

BÁO CÁO THỰC HÀNH LAB 03

THỰC HÀNH LẬP TRÌNH HƯỚNG ĐỐI TƯỢNG

Contents

1. Working with method overloading.....	2
1.1. Overloading by differing types of parameter	2
Code	2
Result.....	2
1.2. Overloading by differing the number of parameters	3
Code	3
Result.....	5
2. Passing parameter	6
Code	6
Result.....	6
3. Class Member and Instance Member.....	7
Code	7
Result.....	9
4. Open the Cart class.....	9
Code	9
Result.....	11
5. Implement the Store class.....	12
Code	12
Result.....	13
6. String, StringBuilder and StringBuffer.....	14
Code	14
Result.....	14
7 Class Diagram	16
Table of Figures	17

1. Working with method overloading

1.1. Overloading by differing types of parameter

Code

- Phương thức mới đầu tiên addDigitalVideoDisc(DigitalVideoDisc[] dvdList) cho phép thêm một danh sách các đĩa DVD vào giỏ hàng.

```
//Mai Minh Quan - 20225661 - Hàm thêm đĩa DVD vào giỏ hàng, tham số đầu vào là 1 mảng
public int addDigitalVideoDisc(DigitalVideoDisc[] dvdArray) {
    int addCount = 0;
    for (DigitalVideoDisc disc : dvdArray) {
        if (qtyOrdered == MAX_NUMBERS_ORDERED) {
            System.out.println(x:"The cart is almost full. Can't add more discs");
            break;
        } else {
            itemsOrdered[qtyOrdered] = disc;
            qtyOrdered++;
            System.out.println("The DVD " + "\"" + disc.getTitle() + "\"" + " has been added!");
            addCount++;
        }
    }
    return addCount;
}
```

Figure 1 - Method addDigitalVideoDisc(DigitalVideoDisc [] dvdList)

- Phương thức mới thứ hai addDigitalVideoDisc(DigitalVideoDisc... dvdArray) sử dụng varargs để cho phép thêm một số lượng tùy ý các đĩa DVD vào giỏ hàng.

```
//Mai Minh Quan - 20225661 - Hàm thêm đĩa DVD vào giỏ hàng, tham số đầu vào là 1 List với số phần tử tùy ý
public int addDigitalVideoDisc(DigitalVideoDisc... dvdArray) {
    int addCount = 0;
    for (DigitalVideoDisc disc : dvdArray) {
        if (qtyOrdered == MAX_NUMBERS_ORDERED) {
            System.out.println(x:"The cart is almost full. Can't add more discs");
            break;
        } else {
            itemsOrdered[qtyOrdered] = disc;
            qtyOrdered++;
            System.out.println("The DVD " + "\"" + disc.getTitle() + "\"" + " has been added!");
            addCount++;
        }
    }
    return addCount;
}
```

Figure 2- Method addDigitalVideoDisc(DigitalVideoDisc... dvdList)

Cách sử dụng varargs linh hoạt hơn vì nó cho phép thêm bất kỳ số lượng đĩa DVD nào mà không cần chỉ định mảng một cách rõ ràng. Điều này làm cho mã nguồn sạch sẽ hơn và thuận tiện hơn khi gọi phương thức. Vì thế em thích phương thức dùng varargs.

```
//Mai Minh Quan - 20225661
package Lab2.AimsProject; //AimsProject
public class AIMS {
    Run | Debug
    public static void main(String[] args) {
        //Mai Minh Quan - 20225661 - Tạo giỏ hàng trống
        Cart anOrder = new Cart();

        //Mai Minh Quan - 20225661 - Thêm DVD vào giỏ hàng theo mảng
        DigitalVideoDisc dvd1 = new DigitalVideoDisc(title:"The Lion King",category:"Animation",
            director:"Roger Allers",length:87,cost:19.95f);

        DigitalVideoDisc dvd2 = new DigitalVideoDisc(title:"Star wars",category:"Science Fiction",
            director:"Geogre Lucas",length:87,cost:24.95f);

        DigitalVideoDisc dvd3 = new DigitalVideoDisc(title:"Aladin",category:"Animation",cost:18.99f);

        DigitalVideoDisc[] dvdArray = {dvd1, dvd2, dvd3};
        anOrder.addDigitalVideoDisc(dvdArray);
    }
}
```

Figure 3 - Aims Class

Result

```
PS C:\Users\MaiMinhQuan\Desktop\OOP lab> c::; cd 'c:\Users\MaiMinhQuan\Desktop\OOP lab'; & 'C:\Program Files\Java\jdk-21\bin\java.exe'
e' '-XX:+ShowCodeDetailsInExceptionMessages' '-cp' 'C:\Users\MaiMinhQuan\AppData\Roaming\Code\User\workspaceStorage\2284bef1afc75fd930
63d65e7c67a03\redhat.java\jdt_ws\OOP lab_e9d54078\bin' 'Lab2.AimsProject.AIMS'
The DVD "The Lion King" has been added!
The DVD "Star wars" has been added!
The DVD "Aladin" has been added!
PS C:\Users\MaiMinhQuan\Desktop\OOP lab> 
```

Figure 4 – Result

1.2. Overloading by differing the number of parameters

Code

```
//Mai Minh Quan - 20225661 - Hàm thêm 2 đĩa DVD vào giỏ hàng
public int addDigitalVideoDisc(DigitalVideoDisc dvd1, DigitalVideoDisc dvd2) {
    if (qtyOrdered + 1 >= MAX_NUMBERS_ORDERED) {
        System.out.println("The cart is almost full. Can't add more discs");
        return 0;
    } else {
        itemsOrdered[qtyOrdered] = dvd1;
        qtyOrdered++;
        System.out.println("The DVD " + "\"" + dvd1.getTitle() + "\"" + " has been added!");

        itemsOrdered[qtyOrdered] = dvd2;
        qtyOrdered++;
        System.out.println("The DVD " + "\"" + dvd2.getTitle() + "\"" + " has been added!");

        return 2;
    }
}
```

Figure 5 - Method addDigitalVideoDisc(dvd1, dvd2)

```
//Mai Minh Quan - 20225661
package Lab2.AimsProject; //AimsProject
public class AIMS {
    Run | Debug
    public static void main(String[] args) {
        //Mai Minh Quan - 20225661 - Tạo giỏ hàng trống
        Cart anOrder = new Cart();

        //Mai Minh Quan - 20225661 - Thêm 2 đĩa DVD vào giỏ hàng
        DigitalVideoDisc dvd1 = new DigitalVideoDisc(title:"The Lion King",category:"Animation",
            director:"Roger Allers",length:87,cost:19.95f);

        DigitalVideoDisc dvd2 = new DigitalVideoDisc(title:"Star wars",category:"Science Fiction",
            director:"Geogre Lucas",length:87,cost:24.95f);

        anOrder.addDigitalVideoDisc(dvd1, dvd2);
    }
}
```

Figure 6 - Aims Class

Result

```
PS C:\Users\MaiMinhQuan\Desktop\OOP lab> c::; cd 'c:\Users\MaiMinhQuan\Desktop\OOP lab'; & 'C:\Program Files\Java\jdk-21\bin\java.exe' '-XX:+ShowCodeDetailsInExceptionMessages' '-cp' 'C:\Users\MaiMinhQuan\AppData\Roaming\Code\User\workspaceStorage\2284bef1afc75fd93063d65e7c67a03\redhat.java\jdt_ws\OOP lab_e9d54078\bin' 'Lab2.AimsProject.AIMS'
```

o The DVD "The Lion King" has been added!

o The DVD "Star wars" has been added!

```
PS C:\Users\MaiMinhQuan\Desktop\OOP lab> 
```

Figure 7 - Result

2. Passing parameter

Câu hỏi: Java là ngôn ngữ lập trình "Pass by Value" hay "Pass by Reference"?

⇒ Trả lời: Java là ngôn ngữ lập trình "Pass by Value". Trong Java, khi bạn truyền một tham số cho một phương thức, giá trị của tham số được sao chép và truyền vào phương thức. Điều này có nghĩa là nếu bạn thay đổi giá trị của tham số bên trong phương thức, giá trị của biến gọi phương thức không bị ảnh hưởng.

Code

```
//Mai Minh Quan - 20225661
package Lab2.AimsProject;
public class TestPassingParameter {
    Run | Debug
    public static void main(String[] args){
        DigitalVideoDisc jungleDVD = new DigitalVideoDisc(title:"Jungle");
        DigitalVideoDisc cinderellaDVD = new DigitalVideoDisc(title:"Cinderella");

        swap(jungleDVD, cinderellaDVD);

        System.out.println("Mai Minh Quan - 20225661 - Jungle dvd title: " + jungleDVD.getTitle());
        System.out.println("Mai Minh Quan - 20225661 - Cinderella dvd title: " + cinderellaDVD.getTitle());

        changeTitle(jungleDVD, cinderellaDVD.getTitle());
        System.out.println("Mai Minh Quan - 20225661 - Jungle dvd title: " + jungleDVD.getTitle());
    }
    public static void swap(Object o1, Object o2) {
        Object tmp = o1;
        o1 = o2;
        o2 = tmp;
    }
    public static void changeTitle(DigitalVideoDisc dvd, String title){
        String oldTitle = dvd.getTitle();
        dvd.setTitle(title);
        dvd = new DigitalVideoDisc(oldTitle);
    }
}
```

Figure 8 - Passing parameter code

Result

```
PS C:\Users\MaiMinhQuan\Desktop\OOP lab> c::; cd 'c:\Users\MaiMinhQuan\Desktop\OOP lab'; & 'C:\Program Files\Java\jdk-21\bin\java.exe' '-XX:+ShowCodeDetailsInExceptionMessages' '-cp' 'C:\Users\MaiMinhQuan\AppData\Roaming\Code\User\workspaceStorage\2284bef1afcf75fd93063d65e7c67a03\redhat.java\jdt_ws\OOP lab_e9d54078\bin' 'Lab2.AimsProject.TestPassingParameter'
Mai Minh Quan - 20225661 - Jungle dvd title: Jungle
Mai Minh Quan - 20225661 - Cinderella dvd title: Cinderella
Mai Minh Quan - 20225661 - Jungle dvd title: Cinderella
PS C:\Users\MaiMinhQuan\Desktop\OOP lab>
```

Figure 9 - Result

- Câu hỏi: After the call of swap(jungleDVD, cinderellaDVD) why does the title of these two objects still remain?
- ⇒ Trả lời: Sau khi thực hiện phương thức swap(jungleDVD, cinderellaDVD), tiêu đề của hai đối tượng vẫn giữ nguyên vì trong Java, tham số được truyền vào phương thức là giá trị của đối tượng, không phải là tham chiếu đến đối tượng. Khi ta thay đổi giá trị của tham số bên trong phương thức (như việc đổi chỗ giữa o1 và o2), sự thay đổi này không ảnh hưởng đến giá trị của các đối tượng gốc.
- Câu hỏi: After the call of changeTitle(jungleDVD, cinderellaDVD.getTitle()) why is the title of the JungleDVD changed?
- ⇒ Sau khi gọi changeTitle(jungleDVD, cinderellaDVD.getTitle()), tiêu đề của jungleDVD bị thay đổi vì trong phương thức changeTitle, ta thực hiện thay đổi trực tiếp trên đối tượng dvd (được truyền vào phương thức) bằng cách gọi dvd.setTitle(title). Điều này ảnh hưởng trực tiếp đến đối tượng gốc được truyền vào phương thức.

Sửa lại hàm swap

```
//Mai Minh Quan - 20225661 - Hàm swap sau khi được sửa
public static void swap(DigitalVideoDisc dvd1, DigitalVideoDisc dvd2) {
    DigitalVideoDisc tmp = new DigitalVideoDisc(dvd1.getTitle(), dvd1.getCategory(),
        dvd1.getDirector(), dvd1.getLength(), dvd1.getCost());

    dvd1.setTitle(dvd2.getTitle());
    dvd1.setCategory(dvd2.getCategory());
    dvd1.setDirector(dvd2.getDirector());
    dvd1.setLength(dvd2.getLength());
    dvd1.setCost(dvd2.getCost());

    dvd2.setTitle(tmp.getTitle());
    dvd2.setCategory(tmp.getCategory());
    dvd2.setDirector(tmp.getDirector());
    dvd2.setLength(tmp.getLength());
    dvd2.setCost(tmp.getCost());
}
```

Figure 10 - Hàm swap sau khi được sửa

Kết quả

```
PS C:\Users\MaiMinhQuan\Desktop\OOP lab> c++; cd 'c:\Users\MaiMinhQuan\Desktop\OOP lab'; & 'C:\Program Files\Java\jdk-21\bin\java.exe' '-XX:+ShowCodeDetailsInExceptionMessages' '-cp' 'C:\Users\MaiMinhQuan\AppData\Roaming\Code\User\workspaceStorage\2284bef1afcf75fd93063d65e7c67a03\redhat.java\jdt_ws\OOP lab_e9d54078\bin' 'Lab2.AimsProject.TestPassingParameter'
Mai Minh Quan - 20225661 - Jungle dvd title: Cinderella
Mai Minh Quan - 20225661 - Cinderella dvd title: Jungle
Mai Minh Quan - 20225661 - Jungle dvd title: Jungle
PS C:\Users\MaiMinhQuan\Desktop\OOP lab>
```

Figure 11 - Result

3. Class Member and Instance Member Code

```
//Mai Minh Quan - 20225661
package Lab2.AimsProject;
public class DigitalVideoDisc {
    //Mai Minh Quan - 20225661 - Khai báo thuộc tính
    private static int nbDigitalVideoDiscs = 0; //Mai Minh Quan - 20225661 - Class attribute
    private String title;
    private String category;
    private String director;
    private int length;
    private float cost;
    private int id; //Mai Minh Quan - 20225661 - Instance attribute

    //Mai Minh Quan - 20225661 - Constructor by title
    public DigitalVideoDisc(String title) {
        super();
        this.title = title;
        this.id = ++nbDigitalVideoDiscs; //Mai Minh Quan - 20225661 - Update class variable and assign id
    }

    //Mai Minh Quan - 20225661 - Constructor by category, title and cost
    public DigitalVideoDisc(String title, String category, float cost) {
        this.title = title;
        this.category = category;
        this.cost = cost;
        this.id = ++nbDigitalVideoDiscs; //Mai Minh Quan - 20225661 - Update class variable and assign id
    }
}
```

Figure 12 - Class member and Instance member

```
//Mai Minh Quan - 20225661 - Constructor by title, category , director, cost
public DigitalVideoDisc(String title, String category, String director, float cost) {
    this.title = title;
    this.category = category;
    this.director = director;
    this.cost = cost;
    this.id = ++nbDigitalVideoDiscs; //Mai Minh Quan - 20225661 - Update class variable and assign id
}

//Mai Minh Quan - 20225661 - Constructor by all attributes
public DigitalVideoDisc(String title, String category, String director, int length, float cost) {
    this.title = title;
    this.category = category;
    this.director = director;
    this.length = length;
    this.cost = cost;
    this.id = ++nbDigitalVideoDiscs; //Mai Minh Quan - 20225661 - Update class variable and assign id
}

//Mai Minh Quan - 20225661 - Getter của các thuộc tính
public String getTitle() { return title; }
public String getCategory() { return category; }
public String getDirector() { return director; }
public int getLength() { return length; }
public float getCost() { return cost; }
public int getId() { return id; }
```

```
//Mai Minh Quan - 20225661 - Setter của các thuộc tính
public void setTitle(String title) { this.title = title; }
public void setCategory(String category) { this.category = category; }
public void setDirector(String director) { this.director = director; }
public void setLength(int length) { this.length = length; }
public void setCost(float cost) { this.cost = cost; }
```


Result

```
//Mai Minh Quan - 20225661
package Lab2.AimsProject.Test;
import Lab2.AimsProject.Cart;
import Lab2.AimsProject.DigitalVideoDisc;

public class CartTest {
    Run | Debug
    public static void main(String[] args) {
        Cart cart = new Cart();
        DigitalVideoDisc dvd1 = new DigitalVideoDisc(title:"The Lion King",category:"Animation",
            director:"Roger Allers",length:87,cost:19.95f);
        cart.addDigitalVideoDisc(dvd1);
        DigitalVideoDisc dvd2 = new DigitalVideoDisc(title:"Star wars",category:"Science Fiction",
            director:"Geogre Lucas",length:87,cost:24.95f);
        cart.addDigitalVideoDisc(dvd2);
        DigitalVideoDisc dvd3 = new DigitalVideoDisc(title:"Aladin",category:"Animation",cost:18.99f);
        cart.addDigitalVideoDisc(dvd3);

        cart.print();
    }
}
```

```
PS C:\Users\MaiMinhQuan\Desktop\OOP lab> c::; cd 'c:\Users\MaiMinhQuan\Desktop\OOP lab'; & 'C:\Program Files\Java\jdk-21\bin\java.exe'
'-XX:+ShowCodeDetailsInExceptionMessages' '-cp' 'C:\Users\MaiMinhQuan\AppData\Roaming\Code\User\workspaceStorage\2284bef1afcf75fd93063d
65e7c67a03\redhat.java\jdt_ws\OOP lab_e9d54078\bin' 'Lab2.AimsProject.Test.CartTest'
The DVD "The Lion King" has been added!
The DVD "Star wars" has been added!
The DVD "Aladin" has been added!
*****CART*****
Ordered items:
1.[The Lion King] - [Animation] - [Roger Allers] - [87]: 19.95 $
2.[Star wars] - [Science Fiction] - [Geogre Lucas] - [87]: 24.95 $
3.[Aladin] - [Animation] - [null] - [0]: 18.99 $
total: 63.89 $
*****
PS C:\Users\MaiMinhQuan\Desktop\OOP lab> 
```

Figure 13 - Result

4. Open the Cart class

Code

```
//Mai Minh Quan - 20225661 - Hàm in ra thông tin của các đĩa DVD trong giỏ hàng
public void print() {
    StringBuilder output = new StringBuilder(str:"*****CART***** \nOrdered items: \n");
    for (int i = 0; i < qtyOrdered;i++) {
        output.append(i+1 + ".[" + itemsOrdered[i].getTitle() + "] - [" + itemsOrdered[i].getCategory() + "] - ["
            + itemsOrdered[i].getDirector() + "] - [" + itemsOrdered[i].getLength() + "]: "
            + itemsOrdered[i].getCost() + " $\n");
    }
    output.append(str:"total: ").append(totalCost()).append(str:" $\n");
    output.append(str:"*****\n");
    System.out.println(output);
}
```

Figure 14 - Code print

- Thêm hàm print() vào Cart.java

- Thêm hàm searchById() vào Cart.java

```
//Mai Minh Quan - 20225661 - Hàm tìm kiếm theo Id
public void searchById(int i) {
    if(i > qtyOrdered) {
        System.out.println(x:"No match found !");
    } else {
        System.out.println("Result: " + "[" + itemsOrdered[i-1].getTitle() +
            "]" - "[" + itemsOrdered[i-1].getCategory() + "]" - "["
            + itemsOrdered[i-1].getDirector() + "]" - "["
            + itemsOrdered[i-1].getLength() + "]: " + itemsOrdered[i-1].getCost() + " $" + "\n");
    }
}
}
```

Figure 15 - Code method search by id

- Thêm hàm searchByTitle() vào Cart.java

```
//Mai Minh Quan - 20225661 - Hàm tìm kiếm theo Title
public void searchByTitle(String title) {
    for(int i = 0; i < qtyOrdered; i++) {
        if(isMatch(itemsOrdered[i].getTitle(), title)) {
            System.out.println("Result: " + "[" + itemsOrdered[i].getTitle() +
                "]" - "[" + itemsOrdered[i].getCategory() + "]" - "["
                + itemsOrdered[i].getDirector() + "]" - "["
                + itemsOrdered[i].getLength() + "]: " + itemsOrdered[i].getCost() + " $" + "\n");
            return;
        }
    }
    System.out.println(x:"No match found !");
}
}
```

Figure 16 - Code method search by title

- Thêm hàm isMatch() vào Cart.java

```
//Mai Minh Quan - 20225661 - Hàm kiểm tra xem đĩa tương ứng có phù hợp với tiêu đề được cung cấp hay không
public boolean isMatch(String title1, String title2) {
    return title1.equalsIgnoreCase(title2);
}
}
```

Figure 17 - isMatch() in DigitalVideoDisc class

- Tạo Class CartTest

```
package Lab2.AimsProject;
public class CartTest {
    Run | Debug
    public static void main(String[] args) {
        Cart cart = new Cart();
        DigitalVideoDisc dvd1 = new DigitalVideoDisc(title:"The Lion King",category:"Animation",
            director:"Roger Allers",length:87,cost:19.95f);
        cart.addDigitalVideoDisc(dvd1);
        DigitalVideoDisc dvd2 = new DigitalVideoDisc(title:"Star wars",category:"Science Fiction",
            director:"Geogre Lucas",length:87,cost:24.95f);
        cart.addDigitalVideoDisc(dvd2);
        DigitalVideoDisc dvd3 = new DigitalVideoDisc(title:"Aladin",category:"Animation",cost:18.99f);
        cart.addDigitalVideoDisc(dvd3);

        cart.print();

        //Mai Minh Quan - 20225661 - Test search by ID method
        cart.searchById(i:3);
        cart.searchById(i:4);

        //Mai Minh Quan - 20225661 - Test search by Title method
        cart.searchByTitle(title:"The Lion King");
        cart.searchByTitle(title:"Alan Walker");
    }
}
```

Figure 18 - CartTest class

Result

```
PS C:\Users\MaiMinhQuan\Desktop\OOP lab> & 'C:\Program Files\Java\jdk-21\bin\java.exe' '-XX:+ShowCodeDetailsInExceptionMessages' '-cp' 'C:\Users\MaiMinhQuan\AppData\Roaming\Code\User\workspaceStorage\2284bef1afc75fd93063d65e7c67a03\redhat.java\jdt_ws\OOP lab_e9d54078\bin' 'Lab2.AimsProject.CartTest'
The DVD "The Lion King" has been added!
The DVD "Star wars" has been added!
The DVD "Aladin" has been added!
*****CART*****
Ordered items:
1.[The Lion King] - [Animation] - [Roger Allers] - [87]: 19.95 $
2.[Star wars] - [Science Fiction] - [Geogre Lucas] - [87]: 24.95 $
3.[Aladin] - [Animation] - [null] - [0]: 18.99 $
total: 63.89 $
*****
Result: [Aladin] - [Animation] - [null] - [0]: 18.99 $

No match found !
Result: [The Lion King] - [Animation] - [Roger Allers] - [87]: 19.95 $

No match found !
PS C:\Users\MaiMinhQuan\Desktop\OOP lab>
```

Figure 19 - Result

5. Implement the Store class

Code

- Tạo Store Class

```
//Mai Minh Quan - 20225661
package Lab2.AimsProject;
import java.util.LinkedList;

public class Store {
    private LinkedList<DigitalVideoDisc> itemsInStore = new LinkedList<DigitalVideoDisc>();

    //Mai Minh Quan - 20225661 - Kiểm tra xem đĩa DVD có trong Store không
    private boolean checkDVD(DigitalVideoDisc disc) {
        for (DigitalVideoDisc digitalVideoDisc : itemsInStore) {
            if (digitalVideoDisc.equals(disc)) {
                return true;
            }
        }
        return false;
    }

    //Mai Minh Quan - 20225661 - Xóa đĩa DVD khỏi Store
    public void removeDVD(DigitalVideoDisc disc) {
        if(checkDVD(disc)) {
            itemsInStore.remove(disc);
            System.out.println( disc.getTitle() + " 've been deleted from the store !");
        } else {
            System.out.println("There is no "+ disc.getTitle() + " in the store !");
        }
    }
}
```

```
//Mai Minh Quan - 20225661 - Thêm đĩa DVD vào Store
public void addDVD(DigitalVideoDisc disc) {
    if(!checkDVD(disc)) {
        itemsInStore.add(disc);
        System.out.println( disc.getTitle() + " 've been added to the store !");
    } else {
        System.out.println( disc.getTitle() + " 'already exists in the store !");
    }
}

//Mai Minh Quan - 20225661 - In ra những đĩa DVD trong Store
@Override
public String toString() {
    StringBuilder string = new StringBuilder(str:"*****STORE*****\nitems in the store: \n");
    if(itemsInStore.isEmpty()) string.append(str:"There is no dvd in the store !\n");
    else {
        for (DigitalVideoDisc dvd : itemsInStore) {
            string.append(dvd.getTitle() + " - " + dvd.getCost() + " $\n");
        }
    }
    string.append(str:"*****");
    return string.toString();
}
```

Figure 20 - Store Class

Tạo StoreTest Class

```
//Mai Minh Quan - 20225661
package Lab2.AimsProject.Test;
import Lab2.AimsProject.DigitalVideoDisc;
import Lab2.AimsProject.Store;

public class StoreTest {
    Run | Debug
    public static void main(String[] args) {
        Store store = new Store();
        DigitalVideoDisc dvd1 = new DigitalVideoDisc(title:"The Lion King", category:"Animation",
            director:"Roger Allers", length:87, cost:19.95f);
        DigitalVideoDisc dvd2 = new DigitalVideoDisc(title:"Star wars", category:"Science Fiction",
            director:"Geogre Lucas", length:87, cost:24.95f);
        DigitalVideoDisc dvd3 = new DigitalVideoDisc(title:"Aladin", category:"Animation", cost:18.99f);
        //Mai Minh Quan - 20225661 - Thêm DVD vào Store
        store.addDVD(dvd1);
        store.addDVD(dvd2);
        store.addDVD(dvd3);

        System.out.println(store.toString());
        //Mai Minh Quan - 20225661 - Xóa DVD khỏi Store
        store.removeDVD(dvd1);
        store.removeDVD(dvd2);
        store.removeDVD(dvd3);

        System.out.println(store.toString());
    }
}
```

Figure 21 - StoreTest Class

Result

```
PS C:\Users\MaiMinhQuan\Desktop\OOP lab> c::; cd 'c:\Users\MaiMinhQuan\Desktop\OOP lab'; & 'C:\Program Files\Java\jdk-21\bin\java.exe' '-XX:+ShowCodeDetailsInExceptionMessages' '-cp' 'C:\Users\MaiMinhQuan\AppData\Roaming\Code\User\workspaceStorage\2284bef1afc75fd93063d65e7c67a03\redhat.java\jdt_ws\OOP lab_e9d54078\bin' 'Lab2.AimsProject.Test.StoreTest'
The Lion King 've been added to the store !
Star wars 've been added to the store !
Aladin 've been added to the store !
*****STORE*****
items in the store:
The Lion King - 19.95 $
Star wars - 24.95 $
Aladin - 18.99 $
*****
The Lion King 've been deleted from the store !
Star wars 've been deleted from the store !
Aladin 've been deleted from the store !
*****STORE*****
items in the store:
There is no dvd in the store !
*****
```

Figure 22 - Result

4. String, StringBuilder and StringBuffer

Code

```
//Mai Minh Quan - 20225661
package Lab2.OtherProjects.garbage;
import java.util.Random;
import static java.lang.System.currentTimeMillis;

public class ConcatenationInLoops {
    Run | Debug
    public static void main(String[] args) {
        Random r = new Random(seed:123);
        long start = currentTimeMillis();

        //Mai Minh Quan - 20225661 - String
        String s = "";
        for (int i = 0; i < 65536; i++) s += r.nextInt(bound:2);
        System.out.println(currentTimeMillis() - start);

        //Mai Minh Quan - 20225661 - StringBuilder
        r = new Random(seed:123);
        start = System.currentTimeMillis();
        StringBuilder sb = new StringBuilder();
        for(int i = 0; i < 65536; i++)
            sb.append(r.nextInt(bound:2));
        s += sb.toString();
        System.out.println(System.currentTimeMillis() - start);
    }
}
```

Figure 23 - So sánh String và StringBuilder

- Tạo Concatenation Class

Result

```
PS C:\Users\MaiMinhQuan\Desktop\OOP lab> c::; cd 'c:\Users\MaiMinhQuan\Desktop\OOP lab'; & 'C:\Program Files\Java\jdk-21\bin\java.exe' '-XX:+ShowCodeDetailsInExceptionMessages' '-cp' 'C:\Users\MaiMinhQuan\AppData\Roaming\Code\User\workspaceStorage\2284bef1afcf75fd93063d65e7c67a03\redhat.java\jdt_ws\OOP lab_e9d54078\bin' 'Lab2.OtherProjects.garbage.ConcatenationInLoops'
598
2
PS C:\Users\MaiMinhQuan\Desktop\OOP lab> 
```

Figure 24 - Result

Code

- Tạo GarbageCreator Class

```
//Mai Minh Quan - 20225661
package Lab2.OtherProjects.garbage;
import java.io.IOException;
import java.nio.file.Files;
import java.nio.file.Paths;

public class GarbageCreator {
    Run | Debug
    public static void main(String[] args) throws IOException {
        String filename = "C:\\Users\\MaiMinhQuan\\Desktop\\OOP lab\\Lab2\\OtherProjects\\garbage\\test.txt";
        byte[] inputBytes = { 0 };
        long startTime, endTime;
        inputBytes = Files.readAllBytes(Paths.get(filename));
        startTime = System.currentTimeMillis();
        String outputString = "";
        for(byte b : inputBytes) {
            outputString += (char)b;
        }
        endTime = System.currentTimeMillis();
        System.out.println(endTime - startTime);
    }
}
```

Figure 25 - GarbageCreator Class

Result

```
PS C:\Users\MaiMinhQuan\Desktop\OOP lab> c::; cd 'c:\Users\MaiMinhQuan\Desktop\OOP lab'; & 'C:\Program Files\Java\jdk-21\bin\java.exe' '-XX:+ShowCodeDetailsInExceptionMessages' '-cp' 'C:\Users\MaiMinhQuan\AppData\Roaming\Code\User\workspaceStorage\2284bef1afcf75fd93063d65e7c67a03\redhat.java\jdt_ws\OOP lab_e9d54078\bin' 'Lab2.OtherProjects.garbage.GarbageCreator'
23
PS C:\Users\MaiMinhQuan\Desktop\OOP lab> █
```

Figure 26 - Result: program hangs

Code

```
//Mai Minh Quan - 20225661
package Lab2.OtherProjects.garbage;
import java.io.IOException;
import java.nio.file.Files;
import java.nio.file.Paths;

public class NoGarbage {
    Run | Debug
    public static void main(String[] args) throws IOException {
        String filename = "C:\\Users\\MaiMinhQuan\\Desktop\\OOP lab\\Lab2\\OtherProjects\\garbage\\test.txt";
        byte[] inputBytes = { 0 };
        long startTime, endTime;

        inputBytes = Files.readAllBytes(Paths.get(filename));
        startTime = System.currentTimeMillis();
        StringBuilder outputStringBuilder = new StringBuilder(str:"");
        for(byte b : inputBytes) {
            outputStringBuilder.append((char)b);
        }
        endTime = System.currentTimeMillis();
        System.out.println(endTime - startTime);
    }
}
```

Figure 27 - NoGarbage Class

Result

```
PS C:\Users\MaiMinhQuan\Desktop\OOP lab> c::; cd 'c:\Users\MaiMinhQuan\Desktop\OOP lab'; & 'C:\Program Files\Java\jdk-21\bin\java.exe'
e' '-XX:+ShowCodeDetailsInExceptionMessages' '-cp' 'C:\Users\MaiMinhQuan\AppData\Roaming\Code\User\workspaceStorage\2284bef1afcf75fd
93063d65e7c67a03\redhat.java\jdt_ws\OOP lab_e9d54078\bin' 'Lab2.OtherProjects.garbage.NoGarbage'
1
PS C:\Users\MaiMinhQuan\Desktop\OOP lab> 
```

Figure 28 - Result: program finishes quickly

7. Class Diagram

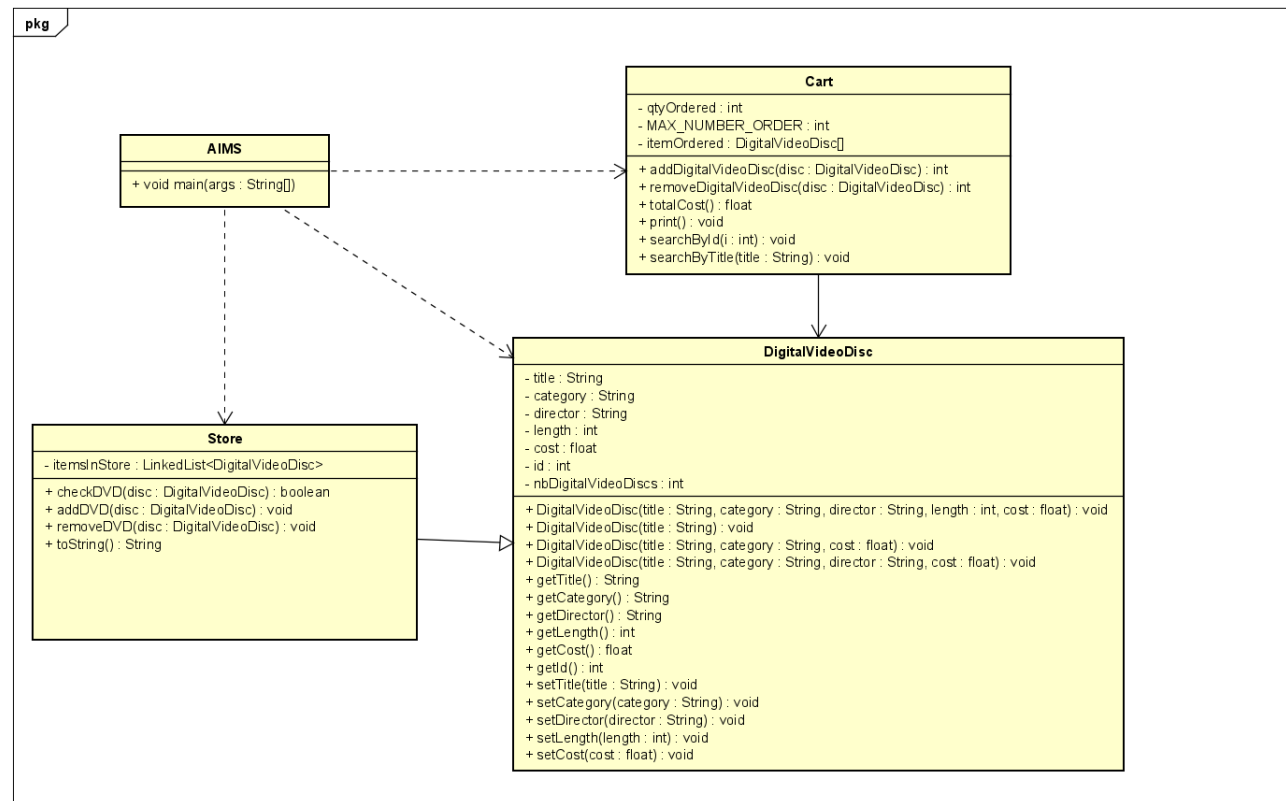


Figure 29 - Class Diagram

Table of Figures

Figure 1 - Method addDigitalVideoDisc(DigitalVideoDisc [] dvdList)	2
Figure 2- Method addDigitalVideoDisc(DigitalVideoDisc... dvdList).....	2
Figure 3 - Aims Class	3
Figure 4 – Result	3
Figure 5 - Method addDigitalVideoDisc(dvd1, dvd2).....	4
Figure 6 - Aims Class	4
Figure 7 - Result	5
Figure 8 - Passing parameter code	6
Figure 9 - Result	6
Figure 10 - Hàm swap sau khi được sửa	7
Figure 11 - Result	7
Figure 12 - Class member and Instance member	8
Figure 13 - Result	9
Figure 14 - Code print	10
Figure 15 - Code method search by id	11
Figure 16 - Code method search by title.....	11
Figure 17 - isMatch() in DigitalVideoDisc class	11
Figure 18 - CartTest class	12
Figure 19 - Result	12
Figure 20 - Store Class.....	13
Figure 21 - StoreTest Class.....	14
Figure 22 - Result	14
Figure 23 - So sánh String và StringBuilder	15
Figure 24 - Result	15
Figure 25 - GarbageCreator Class	16
Figure 26 - Result: program hangs.....	16
Figure 27 - NoGarbage Class	17
Figure 28 - Result: program finishes quickly.....	17
Figure 29 - Class Diagram.....	18