#### **Programming (Languages and Concepts)**

1. **What is the difference between an abstract class and an interface?  
   Answer:** An abstract class can have both abstract and concrete methods, while an interface (pre-Java 8) only has abstract methods. Post-Java 8, interfaces can have default and static methods. An abstract class can have constructors, fields, and methods with implementations, whereas interfaces cannot.
2. **How do you implement a singleton pattern in Java?  
   Answer:** You can implement a singleton by making the constructor private and providing a static method for object creation.  
   java

public class Singleton {

private static Singleton instance;

private Singleton() {}

public static Singleton getInstance() {

if (instance == null) {

instance = new Singleton();

}

return instance;

}

}

1. **What is the difference between synchronous and asynchronous programming?  
   Answer:** Synchronous programming executes tasks one after the other, blocking the current task until it finishes. Asynchronous programming allows tasks to be executed in parallel or without blocking, enabling a program to continue running other tasks while waiting for a task to complete.
2. **What are closures in JavaScript?  
   Answer:** Closures are functions that remember the scope in which they were created, even after that scope has exited. A closure allows a function to access variables from an outer function even after the outer function has completed execution.
3. **Explain the purpose of garbage collection in Java.  
   Answer:** Garbage collection in Java is an automatic process that reclaims memory by identifying and removing objects that are no longer used or referenced, freeing up memory for other objects.
4. **What is the difference between a Stack and a Heap in memory management?  
   Answer:** Stack memory stores primitive data types and function call information (LIFO), while heap memory is used for dynamic memory allocation (objects, large variables). Stack memory is faster and smaller, whereas heap memory is larger but slower.
5. **What is the difference between REST and SOAP web services?  
   Answer:** REST is a lightweight architectural style for APIs that uses standard HTTP methods. SOAP is a protocol with strict standards, using XML for message format and requiring more overhead due to its specifications.
6. **How does exception handling work in Java?  
   Answer:** Exception handling in Java uses try, catch, and finally blocks. Code that might throw an exception is placed in the try block, exceptions are caught in catch, and finally is executed whether or not an exception occurred. You can also throw exceptions explicitly using throw.
7. **What are the four pillars of Object-Oriented Programming (OOP)?  
   Answer:** The four pillars of OOP are:
   * **Encapsulation**: Hiding data through access modifiers.
   * **Inheritance**: Deriving new classes from existing ones.
   * **Polymorphism**: Overriding/overloading methods to allow for different behaviors.
   * **Abstraction**: Hiding complex implementation details and exposing only the necessary parts.
8. **Explain Dependency Injection.  
   Answer:** Dependency Injection is a design pattern used to achieve Inversion of Control (IoC) by passing dependencies (services or objects) to a class instead of having the class create them internally. This decouples classes from the creation of their dependencies and improves testability.
9. **What is a race condition? How do you prevent it?  
   Answer:** A race condition occurs when two or more threads attempt to modify shared data concurrently, leading to unexpected results. Prevent it by using synchronization mechanisms like locks, mutexes, or atomic operations.
10. **What is a deadlock? How can you avoid it?  
    Answer:** A deadlock occurs when two or more threads are blocked forever, waiting for each other to release resources. Avoid deadlocks by acquiring resources in the same order, using timeouts, or applying a deadlock detection algorithm.
11. **What are microservices?  
    Answer:** Microservices are an architectural style that structures an application as a collection of loosely coupled services, each focusing on a specific business functionality. They communicate through lightweight protocols like HTTP/REST or messaging queues.
12. **Explain the difference between SQL and NoSQL databases.  
    Answer:** SQL databases are relational, structured, and use schemas to define the structure of data. NoSQL databases are non-relational, schema-less, and designed for distributed data storage, often used for handling unstructured or semi-structured data.
13. **How does an HTTP request-response cycle work?  
    Answer:** A client sends an HTTP request to a server, specifying the method (GET, POST, PUT, DELETE), headers, and body (if needed). The server processes the request and returns an HTTP response, which includes the status code, headers, and body (if applicable).
14. **What are promises in JavaScript?  
    Answer:** Promises are objects representing the eventual completion (or failure) of an asynchronous operation. They have three states: pending, fulfilled, and rejected, allowing for cleaner handling of asynchronous code compared to callbacks.
15. **What is the difference between method overloading and method overriding?  
    Answer:** Method overloading occurs when multiple methods have the same name but different parameters in the same class. Method overriding occurs when a subclass provides a specific implementation of a method already defined in its superclass.
16. **What are ACID properties in a database?  
    Answer:** ACID properties ensure reliable database transactions:
    * **Atomicity**: All operations in a transaction succeed or fail as a whole.
    * **Consistency**: Transactions leave the database in a consistent state.
    * **Isolation**: Transactions are isolated from one another.
    * **Durability**: Once a transaction is committed, it remains permanent.
17. **What is Git? Explain the difference between Git and GitHub.  
    Answer:** Git is a distributed version control system that tracks changes in source code during software development. GitHub is a web-based platform for hosting Git repositories, offering collaboration features like pull requests and issue tracking.
18. **What are callbacks in JavaScript?  
    Answer:** A callback is a function passed as an argument to another function, allowing code to be executed after the completion of asynchronous operations or other tasks.
19. **Explain how load balancing works.  
    Answer:** Load balancing distributes incoming network traffic across multiple servers, ensuring no single server becomes overwhelmed. It improves fault tolerance and optimizes resource utilization. Algorithms like round-robin, least connections, and IP hash are commonly used.
20. **What is polymorphism in Object-Oriented Programming?  
    Answer:** Polymorphism is the ability of a function, method, or object to take on multiple forms. It can be achieved through method overloading (compile-time polymorphism) or method overriding (runtime polymorphism).
21. **What is continuous integration (CI)?  
    Answer:** Continuous Integration (CI) is a development practice where developers frequently merge code changes into a shared repository, automatically triggering builds and tests to ensure code quality and detect issues early.
22. **What is the difference between TCP and UDP?  
    Answer:** TCP is connection-oriented, reliable, and ensures data is received in order. UDP is connectionless, faster, but less reliable, and does not guarantee the order of data or delivery.
23. **What is a RESTful API?  
    Answer:** A RESTful API is an API that follows the REST (Representational State Transfer) architectural style. It uses HTTP methods (GET, POST, PUT, DELETE) and works with resources represented as URLs, relying on stateless communication between the client and server.
24. **What is a memory leak in software development, and how do you prevent it?  
    Answer:** A memory leak occurs when a program fails to release memory that is no longer in use, causing the application to consume more memory over time. Prevent it by ensuring that objects are dereferenced once they are no longer needed and using tools like garbage collectors (in Java, Python) or memory profilers.
25. **What is the SOLID principle in software development?  
    Answer:** SOLID is a set of five design principles for writing maintainable and scalable object-oriented software:

* **S**: Single Responsibility Principle (SRP)
* **O**: Open/Closed Principle (OCP)
* **L**: Liskov Substitution Principle (LSP)
* **I**: Interface Segregation Principle (ISP)
* **D**: Dependency Inversion Principle (DIP)

1. **Explain the difference between HTTP and HTTPS.  
   Answer:** HTTP is the standard protocol for transferring web data, but it’s not secure. HTTPS is the secure version, which encrypts the communication between the client and server using SSL/TLS to prevent data interception or tampering.
2. **What are WebSockets, and how do they differ from HTTP?  
   Answer:** WebSockets provide full-duplex communication channels over a single TCP connection, allowing real-time data transfer between a client and server. Unlike HTTP, which is request-response-based, WebSockets keep the connection open for continuous communication.
3. **What are the differences between var, let, and const in JavaScript?  
   Answer:**

* var: Function-scoped and can be re-declared and updated.
* let: Block-scoped and can be updated but not re-declared.
* const: Block-scoped and cannot be updated or re-declared.

1. **What is a monolith vs. a microservice architecture?  
   Answer:**

* **Monolith**: A single, unified codebase that handles all application components (UI, backend, database) in one process.
* **Microservice**: An architecture where each application function is built as an independent service that communicates with others, allowing for scalability and flexibility.

1. **Explain SQL Joins and provide examples.  
   Answer:**

* **Inner Join**: Returns rows with matching values in both tables.
* **Left Join**: Returns all rows from the left table and matched rows from the right.
* **Right Join**: Returns all rows from the right table and matched rows from the left.
* **Full Join**: Returns all rows when there’s a match in either table.

Example of an **Inner Join**:

sql

SELECT a.name, b.salary

FROM Employees a

INNER JOIN Salaries b

ON a.id = b.emp\_id;

1. **What is the purpose of git stash, and how is it used?  
   Answer:** git stash temporarily saves your uncommitted changes without committing them. You can apply them later using git stash pop. Example:

bash

git stash save "Work in progress"

git stash pop

1. **What is a NoSQL database, and when would you use one?  
   Answer:** NoSQL databases are non-relational and designed to store unstructured or semi-structured data, offering horizontal scalability. Use NoSQL for use cases like distributed systems, large-scale data (e.g., social networks), or when dealing with flexible schemas (e.g., MongoDB).
2. **What is two-factor authentication (2FA)?  
   Answer:** 2FA is a security process that requires two different forms of identification (e.g., password + a one-time code sent to your phone) to log in. It enhances security by adding an extra layer beyond just the password.
3. **Explain the Observer pattern in software development.  
   Answer:** The Observer pattern defines a one-to-many relationship between objects. When one object (subject) changes, its dependents (observers) are notified automatically. It’s commonly used in event-driven programming and GUIs.
4. **What is the difference between shallow copy and deep copy in Python?  
   Answer:**

* **Shallow Copy**: Copies the reference pointers to the objects (i.e., the top-level object is copied, but nested objects are not).
* **Deep Copy**: Copies the object and all objects it references recursively, creating a fully independent copy.

Example:

python

import copy

shallow = copy.copy(original) # Shallow copy

sdeep = copy.deepcopy(original) # Deep copy

1. **What is cross-site scripting (XSS), and how do you prevent it?  
   Answer:** XSS is a vulnerability that allows attackers to inject malicious scripts into web pages viewed by others. Prevent it by properly escaping/encoding user inputs, using content security policies, and validating inputs.
2. **What is load testing, and why is it important?  
   Answer:** Load testing evaluates how a system performs under expected and peak loads. It helps ensure that an application can handle the expected number of users and helps identify bottlenecks before deployment.
3. **Explain git rebase and how it differs from git merge.  
   Answer:**

* **Git Merge**: Combines two branches, creating a new commit.
* **Git Rebase**: Moves or re-applies commits from one branch onto another, creating a linear history without merge commits.

Example:

bash

git checkout feature

git rebase main

1. **What is CORS (Cross-Origin Resource Sharing), and why is it important?  
   Answer:** CORS is a security feature implemented by browsers to restrict web pages from making requests to a domain different from the one serving the page. CORS headers define which origins are allowed to access server resources.
2. **Explain the concept of "lazy loading".  
   Answer:** Lazy loading delays the loading of resources (like images, objects, or data) until they are needed, improving initial load time and performance by only loading what is immediately necessary.
3. **What is OAuth, and how does it work?  
   Answer:** OAuth is an open standard for authorization, allowing third-party services to access user resources without exposing credentials. The user grants permission to the third-party app through the authorization server, which provides an access token to use for API calls.
4. **What are the pros and cons of using microservices?  
   Answer:**

* **Pros**: Flexibility, scalability, independent deployment, fault isolation.
* **Cons**: Complexity, increased latency due to inter-service communication, deployment challenges, monitoring and debugging difficulties.

1. **What is the difference between == and === in JavaScript?  
   Answer:**

* ==: Checks for equality after performing type coercion.
* ===: Checks for strict equality without type conversion.

Example:

javascript

1 == '1' // true

1 === '1' // false

1. **Explain the Model-View-Controller (MVC) design pattern.  
   Answer:** MVC is a software architectural pattern that separates an application into three main components:

* **Model**: Manages the data and business logic.
* **View**: Displays the data.
* **Controller**: Handles input and updates the Model and View.

1. **What is the difference between a process and a thread?  
   Answer:**

* **Process**: An independent unit with its own memory space.
* **Thread**: A smaller unit within a process that shares memory and resources with other threads.

1. **What is serverless computing?  
   Answer:** Serverless computing allows developers to build and run applications without managing the underlying infrastructure. Cloud providers (like AWS Lambda) handle scaling, availability, and maintenance, letting developers focus on code.
2. **Explain how JWT (JSON Web Tokens) are used for authentication.  
   Answer:** JWTs are compact, URL-safe tokens used for securely transmitting information between parties. They consist of three parts: header, payload, and signature. After logging in, a server generates a token that the client stores and sends with each request to authenticate.
3. **What are Docker and Kubernetes?  
   Answer:**

* **Docker**: A platform that allows developers to package applications and their dependencies into containers, which can run on any environment.
* **Kubernetes**: A container orchestration platform that automates the deployment, scaling, and management of containerized applications.