

# Concurrent Webserver

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## Task Requirement:

Write a program `webserver.c` using threads and sockets supporting HTTP GET requests which works in the following way:

- It creates a pool of threads in the beginning
- Main thread waits on `epoll_wait` for any I/O on sockets
- It stores the requests in a message queue used by all the threads.
- Each client is supposed to go through following stages
  - `READING_REQUEST`
  - `HEADER_PARSING`
  - `READING_DISKFILE`
  - `WRITING_HEADER`
  - `WRITING_BODY`
- After `WRITING_HEADER` stage, client cycles between `READING_DISKFILE` and `WRITING_BODY` stage until full file is transferred
- Connection is not closed until server receives an EOF (i.e. client itself has closed the connection).
- I/O on sockets is non blocking, but reading from file is blocking since it'll always succeed.

## Server performance

Testing is done using `httperf` which can be installed via `sudo apt install httperf`

Some snapshots for the statistics can be found here :

### 1. Number of connections : 100, Rate : 10, File size : 1450 bytes

```
singhcoderr@singhcoderr:~/Desktop/Network-Programming/Assignments/Assignment2$ httperf --server 127.0.0.1 --port 8004 --uri=/files/mrunal.png --num-conns 100 --rate 10 --timeout 1
httplib --timeout=1 --client=0/1 --server=127.0.0.1 --port=8004 --uri=/files/mrunal.png --rate=10 --send-buffer=4096 --recv-buffer=16384 --num-conns=100 --num-calls=1
httplib: warning: open file limit > FD_SETSIZE; limiting max. # of open files to FD_SETSIZE
Maximum connect burst length: 1

Total: connections 100 requests 100 replies 100 test-duration 9.900 s

Connection rate: 10.1 conn/s (99.0 ms/conn, <=1 concurrent connections)
Connection time [ms]: min 0.3 avg 0.5 max 16.5 median 0.5 stddev 1.6
Connection time [ms]: connect 0.0
Connection length [replies/conn]: 1.000

Request rate: 10.1 req/s (99.0 ms/req)
Request size [B]: 78.0

Reply rate [replies/s]: min 10.0 avg 10.0 max 10.0 stddev 0.0 (1 samples)
Reply time [ms]: response 0.4 transfer 0.1
Reply size [B]: header 82.0 content 60960.0 footer 0.0 (total 61042.0)
Reply status: 1xx=0 2xx=100 3xx=0 4xx=0 5xx=0

CPU time [s]: user 2.23 system 7.67 (user 22.5% system 77.5% total 100.0%)
Net I/O: 602.9 KB/s (4.9*10^6 bps)

Errors: total 0 client-time 0 socket-time 0 connrefused 0 connreset 0
Errors: fd-unavail 0 addrunavail 0 ftab-full 0 other 0
```

### 2. Number of connections : 3000, Rate : 50, File size : 1450 bytes

```
singhocoder@singhocoder:~/Desktop/Network-Programming/Assignments/Assignment2$ httpperf --server 127.0.0.1 --port 8004 --uri=/files/mrunal.png --num-conns 3000 --rate 50 --timeout 1
httpperf --timeout=1 --client=0/1 --server=127.0.0.1 --port=8004 --uri=/files/mrunal.png --rate=50 --send-buffer=4096 --recv-buffer=16384 --num-conns=3000 --num-calls=1
httpperf: warning: open file limit > FD_SETSIZE; limiting max. # of open files to FD_SETSIZE
Maximum connect burst length: 1

Total: connections 3000 requests 3000 replies 3000 test-duration 59.981 s

Connection rate: 50.0 conn/s (20.0 ms/conn, <=3 concurrent connections)
Connection time [ms]: min 0.2 avg 0.4 max 49.8 median 0.5 stddev 1.2
Connection time [ms]: connect 0.0
Connection length [replies/conn]: 1.000

Request rate: 50.0 req/s (20.0 ms/req)
Request size [B]: 78.0

Reply rate [replies/s]: min 50.0 avg 50.0 max 50.0 stddev 0.0 (11 samples)
Reply time [ms]: response 0.3 transfer 0.2
Reply size [B]: header 82.0 content 60960.0 footer 0.0 (total 61042.0)
Reply status: 1xx=0 2xx=3000 3xx=0 4xx=0 5xx=0

CPU time [s]: user 13.47 system 46.41 (user 22.5% system 77.4% total 99.8%)
Net I/O: 2985.3 KB/s (24.5*10^6 bps)

Errors: total 0 client-timo 0 socket-timo 0 connrefused 0 connreset 0
Errors: fd-unavail 0 addrunavail 0 ftab-full 0 other 0
```

### 3. Number of connections : 10000, Rate : 50, File size : 1509793 bytes (15.1 MB)

```
singhocoder@singhocoder:~/Desktop/Network-Programming/Assignments/Assignment2$ httpperf --server 127.0.0.1 --port 8004 --uri=/files/video.mp4 --num-conns 10000 --rate 50 --timeout 1
httpperf --timeout=1 --client=0/1 --server=127.0.0.1 --port=8004 --uri=/files/video.mp4 --rate=50 --send-buffer=4096 --recv-buffer=16384 --num-conns=10000 --num-calls=1
httpperf: warning: open file limit > FD_SETSIZE; limiting max. # of open files to FD_SETSIZE
Maximum connect burst length: 1

Total: connections 10000 requests 9426 replies 9398 test-duration 199.980 s

Connection rate: 50.0 conn/s (20.0 ms/conn, <=19 concurrent connections)
Connection time [ms]: min 2.1 avg 44.6 max 329.8 median 33.5 stddev 34.2
Connection time [ms]: connect 0.1
Connection length [replies/conn]: 1.000

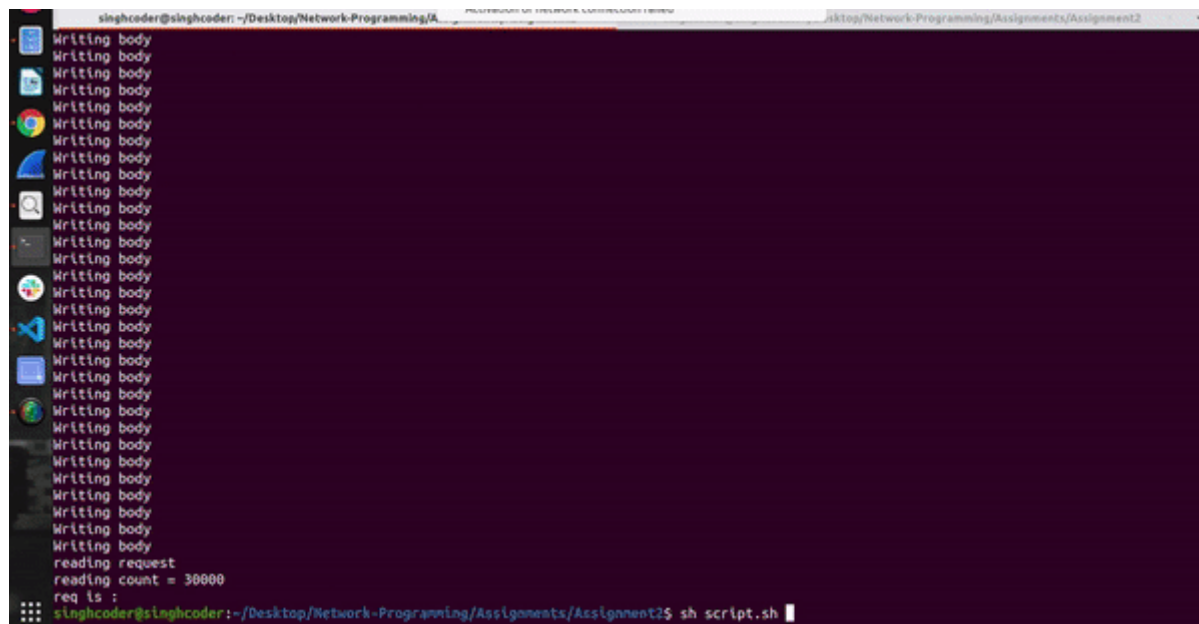
Request rate: 47.1 req/s (21.2 ms/req)
Request size [B]: 77.0

Reply rate [replies/s]: min 0.0 avg 48.2 max 50.6 stddev 8.3 (39 samples)
Reply time [ms]: response 0.5 transfer 44.0
Reply size [B]: header 100.0 content 15086950.0 footer 0.0 (total 15087050.0)
Reply status: 1xx=0 2xx=9398 3xx=0 4xx=0 5xx=0

CPU time [s]: user 24.03 system 175.78 (user 12.0% system 87.9% total 99.9%)
Net I/O: 692396.6 KB/s (5672.1*10^6 bps)

Errors: total 602 client-timo 26 socket-timo 0 connrefused 574 connreset 2
Errors: fd-unavail 0 addrunavail 0 ftab-full 0 other 0
```

## Demo Run



## Dependencies:

- Linux kernel v4.15.0 (or higher)