Report

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Introduction and first description of our solution

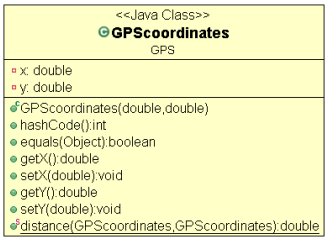
The aim of the myUber Project we did develop is to implement a java code to model all the interactions which are required for a system like Uber to work. It means all the following operations should be implemented.

A customer can enter the GPS coordinates of the place he wants to go and then can choose the type of ride he wants, knowing all the prices. Then the nearest driver should be notified for the ride and can accept or refuse it. If the driver refuses the ride, the system should notify other drivers until one accept it. If no driver can be found the ride is canceled. The customer can also cancel the ride if he did not get into the car. If a driver accepts a ride, he should pick up the customer and notify the myUber system that the ride has started. He should also notify the system when the ride is over, and the customer can then give a mark to the driver.

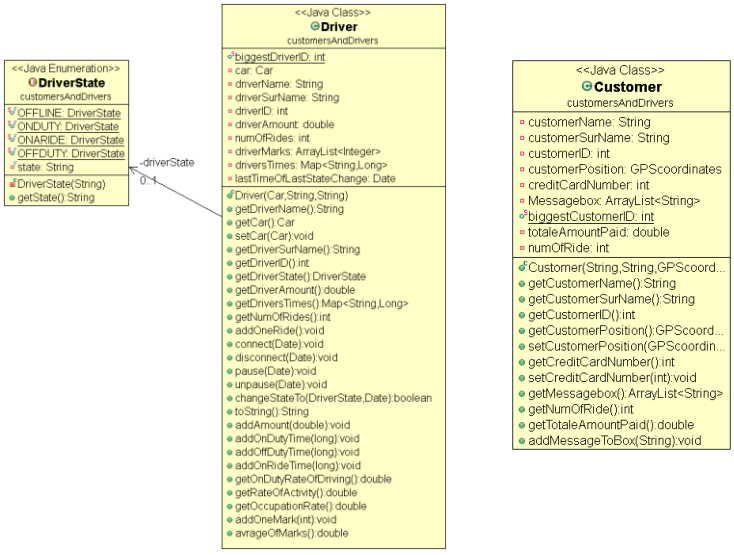
To perform all these operations, we must also do hidden operations to store the status of each, driver, car or ride, so that an operation which is not allowed cannot occur.

To do so we choose to implement the following classes.

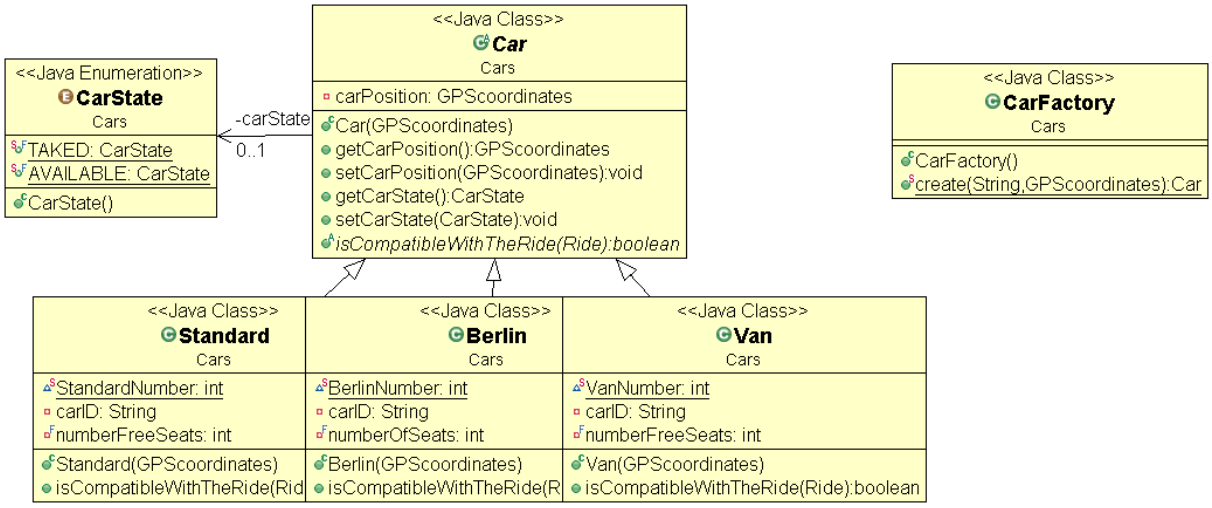
First of all, we choose to implement a GPScoordinates class which allowed us to create and store coordinates of customers, cars or arrival points of rides. We implemented also a method to compute the distance between two points, or a method to find the closest point in a list. We did also Override the hashCode and equals methods to define the equality between points.



The Customer class which should contain all the information of one customer, like his name, his ID, the total amount he paid for rides, his position or his message box.



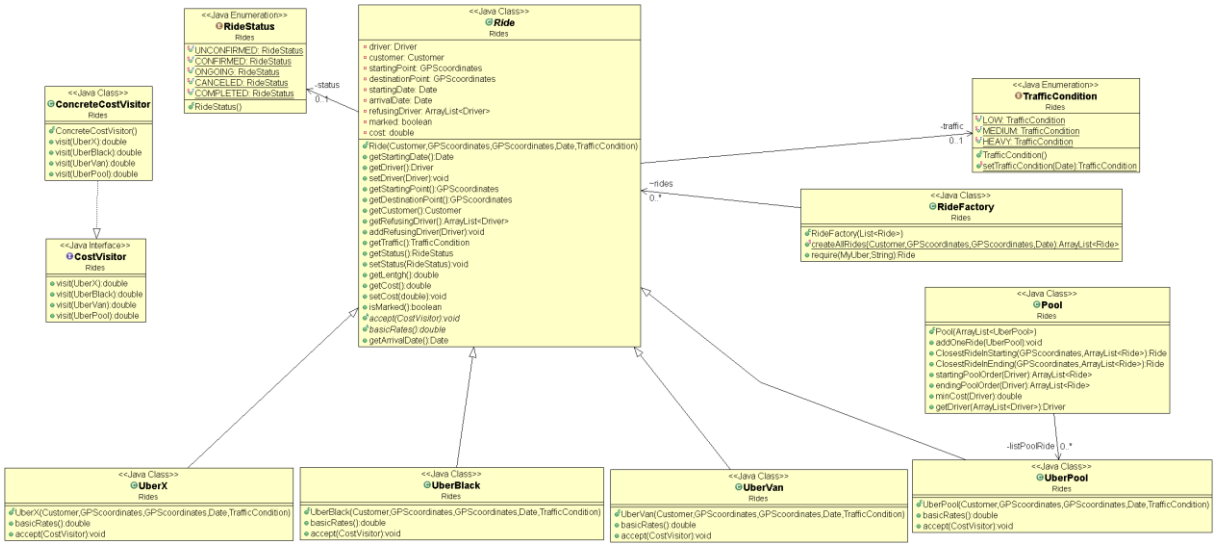
The Driver class should contain the information of one driver, like his name, his ID, his car, his balance, the list of his marks or his status which can be OFFLINE, OFFDUTY, ONDUTY and ONARIDE and shows that the driver can accept a new ride, if he is ONDUTY. The different states also allow the system to compute statistics about the time a driver is driving customers and the time is waiting for them. To implement these states, we choose an enumeration class.



The Car abstract class should contain all the information of the car. The car has a position which is used to find the nearest driver, and a status because two driver can use the same car but not at the same time. The method *changeStateTo(DriverState,Date)* in the Driver class use the car state attribute to check if a driver can connect with his car.

The car class is extended by 3 implementable classes which are corresponding to each type of car. These classes also implement the abstract method *isCompatibleWithTheRide(Ride)* which return a Boolean representing if the car do the specified ride, given its type.

We also choose to implement a factory pattern for cars, which we will discuss in the next part of the report.



The Ride abstract class contains the attributes and methods that characterize a Ride, like the driver, the customer, the starting and ending point of a ride, its cost or the starting and ending date. We use

the RideStatus and the TrafficCondition enumeration class to represent the status and traffic attribute of the class.

4 classes extend the Ride class to represents all the concrete possible rides, and these Rides can be created using the RideFactory class, which is inspired of the factory pattern. We are also using a visitor pattern to compute the cost of a ride and we will discuss the reason and the implementation of these patterns in the next part of the report.

UberPool ride is very particular from all other kind of rides. In fact, several rides can have the same driver and the same car at the same moment, the search of a driver differs also from other cases because it's based on the aggregation of multiple trajectories.

That is why we created the Pool class where we defined the attributes and methods needed for all the functionalities:

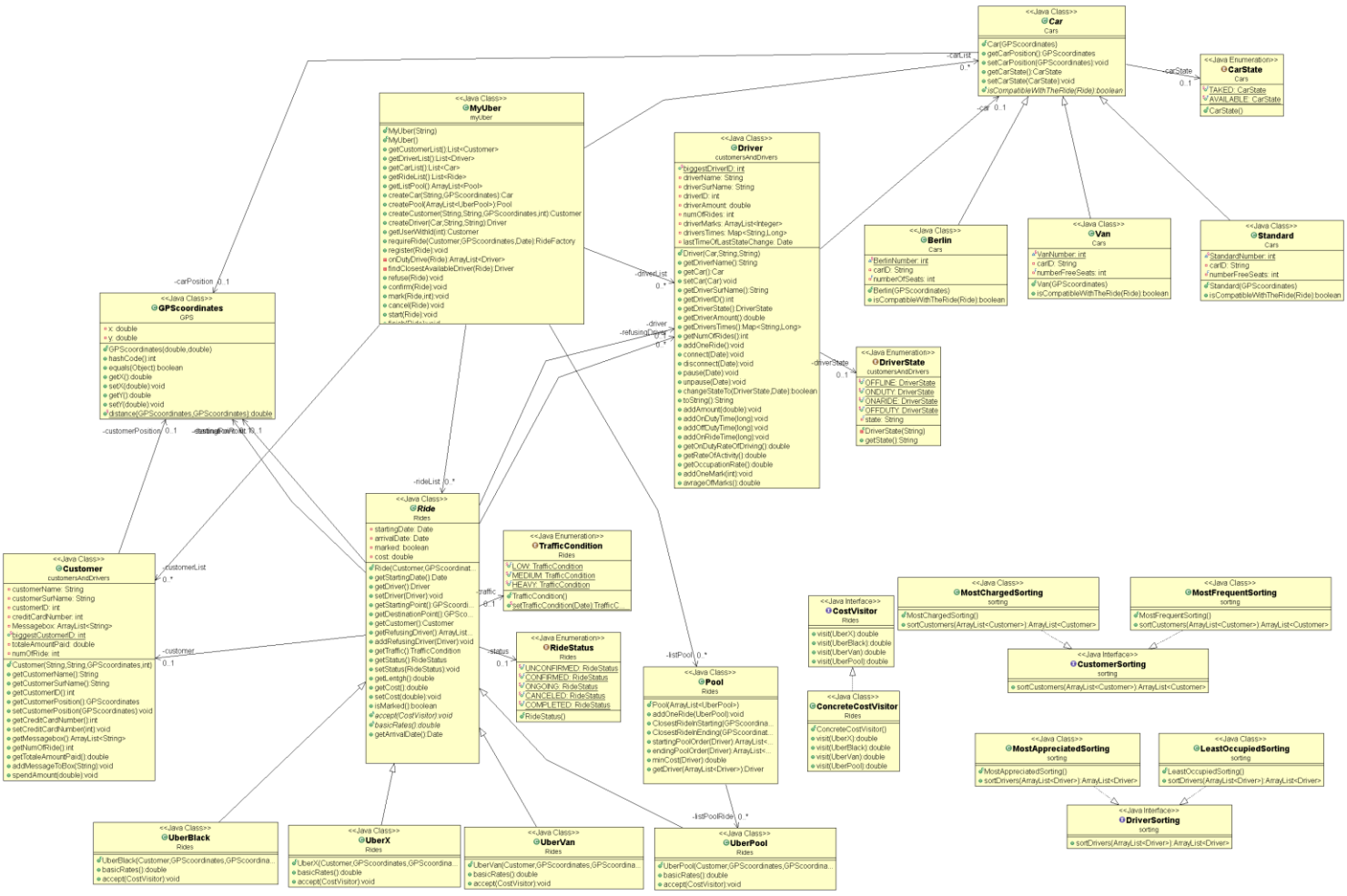
- As principle attribute, we put an ArrayList containing all the shared ride.
- The addOneRide(Ride ride) method to add a new ride to list of all shared rides.
- The ClosestRideInStarting() method to determine the nearest point to the driver between all starting points.
- The ClosestRideInEnding() method to determine the nearest point to the driver between all starting points.
- The StartingPoolOrder to determine the optimal order to follow for taking the customers from their starting points.
- The EndingPoolOrder() to determine the optimal order to follow for dropping off the customers to their destination point starting by a specific position.
- The minCost() method to calculate the minimum cost for a driver from all possible orders.
- The getDriver() method that return the driver with the minimum cost.

Finally, the MyUber class should store the list of all the cars, drivers, customers and rides created for the instance of the class. This class enable many myUber instance to run at the same time with different drivers, cars, customers and rides, what would not be possible if the list of drivers would be a static attribute of the driver class for example.

The myUber class also provides all the methods that a user can use to interact with the system, like methods to create a car, a customer or a driver, to require a ride or to change the status of a ride like confirm, refuse, start and finish for a driver and cancel and mark for a customer.

A MyUber instance can also be created with a text file with the CreateMyUberFromText class. You can then use keywords to create a big number of car, customer and/or drivers and to require a big number of rides with random values. This is a practical way to create an instance with many rides to test, for example, the sorting function.

The UML diagram for all the classes is then the following.


Car
Cars
Car(GPScoordinates)
getCarPosition():GPScoordinates
setCarPosition(GPScoordinates):void
getCarState():CarState
setCarState(CarState):void
isCompatibleWithTheRide(Ride):boolean
CarState
Cars
TAKED: CarState
AVAILABLE: CarState
CarState()
MyUber
myUber
MyUber(String)
MyUber()
getCustomerList():List<Customer>
getDriverList():List<Driver>
getCarList():List<Car>
getRideList():List<Ride>
getListPool():ArrayList<Pool>
createCar(String,GPScoordinates):Car
createPool(ArrayList<UberPool>):Pool
createCustomer(String,String,GPScoordinates,int):Customer
createDriver(Car,String,String):Driver
getUserWithId(int):Customer
requireRide(Customer,GPScoordinates,Date):RideFactory
register(Ride):void
onDutyDrive(Ride):ArrayList<Driver>
findClosestAvailableDriver(Ride):Driver
refuse(Ride):void
confirm(Ride):void
mark(Ride,int):void
cancel(Ride):void
start(Ride):void
finish(Ride):void
Driver
customersAndDrivers
biggestDriverID: int
driverName: String
driverSurName: String
driverID: int
driverAmount: double
numOfRides: int
driverMarks: ArrayList<Integer>
driversTimes: Map<String,Long>
lastTimeOfLastStateChange: Date
Driver(Car,String,String)
getDriverName():String
getCar():Car
setCar(Car):void
getDriverSurName():String
getDriverID():int
getDriverState():DriverState
getDriverAmount():double
getDriversTimes():Map<String,Long>
getNumOfRides():int
addOneRide():void
connect(Date):void
disconnect(Date):void
pause(Date):void
unpause(Date):void
changeStateTo(DriverState,Date):boolean
toString():String
addAmount(double):void
addOnDutyTime(long):void
addOffDutyTime(long):void
addOnRideTime(long):void
getOnDutyRateOfDriving():double
getRateOfActivity():double
getOccupationRate():double
addOneMark(int):void
averageOfMarks():double
Berlin
Cars
BerlinNumber: int
carID: String
numberOfSeats: int
Berlin(GPScoordinates)
isCompatibleWithTheRide(Ride):boolean
Van
Cars
VanNumber: int
carID: String
numberFreeSeats: int
Van(GPScoordinates)
isCompatibleWithTheRide(Ride):boolean
Standard
Cars
StandardNumber: int
carID: String
numberFreeSeats: int
Standard(GPScoordinates)
isCompatibleWithTheRide(Ride):boolean
GPScoordinates
GPS
x: double
y: double
GPScoordinates(double,double)
hashCode():int
equals(Object):boolean
getX():double
setX(double):void
getY():double
setY(double):void
distance(GPScoordinates,GPScoordinates):double
DriverState
customersAndDrivers
OFFLINE: DriverState
ONDUTY: DriverState
ONARIDE: DriverState
OFFDUTY: DriverState
state: String
DriverState(String)
getState():String
Ride
Rides
startingDate: Date
arrivalDate: Date
marked: boolean
cost: double
Ride(Customer,GPScoordinat...
getStartingDate():Date
getDriver():Driver
setDriver(Driver):void
getStartingPoint():GPScoordi...
getDestinationPoint():GPSco...
getCustomer():Customer
getRefusingDriver():ArrayList...
addRefusingDriver(Driver):void
getTraffic():TrafficCondition
getStatus():RideStatus
setStatus(RideStatus):void
getLength():double
getCost():double
setCost(double):void
isMarked():boolean
accept(CostVisitor):void
basicRates():double
getArrivalDate():Date
TrafficCondition
Rides
LOW: TrafficCondition
MEDIUM: TrafficCondition
HEAVY: TrafficCondition
TrafficCondition()
setTrafficCondition(Date):TrafficC...
RideStatus
Rides
UNCONFIRMED: RideStatus
CONFIRMED: RideStatus
ONGOING: RideStatus
CANCELED: RideStatus
COMPLETED: RideStatus
RideStatus()
Customer
customersAndDrivers
customerName: String
customerSurName: String
customerID: int
creditCardNumber: int
Messagebox: ArrayList<String>
biggestCustomerID: int
totaleAmountPaid: double
numOfRide: int
Customer(String,String,GPScoordinates,int)
getCustomerName():String
getCustomerSurName():String
getCustomerID():int
getCustomerPosition():GPScoordinates
setCustomerPosition(GPScoordinates):void
getCreditCardNumber():int
setCreditCardNumber(int):void
getMessagebox():ArrayList<String>
getNumOfRide():int
getTotaleAmountPaid():double
addMessageToBox(String):void
spendAmount(double):void
Pool
Rides
Pool(ArrayList<UberPool>)
addOneRide(UberPool):void
ClosestRideInStarting(GPScoordina...
ClosestRideInEnding(GPScoordinat...
startingPoolOrder(Driver):ArrayList<...
endingPoolOrder(Driver):ArrayList<...
minCost(Driver):double
getDriver(ArrayList<Driver>):Driver
CostVisitor
Rides
visit(UberX):double
visit(UberBlack):double
visit(UberVan):double
visit(UberPool):double
ConcreteCostVisitor
Rides
ConcreteCostVisitor()
visit(UberX):double
visit(UberBlack):double
visit(UberVan):double
visit(UberPool):double
MostChargedSorting
sorting
MostChargedSorting()
sortCustomers(ArrayList<Customer>):ArrayList<Customer>
MostFrequentSorting
sorting
MostFrequentSorting()
sortCustomers(ArrayList<Customer>):ArrayList<Customer>
CustomerSorting
sorting
sortCustomers(ArrayList<Customer>):ArrayList<Customer>
MostAppreciatedSorting
sorting
MostAppreciatedSorting()
sortDrivers(ArrayList<Driver>):ArrayList<Driver>
LeastOccupiedSorting
sorting
LeastOccupiedSorting()
sortDrivers(ArrayList<Driver>):ArrayList<Driver>
DriverSorting
sorting
sortDrivers(ArrayList<Driver>):ArrayList<Driver>
UberBlack
Rides
UberBlack(Customer,GPScoordinates,GPScoordina...
basicRates():double
accept(CostVisitor):void
UberX
Rides
UberX(Customer,GPScoordinates,GPScoordina...
basicRates():double
accept(CostVisitor):void
UberVan
Rides
UberVan(Customer,GPScoordinates,GPScoordina...
basicRates():double
accept(CostVisitor):void
UberPool
Rides
UberPool(Customer,GPScoordinates,GPScoordina...
basicRates():double
accept(CostVisitor):void
-carList
0..*
-carState
0..1
-car
0..1
-carPosition
0..1
-driverList
0..*
-driver
0..1
-refusingDriver
0..*
-driverState
0..1
-customerPosition
0..1
-startingPoint
0..1
-destinationPoint
0..1
-rideList
0..*
-customerList
0..*
-traffic
0..1
-customer
0..1
-status
0..1
-listPool
0..*
-listPoolRide
0..*

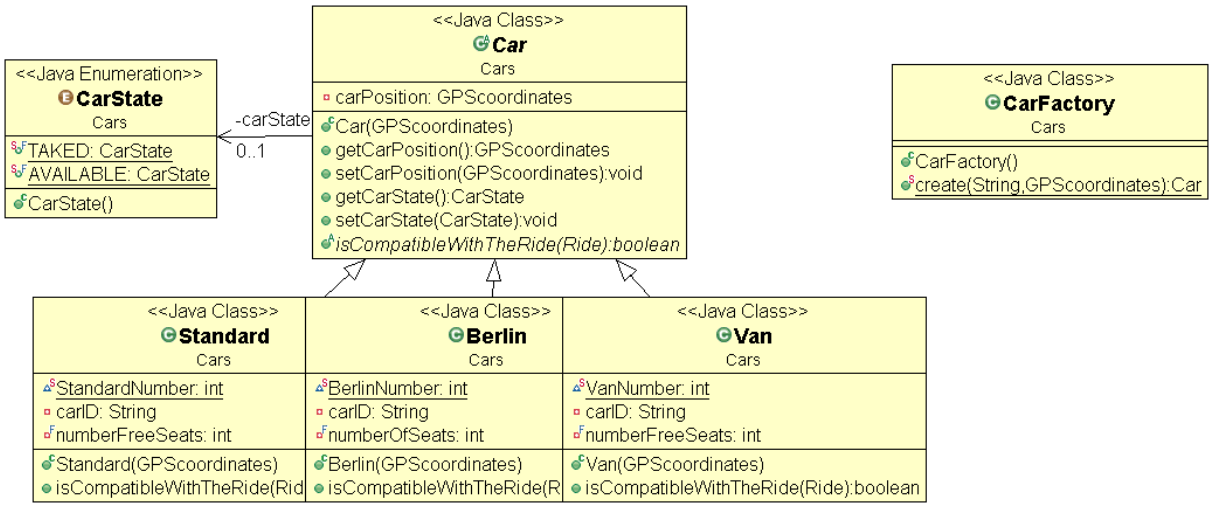
Patterns use in our implementation

To achieve a code that respects the Open Close principle, we used multiple design patterns:

Factory pattern for creating cars:

We create a factory named CarFactory to generate objects of Car classes based on a given string. The factory pattern removes the instantiation of actual implementation classes from client code. Factory pattern makes our code more robust, less coupled and easy to extend. For example, we can easily add a new type of car by adding a class implementation and another "if" block in the CarFactory class. The new type of car should then override the isCompatibleWithRide to easily specify the type of ride it can perform.

This pattern makes it also easier to create a Car in the myUber class because we only need a single method *createCar* that call the CarFactory *create* method and the createCar method of the MyUber class respect then the open-close principle.



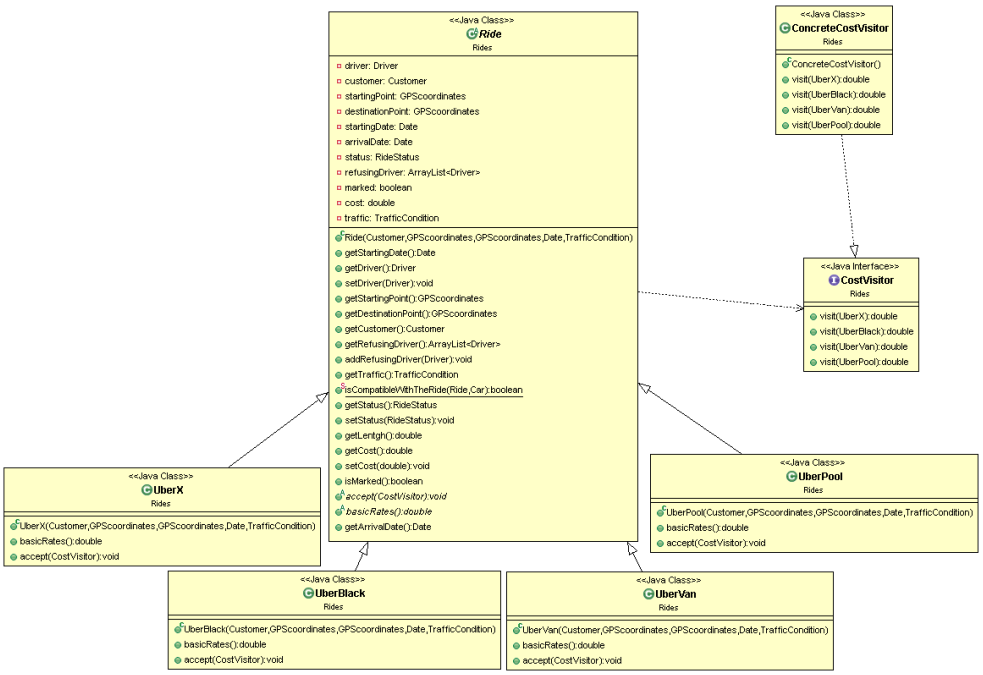
Visitor pattern of rides:

As the fare computation function depends on the kind of ride booked, we decided to use a visitor pattern which consists of:

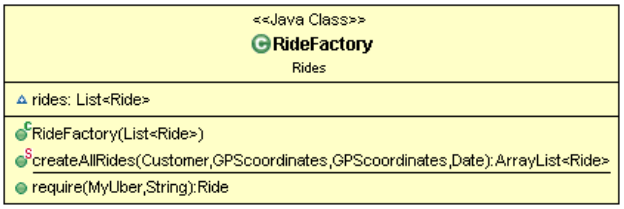
- Visitable abstract class **"Rides"**: It declares the accept() method that invokes the visit() method of the visitor object passed as parameter. The choice of an abstract class instead of an interface was due to the number of similar and identical methods and attributs used in the UberX, UberBlack, UberVan and UberPool classes.
- Visitor interface **"CostVisitor"**: It declares the visit() method

That way, our components (UberX, UberBlack, UberVan, UberPool) will allow the visitor implementation to "visit" them and perform the required action on that element.

Consequently**, we make good use of the Open/Closed principle** as we won't modify the code to add a new functionality, but we'll still be able to extend the functionality by providing a new *Visitor* implementation.



Factory pattern for creating rides:



The RideFactory class is inspired of a factory pattern, even if it is not actually one, because the ride creation only occurs in a specific case: the customer makes a ride request, the system send him back the prices for all the existing rides and the customer finally choose its ride.

So, when we create a ride, we must create all type of rides, then compute the prices for all of them and finally register the chosen one in the MyUber instance.

Therefore, we have two methods in the RideFactory class.

The createAllRides static method takes in argument all the arguments of the Ride constructor and return a list of all type of ride constructed with the given arguments.

With this list, the system can compute the prices for all rides with the visitor pattern.

Then we can create an instance of RideFactory, with the above list in arguments.

And then we can choose the ride by calling the require method on this instance of RideFactory and specifying the type of ride with a String in parameter.

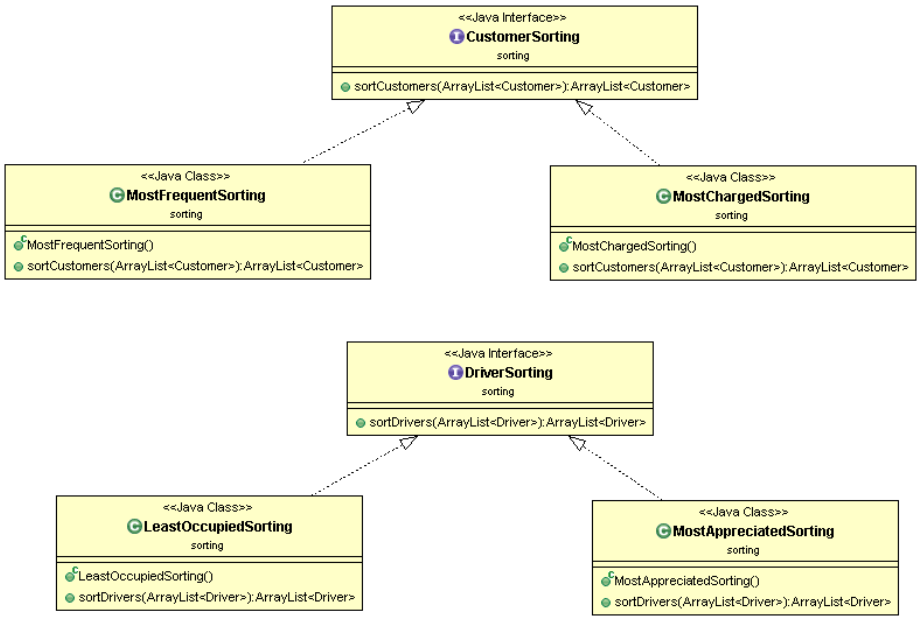
So, if we want to add a type of Ride, we just have to create the class extending Ride, add it to the returned list of the *createAllRides* method and add an “if” case in the require method to match with the String in parameter. So, the RideFactory makes the Ride class more flexible, because new subclasses are easy to create.

Strategy pattern for sorting drivers and customers:

Our requirement was to design a family of algorithms in order to sort

1. Customers based on the number of completed rides and the total amount of charges for all completed rides.
2. Drivers based on their occupation rate and the level of appreciations.

For that, we used two strategy patterns: We defined two sorting algorithms for each case, encapsulate each one, and make them interchangeable.



If we want to sort drivers or customers with new criteria, the only thing to do is adding new classes with its implementations. This is compatible with the open/closed principle (OCP), which proposes that classes should be open for extension but closed for modification.

Observer pattern for uberPool rides:

For Uber Pool, the rides of the customers sharing the same car depends strongly on each others. That's why, when designing the Uber Pool system, we decided to use an Observer Pattern for the following reasons :

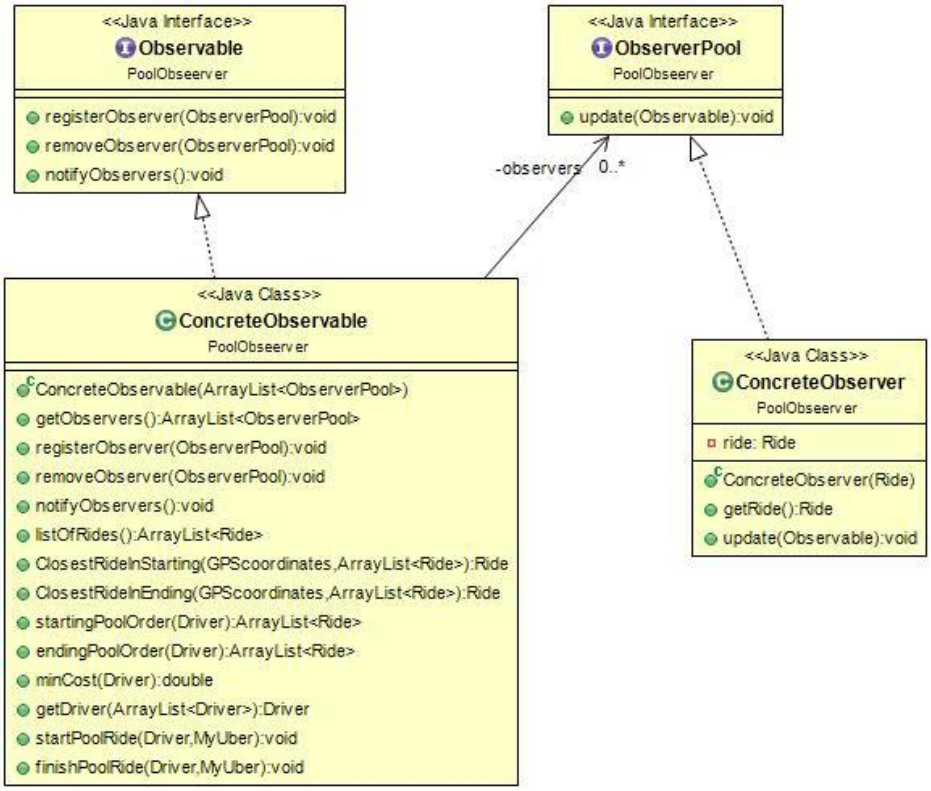
- It supports the principle of loose coupling between objects that interact with each other
- It allows sending data to other objects effectively without any change in the Subject or Observer classes
- Observers can be added/removed at any point in time

In our case, we defined a concrete observer class named « ConcreteObserver » taking a ride (Ride) as attributes. We also defended this methods in the class :

- ConcreteObserever (Ride ride) : As a constructor of the class.
- getRide () : Getter that display the ride of the object.
- update (Observable observable) : this method send a message to all all customers sitting in the car every time a new customer has joined the shared car.

On the other hand, an concrete observable object is defined by an array list containing all the observer sharing the car (maximum 3). In the ConcreteObservable class, we defined all the necessary methods :

- minCost(Driver driver) : this method returns the cost of the optimal trajectory by having the list of all strating points and the list of all destination point. The optimal trajectory is determined by choosing every time the nearest point to the current position.
- getDriver(ArrayList<Driver> list) : this method compares the minCost (first method) of all the drivers and return the driver having the minimum length to travel.
- ClosestRideInStarting(GPScoordinates position, ArrayList<Ride> allRides) : this method return the nearest position to the current position of the car from all starting points.
- ClosestRideInEnding(GPScoordinates position, ArrayList<Ride> allRides) : this method return the nearest position to the current position of the car from all destination points.
- startingPoolOrder(Driver driver) : this method return the list of rides in the ordrer of starting (taking the customers from their starting points).
- endingPoolOrder(Driver driver) : this method return the list of rides in the ending order of ending (taking the customers to their destination points)
- startPoolRide(Driver driver, MyUber myUber) : use the method MyUber.strat() for starting the all the rides in the order.
- finishPoolRide(Driver driver, MyUber myUber) : use the method MyUber.finish() for ending the all the rides in the order.



MyUber Command Line User Interface

After implementing all the classes described in the first part we could implement the Command Line User Interface for MyUber.

The principle of this the CLUI is to recognize a command with its parameters and to execute the corresponding operations with the MyUber methods, we already implemented.

To do so we first read each command line and split it into a list composed of the keyword of the command and of all the parameters. Then we have a long list of if blocks to check all the possible values the keyword can take.

But the hardest part of this work was to think about all of the possible exception a command could throw in order to catch them, print an appropriate message so that the user can still enter other commands after the exception. I will detail the possible exception I handled in the CLUI.

The first thing we must check is if the keyword and the number of parameters of the command is valid. If not our CLUI print a message to inform the user that is command was invalid.

We also must check for each command, if the parameters verify the good conditions. For example, if we want to get a customer, a driver or a car with his id, the corresponding method will throw an Exception if the id is unknown and we can catch this exception in the CLUI. It is the same for checking the type of a car or a ride with their factories.

We also have to check if the parameters are numbers when we want to parse them, or to check if the file path does exist for the init command.

We implemented all the commands described in the description of the project and we added 2 commands to use the uberPool Rides.

The first command is addToPool <customerID> <destination> <time> <driverMark> to notify the system that a customer wants an uberPool ride, but the ride will not start until the simAllPool command is called.

The simAllPool <> command starts all the uberPool rides waiting and groups them between some drivers. The command gives all the information about all the rides in output.

To run the CLUI just run the CLUI file to run the main method. The CLUI will automatically run our .ini file. You can run a test file with the command runtest <filepath.txt>.

If the file is in the eval package, you can just need to give its name: for example, runtest test1.txt run our test1 file.

We provided 2 files to test our functions: test1.txt for testing normal rides and uberPoolTest.txt to test the command for uberPool rides.

Junit Testing

To make sure that all methods are correctly working, we created a new package since the beginning of the project named « JUNITtests » where we put all classes with all testing methods. Every time we have create a method, it was tested several times to check it functionalities and to ensure it runs as per requirements. JUnit promotes the idea of "first testing then coding", which emphasizes on

setting up the test data for a piece of code that can be tested first and then implemented. This approach is like "test a little, code a little, test a little, code a little."