HTTP Key Value Server

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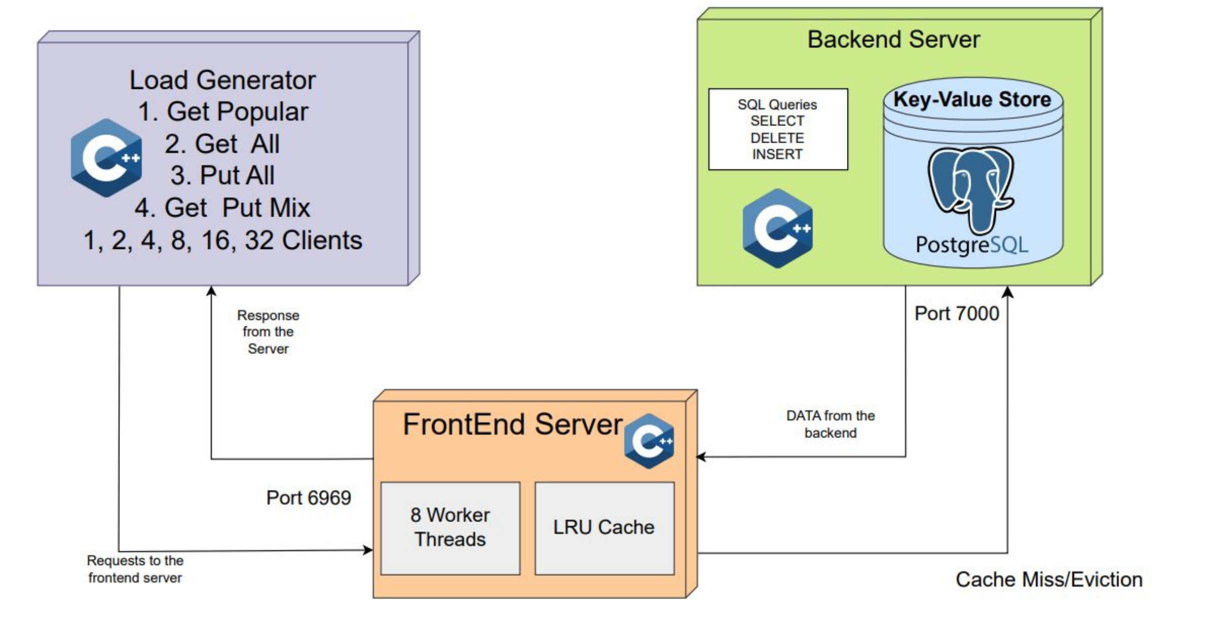
System Architecture



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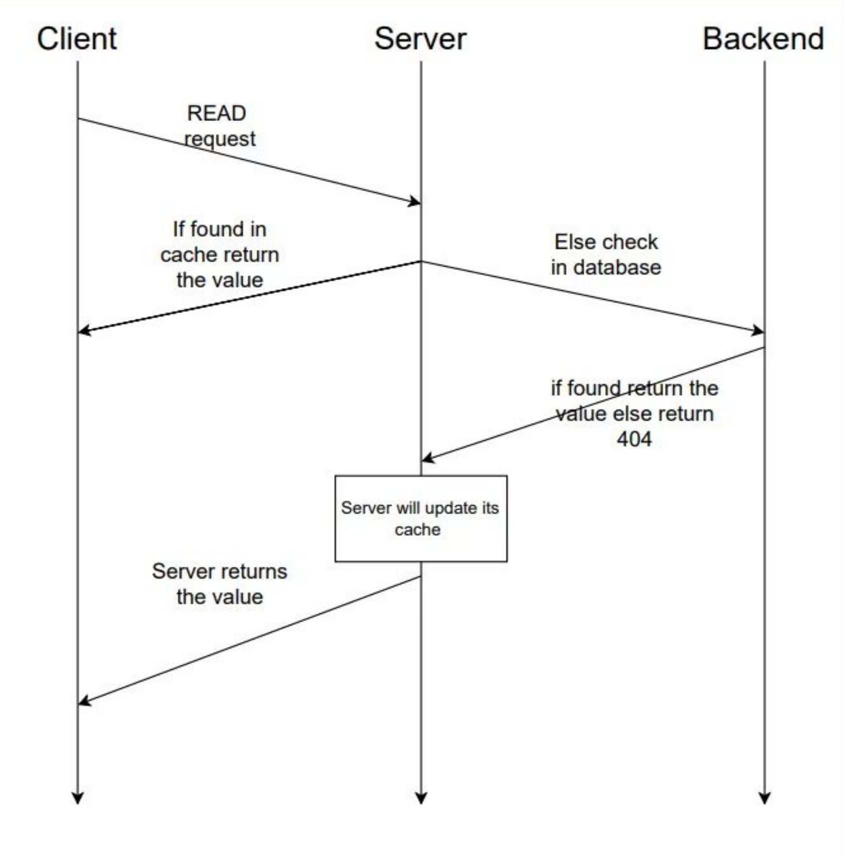
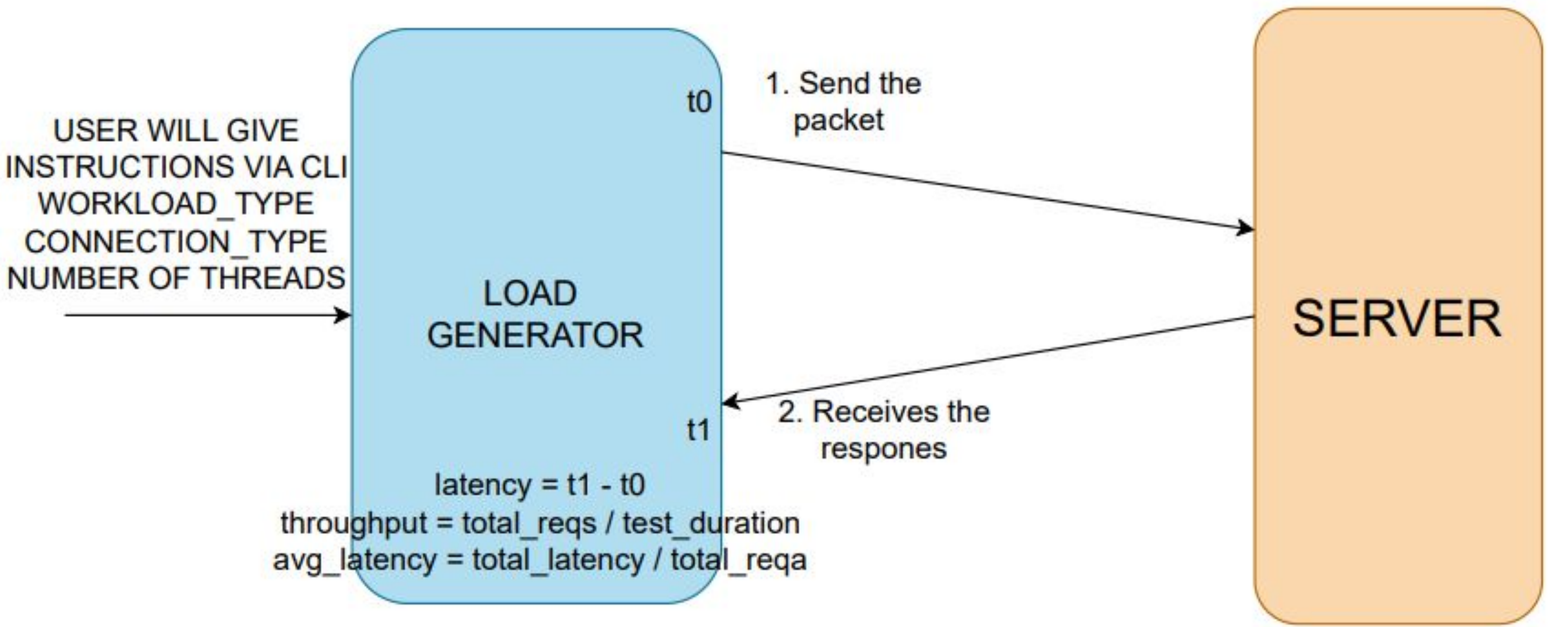
Sequence Diagram (Request Flow)


Client
Server
Backend
READ request
If found in cache return the value
Else check in database
if found return the value else return 404
Server will update its cache
Server returns the value

Load Generator Architecture



USER WILL GIVE
INSTRUCTIONS VIA CLI
WORKLOAD_TYPE
CONNECTION_TYPE
NUMBER OF THREADS

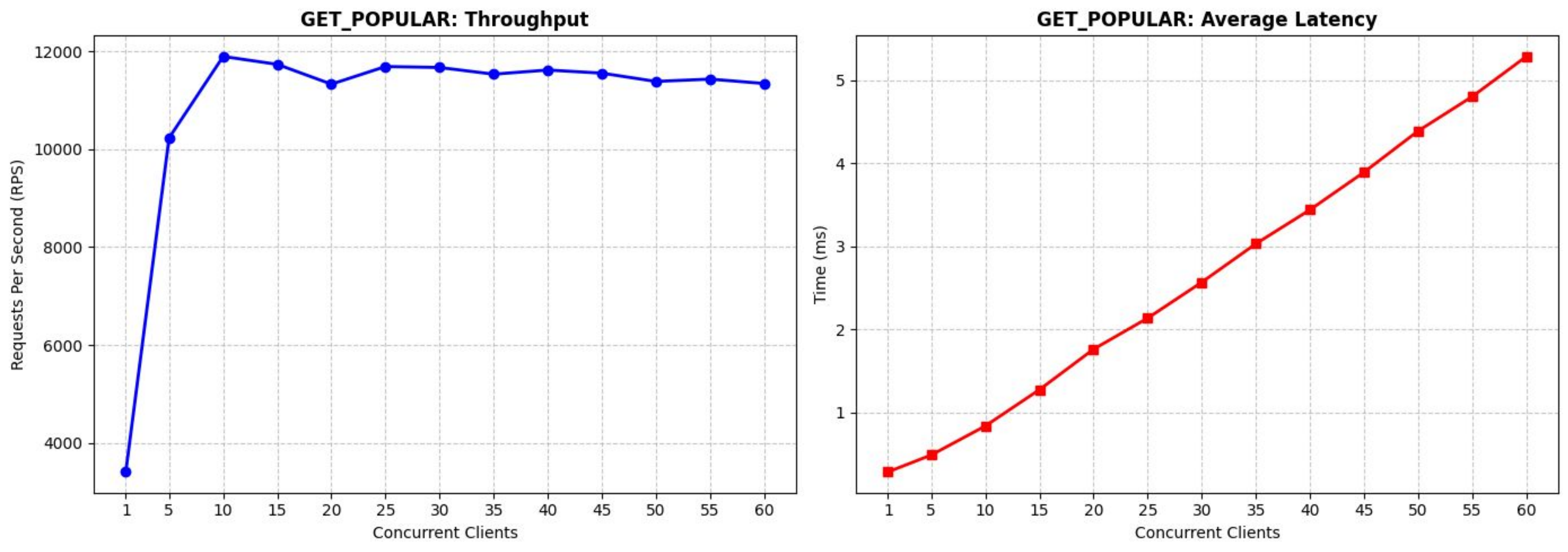
latency = t1 - t0
throughput = total_reqs / test_duration
avg_latency = total_latency / total_reqa

Load Test Setup

1. Everything was tested locally
2. Cloud methods were tried but they were not effective enough
3. The backend_server was pinned to a single core number : 3
4. The frontend_server was pinned to cores 4-7
5. The load_generator was pinned to cores 1-2
6. The bottlenecks for CPU and IO were seen using the htop and iostat command respectively
7. Processor : i5-10300H

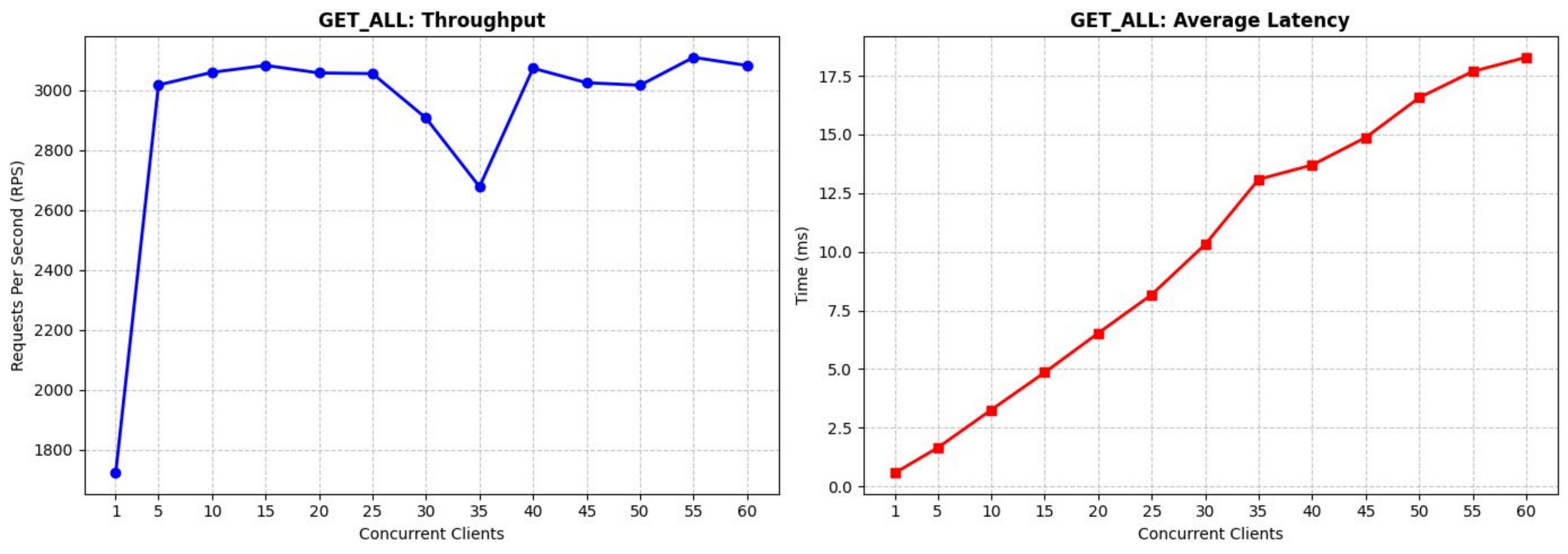
CPU Bottleneck

It was achieved while using the GET_POPULAR workload



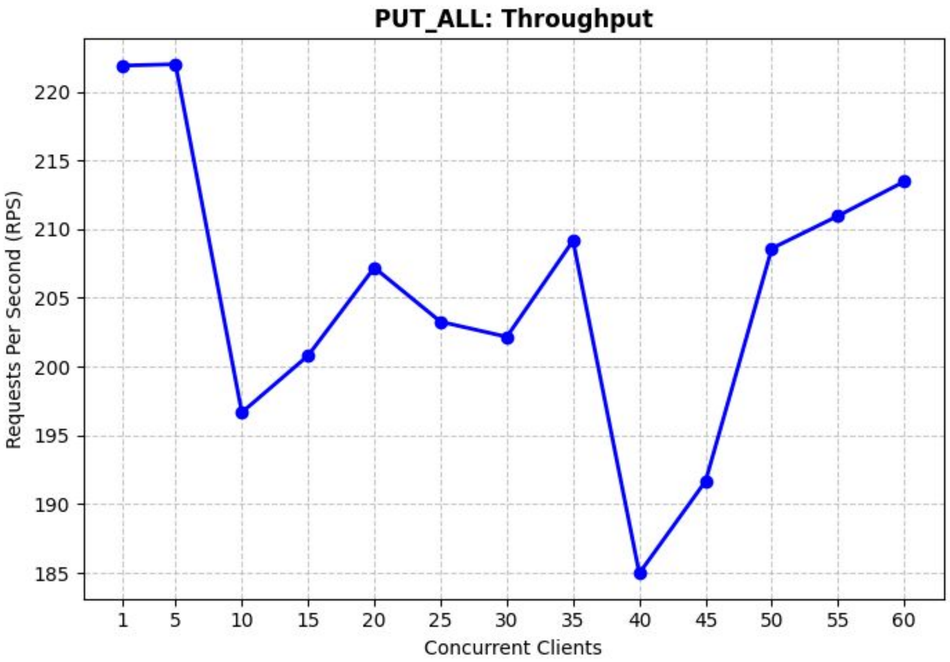
IO Bottleneck

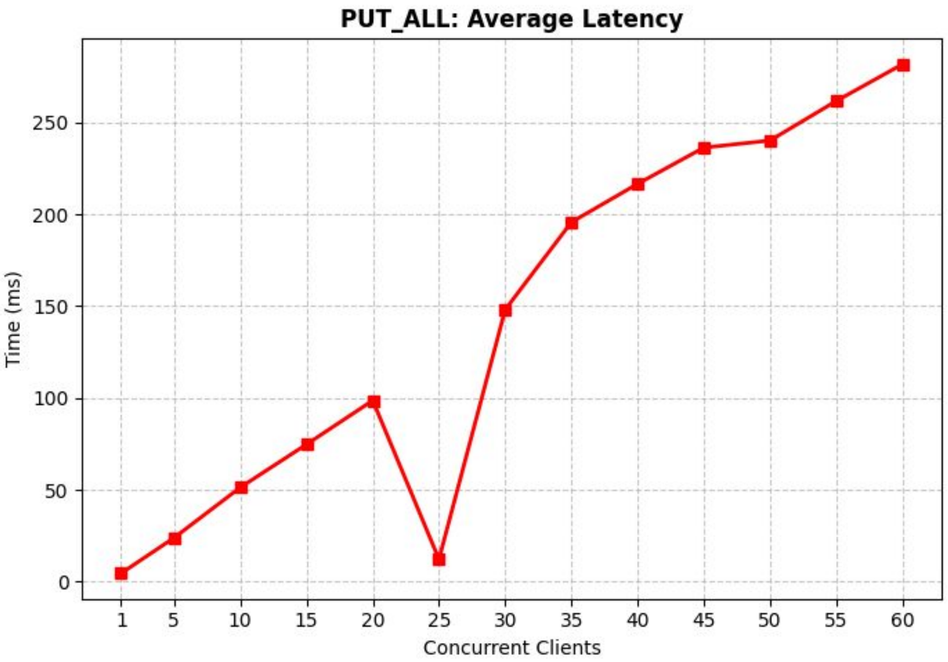
It was achieved while using the GET_ALL workload



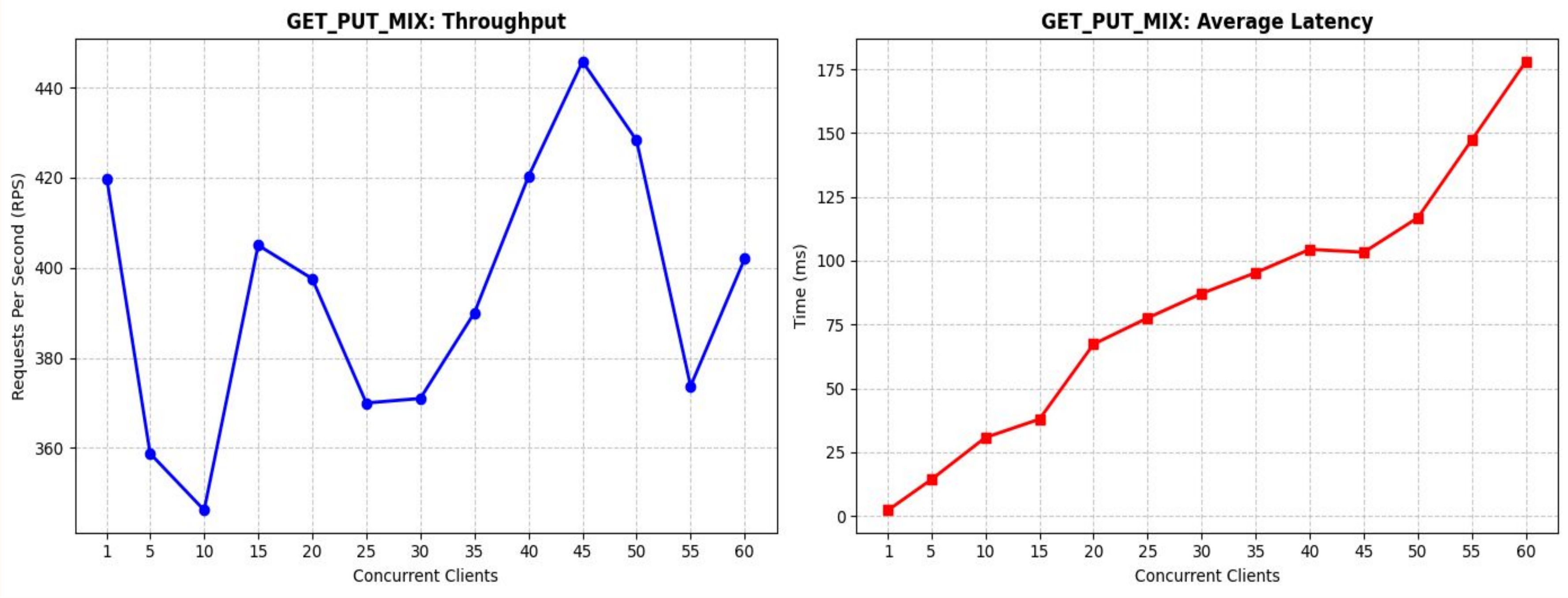
Other workloads :

PUT_ALL

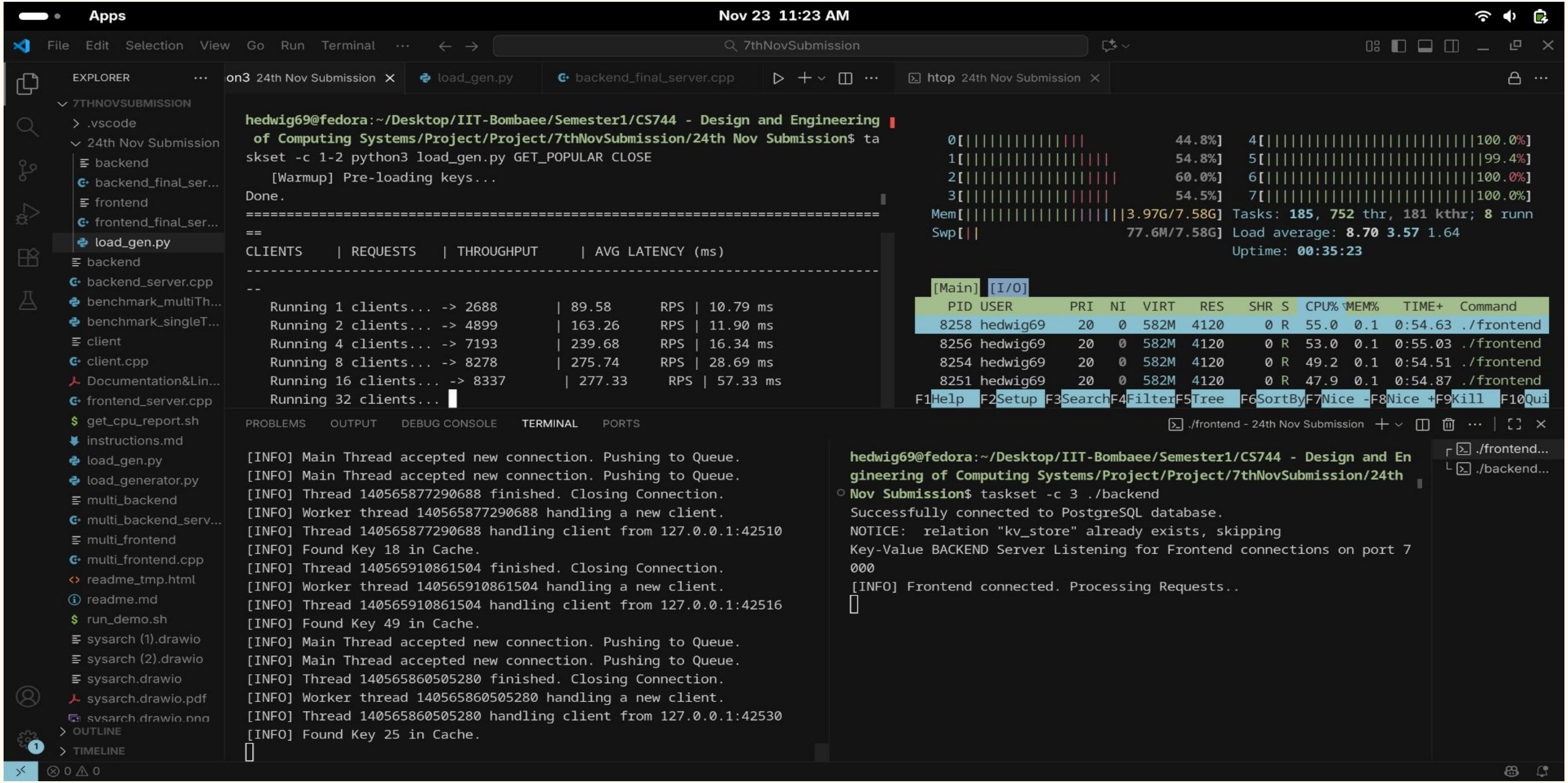




GET_PUT_MIX


GET_PUT_MIX: Throughput
Requests Per Second (RPS)
440
420
400
380
360
1
5
10
15
20
25
30
35
40
45
50
55
60
Concurrent Clients
GET_PUT_MIX: Average Latency
Time (ms)
175
150
125
100
75
50
25
0
1
5
10
15
20
25
30
35
40
45
50
55
60
Concurrent Clients

Some snapshots of performance testing :



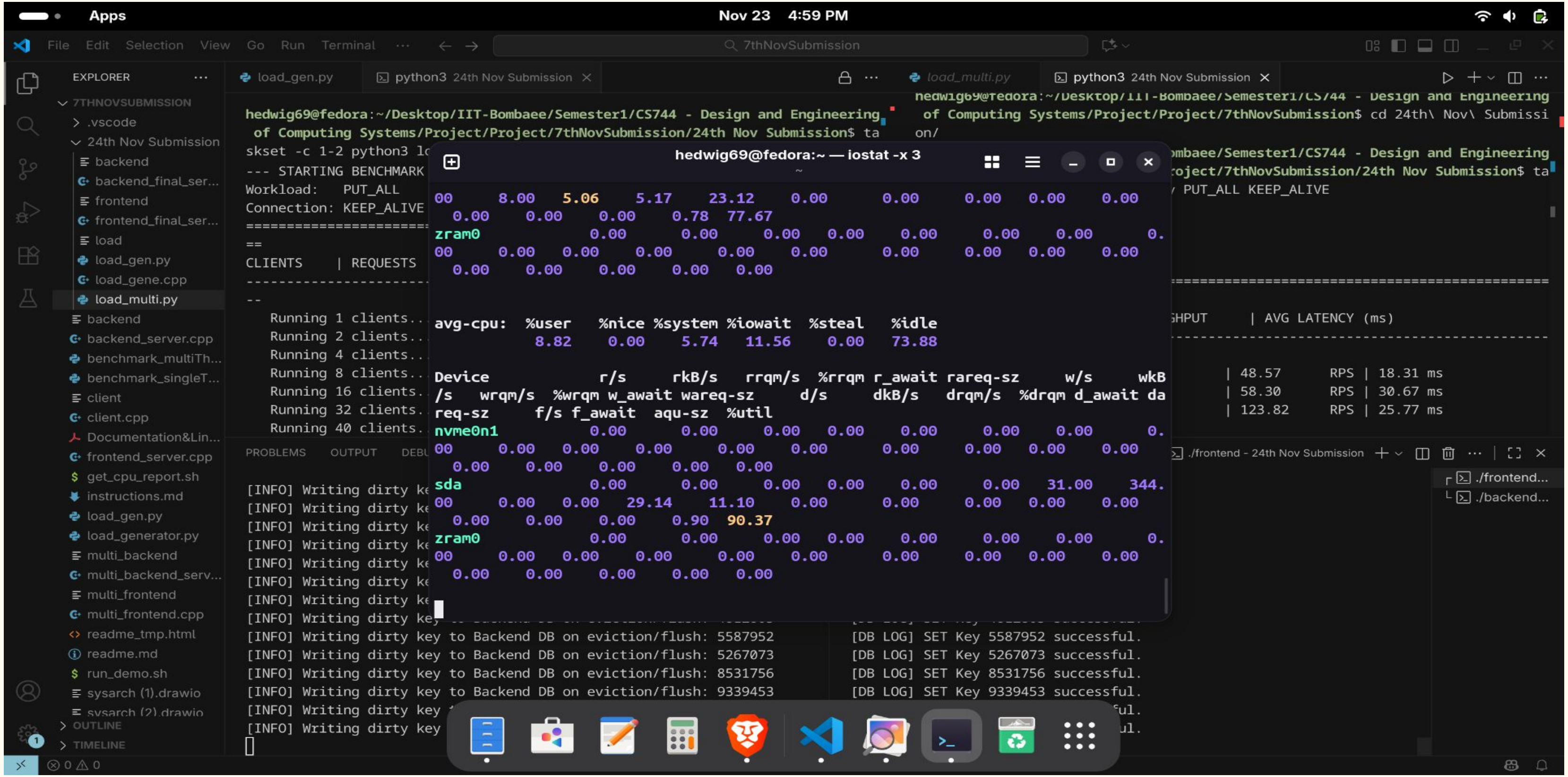
```
hedwig69@fedora:~/Desktop/IIT-Bombaee/Semester1/CS744 - Design and Engineering
 of Computing Systems/Project/Project/7thNovSubmission/24th Nov Submission$ ta
skset -c 1-2 python3 load_gen.py GET_POPULAR CLOSE
   [Warmup] Pre-loading keys...
Done.
==============================================================================
==
CLIENTS     | REQUESTS    | THROUGHPUT      | AVG LATENCY (ms)
------------------------------------------------------------------------------
--
   Running 1 clients... -> 2688        | 89.58      RPS | 10.79 ms
   Running 2 clients... -> 4899        | 163.26     RPS | 11.90 ms
   Running 4 clients... -> 7193        | 239.68     RPS | 16.34 ms
   Running 8 clients... -> 8278        | 275.74     RPS | 28.69 ms
   Running 16 clients... -> 8337        | 277.33     RPS | 57.33 ms
   Running 32 clients...
```

```
    0[|||||||||||||||            44.8%]   4[||||||||||||||||||||||||||100.0%]
    1[||||||||||||||||||         54.8%]   5[||||||||||||||||||||||||||99.4%]
    2[|||||||||||||||||||        60.0%]   6[||||||||||||||||||||||||||100.0%]
    3[||||||||||||||||||         54.5%]   7[||||||||||||||||||||||||||100.0%]
  Mem[|||||||||||||||||||||3.97G/7.58G] Tasks: 185, 752 thr, 181 kthr; 8 runn
  Swp[||                   77.6M/7.58G] Load average: 8.70 3.57 1.64
                                        Uptime: 00:35:23

  [Main] [I/O]
    PID USER       PRI  NI  VIRT   RES    SHR S  CPU% MEM%   TIME+  Command
   8258 hedwig69    20   0  582M  4120      0 R  55.0  0.1  0:54.63 ./frontend
   8256 hedwig69    20   0  582M  4120      0 R  53.0  0.1  0:55.03 ./frontend
   8254 hedwig69    20   0  582M  4120      0 R  49.2  0.1  0:54.51 ./frontend
   8251 hedwig69    20   0  582M  4120      0 R  47.9  0.1  0:54.87 ./frontend
F1Help  F2Setup F3SearchF4FilterF5Tree  F6SortByF7Nice -F8Nice +F9Kill  F10Qui
```

```
[INFO] Main Thread accepted new connection. Pushing to Queue.
[INFO] Main Thread accepted new connection. Pushing to Queue.
[INFO] Thread 140565877290688 finished. Closing Connection.
[INFO] Worker thread 140565877290688 handling a new client.
[INFO] Thread 140565877290688 handling client from 127.0.0.1:42510
[INFO] Found Key 18 in Cache.
[INFO] Thread 140565910861504 finished. Closing Connection.
[INFO] Worker thread 140565910861504 handling a new client.
[INFO] Thread 140565910861504 handling client from 127.0.0.1:42516
[INFO] Found Key 49 in Cache.
[INFO] Main Thread accepted new connection. Pushing to Queue.
[INFO] Main Thread accepted new connection. Pushing to Queue.
[INFO] Thread 140565860505280 finished. Closing Connection.
[INFO] Worker thread 140565860505280 handling a new client.
[INFO] Thread 140565860505280 handling client from 127.0.0.1:42530
[INFO] Found Key 25 in Cache.
```

```
hedwig69@fedora:~/Desktop/IIT-Bombaee/Semester1/CS744 - Design and En
gineering of Computing Systems/Project/Project/7thNovSubmission/24th
Nov Submission$ taskset -c 3 ./backend
Successfully connected to PostgreSQL database.
NOTICE:  relation "kv_store" already exists, skipping
Key-Value BACKEND Server Listening for Frontend connections on port 7
000
[INFO] Frontend connected. Processing Requests..
```



```
hedwig69@fedora:~/Desktop/IIT-Bombaee/Semester1/CS744 - Design and Engineering
 of Computing Systems/Project/Project/7thNovSubmission/24th Nov Submission$ ta
skset -c 1-2 python3 lo
--- STARTING BENCHMARK
Workload:   PUT_ALL
Connection: KEEP_ALIVE
========================
==
CLIENTS     | REQUESTS
------------------------
--
   Running 1 clients..
   Running 2 clients..
   Running 4 clients..
   Running 8 clients..
   Running 16 clients.
   Running 32 clients.
   Running 40 clients.
```

```
hedwig69@fedora:~ — iostat -x 3

00      8.00    5.06     5.17     23.12     0.00       0.00      0.00   0.00     0.00
  0.00     0.00     0.00     0.78  77.67
zram0               0.00       0.00      0.00   0.00     0.00      0.00     0.00      0.
00      0.00    0.00     0.00      0.00     0.00       0.00      0.00   0.00     0.00
  0.00     0.00     0.00     0.00    0.00


avg-cpu:  %user   %nice %system %iowait  %steal   %idle
           8.82    0.00    5.74   11.56    0.00   73.88

Device            r/s     rkB/s   rrqm/s  %rrqm r_await rareq-sz     w/s     wkB
/s   wrqm/s  %wrqm w_await wareq-sz     d/s     dkB/s   drqm/s  %drqm d_await da
req-sz     f/s f_await  aqu-sz  %util
nvme0n1             0.00       0.00      0.00   0.00     0.00      0.00     0.00      0.
00      0.00    0.00     0.00      0.00     0.00       0.00      0.00   0.00     0.00
  0.00     0.00     0.00     0.00    0.00
sda                 0.00       0.00      0.00   0.00     0.00      0.00    31.00    344.
00      0.00    0.00    29.14     11.10     0.00       0.00      0.00   0.00     0.00
  0.00     0.00     0.00     0.90  90.37
zram0               0.00       0.00      0.00   0.00     0.00      0.00     0.00      0.
00      0.00    0.00     0.00      0.00     0.00       0.00      0.00   0.00     0.00
  0.00     0.00     0.00     0.00    0.00
```

```
hedwig69@fedora:~/Desktop/IIT-Bombaee/Semester1/CS744 - Design and Engineering
 of Computing Systems/Project/Project/7thNovSubmission$ cd 24th\ Nov\ Submissi
on/
ombaee/Semester1/CS744 - Design and Engineering
roject/7thNovSubmission/24th Nov Submission$ ta
/ PUT_ALL KEEP_ALIVE

==================================================

GHPUT      | AVG LATENCY (ms)
--------------------------------------------------

           | 48.57      RPS | 18.31 ms
           | 58.30      RPS | 30.67 ms
           | 123.82     RPS | 25.77 ms
```

```
[INFO] Writing dirty ke
[INFO] Writing dirty ke
[INFO] Writing dirty ke
[INFO] Writing dirty ke
[INFO] Writing dirty ke
[INFO] Writing dirty ke
[INFO] Writing dirty ke
[INFO] Writing dirty key
[INFO] Writing dirty key to Backend DB on eviction/flush: 5587952
[INFO] Writing dirty key to Backend DB on eviction/flush: 5267073
[INFO] Writing dirty key to Backend DB on eviction/flush: 8531756
[INFO] Writing dirty key to Backend DB on eviction/flush: 9339453
[INFO] Writing dirty key
[INFO] Writing dirty key
```

```
[DB LOG] SET Key 5587952 successful.
[DB LOG] SET Key 5267073 successful.
[DB LOG] SET Key 8531756 successful.
[DB LOG] SET Key 9339453 successful.
ful.
ul.
```