Object-Oriented Language and Theory

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Lab 8: Polymorphism

* Objectives:

In this lab, you will practice with:

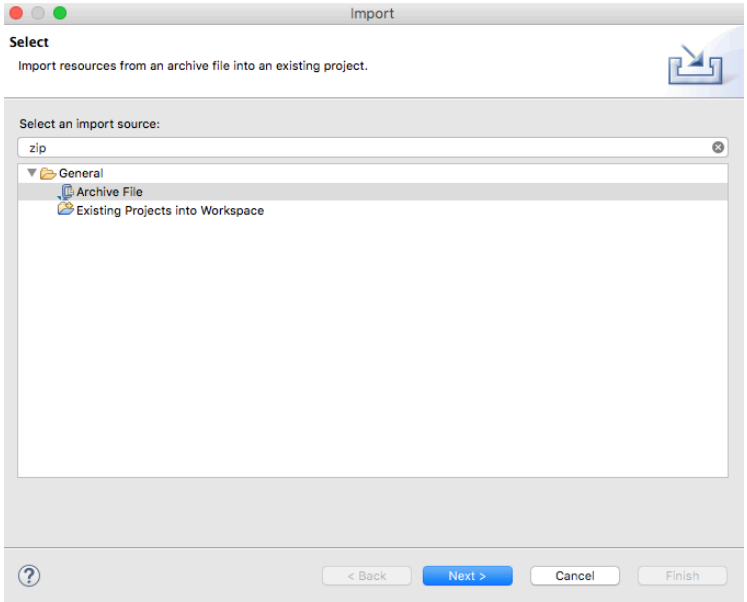
- Polymorphism
- Comparable interface for the purpose of sorting objects within a collection
- Template
- Map

You need to use the project that you did with the previous labs including AimsProject.

1. Import the AimsProject

- Open Eclipse

- Open File → Import. Type zip to find Archive File if you have exported as a zip file before. You may choose Existing Projects into Workspace if you want to open an existing project in your computer. Ignore this step if the `AimsProject` is already opened in the workspace.



- Click Next and Browse to a zip file or a project to open.

2. Implement the `Comparable` interface and sort

- To sort media products, implement the `Comparable` interface on `CompactDisc`, `DigitalVideoDisc`, `Track`, and `Book`.

Note: The `Comparable` interface is part of the Java class library. It is in the java.lang package, so no import statement is needed. Please open the Java docs to see the information of this interface. Which method(s) do you need to implement from this interface?

+ For each of `CompactDisc`, `DigitalVideoDisc`, `Track`, and `Book`, edit the class description to include the `Comparable` interface after the implements keyword in the class declaration. For example, the class declaration for `DigitalVideoDisc` becomes:

```
public class DigitalVideoDisc
   extends Media implements Playable, Comparable {
```

Note: When you save your classes, you will now receive an error in the Tasks view. This is because classes which implement the `Comparable` interface must implement the `compareTo()` method (from `Comparable`) - and this has not yet been completed.

3. Implement the compareTo() method

- For each of `CompactDisc`, `DigitalVideoDisc`, `Track`, and `Book`, create a method called `compareTo()` with the signature:

```
public int compareTo(Object obj)
```

- When implementing the `compareTo()` method of the `Comparable` interface, you often simply use the `compareTo()` method on one of the fields of the class. You will have to cast the `Object` parameter obj to the type of `Object` that you are dealing with. For example, in the `DigitalVideoDisc` class, you must cast the `Object` obj to a `DigitalVideoDisc`, and then return the value of a `compareTo()` on the title fields of the two objects. If the passing object is not an instance of `DigitalVideoDisc`, what happens?
- Since title is a field of `Media` and all of the above `Comparable` classes extend `Media`, you can create the same `compareTo()` method for the `CompactDisc`, `Track`, and `Book`.

4. Test the compareTo() method

- Open `Aims`.java in the editor.
- Locate the `main()` method. At the end of the `main()` method, create a collection (for example, a `ArrayList`) and add some `Media` objects to it (for example, some `DigitalVideoDiscs` as the sample code below). Write more codes for other `Media` types.
- Iterate through the entries in the collection and output them.

- Then use the `Collection.sort()` method to sort the entries in the collection, and output them again. They should now be in sorted order based on the `compareTo()` method that you created for that class.

```
java.util.Collection collection = new java.util.ArrayList();

  // Add the DVD objects to the ArrayList
  collection.add(dvd2);
  collection.add(dvd1);
  collection.add(dvd3);

  // Iterate through the ArrayList and output their titles
  // (unsorted order)
  java.util.Iterator iterator = collection.iterator();

  System.out.println("---------------------------------");
  System.out.println ("The DVDs currently in the order are: ");

  while (iterator.hasNext()) {
        System.out.println
        (((DigitalVideoDisc)iterator.next()).getTitle());
  }

  // Sort the collection of DVDs - based on the compareTo()
  // method
  java.util.Collections.sort((java.util.List)collection);

  // Iterate through the ArrayList and output their titles -
  // in sorted order
  iterator = collection.iterator();

  System.out.println("---------------------------------");
  System.out.println ("The DVDs in sorted order are: ");

  while (iterator.hasNext()) {
        System.out.println
        (((DigitalVideoDisc)iterator.next()).getTitle());
  }

  System.out.println("---------------------------------");
```

- Execute your program (click the Run button as before).
- The output in the Console view may like the following (depends on objects you've created):

```
Playing DVD: The Lion King
DVD length: 87
Playing DVD: Star Wars
DVD length: 124
Playing DVD: Aladdin
DVD length: 90
The total length of the CD to add is: 13
Playing CD: IBM Symphony
CD length:13
Playing DVD: Warmup
DVD length: 3
Playing DVD: Scales
DVD length: 4
Playing DVD: Introduction
DVD length: 6
Total Cost is: 163.83
-----------------------------------
The DVDs currently in the order are:
Star Wars
The Lion King
Aladdin
-----------------------------------
The DVDs in sorted order are:
Aladdin
Star Wars
The Lion King
-----------------------------------
```

5. Change the criteria for sorting media

Suppose you wish to sort your `DVDs` by cost or length, rather than title. What changes would you need to make to your code to do this? Try making the necessary changes to the `compareTo()` method so that your `DVDs` are sorted by cost, from lowest to highest cost.

Do the modification if you want to sort `CDs` by number of tracks then by length, rather than title. If two `CDs` have the same number of tracks, please compare lengths of these two `CDs`.

Modify and run the class the `Aims` class to see the changes.

6. Using template for `Collection`

Please modify all codes which work with `Collection` (from previous labs to this lab) to template style, for example:

```
Collection collection = new ArrayList();
```

should be modified to:

```
List<CompactDisc> discs = new ArrayList<CompactDisc>();
```

Or in the Order class should have:

```
List<Media> itemsOrdered = new ArrayList<Media>();
```

and all related source codes. Run and test again.

7. Counting the frequency of `Book` **content with** `Map`

- Add an attribute `String content` for `Book` with two additional attributes:

+ A sorted list `List<String> contentTokens`

+ A sorted map `Map<String,Integer> wordFrequency`

- Write a method `processContent()` calculating the following information of the book content. This method is called when the content of the book is set/changed.

+ Split the content to tokens by spaces or punctuations, then sort these tokens from a → z and set to the `contentTokens` attribute list

+ Count the frequency of each token, sort by token from a → z and set to the `wordFrequency` attribute map

- Override the method `toString()` to return all information of `Book`: all values of `Book` attributes, the content length (i.e. the number of tokens), the token list and the word frequency of the content.

- Write the `BookTest` class to test all above methods and display information of `Book`.