Pre-Examination Training Material for Specialist Cadre Officers Exam

e) Association

Definition

Association defines a relationship between two or more objects, indicating that they are connected in some way. This relationship can be one-to-one, one-to-many, or many-to-many.

Example

A Student class and a Course class may have an association where a student can enrol in multiple courses, and a course can have multiple students.

Benefits

- Models real-world relationships between entities.
- Facilitates better design and understanding of the system.

f) Aggregation

Definition

Aggregation is a special type of association that represents a "whole-part" relationship between objects. In aggregation, the lifecycle of the part is independent of the whole.

Example

A Library class may aggregate Book objects. If the library is destroyed, the books can still exist independently.

Benefits

- Clearly represents relationships between different components.
- Enhances clarity and organisation in the code structure.

g) Composition

Definition

Composition is a stronger form of aggregation where the lifecycle of the part is tied to the lifecycle of the whole. When the whole is destroyed, the parts are also destroyed.

Example

A House class may consist of Room objects. If the house is demolished, the rooms cease to exist.

Benefits

- Ensures tighter control over object lifecycles.
- Promotes a clearer understanding of ownership and responsibility.

h) Message Passing

Definition

Message passing is a way for objects to communicate with each other. It allows objects to send messages to invoke methods, enabling interaction and collaboration.

Example

In a multiplayer game, a Player object might send a message to a GameController object to update its score.

Benefits

- Facilitates loose coupling between objects.
- Promotes encapsulation by allowing interaction without exposing internal states.

Test your knowledge:

1) **What is the main purpose of the requirements gathering stage in software development?**

A) Designing the architecture

B) Writing the code

C) Identifying user needs

D) Testing the application

E) Deploying the software
Answer: C) Identifying user needs

2) **Which of the following activities is part of the design phase?**

A) Writing code

B) Conducting interviews

C) Developing data models

D) Performing unit tests

E) Fixing bugs
Answer: C) Developing data models

3) **In which stage of the SDLC is the actual code written?**

A) Requirements Gathering

B) Design

C) Implementation

D) Testing

E) Deployment
Answer: C) Implementation

4) **What is the primary goal of the testing phase?**

A) Writing new features

B) Ensuring software operates correctly

C) Gathering requirements

D) Deploying the application

E) Maintaining the software
Answer: B) Ensuring software operates correctly

5) **Which of the following data structures allows access in O(1) time?**

A) Linked List

B) Stack

C) Array

D) Queue

E) Binary Tree
Answer: C) Array

6) **What is the time complexity for inserting an element into a linked list?**

A) O(1)

B) O(n)

C) O(log n)

D) O(n^2)

E) O(1) if the node reference is known
Answer: E) O(1) if the node reference is known

7) **Which data structure follows the Last In First Out (LIFO) principle?**
A) Queue
B) Stack
C) Array

D) Linked List
E) Tree
Answer: B) Stack

8) **What is the primary operation of a queue?**
   A) Pop
   B) Peek
   C) Enqueue
   D) Push
   E) Insert
   Answer: C) Enqueue

9) **What is the average time complexity for searching in a balanced binary search tree?**

A) O(n)

B) O(log n)

C) O(n log n)

D) O(1)

E) O(n^2)
Answer: B) O(log n)

10) **Which of the following sorting algorithms has the worst-case time complexity of O(n^2)?**

A) Merge Sort

B) Quick Sort

C) Bubble Sort

D) Heap Sort

E) Insertion Sort
Answer: C) Bubble Sort

11) **What is encapsulation in Object-Oriented Programming?**

A) Hiding internal state and requiring all interaction to occur through methods

B) Inheriting properties from a parent class

C) Allowing multiple forms of a method

D) Creating relationships between classes

E) Representing a whole-part relationship
Answer: A) Hiding internal state and requiring all interaction to occur through methods

12) **Which OOP concept allows for the creation of a new class from an existing class?**

A) Polymorphism

B) Encapsulation

C) Inheritance

D) Abstraction

E) Composition
Answer: C) Inheritance

13) **What does polymorphism in OOP allow?**

A) Hiding data

B) Creating classes from other classes

C) Using a single interface to represent different data types

D) Establishing relationships between objects

E) Bundling data and methods
Answer: C) Using a single interface to represent different data types

14) **In a binary tree, what traversal method produces sorted output?**

A) Pre-order

B) In-order

C) Post-order

D) Level-order

E) Reverse-order
Answer: B) In-order

15) **Which of the following describes a circular linked list?**

A) Each node points to the next, and the last points to the first

B) Each node points to the previous and next nodes

C) Each node contains a pointer to itself

D) Nodes are stored in non-contiguous memory

E) The list ends with a null pointer
Answer: A) Each node points to the next, and the last points to the first

16) **What is the time complexity of a linear search algorithm?**

A) O(log n)

B) O(n)

C) O(n log n)

D) O(1)

E) O(n^2)
Answer: B) O(n)

17) **Which data structure is best suited for implementing a priority queue?**

A) Stack

B) Queue

C) Heap

D) Array

E) Linked List
Answer: C) Heap

18) **In object-oriented programming, what does the term "message passing" refer to?**

A) Sending data between two classes

B) Invoking methods on objects

C) Sharing code between objects

D) Creating objects from classes

E) Destroying object instances
Answer: B) Invoking methods on objects

19) **What is the key characteristic of a binary search tree (BST)?**

A) Each node can have multiple children

B) The left child has a lesser value than the parent, and the right child has a greater value

C) All nodes are balanced

D) It is a circular structure

E) It allows for duplicate values
Answer: B) The left child has a lesser value than the parent, and the right child has a greater value

20) **Which sorting algorithm divides the array into two halves, sorts them, and then merges them?**

A) Quick Sort

B) Bubble Sort

C) Merge Sort

D) Selection Sort

E) Insertion Sort
Answer: C) Merge Sort

21) **What is the purpose of the maintenance phase in software development?**

A) Gathering requirements

B) Fixing bugs and improving performance

C) Writing new code

D) Deploying the application

E) Designing the software
Answer: B) Fixing bugs and improving performance

22) **Which operation has a time complexity of O(1) in a stack?**

A) Pop

B) Peek

C) Push

D) All of the above

E) None of the above
Answer: D) All of the above

23) **What is the main advantage of using a hash table?**

A) It maintains order of elements

B) It allows for quick data retrieval

C) It reduces memory usage

D) It is easy to implement

E) It handles duplicates well
Answer: B) It allows for quick data retrieval

24) **Which of the following is an example of abstraction?**

A) A class with private variables

B) A method that returns a result

C) A class that hides its implementation details

D) A function calling itself

E) A subclass inheriting from a superclass
Answer: C) A class that hides its implementation details

25) **In OOP, which term describes a "whole-part" relationship where the lifecycle of parts is independent of the whole?**

A) Composition

B) Aggregation

C) Association

D) Inheritance

E) Polymorphism
Answer: B) Aggregation

26) **Which of the following is NOT a characteristic of Object-Oriented Programming?**

A) Encapsulation

B) Inheritance

C) Modularity

D) Structured programming

E) Polymorphism
Answer: D) Structured programming

27) **Which of the following describes a doubly linked list?**

A) Nodes contain data and point to next node only

B) Nodes point to both the next and previous nodes

C) It forms a circle

D) It is stored in contiguous memory

E) It has a fixed size
Answer: B) Nodes point to both the next and previous nodes

28) **Which algorithm is typically used for sorting a linked list?**

A) Bubble Sort

B) Merge Sort

C) Quick Sort

D) Selection Sort

E) Insertion Sort
Answer: B) Merge Sort

29) **What is the primary role of the deployment phase?**

A) To write code

B) To test software

C) To release software to users

D) To gather user feedback

E) To maintain the software
Answer: C) To release software to users

30) **In which data structure are elements stored in a last-in, first-out manner?**

A) Array

B) Queue

C) Stack

D) Linked List

E) Binary Tree
Answer: C) Stack

31) **What is the space complexity of the Quick Sort algorithm in its recursive form?**

A) O(1)

B) O(n)

C) O(log n)

D) O(n log n)

E) O(n^2)
Answer: C) O(log n)

32) **In a binary tree, what does the post-order traversal do?**

A) Visits the left child, then the right child, then the parent

B) Visits the parent first, then the children

C) Visits the right child first, then the left child

D) Visits the parent last

E) Visits all nodes at the same level
Answer: D) Visits the parent last

33) **Which operation in a binary search tree has the time complexity of O(log n)?**

A) Deletion in an unbalanced tree

B) Insertion in a balanced tree

C) Searching in an unbalanced tree

D) Traversing all nodes

E) Counting the nodes
Answer: B) Insertion in a balanced tree

34) **What is the purpose of hashing?**

A) To sort data

B) To map data to a fixed-size table for quick retrieval

C) To store data in a tree structure

D) To create linked lists

E) To generate random numbers
Answer: B) To map data to a fixed-size table for quick retrieval

35) **Which data structure allows for dynamic memory allocation?**

A) Arrays

B) Stacks

C) Linked Lists

D) Heaps

E) All of the above

Answer: C) Linked Lists