OOP Model with Inheritance

Overview

In this practical I was asked to create a complicated object orientated model with many subclasses and inheritance in general with different functionality. That functionality being (for parts 1-3):

- Have passengers sign up for activities in which if they are a premium member, they get to for free otherwise take away from their balance and if they are a senior the get a 10% discount. If they cannot afford the cost, then give an error message.
- Printing the itinerary (The destinations a ship will visit and each destinations activities) of a ship as well as the ships name.
- Print a list of passengers on the ship, including their name and number.
- Print a list of all activities on the itinerary that still have space left.
- Print the details of an individual passenger with their name, number, and a list of all activities they are currently signed up for.

For part 4 functionality includes:

- Have a passenger associated with a cabin class
- Ships can print a list of all cabins they have including if the cabin is occupied or not and if so the name and number of the occupant.
- Have passengers save a history of all activities and cruises they have been on and be able to print out that history.

Design

When designing this program, I created a UML class diagram which can be seen here in figure 1:

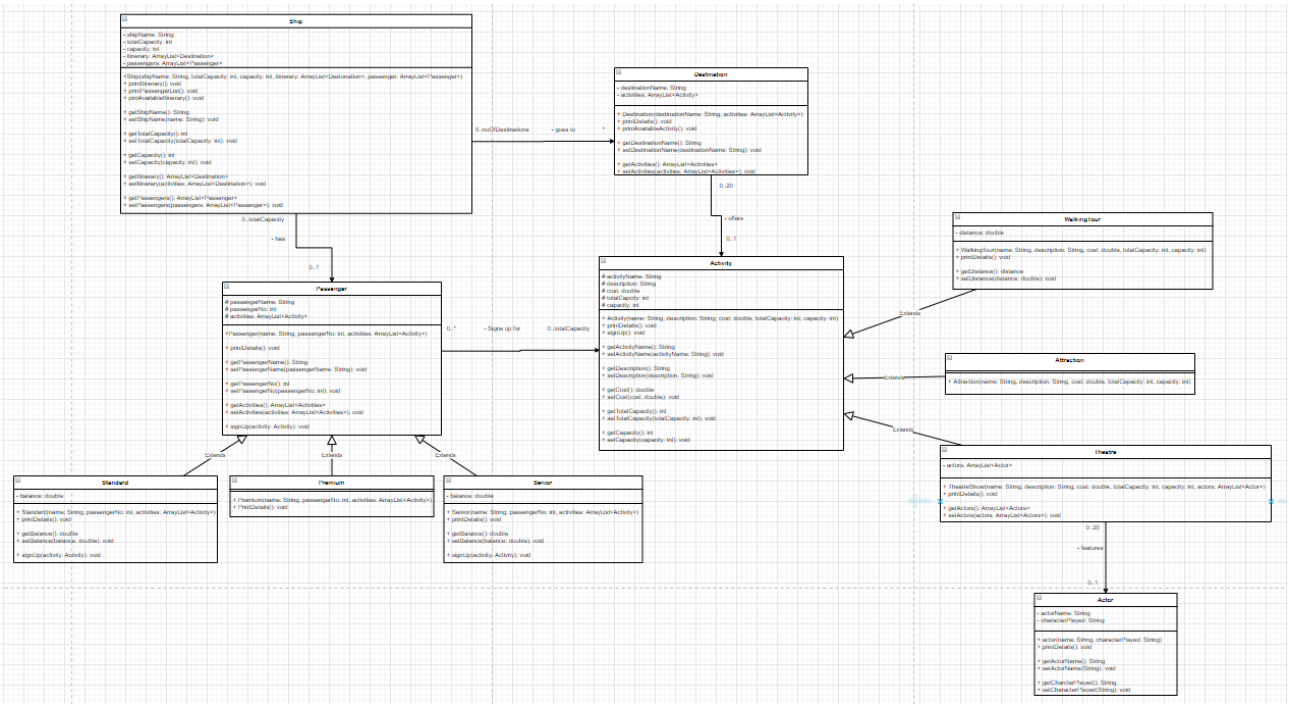

Figure 1: Parts 1-3 UML Class Diagram

In this figure it is difficult to see the exact details of each class, but you can see the general structure of the system.

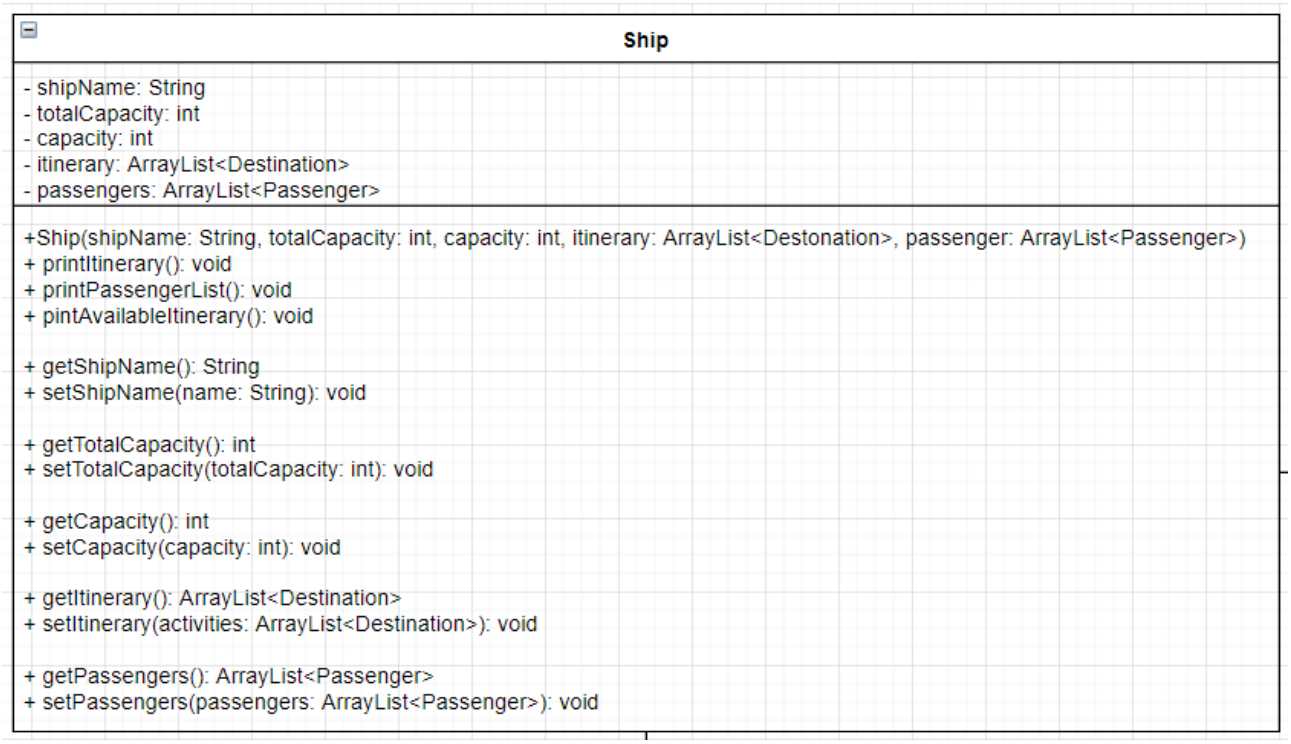

Figure 2: The Ship class in UML

Here in figure 2 we see the attributes and methods of the Ship class. The attributes include the ships name, its total capacity, and the current capacity. The types of these are fairly self explanatory however for the itinerary and passenger list use the java util type ArrayList which I chose so the size of the array of objects could vary as you will not necessarily know how large it is at all times. It also just adds robustness to the program, leading to less errors. For the methods of this class I have the simple constructor that instantiates all attributes and getter/ setter methods for each of said attributes. There are three more methods which print the itinerary (by looping through the itinerary array and calling its print details method), print the passenger list (again looping through the array list but using the passengers get method to print only their name and number) and to print the available itinerary (which is very similar to the print itinerary method except calling the print available activities method from the destination class).

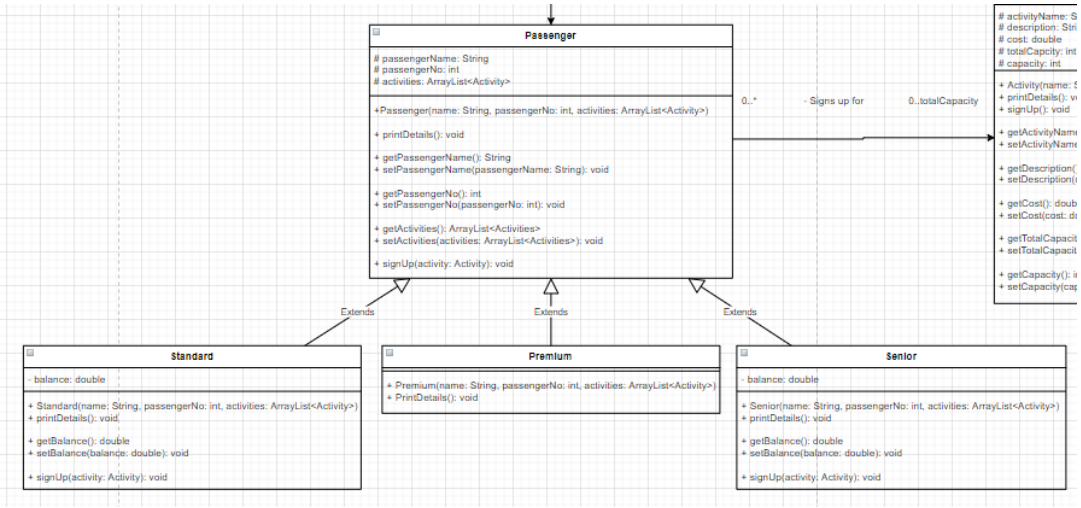

Figure 3: Passenger Class and its various subclasses in UML

Here in figure 3 is the passenger classes and their various subclasses. The passenger superclass contains the passengers name, number, and an array list of the activities they have signed up for. The super class has a constructor that instantiates everything and getter and setter methods. There is also a method that prints the name of the passenger, their number and, using a for loop, the activities they have signed up for. There is also a sign-up method which takes an activity object as a parameter. This method checks if said activity has space left and if so, add the activity to the passenger's array list of activities and also calls the method in the activity class that decrements the current capacity by one.

Then the three subclasses, Standard, Senior and Premium. The premium subclass isn't really worth mentioning as all it includes is a constructor that just calls the super class's constructor and an overridden print details method that calls the super class version but also includes a statement saying the passenger is premium.

The standard subclass includes an extra attribute: the balance as normal passengers must pay for the activities. The only other differences are whit a new get and set method for balance a constructor that calls the super class's constructor but includes balance and an overridden print details and sign up method. For print details they just also print the passengers current balance as well as the inherited attributes and the sign up method doesn't use the super class's method as they need to check if the passenger can afford to sign up an then deduct that cost from the balance. The standard and senior classes are the exact same code and design wise except for the fact that all payments the senior has gets a 10% discount on the cost of activities.

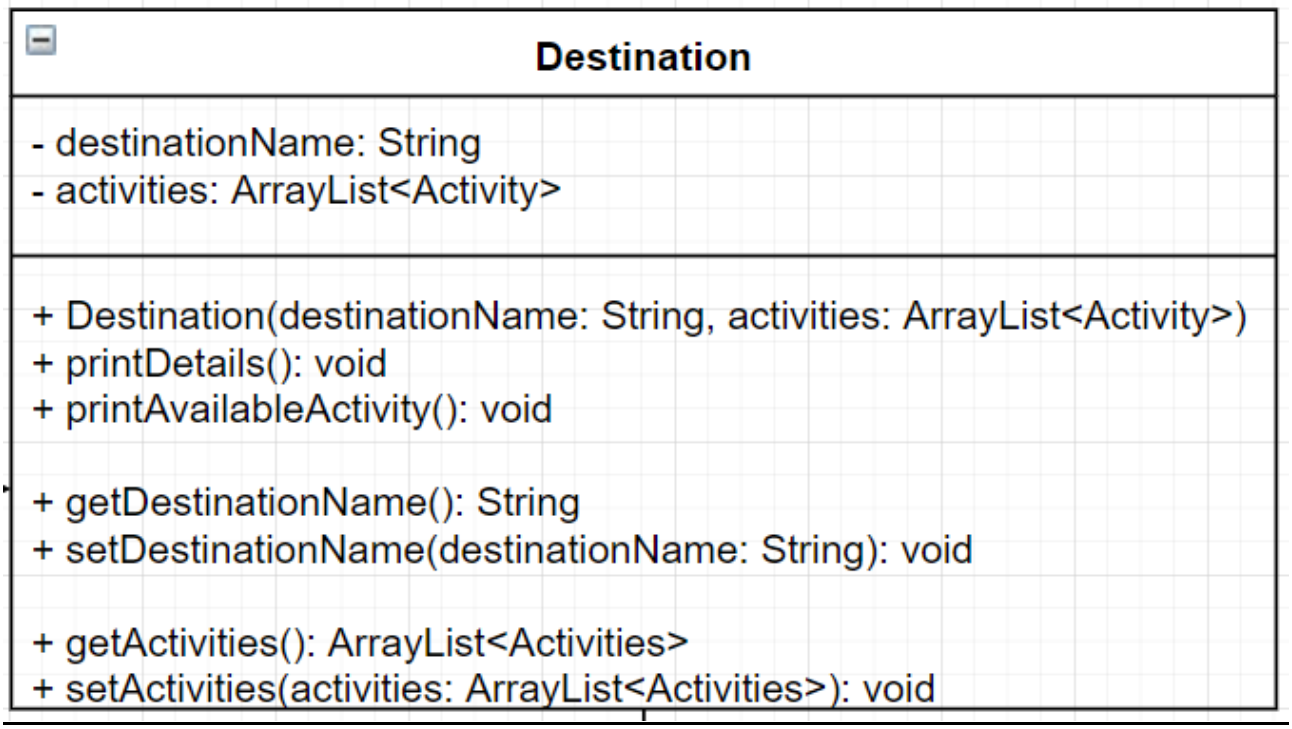

Figure 4: The destination class in UML

In figure 4 we see the destination class which has its name and an array list of the activities featured at said destination. For methods we have another constructor and getter and setter methods. There is also a print details method which gets called by the ship class which prints

the destinations name and, using a for loop, the details of the activities it features. It also has a method that prints the details of all its activities if they have space left.

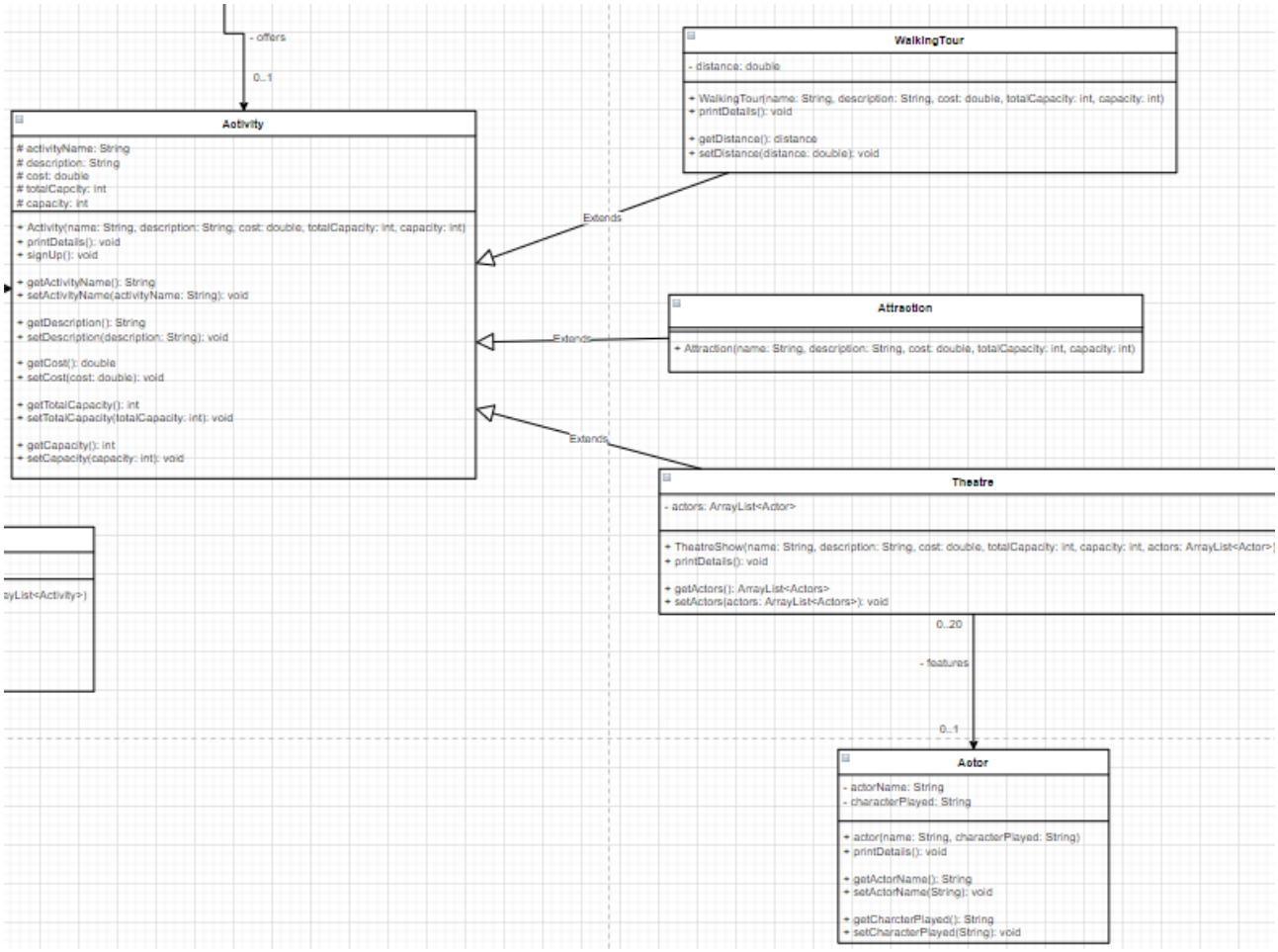

Figure 5: The activity class with its subclasses and the Actor class in UML

Finally, for parts 1-3 there is the activity class which can be seen along with its various subclasses in figure 5. The activity class has attributes for its name, description, cost to book, total capacity, and current capacity. It has a basic constructor like every other class and getter and setter methods. It also has a sign-up method which just decrements the capacity, which is called by the passenger class. It has a basic print details method that does not have a for loop or anything.

Now there are three subclasses: Attraction, Walking Tour and Theatre. Starting with attraction being very basic only including a constructor much like the premium class to the passenger. Then walking tour includes a new attribute for the distance the walk will be. It includes a get and set method for the new attribute with a basic constructor utilising the super class's constructor and an overridden print details method that again uses the super class's print method but also includes the distance.

The theatre class is more interesting as it too has a new attribute. However, that new attribute is an array list of the actor class that stores the actors who act in the play. When it comes to methods it is the same as the walking tour subclass but instead of distance it is the actor list, and it needs a for loop to print the actor's details. The actor class has a basic constructor, attributes for the actor's name and character played and getter setter methods for these attributes. And a print details method as well.

Now for part four's design the program was extended to include a new class and subclass as well as some new attributes and methods to existing classes. The full UML class diagram can be seen below in figure 6:

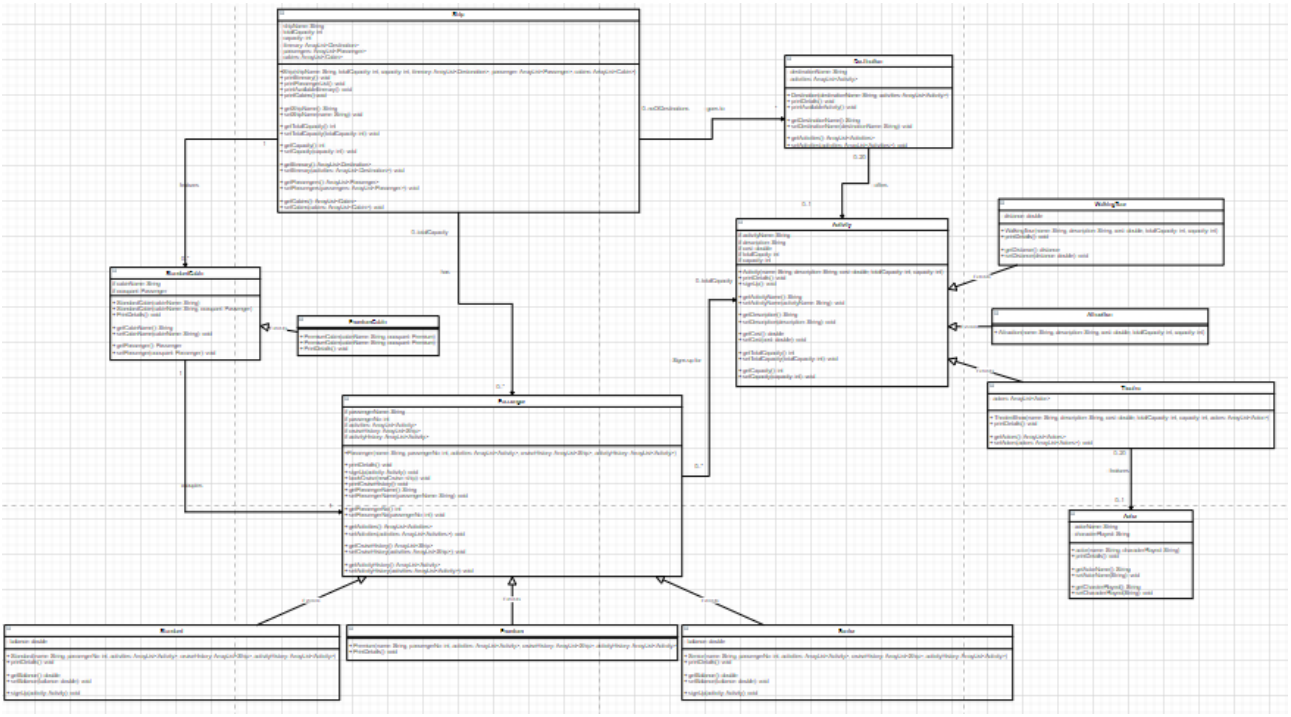

Figure 6: Part 4 UML Class Diagram

However, the only things changed were the new classes and the Ship and Passenger Classes (along with the passengers' subclasses). First the new class and subclass: Standard Cabin and Premium Cabin (a subclass of standard cabin) Seen below in figure 7:

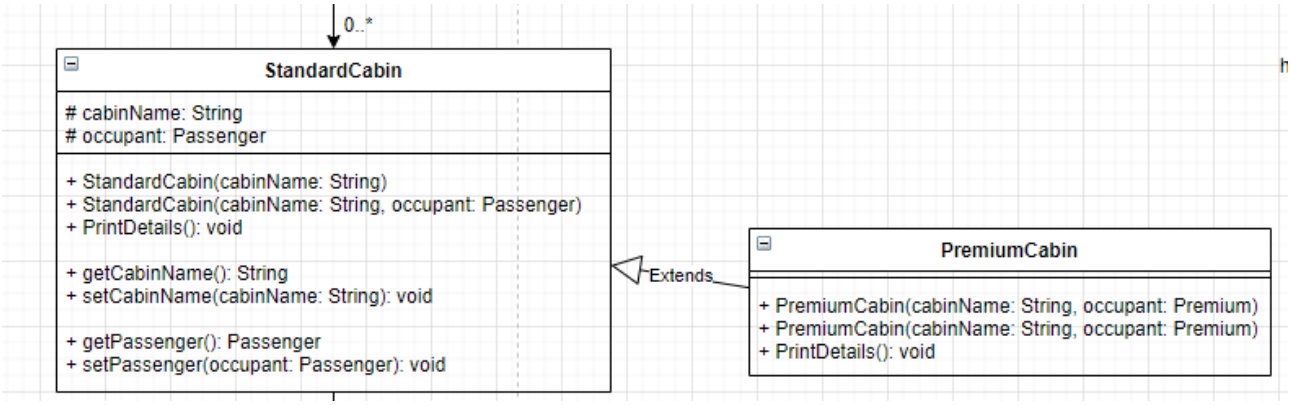

Figure 7: The Standard Cabin and Premium Cabin classes in UML

The standard cabin class has a name attribute and a passenger attribute for who is staying in the room. It has two constructors: one for a cabin with no occupant and one with all attributes instantiated. There is also getter and setter methods as well. Finally, there is a print details method which prints the cabin name then checks to see if the occupant attribute is null, if not display the occupant and if so, then print the statement the room is unoccupied. Then the premium subclass has its own version of those constructors except only takes premium passengers in and a print details method that prints the same as the super class's print method but also includes the statement that the room is premium.

The ship class was changed to include a new attribute: cabins. It is an array list to store cabin objects. The constructor was appropriately updated along with getter and setter methods. There is also a new method which goes through the array to print the details of each cabin.

Finally, the passenger class and its subclasses were changed to include 2 new attributes and 2 new methods. The new attributes being an array list of ships and an array list of activities. These are used to keep a history of what cruises passengers have been on and what activities they have signed up for. So first the constructors were updated to include these new attributes along with get and set methods. The new methods are book cruise which are passed a ship object. This method adds the ship objects to the cruise history list. The other method prints the cruise history and activity history with for loops. The sign-up method was also updated to add the current activity to the activity history array list.

Testing

When it comes to testing there was no stacscheck tests for me to use. So, I designed 3 for parts 1-3 and 2 for part 4. The 3 tests are mainly described in the commentary of the test code, but I will still summarise it here along with provide the results of said tests. In all tests a variety of objects from every class made in both parts of this practical are used.

The first test of parts 1-3, creates objects giving them attributes and tests the print itinerary and print passenger methods to see if the print all activities and passengers. The results were successful and can be seen below:

```
The ships name is Titanic
Destinations:
Destination Name: barcelona
Activities:
Activity name: Romeo and Juliet
Description of activity: An amazing two person performance of Romeo and Juliet
Activity cost: 10.0
Activity total capacity:0
Activity current capacity: 46
Cast List:
Jeremy Cooper plays Romeo
Alexandra Froll plays Juliet
Activity name: Tea Cups
Description of activity: A classic tea cup ride for kids
Activity cost: 2.0
Activity total capacity:0
Activity current capacity: 4
Activity name: Barcelona Walking Tour
Description of activity: A lovely walk around barcelona
Activity cost: 20.0
Activity total capacity:0
Activity current capacity: 10
Distance of walk: 20.0
Destination Name: Rome
Activities:
Activity name: Hamlet
Description of activity: A classic production of Hamlet
Activity cost: 7.0
Activity total capacity:0
Activity current capacity: 2
Cast List:
John Smithsonian plays Hamlet
Laura Ming plays Claudia
Lauren Ping plays Ophelia
Cameron Davis plays Gertrude
Activity name: Rome Collaseum Tour
Description of activity: Walk around the historic collaseum
Activity cost: 50.0
Activity total capacity:0
Activity current capacity: 24
Distance of walk: 10.0

The ships name is Titanic
Passengers:
Passenger name: John Johnson
Passenger number: 1
Passenger name: Alexa Amazon
Passenger number: 2
Passenger name: Carl Carlson
Passenger number: 3
```

Figure 8: Result of test 1 from parts 1-3

The second test again creates objects giving them attributes but instead tests the sign-up method by creating various activity methods and signs multiple passengers up to them. One of which they cannot afford. Then prints the details of each passenger to see if the signup worked correctly. Again, the results were successful and can be seen below:

```
Passenger Name: John Johnson
Passenger Number: 1
Activities John Johnson has signed up for:
Activity name: Romeo and Juliet
Description of activity: An amazing two person performance of Romeo and Juliet
Activity cost: 10.0
Activity total capacity:0
Activity current capacity: 44
Cast List:
Jeremy Cooper plays Romeo
Alexandra Froll plays Juliet
Activity name: Barcelona Walking Tour
Description of activity: A lovely walk around barcelona
Activity cost: 20.0
Activity total capacity:0
Activity current capacity: 9
Distance of walk: 20.0
Activity name: Hamlet
Description of activity: A classic production of Hamlet
Activity cost: 7.0
Activity total capacity:0
Activity current capacity: 1
Cast List:
John Smithsonian plays Hamlet
Laura Ming plays Claudia
Lauren Ping plays Ophelia
Cameron Davis plays Gertrude
Activity name: Romeo and Juliet
Description of activity: An amazing two person performance of Romeo and Juliet
Activity cost: 10.0
Activity total capacity:0
Activity current capacity: 44
Cast List:
Jeremy Cooper plays Romeo
Alexandra Froll plays Juliet
Activity name: Tea Cups
Description of activity: A classic tea cup ride for kids
Activity cost: 2.0
Activity total capacity:0
Activity current capacity: 3
Activity name: Rome Collaseum Tour
Description of activity: Walk around the historic collaseum
Activity cost: 50.0
Activity total capacity:0
Activity current capacity: 23
Distance of walk: 10.0
Passenger balance: 63.0
```

```
Passenger Name: Alexa Amazon
Passenger Number: 2
Activities Alexa Amazon has signed up for:
Activity name: Romeo and Juliet
Description of activity: An amazing two person performance of Romeo and Juliet
Activity cost: 10.0
Activity total capacity:0
Activity current capacity: 44
Cast List:
Jeremy Cooper plays Romeo
Alexandra Froll plays Juliet
Activity name: Barcelona Walking Tour
Description of activity: A lovely walk around barcelona
Activity cost: 20.0
Activity total capacity:0
Activity current capacity: 9
Distance of walk: 20.0
Activity name: Hamlet
Description of activity: A classic production of Hamlet
Activity cost: 7.0
Activity total capacity:0
Activity current capacity: 1
Cast List:
John Smithsonian plays Hamlet
Laura Ming plays Claudia
Lauren Ping plays Ophelia
Cameron Davis plays Gertrude
Activity name: Romeo and Juliet
Description of activity: An amazing two person performance of Romeo and Juliet
Activity cost: 10.0
Activity total capacity:0
Activity current capacity: 44
Cast List:
Jeremy Cooper plays Romeo
Alexandra Froll plays Juliet
Activity name: Tea Cups
Description of activity: A classic tea cup ride for kids
Activity cost: 2.0
Activity total capacity:0
Activity current capacity: 3
Activity name: Rome Collaseum Tour
Description of activity: Walk around the historic collaseum
Activity cost: 50.0
Activity total capacity:0
Activity current capacity: 23
Distance of walk: 10.0
This passenger has a senior discount
Passenger balance: 39.2
```

```
This passenger has a premium membership
Passenger Name: Carl Carlson
Passenger Number: 3
Activities Carl Carlson has signed up for:
Activity name: Romeo and Juliet
Description of activity: An amazing two person performance of Romeo and Juliet
Activity cost: 10.0
Activity total capacity:0
Activity current capacity: 44
Cast List:
Jeremy Cooper plays Romeo
Alexandra Froll plays Juliet
Activity name: Barcelona Walking Tour
Description of activity: A lovely walk around barcelona
Activity cost: 20.0
Activity total capacity:0
Activity current capacity: 9
Distance of walk: 20.0
Activity name: Hamlet
Description of activity: A classic production of Hamlet
Activity cost: 7.0
Activity total capacity:0
Activity current capacity: 1
Cast List:
John Smithsonian plays Hamlet
Laura Ming plays Claudia
Lauren Ping plays Ophelia
Cameron Davis plays Gertrude
Activity name: Romeo and Juliet
Description of activity: An amazing two person performance of Romeo and Juliet
Activity cost: 10.0
Activity total capacity:0
Activity current capacity: 44
Cast List:
Jeremy Cooper plays Romeo
Alexandra Froll plays Juliet
Activity name: Tea Cups
Description of activity: A classic tea cup ride for kids
Activity cost: 2.0
Activity total capacity:0
Activity current capacity: 3
Activity name: Rome Collaseum Tour
Description of activity: Walk around the historic collaseum
Activity cost: 50.0
Activity total capacity:0
Activity current capacity: 23
Distance of walk: 10.0
```

Figure 9, 10 & 11: Results from the second test in parts 1-3

The final test for parts 1-3, tests to see if an activity has no space left does not display in the print available itinerary method. The results here were again successful and can be seen below:

```
Sorry there are no longer any spaces left on this activity. Please try again later or with another activity.
Activities with spaces still available:
Activity name: Romeo and Juliet
Description of activity: An amazing two person performance of Romeo and Juliet
Activity cost: 10.0
Activity total capacity:0
Activity current capacity: 46
Cast List:
Jeremy Cooper plays Romeo
Alexandra Froll plays Juliet
Activity name: Barcelona Walking Tour
Description of activity: A lovely walk around barcelona
Activity cost: 20.0
Activity total capacity:0
Activity current capacity: 10
Distance of walk: 20.0
Activity name: Hamlet
Description of activity: A classic production of Hamlet
Activity cost: 7.0
Activity total capacity:0
Activity current capacity: 2
Cast List:
John Smithsonian plays Hamlet
Laura Ming plays Claudia
Lauren Ping plays Ophelia
Cameron Davis plays Gertrude
```

Figure 12: Test result of the 3rd test of parts 1 - 3

For the first test of part 4, simply creates many objects including cabin objects and tests the print cabins method. The results were successful and can be seen below:

```
Cabin name: A1
Room is unnoccupied
Cabin name: A1
Room is unnoccupied
Cabin name: A1
Room is unnoccupied
```

Figure 13: Test result of the first test of part 4

The second test tests the cruise history and activity history by again creating many objects and then using the book methods and print cruise history methods. The results can be seen here and were successful:

```
Ship name 0: Titanic
Ship capacity 0: 100
Ship name 1: The De La Cruise
Ship capacity 1: 100
Ship name 2: Titanic
Ship capacity 2: 100
Ship name 3: The De La Cruise
Ship capacity 3: 100
Ship name 4: Titanic
Ship capacity 4: 100
Ship name 5: The De La Cruise
Ship capacity 5: 100

Activity name: Romeo and Juliet
Description of activity: An amazing two person performance of Romeo and Juliet
Activity cost: 10.0
Activity total capacity:0
Activity current capacity: 44
Cast List:
Jeremy Cooper plays Romeo
Alexandra Froll plays Juliet

Activity name: Barcelona Walking Tour
Description of activity: A lovely walk around barcelona
Activity cost: 20.0
Activity total capacity:0
Activity current capacity: 9
Distance of walk: 20.0

Activity name: Hamlet
Description of activity: A classic production of Hamlet
Activity cost: 7.0
Activity total capacity:0
Activity current capacity: 1
Cast List:
John Smithsonian plays Hamlet
Laura Ming plays Claudia
Lauren Ping plays Ophelia
Cameron Davis plays Gertrude

Activity name: Romeo and Juliet
Description of activity: An amazing two person performance of Romeo and Juliet
Activity cost: 10.0
Activity total capacity:0
Activity current capacity: 44
Cast List:
Jeremy Cooper plays Romeo
Alexandra Froll plays Juliet
```

```
Activity name: Tea Cups
Description of activity: A classic tea cup ride for kids
Activity cost: 2.0
Activity total capacity:0
Activity current capacity: 3

Activity name: Rome Collaseum Tour
Description of activity: Walk around the historic collaseum
Activity cost: 50.0
Activity total capacity:0
Activity current capacity: 23
Distance of walk: 10.0

Activity name: Rome Collaseum Tour
Description of activity: Walk around the historic collaseum
Activity cost: 50.0
Activity total capacity:0
Activity current capacity: 23
Distance of walk: 10.0
Ship name 0: Titanic
Ship capacity 0: 100
Ship name 1: The De La Cruise
Ship capacity 1: 100
Ship name 2: Titanic
Ship capacity 2: 100
Ship name 3: The De La Cruise
Ship capacity 3: 100
Ship name 4: Titanic
Ship capacity 4: 100
Ship name 5: The De La Cruise
Ship capacity 5: 100

Activity name: Romeo and Juliet
Description of activity: An amazing two person performance of Romeo and Juliet
Activity cost: 10.0
Activity total capacity:0
Activity current capacity: 44
Cast List:
Jeremy Cooper plays Romeo
Alexandra Froll plays Juliet

Activity name: Barcelona Walking Tour
Description of activity: A lovely walk around barcelona
Activity cost: 20.0
Activity total capacity:0
Activity current capacity: 9
Distance of walk: 20.0
```

```
Activity name: Hamlet
Description of activity: A classic production of Hamlet
Activity cost: 7.0
Activity total capacity:0
Activity current capacity: 1
Cast List:
John Smithsonian plays Hamlet
Laura Ming plays Claudia
Lauren Ping plays Ophelia
Cameron Davis plays Gertrude

Activity name: Romeo and Juliet
Description of activity: An amazing two person performance of Romeo and Juliet
Activity cost: 10.0
Activity total capacity:0
Activity current capacity: 44
Cast List:
Jeremy Cooper plays Romeo
Alexandra Froll plays Juliet

Activity name: Tea Cups
Description of activity: A classic tea cup ride for kids
Activity cost: 2.0
Activity total capacity:0
Activity current capacity: 3

Activity name: Rome Collaseum Tour
Description of activity: Walk around the historic collaseum
Activity cost: 50.0
Activity total capacity:0
Activity current capacity: 23
Distance of walk: 10.0

Activity name: Rome Collaseum Tour
Description of activity: Walk around the historic collaseum
Activity cost: 50.0
Activity total capacity:0
Activity current capacity: 23
Distance of walk: 10.0
Ship name 0: Titanic
Ship capacity 0: 100
Ship name 1: The De La Cruise
Ship capacity 1: 100
Ship name 2: Titanic
Ship capacity 2: 100
Ship name 3: The De La Cruise
Ship capacity 3: 100
Ship name 4: Titanic
Ship capacity 4: 100
Ship name 5: The De La Cruise
Ship capacity 5: 100
```

```
Activity name: Romeo and Juliet
Description of activity: An amazing two person performance of Romeo and Juliet
Activity cost: 10.0
Activity total capacity:0
Activity current capacity: 44
Cast List:
Jeremy Cooper plays Romeo
Alexandra Froll plays Juliet

Activity name: Barcelona Walking Tour
Description of activity: A lovely walk around barcelona
Activity cost: 20.0
Activity total capacity:0
Activity current capacity: 9
Distance of walk: 20.0

Activity name: Hamlet
Description of activity: A classic production of Hamlet
Activity cost: 7.0
Activity total capacity:0
Activity current capacity: 1
Cast List:
John Smithsonian plays Hamlet
Laura Ming plays Claudia
Lauren Ping plays Ophelia
Cameron Davis plays Gertrude

Activity name: Romeo and Juliet
Description of activity: An amazing two person performance of Romeo and Juliet
Activity cost: 10.0
Activity total capacity:0
Activity current capacity: 44
Cast List:
Jeremy Cooper plays Romeo
Alexandra Froll plays Juliet

Activity name: Tea Cups
Description of activity: A classic tea cup ride for kids
Activity cost: 2.0
Activity total capacity:0
Activity current capacity: 3

Activity name: Rome Collaseum Tour
Description of activity: Walk around the historic collaseum
Activity cost: 50.0
Activity total capacity:0
Activity current capacity: 23
Distance of walk: 10.0

Activity name: Rome Collaseum Tour
Description of activity: Walk around the historic collaseum
Activity cost: 50.0
Activity total capacity:0
Activity current capacity: 23
Distance of walk: 10.0
```

Figures 14, 15, 16 & 17 The test results of the final test of part 4

Research

There are many other types of UML diagrams used for various other purposes. One of those being a Component Diagram which shows different components relate to interfaces. There are quite like Class Diagrams but provides a lot more detail (Nishadha, 2020). There is also Use Case Diagrams. Like object diagrams in which they show how users and other parts of the system interact with each other but using a specific use case. The main difference between use case and object/class diagrams is the presence of actors which are external components or even real people that interact with the system in some way (Nishadha, UML Diagram Types Guide: Learn About All Types of UML Diagrams with Examples, 2020).

Evaluation

Overall, I think my program I great as it follows the specification well and throughout testing has been seen to be quite robust with using the array list type to create arrays of objects with variable sizes. The code is very readable with appropriate whitespace and commentary. Though I do think some of the attribute names could be clearer but that was to make it easier to code and not make lines incredibly long.

Conclusion

In conclusion I found this practical rather enjoyable. I do not think it was difficult considering the previous practical and the fact that this is the last practical of the semester. It was still an engaging practical that I must carefully consider as I was working though due to the nature and scope of the system itself.

References

Nishadha. (2020, 11 27). *UML Diagram Types Guide: Learn About All Types of UML Diagrams with Examples*. Retrieved from Creately: https://creately.com/blog/diagrams/uml-diagram-types-examples/#ComponentDiagram

Nishadha. (2020, 11 27). *UML Diagram Types Guide: Learn About All Types of UML Diagrams with Examples*. Retrieved from Creately: https://creately.com/blog/diagrams/uml-diagram-types-examples/#UseCaseDiagram