

Java, Spring Boot, Microservices, and Angular Interview Preparation Guide

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Contents

1	Core Java & OOPs	4
1.1	Difference between String, StringBuilder, and StringBuffer	4
1.2	Difference between .equals() method and == operator	5
1.3	Difference between method overloading and method overriding	5
1.4	What is Singleton class?	5
1.5	Create Singleton class	5
1.6	What is thread safety and how do you ensure thread-safe classes?	6
1.7	How does HashMap work internally?	6
1.8	Difference: HashMap vs Hashtable vs ConcurrentHashMap	6
1.9	How does HashMap work with Employee object as key?	6
1.10	What is immutability and how does it help in concurrency?	7
1.11	What is volatile and synchronized?	7
1.12	How many ways can an object be created in Java?	7
1.13	What is the use of ResponseEntity?	8
1.14	What is meant by functional interfaces?	8
1.15	How do functional interfaces work?	8
1.16	What is dependency injection and its types?	8
1.17	Difference between IOC and Dependency Injection	9
1.18	How many ways to achieve dependency injection and which is best?	9
1.19	@Primary vs @Qualifier — which takes priority?	9
1.20	How to create beans manually?	9
1.21	What is the difference between @RestController and @Controller?	9
1.22	What is @SpringBootApplication annotation?	10
1.23	What are stereotype annotations in Spring Boot?	10
1.24	What is path variable?	10
1.25	What is the default server in Spring Boot?	10
1.26	What is the default port in Spring Boot?	10
2	Java 8 Features	11
2.1	Java 8 features used in your project	11
2.2	What is a lambda expression?	11
2.3	Write code using lambda expression	11
2.4	What is Stream API?	11
2.5	Intermediate vs terminal operations in streams	12
2.6	List of intermediate and terminal methods	12
2.7	Why Java introduced default and static methods in interfaces	12
2.8	How to create an immutable class in Java	12

2.9	How to use groupingBy() in streams	13
2.10	How to create an Optional of an employee object	13
2.11	Use Java 8 streams to remove duplicates from a list	13
2.12	Find 3rd highest salary using Java 8 streams	13
3	Spring Boot & Microservices	14
3.1	How do you configure different environments in Spring Boot?	14
3.2	What is a Spring Boot profile and how did you use it?	14
3.3	What is exception handling and what is an advisor?	14
3.4	How does @Transactional annotation work?	14
3.5	What are the design patterns used in microservices?	15
3.6	Explain each design pattern and when to use them	15
3.7	What is microservices architecture?	15
3.8	Why microservices?	15
3.9	How do microservices communicate with each other?	15
3.10	Difference between synchronous and asynchronous communication	15
3.11	When to use synchronous vs asynchronous communication	16
3.12	What is Kafka and how have you implemented it?	16
3.13	How have you used Spring Security in your project?	16
3.14	What is JWT security and how have you used it?	16
3.15	What are the things to consider while developing REST APIs?	17
3.16	Difference between PUT, POST, and PATCH	17
3.17	API versioning strategies	17
3.18	What is idempotency and why is it critical?	17
3.19	How do you achieve idempotency in microservices?	18
3.20	Securing APIs using JWT and OAuth2	18
3.21	Validating incoming payloads with annotations	18
3.22	What are the steps to test Spring Boot microservices applications?	18
3.23	How to handle exceptions in Spring Boot	19
3.24	How to create global exceptions and what annotations are used	19
3.25	How to exclude classes from component scan	19
3.26	How does component scan work?	19
3.27	What is the most challenging task you've done?	19
3.28	What are the top 3 performance bottlenecks in microservices?	19
3.29	How do you monitor microservices?	20
3.30	How do you ensure system resiliency under high load?	20
3.31	What is centralized configuration and secrets management?	20
3.32	What is service discovery (Eureka/Consul)?	20
3.33	Inter-service communication: Feign vs RestTemplate vs WebClient	20
3.34	Circuit Breaker and Retry: Resilience4j	20
3.35	Blue-green vs canary deployments	21
3.36	Handling version mismatch between services	21
3.37	What are Maven commands you use daily?	21
3.38	Have you used Docker? Benefits and challenges?	21
4	Spring & Bean Lifecycle	21
4.1	Bean lifecycle and Spring container	21
4.2	Use of @Component, @Service, @Repository	21
4.3	Role of @ComponentScan, @Configuration, @Bean	22
4.4	What is Spring Boot auto-configuration?	22
5	JPA & Database	22

5.1	What is Fetch Type (Lazy vs Eager Loading)?	22
5.2	Lazy vs Eager loading — real-time use cases	22
5.3	Complex entity relationship experience	22
5.4	What is the N+1 query problem?	22
5.5	How to optimize N+1 using Spring Data JPA	23
5.6	Difference between get() and load() in Hibernate	23
5.7	Writing optimized JPQL and Criteria queries	23
5.8	Transaction management: @Transactional deep dive	23
6	Testing & Mocking	23
6.1	Differences between stubbing and mocking	23
6.2	Why do we need both approaches?	24
6.3	What is Spy in Mockito and when to use it?	24
6.4	How to write JUnit test cases for static methods	24
6.5	What is the use of Mockito framework?	24
7	Coding & Problem Solving	24
7.1	Reverse a string by preserving word position	24
7.2	Remove duplicates from string/array/list	25
7.3	Longest substring without repeating characters	25
7.4	Check if two strings/numbers are palindrome	25
7.5	Check if two strings/numbers are anagram	26
7.6	Sort an array/list/string	26
7.7	Count occurrence of characters in a string	26
7.8	Print duplicate characters in a string	27
7.9	Print only special characters in a string	27
7.10	Reverse the given string	27
7.11	Print difference between two strings	27
7.12	Count words in a string	28
7.13	Find second highest element in an array	28
7.14	Find common elements of two arrays	28
7.15	Decode string like a2b3c1 to aabbbc	29
7.16	Check if a number is prime	29
7.17	Generate Fibonacci series	29
7.18	Find factorial of a number	30
7.19	Find min and max element in an array	30
7.20	Find max repeated word in a sentence	30
7.21	Rotate array from k=2	30
7.22	Merge characters from two strings alternately	31
7.23	Find max repeated word in a sentence	31
7.24	Modify and improve given code	31
7.25	Find a file in a subdirectory	32
7.26	Write a method to fetch employee details	32
8	Angular & Frontend	32
8.1	What is ng-content and how does content projection work?	32
8.2	Difference between @ViewChild and @ContentChild	32
8.3	Explain Dependency Injection in Angular	33
8.4	How does Angular load dynamic components?	33
8.5	What is the PipeTransform interface?	33
8.6	How does Angular bootstrapping work via AppModule?	34
8.7	What is an HTTP interceptor?	34

8.8	Common use cases of HTTP interceptors	34
8.9	What is GraphQL and how does it compare to REST?	34
8.10	Use Apollo in Angular to fetch GraphQL data	34
8.11	Differences: BehaviorSubject, Subject, ReplaySubject	35
8.12	Explain: switchMap, mergeMap, concatMap, exhaustMap	35
8.13	Design a semantic HTML navigation menu	35
8.14	List 5 semantic HTML tags and their uses	35
8.15	Fetch API data and display in a table	35
8.16	Search by name using Reactive Form	36
8.17	Error handling on API failure	36
8.18	Flatten a nested array	36
9	Miscellaneous	36
9.1	What do you know about ISO8583?	36
9.2	How do Angular applications interact with backend APIs?	36
9.3	How do you clone code from Git and commit changes?	37
9.4	How to resolve merge conflicts?	37
9.5	Daily Git commands you use	37
10	Additional Frequently Asked Questions	37
10.1	What is the difference between checked and unchecked exceptions?	37
10.2	What is the purpose of @Autowired annotation in Spring?	37
10.3	What is the Circuit Breaker pattern in microservices?	37

Introduction

This document provides answers and examples for Java, Spring Boot, Microservices, and Angular interview questions, organized by topic. Each question includes a beginner-friendly explanation and a practical example, suitable for interview preparation. Additional common questions are included at the end.

1 Core Java & OOPs

1.1 Difference between String, StringBuilder, and StringBuffer

Answer: String is immutable, creating new objects for modifications. StringBuilder is mutable, non-thread-safe, and fast. StringBuffer is mutable, thread-safe, but slower due to synchronization.

```

1 public class StringExample {
2     public static void main(String[] args) {
3         String str = "Hello";
4         str += " World"; // New object
5         System.out.println(str); // Hello World
6         StringBuilder sb = new StringBuilder("Hello");
7         sb.append(" World");
8         System.out.println(sb); // Hello World
9         StringBuffer sbf = new StringBuffer("Hello");
10        sbf.append(" World");
11        System.out.println(sbf); // Hello World
12    }
13 }

```

1.2 Difference between .equals() method and == operator

Answer: == compares object references or primitive values. .equals() compares object content, customizable for classes.

```
1 public class EqualsExample {
2     public static void main(String[] args) {
3         String s1 = new String("Hello");
4         String s2 = new String("Hello");
5         System.out.println(s1 == s2); // false
6         System.out.println(s1.equals(s2)); // true
7         String s3 = "Hello";
8         String s4 = "Hello";
9         System.out.println(s3 == s4); // true
10    }
11 }
```

1.3 Difference between method overloading and method overriding

Answer: Overloading uses different parameters in the same class (compile-time). Overriding redefines a method in a subclass (runtime).

```
1 class Animal {
2     void sound() { System.out.println("Animal sound"); }
3 }
4 class Dog extends Animal {
5     void sound() { System.out.println("Dog barks"); } // Override
6     void sound(String type) { System.out.println("Dog " + type); } //
    Overload
7 }
8 public class PolymorphismExample {
9     public static void main(String[] args) {
10         Dog dog = new Dog();
11         dog.sound(); // Dog barks
12         dog.sound("growls"); // Dog growls
13     }
14 }
```

1.4 What is Singleton class?

Answer: Ensures one instance with global access, used for shared resources.

1.5 Create Singleton class

Answer: Uses private constructor, static instance, and static access method.

```
1 public class Singleton {
2     private static Singleton instance;
3     private Singleton() {}
4     public static synchronized Singleton getInstance() {
5         if (instance == null) instance = new Singleton();
6         return instance;
7     }
8     public static void main(String[] args) {
9         Singleton s1 = Singleton.getInstance();
10        Singleton s2 = Singleton.getInstance();
11        System.out.println(s1 == s2); // true
12    }
```

13 }

1.6 What is thread safety and how do you ensure thread-safe classes?

Answer: Thread safety prevents data corruption in multi-threaded environments using synchronization, immutability, or thread-safe classes.

```
1 public class ThreadSafeCounter {
2     private int count = 0;
3     public synchronized void increment() { count++; }
4     public synchronized int getCount() { return count; }
5     public static void main(String[] args) throws InterruptedException {
6         ThreadSafeCounter counter = new ThreadSafeCounter();
7         Runnable task = () -> { for (int i = 0; i < 1000; i++) counter.
            increment(); };
8         Thread t1 = new Thread(task); Thread t2 = new Thread(task);
9         t1.start(); t2.start(); t1.join(); t2.join();
10        System.out.println(counter.getCount()); // 2000
11    }
12 }
```

1.7 How does HashMap work internally?

Answer: Uses a hash table with buckets. Keys' hashCode() determines bucket index; collisions use linked lists or trees (Java 8+).

```
1 import java.util.HashMap;
2 public class HashMapExample {
3     public static void main(String[] args) {
4         HashMap<String, Integer> map = new HashMap<>();
5         map.put("A", 1);
6         map.put("B", 2);
7         System.out.println(map.get("A")); // 1
8     }
9 }
```

1.8 Difference: HashMap vs Hashtable vs ConcurrentHashMap

Answer: HashMap: non-thread-safe, allows nulls. Hashtable: thread-safe, no nulls. ConcurrentHashMap: thread-safe, concurrent access, no nulls.

```
1 import java.util.*;
2 public class MapComparison {
3     public static void main(String[] args) {
4         HashMap<String, Integer> hm = new HashMap<>();
5         hm.put(null, 1);
6         System.out.println(hm); // {null=1}
7         Hashtable<String, Integer> ht = new Hashtable<>();
8         ConcurrentHashMap<String, Integer> chm = new ConcurrentHashMap<>();
9     }
10 }
```

1.9 How does HashMap work with Employee object as key?

Answer: Uses Employee's hashCode() and equals() for bucket placement and collision resolution.

```

1 import java.util.HashMap;
2 class Employee {
3     int id; String name;
4     Employee(int id, String name) { this.id = id; this.name = name; }
5     @Override public int hashCode() { return id * 31 + name.hashCode(); }
6     @Override public boolean equals(Object obj) {
7         if (!(obj instanceof Employee)) return false;
8         Employee other = (Employee) obj;
9         return id == other.id && name.equals(other.name);
10    }
11 }
12 public class HashMapEmployee {
13     public static void main(String[] args) {
14         HashMap<Employee, String> map = new HashMap<>();
15         Employee e1 = new Employee(1, "Alice");
16         map.put(e1, "Developer");
17         System.out.println(map.get(new Employee(1, "Alice"))); // Developer
18     }
19 }

```

1.10 What is immutability and how does it help in concurrency?

Answer: Immutability prevents state changes, ensuring thread safety without synchronization.

```

1 public final class ImmutableClass {
2     private final int value;
3     public ImmutableClass(int value) { this.value = value; }
4     public int getValue() { return value; }
5     public static void main(String[] args) {
6         ImmutableClass obj = new ImmutableClass(42);
7         System.out.println(obj.getValue()); // 42
8     }
9 }

```

1.11 What is volatile and synchronized?

Answer: volatile ensures variable visibility; synchronized ensures mutual exclusion.

```

1 public class VolatileSynchronized {
2     private volatile boolean running = true;
3     public synchronized void update() { running = false; }
4     public static void main(String[] args) throws InterruptedException {
5         VolatileSynchronized vs = new VolatileSynchronized();
6         new Thread(() -> { while (vs.running) {} System.out.println("Stopped");
7             }).start();
8         Thread.sleep(1000);
9         vs.update();
10    }

```

1.12 How many ways can an object be created in Java?

Answer: Using new, Class.forName(), clone(), deserialization, factory methods.

```

1 public class ObjectCreation {
2     public static void main(String[] args) throws Exception {
3         ObjectCreation obj1 = new ObjectCreation();
4         ObjectCreation obj2 = (ObjectCreation) Class.forName("ObjectCreation").
            newInstance();
5     }
6 }

```

1.13 What is the use of ResponseEntity?

Answer: Represents HTTP response with status, headers, and body.

```

1 import org.springframework.http.*;
2 import org.springframework.web.bind.annotation.*;
3 @RestController
4 public class ResponseEntityExample {
5     @GetMapping("/user")
6     public ResponseEntity<String> getUser() {
7         return new ResponseEntity<>("User found", HttpStatus.OK);
8     }
9 }

```

1.14 What is meant by functional interfaces?

Answer: Interfaces with one abstract method, used with lambdas.

```

1 @FunctionalInterface
2 interface MyFunction { void apply(String s); }
3 public class FunctionalInterfaceExample {
4     public static void main(String[] args) {
5         MyFunction func = s -> System.out.println(s);
6         func.apply("Hello"); // Hello
7     }
8 }

```

1.15 How do functional interfaces work?

Answer: Enable functional programming via lambda expressions.

```

1 import java.util.function.Consumer;
2 public class FunctionalInterfaceWork {
3     public static void main(String[] args) {
4         Consumer<String> consumer = s -> System.out.println(s);
5         consumer.accept("Hello Consumer"); // Hello Consumer
6     }
7 }

```

1.16 What is dependency injection and its types?

Answer: Provides dependencies externally. Types: constructor, setter, field injection.

```

1 import org.springframework.stereotype.Component;
2 import org.springframework.beans.factory.annotation.Autowired;
3 @Component
4 class Service { public void serve() { System.out.println("Serving"); } }
5 @Component

```



```

6 class Client {
7     private final Service service;
8     @Autowired
9     public Client(Service service) { this.service = service; }
10    public void doWork() { service.serve(); }
11 }

```

1.17 Difference between IOC and Dependency Injection

Answer: IoC inverts control to a framework; DI is a way to achieve IoC.

```

1 // See above (Question 16)

```

1.18 How many ways to achieve dependency injection and which is best?

Answer: Constructor, setter, field injection. Constructor is best for explicit dependencies.

```

1 // See Question 16

```

1.19 @Primary vs @Qualifier — which takes priority?

Answer: @Primary sets default bean; @Qualifier overrides it.

```

1 import org.springframework.stereotype.Component;
2 import org.springframework.beans.factory.annotation.*;
3 interface Service {}
4 @Component @Primary
5 class DefaultService implements Service {}
6 @Component @Qualifier("special")
7 class SpecialService implements Service {}
8 @Component
9 class Client {
10     @Autowired @Qualifier("special") Service service;
11 }

```

1.20 How to create beans manually?

Answer: Use @Bean in a @Configuration class.

```

1 import org.springframework.context.annotation.*;
2 @Configuration
3 public class AppConfig {
4     @Bean
5     public Service myService() { return new Service(); }
6 }

```

1.21 What is the difference between @RestController and @Controller?

Answer: @Controller returns view names; @RestController returns data (e.g., JSON).

```

1 import org.springframework.stereotype.*;
2 import org.springframework.web.bind.annotation.*;
3 @Controller
4 public class MyController {
5     @GetMapping("/view")

```

```

6   public String getView() { return "view"; }
7   }
8   @RestController
9   public class MyRestController {
10      @GetMapping("/api")
11      public String getData() { return "Data"; }
12  }

```

1.22 What is @SpringBootApplication annotation?

Answer: Combines @EnableAutoConfiguration, @ComponentScan, @Configuration.

```

1  import org.springframework.boot.*;
2  import org.springframework.boot.autoconfigure.*;
3  @SpringBootApplication
4  public class Application {
5      public static void main(String[] args) {
6          SpringApplication.run(Application.class, args);
7      }
8  }

```

1.23 What are stereotype annotations in Spring Boot?

Answer: @Component, @Service, @Repository, @Controller mark classes for scanning.

```

1  import org.springframework.stereotype.*;
2  @Service
3  public class MyService {
4      public void serve() { System.out.println("Service"); }
5  }

```

1.24 What is path variable?

Answer: @PathVariable extracts URL path values.

```

1  import org.springframework.web.bind.annotation.*;
2  @RestController
3  public class PathVariableExample {
4      @GetMapping("/user/{id}")
5      public String getUser(@PathVariable int id) {
6          return "User ID: " + id;
7      }
8  }

```

1.25 What is the default server in Spring Boot?

Answer: Tomcat.

```

1  // Run Application.java to start Tomcat

```

1.26 What is the default port in Spring Boot?

Answer: 8080.

```

1  // Access http://localhost:8080

```

2 Java 8 Features

2.1 Java 8 features used in your project

Answer: Lambda expressions, Stream API, Optional, default/static methods, forEach.

```
1 import java.util.*;
2 public class Java8Features {
3     public static void main(String[] args) {
4         List<String> list = Arrays.asList("A", "B");
5         list.forEach(s -> System.out.println(s)); // A, B
6     }
7 }
```

2.2 What is a lambda expression?

Answer: Concise function representation: (params) -> expression.

```
1 import java.util.*;
2 public class LambdaExample {
3     public static void main(String[] args) {
4         List<String> list = Arrays.asList("A", "B");
5         list.forEach(s -> System.out.println(s)); // A, B
6     }
7 }
```

2.3 Write code using lambda expression

```
1 import java.util.*;
2 public class LambdaCode {
3     public static void main(String[] args) {
4         List<Integer> numbers = Arrays.asList(1, 2, 3);
5         numbers.forEach(n -> System.out.println(n * 2)); // 2, 4, 6
6     }
7 }
```

2.4 What is Stream API?

Answer: Processes collections functionally with operations like filter, map, collect.

```
1 import java.util.*;
2 import java.util.stream.*;
3 public class StreamExample {
4     public static void main(String[] args) {
5         List<Integer> numbers = Arrays.asList(1, 2, 3, 4);
6         List<Integer> evens = numbers.stream()
7             .filter(n -> n % 2 == 0)
8             .collect(Collectors.toList());
9         System.out.println(evens); // [2, 4]
10    }
11 }
```

2.5 Intermediate vs terminal operations in streams

Answer: Intermediate (lazy, e.g., filter, map); terminal (triggers, e.g., collect, forEach).

```
1 import java.util.*;
2 public class StreamOperations {
3     public static void main(String[] args) {
4         List<Integer> numbers = Arrays.asList(1, 2, 3);
5         numbers.stream().filter(n -> n > 1).forEach(System.out::println); // 2,
6         3
7     }
8 }
```

2.6 List of intermediate and terminal methods

Answer: Intermediate: filter, map, sorted, distinct. Terminal: collect, forEach, reduce, count.

```
1 import java.util.*;
2 import java.util.stream.*;
3 public class StreamMethods {
4     public static void main(String[] args) {
5         List<Integer> numbers = Arrays.asList(1, 2, 2, 3);
6         long count = numbers.stream().distinct().count(); // 3
7         System.out.println(count);
8     }
9 }
```

2.7 Why Java introduced default and static methods in interfaces

Answer: Default: Add methods without breaking implementations. Static: Utility methods.

```
1 interface MyInterface {
2     default void defaultMethod() { System.out.println("Default"); }
3     static void staticMethod() { System.out.println("Static"); }
4 }
5 class MyClass implements MyInterface {}
6 public class InterfaceExample {
7     public static void main(String[] args) {
8         new MyClass().defaultMethod(); // Default
9         MyInterface.staticMethod(); // Static
10    }
11 }
```

2.8 How to create an immutable class in Java

Answer: Use final class, final fields, no setters, deep copy for mutable objects.

```
1 public final class ImmutableClass {
2     private final int value;
3     public ImmutableClass(int value) { this.value = value; }
4     public int getValue() { return value; }
5     public static void main(String[] args) {
6         ImmutableClass obj = new ImmutableClass(42);
7         System.out.println(obj.getValue()); // 42
8     }
9 }
```

2.9 How to use groupingBy() in streams

Answer: Groups elements by a classifier.

```
1 import java.util.*;
2 import java.util.stream.*;
3 public class GroupingByExample {
4     public static void main(String[] args) {
5         List<String> names = Arrays.asList("Alice", "Bob", "Adam");
6         Map<Character, List<String>> grouped = names.stream()
7             .collect(Collectors.groupingBy(s -> s.charAt(0)));
8         System.out.println(grouped); // {A=[Alice, Adam], B=[Bob]}
9     }
10 }
```

2.10 How to create an Optional of an employee object

Answer: Wraps object to handle null cases.

```
1 import java.util.Optional;
2 class Employee {
3     String name;
4     Employee(String name) { this.name = name; }
5 }
6 public class OptionalExample {
7     public static void main(String[] args) {
8         Optional<Employee> emp = Optional.of(new Employee("Alice"));
9         System.out.println(emp.get().name); // Alice
10     }
11 }
```

2.11 Use Java 8 streams to remove duplicates from a list

```
1 import java.util.*;
2 import java.util.stream.*;
3 public class RemoveDuplicates {
4     public static void main(String[] args) {
5         List<Integer> numbers = Arrays.asList(1, 2, 2, 3);
6         List<Integer> unique = numbers.stream().distinct().collect(Collectors.toList());
7         System.out.println(unique); // [1, 2, 3]
8     }
9 }
```

2.12 Find 3rd highest salary using Java 8 streams

```
1 import java.util.*;
2 import java.util.stream.*;
3 class Employee {
4     double salary;
5     Employee(double salary) { this.salary = salary; }
6     double getSalary() { return salary; }
7 }
8 public class ThirdHighestSalary {
9     public static void main(String[] args) {
10         List<Employee> employees = Arrays.asList(
```

```

11     new Employee(50000), new Employee(70000), new Employee(60000)
12 );
13 double thirdHighest = employees.stream()
14     .map(Employee::getSalary)
15     .distinct()
16     .sorted(Comparator.reverseOrder())
17     .skip(2)
18     .findFirst()
19     .orElse(0.0);
20 System.out.println(thirdHighest); // 0.0 (if <3 salaries)
21 }
22 }

```

3 Spring Boot & Microservices

3.1 How do you configure different environments in Spring Boot?

Answer: Use application-{profile}.properties and spring.profiles.active.

```

1 # application-dev.properties
2 server.port=8081

```

```

1 import org.springframework.context.annotation.*;
2 @Profile("dev")
3 @Component
4 public class DevConfig {}

```

3.2 What is a Spring Boot profile and how did you use it?

Answer: Profiles activate environment-specific configurations.

```

1 # application.properties
2 spring.profiles.active=dev

```

3.3 What is exception handling and what is an advisor?

Answer: Exception handling manages errors; advisor combines AOP advice and point-cut.

```

1 import org.springframework.http.*;
2 import org.springframework.web.bind.annotation.*;
3 @RestController
4 public class ExceptionController {
5     @ExceptionHandler({NullPointerException.class})
6     public ResponseEntity<String> handleNPE() {
7         return new ResponseEntity<>("Error", HttpStatus.BAD_REQUEST);
8     }
9 }

```

3.4 How does @Transactional annotation work?

Answer: Manages transactions, ensuring atomicity.

```

1 import org.springframework.stereotype.*;
2 import org.springframework.transaction.annotation.*;
3 @Service
4 public class UserService {
5     @Transactional
6     public void saveUser() {}
7 }

```

3.5 What are the design patterns used in microservices?

Answer: Circuit Breaker, API Gateway, Service Discovery, Event-Driven, CQRS.

3.6 Explain each design pattern and when to use them

Answer: Circuit Breaker: Prevents failures. API Gateway: Routing/security. Service Discovery: Dynamic location. Event-Driven: Loose coupling. CQRS: Complex domains.

```

1 import io.github.resilience4j.circuitbreaker.annotation.*;
2 @Service
3 public class MyService {
4     @CircuitBreaker(name = "myService")
5     public String callApi() { return "Success"; }
6 }

```

3.7 What is microservices architecture?

Answer: Small, independent services communicating via APIs.

```

1 import org.springframework.web.bind.annotation.*;
2 @RestController
3 public class UserController {
4     @GetMapping("/users")
5     public String getUsers() { return "User List"; }
6 }

```

3.8 Why microservices?

Answer: Scalability, independent deployment, fault isolation.

3.9 How do microservices communicate with each other?

Answer: Via REST, message queues, or gRPC.

```

1 import org.springframework.web.client.RestTemplate;
2 public class Communication {
3     public static void main(String[] args) {
4         RestTemplate restTemplate = new RestTemplate();
5         String response = restTemplate.getForObject("http://other-service/users", String.class);
6     }
7 }

```

3.10 Difference between synchronous and asynchronous communication

Answer: Synchronous: Blocking (REST). Asynchronous: Non-blocking (Kafka).

3.11 When to use synchronous vs asynchronous communication

Answer: Synchronous for immediate responses; asynchronous for decoupled systems.

```
1 import org.springframework.kafka.annotation.*;
2 @Service
3 public class KafkaConsumer {
4     @KafkaListener(topics = "myTopic")
5     public void consume(String message) {
6         System.out.println(message);
7     }
8 }
```

3.12 What is Kafka and how have you implemented it?

Answer: Distributed messaging system for event-driven architectures.

```
1 import org.springframework.kafka.core.*;
2 import org.springframework.stereotype.*;
3 @Service
4 public class KafkaProducer {
5     @Autowired
6     private KafkaTemplate<String, String> kafkaTemplate;
7     public void sendMessage(String msg) {
8         kafkaTemplate.send("myTopic", msg);
9     }
10 }
```

3.13 How have you used Spring Security in your project?

Answer: Secures applications via authentication/authorization.

```
1 import org.springframework.context.annotation.*;
2 import org.springframework.security.config.annotation.web.builders.*;
3 @Configuration
4 @EnableWebSecurity
5 public class SecurityConfig {
6     @Bean
7     public SecurityFilterChain securityFilterChain(HttpSecurity http) throws
8         Exception {
9         http.authorizeRequests().anyRequest().authenticated().and().httpBasic()
10         ;
11         return http.build();
12     }
13 }
```

3.14 What is JWT security and how have you used it?

Answer: Token-based authentication using JSON Web Tokens.

```
1 import io.jsonwebtoken.*;
2 public class JwtExample {
3     public String generateToken(String username) {
4         return Jwts.builder()
5             .setSubject(username)
6             .signWith(SignatureAlgorithm.HS512, "secret")
7             .compact();
8     }
9 }
```



```
9 }
```

3.15 What are the things to consider while developing REST APIs?

Answer: RESTful principles, versioning, error handling, security, documentation.

```
1 import org.springframework.http.*;
2 import org.springframework.web.bind.annotation.*;
3 @RestController
4 @RequestMapping("/api/v1")
5 public class ApiController {
6     @GetMapping("/users")
7     public ResponseEntity<List<String>> getUsers() {
8         return ResponseEntity.ok(Arrays.asList("Alice", "Bob"));
9     }
10 }
```

3.16 Difference between PUT, POST, and PATCH

Answer: POST creates, PUT updates entire resource, PATCH updates partially.

```
1 import org.springframework.web.bind.annotation.*;
2 @RestController
3 public class UserController {
4     @PostMapping("/users") public String createUser() { return "Created"; }
5     @PutMapping("/users/{id}") public String updateUser(@PathVariable int id)
6         { return "Updated"; }
7     @PatchMapping("/users/{id}") public String patchUser(@PathVariable int id
8         ) { return "Patched"; }
9 }
```

3.17 API versioning strategies

Answer: URI versioning, query parameters, headers, media types.

```
1 import org.springframework.web.bind.annotation.*;
2 @RestController
3 @RequestMapping("/api/v1")
4 public class VersionedController {
5     @GetMapping("/users")
6     public String getUsers() { return "Version 1"; }
7 }
```

3.18 What is idempotency and why is it critical?

Answer: Ensures multiple identical requests have the same effect, critical for reliability.

```
1 import org.springframework.web.bind.annotation.*;
2 @RestController
3 public class IdempotentController {
4     @PutMapping("/users/{id}")
5     public ResponseEntity<String> updateUser(@PathVariable int id) {
6         return ResponseEntity.ok("Updated");
7     }
8 }
```

3.19 How do you achieve idempotency in microservices?

Answer: Use unique request IDs or design idempotent operations.

```
1 import java.util.*;
2 @Service
3 public class IdempotentService {
4     private Set<String> processedIds = new HashSet<>();
5     public String process(String requestId) {
6         if (processedIds.contains(requestId)) return "Already processed";
7         processedIds.add(requestId);
8         return "Processed";
9     }
10 }
```

3.20 Securing APIs using JWT and OAuth2

Answer: JWT for authentication, OAuth2 for authorization.

```
1 // See JWT example (Question 14)
```

3.21 Validating incoming payloads with annotations

Answer: Use @Valid and Bean Validation annotations.

```
1 import javax.validation.constraints.*;
2 public class User {
3     @NotNull private String name;
4 }
5 import org.springframework.web.bind.annotation.*;
6 import javax.validation.*;
7 @RestController
8 public class UserController {
9     @PostMapping("/users")
10    public ResponseEntity<String> createUser(@Valid @RequestBody User user) {
11        return ResponseEntity.ok("Valid");
12    }
13 }
```

3.22 What are the steps to test Spring Boot microservices applications?

Answer: Unit tests, integration tests, mock external services, test REST APIs.

```
1 import org.junit.jupiter.api.*;
2 import org.springframework.boot.test.context.*;
3 import org.springframework.boot.test.web.client.*;
4 @SpringBootTest
5 public class UserControllerTest {
6     @Autowired private TestRestTemplate restTemplate;
7     @Test
8     public void testGetUsers() {
9         ResponseEntity<String> response = restTemplate.getForEntity("/users",
10             String.class);
11         Assertions.assertEquals(HttpStatus.OK, response.getStatusCode());
12     }
13 }
```

3.23 How to handle exceptions in Spring Boot

Answer: Use `@ExceptionHandler` or `@ControllerAdvice`.

```
1 import org.springframework.http.*;
2 import org.springframework.web.bind.annotation.*;
3 @ControllerAdvice
4 public class GlobalExceptionHandler {
5     @ExceptionHandler(Exception.class)
6     public ResponseEntity<String> handleException(Exception e) {
7         return new ResponseEntity<>("Error: " + e.getMessage(), HttpStatus.
8             INTERNAL_SERVER_ERROR);
9     }
10 }
```

3.24 How to create global exceptions and what annotations are used

Answer: Use `@ControllerAdvice` and `@ExceptionHandler`.

```
1 // See above
```

3.25 How to exclude classes from component scan

Answer: Use `exclude` or `excludeFilters` in `@ComponentScan`.

```
1 import org.springframework.context.annotation.*;
2 @ComponentScan(basePackages = "com.example", excludeFilters = @Filter(type
3     = FilterType.ASSIGNABLE_TYPE, classes = MyClass.class))
4 @Configuration
5 public class AppConfig {}
```

3.26 How does component scan work?

Answer: Scans packages for stereotype-annotated classes, registering them as beans.

```
1 import org.springframework.stereotype.*;
2 @Component
3 public class MyComponent {}
```

3.27 What is the most challenging task you've done?

Answer: Optimizing a microservice for high load with caching.

```
1 import org.springframework.cache.annotation.*;
2 @Service
3 public class OptimizedService {
4     @Cacheable("data")
5     public String getData() { return "Data"; }
6 }
```

3.28 What are the top 3 performance bottlenecks in microservices?

Answer: Network latency, database queries, resource management.

```

1 import org.springframework.data.jpa.repository.*;
2 public interface UserRepository extends JpaRepository<User, Long> {
3     @Query("SELECT u FROM User u WHERE u.active = true")
4     List<User> findActiveUsers();
5 }

```

3.29 How do you monitor microservices?

Answer: Use Prometheus, Grafana, or Spring Actuator.

```

1 # application.properties
2 management.endpoints.web.exposure.include=*

```

3.30 How do you ensure system resiliency under high load?

Answer: Use circuit breakers, retries, load balancing, caching.

```

1 // See Circuit Breaker (Question 6)

```

3.31 What is centralized configuration and secrets management?

Answer: Centralized configuration (Spring Cloud Config); secrets (Vault).

```

1 # application.properties
2 spring.config.import=configserver:http://config-server

```

3.32 What is service discovery (Eureka/Consul)?

Answer: Dynamically locates services.

```

1 import org.springframework.cloud.netflix.eureka.*;
2 @SpringBootApplication
3 @EnableEurekaClient
4 public class Application {}

```

3.33 Inter-service communication: Feign vs RestTemplate vs WebClient

Answer: RestTemplate (synchronous), WebClient (reactive), Feign (declarative).

```

1 import feign.*;
2 @FeignClient(name = "user-service")
3 interface UserClient {
4     @GetMapping("/users")
5     List<String> getUsers();
6 }

```

3.34 Circuit Breaker and Retry: Resilience4j

Answer: Circuit Breaker prevents failures; Retry attempts failed operations.

```

1 import io.github.resilience4j.circuitbreaker.annotation.*;
2 import io.github.resilience4j.retry.annotation.*;
3 @Service
4 public class ResilientService {
5     @CircuitBreaker(name = "myService")

```

```

6  @Retry(name = "myService")
7  public String call() { return "Success"; }
8  }

```

3.35 Blue-green vs canary deployments

Answer: Blue-Green: Two environments, switch traffic. Canary: Gradual rollout.

3.36 Handling version mismatch between services

Answer: Use API versioning or backward compatibility.

```

1  // See API versioning (Question 17)

```

3.37 What are Maven commands you use daily?

Answer: mvn clean install, mvn test, mvn package.

```

1  mvn clean install

```

3.38 Have you used Docker? Benefits and challenges?

Answer: Benefits: consistency, portability. Challenges: resource overhead.

```

1  FROM openjdk:11
2  COPY target/myapp.jar /app.jar
3  ENTRYPOINT ["java", "-jar", "/app.jar"]

```

4 Spring & Bean Lifecycle

4.1 Bean lifecycle and Spring container

Answer: Creation, dependency injection, initialization, use, destruction.

```

1  import javax.annotation.*;
2  @Component
3  public class MyBean {
4      @PostConstruct
5      public void init() { System.out.println("Initialized"); }
6  }

```

4.2 Use of @Component, @Service, @Repository

Answer: @Component: generic, @Service: business logic, @Repository: data access.

```

1  import org.springframework.stereotype.*;
2  @Repository
3  public class UserRepository {}

```

4.3 Role of @ComponentScan, @Configuration, @Bean

Answer: @ComponentScan scans beans, @Configuration defines config, @Bean creates beans.

```
1 import org.springframework.context.annotation.*;
2 @Configuration
3 @ComponentScan("com.example")
4 public class AppConfig {
5     @Bean
6     public MyBean myBean() { return new MyBean(); }
7 }
```

4.4 What is Spring Boot auto-configuration?

Answer: Automatically configures beans based on dependencies.

```
1 import org.springframework.boot.autoconfigure.*;
2 @SpringBootApplication
3 public class Application {}
```

5 JPA & Database

5.1 What is Fetch Type (Lazy vs Eager Loading)?

Answer: Lazy loads data on demand; Eager loads immediately.

```
1 import javax.persistence.*;
2 @Entity
3 public class User {
4     @OneToMany(fetch = FetchType.LAZY)
5     private List<Order> orders;
6 }
```

5.2 Lazy vs Eager loading — real-time use cases

Answer: Lazy for large datasets; Eager for small, frequent data.

5.3 Complex entity relationship experience

Answer: Managed @OneToMany, @ManyToMany with cascading.

```
1 import javax.persistence.*;
2 @Entity
3 public class Department {
4     @OneToMany(mappedBy = "department")
5     private List<Employee> employees;
6 }
```

5.4 What is the N+1 query problem?

Answer: Multiple queries for related data due to lazy loading.

```
1 List<User> users = repository.findAll();
2 for (User u : users) { u.getOrders().size(); }
```

5.5 How to optimize N+1 using Spring Data JPA

Answer: Use @EntityGraph or JOIN FETCH.

```
1 import org.springframework.data.jpa.repository.*;
2 public interface UserRepository extends JpaRepository<User, Long> {
3     @EntityGraph(attributePaths = {"orders"})
4     List<User> findAll();
5 }
```

5.6 Difference between get() and load() in Hibernate

Answer: get() loads immediately, returns null if not found; load() uses proxy, throws exception if not found.

```
1 import org.hibernate.*;
2 public class HibernateExample {
3     public static void main(String[] args) {
4         Session session = sessionFactory.getCurrentSession();
5         User user = session.get(User.class, 1L);
6         User proxy = session.load(User.class, 1L);
7     }
8 }
```

5.7 Writing optimized JPQL and Criteria queries

```
1 import org.springframework.data.jpa.repository.*;
2 public interface UserRepository extends JpaRepository<User, Long> {
3     @Query("SELECT u FROM User u WHERE u.age > ?1")
4     List<User> findByAgeGreaterThan(int age);
5 }
```

5.8 Transaction management: @Transactional deep dive

Answer: Controls transaction boundaries, rolls back on exceptions.

```
1 import org.springframework.transaction.annotation.*;
2 @Transactional(rollbackOn = Exception.class)
3 public void saveUser(User user) {}
```

6 Testing & Mocking

6.1 Differences between stubbing and mocking

Answer: Stubbing provides canned responses; mocking verifies interactions.

```
1 import org.junit.jupiter.api.*;
2 import static org.mockito.Mockito.*;
3 public class MockTest {
4     @Test
5     public void testMock() {
6         List<String> mockedList = mock(List.class);
7         when(mockedList.get(0)).thenReturn("Stubbed");
8         verify(mockedList).get(0);
9     }
10 }
```

6.2 Why do we need both approaches?

Answer: Stubbing for outputs, mocking for behavior verification.

6.3 What is Spy in Mockito and when to use it?

Answer: Wraps real object, allows real calls unless overridden.

```
1 import org.junit.jupiter.api.*;
2 import static org.mockito.Mockito.*;
3 public class SpyTest {
4     @Test
5     public void testSpy() {
6         List<String> list = new ArrayList<>();
7         List<String> spy = spy(list);
8         spy.add("test");
9         verify(spy).add("test");
10    }
11 }
```

6.4 How to write JUnit test cases for static methods

Answer: Use PowerMock or refactor to instance methods.

```
1 public class StaticUtil {
2     public static String getName() { return "Test"; }
3 }
4 import org.junit.jupiter.api.*;
5 public class StaticTest {
6     @Test
7     public void testStatic() {
8         Assertions.assertEquals("Test", StaticUtil.getName());
9     }
10 }
```

6.5 What is the use of Mockito framework?

Answer: Creates mocks/spies for dependency-free testing.

```
1 import org.junit.jupiter.api.*;
2 import static org.mockito.Mockito.*;
3 public class MockitoTest {
4     @Test
5     public void testMockito() {
6         Service service = mock(Service.class);
7         when(service.getData()).thenReturn("Mocked");
8         Assertions.assertEquals("Mocked", service.getData());
9     }
10 }
```

7 Coding & Problem Solving

7.1 Reverse a string by preserving word position


```

1 public class StringReverse {
2     public static String reverseWords(String s) {
3         String[] words = s.split(" ");
4         StringBuilder result = new StringBuilder();
5         for (String word : words) {
6             result.append(new StringBuilder(word).reverse()).append(" ");
7         }
8         return result.toString().trim();
9     }
10    public static void main(String[] args) {
11        System.out.println(reverseWords("Hello World")); // olleH dlroW
12    }
13 }

```

7.2 Remove duplicates from string/array/list

```

1 import java.util.*;
2 import java.util.stream.*;
3 public class RemoveDuplicates {
4     public static void main(String[] args) {
5         List<Integer> numbers = Arrays.asList(1, 2, 2, 3);
6         List<Integer> unique = numbers.stream().distinct().collect(Collectors.toList());
7         System.out.println(unique); // [1, 2, 3]
8     }
9 }

```

7.3 Longest substring without repeating characters

```

1 import java.util.*;
2 public class LongestSubstring {
3     public static int lengthOfLongestSubstring(String s) {
4         Set<Character> set = new HashSet<>();
5         int max = 0, i = 0, j = 0;
6         while (j < s.length()) {
7             if (!set.contains(s.charAt(j))) {
8                 set.add(s.charAt(j++));
9                 max = Math.max(max, set.size());
10            } else {
11                set.remove(s.charAt(i++));
12            }
13        }
14        return max;
15    }
16    public static void main(String[] args) {
17        System.out.println(lengthOfLongestSubstring("abcabcbb")); // 3
18    }
19 }

```

7.4 Check if two strings/numbers are palindrome

```

1 public class Palindrome {
2     public static boolean isPalindrome(String s) {

```

```

3      s = s.toLowerCase().replaceAll("[^a-z0-9]", "");
4      int i = 0, j = s.length() - 1;
5      while (i < j) {
6          if (s.charAt(i++) != s.charAt(j--)) return false;
7      }
8      return true;
9  }
10 public static void main(String[] args) {
11     System.out.println(isPalindrome("A man, a plan, a canal: Panama")); //
        true
12 }
13 }

```

7.5 Check if two strings/numbers are anagram

```

1 public class Anagram {
2     public static boolean isAnagram(String s1, String s2) {
3         if (s1.length() != s2.length()) return false;
4         int[] count = new int[26];
5         for (char c : s1.toCharArray()) count[c - 'a']++;
6         for (char c : s2.toCharArray()) count[c - 'a']--;
7         for (int c : count) if (c != 0) return false;
8         return true;
9     }
10    public static void main(String[] args) {
11        System.out.println(isAnagram("listen", "silent")); // true
12    }
13 }

```

7.6 Sort an array/list/string

```

1 import java.util.*;
2 public class SortExample {
3     public static void main(String[] args) {
4         List<Integer> list = Arrays.asList(3, 1, 2);
5         Collections.sort(list);
6         System.out.println(list); // [1, 2, 3]
7     }
8 }

```

7.7 Count occurrence of characters in a string

```

1 import java.util.*;
2 import java.util.stream.*;
3 public class CharCount {
4     public static Map<Character, Integer> countChars(String s) {
5         return s.chars()
6             .mapToObj(c -> (char) c)
7             .collect(Collectors.groupingBy(c -> c, Collectors.counting()))
8             .entrySet().stream()
9             .collect(Collectors.toMap(Map.Entry::getKey, e -> e.getValue().
                intValue()));
10    }
11    public static void main(String[] args) {

```

```

12     System.out.println(countChars("hello")); // {h=1, e=1, l=2, o=1}
13 }
14 }

```

7.8 Print duplicate characters in a string

```

1 import java.util.*;
2 import java.util.stream.*;
3 public class DuplicateChars {
4     public static void printDuplicates(String s) {
5         Map<Character, Long> map = s.chars()
6             .mapToObj(c -> (char) c)
7             .collect(Collectors.groupingBy(c -> c, Collectors.counting()));
8         map.entrySet().stream()
9             .filter(e -> e.getValue() > 1)
10            .forEach(e -> System.out.println(e.getKey()));
11    }
12    public static void main(String[] args) {
13        printDuplicates("hello"); // l
14    }
15 }

```

7.9 Print only special characters in a string

```

1 public class SpecialChars {
2     public static void printSpecial(String s) {
3         s.chars()
4             .mapToObj(c -> (char) c)
5             .filter(c -> !Character.isLetterOrDigit(c))
6             .forEach(System.out::println);
7     }
8     public static void main(String[] args) {
9         printSpecial("Hello!@#"); // !, @, #
10    }
11 }

```

7.10 Reverse the given string

```

1 public class ReverseString {
2     public static String reverse(String s) {
3         return new StringBuilder(s).reverse().toString();
4     }
5     public static void main(String[] args) {
6         System.out.println(reverse("Hello")); // olleH
7     }
8 }

```

7.11 Print difference between two strings

```

1 public class StringDiff {
2     public static void printDiff(String s1, String s2) {
3         for (int i = 0; i < Math.min(s1.length(), s2.length()); i++) {
4             if (s1.charAt(i) != s2.charAt(i)) {

```

```

5         System.out.println("Diff at " + i + ": " + s1.charAt(i) + " vs " +
6             s2.charAt(i));
7     }
8 }
9 public static void main(String[] args) {
10     printDiff("hello", "heelo"); // Diff at 2: l vs e
11 }
12 }

```

7.12 Count words in a string

```

1 public class WordCount {
2     public static int countWords(String s) {
3         return s.trim().split("\\s+").length;
4     }
5     public static void main(String[] args) {
6         System.out.println(countWords("Hello World")); // 2
7     }
8 }

```

7.13 Find second highest element in an array

```

1 public class SecondHighest {
2     public static int findSecondHighest(int[] arr) {
3         int max = Integer.MIN_VALUE, second = Integer.MIN_VALUE;
4         for (int num : arr) {
5             if (num > max) {
6                 second = max; max = num;
7             } else if (num > second && num != max) {
8                 second = num;
9             }
10        }
11        return second;
12    }
13    public static void main(String[] args) {
14        System.out.println(findSecondHighest(new int[]{5, 3, 8, 1})); // 5
15    }
16 }

```

7.14 Find common elements of two arrays

```

1 import java.util.*;
2 import java.util.stream.*;
3 public class CommonElements {
4     public static List<Integer> findCommon(int[] arr1, int[] arr2) {
5         Set<Integer> set = Arrays.stream(arr1).boxed().collect(Collectors.toSet
6             ());
7         return Arrays.stream(arr2).filter(set::contains).boxed().collect(
8             Collectors.toList());
9     }
10    public static void main(String[] args) {
11        System.out.println(findCommon(new int[]{1, 2, 3}, new int[]{2, 3, 4}));
12        // [2, 3]
13    }
14 }

```

```
10 }  
11 }
```

7.15 Decode string like a2b3c1 to aabbbc

```
1 public class DecodeString {  
2     public static String decode(String s) {  
3         StringBuilder result = new StringBuilder();  
4         for (int i = 0; i < s.length(); i += 2) {  
5             char c = s.charAt(i);  
6             int count = Character.getNumericValue(s.charAt(i + 1));  
7             result.append(String.valueOf(c).repeat(count));  
8         }  
9         return result.toString();  
10    }  
11    public static void main(String[] args) {  
12        System.out.println(decode("a2b3c1")); // aabbbc  
13    }  
14 }
```

7.16 Check if a number is prime

```
1 public class PrimeCheck {  
2     public static boolean isPrime(int n) {  
3         if (n <= 1) return false;  
4         for (int i = 2; i <= Math.sqrt(n); i++) {  
5             if (n % i == 0) return false;  
6         }  
7         return true;  
8     }  
9     public static void main(String[] args) {  
10        System.out.println(isPrime(7)); // true  
11    }  
12 }
```

7.17 Generate Fibonacci series

```
1 public class Fibonacci {  
2     public static void printFibonacci(int n) {  
3         int a = 0, b = 1;  
4         for (int i = 0; i < n; i++) {  
5             System.out.print(a + " ");  
6             int next = a + b;  
7             a = b; b = next;  
8         }  
9     }  
10    public static void main(String[] args) {  
11        printFibonacci(5); // 0 1 1 2 3  
12    }  
13 }
```

7.18 Find factorial of a number

```
1 public class Factorial {
2     public static long factorial(int n) {
3         if (n == 0) return 1;
4         return n * factorial(n - 1);
5     }
6     public static void main(String[] args) {
7         System.out.println(factorial(5)); // 120
8     }
9 }
```

7.19 Find min and max element in an array

```
1 public class MinMax {
2     public static int[] findMinMax(int[] arr) {
3         int min = arr[0], max = arr[0];
4         for (int num : arr) {
5             min = Math.min(min, num);
6             max = Math.max(max, num);
7         }
8         return new int[]{min, max};
9     }
10    public static void main(String[] args) {
11        int[] result = findMinMax(new int[]{3, 1, 4, 2});
12        System.out.println("Min: " + result[0] + ", Max: " + result[1]); // Min
13                                : 1, Max: 4
14    }
15 }
```

7.20 Find max repeated word in a sentence

```
1 import java.util.*;
2 import java.util.stream.*;
3 public class MaxRepeatedWord {
4     public static String findMaxRepeated(String s) {
5         Map<String, Long> map = Arrays.stream(s.split("\\s+"))
6             .collect(Collectors.groupingBy(w -> w, Collectors.counting()));
7         return map.entrySet().stream()
8             .max(Map.Entry.comparingByValue())
9             .map(Map.Entry::getKey)
10            .orElse("");
11    }
12    public static void main(String[] args) {
13        System.out.println(findMaxRepeated("hello world hello")); // hello
14    }
15 }
```

7.21 Rotate array from k=2

```
1 public class RotateArray {
2     public static void rotate(int[] arr, int k) {
3         k = k % arr.length;
4         reverse(arr, 0, arr.length - 1);
```

```

5     reverse(arr, 0, k - 1);
6     reverse(arr, k, arr.length - 1);
7 }
8 private static void reverse(int[] arr, int start, int end) {
9     while (start < end) {
10         int temp = arr[start];
11         arr[start++] = arr[end];
12         arr[end--] = temp;
13     }
14 }
15 public static void main(String[] args) {
16     int[] arr = {1, 2, 3, 4, 5};
17     rotate(arr, 2);
18     System.out.println(Arrays.toString(arr)); // [4, 5, 1, 2, 3]
19 }
20 }

```

7.22 Merge characters from two strings alternately

```

1 public class MergeStrings {
2     public static String mergeAlternately(String s1, String s2) {
3         StringBuilder result = new StringBuilder();
4         int i = 0;
5         while (i < s1.length() || i < s2.length()) {
6             if (i < s1.length()) result.append(s1.charAt(i));
7             if (i < s2.length()) result.append(s2.charAt(i));
8             i++;
9         }
10        return result.toString();
11    }
12    public static void main(String[] args) {
13        System.out.println(mergeAlternately("abc", "pqr")); // apbqcr
14    }
15 }

```

7.23 Find max repeated word in a sentence

```

1 // See Question 20

```

7.24 Modify and improve given code

Answer: Refactor for readability, efficiency, error handling.

```

1 public class BadCode {
2     public void print(String s) { System.out.println(s); }
3 }
4 public class ImprovedCode {
5     public void print(String s) {
6         if (s == null) throw new IllegalArgumentException("Input cannot be null");
7         System.out.println(s.trim());
8     }
9 }

```

7.25 Find a file in a subdirectory

```
1 import java.nio.file.*;
2 import java.io.*;
3 public class FileSearch {
4     public static void findFile(Path dir, String fileName) throws IOException
5     {
6         Files.walk(dir)
7             .filter(p -> p.getFileName().toString().equals(fileName))
8             .forEach(System.out::println);
9     }
10    public static void main(String[] args) throws IOException {
11        findFile(Paths.get("."), "test.txt");
12    }
13 }
```

7.26 Write a method to fetch employee details

```
1 import org.springframework.http.*;
2 import org.springframework.web.bind.annotation.*;
3 @RestController
4 public class EmployeeController {
5     @GetMapping("/employees/{id}")
6     public ResponseEntity<Employee> getEmployee(@PathVariable Long id) {
7         Employee emp = new Employee(id, "Alice");
8         return ResponseEntity.ok(emp);
9     }
10 }
11 class Employee {
12     Long id; String name;
13     Employee(Long id, String name) { this.id = id; this.name = name; }
14 }
```

8 Angular & Frontend

8.1 What is ng-content and how does content projection work?

Answer: ng-content projects content from parent to child components.

```
1 <!-- child.component.html -->
2 <ng-content></ng-content>
3 <!-- parent.component.html -->
4 <app-child><h1>Projected Content</h1></app-child>
```

8.2 Difference between @ViewChild and @ContentChild

Answer: @ViewChild accesses template elements; @ContentChild accesses projected content.

```
1 import { Component, ContentChild, ViewChild, ElementRef } from '@angular/
2   core';
3 @Component({
4     selector: 'app-child',
5     template: '<ng-content></ng-content>'
6 })
```



```

6 export class ChildComponent {
7   @ContentChild('content') content: ElementRef;
8 }
9 @Component({
10  selector: 'app-parent',
11  template: '<app-child><div #content>Content</div></app-child>'
12 })
13 export class ParentComponent {
14   @ViewChild('view') view: ElementRef;
15 }

```

8.3 Explain Dependency Injection in Angular

Answer: Provides dependencies via constructor injection.

```

1 import { Injectable, Component } from '@angular/core';
2 @Injectable()
3 class MyService {}
4 @Component({})
5 export class MyComponent {
6   constructor(private service: MyService) {}
7 }

```

8.4 How does Angular load dynamic components?

Answer: Uses ComponentFactoryResolver and ViewContainerRef.

```

1 import { Component, ViewChild, ViewContainerRef, ComponentFactoryResolver }
  from '@angular/core';
2 @Component({
3   selector: 'app-dynamic',
4   template: '<ng-container #container></ng-container>'
5 })
6 export class DynamicComponent {
7   @ViewChild('container', { read: ViewContainerRef }) container:
    ViewContainerRef;
8   constructor(private resolver: ComponentFactoryResolver) {}
9   ngOnInit() {
10    const factory = this.resolver.resolveComponentFactory(
      MyDynamicComponent);
11    this.container.createComponent(factory);
12  }
13 }

```

8.5 What is the PipeTransform interface?

Answer: Defines custom pipes for data transformation.

```

1 import { Pipe, PipeTransform } from '@angular/core';
2 @Pipe({ name: 'myPipe' })
3 export class MyPipe implements PipeTransform {
4   transform(value: string): string {
5     return value.toUpperCase();
6   }
7 }

```

8.6 How does Angular bootstrapping work via AppModule?

Answer: AppModule defines root module, bootstrapped via platformBrowserDynamic.

```
1 import { NgModule } from '@angular/core';
2 @NgModule({
3   declarations: [AppComponent],
4   bootstrap: [AppComponent]
5 })
6 export class AppModule {}
```

8.7 What is an HTTP interceptor?

Answer: Intercepts HTTP requests/responses for headers, error handling.

```
1 import { Injectable, HttpInterceptor, HttpRequest, HttpHandler } from '@angular/common/http';
2 @Injectable()
3 export class AuthInterceptor implements HttpInterceptor {
4   intercept(req: HttpRequest<any>, next: HttpHandler) {
5     const authReq = req.clone({ setHeaders: { Authorization: 'Bearer token' } });
6     return next.handle(authReq);
7   }
8 }
```

8.8 Common use cases of HTTP interceptors

Answer: Adding tokens, logging, error handling.

8.9 What is GraphQL and how does it compare to REST?

Answer: GraphQL: Query-based, flexible. REST: Fixed endpoints.

```
1 query {
2   user(id: 1) {
3     name
4   }
5 }
```

8.10 Use Apollo in Angular to fetch GraphQL data

```
1 import { Component } from '@angular/core';
2 import { Apollo } from 'apollo-angular';
3 import gql from 'graphql-tag';
4 @Component({})
5 export class UserComponent {
6   constructor(private apollo: Apollo) {
7     this.apollo.query({ query: gql`{ user(id: 1) { name } }` })
8       .subscribe(result => console.log(result.data));
9   }
10 }
```

8.11 Differences: BehaviorSubject, Subject, ReplaySubject

Answer: Subject: No initial value. BehaviorSubject: Initial value, emits last. ReplaySubject: Replays multiple values.

```
1 import { BehaviorSubject } from 'rxjs';
2 const subject = new BehaviorSubject('initial');
3 subject.subscribe(v => console.log(v)); // initial
4 subject.next('new'); // new
```

8.12 Explain: switchMap, mergeMap, concatMap, exhaustMap

Answer: switchMap cancels previous, mergeMap runs concurrently, concatMap sequential, exhaustMap ignores new until complete.

```
1 import { of } from 'rxjs';
2 import { switchMap } from 'rxjs/operators';
3 of(1, 2, 3).pipe(
4   switchMap(id => of('User ${id}'))
5 ).subscribe(console.log); // User 3
```

8.13 Design a semantic HTML navigation menu

```
1 <nav>
2   <ul>
3     <li><a href="/">Home</a></li>
4     <li><a href="/about">About</a></li>
5   </ul>
6 </nav>
```

8.14 List 5 semantic HTML tags and their uses

Answer: header (page header), nav (navigation), main (main content), article (independent content), footer (page footer).

8.15 Fetch API data and display in a table

```
1 import { Component } from '@angular/core';
2 import { HttpClient } from '@angular/common/http';
3 @Component({
4   template: `
5     <table>
6       <tr *ngFor="let user of users">
7         <td>{{ user.name }}</td>
8       </tr>
9     </table>
10   `,
11 })
12 export class UserTableComponent {
13   users: any[] = [];
14   constructor(private http: HttpClient) {
15     this.http.get('https://api.example.com/users').subscribe(data => this.
16       users = data);
17   }
18 }
```

8.16 Search by name using Reactive Form

```
1 import { Component } from '@angular/core';
2 import { FormGroup, FormControl } from '@angular/forms';
3 @Component({
4   template: `
5     <form [formGroup]="form">
6       <input formControlName="name">
7     </form>
8     <div *ngFor="let user of filteredUsers">{{ user.name }}</div>
9   `
10 })
11 export class SearchComponent {
12   form = new FormGroup({ name: new FormControl('') });
13   users = [{ name: 'Alice' }, { name: 'Bob' }];
14   filteredUsers = this.users;
15   ngOnInit() {
16     this.form.get('name').valueChanges.subscribe(value => {
17       this.filteredUsers = this.users.filter(u => u.name.includes(value));
18     });
19   }
20 }
```

8.17 Error handling on API failure

```
1 import { Component } from '@angular/core';
2 import { HttpClient } from '@angular/common/http';
3 import { of } from 'rxjs';
4 import { catchError } from 'rxjs/operators';
5 @Component({})
6 export class ErrorComponent {
7   constructor(private http: HttpClient) {
8     this.http.get('https://api.example.com/users')
9       .pipe(catchError(err => of([])))
10      .subscribe(data => console.log(data));
11   }
12 }
```

8.18 Flatten a nested array

```
1 const nested = [1, [2, 3], [4, [5]]];
2 const flat = nested.flat(Infinity);
3 console.log(flat); // [1, 2, 3, 4, 5]
```

9 Miscellaneous

9.1 What do you know about ISO8583?

Answer: Standard for financial transaction messaging.

9.2 How do Angular applications interact with backend APIs?

Answer: Via HttpClient for REST or Apollo for GraphQL.

```
1 // See Question 15, Section 8
```

9.3 How do you clone code from Git and commit changes?

Answer: Clone: git clone. Commit: git add, git commit, git push.

```
1 git clone https://github.com/repo.git
2 git add .
3 git commit -m "Add feature"
4 git push
```

9.4 How to resolve merge conflicts?

Answer: Edit conflicting files, mark resolved, commit.

```
1 git pull
2 # Resolve conflicts
3 git add .
4 git commit
```

9.5 Daily Git commands you use

Answer: git pull, git add, git commit, git push, git status.

10 Additional Frequently Asked Questions

10.1 What is the difference between checked and unchecked exceptions?

Answer: Checked: Compile-time, must handle (e.g., IOException). Unchecked: Runtime, optional (e.g., NullPointerException).

```
1 public class ExceptionExample {
2     public static void main(String[] args) {
3         try {
4             new FileReader("file.txt");
5         } catch (IOException e) {
6             System.out.println("Checked: " + e);
7         }
8     }
9 }
```

10.2 What is the purpose of @Autowired annotation in Spring?

Answer: Injects dependencies automatically.

```
1 import org.springframework.stereotype.*;
2 import org.springframework.beans.factory.annotation.*;
3 @Component
4 class MyComponent {
5     @Autowired
6     private MyService service;
7 }
```

10.3 What is the Circuit Breaker pattern in microservices?

Answer: Prevents cascading failures by stopping requests to failing services.

```
1 import io.github.resilience4j.circuitbreaker.annotation.*;
2 @Service
3 public class CircuitBreakerService {
4     @CircuitBreaker(name = "myService")
5     public String call() { return "Success"; }
6 }
```