

Institute of Technology, University of Washington Tacoma
TCSS 305 Programming Practicum, Autumn 2018
Assignment 2 – Bookstore
Value: 6% of the course grade
Due: Friday, 12 October 2018, 23:59:59

Program Description:

This assignment will give you practice writing Java classes to a provided API and using Collections. You are to write a set of supporting classes for a simple shopping cart. The instructor has provided the Graphical User Interface (GUI) that will provide the "front end" or "view" to your program. You are to write the back end (what is often referred to as the "domain specific code" or the "model").

Here is a screen shot of what the program could look like when the user has selected various items to order (note that the exact appearance may be platform dependent):

Prices are expressed as real numbers and quantities are expressed as integers (*i.e.*, you can't buy 2.345 units of something). Notice that some of the items have a discount when you buy more. For example, Silly Putty normally costs \$4.41 per unit, but you can buy 6 for \$10.04. These items have, in effect, two prices: a single item price and a bulk item price for a bulk quantity. The bulk quantity discount is only used if the membership checkbox at the bottom of the GUI is selected. When computing the total with the bulk item discount, apply as many of the bulk quantity as you can and then use the single item price for any leftovers. For example, the user is ordering 12 buttons that cost \$0.95 each but can be bought in bulk at 10 for \$5.00. The first 10 are sold at that bulk price (\$5.00) and the two extras are charged at the single item price (\$0.95 each) for a total of \$6.90. If the user were ordering 22 buttons, the total would be \$11.90 (two bulk quantities plus two extras).

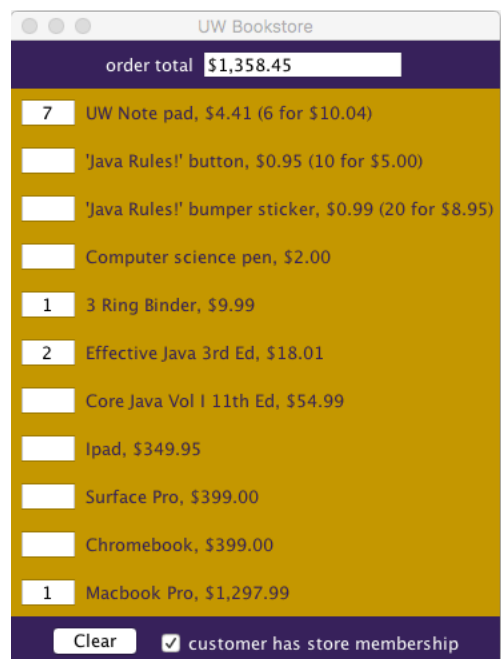
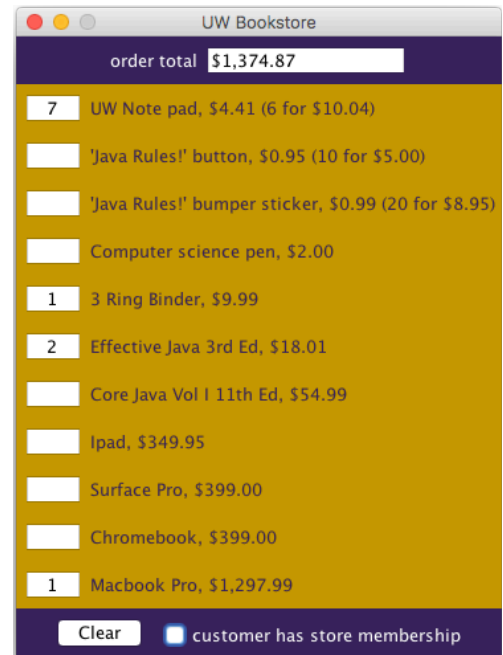
At the bottom of the GUI there is a checkbox for a discount for customers who have a store membership. If this box is checked, the bulk pricing discount is applied to any items with bulk pricing as described above.

For example, if we select that checkbox, the GUI looks like this:

Implementation Guidelines:

Your task is to implement the three classes that are used to make this code work:

- Item
- ItemOrder
- Cart



An `Item` object stores information about an individual item. It must have the following public methods. Note that the names (such as *price* and *bulk quantity*) given here are not meant to be the actual parameter names (Checkstyle would complain about them); they're meant to be descriptive.

Method	Description
<code>Item(name, price)</code>	Constructor that takes a name and a price as arguments. The name is a <code>String</code> and the price is a <code>BigDecimal</code> .
<code>Item(name, price, bulk quantity, bulk price)</code>	Constructor that takes a name, a single-item price, a bulk quantity, and a bulk price as arguments. The name is a <code>String</code> , the quantity is an <code>int</code> and the prices are <code>BigDecimal</code> s.
<code>getPrice()</code>	Returns the single item price for this <code>Item</code> . (<code>BigDecimal</code> return type)
<code>getBulkQuantity()</code>	Returns the bulk quantity for this <code>Item</code> . (<code>int</code> return type)
<code>getBulkPrice()</code>	Returns the bulk price for this <code>Item</code> . (<code>BigDecimal</code> return type)
<code>isBulk()</code>	Returns <code>True</code> if the <code>Item</code> has bulk pricing; <code>false</code> otherwise
<code>toString()</code>	Returns a <code>String</code> representation of this <code>Item</code> : name, followed by a comma and a space, followed by price. If the item has a bulk price, you should append an extra space and a parenthesized description of the bulk pricing that has the bulk quantity, the word "for" and the bulk price. See the examples below.
<code>equals(object)</code>	Returns <code>true</code> if the specified object is equivalent to this <code>Item</code> , and <code>false</code> otherwise. Two items are equivalent if they have <i>exactly</i> equivalent names, prices, bulk quantities and bulk prices. This method must properly override <code>java.lang.Object.equals()</code> .
<code>hashCode()</code>	Returns an integer hash code for this item. This method must override <code>java.lang.Object.hashCode()</code> and be consistent with <code>equals()</code> .

The `String` representation of an `Item` must *exactly* match that shown in the screenshots. For example, an `Item` named "X" with a per-item price of \$19.99 and no bulk quantity would have the `String` representation "X, \$19.99" (without the quotes); an item named "X" with a per-item price of \$19.99, a bulk quantity of 5, and a bulk price of \$89.99 would have the `String` representation "X, \$19.99 (5 for \$89.99)" (without the quotes). The format of these `String` representations will be tested.

An `ItemOrder` object stores information about a purchase order for an item: namely, a reference to the item itself and the quantity desired. It must have the following public methods.

Method	Description
<code>ItemOrder(item, quantity)</code>	Constructor that creates an item order for the given quantity of the given <code>Item</code> . The quantity is an <code>int</code> .
<code>getItem()</code>	Returns a reference to the <code>Item</code> in this <code>ItemOrder</code> .
<code>getQuantity()</code>	Returns the quantity for this <code>ItemOrder</code> .
<code>toString()</code>	Returns a <code>String</code> representation of this <code>ItemOrder</code> : You may use any format that seems reasonable to you for this <code>String</code> .

A `Cart` object stores information about the customer's overall purchase. One field must be a collection of some type to hold information about all the `Items` the customer has ordered. (Use a generic collection from the Java Collections Framework. One possible choice, though perhaps not the easiest to work with, is `List<ItemOrder>`). `Cart` class must have the following public methods.

Method	Description
<code>Cart()</code>	Constructor that creates an empty shopping cart.
<code>add(order)</code>	Adds an order to the shopping cart, replacing any previous order for an <i>equivalent</i> item with the new order. The parameter is an <code>ItemOrder</code> . (<code>equals()</code> would return true if used to compare <i>equivalent</i> items) The return type of this method is <code>void</code>
<code>setMembership(value)</code>	Sets whether or not the customer for this shopping cart has a store membership (the parameter is a <code>boolean</code> ; <code>true</code> means the customer has a membership, <code>false</code> means the customer doesn't). The return is <code>void</code> .
<code>calculateTotal()</code>	Returns the total cost of this shopping cart as a <code>BigDecimal</code> . This returned <code>BigDecimal</code> should have scale of 2 and use the <code>ROUND_HALF_EVEN</code> rounding rule.
<code>clear()</code>	Removes all orders from the cart. The return is <code>void</code> .
<code>toString()</code>	Returns a <code>String</code> representation of this <code>Cart</code> : You may use any format that seems reasonable to you for this <code>String</code> .

You *must not* change any method signatures or return types defined in this assignment. (You may change parameter *names* but not parameter data types.) You *must not* introduce any other non-private methods to these classes, although you may add your own *private* helper methods. You must override `toString` in these classes (you may find this helpful for testing and debugging). You are also allowed to override other (non-final) methods declared in `java.lang.Object`, such as `equals` and `hashCode`. If you do, however, your definitions must be reasonable and consistent with each other; if you implement inconsistent `equals` and `hashCode` methods, you will certainly lose points. You *must* override `equals` and `hashCode` for the `Item` class, as described above (this will be tested when I grade your assignment even if you don't use those methods in your own code).

For this assignment, code defensively:

Setters and constructors should test for invalid values.

Throw `IllegalArgumentException` (explicitly) for any of the following conditions: prices passed to your classes are < 0 , quantities passed to your classes are < 0 , `Strings` passed to your classes are empty.

Throw `NullPointerException` (implicitly) for any of the following conditions: `Strings` passed to your classes are `null`, `BigDecimal` objects passed to your classes are `null`, the `Item` passed to the `ItemOrder` constructor is `null`, the `ItemOrder` passed to the `add` method in `Cart` is `null`.

(Of course the behavior for overridden methods from class `Object`, such as the `.equals()` method, are defined in class `Object`.)

You are required to develop unit tests for the `Item` class (it is recommended that you also do this for the `ItemOrder` and `Cart` classes). This will allow you to develop these classes in stages rather than all at once. When you have confidence that your classes are working, you should combine them with the set of classes developed by the instructor to make sure that they are working properly when combined. Place your unit tests in the 'tests' package.

Hints and Suggestions:

As you develop your classes do not code any dependencies based on the current list of items. That is, your classes should still work correctly if the list of items is replaced with an entirely different list of items.

Most of these methods are simple to write, but notice that when you add an `ItemOrder` to a `Cart` you must deal with replacing any old order for an equivalent item. A user might initially request 3 of some item and later change the request to 5 of that item. The order for 5 replaces the order for 3. The user is not requesting 8 of the item when he makes such a change. The add method might be passed an item order with a quantity of 0. This should behave just like the others, replacing any current order for the item.

One technique (which is not the best one, but will certainly work) is to use an `ArrayList` to implement your `Cart`. If you do, the methods you are most likely to be interested in are the following:

Method	Description
<code>ArrayList<T>()</code>	Constructor that creates an empty <code>ArrayList</code> to hold elements of type <code>T</code> .
<code>add(value)</code>	Adds the given value to end of the <code>ArrayList</code> . The parameter type is <code>T</code> , so only the type you specified at construction can be added to the <code>ArrayList</code> .
<code>get(index)</code>	Gets the item at the given index (0-based). The return type is <code>T</code> .
<code>set(index, value)</code>	Sets the entry at the given index to be the given value.
<code>remove(index)</code>	Removes the value at the given index.
<code>toString()</code>	Returns a string representation of the list.
<code>size()</code>	Returns the number of values stored in the list.

In the `Item` class, you need to construct a `String` representation of the price. This is not easy to do for several reasons, but Java provides a convenient built-in class that will do it for you. It is called `NumberFormat` and is part of the `java.text` package (so you need to import `java.text.NumberFormat`). You obtain a number formatter by calling the static method named `getCurrencyInstance()`, as in:

```
NumberFormat nf = NumberFormat.getCurrencyInstance(Locale.US);
```

You can then call the `format` method of this object, passing it the price as a `BigDecimal`, and it will return a `String` with a dollar sign and the price in dollars and cents. For example, you might say:

```
BigDecimal price = BigDecimal.valueOf(38.50);
String text = nf.format(price);
```

This would set the variable `text` to `"$38.50"`. Note that you only need *one* `NumberFormat` reference, and you can use it repeatedly. Do not create a number formatter every time you need to format a number, as that would be wasteful of memory (and would cost you points for redundancy in your implementation). Instead make a single `NumberFormat` reference that can be shared by all `Item` objects. An alternate acceptable way to format the output would be to use the `format()` method of the `String` class.

Your classes are to *exactly* reproduce the format and overall price shown in the two screenshots and described above. You should run the GUI and enter the individual quantities from the screenshots to verify that your classes are working correctly (and / or write a unit test that does so). Note that the values shown in the screenshots are *not* the only values your program will be tested with (and, in fact, the list of items in the screenshots is not the only list of items your classes will be tested with).

NOTE: No console output should appear when running the BookstoreMain program or when running your unit tests.

Stylistic Guidelines:

You will be graded on program style, including the use of descriptive variable names and full Javadoc comments on each method. Note that the class skeletons provided for you have no comments of any kind; adding the comments is a critical part of the assignment. The provided `BookstoreFrame` and `BookstoreMain` classes have full Javadoc comments that would be considered acceptable in a homework submission.

Notice that the provided classes (other than the skeletons you must fill in) have no Checkstyle, FindBugs, PMD, or Metrics warnings. It is generally a good idea to eliminate *all* warnings before submitting your code; if you have questions about what a warning means, and a quick online search doesn't help, ask the instructor as soon as possible (preferably by posting your question on the Canvas discussion forum without posting actual code from your project).

You *must* include a header comment at the beginning of each file with some basic information, in addition to full Javadoc comments. Examples of acceptable file headers (including the class Javadoc comment) appear in Assignment 0 and in the provided `BookstoreFrame` and `BookstoreMain` classes.

Submission and Grading:

Create your Eclipse project by downloading the `hw2-project.zip` file from Canvas, importing it into your workspace (as described for `hw0-project.zip` in Assignment 0), and using “Refactor” to change “username” in the project name to your UWNetID. Remember to make this change *before* you first commit the project to Subversion. As with Assignment 0, incorrectly-named projects will be penalized.

Also, as with Assignment 0, you can use whichever bracket style you like. The provided templates and classes use the same line style; if you switch the line style, execute a “Format” command (in Eclipse’s “Source” menu) for each source file after doing so to change the provided templates and classes.

You must check your Eclipse project into Subversion (following the instructions from Lecture 1 and Assignment 0), including all configuration files that were supplied with it (even if you have not changed them from the ones that were distributed). If you have any questions about this, ask the instructor as soon as possible. When you have checked in the revision of your code you wish to submit, make a note of its Subversion revision number. To get the revision number, *perform an update* on the top level of your project; the revision number will then be displayed next to the project name. Your revision number will pick up where you left off on Assignment 1; if you submitted revision 12 of Assignment 1, the first commit of Assignment 2 will have a number greater than 12. This is because you have a single Subversion repository for all your projects, and the revision number counts revisions to the entire repository.

After checking your project into Subversion, you must submit (on Canvas) an *executive summary*, containing the Subversion revision number of your submission, an “assignment overview” (1 paragraph, up to about 250 words) explaining what you understand to be the purpose and scope of the assignment, and a “technical impression” section (1-2 paragraphs, about 200-500 words) describing your experiences while carrying out the assignment.

The filename for your executive summary must be “**username-bookstore.txt**”, where `username` is your UWNetID. As with the naming convention for your Eclipse project, your assignment will be penalized if it does not follow this naming convention. An executive summary template, which you must use, is available on Canvas. Your executive summary must have a line containing exactly the text “Subversion Revision Number: #”, with no leading spaces, where “#” is the Subversion revision number you made a note of above (with no parentheses or other symbols). Executive summaries without a line following this exact format will be penalized. Executive summaries will *only* be accepted in plain text format – other file formats (RTF, Microsoft Word, Acrobat PDF, Apple Pages) are *not* acceptable. Using an unacceptable file format for the executive summary will result in a reduction in the grade for the assignment.

Part of your program's score will come from its “external correctness.” For this assignment, external correctness is measured by the output generated (correct calculations, correct behavior when values are entered, changed and deleted, correct discount behavior, *etc.*), and is determined by running automated tests on your code.

Another part of your program's score will come from its “internal correctness.” Internal correctness includes meaningful and systematically assigned identifier names, proper encapsulation, avoidance of redundancy, good choices of data representation (though this is not applicable to this assignment), the use of comments on particularly complex code sections, and the inclusion of headers (as described above) on your classes. Internal correctness also includes whether your source code follows the stylistic guidelines discussed in class. This includes criteria such as the presence of Javadoc comments on *every* method and field (even private ones!), the use of variable names, spacing, indentation, and bracket placement specified in the class coding standard, and the absence of certain common coding errors that can be detected by the tools. It is therefore to your advantage to be sure the plugin tools like your code before you submit it.

For this assignment, the percentage breakdown is 10% executive summary, 45% external correctness, 45% internal correctness (Including unit tests of the Item class).