

Introduction

The purpose of these labs is to provide practice problems for you to get used to the concepts being covered in class. It is very important that you do these labs on your own without relying on available AI tools. Questions on exams are often very similar to exercises presented in these labs, so understanding them and solving these problems gives you a huge advantage for the exams. Make sure that you complete both the code as well as provide written answers to the blue questions within the boxes.

When you have concluded this lab, you should submit the following files to OWL Brightspace:

Book.java (code written for Exercise 01)

Library.java (code written for Exercise 02)

Q01_Q2.txt (written answers to questions in Exercise 01 and 02)

Exercise03.txt (written answers to questions asked in Exercise 03)

Exercise04.java (code written for Exercise 04)

Topics Covered

- Classes
- Arrays and ArrayLists
- Data types
- Access modifiers

Exercise 01

Developing a custom class

Let's write a custom **Book** class! There should be three private instance variables:

- title: The title of the book (String)
- author: The author of the book (String)
- year: The publication year of the book (int)

Q 01.1

Why would we want these instance variables to be private and not public?

We should also write the following public methods:

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- **getAuthor()** which returns the name of the author.
- **getTitle()** which returns the name of the book.
- **getPublicationYear()** which returns the year of publication.
- **equals(Book other)** which returns a boolean reflecting whether or not two Book objects are equal (equivalent authors, titles, and publication year).

I will provide this for you (note that && is equivalent to 'and' in Python):

```
public boolean equals(Book other) {  
    if (this.title == other.title && this.author == other.author && this.publicationYear == other.publicationYear) {  
        return true;  
    }  
    return false;  
}
```

- **getBookInformation()** which returns a String in the format of "Book: <title>, Author: <author>, Year: <year>."

As well as a constructor:

- **Book(String title, String author, int publicationYear)** that sets the values for the three instance variables.

Q 01.2

Why do we want all of the methods to be public? What would happen if they were, for example, private? What is the issue with this?

Placing the following main method within your class:

```
public static void main(String[] args) {  
    Book book1 = new Book("The Hobbit", "JRR Tolkien", 1937);  
    System.out.println(book1.getBookInformation());  
}
```

Should produce the output:

Title: The Hobbit, Author: JRR Tolkien, Year: 1937

Q 01.3

Could there potentially be more than one constructor assuming that they took unique arguments?

Exercise 02

Writing a Library class

Let's write a custom **Library** class to hold objects of type **Book**. There should be two instance variables:

- **books**: An ArrayList of Books
- **name**: A library name (String)

We should also write the following public methods:

- **addBook(Book book)** which adds a book to the books ArrayList.
- **getBookCount(Book book)** which returns the number of books in the library that match the Book object passed as an argument. You will want to make use of the equal method in the Book class in this method.
- **getLibraryName()** which returns the name of the library.

As well as the constructor, which I will give you:

- **Library(String name)** that sets the values for the library name. The books ArrayList should be empty upon construction of a Library object.

```
public Library(String name) {  
    this.books = new ArrayList<Book>(); // initialize books ArrayList here  
    this.name = name;  
}
```

Q 02.1

Could we use an Array rather than an ArrayList to keep track of the Book objects in the Library? Why or why not?

Q 02.2

How might we adjust the code to allow for the borrowing (checking a book out) and returning (checking a book back in) of books? What would need to change in the Book class and/or the Library class? Explain in detail (you don't necessarily need to write any code).

Exercise 03

For each primitive data type, state which option is valid and which is not (for example, 'byte2' is valid because ____, byte1 is not valid because ____' :

```
public class Example {
    public static void main(String[] args) {
        // byte
        byte byte1 = 182;
        byte byte2 = -127;

        // short
        short short1 = 32767;
        short short2 = -32802;

        // int
        int int1 = -2147483648;
        int int2 = -3294586023;

        // long
        long long1 = 9223372036854775807L;
        long long2 = 9223372036854775807;

        // float
        float float1 = 3.2F;
        float float2 = 3.2;

        // double
        double double1 = 3.2;
        double double2 = "3.2";

        // char
        char char1 = '\u03A9';
        char char2 = 'a';
        char char3 = '!';
        char char4 = 'xyz';

        // boolean
        boolean bool1 = false;
        boolean bool2 = False;
    }
}
```

Exercise 04

For this exercise, you are going to be practicing creating arrays and performing basic operations on them in Java.

You will start by defining an array to hold 5 integer elements and initialize it with values of your choice, such as 1, 2, 3, 4, and 5 (this will be a private instance variable of the class you are creating).

Your task will include implementing a method **viewElement** that takes an index as an argument and prints the element at that index, ensuring the index is valid (between 0 and 4).

Additionally, you will implement a method **updateElement** that takes an index and a new value as arguments, updating the element at that index and printing a message indicating whether the update was successful.

Another method, **displayArray**, should be implemented to print all the elements in the array.

On the following page is a template that you can use to begin your solution. When you've finished coding, the output should be:

```
[1, 2, 3, 4, 5]
```

```
4
```

```
[1, 2, 20, 4, 5]
```

```
// what should you import here to help you out in the displayArray method?  
// Hint: java.util.<something that rhymes with 'delay'>
```

```
public class Exercise04 {  
    // what should go here?  
  
    public ____ viewElement(int pos) {  
        /*  
        check that the pos is valid  
        if not, print "Invalid index"  
        note that || is the Java equivalent to 'or' in Python  
        if valid, print the element at that position  
        */  
    }  
  
    public ____ updateElement(int pos, int val) {  
        /*  
        check that the pos is valid  
        if not, print "Invalid index"  
        note that || is the Java equivalent to 'or' in Python  
        if valid, update the value of the element at index pos  
        */  
    }  
  
    public ____ displayArray() {  
        // print the array  
    }  
  
    public static void main(String[] args) {  
        Exercise04 arr = new Exercise04();  
        arr.displayArray();  
        arr.updateElement(2, 20);  
        arr.viewElement(3);  
        arr.displayArray();  
    }  
}
```