

Object-Oriented Programming

Final Lab - Dependency Injection and Synchronization

Objectives

- Get familiar with Dependency Injection in OOP
- Get familiar with Threads Synchronization

References

- <https://www.journaldev.com/2394/java-dependency-injection-design-pattern-example-tutorial>
- https://en.wikipedia.org/wiki/Dependency_injection
- <https://www.codejava.net/coding/what-is-dependency-injection-with-java-code-example>
- <https://www.geeksforgeeks.org/synchronized-in-java/>
- <https://javatpoint.com/synchronization-in-java>

Exercises: Simple transport services simulation

In the system, the following requirements are applied:

- There are 3 transport services: Grab, Gojek and Be. The price for each services are as follows:
 - Grab
 - The first 2 km: 0.5\$/km
 - After 2 km: 1\$/km
 - Gojek
 - The first 5 km: 0.7\$/km
 - After 5 km: 1.2\$/km
 - Be
 - The first 3 km: 0.5 \$/km
 - After 3 km: 1.5 \$/km
- There are 3 payment methods: Visa, E-wallet and Cash. The fee for each method are as follows:
 - Visa: 1% per transaction
 - E-Wallet: 0.8 % per transaction
 - IBanking (Internet Banking): 0.5% per transaction
- Visa and E-Wallet have special policies for their customers:
 - Visa: let customer lend 10\$ in their account when needed (The min value for balance will be -10).
 - E-Wallet: the transaction fee become 0.5% for every 3 transactions (3rd, 6th, 9th...)
- A driver can only belong to 1 transport service and serve 1 customer at a time. Drivers have all payment accounts.
- A customer can only book a service at a time and use one or more payment methods.
- After finishing a booked service, 80% of cost of the service goes to the account of the driver. 20% of cost goes to the account of the service provider. The driver is now free to receive the next customer, and the customer can book another service.

- A transport service provider receive service fee directly from the payment providers and store inside their company.
 - For each km, a driver has to take 2 seconds to complete. So, if the customer book a service for 5 km, a driver will take 10 seconds to complete the request.
 - Each customer should have one of following status:
 - **Booking** : Default status or when trying to book a service.
 - **Processing**: when being served by a driver.
 - **Banned**: whenever a customer cannot pay for the service he booked, he is permanently banned from all the transport service and cannot make new booking.
 - Each driver should have one of the following status:
 - **Free**: Default status or when there is no assigned booking.
 - **Processing**: when serving a customer.
- a. Apply “Dependency Injection” and “Synchronization” to write all necessary classes to simulate the system:
- Grab, GoJek and Be should extend Transport Service class (or implement Transport Interface).
 - Visa, E-Wallet, IBanking should extend Payment Service class (or implement Payment Interface).
 - Driver and Customer should not specify their transport and payment services in the source code. These dependencies should be injected by using Dependency Injection method (through constructor/getter method/public method).
- b. Test the system using following steps:
- Randomly create **n** number of customer and set the value for their balance in three payment methods. **n** should be less than 10, and the value for the balance should be greater than 10\$ and less than 20\$ for each account.
 - Randomly create **m** number of drivers. **m** should be less than 10.
 - Until all customers cannot make new booking (all are banned):
 1. Customers try to make new booking with a random distance (should be less than 10). If the targeted service do not have any free driver, customers will wait for 1 second and try to select another service.
 2. Transport provider randomly assign new booking for a free driver.
 3. The balance of customers, drivers, transport providers and payment providers should be updated whenever a driver finish serving his customer.
 - Print out some information on the console every second to keep track of the system. (See below sample output)
 - **Note 1**: customer and should implement runnable interface, so they can run concurrently. Each thread will handle a customer and corresponding booking.
 - **Note 2**: remember to use synchronized functions whenever a resource can be accessed by multiple threads at the same time.
 - **Note 3**: test your system carefully.

Sample output:

*****Initial State*****

[Customer]

ID	Visa	E-Wallet	IBanking
C001	---	15.0	12.0
C002	---	14.0	15.0
C003	12.0	---	---
C004	---	11.0	---
C005	---	---	13.0
C006	---	17.0	---

[Driver]

ID	Service
D001	Be
D002	Be
D003	Be
D004	Grab
D005	Be
D006	Gojek
D007	Be
D008	Be

=====System Status=====

Customer	Status	Balance
C001	Being carried by D008 (Be)	27.00 (Visa: 0.00 E-Wallet: 15.00 IBanking: 12.00)
C002	Being carried by D003 (Be)	29.00 (Visa: 0.00 E-Wallet: 14.00 IBanking: 15.00)
C003	Being carried by D006 (Gojek)	12.00 (Visa: 12.00 E-Wallet: 0.00 IBanking: 0.00)
C004	Being carried by D004 (Grab)	11.00 (Visa: 0.00 E-Wallet: 11.00 IBanking: 0.00)
C005	Being carried by D005 (Be)	13.00 (Visa: 0.00 E-Wallet: 0.00 IBanking: 13.00)
C006	BOOKING (Gojek)	17.00 (Visa: 0.00 E-Wallet: 17.00 IBanking: 0.00)

Driver	Service	Status	Balance
D001	Be	FREE	0.00 (Visa: 0.00 E-Wallet: 0.00 IBanking: 0.00)
D002	Be	FREE	0.00 (Visa: 0.00 E-Wallet: 0.00 IBanking: 0.00)
D003	Be	Carrying C002	0.00 (Visa: 0.00 E-Wallet: 0.00 IBanking: 0.00)
D004	Grab	Carrying C004	0.00 (Visa: 0.00 E-Wallet: 0.00 IBanking: 0.00)
D005	Be	Carrying C005	0.00 (Visa: 0.00 E-Wallet: 0.00 IBanking: 0.00)
D006	Gojek	Carrying C003	0.00 (Visa: 0.00 E-Wallet: 0.00 IBanking: 0.00)
D007	Be	FREE	0.00 (Visa: 0.00 E-Wallet: 0.00 IBanking: 0.00)
D008	Be	Carrying C001	0.00 (Visa: 0.00 E-Wallet: 0.00 IBanking: 0.00)

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			System Status=====			
Customer	Status	Balance				
C001	Being carried by D006 (Gojek)	4.45	(Visa: 0.00	E-Wallet: 0.85	IBanking: 3.60)
C002	I am BANNED...	18.32	(Visa: 0.00	E-Wallet: 10.14	IBanking: 8.17)
C003	I am BANNED...	-4.61	(Visa: -4.61	E-Wallet: 0.00	IBanking: 0.00)
C004	I am BANNED...	0.20	(Visa: 0.00	E-Wallet: 0.20	IBanking: 0.00)
C005	I am BANNED...	0.93	(Visa: 0.00	E-Wallet: 0.00	IBanking: 0.93)
C006	I am BANNED...	0.83	(Visa: 0.00	E-Wallet: 0.83	IBanking: 0.00)

Driver	Service	Status	Balance			
D001	Be	FREE	4.00	(Visa: 0.00	E-Wallet: 0.00	IBanking: 4.00)
D002	Be	FREE	11.20	(Visa: 6.40	E-Wallet: 0.00	IBanking: 4.80)
D003	Be	FREE	2.80	(Visa: 0.00	E-Wallet: 0.00	IBanking: 2.80)
D004	Grab	FREE	11.20	(Visa: 0.00	E-Wallet: 5.60	IBanking: 5.60)
D005	Be	FREE	8.80	(Visa: 0.00	E-Wallet: 6.00	IBanking: 2.80)
D006	Gojek	Carrying C001	13.04	(Visa: 5.68	E-Wallet: 7.36	IBanking: 0.00)
D007	Be	FREE	7.20	(Visa: 0.00	E-Wallet: 7.20	IBanking: 0.00)
D008	Be	FREE	8.00	(Visa: 0.00	E-Wallet: 7.20	IBanking: 0.80)

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