

METROINFORMATOR

Technical solution description

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30 October, 2018

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1. TASK

Develop application that represents information system for private metro company. The system provides the ability to purchase electronic ticket on the train in different directions.

User cases:

- search train chains passing through station A to station B in a given date
- schedule of trains on station;
- ticket purchase:
 - if train has empty seats;
 - before the departure not less than 10 minutes;
 - the trip will take no more than one day

Administrator cases:

- adding new trains;
- opening/closing stations;
- deleting trains;
- viewing of all registered passenger train;
- viewing all trains;
- viewing status of all stations

Additionally, to develop co-application for railway scoreboard retrieving data from main application.

2. PROJECT GOALS

- The useful, reliable, fast and automated system
- Cohesive data model
- User-friendly interface
- Separate access to different system's part

3. ADDITIONAL FEATURES

- Search time-optimized path between stations on different branches taking into account closed transition stations
- Buying multiply tickets if begin and end stations located on different branches
- Automated schedule creation for the week ahead (can be changed)
- Automated cleaning old schedules
- Automated ticket-invalidation ticket if begin or end station are closed and before departure or arrival less than 10 minutes
- Sending SMS-messages:
 - when user was registered successfully
 - when ticket was invalidated (closed station or deleted train)
- Selenium UI – tests
- For tests used mini database in Docker
- JProfiler used for performance optimization and CPU-load control
- Continuous Integration with Jenkins

4. INSTRUMENTS AND TECHNOLOGIES

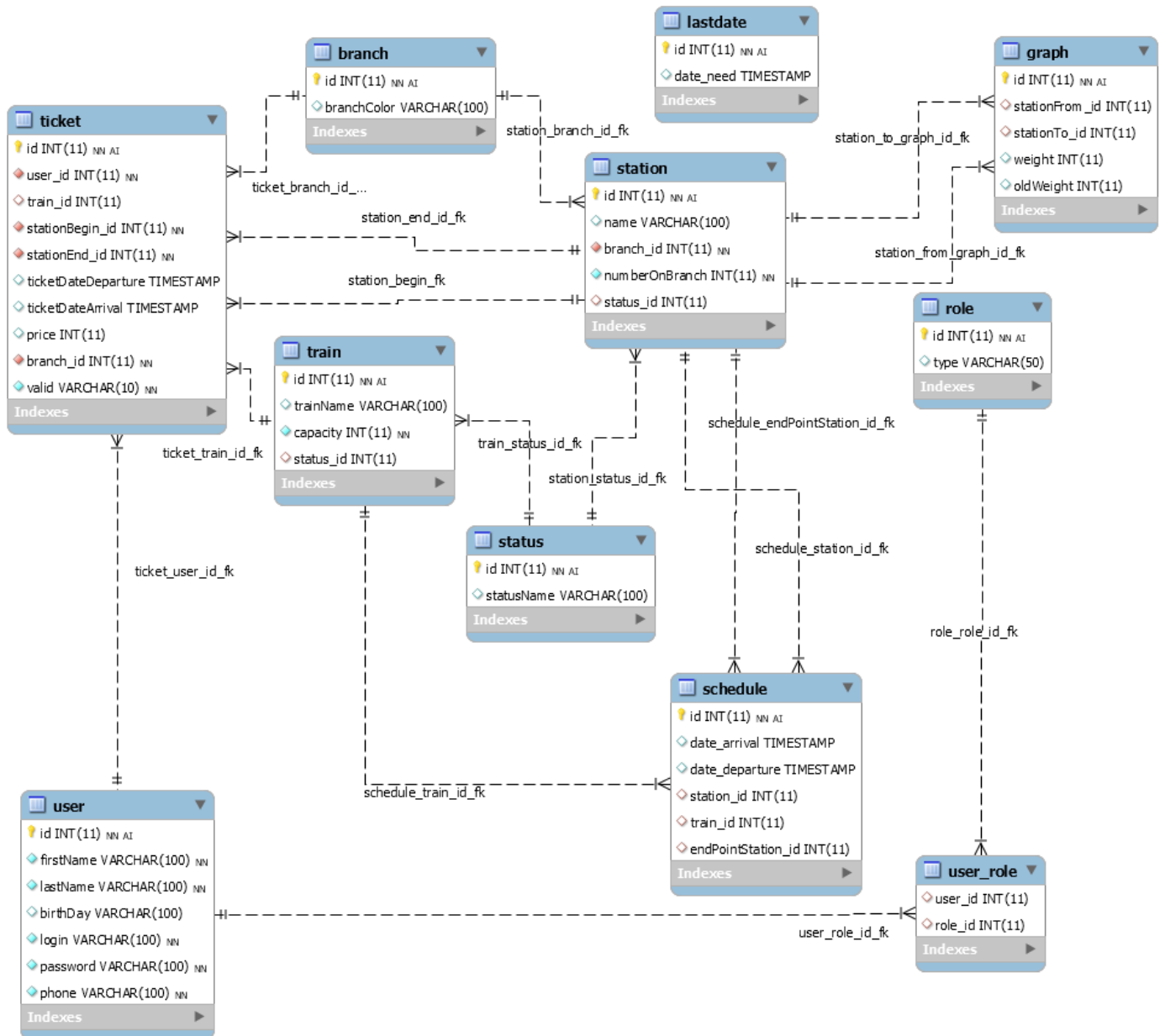
INSTRUMENTS

- IDE – IntelliJ IDEA
- DB – MySQL 8.0.12
- Docker 18.06.1-ce-win73 (19507)
- Jenkins 2.146
- JProfiler 10.1.3
- MAINSMS
- Maven 3.5.4
- Tomcat 8.5.33
- Wildfly 14.0.1.Final

TECHNOLOGIES

- Ajax
- Bootstrap 4.0
- Hibernate 5.3.1.Final
- Java 8
- JavaScript
- JPA 2.0
- JQuery
- JSF 2.1.7
- JSP 2.3.1
- JUnit
- Log4j 1.2.17
- Lombok 1.16.20
- Mockito 1.10.19
- Primefaces 6.1
- RabbitMQ 3.7.8
- REST
- Selenium 2.53.1
- SonarQube 6.7.5
- Spring Framework 5.0.8
- Spring Security 5.0.6

5. DATABASE MODEL



6. SYSTEM INFRASTRUCTURE

Front-end (browser presentation level):

- 1) Web-page structure - HTML
- 2) Page-design - CSS
- 3) Dynamic content - JavaScript, JQuery, Ajax.

Back-end (server based level):

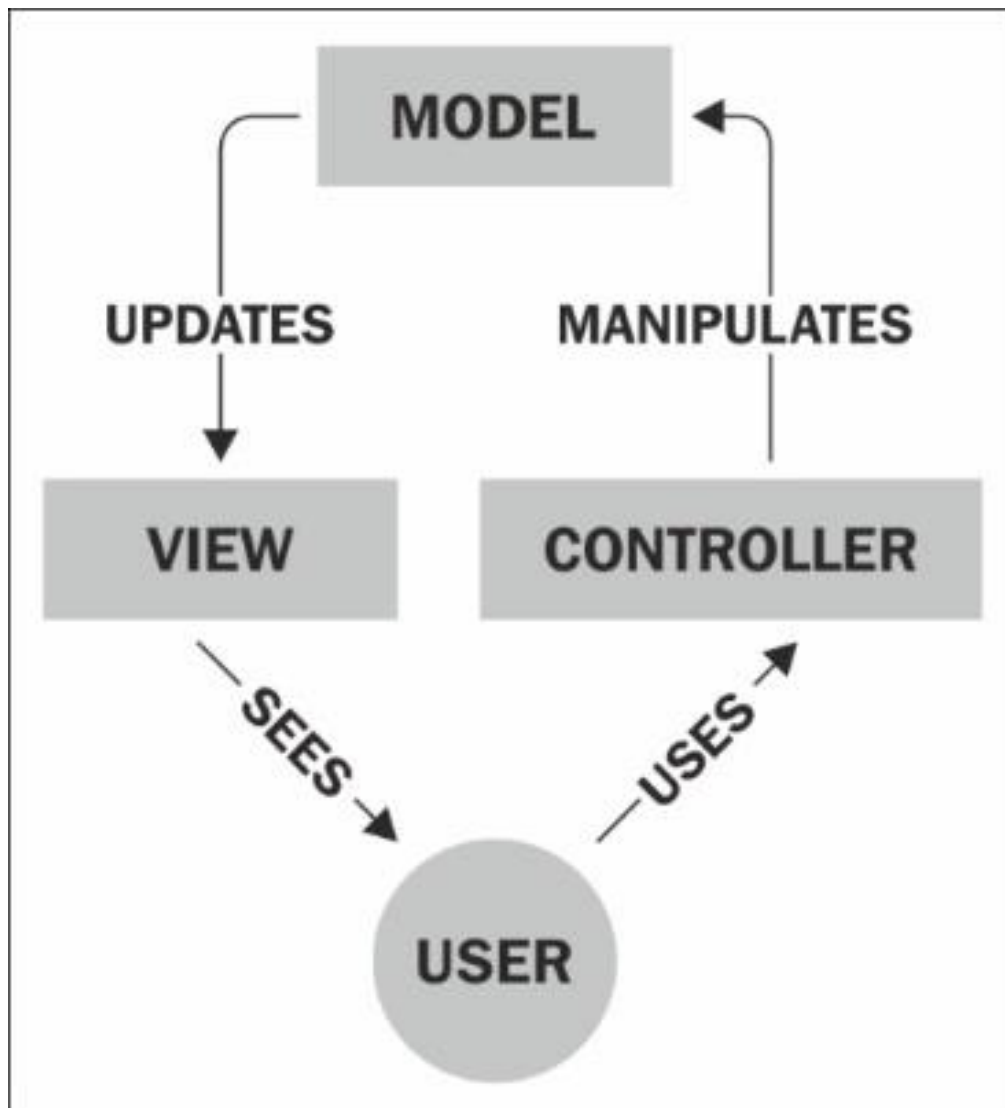
- 1) Application server - Tomcat
- 2) Database - MySQL
- 3) Server logic - Spring Framework

Client advertisement application:

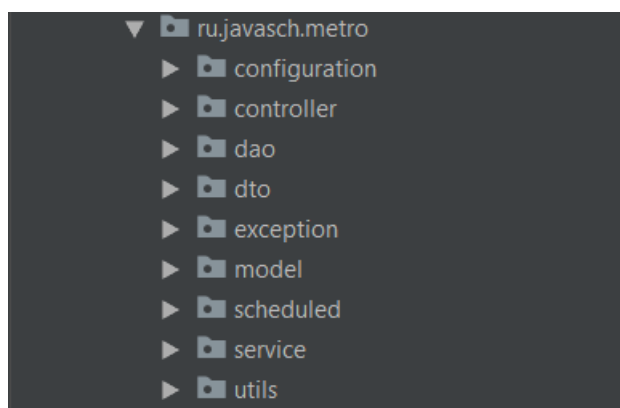
- 1) Web-pages - JSF
- 2) JMS - RabbitMQ
- 3) Application server - WildFly
- 4) Server logic - EJB
- 5) WS - REST

7. SYSTEM ARCHITECTURE

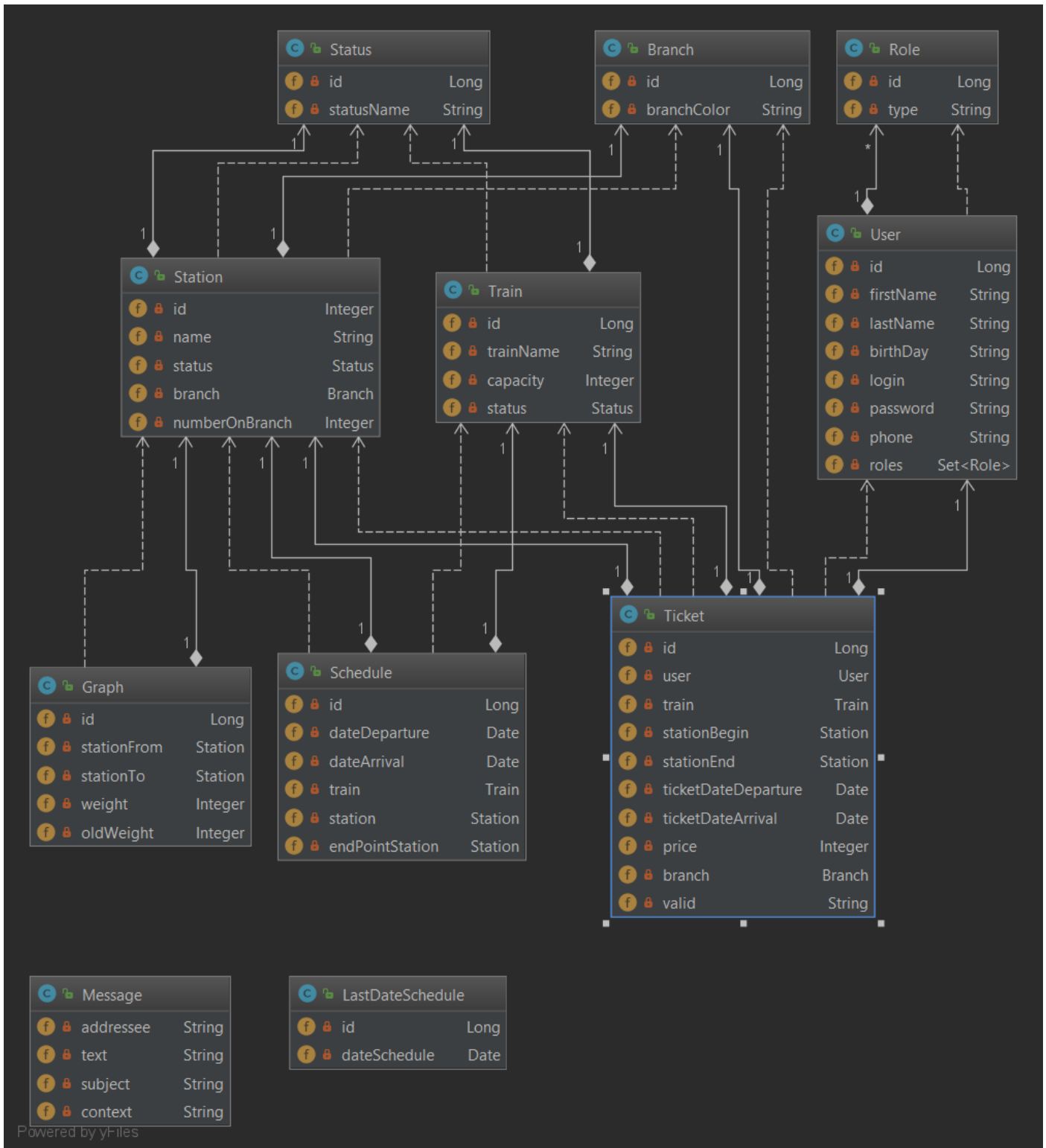
Architecture of server-based part presented by MVC - design pattern.



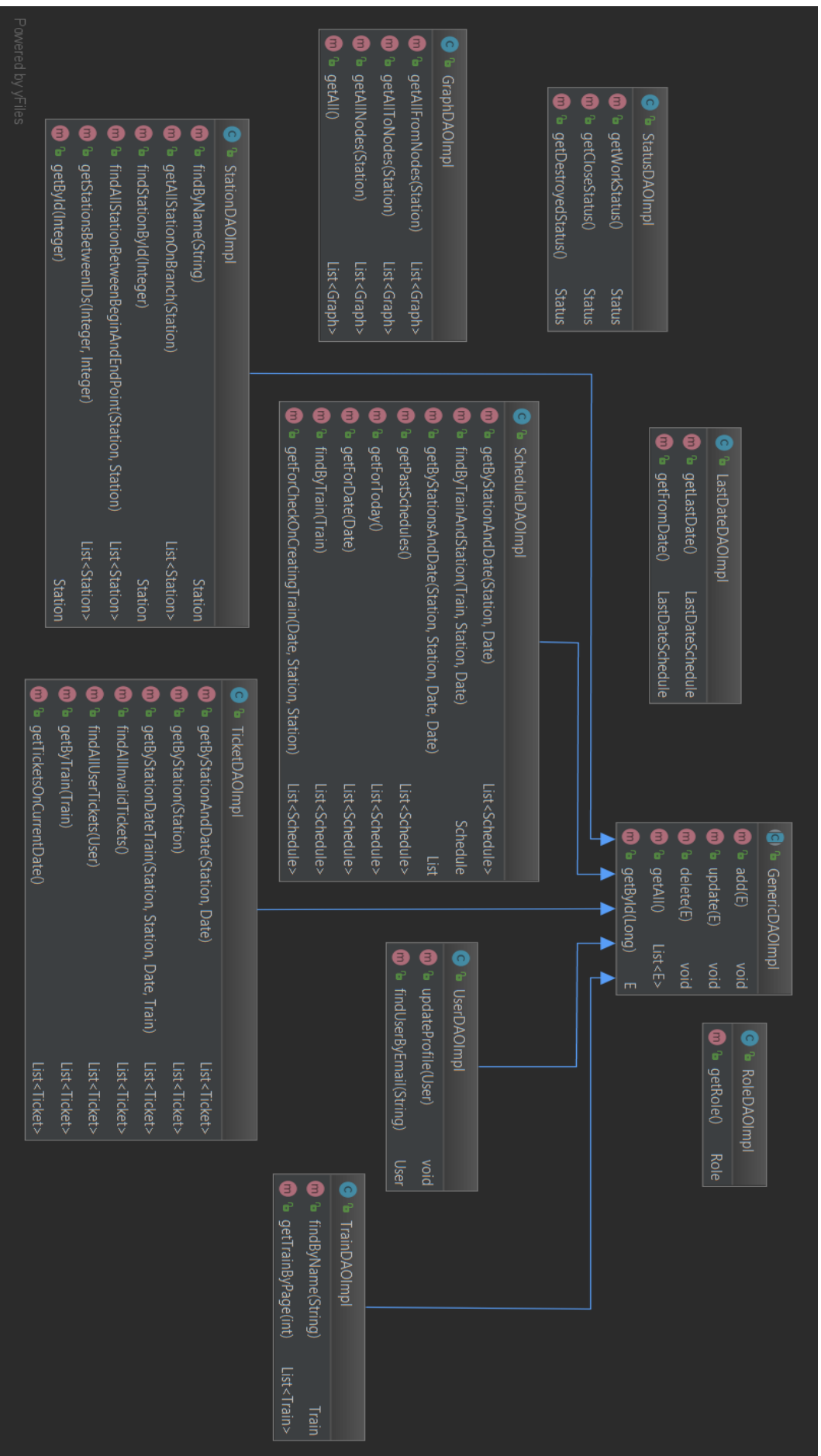
Class Structure:



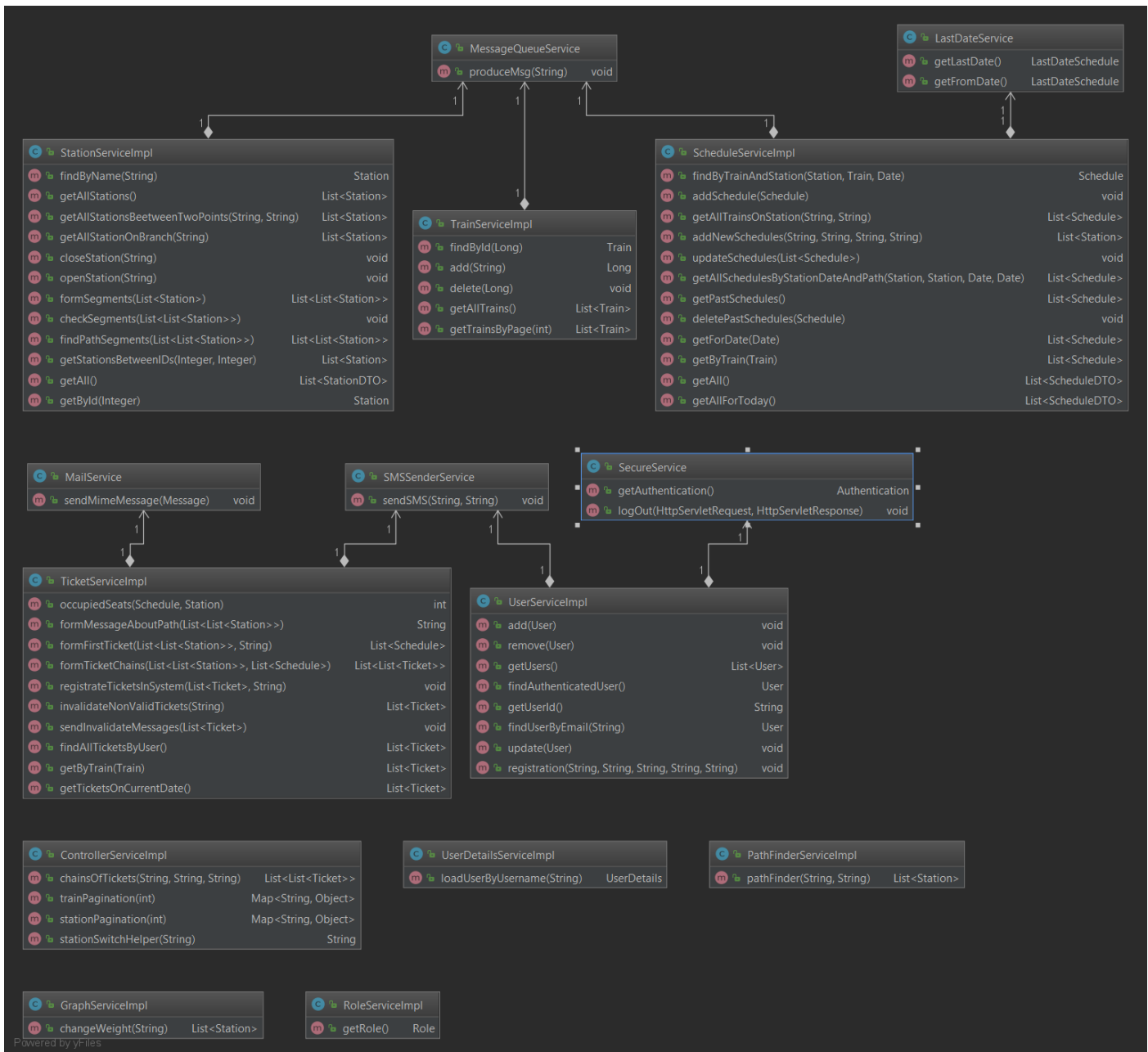
Model Level:



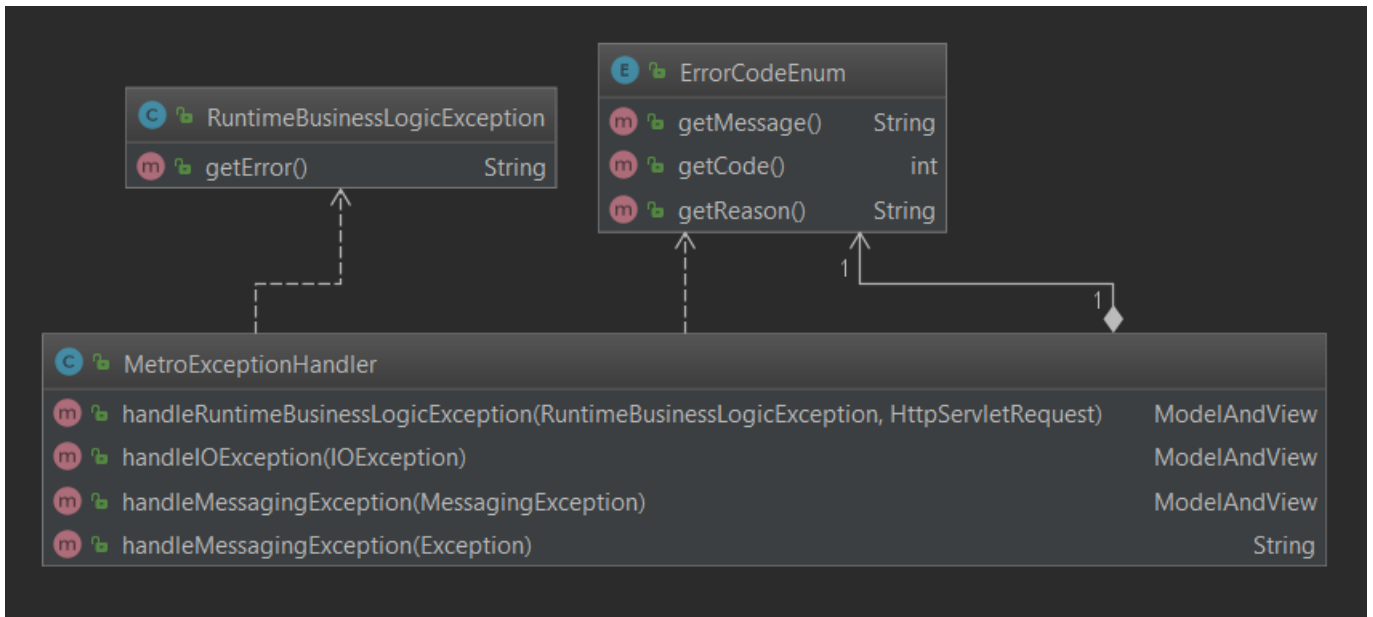
DAO Level:



Service Level:



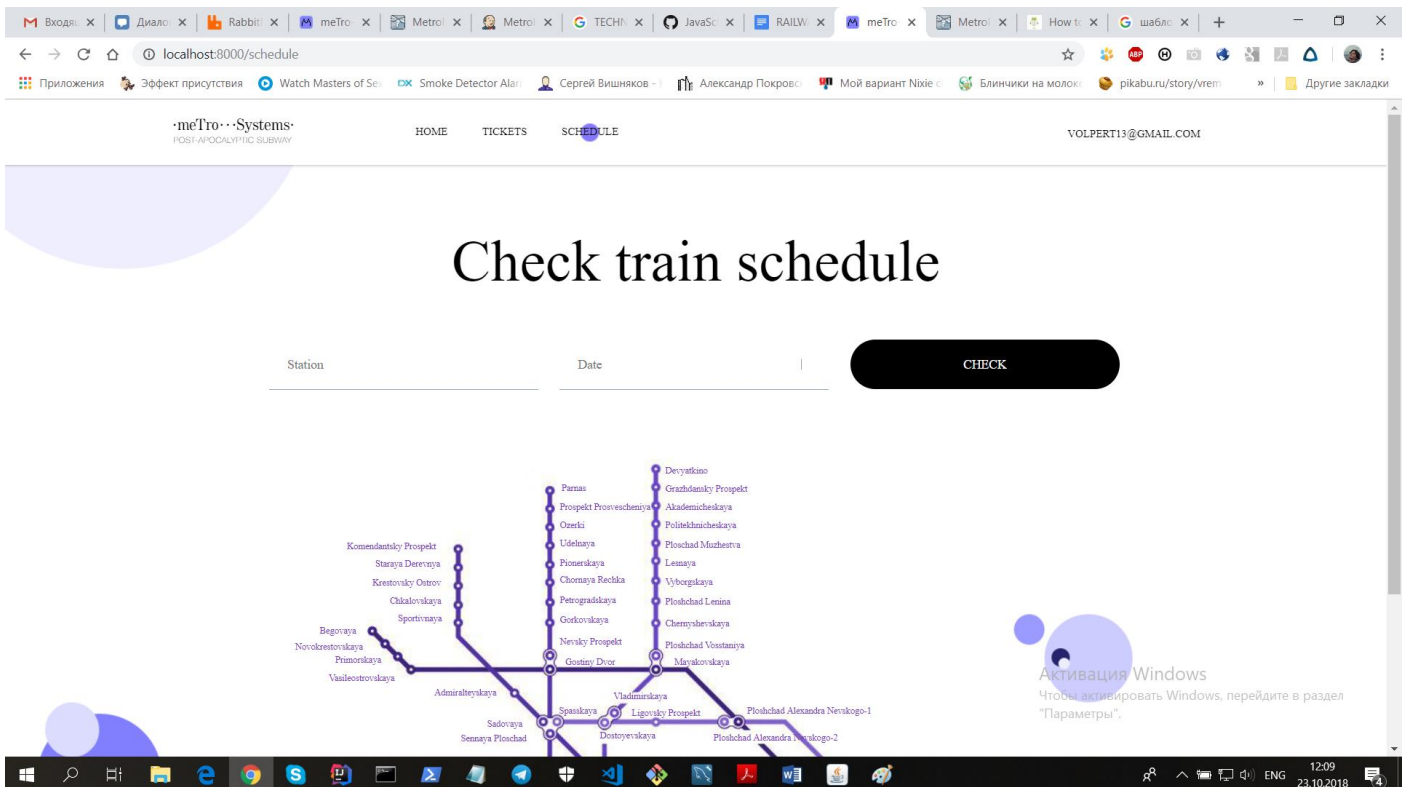
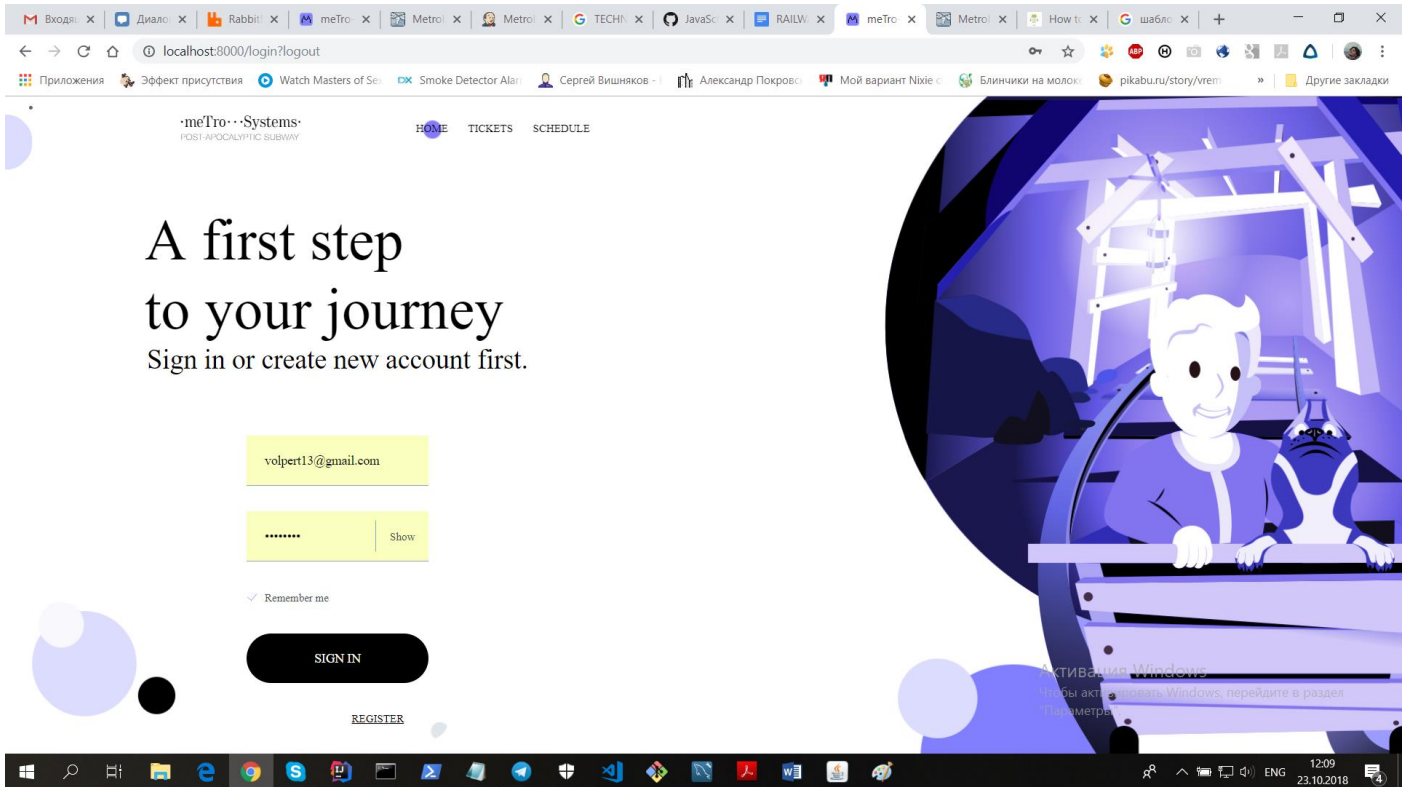
Exception Handler:



Error Codes:

```
USER_EXIST(1, "User already exist"),
EMPTY_FIELDS(2, "One or two fields are empty"),
BEGIN_STATION_CLOSED(3, "Begin station is closed"),
END_STATION_CLOSED(4, "End station is closed"),
ATS_ARE_CLOSED(5, "All Transition Stations are Closed. Can't find the way"),
STATION_CLOSED(6, "Station closed for some reason"),
NO_MORE_TICKETS(7, "All tickets was already booked. Please try new search"),
TRAIN_EXIST(8, "Such train already exist"),
NO_TRAIN_ON_DATE(9, "No trains on that date"),
INCORRECT_CRED(10, "Password must contain not less 6 numbers or letters"),
INCORRECT_EMAIL(11, "Invalid email"),
TO_LATE_FOR_TRAIN(12, "To late for train"),
EMPTY_FIELDS_TRAIN_FORM(13, "One or two fields are empty in train form are empty"),
INCORRECT_DATE_SCHEDULE(14, "Your date is in past"),
INCORRECT_DATE_TICKETS(15, "You trying to get tickets in past"),
TRAIN_IN_PAST(16, "You trying to add train in past"),
DONT_KNOW_STATION(17, "No such station in that form"),
THAT_TIME_ALREADY_USED_BY_ANOTHER_TRAIN(18, "That time already used by another train"),
NOT_AUTHORIZED_ADDING(19, "You trying to add train past schedules time border");
```

8. USER INTERFACE EXAMPLES



meTro...Systems
POST-APOCALYPTIC SUBWAY

HOME TICKETS SCHEDULE VOLPERT13@GMAIL.COM

Search for tickets

DEPARTURE	ARRIVAL	TRAIN	TRANSITIONS	TICKETS
08:00 Ozerki	18:25 Politekhniicheskaya	T-13	1 TRANSITION	BUY TICKETS
08:00 Ozerki	12:35 Tekhnologicheskyy Institut-2	T-13		
13:15 Tekhnologicheskyy Institut-1	18:25 Politekhniicheskaya	T-92		
08:35 Ozerki	19:00 Politekhniicheskaya	T-14	1 TRANSITION	BUY TICKETS
09:10 Ozerki	19:35 Politekhniicheskaya	T-15	1 TRANSITION	BUY TICKETS
09:45 Ozerki	20:10 Politekhniicheskaya	T-16	1 TRANSITION	BUY TICKETS

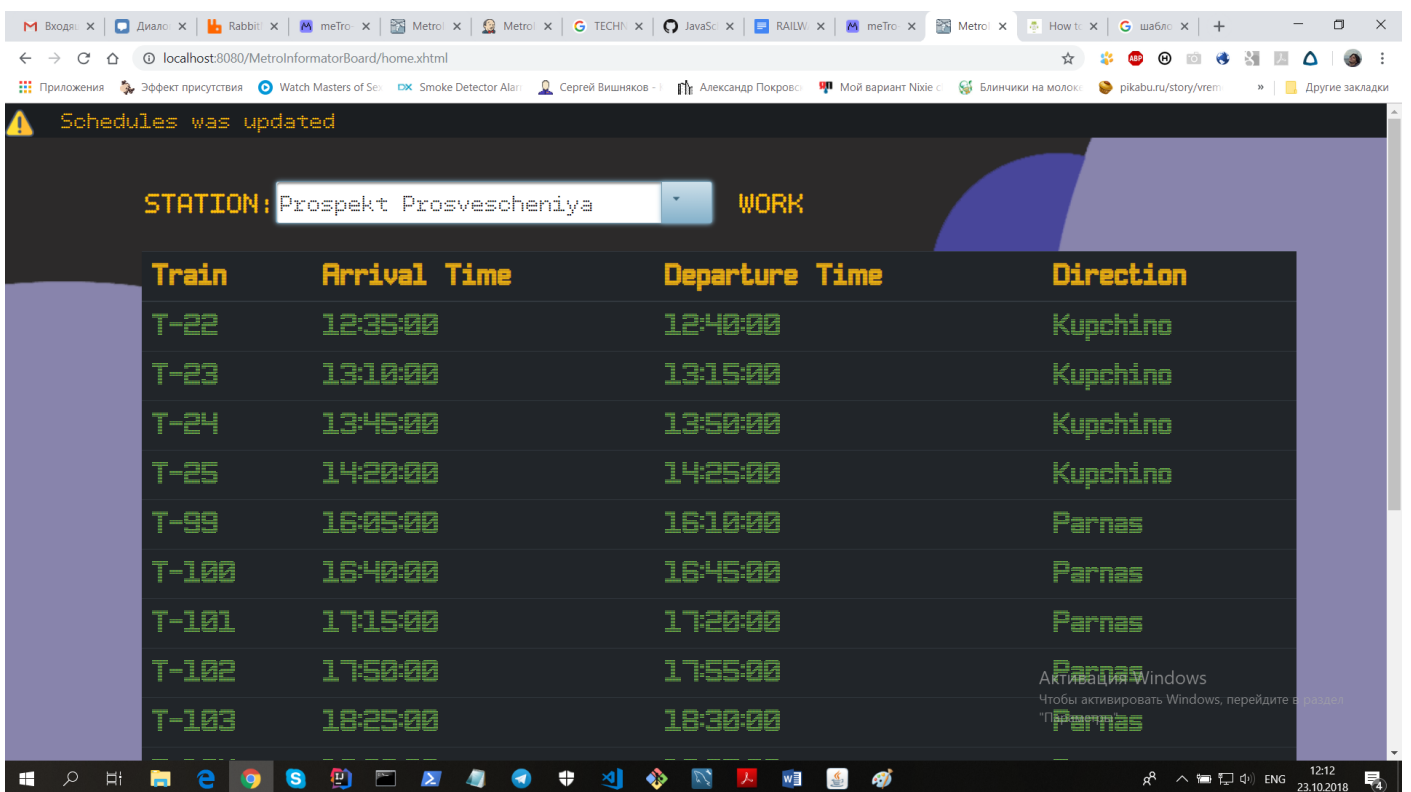
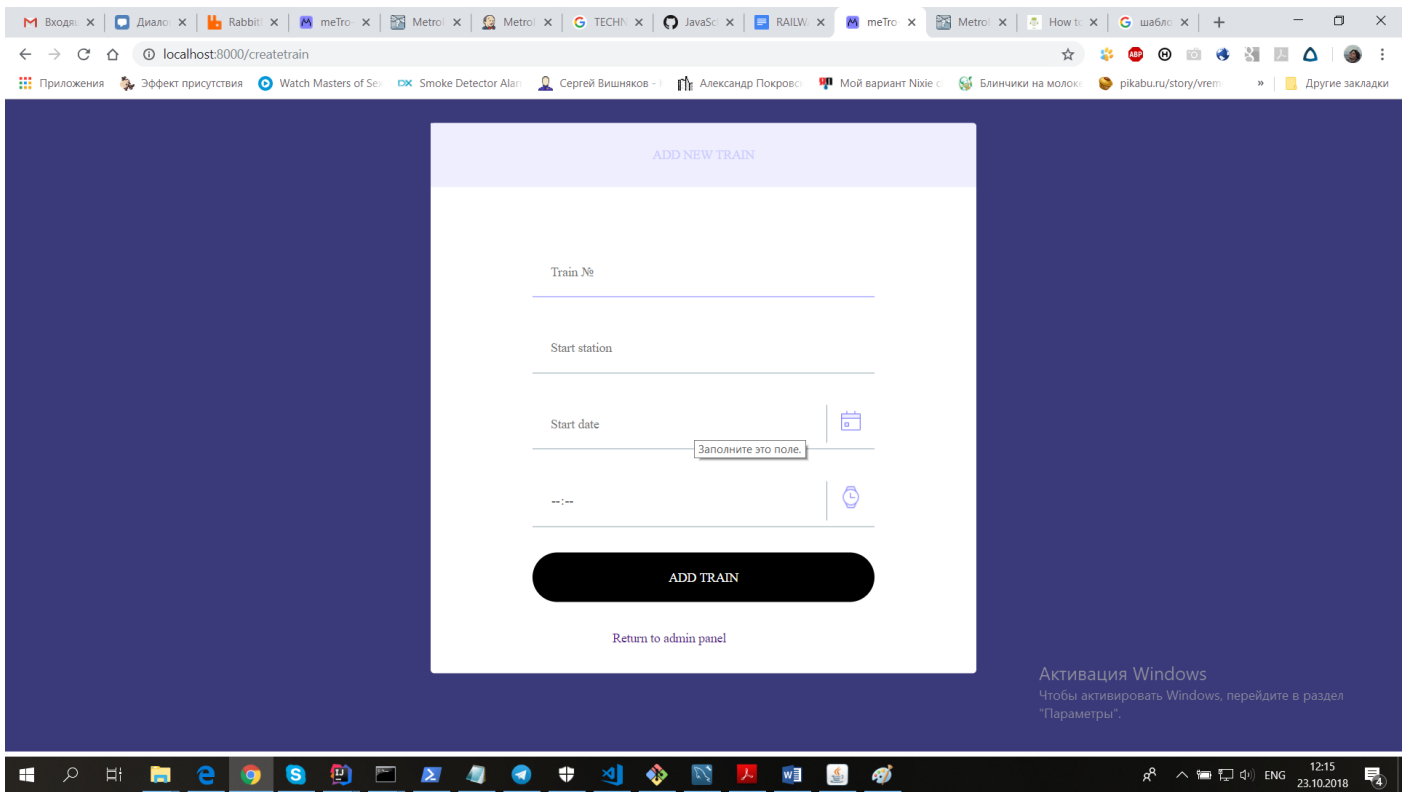
meTro...Systems
POST-APOCALYPTIC SUBWAY

HOME TICKETS SCHEDULE VOLPERT13@GMAIL.COM

Admin panel

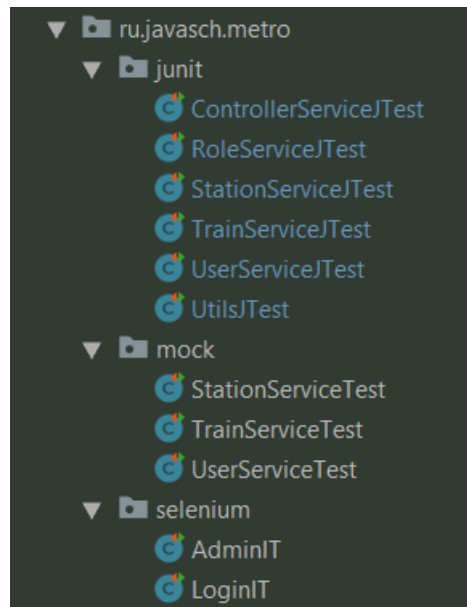
TRAINS STATIONS

STATION	STATUS
Devyatkino	WORKED
Grazhdansky Prospekt	WORKED
Akademicheskaya	WORKED
Politekhniicheskaya	WORKED
Plotschad Muzhestva	WORKED
Lesnaya	WORKED
Vyborgskaya	WORKED



9. CODE QUALITY

Test Structure:



JUnit Tests:

```
[INFO] Tests run: 3, Failures: 0, Errors: 0, Skipped: 0, Time elapsed: 6.792 s - in ru.javasch.metro.junit.ControllerServiceJTest
[INFO] Running ru.javasch.metro.junit.RoleServiceJTest
[INFO] Tests run: 1, Failures: 0, Errors: 0, Skipped: 0, Time elapsed: 0.005 s - in ru.javasch.metro.junit.RoleServiceJTest
[INFO] Running ru.javasch.metro.junit.StationServiceJTest
[INFO] Tests run: 7, Failures: 0, Errors: 0, Skipped: 0, Time elapsed: 0.459 s - in ru.javasch.metro.junit.StationServiceJTest
[INFO] Running ru.javasch.metro.junit.TrainServiceJTest
INFO    2018-10-23 12:14:41,461 [main] ru.javasch.metro.service.implementations.TrainServiceImpl - TRAIN ADDED
INFO    2018-10-23 12:14:41,464 [main] ru.javasch.metro.service.implementations.TrainServiceImpl - TRAIN T-999 REMOVED
INFO    2018-10-23 12:14:41,602 [main] ru.javasch.metro.service.implementations.MessageQueueService - [x] Sent 'deletedtrain schedules []'
[INFO] Tests run: 5, Failures: 0, Errors: 0, Skipped: 0, Time elapsed: 0.378 s - in ru.javasch.metro.junit.TrainServiceJTest
[INFO] Running ru.javasch.metro.junit.UserServiceJTest
INFO    2018-10-23 12:14:41,820 [main] ru.javasch.metro.service.implementations.UserServiceImpl - EXCEPTION: One or two fields are empty
[INFO] Tests run: 3, Failures: 0, Errors: 0, Skipped: 0, Time elapsed: 0.179 s - in ru.javasch.metro.junit.UserServiceJTest
[INFO] Running ru.javasch.metro.junit.UtilsJTest
[INFO] Tests run: 2, Failures: 0, Errors: 0, Skipped: 0, Time elapsed: 0.005 s - in ru.javasch.metro.junit.UtilsJTest
[INFO] Running ru.javasch.metro.mock.StationServiceTest
[INFO] Tests run: 3, Failures: 0, Errors: 0, Skipped: 0, Time elapsed: 0.088 s - in ru.javasch.metro.mock.StationServiceTest
[INFO] Running ru.javasch.metro.mock.TrainServiceTest
[INFO] Tests run: 2, Failures: 0, Errors: 0, Skipped: 0, Time elapsed: 0.005 s - in ru.javasch.metro.mock.TrainServiceTest
[INFO] Running ru.javasch.metro.mock.UserServiceTest
[INFO] Tests run: 5, Failures: 0, Errors: 0, Skipped: 0, Time elapsed: 0.004 s - in ru.javasch.metro.mock.UserServiceTest
[INFO] Results:
[INFO] Tests run: 31, Failures: 0, Errors: 0, Skipped: 0
[INFO] BUILD SUCCESS
[INFO] Total time: 14.401 s
[INFO] Finished at: 2018-10-23T12:14:42+03:00
```

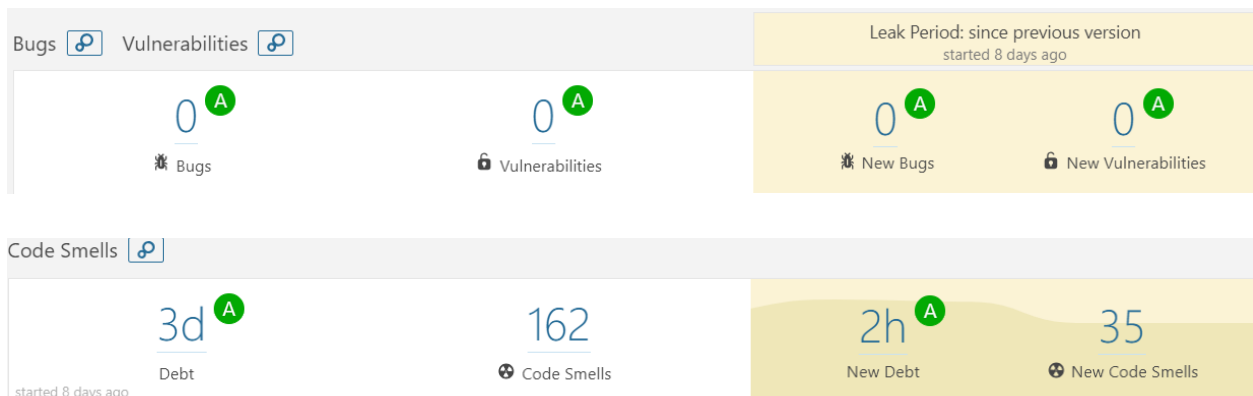
Selenium Tests:

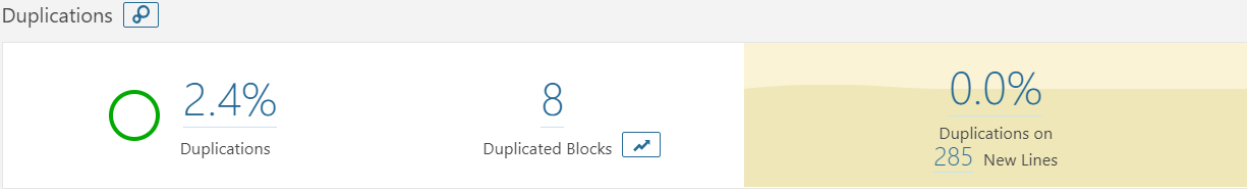
```
[INFO] -----
[INFO] T E S T S
[INFO] -----
[INFO] Running ru.javasch.metro.selenium.AdminIT
SLF4J: Failed to load class "org.slf4j.impl.StaticLoggerBinder".
SLF4J: Defaulting to no-operation (NOP) logger implementation
SLF4J: See http://www.slf4j.org/codes.html#StaticLoggerBinder for further details.
Starting ChromeDriver 2.42.591088 (7b2b2dca23cca0862f674758c9a3933e685c27d5) on port 28063
Only local connections are allowed.
Starting ChromeDriver 2.42.591088 (7b2b2dca23cca0862f674758c9a3933e685c27d5) on port 3941
Only local connections are allowed.
Starting ChromeDriver 2.42.591088 (7b2b2dca23cca0862f674758c9a3933e685c27d5) on port 45296
Only local connections are allowed.
[INFO] Tests run: 3, Failures: 0, Errors: 0, Skipped: 0, Time elapsed: 35.17 s - in ru.javasch.metro.selenium.AdminIT
[INFO] Running ru.javasch.metro.selenium.LoginIT
Starting ChromeDriver 2.42.591088 (7b2b2dca23cca0862f674758c9a3933e685c27d5) on port 46622
Only local connections are allowed.
Starting ChromeDriver 2.42.591088 (7b2b2dca23cca0862f674758c9a3933e685c27d5) on port 42516
Only local connections are allowed.
Starting ChromeDriver 2.42.591088 (7b2b2dca23cca0862f674758c9a3933e685c27d5) on port 44509
Only local connections are allowed.
Starting ChromeDriver 2.42.591088 (7b2b2dca23cca0862f674758c9a3933e685c27d5) on port 28756
Only local connections are allowed.
[INFO] Tests run: 4, Failures: 0, Errors: 0, Skipped: 0, Time elapsed: 24.964 s - in ru.javasch.metro.selenium.LoginIT
[INFO]
[INFO] Results:
[INFO]
[INFO] Tests run: 7, Failures: 0, Errors: 0, Skipped: 0
[INFO]
[INFO] -----
[INFO] BUILD SUCCESS
[INFO] -----
```

Sonar Report:

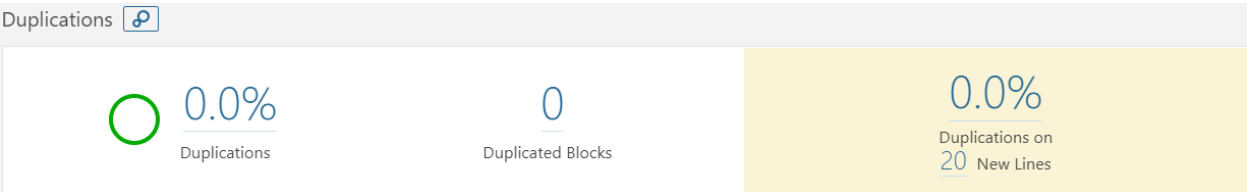
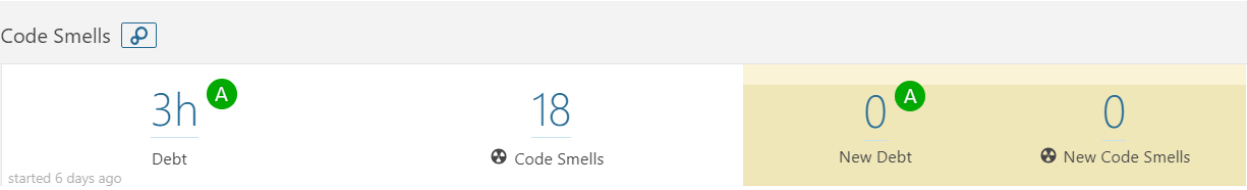
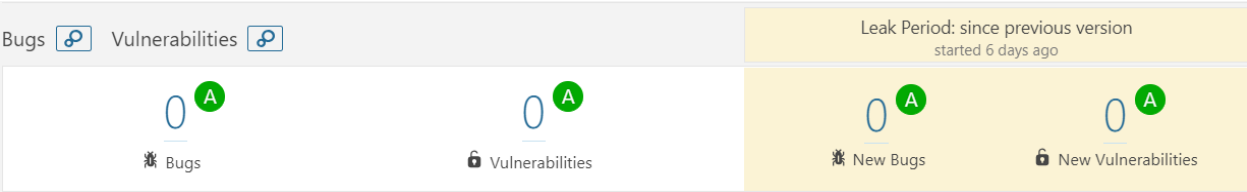
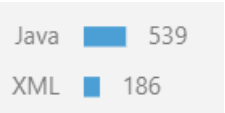
Main App:

Java 3.8k
XML 317





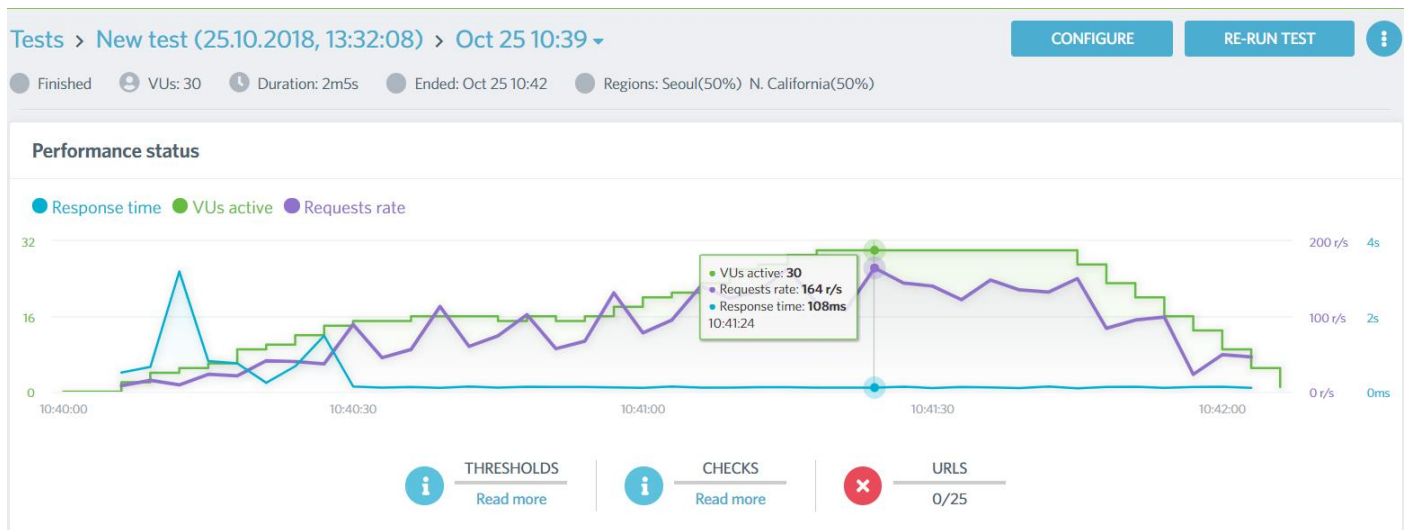
Scoreboard App:



Stress Testing:

Load Impact

(30 virtual users, through NGROK)



JMeter + JProfiler

(1000 users)

Jmeter test

HTTP Request

Name: HTTP Request

Comments:
▲▼

Basic Advanced

Web Server

Protocol [http]: http Server Name or IP: localhost Port Number: 8000

HTTP Request

Method: POST Path: /schedule Content encoding:
Redirect Automatically Follow Redirects Use KeepAlive Use multipart/form-data Browser-compatible headers

Parameters Body Data Files Upload

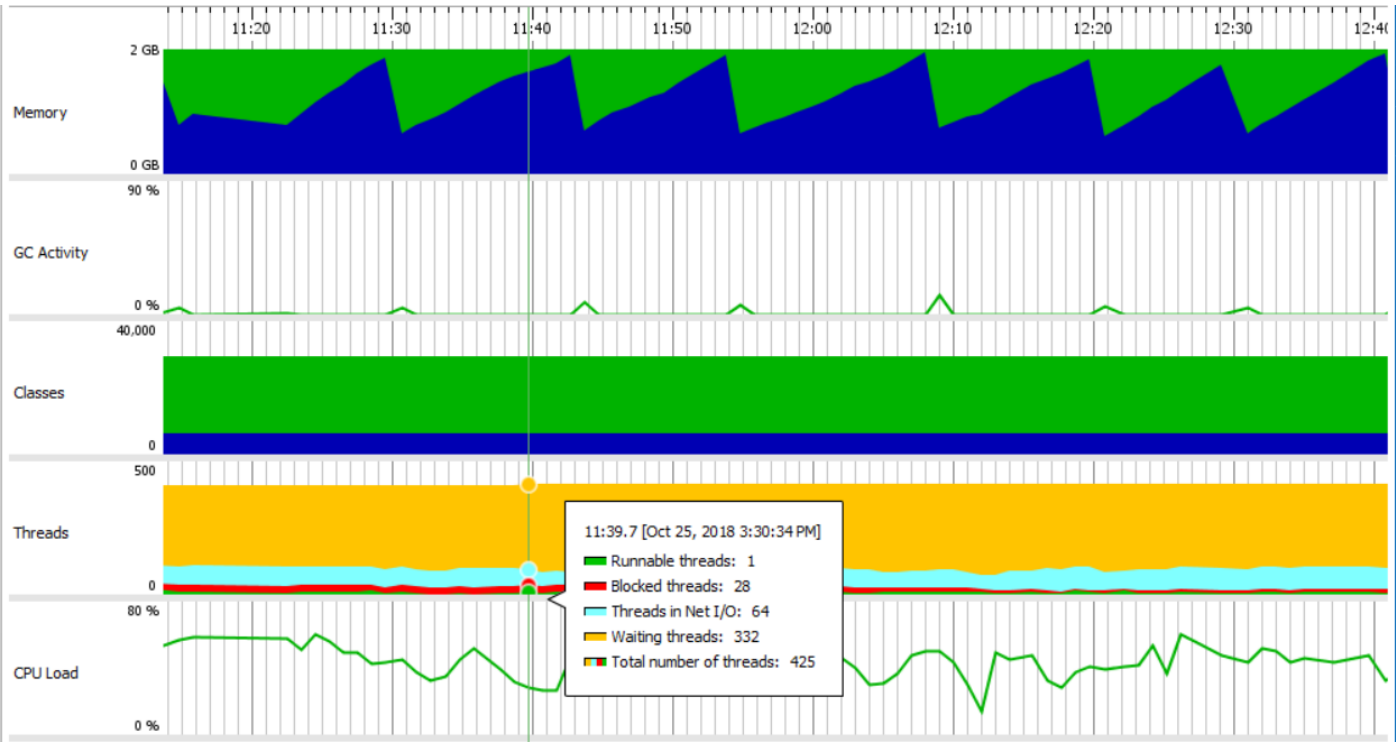
Send Parameters With the Request:

Name	Value	URL Encode?	Content-Type	Include Equals?
start	Kupchino	<input type="checkbox"/>	text/plain	<input type="checkbox"/>
date	26.10.2018	<input type="checkbox"/>	text/plain	<input checked="" type="checkbox"/>

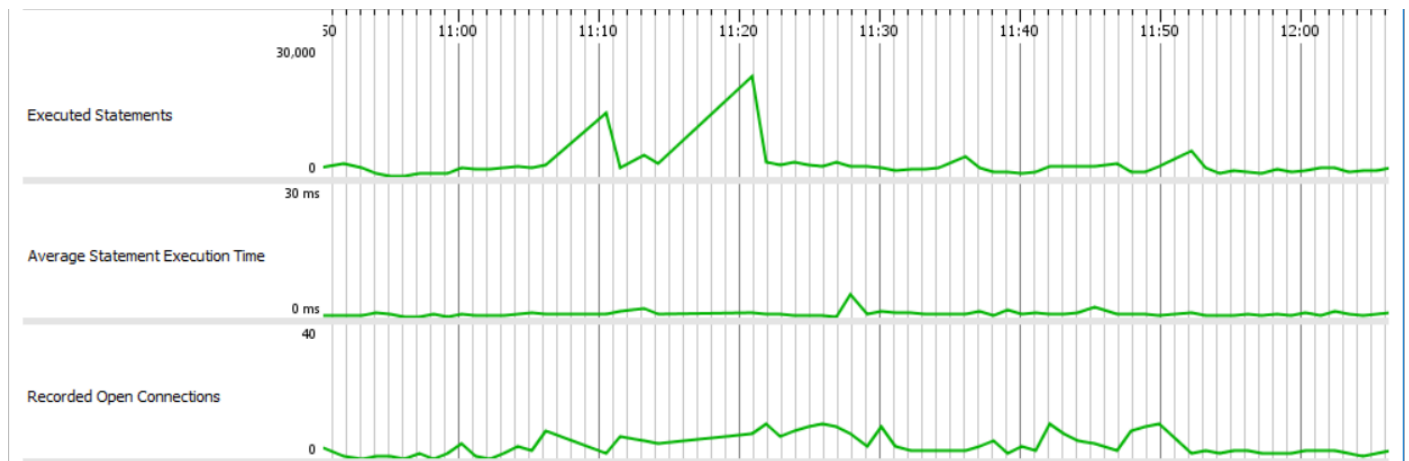
Jmeter results (error rate is ~3 - 6% due to Windows port recycling):

Sample #	Start Time	Thread Name	Label	Sample Time(ms)	Status	Bytes	Sent Bytes	Latency	Connect Time(ms)
256113	15:33:10.379	Thread Group 1-72	HTTP Request	104	✓	36838	118	104	0
256114	15:33:10.348	Thread Group 1-60	HTTP Request	135	✓	36838	118	134	0
256115	15:33:10.483	Thread Group 1-72	HTTP Request	1	✓	26217	123	1	0
256116	15:33:10.483	Thread Group 1-60	HTTP Request	2	✓	26217	123	1	0
256117	15:33:10.382	Thread Group 1-8	HTTP Request	104	✓	26217	123	103	0
256118	15:33:10.197	Thread Group 1-48	HTTP Request	289	✓	36838	118	287	0
256119	15:33:10.382	Thread Group 1-61	HTTP Request	106	✓	36838	118	105	0
256120	15:33:10.483	Thread Group 1-77	HTTP Request	7	✗	2531	0	0	7
256121	15:33:10.490	Thread Group 1-8	HTTP Request	4	✗	2531	0	0	4
256122	15:33:10.490	Thread Group 1-77	HTTP Request	4	✗	2531	0	0	4
256123	15:33:10.488	Thread Group 1-61	HTTP Request	7	✓	26217	123	1	0
256124	15:33:10.405	Thread Group 1-2	HTTP Request	109	✓	26217	123	92	0
256125	15:33:10.234	Thread Group 1-12	HTTP Request	280	✓	13365	241	280	0
256126	15:33:10.514	Thread Group 1-12	HTTP Request	2	✓	36838	118	1	0
256127	15:33:10.494	Thread Group 1-8	HTTP Request	39	✗	2531	0	0	39
256128	15:33:10.224	Thread Group 1-85	HTTP Request	310	✓	13365	241	310	0
256129	15:33:10.534	Thread Group 1-85	HTTP Request	1	✓	36838	118	1	0
256130	15:33:10.535	Thread Group 1-85	HTTP Request	1	✓	26217	123	1	0
256131	15:33:10.415	Thread Group 1-87	HTTP Request	122	✓	26217	123	122	0
256132	15:33:10.372	Thread Group 1-5	HTTP Request	166	✓	13365	241	162	1
256133	15:33:10.538	Thread Group 1-5	HTTP Request	1	✓	36838	118	0	0
256134	15:33:10.349	Thread Group 1-57	HTTP Request	200	✓	13365	241	200	0
256135	15:33:10.533	Thread Group 1-2	HTTP Request	34	✗	2531	0	0	34
256136	15:33:10.533	Thread Group 1-8	HTTP Request	34	✗	2531	0	0	34
256137	15:33:10.540	Thread Group 1-85	HTTP Request	28	✗	2531	0	0	28
256138	15:33:10.568	Thread Group 1-8	HTTP Request	4	✗	2531	0	0	4
256139	15:33:10.567	Thread Group 1-87	HTTP Request	5	✗	2531	0	0	5
256140	15:33:10.328	Thread Group 1-15	HTTP Request	244	✓	13365	241	244	1
256141	15:33:10.377	Thread Group 1-40	HTTP Request	195	✓	13365	241	195	1
256142	15:33:10.572	Thread Group 1-40	HTTP Request	1	✓	36838	118	1	0
256143	15:33:10.572	Thread Group 1-15	HTTP Request	1	✓	36838	118	1	0
256144	15:33:10.573	Thread Group 1-15	HTTP Request	1	✓	26217	123	1	0
256145	15:33:10.573	Thread Group 1-40	HTTP Request	1	✓	26217	123	1	0

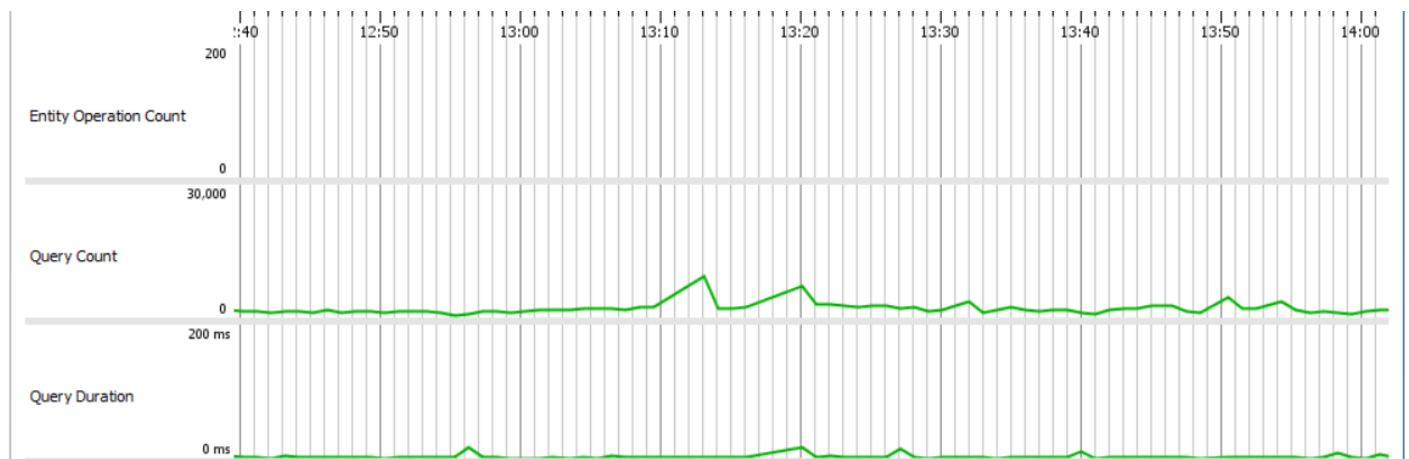
JProfiler under load



JDBC under load



JPA/Hibernate under load




Logging:






```
INFO 2018-10-23 12:30:06,137 [pool-1-thread-3] ru.javasch.metro.scheduled.ScheduledTasks - deleted schedules[]
INFO 2018-10-23 12:30:06,138 [pool-1-thread-3] ru.javasch.metro.scheduled.ScheduledTasks - MESSAGE SENDED: deleted schedules
INFO 2018-10-23 12:30:06,139 [pool-1-thread-3] ru.javasch.metro.scheduled.ScheduledTasks - TIME SCHEDULE CLEANER END WORK. CLEANED 0 RECORDS
INFO 2018-10-23 12:30:56,046 [pool-1-thread-2] ru.javasch.metro.scheduled.ScheduledTasks - TICKET INVALIDATOR CLEANER STARTED
INFO 2018-10-23 12:30:56,048 [pool-1-thread-2] ru.javasch.metro.scheduled.ScheduledTasks - TICKET INVALIDATOR CLEANER END WORK. 0 WAS INVALIDATED
INFO 2018-10-23 12:31:06,148 [pool-1-thread-7] ru.javasch.metro.scheduled.ScheduledTasks - TIME SCHEDULE CLEANER STARTED
INFO 2018-10-23 12:31:06,163 [pool-1-thread-7] ru.javasch.metro.service.implementations.MessageQueueService - [x] Sent 'deletedupdate schedules []'
INFO 2018-10-23 12:31:06,166 [pool-1-thread-7] ru.javasch.metro.scheduled.ScheduledTasks - deleted schedules[]
INFO 2018-10-23 12:31:06,168 [pool-1-thread-7] ru.javasch.metro.scheduled.ScheduledTasks - MESSAGE SENDED: deleted schedules
INFO 2018-10-23 12:31:06,170 [pool-1-thread-7] ru.javasch.metro.scheduled.ScheduledTasks - TIME SCHEDULE CLEANER END WORK. CLEANED 0 RECORDS
INFO 2018-10-23 12:31:56,058 [pool-1-thread-8] ru.javasch.metro.scheduled.ScheduledTasks - TICKET INVALIDATOR CLEANER STARTED
INFO 2018-10-23 12:31:56,059 [pool-1-thread-8] ru.javasch.metro.scheduled.ScheduledTasks - TICKET INVALIDATOR CLEANER END WORK. 0 WAS INVALIDATED
INFO 2018-10-23 12:32:06,181 [pool-1-thread-1] ru.javasch.metro.scheduled.ScheduledTasks - TIME SCHEDULE CLEANER STARTED
INFO 2018-10-23 12:32:06,189 [pool-1-thread-1] ru.javasch.metro.service.implementations.MessageQueueService - [x] Sent 'deletedupdate schedules []'
INFO 2018-10-23 12:32:06,192 [pool-1-thread-1] ru.javasch.metro.scheduled.ScheduledTasks - deleted schedules[]
INFO 2018-10-23 12:32:06,193 [pool-1-thread-1] ru.javasch.metro.scheduled.ScheduledTasks - MESSAGE SENDED: deleted schedules
INFO 2018-10-23 12:32:06,193 [pool-1-thread-1] ru.javasch.metro.scheduled.ScheduledTasks - TIME SCHEDULE CLEANER END WORK. CLEANED 0 RECORDS
INFO 2018-10-23 12:32:56,065 [pool-1-thread-9] ru.javasch.metro.scheduled.ScheduledTasks - TICKET INVALIDATOR CLEANER STARTED
INFO 2018-10-23 12:32:56,067 [pool-1-thread-9] ru.javasch.metro.scheduled.ScheduledTasks - TICKET INVALIDATOR CLEANER END WORK. 0 WAS INVALIDATED
INFO 2018-10-23 12:33:06,204 [pool-1-thread-10] ru.javasch.metro.scheduled.ScheduledTasks - TIME SCHEDULE CLEANER STARTED
INFO 2018-10-23 12:33:06,242 [pool-1-thread-10] ru.javasch.metro.service.implementations.MessageQueueService - [x] Sent 'deletedupdate schedules []'
INFO 2018-10-23 12:33:06,249 [pool-1-thread-10] ru.javasch.metro.scheduled.ScheduledTasks - deleted schedules[]
INFO 2018-10-23 12:33:06,251 [pool-1-thread-10] ru.javasch.metro.scheduled.ScheduledTasks - MESSAGE SENDED: deleted schedules
```

10. DEVELOPMENT WORKFLOW

Jenkins (reports and settings):

 **История сборок** [тренд](#)

x

 #119	23.10.2018 12:24
 #118	23.10.2018 12:09
 #117	23.10.2018 11:54
 #116	23.10.2018 11:39
 #115	23.10.2018 11:24

General [Управление исходным кодом](#) [Триггеры сборки](#) [Среда сборки](#) [Сборка](#) [Послесборочные операции](#)

Описание

[Plain text] [Предпросмотр](#)

☒ GitHub project

Project url

[Расширенные...](#)

Управление исходным кодом


☐ Нет ☒ Git

Repositories

Repository URL

Credentials

- none -

 Add

[Расширенные...](#)

[Add Repository](#)

Branches to build

Branch Specifier (blank for 'any')

[X](#)

[Add Branch](#)

Просмотрщик репозитория

Additional Behaviours

[Добавить](#)

Сборка

Вызвать цели Maven верхнего уровня

Версия Maven MAVEN

Цели -f MetroInformer/pom.xml test

Расширенные...

Вызвать цели Maven верхнего уровня

Версия Maven MAVEN

Цели -f MetroInformer/pom.xml sonar:sonar

Расширенные...

Вызвать цели Maven верхнего уровня

Версия Maven MAVEN

Цели -f MetroInformerBoard/pom.xml clean install

Расширенные...

Вызвать цели Maven верхнего уровня

Версия Maven MAVEN

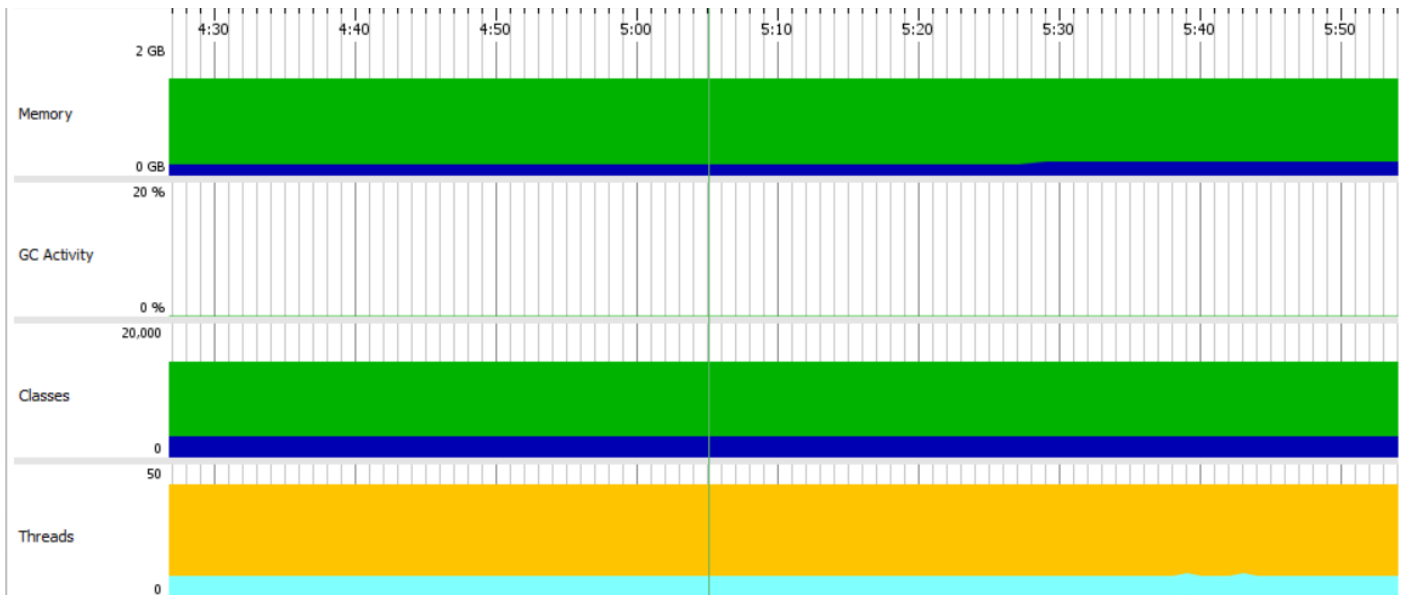
Цели -f MetroInformerBoard/pom.xml sonar:sonar

Расширенные...

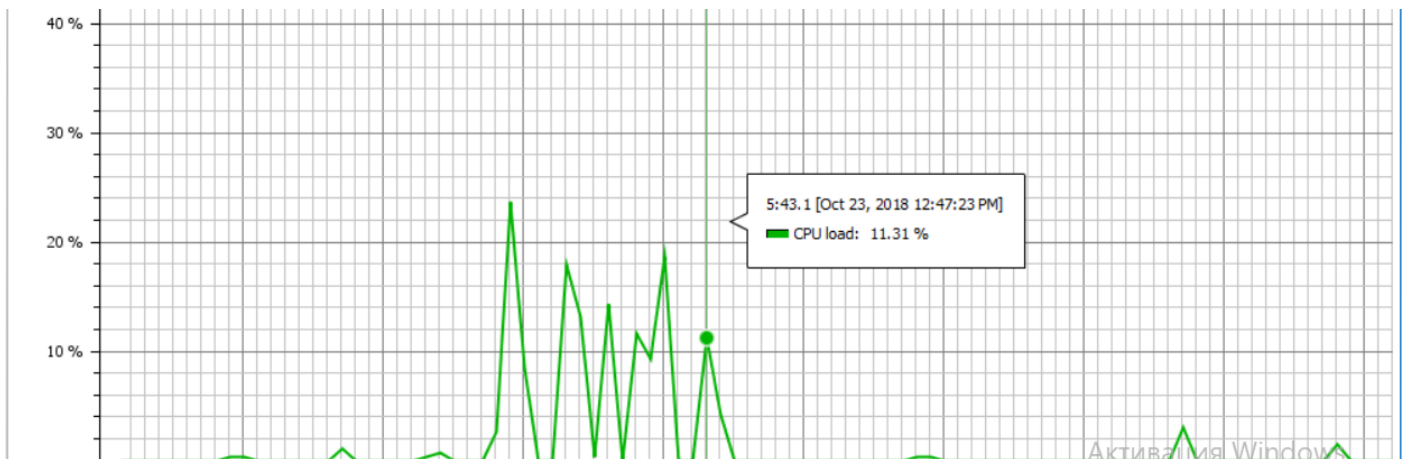
JProfiler metrics (idle):

MAIN APP

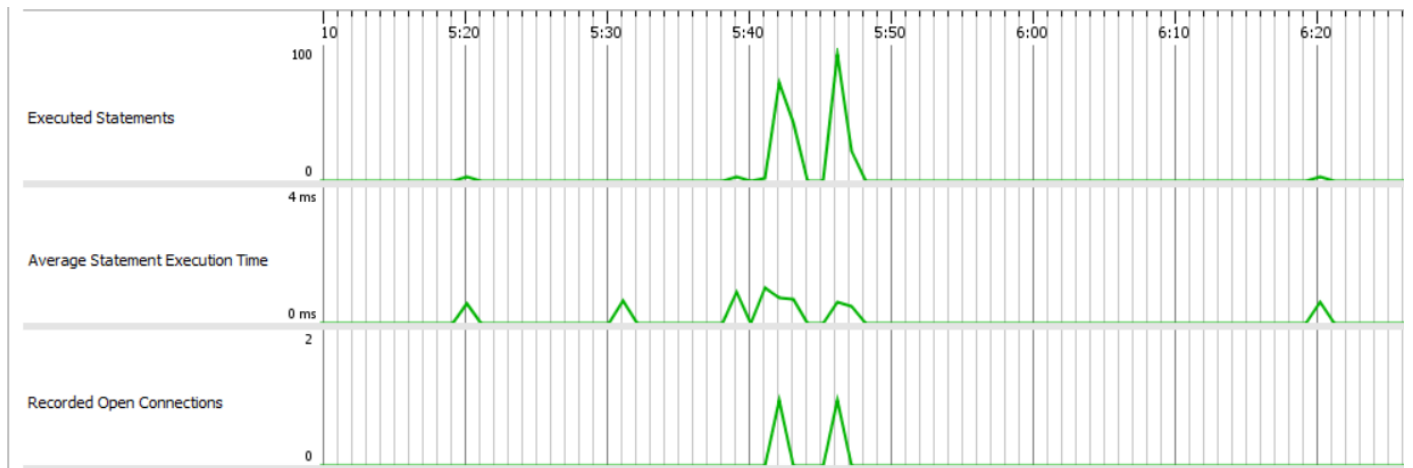
Common metrics



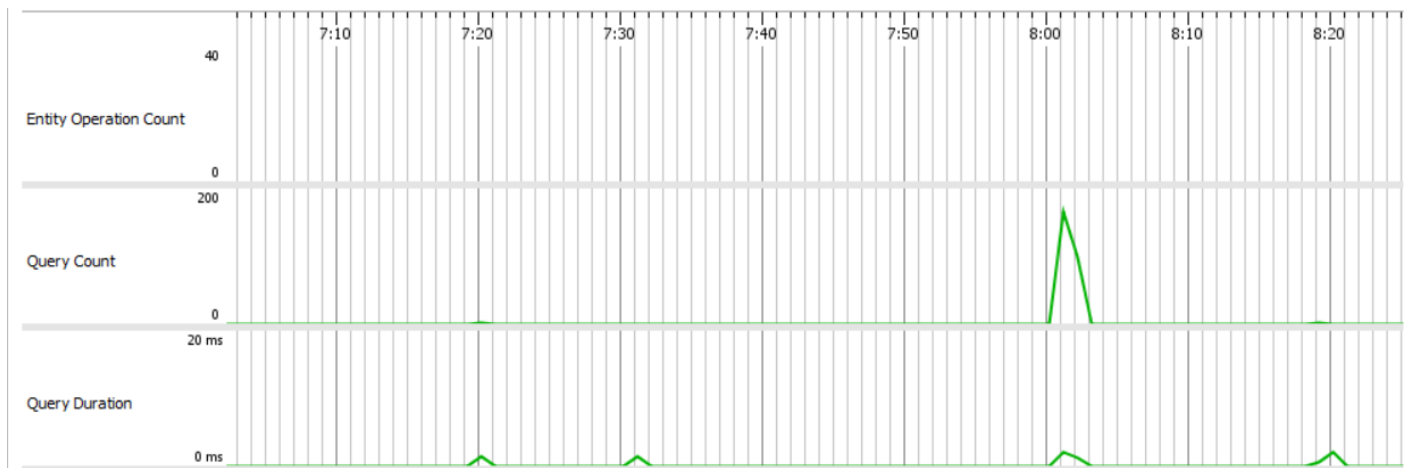
CPU Load



JDBC

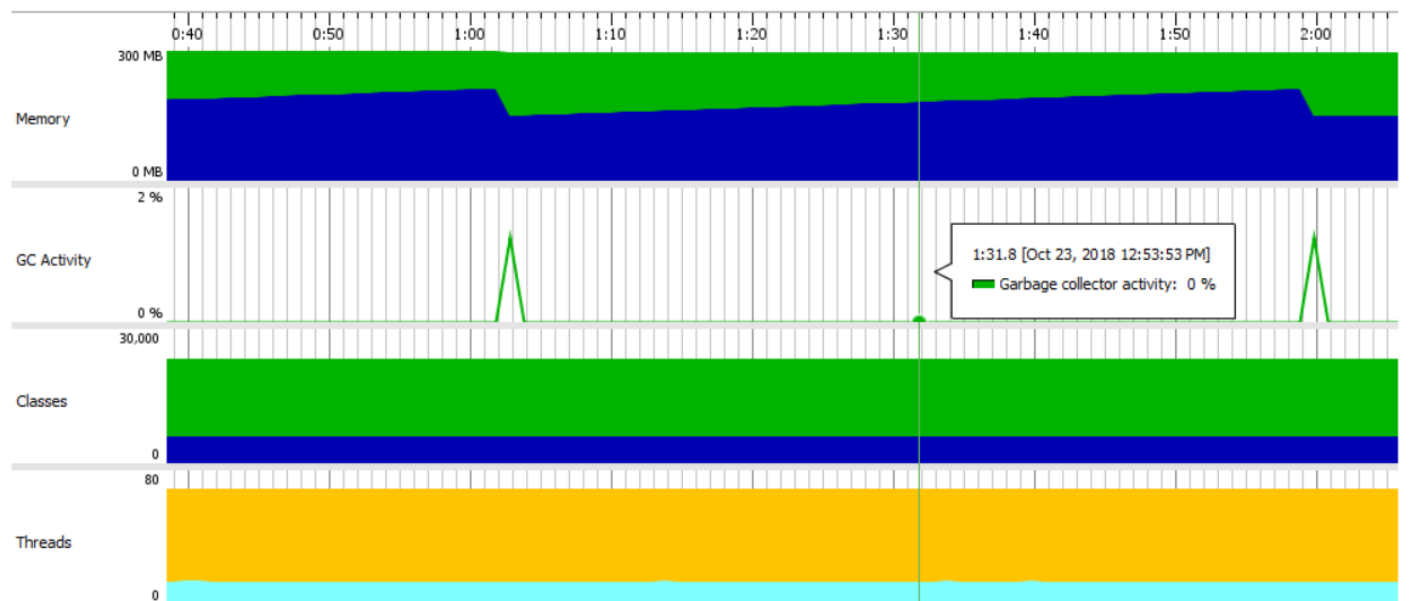


JPA/Hibernate



SCOREBOARD APP

Common metrics



CPU Load



11. BUILD AND DEPLOY

Database:

mysql -u root -padmin

initialization script: fullcreator.sql

NGROK:

Ngrok http 8000

RabbitMQ:

rabbitmq-server start

Start Tomcat Application Server:

%CATALINA_HOME%/bin/startup.bat

Start Wildfly Application Server:

%WILDFLY_HOME%/bin/standalone.bat

Setup test database in Docker:

*docker run -p 6161:3306 --name basename -e MYSQL_ROOT_PASSWORD=admin
-d mysql:latest*

*docker cp ./docker-entrypoint-initdb.d/test.sql basename:docker-entrypoint-
initdb.d/H2Script.sql*

docker exec -it basename mysql -uroot -padmin

source ./docker-entrypoint-initdb.d/H2Script.sql

For Windows - be sure, that your account has password

Start/stop test database:

docker start basename

docker stop basename

Test main application:

JUnit tests: *mvn test*

Selenium tests: *mvn failsafe:integration-test*

Deploy applications application:

mvn -f MetroDTO package & mvn -f MetroInformator tomcat7:deploy & mvn -f MetroInformatorBoard wildfly:deploy

JProfiler (after application deployment):

*Attach -> c:/WILDFLY/jboss-modules.jar -mp c:/WILDFLY/modules
org.jboss.as.standalone -Djboss.home.dir=c:/WILDFLY -> Sampling*

Attach -> org.apache.catalina.startup.Bootstrap start -> Sampling

Ports:

localhost:3306 – main DB

localhost:4040 – ngrok panel

localhost:5673 – RabbitMQ

localhost:6161 – test DB in Docker

localhost:8000 – Tomcat

localhost:8080 – Wildfly

localhost:8282 – Jenkins

localhost:9000 – SonarQube

localhost:15672 – RabbitMQ Admin panel

12. FUTURE IMPROVEMENTS

- add OAuth2 authorization
- add payment system imitation
- improvement of user profiles system (trip history, editing information, etc.)
- additional application for management (branch load, ticket statistic, etc.)
- implementation of Testcontainers
- whole dockerization of system infrastructure
- refactoring code and performance improvement