**Home exercise 1 (Programming)**

**Course name: Object oriented programming and design for engineering**

**Course number: 157109**

**Subject: Interfaces**

The goal of this exercise is to make sure you are on the same page for subjects like Java programming, inheritance, interfaces and polymorphism.

**Part 1 (Introduction): Interface definition**

Below is a code segment with no errors in it:

public static void main(String[] args)

{

int x;

String y;

C b1 = new B();

A[] arrA = new A[3];

arrA[0] = new B(x, y);

arrA[1] = new B();

arrA[2] = new C();

arrA[0].f();

arrA[0].g();

arrA[0].h();

}

**Section A**

Write class *A* fully assuming that it is an interface.

**Section B**

Write classes *B* and *C*.

Do not implement the classes’ methods, only write their signatures.

If the classes have attributes, write them as well.

**Section C**

Draw a UML diagram which displays the exact relations between *A*, *B* and *C*.

Explain the basis for deducing these relations. Are other relations possible?

**Section D**

Can *C* be an interface? If so, write it as an interface. If not, explain why.

**Part 2 (programming): Plane and train system**

Write a program that simulates an airport's information system. The information system will allow the user to receive information about plane and train traffic between airports.

The system includes the following enum which denotes location:

public enum Location {

Jerusalem, Paris, NewYork,London, Rome, Barcelona, Madrid, Copenhagen, Helsinki, Bordeaux

}

**The Plane class**

This class defines an object of type “Plane” and implements the Movable and Comparable interfaces (Movable's definition is supplied). The plane's properties are:

1. The plane's license number
2. Its route’s point of origin (Location)
3. The destination (Location)
4. Maximal flight altitude (between 0 and 1500)

The plane's actions which implement the interfaces are:

1. *compareTo* compares the maximal flight altitude between objects
2. *move* switches between the origin and destination
3. *getType* returns the string “Plane”
4. *getSource*, *getDestination* return the origin and destination, respectively.
5. *getCurrentLocation* returns the current city in which the plane is located, for example “Paris”

The Train class

This class defines an object of type “Train” and implements the Movable and Comparable interfaces. The train's properties are:

1. The train's license number
2. Its route’s point of origin (Location)
3. The destination (Location)
4. The number of stations on the route (between 1 and 5)
5. The current station number (starts at 0)
6. The maximal number of passengers (between 0 and 500).

The train's actions which implement the interfaces are:

1. *compareTo* compares the maximal number of passengers between objects
2. *move* increases the current station number by 1. If the train arrives at its destination (the current station number equals the train’s number of stations), it switches between the origin and destination and resets the station number.
3. *getType* returns the string “Train”
4. *getSource*, *getDestination* return the origin and destination, respectively.
5. *getCurrentLocation*, if the train is at station 0, returns the current city in which the train is located, for example “Paris”. Otherwise it returns the current station, for example:

"station 1 between Copenhagen and Bordeaux"

**The AirportUtil class**

This is a service class which includes static methods which allow the user to sort various vehicles and produces reports about their movement in the airport. You should implement the following interface:

|  |  |
| --- | --- |
| **The method’s description** | **The method’s signature** |
| Sorts an array of objects of type Comparable according to the “comparison key” defined for them | static void sortTransport(Comparable[] transport) |
| Returns a string for all objects of type Movable in the supplied array (see example below) | static String reportAll (Movable[] movable) |

In order to implement the *sortTransport*() method, use the static method *sort*(Object[] a) of the *Arrays* class as described is in the [Java API](https://docs.oracle.com/javase/8/docs/api/java/util/Arrays.html).

1. Complete and test the Plane class
2. Complete and test the Train class
3. Complete and test the AirportUtil class

After you have written the three classes, test them with the code appearing in the AirportUtilTest.

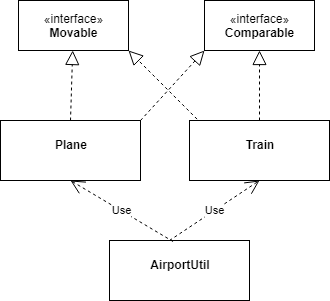
**Make sure you completed all the places marked with TODO!**

1. Theoretical question: What would happen if we initialized an array of Comparable with planes and trains and called *sortTransport* on it? Explain! During the course we will learn how to handle this issue.

You are supplied with a skeleton for the project. You should complete the classes Plane, Train, AirportUtil and submit and verify them through the VPL component. You are also required to fill the file with the submitters' names and IDs. In addition your submission should contain a pdf file which includes the students’ details and the answers for part 1 and section D of part 2. The pdf file will be named based on the submitter’s ID number (for example 12346\_1235.pdf). Make sure you have read the general instruction file for programming exercises and that your exercise meets the instructions.

Good luck!

Appendix 1: The types of relations used in the program are described in the following diagram:



Appendix 2: Below are segments from the expected output. Use this example and the automatic checker in order to have the full details on the requirements. Note, the following segments should appear in **exactly** the same way in your program (an exercise whose output will appear differently, even if only in things like spacing or punctuation marks, will not be graded 0). We used a seed which fixes the randomly generated values. Grading will be done with a different seed.

Enter seed:

2

Details about Train number 1

licence = 6108, source = NewYork, destination = Jerusalem, station = 0, maxPassengers = 389

Details about Train number 2

licence = 3350, source = Madrid, destination = Bordeaux, station = 0, maxPassengers = 68

Details about Train number 3

licence = 94, source = Madrid, destination = Rome, station = 0, maxPassengers = 14

Details about Train number 4

licence = 416, source = Copenhagen, destination = Bordeaux, station = 0, maxPassengers = 231

Details about Train number 5

licence = 6678, source = Copenhagen, destination = Bordeaux, station = 0, maxPassengers = 256

Details about Plane number 1

licence = 6214, source = NewYork, destination = Barcelona, maxHeight = 1053

Details about Plane number 2

licence = 5362, source = Bordeaux, destination = Madrid, maxHeight = 307

Details about Plane number 3

licence = 7150, source = Jerusalem, destination = Rome, maxHeight = 1497

Details about Plane number 4

licence = 2615, source = Copenhagen, destination = Helsinki, maxHeight = 902

Details about Plane number 5

licence = 155, source = Helsinki, destination = Bordeaux, maxHeight = 342

---Sorting trains...---

Train 94 going from Madrid to Rome. Currently in Madrid

Train 3350 going from Madrid to Bordeaux. Currently in Madrid

Train 416 going from Copenhagen to Bordeaux. Currently in Copenhagen

Train 6678 going from Copenhagen to Bordeaux. Currently in Copenhagen

Train 6108 going from NewYork to Jerusalem. Currently in NewYork

---Sorting planes...---

Plane 5362 going from Bordeaux to Madrid. Currently in Bordeaux

Plane 155 going from Helsinki to Bordeaux. Currently in Helsinki

Plane 2615 going from Copenhagen to Helsinki. Currently in Copenhagen

Plane 6214 going from NewYork to Barcelona. Currently in NewYork

Plane 7150 going from Jerusalem to Rome. Currently in Jerusalem

---All together...---

Train 94 going from Madrid to Rome. Currently in Madrid

Plane 5362 going from Bordeaux to Madrid. Currently in Bordeaux

Train 3350 going from Madrid to Bordeaux. Currently in Madrid

Plane 155 going from Helsinki to Bordeaux. Currently in Helsinki

Train 416 going from Copenhagen to Bordeaux. Currently in Copenhagen

Plane 2615 going from Copenhagen to Helsinki. Currently in Copenhagen

Train 6678 going from Copenhagen to Bordeaux. Currently in Copenhagen

Plane 6214 going from NewYork to Barcelona. Currently in NewYork

Train 6108 going from NewYork to Jerusalem. Currently in NewYork

Plane 7150 going from Jerusalem to Rome. Currently in Jerusalem

---All together after move...---

Train 94 going from Madrid to Rome. Currently in station 1 between Madrid and Rome.

Plane 5362 going from Madrid to Bordeaux. Currently in Madrid

Train 3350 going from Madrid to Bordeaux. Currently in station 1 between Madrid and Bordeaux.

Plane 155 going from Bordeaux to Helsinki. Currently in Bordeaux

Train 416 going from Bordeaux to Copenhagen. Currently in Bordeaux

Plane 2615 going from Helsinki to Copenhagen. Currently in Helsinki

Train 6678 going from Copenhagen to Bordeaux. Currently in station 1 between Copenhagen and Bordeaux.

Plane 6214 going from Barcelona to NewYork. Currently in Barcelona

Train 6108 going from NewYork to Jerusalem. Currently in station 1 between NewYork and Jerusalem.

Plane 7150 going from Rome to Jerusalem. Currently in Rome

---All together after move...---

Train 94 going from Madrid to Rome. Currently in station 2 between Madrid and Rome.

Plane 5362 going from Bordeaux to Madrid. Currently in Bordeaux

Train 3350 going from Madrid to Bordeaux. Currently in station 2 between Madrid and Bordeaux.

Plane 155 going from Helsinki to Bordeaux. Currently in Helsinki

Train 416 going from Copenhagen to Bordeaux. Currently in Copenhagen

Plane 2615 going from Copenhagen to Helsinki. Currently in Copenhagen

Train 6678 going from Copenhagen to Bordeaux. Currently in station 2 between Copenhagen and Bordeaux.

Plane 6214 going from NewYork to Barcelona. Currently in NewYork

Train 6108 going from NewYork to Jerusalem. Currently in station 2 between NewYork and Jerusalem.

Plane 7150 going from Jerusalem to Rome. Currently in Jerusalem

---All together after move...---

Train 94 going from Madrid to Rome. Currently in station 3 between Madrid and Rome.

Plane 5362 going from Madrid to Bordeaux. Currently in Madrid

Train 3350 going from Bordeaux to Madrid. Currently in Bordeaux

Plane 155 going from Bordeaux to Helsinki. Currently in Bordeaux

Train 416 going from Bordeaux to Copenhagen. Currently in Bordeaux

Plane 2615 going from Helsinki to Copenhagen. Currently in Helsinki

Train 6678 going from Bordeaux to Copenhagen. Currently in Bordeaux

Plane 6214 going from Barcelona to NewYork. Currently in Barcelona

Train 6108 going from Jerusalem to NewYork. Currently in Jerusalem

Plane 7150 going from Rome to Jerusalem. Currently in Rome

---All together after move...---

Train 94 going from Madrid to Rome. Currently in station 4 between Madrid and Rome.

Plane 5362 going from Bordeaux to Madrid. Currently in Bordeaux

Train 3350 going from Bordeaux to Madrid. Currently in station 1 between Bordeaux and Madrid.

Plane 155 going from Helsinki to Bordeaux. Currently in Helsinki

Train 416 going from Copenhagen to Bordeaux. Currently in Copenhagen

Plane 2615 going from Copenhagen to Helsinki. Currently in Copenhagen

Train 6678 going from Bordeaux to Copenhagen. Currently in station 1 between Bordeaux and Copenhagen.

Plane 6214 going from NewYork to Barcelona. Currently in NewYork

Train 6108 going from Jerusalem to NewYork. Currently in station 1 between Jerusalem and NewYork.

Plane 7150 going from Jerusalem to Rome. Currently in Jerusalem