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:
 - o Grab

■ The first 2 km: 0.5\$/km

■ After 2 km: 1\$/km

Goiek

The first 5 km: 0.7\$/kmAfter 5 km: 1.2\$/km

o Be

The first 3 km: 0.5 \$/kmAfter 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.
 - o **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):
 - 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:

Customerl	*********	************	*********	**III (I G	t State	t-d-d-d-d-d-d-d-d-d-d-d-d-d-d-d-d-d-d-d	************	to de de de de de de	***********	*********
ID	l Visa	E-Wallet	IBank	ina						
C001	V13u	15.0		2.0						
C002		14.0		5.0						
C003	12.0	14.0								
C004		11.0	1							
C005				3.0						
C006	i	17.0	-							
Driver]										
ID	Service									
D001	l Be									
D001	l Be									
D002	l Be									
D003	l Grab									
D005	i Be									
D005	Gojek									
D007	l Be									
D008	Be									
D008		*****						*****	*****	*****
D008	Be			******* ==System Balan	Status			*****	*****	******
D008 ****** ustomer	Be ************************** Status			==System Balan	Status ce					
D008 ******** Customer 0001	Be ****************** Status Being carr:	ied by D008	(Be)	==System Balan 27.00	Status ce (Visa:	0.00	E-Wallet:	15.00	IBanking:	12.00)
D008 ******** Customer 001 002	Be	ied by D008	(Be) (Be)	==System Balan 27.00 29.00	Status ce (Visa: (Visa:	0.00 0.00	E-Wallet:	15.00 14.00	IBanking: IBanking:	12.00)
D008 ******** Customer 001 002 003	Be Status Being carr: Being carr: Being carr:	ied by D008	(Be) (Be) (Gojek)	==System Balan 27.00 29.00 12.00	Status ce (Visa: (Visa: (Visa:	0.00 0.00 12.00	E-Wallet: E-Wallet: E-Wallet:	15.00 14.00 0.00	IBanking: IBanking: IBanking:	12.00) 15.00) 0.00)
D008 **********************************	Being carr: Being carr: Being carr: Being carr: Being carr:	ied by D008 ied by D003 ied by D006 ied by D004	(Be) (Be) (Gojek) (Grab)	==System Balan 27.00 29.00 12.00 11.00	Status ce (Visa: (Visa: (Visa: (Visa:	0.00 0.00 12.00 0.00	E-Wallet: E-Wallet: E-Wallet: E-Wallet:	15.00 14.00 0.00 11.00	IBanking: IBanking: IBanking: IBanking:	12.00) 15.00) 0.00)
D008 ck+ck+ck+ck-ck-ck-ck-ck-ck-ck-ck-ck-ck-ck-ck-ck-c	Being carr: Being carr: Being carr: Being carr: Being carr:	ied by D008 ied by D003 ied by D006 ied by D004 ied by D005	(Be) (Be) (Gojek) (Grab)	==System Balan 27.00 29.00 12.00 11.00 13.00	Status ce (Visa: (Visa: (Visa:	0.00 0.00 12.00 0.00 0.00	E-Wallet: E-Wallet: E-Wallet:	15.00 14.00 0.00 11.00 0.00	IBanking: IBanking: IBanking:	12.00) 15.00) 0.00) 0.00)
D008 ******** Customer 001 002	Be*********** Status Being carr: Being carr: Being carr: Being carr: Being carr: Being carr: BookING (Go	ied by D008 ied by D003 ied by D006 ied by D004 ied by D005	(Be) (Be) (Gojek) (Grab)	==System Balan 27.00 29.00 12.00 11.00 13.00	Status ce (Visa: (Visa: (Visa: (Visa: (Visa: (Visa:	0.00 0.00 12.00 0.00 0.00	E-Wallet: E-Wallet: E-Wallet: E-Wallet:	15.00 14.00 0.00 11.00 0.00	IBanking: IBanking: IBanking: IBanking: IBanking:	12.00) 15.00) 0.00) 0.00)
D008 ********* "ustomer 001 002 003 004 005 006	Be*********** Status Being carr: Being carr: Being carr: Being carr: Being carr: Being carr: BookING (Go	ied by D008 ied by D003 ied by D006 ied by D004 ied by D005 jek)	(Be) (Be) (Gojek) (Grab)	==System Balan 27.00 29.00 12.00 11.00 13.00 17.00	Status ce (Visa: (Visa: (Visa: (Visa: (Visa: (Visa:	0.00 0.00 12.00 0.00 0.00 0.00	E-Wallet: E-Wallet: E-Wallet: E-Wallet:	15.00 14.00 0.00 11.00 0.00 17.00	IBanking: IBanking: IBanking: IBanking: IBanking:	12.00) 15.00) 0.00) 0.00) 13.00) 0.00)
D008 ********* ustomer 001 002 003 004 005 006 rriver	Be ************ Status Being carr. BookING (Gel Service	ied by D008 ied by D003 ied by D006 ied by D004 ied by D005 jjek)	(Be) (Be) (Gojek) (Grab)	==System Balan 27.00 29.00 12.00 11.00 13.00 17.00	Status ce (Visa: (Visa: (Visa: (Visa: (Visa: (Visa:	0.00 0.00 12.00 0.00 0.00 0.00	E-Wallet: E-Wallet: E-Wallet: E-Wallet: E-Wallet: E-Wallet:	15.00 14.00 0.00 11.00 0.00 17.00	IBanking: IBanking: IBanking: IBanking: IBanking: IBanking:	12.00) 15.00) 0.00) 0.00) 13.00) 0.00)
D008 ********* ustomer 001 002 003 004 005 006 river 001 002	Be************ Status Being carr. BookING (Gold Service Be	ied by D008 ied by D003 ied by D006 ied by D004 ied by D005 ojek)	(Be) (Be) (Gojek) (Grab) (Be)	==System Balan 27.00 29.00 12.00 11.00 13.00 17.00 Balan	Status ce (Visa: (Visa: (Visa: (Visa: (Visa: (Visa: ce	0.00 0.00 12.00 0.00 0.00 0.00	E-Wallet: E-Wallet: E-Wallet: E-Wallet: E-Wallet:	15.00 14.00 0.00 11.00 0.00 17.00	IBanking: IBanking: IBanking: IBanking: IBanking: IBanking:	12.00) 15.00) 0.00) 0.00) 13.00) 0.00)
D008 ********** ustomer 001 002 003 004 005 006 river 001 002 003	Be Status Status Being carr: BookING (G	ied by D008 ied by D006 ied by D006 ied by D005 jek) Status	(Be) (Be) (Gojek) (Grab) (Be)	==System Balan 27.00 29.00 12.00 11.00 13.00 17.00 Balan 0.00 0.00	Status: ce (Visa:	0.00 0.00 12.00 0.00 0.00 0.00 0.00	E-Wallet: E-Wallet: E-Wallet: E-Wallet: E-Wallet: E-Wallet:	15.00 14.00 0.00 11.00 0.00 17.00	IBanking: IBanking: IBanking: IBanking: IBanking: IBanking:	12.00) 15.00) 0.00) 13.00) 0.00)
D008 ******** 001 002 003 004 005 006 river 001 002 003 004 009 001 000	Be ************ Status Being carr. Beowline BookING (Gold Service Be Be Be Be	ied by D008 ied by D006 ied by D006 ied by D005 jek) Status FREE FREE Carrying ((Be) (Be) (Gojek) (Grab) (Be)	==System	Status ce (Visa:	0.00 0.00 12.00 0.00 0.00 0.00	E-Wallet: E-Wallet: E-Wallet: E-Wallet: E-Wallet: E-Wallet: E-Wallet:	15.00 14.00 0.00 11.00 0.00 17.00	IBanking: IBanking: IBanking: IBanking: IBanking: IBanking: IBanking:	12.00) 15.00) 0.00) 13.00) 0.00) 0.00)
D008 ********* 001 002 003 004 005 006 rriver 001 002 003 004 009 005	Be************ Status Being carr. Being carr. Being carr. Being carr. Being carr. Being carr. BookING (Go	ied by D008 led by D003 ied by D006 ied by D006 led by D005 jek) Status FREE FREE Carrying ((Be) (Be) (Gojek) (Grab) (Be)	==System Balan 27.00 29.00 12.00 11.00 13.00 17.00 Balan	Status ce (Visa:	0.00 0.00 12.00 0.00 0.00 0.00 0.00 0.00	E-Wallet: E-Wallet: E-Wallet: E-Wallet: E-Wallet: E-Wallet: E-Wallet: E-Wallet:	15.00 14.00 0.00 11.00 0.00 17.00	IBanking:	12.00) 15.00) 0.00) 0.00) 13.00) 0.00)
D008 ********* Customer 001 002 003 004 005 006	Be Status Status Being carr: Being	ied by D008 ied by D006 ied by D006 ied by D005 jek) Status FREE FREE Carrying (Carrying ((Be) (Be) (Gojek) (Grab) (Be)	==System Balan 27.00 29.00 11.00 13.00 17.00 Balan 0.00	Statusce (Visa:	0.00 0.00 12.00 0.00 0.00 0.00 0.00	E-Wallet: E-Wallet: E-Wallet: E-Wallet: E-Wallet: E-Wallet: E-Wallet: E-Wallet: E-Wallet:	15.00 14.00 0.00 11.00 0.00 17.00	IBanking:	12.00) 15.00) 0.00) 0.00) 13.00) 0.00)

.

Customer	Status		==System Status===================================							
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		i -4.61	(Visa:	-4.61	E-Wallet:	0.00	IBanking:	0.00)
C004	I am BANNED		0.20	(Visa:		E-Wallet:		IBanking:		
C005			0.93	(Visa:		E-Wallet:		IBanking:		
C005	I am BANNED I am BANNED		0.83	(Visa:		E-Wallet:		IBanking:		
 Driver	Service	Balan	Balance							
	·		·							
D001	Be	FREE	4.00	(Visa:		E-Wallet:		IBanking:		
D002	Be	FREE		(Visa:		E-Wallet:		IBanking:		
D003	Be	FREE	2.80	(Visa:	0.00	E-Wallet:	0.00	IBanking:	2.80)
D004	i Grab i	FREE	i 11.20	(Visa:	0.00	E-Wallet:	5.60	IBanking:		
D005	i Be	FREE	8.80	(Visa:		E-Wallet:		IBanking:		
				(Visa:						
D006	Gojek	Carrying C001				E-Wallet:		IBanking:		
D007	Be	FREE	7.20	(Visa:		E-Wallet:		IBanking:		
D008	Be	FREE	8.00	(Visa:		E-Wallet:		IBanking:)
	Status	Balan								
 C001	Being carried by D006 (Gojek)		4.45	(Visa:	0.00	E-Wallet:	0.85	IBanking:	3.60)
C002	I am BANNED			(Visa:		E-Wallet:		IBanking:		
C003	I am BANNED									
				(Visa:		E-Wallet:		IBanking:		
C004	I am BANNED		0.20	(Visa:		E-Wallet:		IBanking:		
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	i Be i	FREE	i 11.20	(Visa:	6.40	E-Wallet:	0.00	IBanking:		
D003	i Be	FREE	2.80	(Visa:		E-Wallet:		IBanking:		
	i Grab					E-Wallet:				
D004		FREE		(Visa:				IBanking:		
D005	Be	FREE	8.80	(Visa:		E-Wallet:		IBanking:		
D006	Gojek	Carrying C001	13.04	(Visa:	5.68	E-Wallet:	7.36	IBanking:	0.00)
D007	i Be i	FREE	7.20	(Visa:	0.00	E-Wallet:	7.20	IBanking:	0.00)
D008	Be	FREE	8.00	(Visa:		E-Wallet:	7.20	IBanking:	0.80)
										====
	Status		==system Balan							
C001	I am BANNED		4.45	(Visa:	0.00	E-Wallet:		IBanking:		
C002	I am BANNED)	18.32	(Visa:	0.00	E-Wallet:	10.14	IBanking:	8.17)
C003	I am BANNED			(Visa:				IBanking:		
C004	I am BANNED		0.20	(Visa:		E-Wallet:		IBanking:		
	I am BANNED									
C005			0.93	(Visa:		E-Wallet:		IBanking:		
C006	I am BANNED)	0.83	(Visa:	0.00	E-Wallet:	0.83	IBanking:	0.00)
Driver	Service Status Balance									
	l Be l	FREE	1 4.00	(Visa:	0.00	E-Wallet:	0.00	IBanking:	4.00)
				(Visa:		E-Wallet:		IBanking:		
D001				'ATOG'						,
D001 D002	Be i	FREE		(Mier-						1
D001 D002 D003	Be Be	FREE	2.80	(Visa:		E-Wallet:		IBanking:		
D001 D002 D003 D004	Be Be Grab	FREE FREE	2.80 11.20	(Visa:	0.00	E-Wallet:	5.60	IBanking:	5.60)
D001 D002 D003 D004	Be Be	FREE	2.80		0.00		5.60		5.60)
D001 D002 D003	Be Be Grab Be	FREE FREE FREE	2.80 11.20 8.80	(Visa: (Visa:	0.00	E-Wallet: E-Wallet:	5.60	IBanking: IBanking:	5.60 2.80)
D001 D002 D003 D004 D005	Be Be Grab	FREE FREE	2.80 11.20 8.80	(Visa:	0.00 0.00 5.68	E-Wallet:	5.60 6.00 7.36	IBanking:	5.60 2.80 0.00)