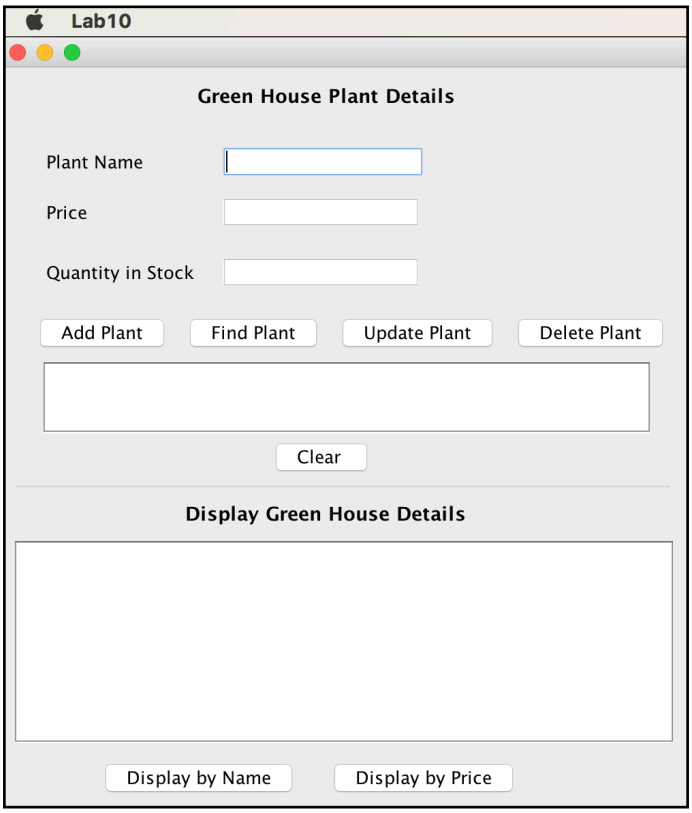
The University of the West Indies, St. Augustine
COMP 2603 Object Oriented Programming 1
2020/2021 Semester 2
Lab 11

In this lab, we will continue with the GUI and a domain class from Lab 10 using TreeSets and HashSets, and the Comparable interface. You may use either Netbeans or the BlueJ IDE for this lab



Part 6: HashSet as a Collection - Duplicates not allowed, unsorted, reliance on hashCode( ) and equals( )

Let's deal with the unwanted duplication of the plants now. We can fix this easily using a different collection - a HashSet. A **HashSet** is backed by a hash table (actually a HashMap instance) and it does not allow duplicate objects to be stored.

1. In the **Nursery** class, change the *dynamic* type of **plants** to **HashSet**. Why can we do this without needing to change any of the code in the **Nursery** class?

   Answer:
   We can do this because the static type of plants is Collection and we mainly used collection methods (except the updatePlant method).

2. Try adding the following plants using the GUI:

   ```
   Plant Name: Aloe, price: 10.00, quantity: 50
   Plant Name: Aloe, price: 10.00, quantity: 50
   ```

   Did it work? Explain what you observe and why it occurs

   Answer:
   If we did not specify an overridden hashCode() method in the Plant class, the collection will allow duplicates. This is because the HashSet collection determines "equality" using that method.

3. Override the **hashCode( )** method in the **Plant** class so that it generates a hash code using the String produced by the toString( ) method. Repeat step 2. What do you observe?

   Answer:

   It did not work because the plants collection is now a HashSet, which does not allow duplicates.

4. Override the **hashCode( )** method in the **Plant** class so that it generates a hash code using the same criteria that is used to test equality in the **equals( )** method. Repeat step 2 again. What do you observe this time? Why must these methods use the same criteria on which to base their functionality?

   Answer:

   It still does not add duplicates; however, this time it determines the duplicate criteria by name only

5. Add a few plants:

```
Plant Name: Aloe, price: 10.00, quantity: 50
Plant Name: Penta, price: 10.00, quantity: 12
Plant Name: Hosta, price: 6.00, quantity: 10
Plant Name: Aloe, price: 10.00, quantity: 50
```

   Click on the **Display by Name** button. Is the list sorted by name? Why not?

Answer:

The list is not sorted because HashSets don't sort elements automatically

Part 7: TreeSet as a Collection - Duplicates not allowed, sorted, reliance on hashCode( ) and equals( ), requirement of Comparable objects

Let's deal with the sorting of the plants by name now. We can fix this easily again using a different collection - a TreeSet. A **TreeSet** does not allow duplicate objects to be stored. The elements are ordered using their natural ordering, or by a `Comparator` provided at set creation time, depending on which constructor is used.

1. In the **Nursery** class, change the *dynamic* type of **plants** to **TreeSet**. Why can we do this again without needing to change any of the code in the **Nursery** class?

Answer:

Because the static type of plants is Collection and we only use collection methods.

2. Try adding the following plants using the GUI:

```
Plant Name: Aloe, price: 10.00, quantity: 50
Plant Name: Aloe, price: 10.00, quantity: 50
```

   Did it work? Explain what you observe and why it occurs.

Answer:

If our Plant class does not implement the Comparable interface, we will encounter a ClassCastException when we try to add items to the TreeSet.

3. Modify the **Plant** class so that it implements the **Comparable** interface. What method are you required to add to the **Plant** class now?

Answer:

We are required to add the compareTo() method

4. Add a **int compareTo(Object obj)** method to the **Plant** class that compares the name of two **Plant** objects and returns 0 if the names are identical, returns 1 if the plant's name is alphabetically higher than the one being compared to, or returns -1 if the plant's name is alphabetically lower than the one being compared to. A **java.lang.IllegalArgumentException( )** should be thrown if a non-Plant object is supplied for comparison.

5. Try adding the following plants using the GUI:

```
Plant Name: Aloe, price: 10.00, quantity: 50
Plant Name: Aloe, price: 10.00, quantity: 50
Plant Name: Penta, price: 10.00, quantity: 12
Plant Name: Hosta, price: 6.00, quantity: 10
```

   Did it work? Why did this work now?

   Answer:
   Yes it worked. Because we specified the criteria to sort elements by in the compareTo method.

6. Click on the **Display by Name** button. Is the list sorted by name? How about if we wanted to make it sorted in descending order instead. What would you change in the compareTo( ) method?

   Answer:
   Yes, the list is sorted by name. We can just negate the current result produced the the compareTo method of the String class to sort in descending order.

Part 8: TreeSet as a Collection - Duplicates not allowed, sorted, reliance on hashCode( ) and equals( ), use of Comparators for sorting

Let's deal with the sorting of the plants by price now. We can do this using a separate Collection to the plants collection, and a **Comparator** class.

1. In the **Nursery** class, create a private inner class called **PriceComparator** that implements the **Comparator** interface. Which method must the **PriceComparator** class provide?

   Answer:
   We must provide the compare() method

2. Write the code for the **compare(..)** method in the **PriceComparator** class with the signature: **public int compare(Object o1, Object o2)**

   The method should compare the prices of two **Plant** objects and return 0 if the prices are identical, return 1 if plant 1's price is larger than plant 2's, or return -1 if the plant 1's price is smaller than plant 2's.
   A **java.lang.IllegalArgumentException( )** should be thrown if a non-Plant object is supplied for comparison.
3. In the **Nursery** class, in **getPlantsByPrice( )** method, create a new **PriceComparator** object. Create a new **TreeSet** collection called **plantsByPrice** that orders elements based on the new **PriceComparator** object. Add all of the elements in the current **plants** collection to the **plantsByPrice** collection. The method should now return the result of invoking the toString( ) method on the **plantsByPrice** collection if it is not empty.

   What does the **getPlantsByPrice( )** method do now?

   Answer:

   It should return the elements from the plant collection sorted by their prices.

4. Try adding the following plants using the GUI:

   ```
   Plant Name: Aloe, price: 10.00, quantity: 50
   Plant Name: Penta, price: 10.00, quantity: 12
   Plant Name: Hosta, price: 6.00, quantity: 10
   ```

   Does everything still work? Try out the Display by Price button. Did it sort by price? Why not? What do you need to do?

   Answer:

   If we did not setup the displaybyprice button's event to trigger some functionality, nothing happens.

5. In the **GreenhouseGUI** class, add functionality so that the **Display by Price** button presents a sorted list (by price) of all the plants (and their details) stored in the collection. This requires code to be added to the **sortByPriceButtonActionPerformed(..)** method that invokes the **getPlantsByPrice( )** on the nursery object and displays the String returned by the in the **displayArea** JTextArea in the GUI.

6. Repeat step 4. Toggle between clicking on the **Display by Price** button and the

Display by Name button. What do you observe? Explain what is happening.

Answer:

Yes it did kinda work and it did sort by price. However, only Penta and Hosta elements were shown.

Alternative fix (recommended by John): To have secondary sorting in the comparator class by name if two elements have the same price.

7. We need to fix the **getPlantsByPrice( )** method so that the new **PriceComparator** object used with a different collection. Delete the **TreeSet** from step 3 and all related code for that object. Create a new **ArrayList** collection called **plantsByPrice** that is initialised with all of the elements in the current **plants** collection.

   TIP: There is a difference between Collection and Collections (plural) interfaces in Java

   Explore the Collections interface for a method that will sort the **ArrayList** using the **PriceComparator**.
   What is the name of this method and how is it invoked?

   Answer:
   We can use the sort method of the Collections class, which takes a List and a comparator object and sorts that list.

   Add code to the **getPlantsByPrice( )** method based on your answer above.

8. Repeat step 4 again. Toggle between clicking on the **Display by Price** button and the **Display by Name** button. What do you observe now?

   Answer:

   It works as expected.

Additional Activities - At Home Practice

- Add code to the application to make the Update Plant button work
- Add code to the application to make the Delete Plant button work.