



DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

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Experiment 4

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**Subject Name: Project Based Learning
in Java with Lab**

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1. Aim: Develop Java programs using core concepts such as data structures, collections, and multithreading to manage and manipulate data.

2. Objective : Develop Java programs using ArrayList, Collection Interface, and Thread Synchronization to efficiently manage employee records, store and search card details, and implement a synchronized ticket booking system with prioritized VIP bookings.

3. Implementation/Code:

3.1 Write a Java program to implement an ArrayList that stores employee details (ID, Name, and Salary). Allow users to add, update, remove, and search employees.

```
import java.util.ArrayList;
import java.util.Scanner;
class Employee {
    private int id;
    private String name;
    private double salary;
    public Employee(int id, String name, double salary) {
        this.id = id;
        this.name = name;
        this.salary = salary;
    }
    public int getId() { return id; }
    public String getName() { return name; }
    public double getSalary() { return salary; }
    public void setName(String name) { this.name = name; }
    public void setSalary(double salary) { this.salary = salary; }
    @Override
    public String toString() {
        return "Employee [ID=" + id + ", Name=" + name + ", Salary=" + salary + "];"
    }
}
public class Main {
    private static ArrayList<Employee> employees = new ArrayList<>();
```



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```
private static Scanner scanner = new Scanner(System.in);
public static void main(String[] args) {
    while (true) {
        System.out.println("\n1. Add 2. Update 3. Remove 4. Search 5. Display 6. Exit");
        switch (scanner.nextInt()) {
            case 1 -> addEmployee();
            case 2 -> updateEmployee();
            case 3 -> removeEmployee();
            case 4 -> searchEmployee();
            case 5 -> displayAllEmployees();
            case 6 -> { System.out.println("Exiting..."); return; }
            default -> System.out.println("Invalid choice.");
        }
    }
}

private static void addEmployee() {
    System.out.print("ID: "); int id = scanner.nextInt();
    System.out.print("Name: "); String name = scanner.next();
    System.out.print("Salary: "); double salary = scanner.nextDouble();
    employees.add(new Employee(id, name, salary));
    System.out.println("Employee added.");
}

private static void updateEmployee() {
    System.out.print("ID to update: "); int id = scanner.nextInt();
    for (Employee e : employees) {
        if (e.getId() == id) {
            System.out.print("New Name: "); e.setName(scanner.next());
            System.out.print("New Salary: "); e.setSalary(scanner.nextDouble());
            System.out.println("Employee updated."); return;
        }
    }
    System.out.println("Employee not found.");
}

private static void removeEmployee() {
    System.out.print("ID to remove: "); int id = scanner.nextInt();
    employees.removeIf(e -> e.getId() == id);
    System.out.println("Employee removed.");
}

private static void searchEmployee() {
    System.out.print("ID to search: "); int id = scanner.nextInt();
    employees.stream().filter(e -> e.getId() == id).forEach(System.out::println);
}
```

```
private static void displayAllEmployees() {  
    if (employees.isEmpty()) System.out.println("No employees found.");  
    else employees.forEach(System.out::println);  
}  
}
```

3.2 Create a program to collect and store all the cards to assist the users in finding all the cards in a given symbol using Collection interface.

```
import java.util.*;  
interface CardOperations {  
    void addCard();  
    void searchCardsBySymbol();  
    void displayAllCards();  
}  
class Card {  
    private String symbol;  
    private String value;  
    public Card(String symbol, String value) {  
        this.symbol = symbol;  
        this.value = value;  
    }  
    public String getSymbol() {  
        return symbol;  
    }  
    @Override  
    public String toString() {  
        return "Card{Symbol='" + symbol + "', Value='" + value + "'}";  
    }  
}  
class CardCollection implements CardOperations {  
    private Collection<Card> cards = new ArrayList<>();  
    private Scanner scanner = new Scanner(System.in);  
    @Override  
    public void addCard() {  
        System.out.print("Enter Card Symbol: ");  
        String symbol = scanner.next();  
        System.out.print("Enter Card Value: ");  
        String value = scanner.next();  
        cards.add(new Card(symbol, value));  
        System.out.println("Card added successfully!");  
    }  
    @Override  
    public void searchCardsBySymbol() {
```

```
        System.out.print("Enter symbol to search: ");
        String symbol = scanner.next();
        cards.stream()
            .filter(card -> card.getSymbol().equalsIgnoreCase(symbol))
            .forEach(System.out::println);
    }
    @Override
    public void displayAllCards() {
        if (cards.isEmpty()) {
            System.out.println("No cards in the collection.");
        } else {
            cards.forEach(System.out::println);
        }
    }
    public static void main(String[] args) {
        CardOperations cardCollection = new CardCollection();
        Scanner scanner = new Scanner(System.in);
        while (true) {
            System.out.println("\n1. Add Card");
            System.out.println("2. Search Cards by Symbol");
            System.out.println("3. Display All Cards");
            System.out.println("4. Exit");
            System.out.print("Enter choice: ");
            int choice = scanner.nextInt();
            switch (choice) {
                case 1: cardCollection.addCard(); break;
                case 2: cardCollection.searchCardsBySymbol(); break;
                case 3: cardCollection.displayAllCards(); break;
                case 4: System.exit(0);
                default: System.out.println("Invalid choice!");
            }
        }
    }
}
```

3.3 Develop a ticket booking system with synchronized threads to ensure no double booking of seats. Use thread priorities to simulate VIP bookings being processed first.

```
import java.util.*;
class TicketBookingSystem {
    private int availableSeats;
    public TicketBookingSystem(int seats) {
        this.availableSeats = seats;    }
```



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```
public synchronized boolean bookTicket(String name) {
    if (availableSeats > 0) {
        System.out.println(name + " successfully booked a ticket. Seats left: " + (--availableSeats));
        return true;
    } else {
        System.out.println(name + " failed to book a ticket. No seats available.");
        return false;
    }
}

class BookingThread extends Thread {
    private TicketBookingSystem system;
    private String userName;
    public BookingThread(TicketBookingSystem system, String userName, int priority) {
        this.system = system;
        this.userName = userName;
        setPriority(priority); // Set thread priority
    }
    @Override
    public void run() {
        system.bookTicket(userName);
    }
}

public class TicketBookingMain {
    public static void main(String[] args) {
        TicketBookingSystem system = new TicketBookingSystem(5); // 5 seats available
        List<BookingThread> threads = new ArrayList<>();
        threads.add(new BookingThread(system, "VIP_Hardik", Thread.MAX_PRIORITY)); // VIP Booking (High Priority)
        threads.add(new BookingThread(system, "User_Rahul", Thread.NORM_PRIORITY));
        threads.add(new BookingThread(system, "VIP_Virat", Thread.MAX_PRIORITY)); // VIP Booking (High Priority)
        threads.add(new BookingThread(system, "User_Rohit", Thread.NORM_PRIORITY));
        threads.add(new BookingThread(system, "User_Shubman", Thread.MIN_PRIORITY)); // Low priority
        // Start all threads
        for (BookingThread thread : threads) {
            thread.start();
        }
        // Wait for all threads to finish
        for (BookingThread thread : threads) {
```

```
        try {  
            thread.join();  
        } catch (InterruptedException e) {  
            e.printStackTrace();  
        }  
        System.out.println("All bookings completed!");  
    }  
}
```

4. Output:

```
4.1 1. Add 2. Update 3. Remove 4. Search 5. Display 6. Exit  
1  
ID: 101  
Name: ABC  
Salary: 1234  
Employee added.  
  
1. Add 2. Update 3. Remove 4. Search 5. Display 6. Exit  
5  
Employee [ID=101, Name=ABC, Salary=1234.0]
```

```
4.2 1. Add Card  
2. Search Cards by Symbol  
3. Display All Cards  
4. Exit  
Enter choice: 1  
Enter Card Symbol: ♥  
Enter Card Value: A  
Card added successfully!  
  
1. Add Card  
2. Search Cards by Symbol  
3. Display All Cards  
4. Exit  
Enter choice: 3  
Card{Symbol='♥', Value='A'}
```

```
4.3 VIP_Hardik successfully booked a ticket. Seats left: 4
User_Shubman successfully booked a ticket. Seats left: 3
User_Rohit successfully booked a ticket. Seats left: 2
User_Rahul successfully booked a ticket. Seats left: 1
VIP_Virat successfully booked a ticket. Seats left: 0
All bookings completed!

Process finished with exit code 0
```

5. Learning Outcomes:

- Understand ArrayList operations for storing and managing structured data dynamically.
- Gain hands-on experience with Collection interfaces for efficient data storage and retrieval.
- Learn thread synchronization to prevent data inconsistency in concurrent environments.
- Implement thread priorities to manage task execution order in multi-threaded applications.
- Develop real-world problem-solving skills by handling data structures, collections, and concurrency in Java