COMPREHENSIVE COURSE WORK

Class : R6 B

Date:06/05/2025

Time: 1 hr

1. Consider a B+ tree with order 4. What is the maximum number of keys that can be stored in a node?

   a) 2
   b) 3
   c) 4
   d) 5

2. The language accepted by Linear Bounded Automaton:

   a) Recursive Language
   b) Context-free language
   c) Context-sensitive language
   d) All of the mentioned

3. The Chomsky hierarchy classifies formal languages into how many levels?

   a) 2
   b) 3
   c) 4
   d) 5

4. A finite automaton requires a minimum _____ number of stacks.

   a) 1
   b) 0
   c) 2
   d) None of the mentioned

5. Regular expression for all strings that start with 'ab' and end with 'bba' is:

   a) ababbba
   b) ab(ab)bba
   c) ab(a+b)bba
   d) All of the mentioned

6. The Grammar can be defined as: G = (V, Σ, p, S). In this definition, what does 'S' represent?

   a) Accepting State
   b) Starting Variable
   c) Sensitive Grammar
   d) None of these

7. The closure property of context-free grammar includes:

   a) Kleene
   b) Concatenation
   c) Union
   d) All of the mentioned

8. A multitape Turing machine is _____ powerful than a single tape Turing machine.

   a) More
   b) Less
   c) Equal
   d) None of the mentioned

9. A Turing machine that is able to simulate other Turing machines:

   a) Nested Turing machines
   b) Universal Turing machine
   c) Counter machine
   d) None of the mentioned

10. Which of the following statements are false?

    a) Every recursive language is recursively enumerable
    b) Recursively enumerable language may not be recursive
    c) Recursive languages may not be recursively enumerable
    d) None of the mentioned

11. If L is a recursive language, L' is:

    a) Recursive
    b) Recursively Enumerable
    c) Recursive and Recursively Enumerable
    d) None of the mentioned

12. Consider the following **SQL query**:

SELECT COUNT(*)

FROM Employees

WHERE Salary > (SELECT AVG(Salary) FROM Employees);

What does this query compute?

a) The total salary of all employees
b) The number of employees earning above the average salary
c) The average salary of all employees
d) The count of employees with the lowest salary

13. Which **SQL command** is used to remove a table from a database?

    a) DELETE
    b) REMOVE
    c) DROP
    d) ERASE

14. Which of the following **properties** ensures that a database transaction is completed or entirely rolled back?

a) Consistency
b) Durability
c) Atomicity
d) Isolation

15. What is the **role of the primary key** in a database?

a) To uniquely identify a record in a table
b) To store large data
c) To index the table
d) To allow duplicate records

16. **A schedule** is said to be conflict serializable if:

a) It can be transformed into a serial schedule by swapping non-conflicting operations
b) It allows concurrent execution of all transactions
c) It maintains the **ACID** properties of transactions
d) It ensures no deadlocks occur

17. Given a relation **R(A, B, C)** with functional dependencies **{A → B, B → C}**, which of the following is a super key?
a) A
b) B
c) C
d) AB

18. For a relation **R(A, B, C, D)** with candidate keys **{A, BC}**, which normal form does it violate if **A → B** and **B → C** exist?
a) INF
b) 2NF
c) 3NF
d) BCNF

19. Given the following **relational algebra query**:
π_name(σ_age > 30(Employees))

What does this query return?

a) All employee names
b) Names of employees older than 30
c) Ages of all employees
d) Names and ages of employees

20. Which of the following techniques is used to handle branch hazards?

a) Instruction Prefetch
b) Branch Prediction
c) Delayed Branch
d) Both (b) and (c)

21. Which of the following is a key feature of a relational database?

a) Data is stored as objects
b) Data is stored in the form of tables
c) Data is stored in XML format
d) Data is stored as scripts

22. Which of the following is an example of a process scheduling algorithm?

a) Round Robin
b) Bubble sort
c) DFS
d) Quick sort

23. A CPU has a clock cycle time of 2 ns and executes a program with 1 billion instructions. The CPI of the processor is 1.5. What is the total execution time?

a) 3 s
b) 1 s
c) 2 s
d) 0.5 s

24. In a 4-way set associative cache, the total cache size is 64 KB and block size is 16 bytes. What is the number of sets in the cache?

a) 256
b) 1024
c) 2048
d) 512

25. Which of the following addressing modes is used in the instruction MOV AX, [BX]?

a) Register Addressing
b) Direct Addressing
c) Register Indirect Addressing
d) Immediate Addressing

26. A computer has 16 GB of RAM and a 32-bit virtual address space. If the page size is 4 KB, what is the size of the page table?

a) 8 MB
b) 16 MB
c) 4 MB
d) 32 MB

27. In a pipelined processor, the instruction throughput increases because:

a) Each instruction uses fewer resources
b) Multiple instructions are executed simultaneously
c) The clock cycle time is reduced
d) The instruction set is simplified

28. If a CPU has 4 registers and 32 instructions, how many bits are required for the opcode?

a) 4
b) 5
c) 3
d) 6

29. A system has a 32 KB 2-way set associative cache and a block size of 16 bytes. How many cache lines are in one set?

a) 1024
b) 2048
c) 4096
d) 8192

30. A system uses a direct-mapped cache with 512 blocks and a block size of 32 bytes. What is the size of the tag field for a 32-bit memory address?

a) 19 bits
b) 18 bits
c) 17 bits
d) 16 bits

31. Which memory type is the closest to the CPU and provides fast access to frequently used data?

a) Cache memory
b) Main memory (RAM)
c) Virtual memory
d) Secondary memory (Hard Disk)

32. The prerequisite of the binary search algorithm is:

a) Array should be sorted in descending order
b) Array should be randomly arranged
c) Array should be sorted in ascending order
d) None of these

33. In a binary heap, what is the time complexity of deleting the maximum element?

a) O(1)
b) O(log n)
c) O(n)
d) O(log log n)

34. In a max-heap with n elements, where are the leaf nodes stored?

a) Levels 0 to log n - 1
b) Last level only
c) Levels log n to n
d) Randomly

35. A hash table is:

a) A structure used to implement stack and queue
b) A structure used for storage
c) A structure that maps values to keys
d) A structure that maps keys to values

36. In a circular queue implemented with an array, how do you determine if the queue is full?

a) (rear == front)
b) (rear + 1) % size == front
c) (rear - front) == size
d) (front + size) % rear == 1

37. How many edges does a complete graph with n vertices have?

a) n(n-1)
b) n(n-1)/2
c) n^2
d) n^2 - n

38. The data structure used in breadth-first search algorithm is:

a) Queue
b) Stack
c) Heap
d) Hash table

39. What is the amortized time complexity of operations in a dynamic array?

a) O(1)
b) O(log n)
c) O(n)
d) $O(n^2)$

40. Which of the following traversal algorithms ensures elements are visited in sorted order for a binary search tree?

a) Pre-order
b) Post-order
c) In-order
d) Level-order

41. What is the maximum number of nodes in a binary tree of height h?

a) 2^h - 1
b) 2^(h-1) - 1
c) 2^(h+1) - 1
d) 2^h

42. In a multi threaded environment, which of the following is used to avoid race conditions?

a) Thread Pooling
b) Mutex
c) Paging
d) Deadlock

43. In a two-level directory structure, which of the following is true?

a) Files in different directories can have the same name
b) Files in the same directory can have the same name
c) Directories cannot have sub directories
d) Each user can only have one file

44. A system is said to be in a deadlock state when:

a) All processes are blocked
b) Processes are waiting for resources held by each other
c) CPU utilization is 0%
d) Processes are in the ready state

45. In a multi threaded program, a thread takes 100 ms for computation and 10 ms for I/O. If there are 5 such threads, what is the CPU utilization?

a) 33.3%
b) 50%
c) 90.9%
d) 100%

46. A paging system has a 3-level page table. If the first, second, and third levels occupy 1 KB each, what is the minimum memory needed to store the page tables for a process with 2 MB of virtual memory and 4 KB page size?

a) 2 KB
b) 4 KB
c) 6 KB
d) 8 KB

47. In a system with multiple processes, which synchronization mechanism ensures mutual exclusion?

a) Semaphore
b) Paging
c) Spooling
d) Deadlock

48. A system has 5 processes and 3 resource types with the following allocation and request matrices: Allocation: [1, 0,

2], [0, 1, 0], [1, 3, 5], [1, 0, 0], [0, 0, 1] Request: [0, 0, 0], [1, 0, 2], [1, 1, 0], [0, 2, 1], [0, 0, 0] Available: [1, 1, 1] What is the state of the system?

a) Safe
b) Unsafe
c) Deadlocked
d) Indeterminate

49. Consider a paging system with a page size of 4 KB. How many bits are used for the offset in a 32-bit address?

a) 10 bits
b) 12 bits
c) 14 bits
d) 16 bits

50. What is the primary purpose of an operating system?

a) To enable direct hardware control
b) To manage system resources
c) To compile programs
d) To act as a debugger.