4343203 Winter 2024 Solution - English

Question 1(a): List out various Primitive data types in Java. (Marks: 03)

Answer 1(a)

Java has 8 primitive data types:

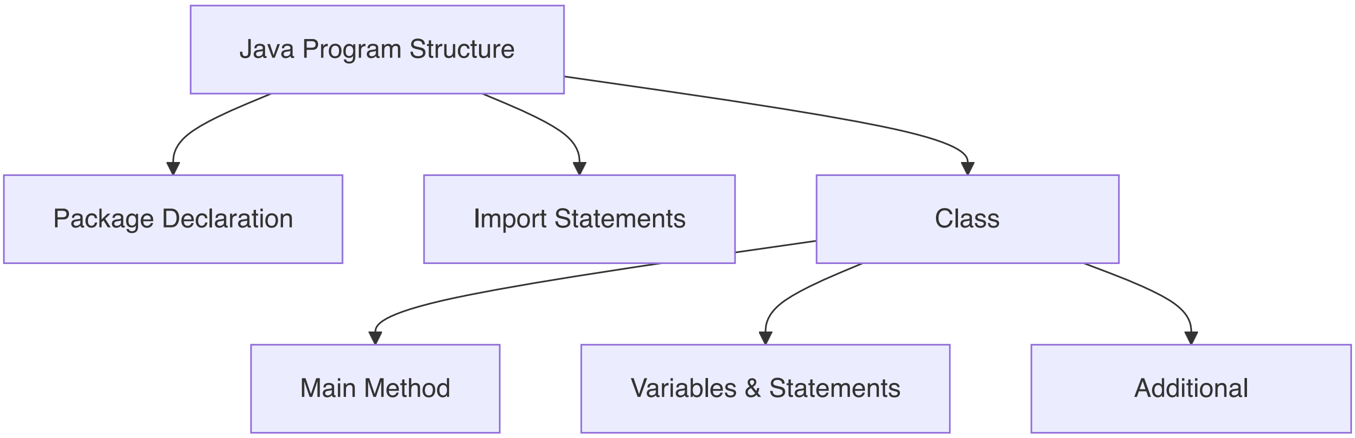
Data Type	Size	Description
byte	1 byte	Stores whole numbers from -128 to 127
short	2 bytes	Stores whole numbers from -32,768 to 32,767
int	4 bytes	Stores whole numbers from -2^{31} to $2^{31}-1$
long	8 bytes	Stores whole numbers from -2^{63} to $2^{63}-1$
float	4 bytes	Stores fractional numbers with 6-7 decimal digits
double	8 bytes	Stores fractional numbers with 15 decimal digits
boolean	1 bit	Stores true or false values
char	2 bytes	Stores a single character/letter or ASCII value

Mnemonic: "**I See Bears Drinking Chocolate Foam Latte**" (Int, Char, Boolean, Double, Character, Float, Long)

Question 1(b): Explain Structure of Java Program with suitable example. (Marks: 04)

Answer 1(b)

The structure of a Java program consists of several key components:



```java
// 1. Package Declaration (Optional)
package com.example;

// 2. Import Statements (Optional)
import java.util.Scanner;

// 3. Class Declaration (Required)
public class HelloWorld {

    // 4. Main Method (Required for executable programs)
    public static void main(String[] args) {

        // 5. Variables, Statements, and Expressions
        String message = "Hello, World!";
        System.out.println(message);

    } // End of main method

    // 6. Additional Methods (Optional)
    public static void greet() {
        System.out.println("Welcome!");
    }

} // End of class
```

Key Components:

- **Package Declaration**: Organizes related classes
- **Import Statements**: Access classes from other packages
- **Class Declaration**: Contains all code and defines object properties
- **Main Method**: Entry point of execution (must be exactly as shown)
- **Statements**: Individual instructions
- **Methods**: Reusable blocks of code with specific functionality

Mnemonic: "**PICSM**" - Package, Imports, Class, Statements, Methods

Question 1(c): List arithmetic operators in Java. Develop a Java program using any three arithmetic operators and show the output of program. (Marks: 07)

Answer 1(c)

Arithmetic Operators in Java

Operator	Description	Example
+	Addition	a + b
-	Subtraction	a - b
*****	Multiplication	a * b
/	Division	a / b
%	Modulus (Remainder)	a % b
++	Increment	a++ or ++a
--	Decrement	a-- or --a

Mnemonic: "**MASID++**" (Multiply, Add, Subtract, Increment, Decrement, Divide, Modulus)

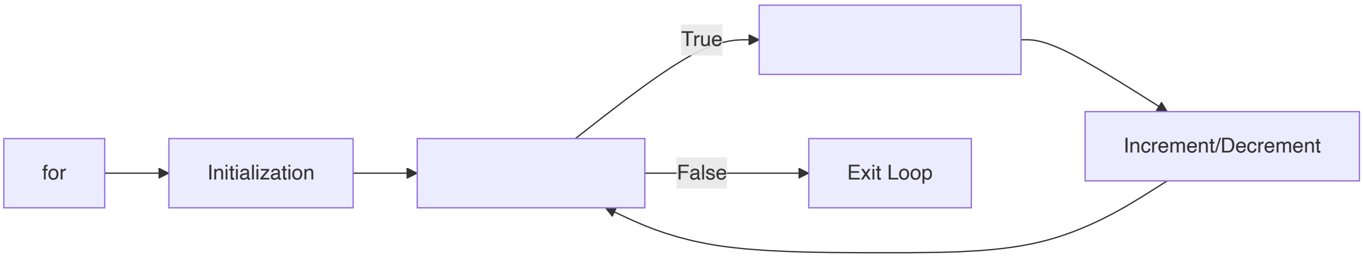
Java Program using Three Arithmetic Operators

```
public class ArithmeticDemo {
    public static void main(String[] args) {
        // Declare variables
        int num1 = 20;
        int num2 = 5;
        int result1, result2, result3;

        // Using three arithmetic operators
        result1 = num1 + num2;  // Addition
        result2 = num1 - num2;  // Subtraction
        result3 = num1 * num2;  // Multiplication

        // Display output
        System.out.println("Number 1: " + num1);
        System.out.println("Number 2: " + num2);
        System.out.println("Addition: " + result1);       // Output: 25
        System.out.println("Subtraction: " + result2);    // Output: 15
        System.out.println("Multiplication: " + result3); // Output: 100
    }
}
```

Question 1(c OR): Write syntax of Java for loop statement. Develop a Java program to find out prime number between 1 to 10. (Marks: 07)

Answer 1(c OR)

Java for Loop Syntax



```
for (initialization; condition; increment/decrement) {
    // code to be executed
}
```

Key Parts:

- **Initialization**: Executes once at the beginning
- **Condition**: Checked before each iteration
- **Increment/Decrement**: Executes after each iteration

Java Program to Find Prime Numbers between 1 to 10

```
public class PrimeNumbers {
    public static void main(String[] args) {
        System.out.println("Prime Numbers between 1 and 10:");

        // Outer loop - check each number from 1 to 10
        for (int num = 1; num <= 10; num++) {
            boolean isPrime = true;

            // Skip 1 as it's not a prime number
            if (num == 1) {
                isPrime = false;
            }

            // Inner loop - check if divisible by any number
            for (int i = 2; i < num; i++) {
                if (num % i == 0) {
                    isPrime = false;
                    break;
                }
            }

            // Print if prime
            if (isPrime) {
                System.out.print(num + " ");
            }
        }
        // Output: 2 3 5 7
    }
}
```

Mnemonic for Prime Numbers: "**2357**" - These are the prime numbers between 1 and 10

Question 2(a): List the differences between Procedure-Oriented Programming (POP) and Object-Oriented Programming (OOP). (Marks: 03)

Answer 2(a)

Procedure-Oriented Programming (POP)	Object-Oriented Programming (OOP)
Function-centered approach	**Object-centered** approach
Data moves freely between functions	Data is **encapsulated** within objects
Follows **top-down** approach	Follows **bottom-up** approach
Security is less (data is global)	**Security** is more (data hiding)
No concept of **inheritance**	Supports **inheritance** and reusability
Examples: C, FORTRAN, Pascal	Examples: Java, C++, Python

Mnemonic: "**FEED SI**" - Focus, Encapsulation, Execution, Data access, Security, Inheritance

Question 2(b): Explain static keyword with example. (Marks: 04)

Answer 2(b)

The **static** keyword in Java:

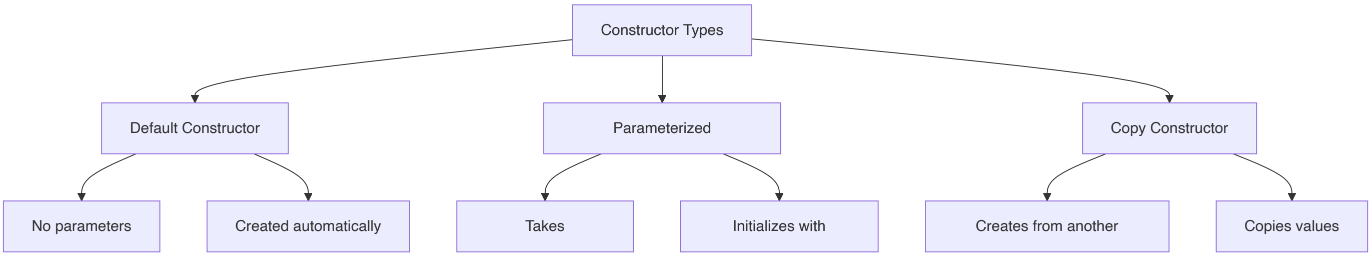
- Makes a member **belong to the class** rather than to instances (objects)
- Can be applied to **variables**, **methods**, **blocks**, and **nested classes**
- Static members are **loaded into memory** when class is loaded
- Can be **accessed without creating objects**

```
public class StaticDemo {
    // Static variable - shared across all instances
    static int count = 0;

    // Instance variable - unique to each instance
    int instanceNum;

    // Constructor
    StaticDemo() {
        count++;          // Increment static counter
        instanceNum = count;  // Assign instance number
    }
    // Static method
    static void displayCount() {
        System.out.println("Total objects: " + count);
    }

    public static void main(String[] args) {
        // Access static method without object
        StaticDemo.displayCount();  // Output: Total objects: 0

        // Create objects
        StaticDemo obj1 = new StaticDemo();
        StaticDemo obj2 = new StaticDemo();

        // Call static method
        StaticDemo.displayCount();  // Output: Total objects: 2
    }
}
```

Question 2(c): Define Constructor. List types of Constructors. Develop a java code to explain Parameterized constructor. (Marks: 07)

Answer 2(c)

Constructor: A special type of method used to **initialize objects** when they are created. It has the **same name as the class** and **no return type**.



Types of Constructors:

1. **Default Constructor**: No parameters, created by Java if no constructor is defined
2. **Parameterized Constructor**: Takes parameters to initialize object with specific values
3. **Copy Constructor**: Creates object by copying values from another object

Java Code for Parameterized Constructor:

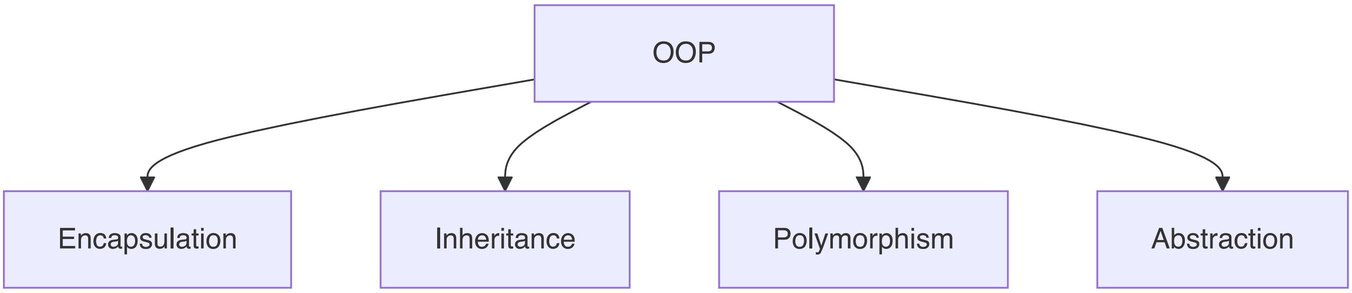
```
public class Student {
    // Instance variables
    private int id;
    private String name;
    private double marks;
    // Parameterized constructor
    public Student(int studentId, String studentName, double studentMarks) {
        id = studentId;
        name = studentName;
        marks = studentMarks;
    }

    // Method to display student details
    public void displayDetails() {
        System.out.println("Student ID: " + id);
        System.out.println("Student Name: " + name);
        System.out.println("Student Marks: " + marks);
    }

    public static void main(String[] args) {
        // Creating objects using parameterized constructor
        Student s1 = new Student(101, "Raj", 85.5);
        Student s2 = new Student(102, "Priya", 92.0);

        // Displaying student details
        System.out.println("First Student:");
        s1.displayDetails();

        System.out.println("\nSecond Student:");
        s2.displayDetails();
    }
}
```

Mnemonic for Constructor Types: "**DPC**" - Default, Parameterized, Copy

Question 2(a OR): List the basic OOP concepts in Java and explain any one. (Marks: 03)

Answer 2(a OR)

Basic OOP Concepts in Java:



- **Encapsulation**: Bundling data and methods that operate on that data
- **Inheritance**: Creating new classes from existing ones

- **Polymorphism**: Same method behaving differently in different contexts
- **Abstraction**: Hiding complex implementation details, showing only functionality

Explanation of Encapsulation:
Encapsulation is the process of **binding data and methods together** as a single unit (class) and **hiding data** from the outside world. It is achieved through:

- **Private data members**: Access restricted within the class
- **Public getter/setter methods**: Controlled access to private data
- **Benefits**: Improved security, data hiding, and modular code

Mnemonic: "**EIPA**" - Encapsulation, Inheritance, Polymorphism, Abstraction

Question 2(b OR): Explain final keyword with example. (Marks: 04)

Answer 2(b OR)

The **final** keyword in Java:

- Creates **constants** that cannot be changed
- Can be applied to **variables**, **methods**, and **classes**
- **Final variable**: Value cannot be changed after initialization
- **Final method**: Cannot be overridden by subclasses
- **Final class**: Cannot be extended (no inheritance)

```java
public class FinalDemo {
    // Final variable (constant)
    final double PI = 3.14159;

    // Final method
    final void display() {
        System.out.println("This method cannot be overridden");
    }

    public static void main(String[] args) {
        FinalDemo obj = new FinalDemo();

        // Using final variable
        System.out.println("Value of PI: " + obj.PI);

        // Cannot modify final variable
        // obj.PI = 3.14;  // This would cause compilation error

        // Calling final method
        obj.display();
    }
}
```

```java
// Final class
final class SecureClass {
    void show() {
        System.out.println("This class cannot be extended");
    }
}

// Cannot extend final class
// class ChildClass extends SecureClass {} // This would cause compilation error
```

Question 2(c OR): Write scope of java access modifier. Develop a java code to explain public modifier. (Marks: 07)

Answer 2(c OR)

Java Access Modifiers Scope:

Modifier	Class	Package	Subclass	World
private	Yes	No	No	No
default (no modifier)	Yes	Yes	No	No
protected	Yes	Yes	Yes	No
public	Yes	Yes	Yes	Yes

Mnemonic: "**Pri-De-Pro-Pub**" (Private-Default-Protected-Public) with increasing accessibility

Java Code to Explain Public Modifier:

```java
// File: AccessDemo.java
package demo.access;

public class AccessDemo {
    // Public variable
    public int publicVar = 100;

    // Public method
    public void publicMethod() {
        System.out.println("This is a public method");
        System.out.println("Public variable value: " + publicVar);
    }

    public static void main(String[] args) {
        // Creating object of the same class
        AccessDemo obj1 = new AccessDemo();
        // Accessing public members within the same class
        System.out.println("Accessing from same class: " + obj1.publicVar);
        obj1.publicMethod();
    }
}

// File: AccessTester.java
package demo.access;

public class AccessTester {
    public static void main(String[] args) {
        // Creating object of AccessDemo class
        AccessDemo obj = new AccessDemo();

        // Accessing public members from different class
        System.out.println("Accessing from different class: " + obj.publicVar);
        obj.publicMethod();

        // Can be accessed from any package, class, or subclass
    }
}
```

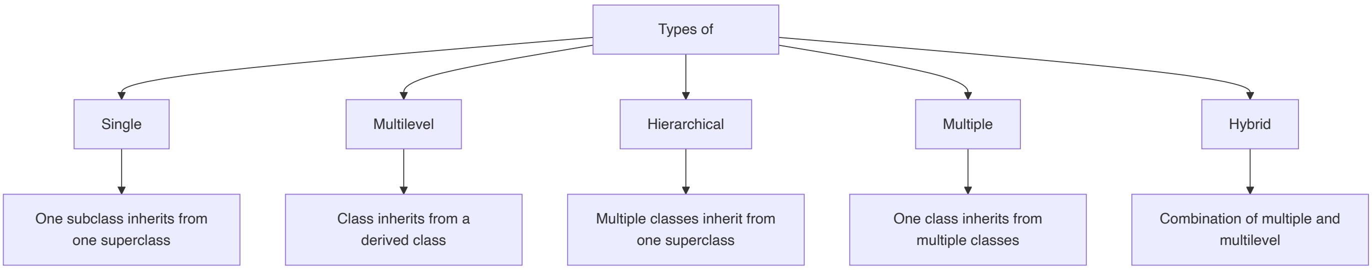
Key Points about Public Modifier:

- **Accessible everywhere**: within class, package, subclass, and outside package
- Used for **interfaces**, **API methods**, and **general-purpose functionality**
- Allows **maximum accessibility** with minimum restriction
- Should be used carefully to maintain **encapsulation**

Question 3(a): List out different types of inheritance and explain any one with example. (Marks: 03)

Answer 3(a)

Types of Inheritance in Java:



Types of
Single
Multilevel
Hierarchical
Multiple
Hybrid
One subclass inherits from one superclass
Class inherits from a derived class
Multiple classes inherit from one superclass
One class inherits from multiple classes
Combination of multiple and multilevel

Type	Description
Single	One subclass inherits from one superclass
Multilevel	Class inherits from a derived class
Hierarchical	Multiple classes inherit from one superclass
Multiple	One class inherits from multiple classes (through interfaces in Java)
Hybrid	Combination of multiple and multilevel inheritance

Single Inheritance Example:

```
// Parent class
class Animal {
    void eat() {
        System.out.println("Animal is eating");
    }
}

// Child class inheriting from Animal
class Dog extends Animal {
    void bark() {
        System.out.println("Dog is barking");
    }
}

// Usage
class InheritanceDemo {
    public static void main(String[] args) {
        Dog d = new Dog();
        d.eat();  // Inherited from Animal class
        d.bark(); // Dog's own method
    }
}
```

Mnemonic: "**SIMHH**" - Single, Inheritance, Multiple, Hierarchical, Hybrid

Question 3(b): Explain any two String buffer class methods with suitable example. (Marks: 04)

Answer 3(b)

StringBuffer Class Methods:

1. **append()**: Adds characters to the end of StringBuffer
2. **insert()**: Inserts characters at specified position

```
public class StringBufferDemo {
    public static void main(String[] args) {
        // Create StringBuffer object
        StringBuffer sb = new StringBuffer("Hello");

        // 1. append() method
        sb.append(" World");
        System.out.println("After append: " + sb);  // Output: Hello World

        // 2. insert() method
        sb.insert(5, " Java");
        System.out.println("After insert: " + sb);  // Output: Hello Java World

        // Additional information about StringBuffer
        System.out.println("Length: " + sb.length());
        System.out.println("Capacity: " + sb.capacity());
    }
}
```

Other Important StringBuffer Methods:

- **delete(int start, int end)**: Removes characters
- **reverse()**: Reverses the characters
- **replace(int start, int end, String str)**: Replaces characters
- **capacity()**: Returns current capacity

Question 3(c): Define Interface. Write a java program to demonstrate multiple inheritance using interface. (Marks: 07)

Answer 3(c)

Interface: A blueprint of a class that contains **abstract methods** and **constants**. It represents "what" a class does, not "how". It supports **multiple inheritance** in Java.

Characteristics:

- All methods are **public** and **abstract** by default
- All variables are **public**, **static**, and **final** by default
- Cannot be instantiated (no objects)
- Implemented using the **implements** keyword

```
// First interface
interface Drawable {
    void draw();  // Abstract method

    // Constant
    int SIZE = 10;
}
```

```java
// Second interface
interface Colorable {
    void setColor(String color);  // Abstract method
}

// Class implementing multiple interfaces (multiple inheritance)
class Circle implements Drawable, Colorable {
    private String color;

    // Implementing Drawable interface method
    @Override
    public void draw() {
        System.out.println("Drawing a circle with size " + SIZE);
    }

    // Implementing Colorable interface method
    @Override
    public void setColor(String color) {
        this.color = color;
        System.out.println("Circle color set to " + color);
    }

    // Additional method
    public void displayInfo() {
        System.out.println("This is a " + color + " circle");
    }
}

// Main class
public class InterfaceDemo {
    public static void main(String[] args) {
        Circle c = new Circle();
        c.draw();           // From Drawable interface
        c.setColor("Red"); // From Colorable interface
        c.displayInfo();   // Circle's own method

        // Using interface reference variables
        Drawable d = new Circle();
        d.draw();  // Can call only Drawable methods

        Colorable col = new Circle();
        col.setColor("Blue");  // Can call only Colorable methods
    }
}
```

Mnemonic for Interface: "**CAMP**" **-** Constants, Abstract methods, Multiple inheritance, Public

Question 3(a OR): Give differences between Abstract class and Interface. (Marks: 03)

Answer 3(a OR)

Abstract Class	Interface
Uses **abstract** keyword	Uses **interface** keyword
Can have **abstract and non-abstract** methods	All methods are **abstract** by default (prior to Java 8)
Can have **constructors**	**Cannot** have constructors
Supports **partial implementation**	Provides **full abstraction**
Single inheritance only	Supports **multiple inheritance**
Can have **instance variables**	Variables are **static and final** only
Methods can have **any access modifier**	Methods are **public** by default

Mnemonic: "**CAMP vs SCIM**"

- For Interface: Constants, Abstract methods, Multiple inheritance, Public
- For Abstract: Some implementation, Constructors, Instance variables, Mixed access

Question 3(b OR): Explain any two String class methods with suitable example. (Marks: 04)

Answer 3(b OR)

String Class Methods:

1. **substring()**: Extracts a portion of a string
2. **equals()**: Compares string content

```
public class StringMethodsDemo {
    public static void main(String[] args) {
        String str = "Hello Java Programming";

        // 1. substring() method
        String sub1 = str.substring(6);        // From index 6 to end
        String sub2 = str.substring(6, 10);    // From index 6 to 9

        System.out.println("Original: " + str);
        System.out.println("substring(6): " + sub1);       // Output: Java Programming
        System.out.println("substring(6, 10): " + sub2);   // Output: Java

        // 2. equals() method
        String s1 = "Java";
        String s2 = "java";
        String s3 = "Java";
        String s4 = new String("Java");
        System.out.println("s1.equals(s2): " + s1.equals(s2));         // false
        System.out.println("s1.equals(s3): " + s1.equals(s3));         // true
        System.out.println("s1.equals(s4): " + s1.equals(s4));         // true
        System.out.println("s1.equalsIgnoreCase(s2): " + s1.equalsIgnoreCase(s2)); // true
        System.out.println("s1 == s3: " + (s1 == s3));                 // true
        System.out.println("s1 == s4: " + (s1 == s4));                 // false (different
objects)
    }
}
```

Other Important String Methods:

- **length()**: Returns string length
- **charAt()**: Returns character at specific position
- **indexOf()**: Returns index of a substring
- **concat()**: Concatenates strings
- **replace()**: Replaces characters/substrings

Question 3(c OR): Explain package and list out steps to create package with suitable example. (Marks: 07)

Answer 3(c OR)

Package: A namespace that organizes a set of related classes and interfaces. It helps in **avoiding naming conflicts** and **managing access control**.

Benefits of Packages:

- **Namespace management**: Prevents naming conflicts
- **Access control**: Controls visibility of classes
- **Code organization**: Groups related classes

Steps to Create and Use Package:

1. **Declare** the package at the beginning of the file
2. **Save** the file with proper directory structure
3. **Compile** the file with proper package structure
4. **Use** the package by importing it

```
// Step 1: Declare package (save as Calculator.java)
package com.mymath.util;

public class Calculator {
    // Calculator methods
    public int add(int a, int b) {
        return a + b;
    }

    public int subtract(int a, int b) {
        return a - b;
    }

    public int multiply(int a, int b) {
        return a * b;
    }

    public int divide(int a, int b) {
        if (b == 0) {
            System.out.println("Cannot divide by zero");
            return 0;
        }
        return a / b;
    }
}

// Step 4: Use the package (save as PackageDemo.java)
// Different file that uses the package
import com.mymath.util.Calculator;

public class PackageDemo {
    public static void main(String[] args) {
        // Create object of the Calculator class
        Calculator calc = new Calculator();

        // Use methods
        System.out.println("10 + 5 = " + calc.add(10, 5));
        System.out.println("10 - 5 = " + calc.subtract(10, 5));
        System.out.println("10 * 5 = " + calc.multiply(10, 5));
        System.out.println("10 / 5 = " + calc.divide(10, 5));
    }
}
```

Terminal Commands for Steps 2 & 3:

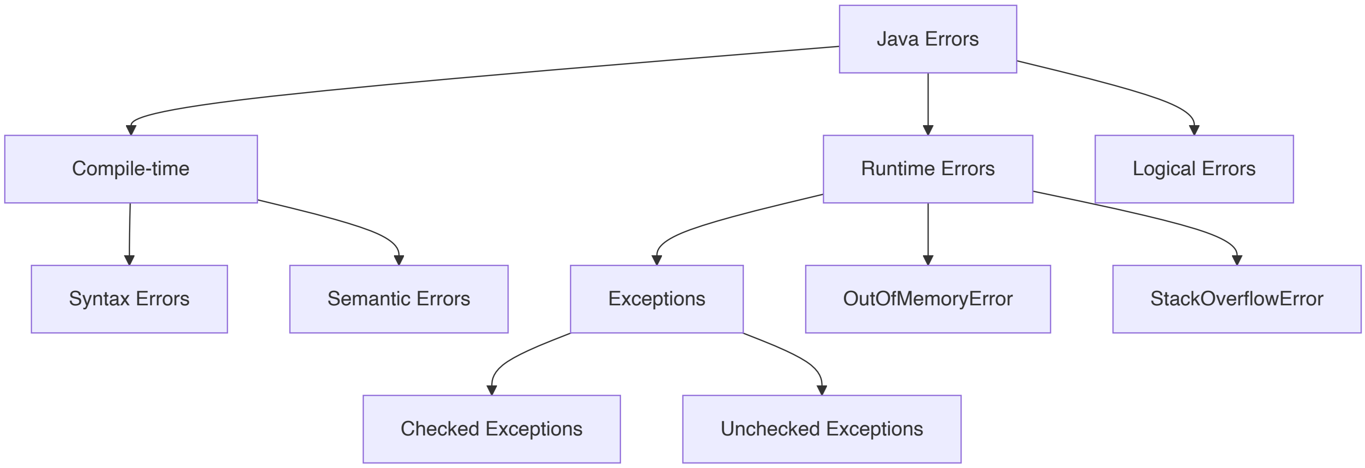
```
# Create directory structure
mkdir -p com/mymath/util

# Move source file to appropriate directory
mv Calculator.java com/mymath/util/

# Compile with proper directory structure
javac com/mymath/util/Calculator.java

# Compile and run the main class
javac PackageDemo.java
java PackageDemo
```

Mnemonic for Package Creation: "**DCCU**" - Declare, Create directory, Compile, Use/import

Question 4(a): List types of errors in Java. (Marks: 03)

Answer 4(a)

Types of Errors in Java:



Brief Description:

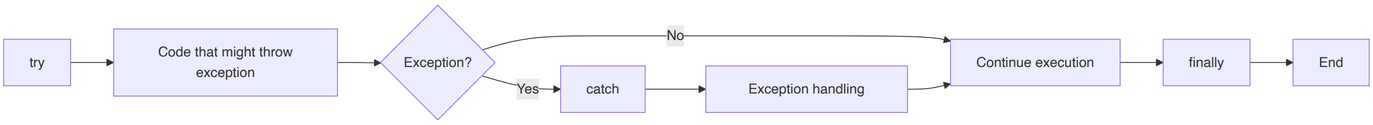
- **Compile-time Errors**: Detected during compilation
  - **Syntax Errors**: Incorrect syntax/grammar
  - **Semantic Errors**: Wrong types, undeclared variables
- **Runtime Errors**: Occur during program execution
  - **Exceptions**: IOException, NullPointerException
- **Logical Errors**: Program runs but produces incorrect results

Mnemonic: "**CRL**" - Compile-time, Runtime, Logical

Question 4(b): Explain try catch block with example. (Marks: 04)

Answer 4(b)

Try-Catch Block: A mechanism to handle runtime exceptions that may occur during program execution.



Example Code:

```
public class TryCatchDemo {
    public static void main(String[] args) {
        try {
            // Code that might throw exception
            int[] numbers = {1, 2, 3};
            System.out.println("Accessing element: " + numbers[5]); //
ArrayIndexOutOfBoundsException

            // This line won't execute if exception occurs above
            System.out.println("This won't be printed");
        }
        catch (ArrayIndexOutOfBoundsException e) {
            // Exception handling code
            System.out.println("Exception caught: Array index out of bounds");
            System.out.println("Error message: " + e.getMessage());
        }

        // Program continues execution
        System.out.println("Program continues after exception handling");
    }
}
```

Key Points:

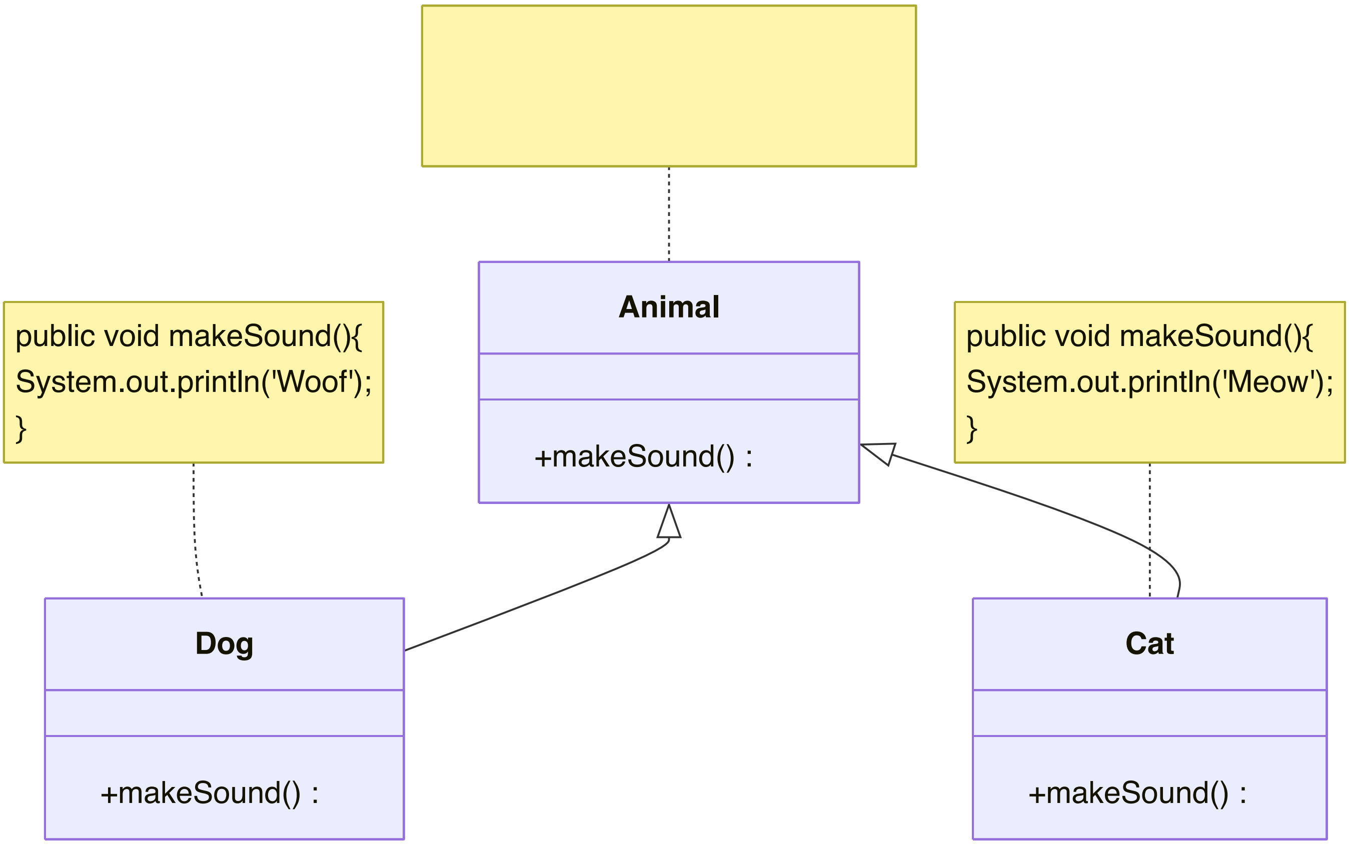
- **try**: Contains code that might throw exceptions
- **catch**: Handles specific exceptions that occur in try block
- **finally**: (optional) Always executes, regardless of exception
- Multiple catch blocks can handle different exception types

Question 4(c): List out any four differences between method overloading and overriding. Write a java code to explain method overriding. (Marks: 07)

Answer 4(c)

Differences between Method Overloading and Overriding:

Method Overloading	Method Overriding
Same class	**Parent-child class** relationship
Different parameters (number, type, order)	**Same parameters** and return type
Resolved at **compile-time**	Resolved at **runtime**
Increases method **readability**	Supports **polymorphism**



Java Code to Explain Method Overriding:

```java
// Parent class
class Animal {
    // Method to be overridden
    public void makeSound() {
        System.out.println("Animal makes a sound");
    }
}

// Child class 1
class Dog extends Animal {
    // Overriding the parent class method
    @Override
    public void makeSound() {
        System.out.println("Dog barks: Woof! Woof!");
    }
}

// Child class 2
class Cat extends Animal {
    // Overriding the parent class method
    @Override
    public void makeSound() {
        System.out.println("Cat meows: Meow!");
    }
}
```

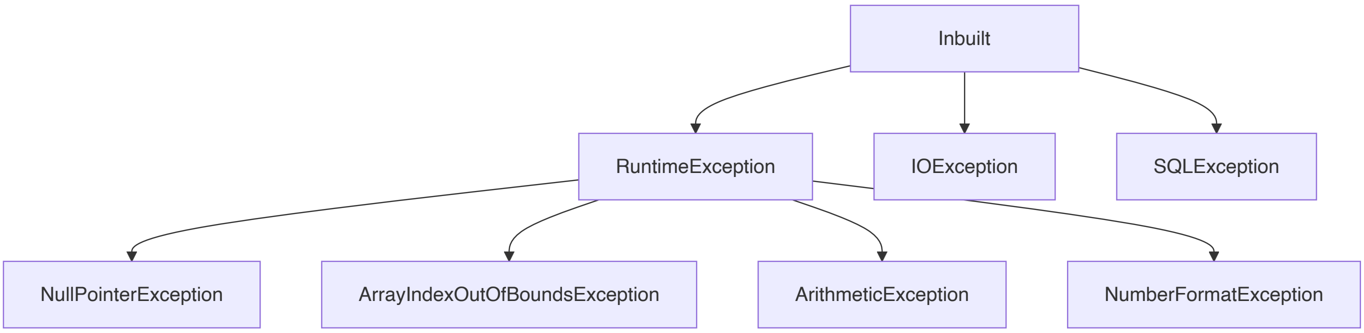
```
// Main class
public class OverridingDemo {
    public static void main(String[] args) {
        // Parent class reference and object
        Animal a1 = new Animal();
        a1.makeSound();  // Output: Animal makes a sound

        // Child class objects
        Dog d1 = new Dog();
        d1.makeSound();  // Output: Dog barks: Woof! Woof!

        Cat c1 = new Cat();
        c1.makeSound();  // Output: Cat meows: Meow!

        // Polymorphic behavior - Parent reference, child objects
        Animal a2 = new Dog();
        a2.makeSound();  // Output: Dog barks: Woof! Woof!

        Animal a3 = new Cat();
        a3.makeSound();  // Output: Cat meows: Meow!
    }
}
```

Mnemonic for Method Overriding: "**SOAP**" - Same method, Object of child, After inheritance, Polymorphism

Question 4(a OR): List any four inbuilt exceptions. (Marks: 03)

Answer 4(a OR)

Inbuilt Exceptions in Java:



Common Inbuilt Exceptions:

1. **NullPointerException**: When attempting to use null object reference
2. **ArrayIndexOutOfBoundsException**: When accessing invalid array index
3. **ArithmeticException**: For arithmetic errors like division by zero

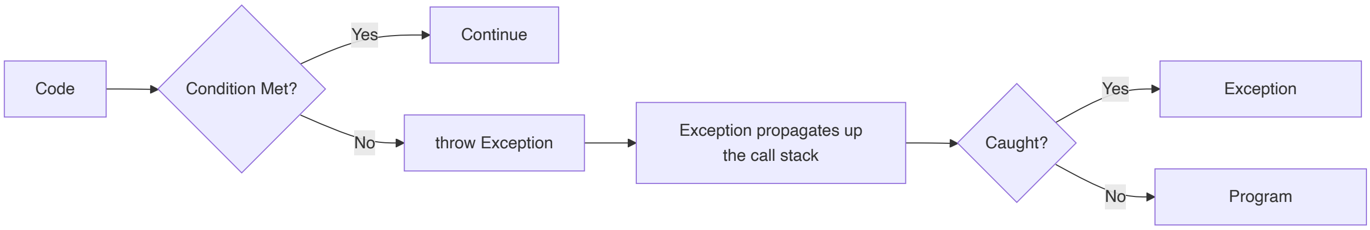
4. **NumberFormatException**: When attempting to convert invalid string to number
5. **IOException**: When I/O operation fails
6. **ClassNotFoundException**: When trying to access a class that doesn't exist
7. **IllegalArgumentException**: When illegal argument is passed to a method

Mnemonic: "**NANI-CIL**" - NullPointer, ArrayIndexOutOfBounds, NumberFormat, IOException, ClassNotFound, IllegalArgument

Question 4(b OR): Explain "throw" keyword with suitable example. (Marks: 04)

Answer 4(b OR)

Throw Keyword: Used to explicitly throw an exception from a method or block of code.



Example Code:

```java
public class ThrowDemo {
    // Method that throws an exception
    static void checkAge(int age) {
        if (age < 18) {
            // Explicitly throw exception
            throw new ArithmeticException("Access denied - You must be at least 18 years old.");
        } else {
            System.out.println("Access granted - You are old enough!");
        }
    }

    public static void main(String[] args) {
        try {
            // Test the checkAge method
            checkAge(15);  // This will throw exception
        } catch (ArithmeticException e) {
            System.out.println("Exception caught: " + e.getMessage());
        }

        System.out.println("Program continues...");
    }
}
```

Output:

```
Exception caught: Access denied - You must be at least 18 years old.
Program continues...
```

Key Points:

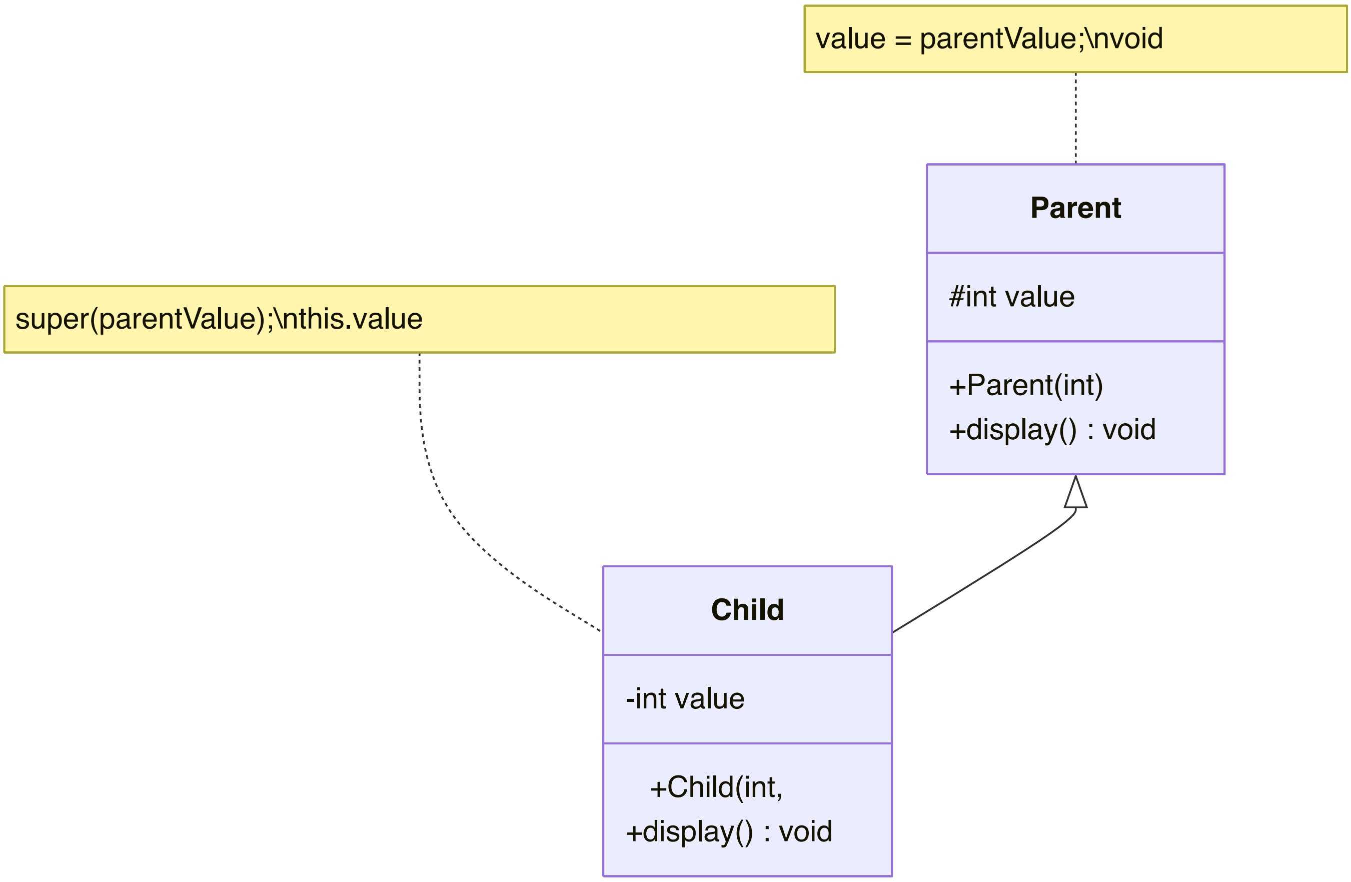
- **throw** creates a new exception object and throws it
- Can throw **built-in** or **custom exceptions**
- Must be handled by **try-catch** or declared with **throws**
- Used for **custom validation** and error handling

Question 4(c OR): Compare 'this' keyword Vs 'Super' keyword. Explain super keyword with suitable Example. (Marks: 07)

Answer 4(c OR)

Comparison between 'this' and 'super' keywords:

'this' Keyword	'super' Keyword
Refers to **current class object**	Refers to **parent class object**
Used to access **current class members**	Used to access **parent class members**
Used with **constructors**, **methods**, **variables**	Used with **constructors**, **methods**, **variables**
Cannot be used in **static context**	Cannot be used in **static context**
Used to **eliminate variable shadowing**	Used to **access overridden methods**



Java Code to Explain 'super' Keyword:

```
// Parent class
class Person {
    // Instance variables
    String name;
    int age;

    // Constructor
    Person(String name, int age) {
        this.name = name;
        this.age = age;
    }

    // Method
    void display() {
        System.out.println("Name: " + name);
        System.out.println("Age: " + age);
    }
}

// Child class
class Student extends Person {
    // Additional instance variable
    String course;
```

```java
    // Constructor using super
    Student(String name, int age, String course) {
        // Call parent constructor
        super(name, age);
        this.course = course;
    }

    // Overriding parent method
    @Override
    void display() {
        // Call parent method
        super.display();
        // Add additional info
        System.out.println("Course: " + course);
    }

    // Method to show variable shadowing
    void displayAge(int age) {
        System.out.println("Local age: " + age);
        System.out.println("This object's age: " + this.age);
        System.out.println("Parent class age: " + super.age); // Same as this.age in this case
    }
}

// Main class
public class SuperDemo {
    public static void main(String[] args) {
        // Create Student object
        Student s = new Student("John", 20, "Java Programming");

        // Call overridden method
        s.display();

        // Test method with local variable shadowing
        s.displayAge(25);
    }
}
```

Output:

```
Name: John
Age: 20
Course: Java Programming
Local age: 25
This object's age: 20
Parent class age: 20
```

Uses of 'super' Keyword:

- **super()**: Call parent constructor

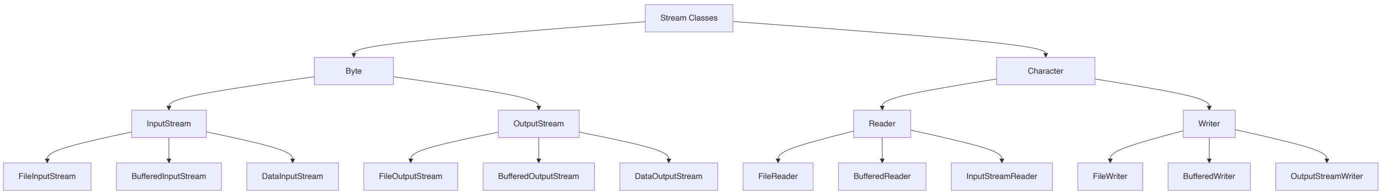
- **super.variable**: Access parent variable
- **super.method()**: Call parent method

Mnemonic: "**CVM**" - Constructor, Variables, Methods (for both this and super)

Question 5(a): List Different Stream Classes. (Marks: 03)

Answer 5(a)

Java Stream Classes:



Key Stream Classes:

- **Byte Streams**: Process data byte by byte (8 bits)
    - **InputStream**: Abstract class for reading bytes
    - **OutputStream**: Abstract class for writing bytes
- **Character Streams**: Process data character by character (16 bits)
    - **Reader**: Abstract class for reading characters
    - **Writer**: Abstract class for writing characters

Mnemonic: "**BIOS-RW**" - Byte Input/Output Streams, Reader/Writer

Question 5(b): Write a java program to develop user defined exception for "Divide by zero" error. (Marks: 04)

Answer 5(b)

User-Defined Exception for "Divide by Zero" Error:

```
// Custom exception class
class DivideByZeroException extends Exception {
    // Constructor
    public DivideByZeroException(String message) {
        // Call parent constructor
        super(message);
    }
}

// Main class
public class CustomExceptionDemo {
    // Method that throws custom exception
    public static double divide(int a, int b) throws DivideByZeroException {
        if (b == 0) {
            // Throw custom exception
            throw new DivideByZeroException("Cannot divide by zero!");
        }
        return (double) a / b;
    }

    public static void main(String[] args) {
        try {
            // Test the divide method
            System.out.println("10 / 2 = " + divide(10, 2));  // Works fine
            System.out.println("10 / 0 = " + divide(10, 0));  // Throws exception
        } catch (DivideByZeroException e) {
            System.out.println("Custom Exception: " + e.getMessage());
        } finally {
            System.out.println("Program execution complete");
        }
    }
}
```

Output:

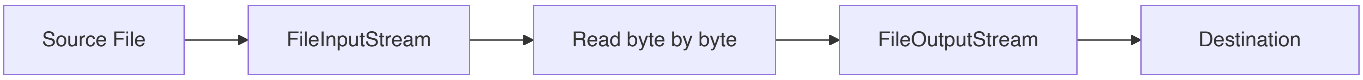
```
10 / 2 = 5.0
Custom Exception: Cannot divide by zero!
Program execution complete
```

Steps to Create User-Defined Exception:

1. **Create class** extending Exception
2. **Define constructor** to pass message to parent
3. **Throw exception** when condition is met
4. **Handle exception** with try-catch block

Question 5(c): Write a program in Java that reads the content of a file byte by byte and copy it into another file. (Marks: 07)

Answer 5(c)



Source File → FileInputStream → Read byte by byte → FileOutputStream → Destination

Java Program to Copy File Byte by Byte:

```
import java.io.FileInputStream;
import java.io.FileOutputStream;
import java.io.IOException;
```

```java
public class FileCopyByteByByte {
    public static void main(String[] args) {
        // Source and destination file paths
        String sourceFile = "source.txt";
        String destFile = "destination.txt";

        // Declare file streams
        FileInputStream fis = null;
        FileOutputStream fos = null;

        try {
            // Initialize input stream
            fis = new FileInputStream(sourceFile);

            // Initialize output stream
            fos = new FileOutputStream(destFile);

            // Variable to store each byte
            int byteData;

            // Read and write byte by byte
            System.out.println("Copying file byte by byte...");
            while ((byteData = fis.read()) != -1) {
                // Write the byte to destination file
                fos.write(byteData);
            }

            System.out.println("File copied successfully!");

        } catch (IOException e) {
            System.out.println("Error: " + e.getMessage());
            e.printStackTrace();
        } finally {
            // Close streams
            try {
                if (fis != null) {
                    fis.close();
                }
                if (fos != null) {
                    fos.close();
                }
            } catch (IOException e) {
                System.out.println("Error closing streams: " + e.getMessage());
            }
        }
    }
}
```

Key Points about File Handling:

- **Always close** streams in finally block

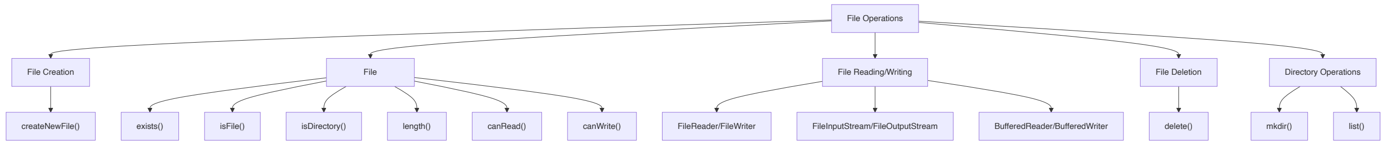
- Use **try-with-resources** in Java 7+ for automatic closing
- **BufferedInputStream/BufferedOutputStream** improve performance
- **Byte-by-byte** copying works for all file types (text and binary)

Mnemonic for File Copying Steps: "**CROW**" - Create streams, Read source, Output to destination, Wrap up (close)

Question 5(a OR): List different file operations in Java. (Marks: 03)

Answer 5(a OR)

File Operations in Java:



Common File Operations:

- **File Creation**: Create new files
- **File Information**: Check file attributes
- **File Reading**: Read data from files
- **File Writing**: Write data to files
- **File Deletion**: Delete files
- **Directory Operations**: Create and manage directories

Methods for File Operations:

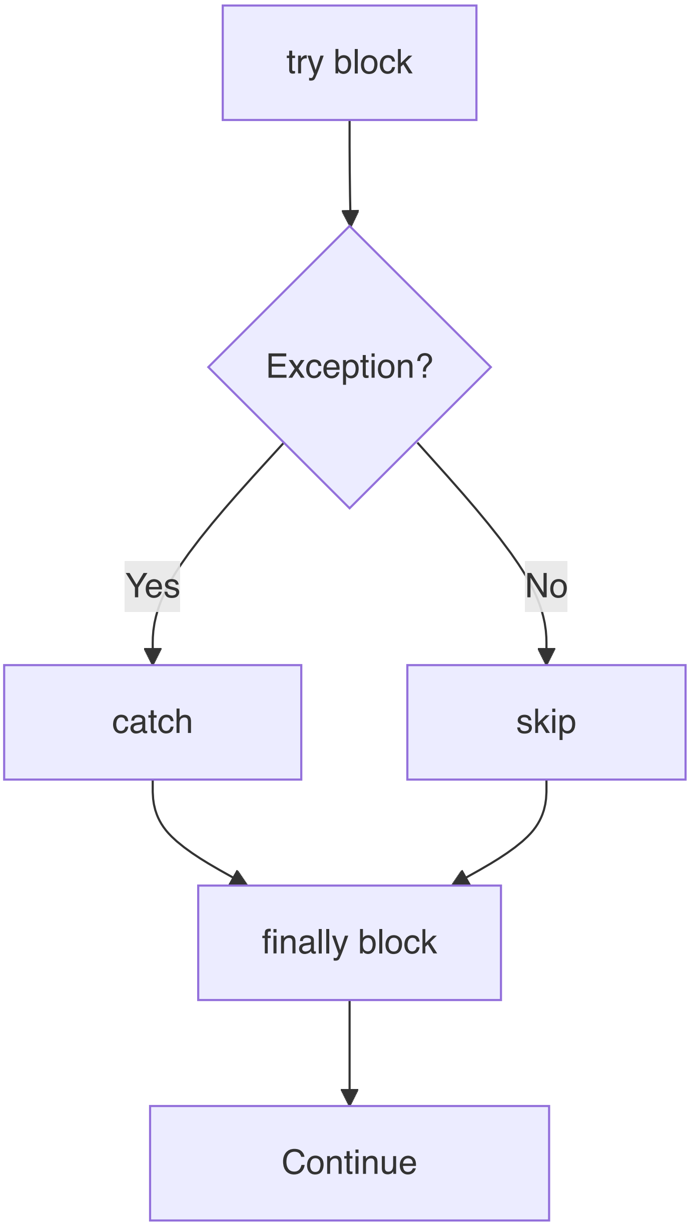
- **createNewFile()**: Creates new file
- **exists()**: Checks if file exists
- **delete()**: Deletes file
- **mkdir()**: Creates directory
- **list()**: Lists files in directory
- **length()**: Gets file size

Mnemonic: "**CIRDWD**" - Create, Info, Read, Delete, Write, Directory

Question 5(b OR): Write a java program to explain finally block in exception handling. (Marks: 04)

Answer 5(b OR)

Finally Block: A block that **always executes** regardless of whether an exception is thrown or caught, typically used for cleanup operations.



Java Program to Explain Finally Block:

```java
import java.io.FileInputStream;
import java.io.FileNotFoundException;
import java.io.IOException;

public class FinallyBlockDemo {
    public static void main(String[] args) {
        FileInputStream fis = null;

        try {
            // Try to open file
            System.out.println("Inside try block");
            fis = new FileInputStream("nonexistent.txt");  // Will throw exception
            // This won't execute if exception occurs
            System.out.println("File opened successfully");

        } catch (FileNotFoundException e) {
            // Handle the exception
            System.out.println("Inside catch block");
            System.out.println("Exception: " + e.getMessage());

        } finally {
            // Always executes
            System.out.println("Inside finally block");

            // Close resource
            try {
                if (fis != null) {
                    fis.close();
                }
                System.out.println("File stream closed");
            } catch (IOException e) {
                System.out.println("Error closing file: " + e.getMessage());
            }

            System.out.println("Finally block executed");
        }

        System.out.println("Program continues after try-catch-finally");
    }
}
```

Output:

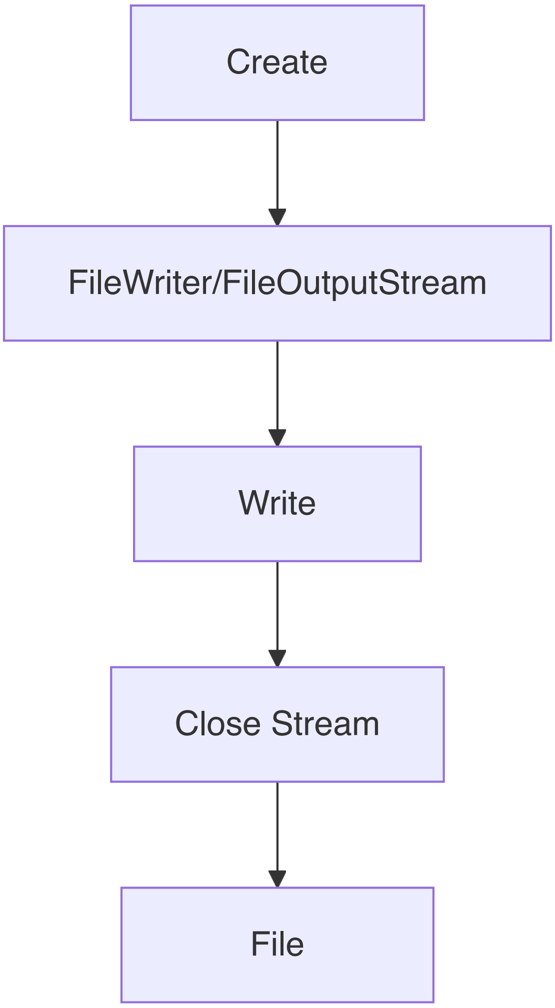
```
Inside try block
Inside catch block
Exception: nonexistent.txt (No such file or directory)
Inside finally block
File stream closed
Finally block executed
Program continues after try-catch-finally
```

Key Points about Finally Block:

- **Always executes** whether exception occurs or not
- Used for **cleanup resources** (close files, connections)
- Executes **before method returns**
- Can exist **without catch** block (try-finally)

Question 5(c OR): Write a java program to create a file and perform write operation on this file. (Marks: 07)

Answer 5(c OR)



Java Program to Create and Write to a File:

```
import java.io.BufferedWriter;
import java.io.File;
import java.io.FileWriter;
import java.io.IOException;

public class FileCreateAndWrite {
    public static void main(String[] args) {
        // File path
        String filePath = "myfile.txt";

        // Content to write
        String content = "Hello, this is a sample text.\n";
        content += "This file was created using Java I/O operations.\n";
        content += "Java makes file handling easy!";

        // File writer objects
        FileWriter fw = null;
        BufferedWriter bw = null;
        try {
            // Step 1: Create File object
            File file = new File(filePath);

            // Check if file already exists
            if (file.exists()) {
                System.out.println("File already exists: " + filePath);
            } else {
                // Create new file
                if (file.createNewFile()) {
                    System.out.println("File created: " + filePath);
                } else {
                    System.out.println("Failed to create file");
                    return;
                }
            }

            // Step 2: Create FileWriter
            fw = new FileWriter(file);

            // Step 3: Create BufferedWriter for better performance
            bw = new BufferedWriter(fw);

            // Step 4: Write content to file
            bw.write(content);

            System.out.println("Successfully wrote to the file");

        } catch (IOException e) {
            System.out.println("An error occurred: " + e.getMessage());
            e.printStackTrace();
        } finally {
            try {
                // Step 5: Close resources
                if (bw != null) {
                    bw.close();
                }
                if (fw != null) {
                    fw.close();
                }
            } catch (IOException e) {
                System.out.println("Error closing resources: " + e.getMessage());
            }
        }

        // Verify file information
        File file = new File(filePath);
        if (file.exists()) {
            System.out.println("\nFile Information:");
            System.out.println("Path: " + file.getAbsolutePath());
            System.out.println("Size: " + file.length() + " bytes");
            System.out.println("Readable: " + file.canRead());
            System.out.println("Writable: " + file.canWrite());
        }
    }
}
```

Steps to Create and Write to a File:

1. **Create File object**: Represents the file path
2. **Create file**: Use createNewFile() method
3. **Initialize writer**: FileWriter or FileOutputStream
4. **Write data**: Write content to file
5. **Close resources**: Release system resources

File Writer Methods:

- **write(String)**: Writes string to file
- **write(char[])**: Writes character array
- **newLine()**: Adds new line (BufferedWriter only)
- **append(char)**: Appends character to end
- **flush()**: Forces write to disk

Mnemonic for File Writing Steps: "**FICRW**" - File object, Initialize, Create, Resource, Write