CS6650 Homework 1 Report

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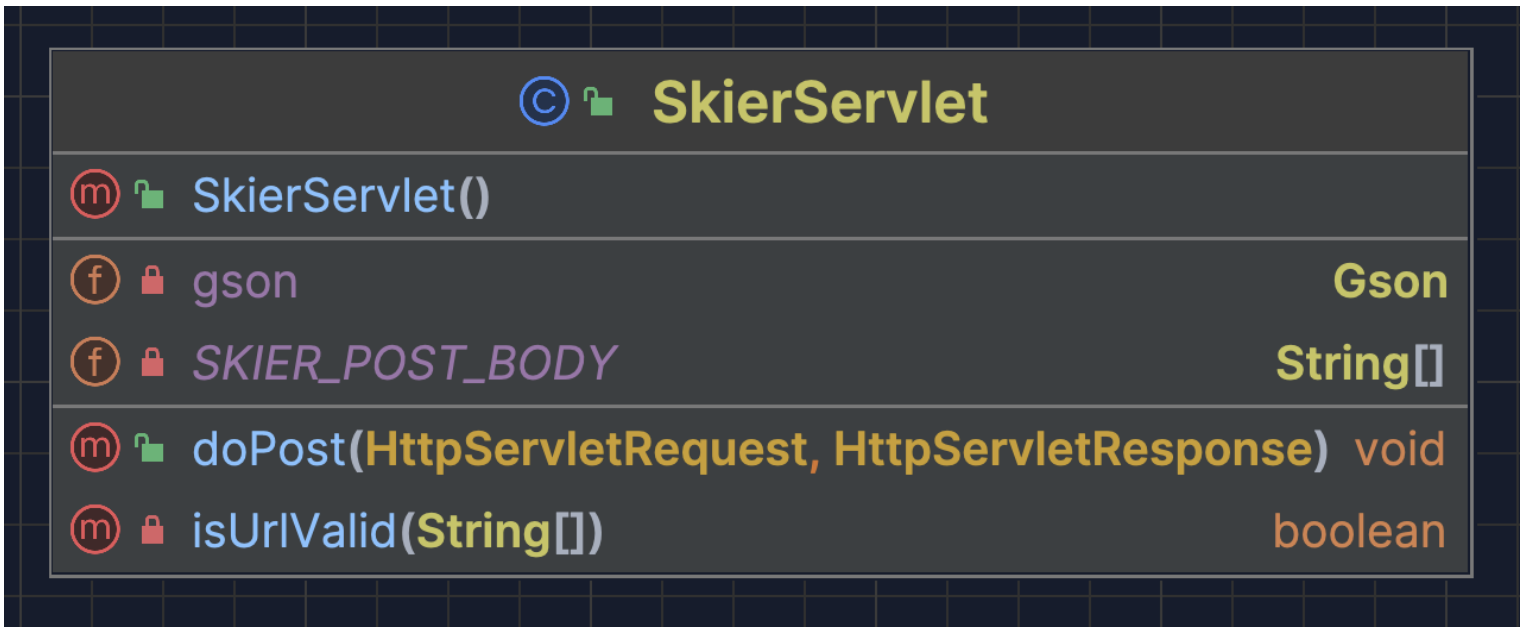
Overall Information

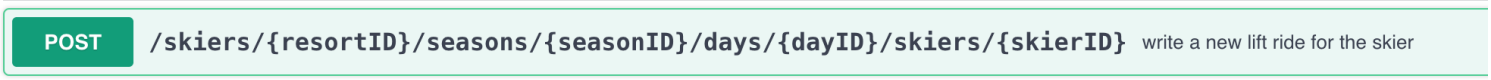
Repo URL: https://github.com/zhxunynn/CS6650Assignments/tree/main/Assignment1

Late Day: A week (request was approved by Professor)

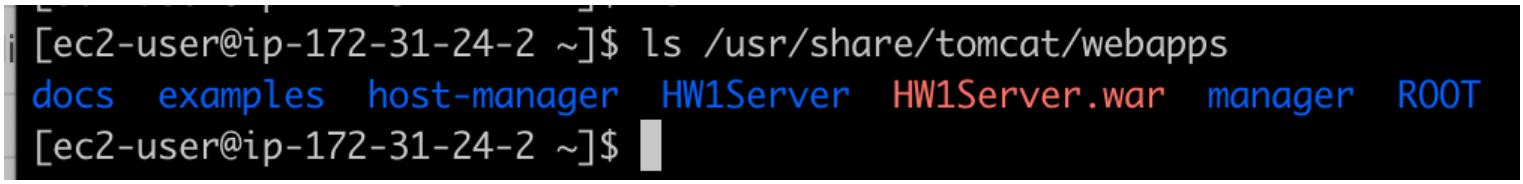
Server



Based on SkiDataAPI in Swagger, I implemetned the SkierServlet, which can handle the following RESTful API:



By deploying it to the AWS EC2:



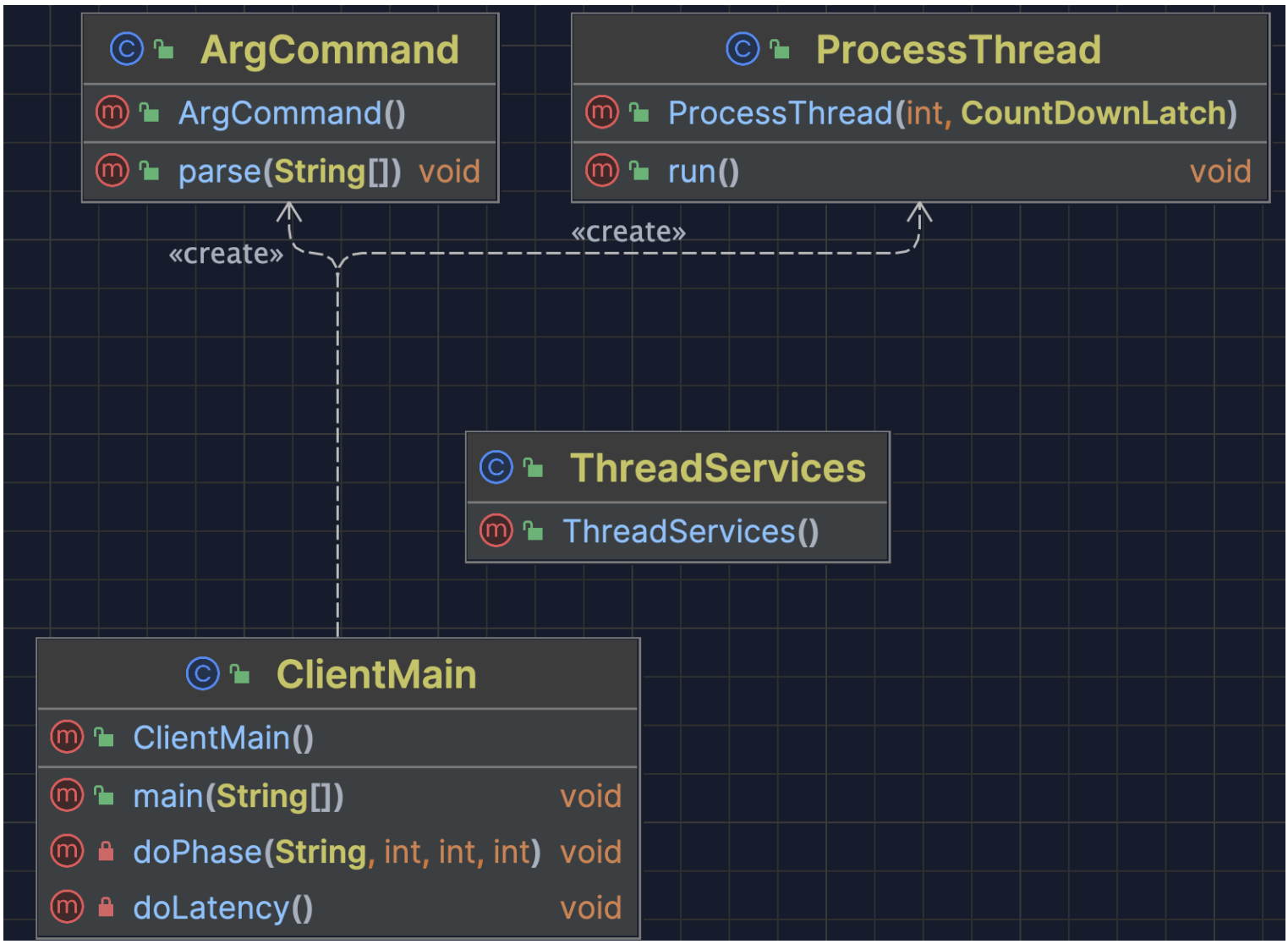
We can send request by either Postman, or `curl`, or our client to the

`API_BASE = http://server:8080/HW1Server`.

Clients

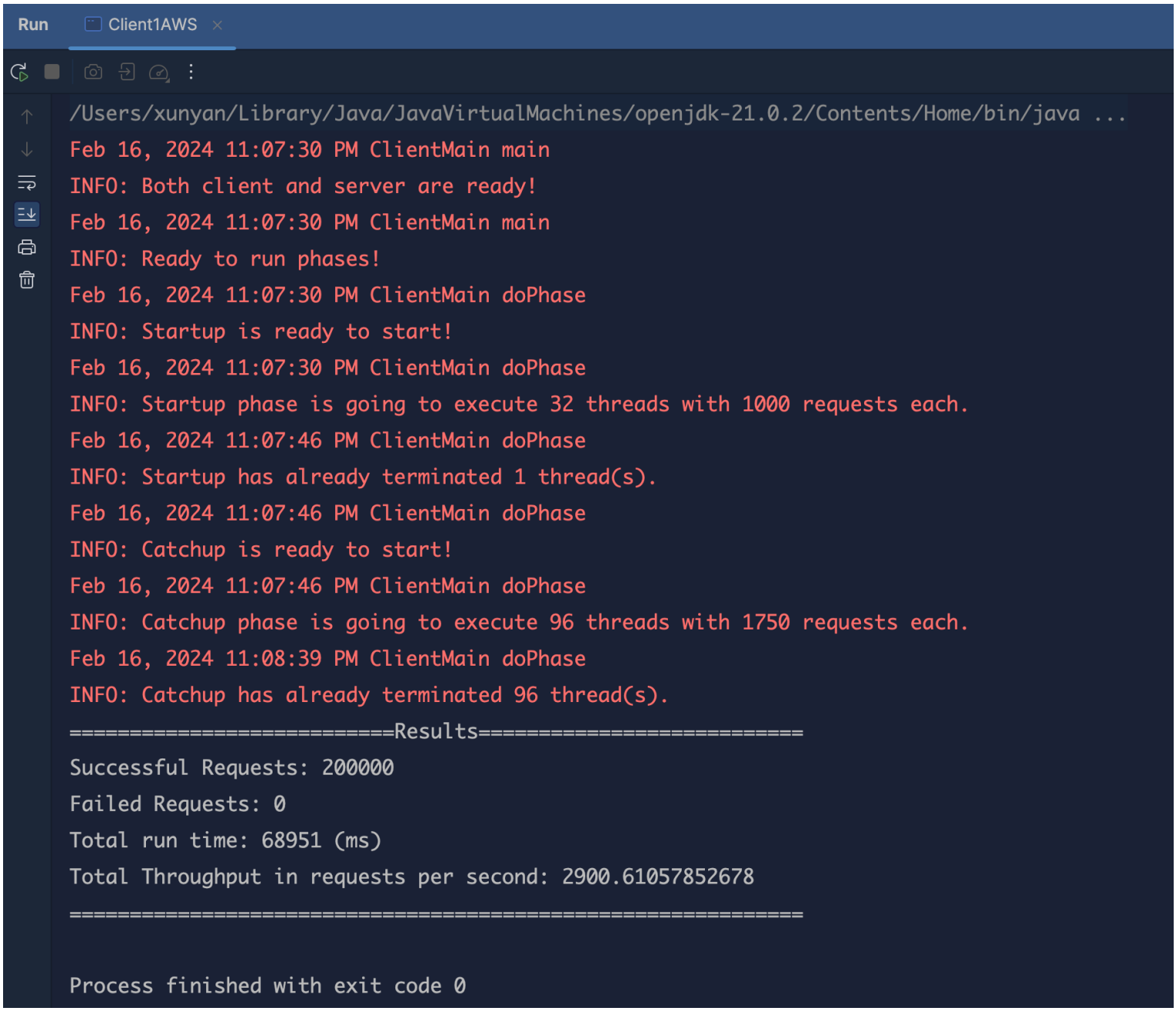
Client1

Design & Archtecture



In Client1, I introduced helper class `ArgCommand` and `ThreadSerivces`. The `ArgCommand` defines all the arguments that Client can accept, for example, `numOfRequests` is 200k by default, but we can modulate this to achieve quick test.

`ThreadServices` is served as a singleton static class, which contains the thread-safe counting data structures.



With the arguments: `-nt 32 -nr 200000 --host ec2-35-86-254-97.us-west-2.compute.amazonaws.com:8080`, the multithreaded program ran super quickly. The throughput is 2900.61057852678.

Little's Law

First of all, I did a latency test against `us-west-2 (Oregon)`, the result is:

```
/Users/xunyan/Library/Java/JavaVirtualMachines/openjdk-21.0.2/Contents/Home/bin/java ...
Feb 16, 2024 9:57:55 PM ClientMain doLatency
INFO: Ready to test latency!
Feb 16, 2024 10:00:34 PM ClientMain doLatency
INFO: Total Duration is 159.208s with average latency about 0.079604 s.

Process finished with exit code 0
```

Where the arguments are `-nr 2000 --latency --host ec2-35-86-254-97.us-west-2.compute.amazonaws.com:8080/HW1Server`.

In my program, I have 32 + 32*3 = 128 threads, and based on

$L = \lambda W$, we can get:

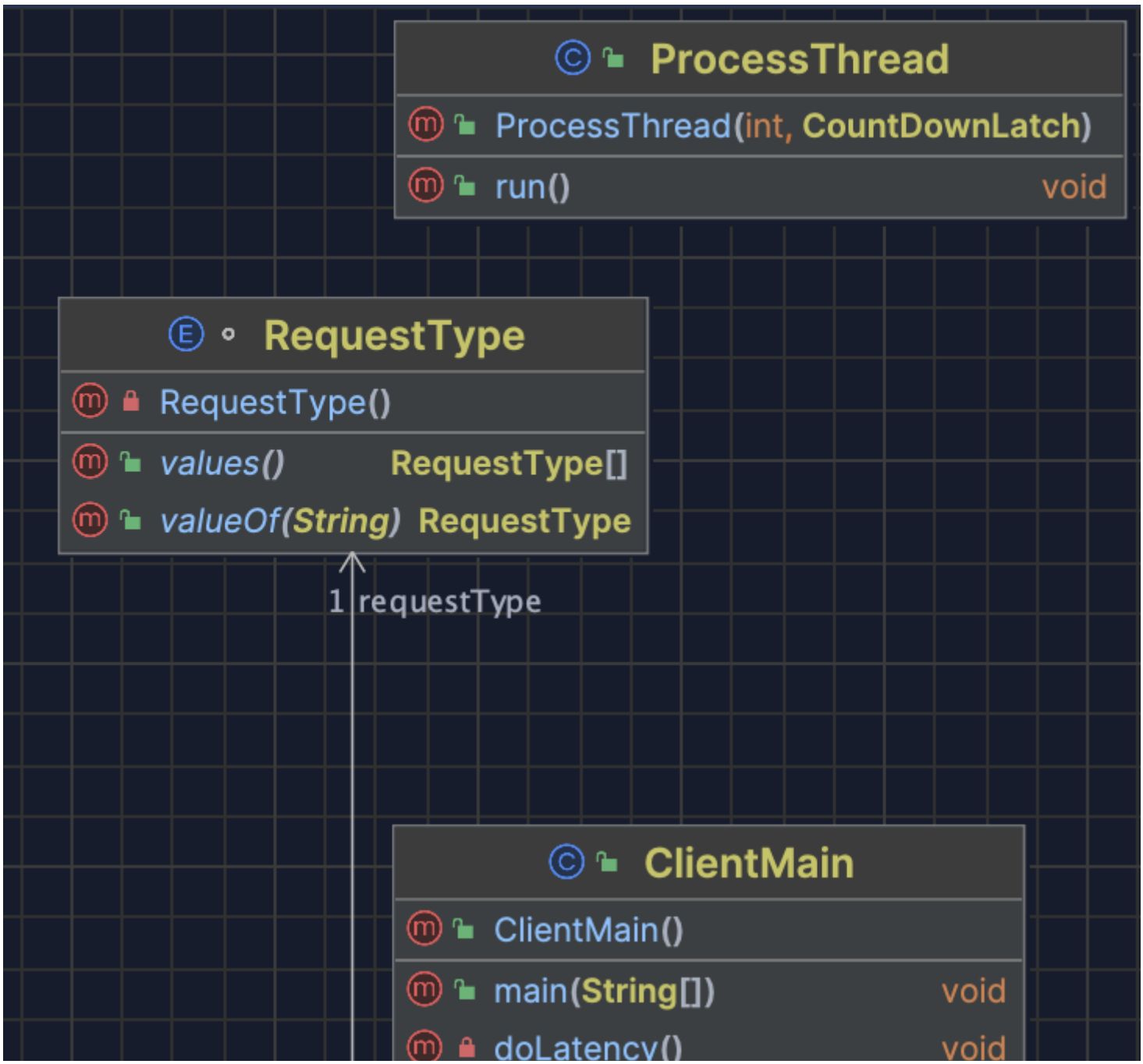
$\lambda = \frac{L}{W} = 128/0.079604 = 1607.95939903$

Based on the output above, we can notice the requests per thread $(32 * 1000 + 96 * 1750)/128 = 1562.5$

Which is super close to 1607, thus Little's Law holds.

Client2

Design & Archtecture




doPhase(String, int, int, int) void
1
Record
Record(long, String, long, int)
latency long
responseCode int
startTime long
requestType RequestType
toString() String
compareTo(Record) int
requestType String
responseCode int
startTime long
latency long
* records
ArgCommand
ArgCommand()
parse(String[]) void
1
ThreadServices
ThreadServices()
addToRecords(Record) void

In addition to Client1, I introduced csv utilities into `ThreadServices`, which holds an `ArrayList` of `Records`, and can also print out the statistics into console & csv file.

Statistics

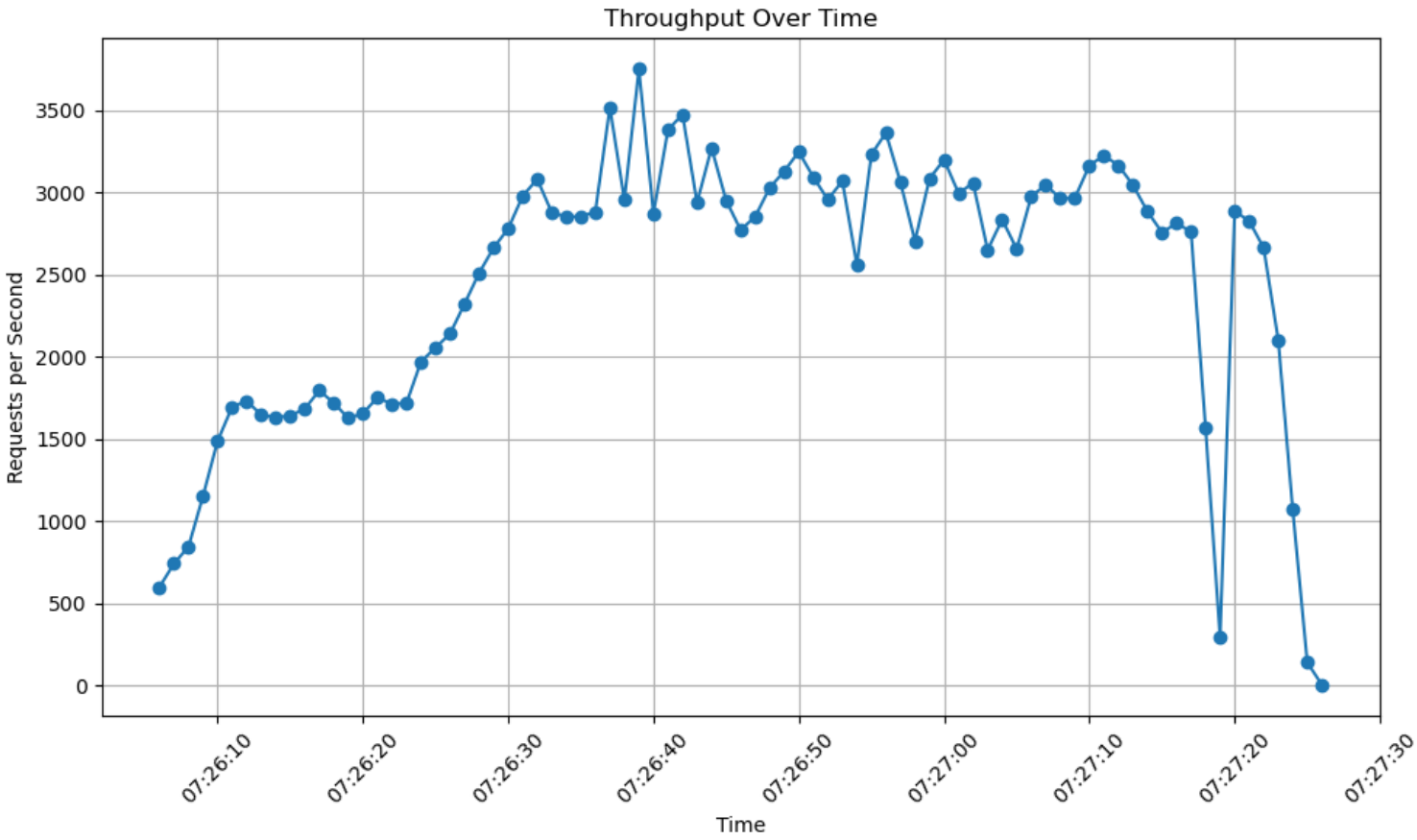
```
/Users/xunyan/Library/Java/JavaVirtualMachines/openjdk-21.0.2/Contents/Home/bin/java ...
Feb 16, 2024 11:13:17 PM ClientMain main
INFO: Both client and server are ready!
Feb 16, 2024 11:13:17 PM ClientMain main
INFO: Ready to run phases!
Feb 16, 2024 11:13:17 PM ClientMain doPhase
INFO: Startup is ready to start!
Feb 16, 2024 11:13:17 PM ClientMain doPhase
INFO: Startup phase is going to execute 32 threads with 1000 requests each.
Feb 16, 2024 11:13:33 PM ClientMain doPhase
INFO: Startup has already terminated 1 thread(s).
Feb 16, 2024 11:13:33 PM ClientMain doPhase
INFO: Catchup is ready to start!
Feb 16, 2024 11:13:33 PM ClientMain doPhase
INFO: Catchup phase is going to execute 96 threads with 1750 requests each.
Feb 16, 2024 11:14:25 PM ClientMain doPhase
INFO: Catchup has already terminated 96 thread(s).
============================Results============================
Successful Requests: 200000
Failed Requests: 0
Total run time: 67281 (ms)
Total Throughput in requests per second: 2972.607422600734
===============================================================
Mean response time: 26.992565
Median response time: 24.0
Throughput: 37.04723874889252
99th response time: 46.0
min and max response time: min: 9.0 , max: 3034.0

Process finished with exit code 0
```

As we can see, the 2972/2900 - 1 = 2% < 5%. The requested information like mean, median, throughput, 99th response time can be found in the picture and below:

id	iterm	value
1	mean	26.992565
2	median	37.04723874889252
3	total throughput	2972.607422600734
4	99th	46.0
5	min	9.0
6	max	3034.0

Chart

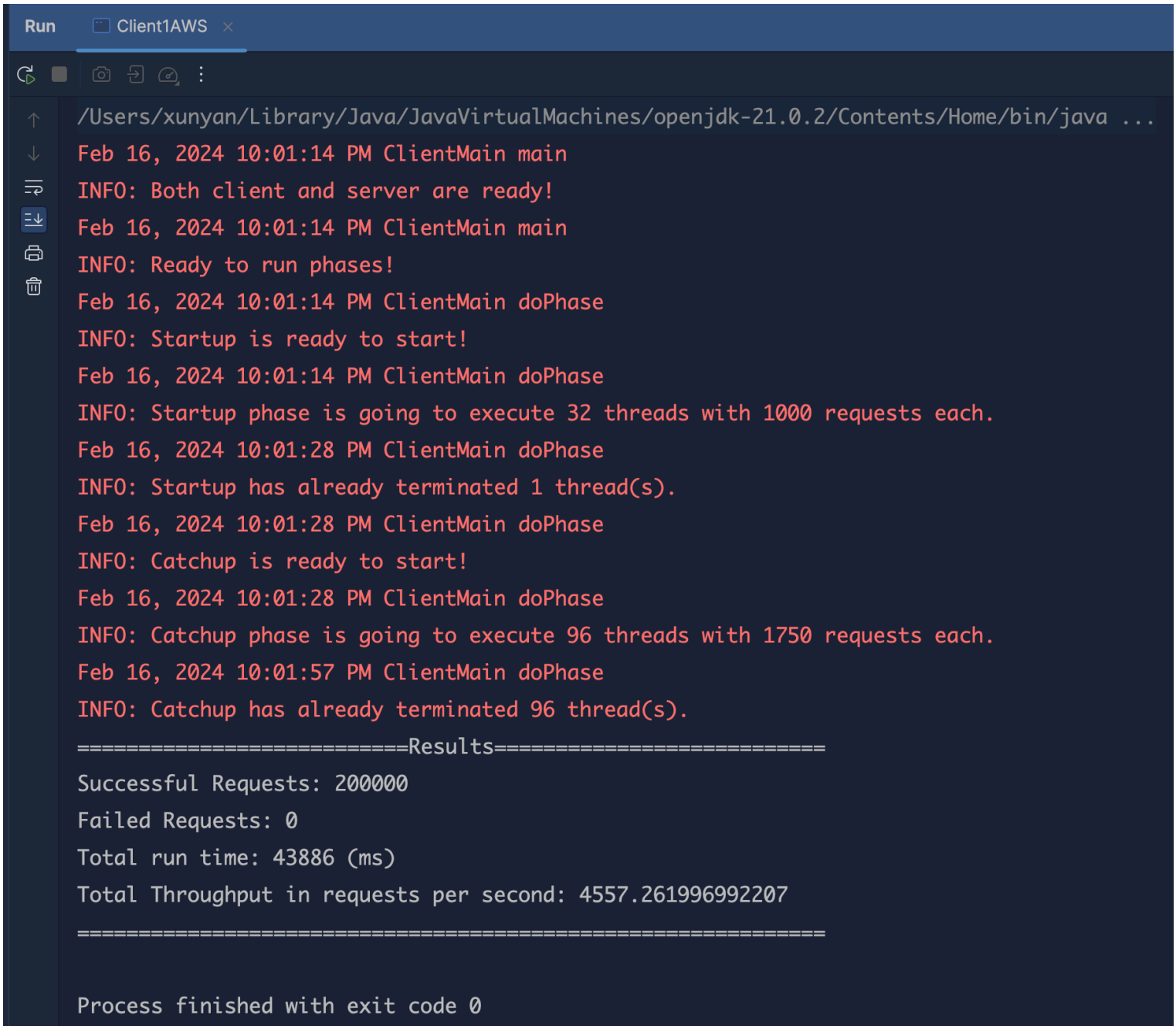
I utilized `pandas` and `matplotlib` in python to get this figure:



The code can be found at Assignment1/Chart.py

Bonus

By applying Spring, I get the following results:



The total throughput (**4557.27**) is faster than the previous one (**2900**), which is **157%** as servlet one.

The Spring code can be found in Bonus folder.