) C does not support parameter passing.

18. Which of the following operations is not efficient in a singly linked list?
A) Insertion at the beginning
B) Deletion at the beginning
C) Insertion at the end when tail pointer is maintained
D) Deletion of the last node without a tail pointer

19. Which of the following algorithms is based on the divide-and-conquer paradigm?
A) Dijkstra's algorithm
B) Merge Sort
C) Kruskal's algorithm
D) Prim's algorithm

20. In graph theory, which algorithm is commonly used to find the minimum spanning tree of a connected, undirected graph?
A) Bellman-Ford algorithm
B) Floyd-Warshall algorithm
C) Prim's algorithm
D) Depth-First Search

21. Which sorting algorithm has the best average-case time complexity?
A) Bubble Sort
B) Insertion Sort
C) Quick Sort
D) Selection Sort

22. Which of the following statements is true regarding the classes P and NP?
A) P is a subset of NP.
B) NP is a subset of P.
C) P and NP are disjoint sets.
D) P and NP are identical sets.

23. Which of the following languages is not regular?
A) The set of all strings over {a, b} with an even number of a's.
B) The set of all strings over {a, b} where the number of a's equals the number of b's.
C) The set of all strings over {a, b} that do not contain the substring "aa".
D) The set of all strings over {a, b} that end with "ab".

24. Which of the following problems is undecidable?
A) Determining if a context-free grammar is ambiguous.
B) Determining if a finite automaton accepts a given string.
C) Determining if a context-free grammar generates an empty language.
D) Determining if a Turing machine halts on a given input.

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25. Which of the following is a characteristic of a Turing machine that distinguishes it from finite automata and pushdown automata?
A) It has a finite set of states.
B) It has an infinite tape for memory.
C) It can recognize regular languages.
D) It uses a stack for memory.

26. In syntax-directed translation, what does an attribute grammar provide?
A) A method to parse ambiguous grammars
B) A way to attach semantic information to syntax rules
C) A technique for code optimization
D) A strategy for error detection and recovery

27. Which optimization technique involves moving computations outside of loops when possible?
A) Constant folding
B) Loop unrolling
C) Code motion
D) Dead code elimination

28. Which phase of the compiler is responsible for checking the grammar and structure of the source code?
A) Lexical analysis
B) Syntax analysis
C) Semantic analysis
D) Code generation

29. What is the purpose of inter-process communication (IPC)?
A) To prevent processes from sharing data
B) To facilitate communication and data exchange between processes
C) To allow threads to execute simultaneously
D) To avoid synchronization issues

30. Which of the following memory management techniques uses a paging mechanism?
A) Segmentation
B) Virtual memory
C) Fragmentation
D) Stack-based memory allocation

31. Which of the following file systems supports hierarchical directory structure?
A) FAT32 B) NTFS
C) FAT16 D) Ext2

32. Which of the following is a common technique used for deadlock prevention?
A) Resource allocation graph
B) Lock-free data structures
C) Preemption
D) Randomized CPU scheduling

33. In relational tuple calculus, which of the following is true?
A) It defines queries based on the manipulation of tables
B) It uses a set of operators to compute the result
C) It specifies what to retrieve, not how to retrieve it
D) It is mostly used for optimizing queries

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34. Which of the following is a normal form used to normalize a relational database?
    A) First Normal Form (1NF)
    B) Second Normal Form (2NF)
    C) Third Normal Form (3NF)
    D) All of the above

35. Which of the following is a primary benefit of using indexing in databases?
    A) To minimize disk space usage
    B) To improve query performance by reducing the number of records to scan
    C) To prevent database corruption
    D) To enforce referential integrity

36. What is the main advantage of using B-trees or B+ trees for indexing?
    A) They allow sequential access of records
    B) They use hash functions to distribute records evenly
    C) They keep the data sorted and allow efficient searching, insertion, and deletion
    D) They store data in memory only, avoiding disk access

37. Which of the following is a flow control technique used in computer networks?
    A) Acknowledgments
    B) Error detection
    C) Compression
    D) Redundancy

38. Which network device operates at the Data Link layer of the OSI model?
    A) Router
    B) Switch
    C) Gateway
    D) Hub

39. What is a digital signature used for in network security?
    A) To authenticate a user's identity
    B) To verify the integrity of data
    C) To provide encryption keys
    D) To encode the message for secrecy

40. Which of the following is a type of firewall?
    A) Application firewall
    B) Circuit-level gateway
    C) Packet filtering firewall
    D) All of the above

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ANSWER KEY

1. A
2. A
3. B
4. A
5. A
6. C
7. B
8. B
9. B
10. A
11. D
12. B
13. B
14. A
15. B
16. B
17. C
18. D
19. B
20. C
21. C
22. A
23. B
24. D
25. B
26. B
27. C
28. B
29. B
30. B
31. B
32. A
33. C
34. D
35. B
36. C
37. A
38. B
39. B
40. D

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