

Module 1 - Design Patterns and Principles

Exercise 1: Implementing the Singleton Pattern(mandatory)

```
public class SingletonPatternExample {

    static class Logger {

        private static Logger instance;

        private Logger() {

            System.out.println("Logger instance created");

        }

        public static Logger getInstance() {

            if (instance == null) {

                instance = new Logger();

            }

            return instance;

        }

        public void log(String message) {

            System.out.println("LOG: " + message);

        }

    }

    public static void main(String[] args) {

        Logger logger1 = Logger.getInstance();

        logger1.log("Starting the application");

        Logger logger2 = Logger.getInstance();
```

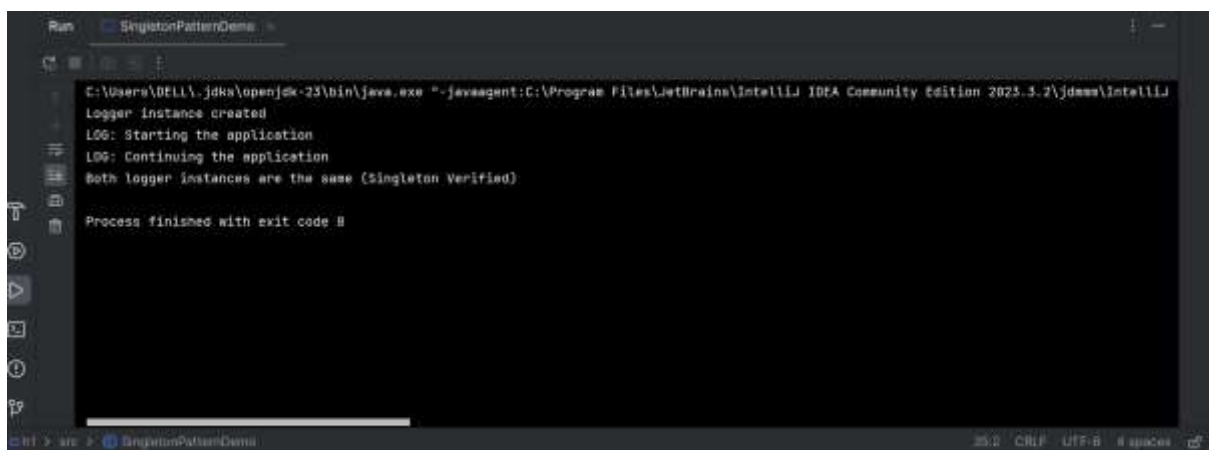
```

logger2.log("Continuing the application");

if (logger1 == logger2) {
    System.out.println("Both logger instances are the same (Singleton Verified)");
} else {
    System.out.println("Different instances");
}
}
}
}

```

Output:



```

Run SingletonPatternDemo
C:\Users\DELL\jdk\openjdk-23\bin\java.exe "-javaagent:C:\Program Files\JetBrains\IntelliJ IDEA Community Edition 2023.3.2\jbr\lib\idea_rt.jar"
Logger instance created
LOG: Starting the application
LOG: Continuing the application
Both logger instances are the same (Singleton Verified)
Process finished with exit code 0

```

Exercise 2: Implementing the Factory Method Pattern(mandatory)

```

public class FactoryMethodPatternDemo {

    interface Document {

        void open();

    }

    static class WordDocument implements Document {

        public void open() {

```

```
        System.out.println("Opening a Word Document");
    }
}
```

```
static class PdfDocument implements Document {
    public void open() {
        System.out.println("Opening a PDF Document");
    }
}
```

```
static class ExcelDocument implements Document {
    public void open() {
        System.out.println("Opening an Excel Document");
    }
}
```

```
abstract static class DocumentFactory {
    public abstract Document createDocument();
}
```

```
static class WordDocumentFactory extends DocumentFactory {
    public Document createDocument() {
        return new WordDocument();
    }
}
```

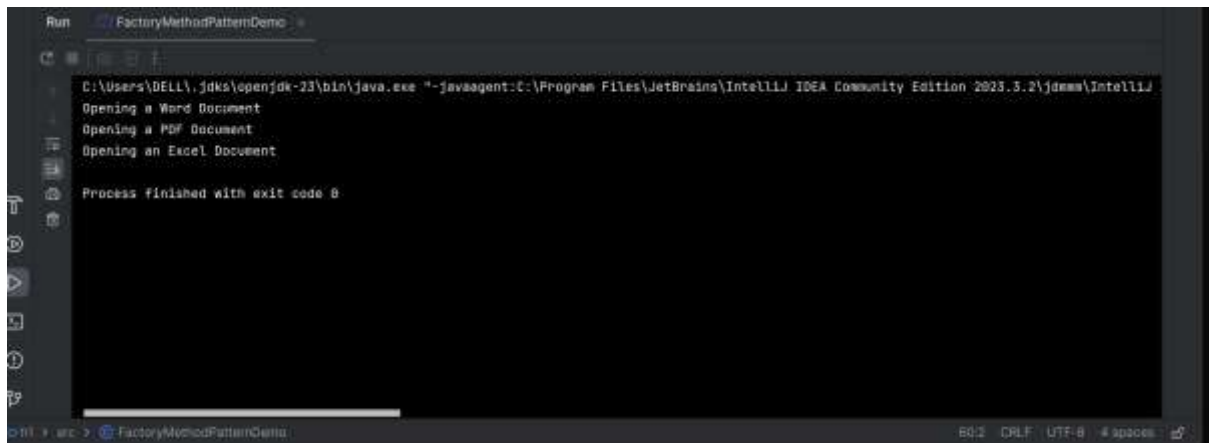
```
static class PdfDocumentFactory extends DocumentFactory {
    public Document createDocument() {
        return new PdfDocument();
    }
}
```

```
}  
}
```

```
static class ExcelDocumentFactory extends DocumentFactory {  
    public Document createDocument() {  
        return new ExcelDocument();  
    }  
}
```

```
public static void main(String[] args) {  
    DocumentFactory wordFactory = new WordDocumentFactory();  
    Document wordDoc = wordFactory.createDocument();  
    wordDoc.open();  
  
    DocumentFactory pdfFactory = new PdfDocumentFactory();  
    Document pdfDoc = pdfFactory.createDocument();  
    pdfDoc.open();  
  
    DocumentFactory excelFactory = new ExcelDocumentFactory();  
    Document excelDoc = excelFactory.createDocument();  
    excelDoc.open();  
}  
}
```

Output:

A screenshot of a Java IDE's run console. The title bar says 'Run FactoryMethodPatternDemo'. The console output shows the following lines: 'C:\Users\DELL\jdk\openjdk-23\bin\java.exe "-javaagent:C:\Program Files\JetBrains\IntelliJ IDEA Community Edition 2023.3.2\jbr\IntelliJ...', 'Opening a Word Document', 'Opening a PDF Document', 'Opening an Excel Document', and 'Process finished with exit code 0'. The IDE interface includes a sidebar with icons for Run, Debug, and other tools, and a status bar at the bottom showing 'Ed:3 CRLF UTF-8 4 spaces'.

Exercise 6: Implementing the Proxy Pattern(additional)

```
public class ProxyPatternExample {  
  
    interface Image {  
        void display();  
    }  
  
    static class ReallImage implements Image {  
        private String filename;  
  
        public ReallImage(String filename) {  
            this.filename = filename;  
            loadFromServer();  
        }  
  
        private void loadFromServer() {  
            System.out.println("Loading image from remote server: " + filename);  
        }  
  
        public void display() {  
            System.out.println("Displaying image: " + filename);  
        }  
    }  
  
    static class ProxyImage implements Image {  
        private ReallImage reallImage;  
        private String filename;
```

```
public ProxyImage(String filename) {
    this.filename = filename;
}

public void display() {
    if (reallImage == null) {
        reallImage = new ReallImage(filename);
    }
else {
    System.out.println("Using cached image for: " + filename);
    }
    reallImage.display();
}

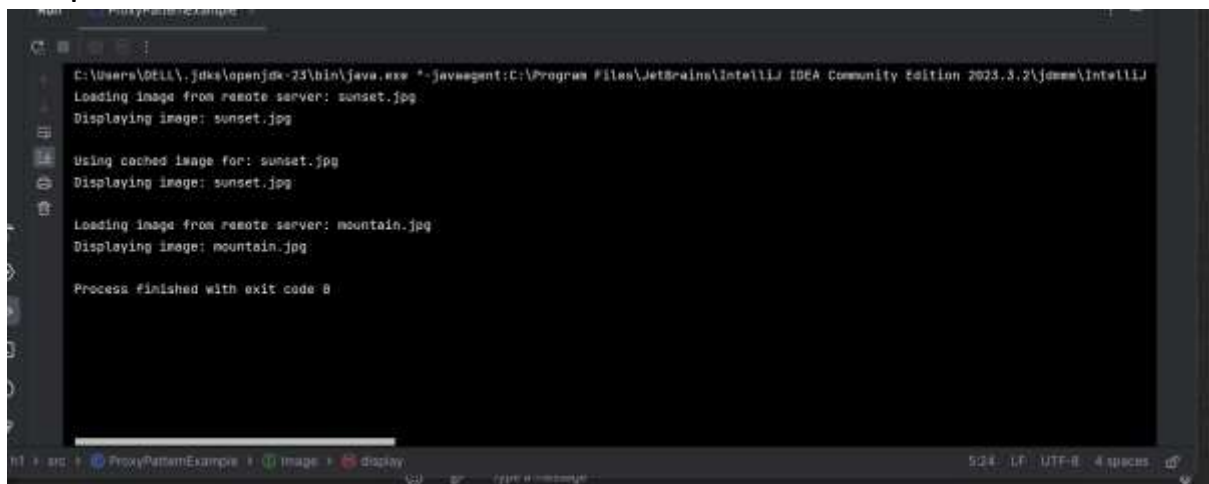
public static void main(String[] args) {
    Image image1 = new ProxyImage("sunset.jpg");
    Image image2 = new ProxyImage("mountain.jpg");

    image1.display();
    System.out.println();

    image1.display();
    System.out.println();

    image2.display();
}
}
```

output:



Module 2 - Data Structures and Algorithms

Exercise 2: E-commerce Platform Search Function(mandatory)

```
import java.util.*;
```

```
class Product {
```

```
    int productId;
```

```
    String productName;
```

```
    String category;
```

```
    Product(int productId, String productName, String category) {
```

```
        this.productId = productId;
```

```
        this.productName = productName;
```

```
        this.category = category;
```

```
    }
```

```
}
```

```
class LinearSearch {
```

```
    static int search(Product[] products, String key) {
```

```
        for (int i = 0; i < products.length; i++) {
```

```

        if (products[i].productName.equalsIgnoreCase(key)) {
            return i;
        }
    }
    return -1;
}
}

```

```

class BinarySearch {
    static int search(Product[] products, String key) {
        Arrays.sort(products, Comparator.comparing(p -> p.productName));
        int left = 0, right = products.length - 1;
        while (left <= right) {
            int mid = (left + right) / 2;
            int comp = products[mid].productName.compareToIgnoreCase(key);
            if (comp == 0)
                return mid;
            else if (comp < 0)
                left = mid + 1;
            else
                right = mid - 1;
        }
        return -1;
    }
}

```

```

public class EcommerceSearchFunction {
    public static void main(String[] args) {
        Product[] products = {

```



```

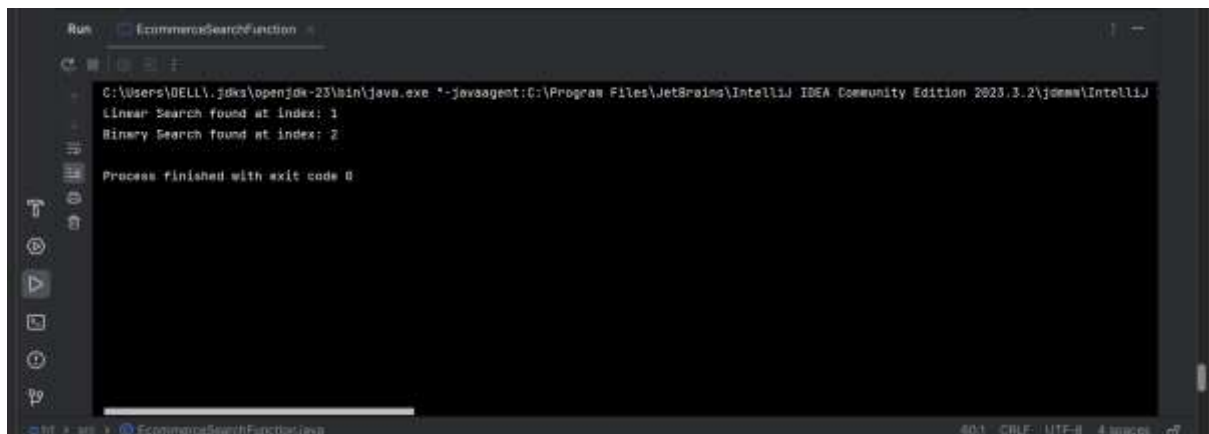
        new Product(101, "Laptop", "Electronics"),
        new Product(102, "Phone", "Electronics"),
        new Product(103, "Shoes", "Fashion"),
        new Product(104, "Book", "Stationery")
    };

    int index1 = LinearSearch.search(products, "Phone");
    System.out.println("Linear Search found at index: " + index1);

    int index2 = BinarySearch.search(products, "Phone");
    System.out.println("Binary Search found at index: " + index2);
}
}

```

Output:



```

Run | EcommerceSearchFunction
C:\Users\DELL\jdk\openjdk-23\bin\java.exe "-javaagent:C:\Program Files\JetBrains\IntelliJ IDEA Community Edition 2023.3.2\jbr\lib\idea-agent-2.jar" -classpath C:\Users\DELL\jdk\openjdk-23\bin\java.exe "-javaagent:C:\Program Files\JetBrains\IntelliJ IDEA Community Edition 2023.3.2\jbr\lib\idea-agent-2.jar" -classpath C:\Users\DELL\jdk\openjdk-23\bin\java.exe "-javaagent:C:\Program Files\JetBrains\IntelliJ IDEA Community Edition 2023.3.2\jbr\lib\idea-agent-2.jar"
Linear Search found at index: 1
Binary Search found at index: 2
Process finished with exit code 0

```

Exercise 7: Financial Forecasting(mandatory)

```

class Forecast {
    static double predictRecursive(double initial, double rate, int years) {
        if (years == 0)
            return initial;
        return predictRecursive(initial, rate, years - 1) * (1 + rate);
    }
}

```

```

    }

    static double predictIterative(double initial, double rate, int years) {
        for (int i = 0; i < years; i++) {
            initial *= (1 + rate);
        }
        return initial;
    }
}

public class FinancialForecasting {
    public static void main(String[] args) {
        double initialAmount = 10000;
        double annualGrowthRate = 0.08;
        int years = 5;

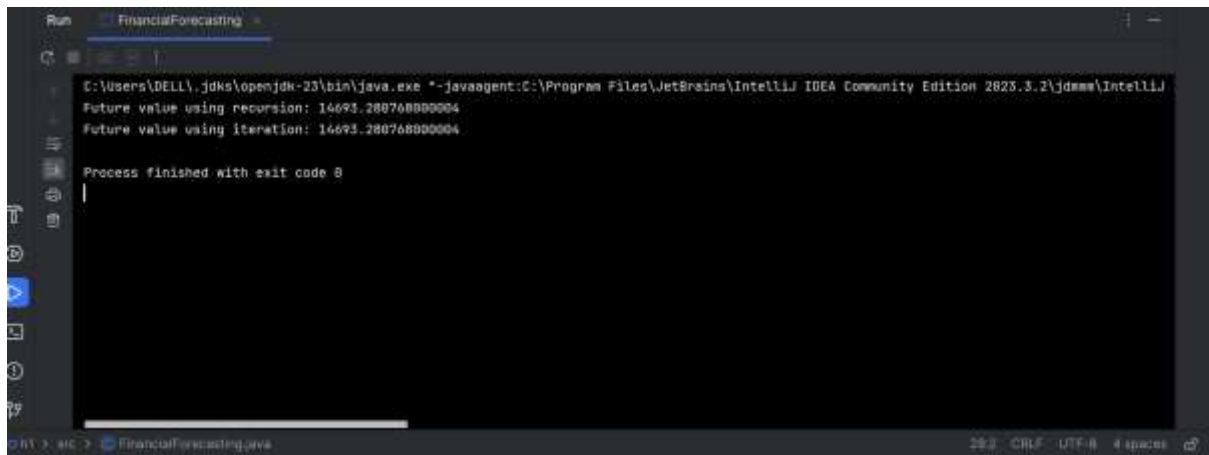
        double futureValueRecursive = Forecast.predictRecursive(initialAmount,
annualGrowthRate, years);

        double futureValueIterative = Forecast.predictIterative(initialAmount,
annualGrowthRate, years);

        System.out.println("Future value using recursion: " + futureValueRecursive);
        System.out.println("Future value using iteration: " + futureValueIterative);
    }
}

```

Output:



```
Run FinancialForecasting
C:\Users\DELL\jdk\openjdk-23\bin\java.exe --javaagent:C:\Program Files\JetBrains\IntelliJ IDEA Community Edition 2023.3.2\jbrms\IntelliJ
Future value using recursion: 14693.288768880004
Future value using iteration: 14693.288768880004

Process finished with exit code 0
```

Exercise 6: Library Management System(additional)

```
import java.util.Arrays;
```

```
import java.util.Comparator;
```

```
class Book {
```

```
    int bookId;
```

```
    String title;
```

```
    String author;
```

```
    Book(int bookId, String title, String author) {
```

```
        this.bookId = bookId;
```

```
        this.title = title;
```

```
        this.author = author;
```

```
    }
```

```
}
```

```
class LinearSearch {
```

```

static int search(Book[] books, String key) {
    for (int i = 0; i < books.length; i++) {
        if (books[i].title.equalsIgnoreCase(key)) {
            return i;
        }
    }
    return -1;
}
}

```

```

class BinarySearch {
    static int search(Book[] books, String key) {
        Arrays.sort(books, Comparator.comparing(b -> b.title.toLowerCase()));
        int left = 0, right = books.length - 1;
        while (left <= right) {
            int mid = (left + right) / 2;
            int cmp = books[mid].title.compareToIgnoreCase(key);
            if (cmp == 0)
                return mid;
            else if (cmp < 0)
                left = mid + 1;
            else
                right = mid - 1;
        }
        return -1;
    }
}

```

```

public class LibraryManagementSystem {

```

```

public static void main(String[] args) {

    Book[] books = {

        new Book(1, "The Alchemist", "Paulo Coelho"),
        new Book(2, "Clean Code", "Robert Martin"),
        new Book(3, "1984", "George Orwell"),
        new Book(4, "To Kill a Mockingbird", "Harper Lee")

    };

    int index1 = LinearSearch.search(books, "Clean Code");

    System.out.println("Linear Search found at index: " + index1);

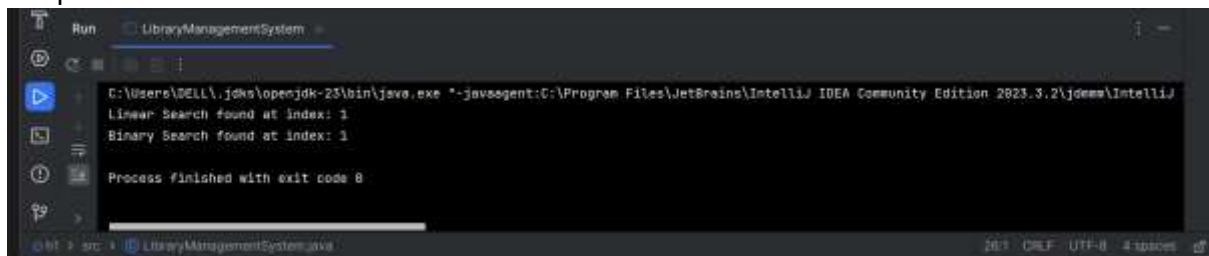
    int index2 = BinarySearch.search(books, "Clean Code");

    System.out.println("Binary Search found at index: " + index2);

}
}

```

Output :



```

Run LibraryManagementSystem
C:\Users\DELL\jdk\openjdk-25\bin\java.exe "-javaagent:C:\Program Files\JetBrains\IntelliJ IDEA Community Edition 2023.3.2\jbr\IntelliJ
Linear Search found at index: 1
Binary Search found at index: 1
Process finished with exit code 0

```