Experiment 5.1

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Aim: Write a Java program to calculate the sum of a list of integers using autoboxing and unboxing. Include methods to parse strings into their respective wrapper classes (e.g., Integer.parseInt()).

Objective: Demonstrate **autoboxing** and **unboxing** in Java by converting string numbers into Integer objects, storing them in a list, and computing their sum.

Algorithm:

Step 1: Initialize the Program

1. Start the program.
2. Import ArrayList and List classes.
3. Define the AutoboxingExample class.

Step 2: Convert String Array to Integer List

1. Define the method parseStringArrayToIntegers(String[] strings).
2. Create an empty ArrayList<Integer>.
3. Iterate through the string array:
   - Convert each string to an Integer using Integer.parseInt(str).
   - Add the integer to the list (**autoboxing** happens here).
4. Return the list of integers.

Step 3: Calculate the Sum of Integers

1. Define the method calculateSum(List<Integer> numbers).
2. Initialize a variable sum to 0.
3. Iterate through the list:
   - Extract each integer (**unboxing** happens here).
   - Add it to sum.
4. Return the total sum.

Step 4: Execute Main Function

1. Define main(String[] args).
2. Create a string array with numeric values.
3. Call parseStringArrayToIntegers() to convert it into a list of integers.
4. Call calculateSum() to compute the sum.
5. Print the result.

Step 5: Terminate the Program

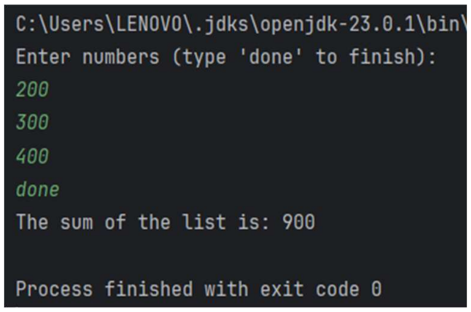
1. End the execution.

Code:

```
import java.util.ArrayList;   // Importing ArrayList to store integers
import java.util.List;        // Importing List interface for flexibility
import java.util.Scanner;     // Importing Scanner for user input

public class IntegerSumCalculator {

   // Method to parse a string into an Integer
   public static Integer parseStringToInteger(String str) {
      try {
         return Integer.parseInt(str); // Converts string to Integer (Autoboxing happens here)
      } catch (NumberFormatException e) { // Handles invalid inputs that cannot be converted
         System.out.println("Invalid number format: " + str);
         return null; // Return null for invalid input
      }
   }

   // Method to calculate the sum of a list of Integers
   public static int calculateSum(List<Integer> numbers) {
      int sum = 0; // Variable to store the sum
      for (Integer num : numbers) { // Iterates through the list
         if (num != null) { // Ensures null values are ignored
            sum += num; // Adds the value to sum (Unboxing happens here)
         }
      }
      return sum; // Returns the total sum
   }

   public static void main(String[] args) {
      Scanner scanner = new Scanner(System.in); // Creating Scanner object to take input
      List<Integer> numbers = new ArrayList<>(); // List to store integer inputs

      System.out.println("Enter numbers (type 'done' to finish):");

      while (true) { // Infinite loop until 'done' is entered
         String input = scanner.nextLine(); // Reads user input as a string
         if (input.equalsIgnoreCase("done")) { // Checks if user wants to stop
            break; // Exit loop
         }
         Integer number = parseStringToInteger(input); // Converts input to Integer
         if (number != null) { // Adds only valid numbers to the list
            numbers.add(number); // Autoboxing: Converts int to Integer automatically
         }
      }

      scanner.close(); // Closing the scanner to prevent memory leaks

      // Calculating and displaying the sum of valid numbers entered
      System.out.println("The sum of the list is: " + calculateSum(numbers));
   }
}
```

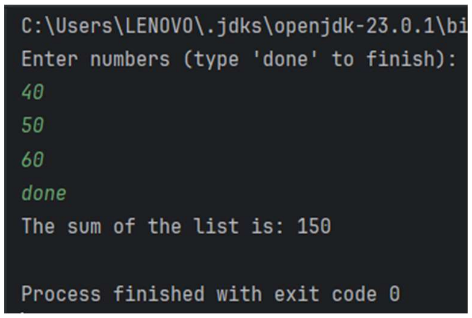
Output:

Test case 1:



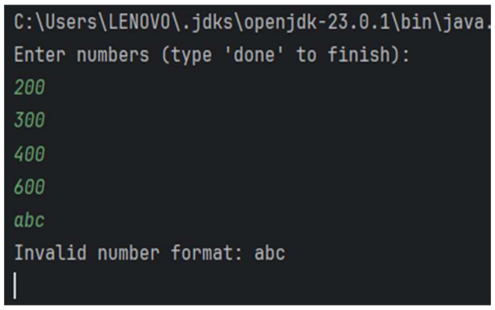
```
C:\Users\LENOVO\.jdks\openjdk-23.0.1\bin\
Enter numbers (type 'done' to finish):
200
300
400
done
The sum of the list is: 900

Process finished with exit code 0
```

Test case 2:



```
C:\Users\LENOVO\.jdks\openjdk-23.0.1\bi
Enter numbers (type 'done' to finish):
40
50
60
done
The sum of the list is: 150

Process finished with exit code 0
```

Test case 3:



```
C:\Users\LENOVO\.jdks\openjdk-23.0.1\bin\java.
Enter numbers (type 'done' to finish):
200
300
400
600
abc
Invalid number format: abc
|
```

- **Learning Outcomes:**
  - Understand the concept of **autoboxing and unboxing** in Java and how primitive types are automatically converted to their wrapper classes and vice versa.
  - Learn how to **convert string values into Integer objects** using Integer.parseInt() and store them in a list.
  - Gain experience in **working with ArrayLists** to store and manipulate a collection of numbers dynamically.
  - Develop proficiency in **iterating through collections** and performing arithmetic operations like summation.

Experiment 5.2

1. **Aim:** Create a Java program to serialize and deserialize a Student object.
The program should:

- Serialize a Student object (containing id, name, and GPA) and save it to a file.
- Deserialize the object from the file and display the student details.
- Handle FileNotFoundException, IOException, and ClassNotFoundException using exception handling.

2. **Objective:** The objective is to serialize and deserialize a Student object, store and retrieve its id, name, and GPA from a file, and handle exceptions like FileNotFoundException, IOException, and ClassNotFoundException.

3. Algorithm:

Step 1: Initialize the Program

1. Start the program.
2. Import the necessary classes (java.io.*).
3. Define a Student class implementing Serializable.
4. Declare attributes:
    - id (int)
    - name (String)
    - gpa (double)
5. Define a constructor to initialize Student objects.
6. Override toString() to display student details.

Step 2: Define the Serialization Method

1. Create serializeStudent(Student student).
2. Use a try-with-resources block to create an ObjectOutputStream:
    - Open a FileOutputStream to write to student.ser.
    - Write the Student object to the file using writeObject().
3. Handle exceptions:
    - FileNotFoundException → Print error message.
    - IOException → Print error message.
4. Print a success message if serialization is successful.

Step 3: Define the Deserialization Method

1. Create deserializeStudent().
2. Use a try-with-resources block to create an ObjectInputStream:
    - Open a FileInputStream to read student.ser.
    - Read the Student object using readObject().
3. Handle exceptions:
    - FileNotFoundException → Print error message.
    - IOException → Print error message.
    - ClassNotFoundException → Print error message.
4. Print the deserialized student details.

Step 4: Execute Main Function

1. Define main(String[] args).
2. Create a Student object with sample data.
3. Call serializeStudent() to save the object.
4. Call deserializeStudent() to read and display the object.
5.

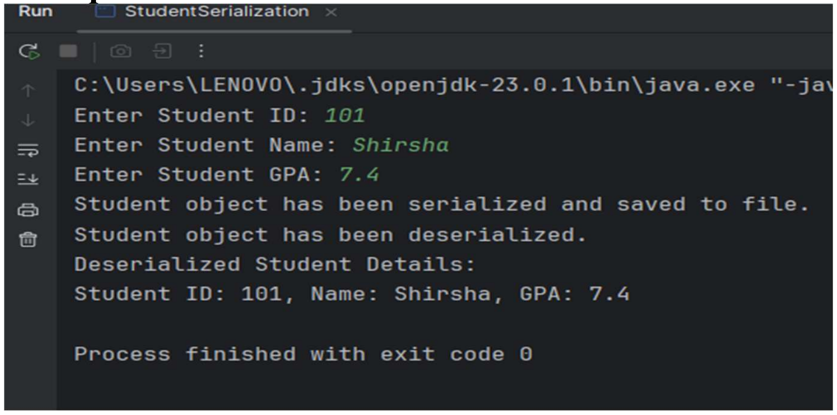
6. Step 5: Terminate the Program
7. End execution.

4. Implementation Code:

```
import java.io.*;   // Importing required classes for serialization and file handling   //Exp 5.2
import java.util.Scanner; // Importing Scanner class for user input


// Student class implementing Serializable to enable object serialization
class Student implements Serializable {
   private static final long serialVersionUID = 1L; // Recommended to ensure compatibility during
deserialization
   // Private fields to store student details
   private int id;
   private String name;
   private double gpa;
   // Constructor to initialize Student object
   public Student(int id, String name, double gpa) {
      this.id = id;
      this.name = name;
      this.gpa = gpa;
   }

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

// Main class for serialization and deserialization
public class StudentSerialization {
   private static final String FILE_NAME = "student.ser"; // File where the student object will be
saved

   // Method to serialize Student object to file
   public static void serializeStudent(Student student) {
      try (ObjectOutputStream oos = new ObjectOutputStream(new
FileOutputStream(FILE_NAME))) {
         oos.writeObject(student); // Writing student object to file
         System.out.println("Student object has been serialized and saved to file.");
      } catch (IOException e) { // Handling possible I/O exceptions
         System.out.println("Error during serialization: " + e.getMessage());
      }
   }
```

```
    // Method to deserialize Student object from file
    public static Student deserializeStudent() {
        try (ObjectInputStream ois = new ObjectInputStream(new FileInputStream(FILE_NAME))) {
            return (Student) ois.readObject(); // Reading object from file and casting it back to Student
        } catch (FileNotFoundException e) { // Handling file not found exception
            System.out.println("Error: File not found.");
        } catch (IOException e) { // Handling input/output errors
            System.out.println("Error during deserialization: " + e.getMessage());
        } catch (ClassNotFoundException e) { // Handling case where class is not found
            System.out.println("Error: Class not found.");
        }
        return null; // Return null if deserialization fails
    }

    public static void main(String[] args) {
        Scanner scanner = new Scanner(System.in); // Scanner object to take user input

        // Taking user input for Student details
        System.out.print("Enter Student ID: ");
        int id = scanner.nextInt(); // Reading integer input for student ID
        scanner.nextLine(); // Consuming the newline left after nextInt()

        System.out.print("Enter Student Name: ");
        String name = scanner.nextLine(); // Reading student name as a string

        System.out.print("Enter Student GPA: ");
        double gpa = scanner.nextDouble(); // Reading double input for GPA

        // Creating a Student object with the provided details
        Student student = new Student(id, name, gpa);

        // Calling method to serialize (save) the Student object to a file
        serializeStudent(student);

        // Calling method to deserialize (read) the Student object from the file
        Student deserializedStudent = deserializeStudent();

        // If deserialization was successful, display the student details
        if (deserializedStudent != null) {
            System.out.println("Student object has been deserialized.");
            System.out.println("Deserialized Student Details:");
            deserializedStudent.display(); // Calling display method of the deserialized object
        }

        scanner.close(); // Closing scanner to prevent memory leaks
    }
}
```

5. **Output**



```
C:\Users\LENOVO\.jdks\openjdk-23.0.1\bin\java.exe "-jav
Enter Student ID: 101
Enter Student Name: Shirsha
Enter Student GPA: 7.4
Student object has been serialized and saved to file.
Student object has been deserialized.
Deserialized Student Details:
Student ID: 101, Name: Shirsha, GPA: 7.4

Process finished with exit code 0
```

6. **Learning Outcomes:**

- Understand object serialization and deserialization in Java.
- Learn how to use ObjectOutputStream and ObjectInputStream for file operations.
- Implement exception handling for FileNotFoundException, IOException, and ClassNotFoundException.
- Gain hands-on experience in storing and retrieving objects from a file.
- Develop skills in data persistence and file management using Java.

Experiment 5.3

1. **Aim:** Create a menu-based Java application with the following options.

1. Add an Employee
2. Display All
3. Exit If option 1 is selected, the application should gather details of the employee like employee name, employee id, designation and salary and store it in a file. If option 2 is selected, the application should display all the employee details. If option 3 is selected the application should exit.

2. **Objective:** The objective is to develop a menu-based Java application that allows users to **add employee details**, **store them in a file**, and **display all stored employee records**, with an option to exit the program.

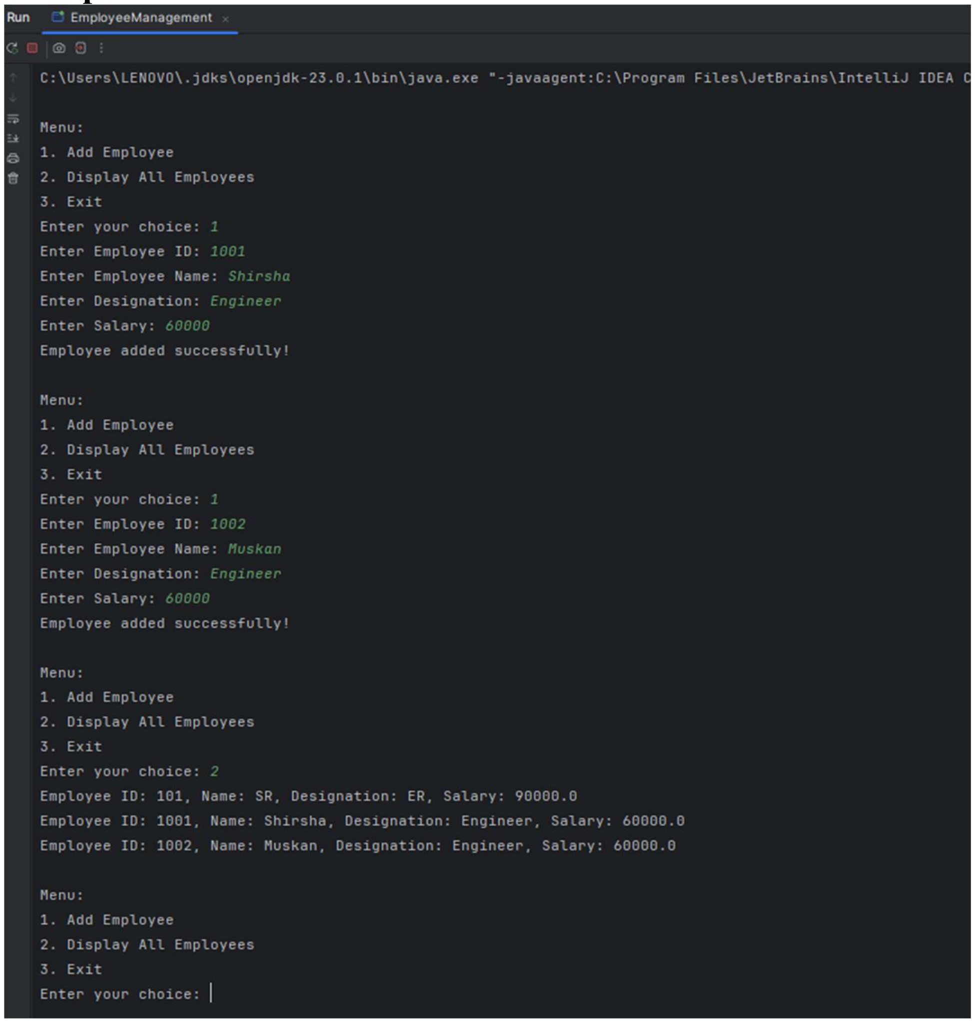
3. **Algorithm:**

```
1. Start
2. Display Menu:
   • Add an Employee
   • Display All Employees
   • Exit
3. Repeat Until User Selects Exit:
      • If user selects option 1 (Add an Employee):
      • Prompt user to enter Employee Name, Employee ID, Designation, and Salary.
4. Store the details in an Employee object.
5. Append the Employee object to a file.
6. If user selects option 2 (Display All Employees):
   Read employee details from the file.
   Display all stored employee records.
7. If user selects option 3 (Exit):
   Terminate the program.
   Else:
   Display an "Invalid option" message.
8. End
```

4. Implementation Code:

```
import java.io.*;  // Importing necessary classes for file handling and serialization  //Exp 5.3
import java.util.*; // Importing utility classes, including List and Scanner

// Employee class implementing Serializable to allow object serialization
class Employee implements Serializable {
    private static final long serialVersionUID = 1L; // Ensures compatibility during deserialization

    // Private fields to store employee details
    private int id;
    private String name;
    private String designation;
    private double salary;
    // Constructor to initialize Employee object
    public Employee(int id, String name, String designation, double salary) {
        this.id = id;
        this.name = name;
        this.designation = designation;
        this.salary = salary;
    }

    // Method to display employee details
    public void display() {
        System.out.println("Employee ID: " + id + ", Name: " + name + ", Designation: " +
designation + ", Salary: " + salary);
    }
}

// Main class for employee management system
public class EmployeeManagement {
    private static final String FILE_NAME = "employees.ser"; // File where employee objects will be
stored
    private static final Scanner scanner = new Scanner(System.in); // Scanner object for user input

    // Method to add a new employee and save it to file
    public static void addEmployee() {
        System.out.print("Enter Employee ID: ");
        int id = scanner.nextInt(); // Read employee ID
        scanner.nextLine(); // Consume the newline character left by nextInt()



        System.out.print("Enter Employee Name: ");
        String name = scanner.nextLine(); // Read employee name

        System.out.print("Enter Designation: ");
        String designation = scanner.nextLine(); // Read employee designation

        System.out.print("Enter Salary: ");
        double salary = scanner.nextDouble(); // Read employee salary

        // Creating an Employee object with user input
        Employee employee = new Employee(id, name, designation, salary);

        // Save the employee object to the file
        saveEmployeeToFile(employee);

        System.out.println("Employee added successfully!");
    }

    // Method to save an employee object to file using serialization
    public static void saveEmployeeToFile(Employee employee) {
        List<Employee> employees = readEmployeesFromFile(); // Read existing employees from file
        employees.add(employee); // Add the new employee to the list
        // Serialize the updated list of employees and save it to the file
        try (ObjectOutputStream oos = new ObjectOutputStream(new
FileOutputStream(FILE_NAME))) {
            oos.writeObject(employees); // Writing the list of employees to the file
        } catch (IOException e) {
            e.printStackTrace(); // Print error details for debugging
        }
    }

    // Method to display all employees stored in the file
    public static void displayAllEmployees() {
        List<Employee> employees = readEmployeesFromFile(); // Retrieve list of employees from
file

        if (employees.isEmpty()) { // Check if there are no employees
            System.out.println("No employees found.");
        } else {
            for (Employee emp : employees) { // Loop through the list and display each employee
                emp.display();
            }
        }
    }

    // Method to read the list of employees from the file
    @SuppressWarnings("unchecked") // Suppresses unchecked cast warning
    public static List<Employee> readEmployeesFromFile() {
        List<Employee> employees = new ArrayList<>(); // Initialize an empty list to store employees

        try (ObjectInputStream ois = new ObjectInputStream(new FileInputStream(FILE_NAME))) {
            employees = (List<Employee>) ois.readObject(); // Read and cast object from file
        } catch (FileNotFoundException e) {
            // If file not found, no action needed (first run scenario)
        } catch (IOException | ClassNotFoundException e) {
            e.printStackTrace(); // Print error details for debugging
        }

        return employees; // Return the list of employees
    }

    // Main method to display menu and handle user choices
    public static void main(String[] args) {
        while (true) { // Infinite loop for menu until user chooses to exit
            System.out.println("\nMenu:");
            System.out.println("1. Add Employee");
            System.out.println("2. Display All Employees");
            System.out.println("3. Exit");
            System.out.print("Enter your choice: ");

            int choice = scanner.nextInt(); // Read user choice
            switch (choice) {
                case 1:
                    addEmployee(); // Call method to add employee
                    break;
                case 2:
                    displayAllEmployees(); // Call method to display employees
                    break;
                case 3:
                    System.out.println("Exiting program...");
                    scanner.close(); // Close scanner before exiting
                    return; // Exit program
                default:
                    System.out.println("Invalid choice. Please try again."); // Handle invalid input
            }
        }
    }
```

5.Output:



```
C:\Users\LENOVO\.jdks\openjdk-23.0.1\bin\java.exe "-javaagent:C:\Program Files\JetBrains\IntelliJ IDEA C

Menu:
1. Add Employee
2. Display All Employees
3. Exit
Enter your choice: 1
Enter Employee ID: 1001
Enter Employee Name: Shirsha
Enter Designation: Engineer
Enter Salary: 60000
Employee added successfully!

Menu:
1. Add Employee
2. Display All Employees
3. Exit
Enter your choice: 1
Enter Employee ID: 1002
Enter Employee Name: Muskan
Enter Designation: Engineer
Enter Salary: 60000
Employee added successfully!

Menu:
1. Add Employee
2. Display All Employees
3. Exit
Enter your choice: 2
Employee ID: 101, Name: SR, Designation: ER, Salary: 90000.0
Employee ID: 1001, Name: Shirsha, Designation: Engineer, Salary: 60000.0
Employee ID: 1002, Name: Muskan, Designation: Engineer, Salary: 60000.0

Menu:
1. Add Employee
2. Display All Employees
3. Exit
Enter your choice: 
```

6.Learning Outcomes:

- Understand file handling and serialization in Java to store and retrieve objects persistently.
- Learn how to implement a menu-driven console application using loops and conditional statements.
- Gain experience in object-oriented programming (OOP) by defining and managing Employee objects.
- Practice exception handling to manage file-related errors like FileNotFoundException and IOException.
- Develop skills in list manipulation and user input handling using ArrayList and Scanner.