



MARMARA UNIVERSITY
FACULTY OF ENGINEERING
COMPUTER ENGINEERING DEPARTMENT
CSE 4074
PROGRAMMING ASSIGNMENT REPORT

Socket Programming-HTTP Server and Proxy Server

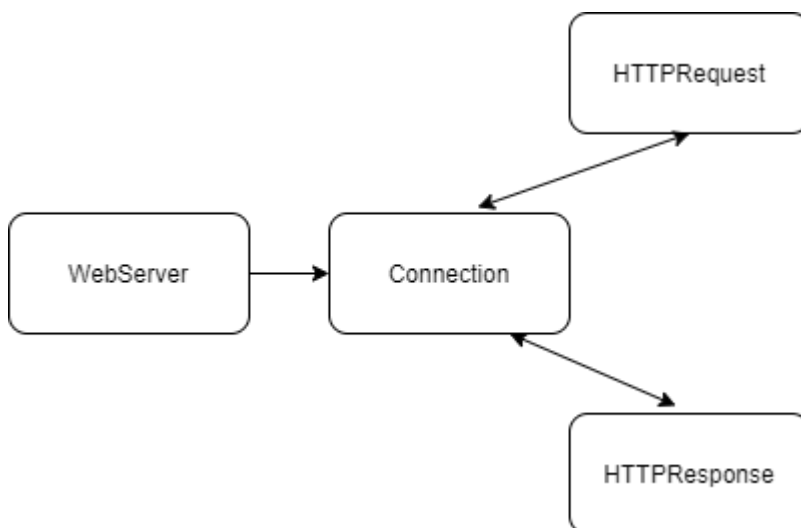
Enes Garip 150116034
Abdullah Gülçür 150116014

Design and Implementation Details

HTTP Server

In this project, we design a HTTP Web Server using Java. The logic behind the structure is using threads to serve as many clients as possible. For each client, we create a socket for communication and then the thread starts the process the data that given from client.

Our structure is as follows:



In the WebServer class, the main method controls the argument of the program and then creates a server socket. The port of the server socket is the argument of the program. After that, in an infinite loop, it creates a socket and accepts the requests. Lastly, it creates a Connection object to pass the socket to the Connect class.

In the Connection class, there are streams for taking the request information and sending response to the client. In the run method, the thread tries to read the request of the client. If it is a valid request then creates a HTTPRequest object. In that class, the request is parsed. After that, if all the conditions are met, then creates a HTTPResponse object. Lastly, the output sends to the client via browser and console.

In the HTTPResponse class, a html file created. The idea behind the html file creation is as follows: The html, title, body and it's closing tags and also CRLF (Carriage Return Line Feed) is nearly 62 characters. For instance, a client requested a file with the length of 500 bytes, a for loop iterates 0 to 500-61 and in every iteration, it randomly selects one character in the alphabet. At the end of the for loop, there is a string with proper html tags with the length of 500 bytes. Also, the class includes bad request and not implemented error responses.

Proxy Server

In Proxy Server's main function, we create a Server Socket for listening the requests. In the ThreadProxy class, there are variables for requests and response to the client. For each request, we create a socket to pass the request to the web server. When all the conditions are met, the request of the client is parsed. After the parsing process, the request is transmitted to the web server. If all goes well, the response returns to the proxy server. At the end of that process, the response returned to the client via web browser and console.

Answers of the questions

a)

```

C:\ Command Prompt
Microsoft Windows [Version 10.0.18363.1256]
(c) 2019 Microsoft Corporation. All rights reserved.

C:\Users\Garip>cd Desktop

C:\Users\Garip\Desktop>ab -n 10 -c 1 http://ipv4.download.thinkbroadband.com/5MB.zip
This is ApacheBench, Version 2.3 <$Revision: 1879490 $>
Copyright 1996 Adam Twiss, Zeus Technology Ltd, http://www.zeustech.net/
Licensed to The Apache Software Foundation, http://www.apache.org/

Benchmarking ipv4.download.thinkbroadband.com (be patient).....done


Server Software:      nginx
Server Hostname:      ipv4.download.thinkbroadband.com
Server Port:          80

Document Path:        /5MB.zip
Document Length:      5242880 bytes

Concurrency Level:    1
Time taken for tests:  45.247 seconds
Complete requests:    10
Failed requests:      0
Total transferred:    52431510 bytes
HTML transferred:     52428800 bytes
Requests per second:  0.22 [#/sec] (mean)
Time per request:     4524.729 [ms] (mean)
Time per request:     4524.729 [ms] (mean, across all concurrent requests)
Transfer rate:        1131.62 [Kbytes/sec] received


Connection Times (ms)
              min  mean[+/-sd] median   max
Connect:        61   63   2.0      63     66
Processing:    4268 4462 131.4    4454   4743
Waiting:        62   64   1.9      64     68
Total:         4328 4525 131.9    4516   4805


Percentage of the requests served within a certain time (ms)
 50%    4516
 66%    4578
 75%    4598
 80%    4606
 90%    4805
 95%    4805
 98%    4805
 99%    4805
100%    4805 (longest request)

C:\Users\Garip\Desktop>
```

b)

```
Command Prompt
Microsoft Windows [Version 10.0.18363.1256]
(c) 2019 Microsoft Corporation. All rights reserved.

C:\Users\Garip>cd Desktop

C:\Users\Garip\Desktop>ab -n 10 -c 5 http://ipv4.download.thinkbroadband.com/5MB.zip
This is ApacheBench, Version 2.3 <$Revision: 1879490 $>
Copyright 1996 Adam Twiss, Zeus Technology Ltd, http://www.zeustech.net/
Licensed to The Apache Software Foundation, http://www.apache.org/

Benchmarking ipv4.download.thinkbroadband.com (be patient).....done


Server Software:      nginx
Server Hostname:      ipv4.download.thinkbroadband.com
Server Port:          80

Document Path:        /5MB.zip
Document Length:      5242880 bytes

Concurrency Level:    5
Time taken for tests:  39.561 seconds
Complete requests:    10
Failed requests:      0
Total transferred:    52431510 bytes
HTML transferred:     52428800 bytes
Requests per second:  0.25 [#/sec] (mean)
Time per request:     19780.585 [ms] (mean)
Time per request:     3956.117 [ms] (mean, across all concurrent requests)
Transfer rate:        1294.27 [Kbytes/sec] received


Connection Times (ms)
              min  mean[+/-sd] median   max
Connect:        63    72   9.9    70    92
Processing: 15631 18463 1454.9 19282 19926
Waiting:        65   103   60.9    83   254
Total:         15696 18535 1457.1 19352 19991


Percentage of the requests served within a certain time (ms)
 50% 19352
 66% 19371
 75% 19597
 80% 19647
 90% 19991
 95% 19991
 98% 19991
 99% 19991
100% 19991 (longest request)

C:\Users\Garip\Desktop>
```

c)

```
Command Prompt
Microsoft Windows [Version 10.0.18363.1256]
(c) 2019 Microsoft Corporation. All rights reserved.

C:\Users\Garip>cd Desktop

C:\Users\Garip\Desktop>ab -n 10 -c 10 http://ipv4.download.thinkbroadband.com/5MB.zip
This is ApacheBench, Version 2.3 <$Revision: 1879490 $>
Copyright 1996 Adam Twiss, Zeus Technology Ltd, http://www.zeustech.net/
Licensed to The Apache Software Foundation, http://www.apache.org/

Benchmarking ipv4.download.thinkbroadband.com (be patient).....done


Server Software:      nginx
Server Hostname:      ipv4.download.thinkbroadband.com
Server Port:          80

Document Path:        /5MB.zip
Document Length:       5242880 bytes

Concurrency Level:    10
Time taken for tests:  39.425 seconds
Complete requests:    10
Failed requests:       0
Total transferred:    52431510 bytes
HTML transferred:     52428800 bytes
Requests per second:  0.25 [#/sec] (mean)
Time per request:      39425.335 [ms] (mean)
Time per request:      3942.534 [ms] (mean, across all concurrent requests)
Transfer rate:         1298.72 [Kbytes/sec] received


Connection Times (ms)
              min  mean[+/-sd] median   max
Connect:        60   185 321.1    75   1094
Processing:    34057 37678 1639.9  38679  39097
Waiting:        65  1089 687.9   1440   1728
Total:         34232 37863 1564.2  38745  39172


Percentage of the requests served within a certain time (ms)
 50%  38745
 66%  38759
 75%  38927
 80%  39021
 90%  39172
 95%  39172
 98%  39172
 99%  39172
100%  39172 (longest request)

C:\Users\Garip\Desktop>
```

When we increase the concurrency level in each part, we see that some values changed.

- i) Time taken for tests -> In each iteration, the time taken for test decreased.
- ii) Total transferred and HTML transferred -> These are not changed.
- iii) Time per request -> The time per request is decreased for all concurrent requests but the mean is increased.
- iv) Requests per second -> Because of the concurrency, request per second is increased.
- v) Transfer rate -> Transfer rate is increased.
- vi) Connection times -> Because of the concurrency level difference, connection time table is changed. The processing time is increased so the total is increased. Other values changes but the difference is too low.

d)

```

C:\ Command Prompt
Microsoft Windows [Version 10.0.18363.1256]
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C:\Users\Garip>cd Desktop

C:\Users\Garip\Desktop>ab -n 10 -c 1 -k http://ipv4.download.thinkbroadband.com/5MB.zip
This is ApacheBench, Version 2.3 <$Revision: 1879490 $>
Copyright 1996 Adam Twiss, Zeus Technology Ltd, http://www.zeustech.net/
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Benchmarking ipv4.download.thinkbroadband.com (be patient).....done


Server Software:      nginx
Server Hostname:      ipv4.download.thinkbroadband.com
Server Port:          80

Document Path:        /5MB.zip
Document Length:       5242880 bytes

Concurrency Level:     1
Time taken for tests:   46.357 seconds
Complete requests:     10
Failed requests:        0
Keep-Alive requests:   10
Total transferred:     52431560 bytes
HTML transferred:      52428800 bytes
Requests per second:   0.22 [#/sec] (mean)
Time per request:      4635.660 [ms] (mean)
Time per request:      4635.660 [ms] (mean, across all concurrent requests)
Transfer rate:         1104.54 [Kbytes/sec] received


Connection Times (ms)
              min  mean[+/-sd] median  max
Connect:        0    6  20.0      0    63
Processing:    4184 4629 575.8   4315  5955
Waiting:        64   66   1.8     65   70
Total:         4184 4636 592.1   4315  6018


Percentage of the requests served within a certain time (ms)
 50%    4315
 66%    4841
 75%    4865
 80%    5131
 90%    6018
 95%    6018
 98%    6018
 99%    6018
100%    6018 (longest request)

C:\Users\Garip\Desktop>
```


Command Prompt

Microsoft Windows [Version 10.0.18363.1256]

(c) 2019 Microsoft Corporation. All rights reserved.

C:\Users\Garip>cd Desktop

C:\Users\Garip\Desktop>ab -n 10 -c 5 -k http://ipv4.download.thinkbroadband.com/5MB.zip

This is ApacheBench, Version 2.3 <\$Revision: 1879490 \$>

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Benchmarking ipv4.download.thinkbroadband.com (be patient).....done

Server Software: nginx
Server Hostname: ipv4.download.thinkbroadband.com
Server Port: 80

Document Path: /5MB.zip
Document Length: 5242880 bytes

Concurrency Level: 5
Time taken for tests: 40.615 seconds
Complete requests: 10
Failed requests: 0
Keep-Alive requests: 10
Total transferred: 52431560 bytes
HTML transferred: 52428800 bytes
Requests per second: 0.25 [#/sec] (mean)
Time per request: 20307.355 [ms] (mean)
Time per request: 4061.471 [ms] (mean, across all concurrent requests)
Transfer rate: 1260.69 [Kbytes/sec] received

Connection Times (ms)

	min	mean[+/-sd]	median	max
Connect:	0	36 39.9	61	103
Processing:	15981	19360 2852.2	18541	23772
Waiting:	65	105 58.0	82	240
Total:	16044	19396 2850.7	18555	23832

Percentage of the requests served within a certain time (ms)

50%	18555
66%	20429
75%	21736
80%	23492
90%	23832
95%	23832
98%	23832
99%	23832
100%	23832 (longest request)

C:\Users\Garip\Desktop>_

```

Command Prompt
Microsoft Windows [Version 10.0.18363.1256]
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C:\Users\Garip>cd Desktop

C:\Users\Garip\Desktop>ab -n 10 -c 10 -k http://ipv4.download.thinkbroadband.com/5MB.zip
This is ApacheBench, Version 2.3 <$Revision: 1879490 $>
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Benchmarking ipv4.download.thinkbroadband.com (be patient)....done


Server Software:      nginx
Server Hostname:      ipv4.download.thinkbroadband.com
Server Port:          80

Document Path:        /5MB.zip
Document Length:      5242880 bytes

Concurrency Level:    10
Time taken for tests:  39.885 seconds
Complete requests:    10
Failed requests:      0
Keep-Alive requests:  10
Total transferred:    52431560 bytes
HTML transferred:     52428800 bytes
Requests per second:  0.25 [#/sec] (mean)
Time per request:     39885.459 [ms] (mean)
Time per request:     3988.546 [ms] (mean, across all concurrent requests)
Transfer rate:        1283.74 [Kbytes/sec] received


Connection Times (ms)
              min  mean[+/-sd] median   max
Connect:        60   179 310.5      83   1061
Processing:    34723 36598 1626.0   36060  39474
Waiting:        63   1122 585.3     1361   1667
Total:         34804 36777 1604.4   36882  39541


Percentage of the requests served within a certain time (ms)
 50%  36882
 66%  37364
 75%  38191
 80%  38587
 90%  39541
 95%  39541
 98%  39541
 99%  39541
100%  39541 (longest request)

C:\Users\Garip\Desktop>_

```

In that part, the keep-alive argument affects the values.

- i) Time taken for tests -> In each iteration, the time taken for test decreased. But without -k argument the time decreased.
- ii) Total transferred and HTML transferred -> These are not changed.
- iii) Time per request -> In that part, it is higher than without -k argument test.
- iv) Requests per second -> It seems that these are not changed.
- v) Transfer rate -> Transfer rate is increasing at each level but without -k argument the test has higher values.
- vi) Connection times -> In the mean part, the value is higher without -k test. But at the end of the test, when concurrency level equals to 10, the mean part is lower.

ApacheBench Tests

Web Server

```
C:\Users\Garip\Desktop>ab -n 10000 -c 1 localhost:8080/100
This is ApacheBench, Version 2.3 <$Revision: 1879490 $>
Copyright 1996 Adam Twiss, Zeus Technology Ltd, http://www.zeustech.net/
Licensed to The Apache Software Foundation, http://www.apache.org/

Benchmarking localhost (be patient)
Completed 1000 requests
Completed 2000 requests
Completed 3000 requests
Completed 4000 requests
Completed 5000 requests
Completed 6000 requests
Completed 7000 requests
Completed 8000 requests
Completed 9000 requests
Completed 10000 requests
Finished 10000 requests


Server Software:
Server Hostname:      localhost
Server Port:          8080


Document Path:        /100
Document Length:      100 bytes


Concurrency Level:    1
Time taken for tests:  11.276 seconds
Complete requests:    10000
Failed requests:      0
Total transferred:    1190000 bytes
HTML transferred:     1000000 bytes
Requests per second:  886.85 [#/sec] (mean)
Time per request:     1.128 [ms] (mean)
Time per request:     1.128 [ms] (mean, across all concurrent requests)
Transfer rate:        103.06 [Kbytes/sec] received


Connection Times (ms)
              min    mean[+/-sd] median    max
Connect:      0      0   0.4      0      4
Processing:   0      1   0.6      1     31
Waiting:      0      1   0.7      1     31
Total:        0      1   0.6      1     31


Percentage of the requests served within a certain time (ms)
 50%      1
 66%      1
 75%      1
 80%      1
 90%      1
 95%      2
 98%      2
 99%      2
100%     31 (longest request)
```

```
C:\Users\Garip\Desktop>ab -n 10000 -c 10 localhost:8080/100
This is ApacheBench, Version 2.3 <$Revision: 1879490 $>
Copyright 1996 Adam Twiss, Zeus Technology Ltd, http://www.zeustech.net/
Licensed to The Apache Software Foundation, http://www.apache.org/
```

Benchmarking localhost (be patient)

```
Completed 1000 requests
Completed 2000 requests
Completed 3000 requests
Completed 4000 requests
Completed 5000 requests
Completed 6000 requests
Completed 7000 requests
Completed 8000 requests
Completed 9000 requests
Completed 10000 requests
Finished 10000 requests
```

```
Server Software:
Server Hostname:      localhost
Server Port:          8080

Document Path:        /100
Document Length:      100 bytes

Concurrency Level:     10
Time taken for tests:   4.878 seconds
Complete requests:     10000
Failed requests:        0
Total transferred:     1190000 bytes
HTML transferred:      1000000 bytes
Requests per second:    2050.05 [#/sec] (mean)
Time per request:       4.878 [ms] (mean)
Time per request:       0.488 [ms] (mean, across all concurrent requests)
Transfer rate:          238.24 [Kbytes/sec] received
```

Connection Times (ms)

	min	mean	mean[+/-sd]	median	max
Connect:	0	0	0.4	0	6
Processing:	1	5	1.8	4	23
Waiting:	0	4	1.8	4	23
Total:	1	5	1.8	4	23

Percentage of the requests served within a certain time (ms)

50%	4
66%	5
75%	5
80%	6
90%	7
95%	8
98%	10
99%	12
100%	23 (longest request)

```
C:\Users\Garip\Desktop>ab -n 10000 -c 100 localhost:8080/100
This is ApacheBench, Version 2.3 <$Revision: 1879490 $>
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```

Benchmarking localhost (be patient)

```
Completed 1000 requests
Completed 2000 requests
Completed 3000 requests
Completed 4000 requests
Completed 5000 requests
Completed 6000 requests
Completed 7000 requests
Completed 8000 requests
Completed 9000 requests
Completed 10000 requests
Finished 10000 requests
```

Server Software:

Server Hostname: localhost

Server Port: 8080

Document Path: /100

Document Length: 100 bytes

Concurrency Level: 100

Time taken for tests: 24.589 seconds

Complete requests: 10000

Failed requests: 0

Total transferred: 1190000 bytes

HTML transferred: 1000000 bytes

Requests per second: 406.68 [#/sec] (mean)

Time per request: 245.893 [ms] (mean)

Time per request: 2.459 [ms] (mean, across all concurrent requests)

Transfer rate: 47.26 [Kbytes/sec] received

Connection Times (ms)

	min	mean[+/-sd]	median	max
Connect:	0	2 32.4	0	504
Processing:	2	243 247.9	35	626
Waiting:	1	209 239.9	32	623
Total:	2	246 248.2	36	626

Percentage of the requests served within a certain time (ms)

50%	36
66%	534
75%	534
80%	535
90%	536
95%	538
98%	550
99%	569
100%	626 (longest request)

```
C:\Users\Garip\Desktop>ab -n 10000 -c 1000 localhost:8080/100
This is ApacheBench, Version 2.3 <$Revision: 1879490 $>
Copyright 1996 Adam Twiss, Zeus Technology Ltd, http://www.zeustech.net/
Licensed to The Apache Software Foundation, http://www.apache.org/
```

Benchmarking localhost (be patient)

```
Completed 1000 requests
Completed 2000 requests
Completed 3000 requests
Completed 4000 requests
Completed 5000 requests
Completed 6000 requests
Completed 7000 requests
Completed 8000 requests
Completed 9000 requests
Completed 10000 requests
Finished 10000 requests
```

Server Software:

Server Hostname: localhost

Server Port: 8080

Document Path: /100

Document Length: 100 bytes

Concurrency Level: 1000

Time taken for tests: 20.667 seconds

Complete requests: 10000

Failed requests: 0

Total transferred: 1190000 bytes

HTML transferred: 1000000 bytes

Requests per second: 483.86 [#/sec] (mean)

Time per request: 2066.715 [ms] (mean)

Time per request: 2.067 [ms] (mean, across all concurrent requests)

Transfer rate: 56.23 [Kbytes/sec] received

Connection Times (ms)

	min	mean[+/-sd]	median	max
Connect:	0	2 29.2	0	503
Processing:	57	1938 689.0	1867	3838
Waiting:	0	1270 709.3	1242	2875
Total:	57	1940 689.4	1867	3838

Percentage of the requests served within a certain time (ms)

50%	1867
66%	1875
75%	2368
80%	2371
90%	2872
95%	3326
98%	3347
99%	3354
100%	3838 (longest request)

```

C:\Users\Garip\Desktop>ab -n 10000 -c 5000 localhost:8080/100
This is ApacheBench, Version 2.3 <$Revision: 1879490 $>
Copyright 1996 Adam Twiss, Zeus Technology Ltd, http://www.zeustech.net/
Licensed to The Apache Software Foundation, http://www.apache.org/

Benchmarking localhost (be patient)
Completed 1000 requests
Completed 2000 requests
Completed 3000 requests
Completed 4000 requests
Completed 5000 requests
Completed 6000 requests
Completed 7000 requests
Completed 8000 requests
Completed 9000 requests
Completed 10000 requests
Finished 10000 requests


Server Software:
Server Hostname:      localhost
Server Port:          8080

Document Path:        /100
Document Length:      100 bytes

Concurrency Level:    5000
Time taken for tests:  21.705 seconds
Complete requests:    10000
Failed requests:       0
Total transferred:    1190000 bytes
HTML transferred:     1000000 bytes
Requests per second:  460.72 [#/sec] (mean)
Time per request:     10852.573 [ms] (mean)
Time per request:     2.171 [ms] (mean, across all concurrent requests)
Transfer rate:        53.54 [Kbytes/sec] received


Connection Times (ms)
              min      mean[+/-sd] median    max
Connect:        0        2   29.6         0     503
Processing:    558    7293  4171.9     6667   14676
Waiting:        2    5500  3825.6     4524   14516
Total:          559    7295  4172.6     6667   14676


Percentage of the requests served within a certain time (ms)
 50%    6667
 66%    9559
 75%   10911
 80%   11388
 90%   13256
 95%   14185
 98%   14652
 99%   14665
100%   14676 (longest request)

```



```
C:\Users\Garip\Desktop>ab -n 10000 -c 10000 localhost:8080/100
This is ApacheBench, Version 2.3 <$Revision: 1879490 $>
Copyright 1996 Adam Twiss, Zeus Technology Ltd, http://www.zeustech.net/
Licensed to The Apache Software Foundation, http://www.apache.org/
```

Benchmarking localhost (be patient)

```
Completed 1000 requests
Completed 2000 requests
Completed 3000 requests
Completed 4000 requests
Completed 5000 requests
Completed 6000 requests
Completed 7000 requests
Completed 8000 requests
Completed 9000 requests
Completed 10000 requests
Finished 10000 requests
```

Server Software:

Server Hostname: localhost
Server Port: 8080

Document Path: /100
Document Length: 100 bytes

Concurrency Level: 10000
Time taken for tests: 27.182 seconds
Complete requests: 10000
Failed requests: 0
Total transferred: 1190000 bytes
HTML transferred: 1000000 bytes
Requests per second: 367.90 [#/sec] (mean)
Time per request: 27181.642 [ms] (mean)
Time per request: 2.718 [ms] (mean, across all concurrent requests)
Transfer rate: 42.75 [Kbytes/sec] received

Connection Times (ms)

	min	mean[+/-sd]	median	max
Connect:	0	3 33.9	0	502
Processing:	1293	13655 7294.8	13421	26349
Waiting:	0	12970 7504.6	12715	26069
Total:	1293	13658 7294.8	13421	26350

Percentage of the requests served within a certain time (ms)

```
50% 13421
66% 17742
75% 19910
80% 20997
90% 24171
95% 25261
98% 25816
99% 26332
100% 26350 (longest request)
```

-N	-C	T.P.Request	R.P.Second	Time
10000	1	1.128	886.85	11.726
10000	10	0.488	2050.05	4.878
10000	100	2.459	406.68	24.589
10000	1000	2.067	483.86	20.667
10000	5000	2.171	460.72	21.705
10000	10000	2.718	367.90	27.182
-	-	Avg=1.386	Avg=776.01	Avg=18.457

How do these values change by increasing level of concurrency? Maximum of how many concurrent requests do your server handle in a reasonable time?

The increase of the concurrency causes the increase of time per request and decrease of request per second. If the reasonable time is 15-20 seconds, then the concurrency level can be nearly 4000-5000.

Proxy Server

```
C:\Users\Garip\Desktop>ab -n 10000 -c 1 http://127.0.0.1:8080/100
This is ApacheBench, Version 2.3 <$Revision: 1879490 $>
Copyright 1996 Adam Twiss, Zeus Technology Ltd, http://www.zeustech.net/
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Benchmarking 127.0.0.1 (be patient)
Completed 1000 requests
Completed 2000 requests
Completed 3000 requests
Completed 4000 requests
Completed 5000 requests
Completed 6000 requests
Completed 7000 requests
Completed 8000 requests
Completed 9000 requests
Completed 10000 requests
Finished 10000 requests


Server Software:
Server Hostname:      127.0.0.1
Server Port:          8080

Document Path:        /100
Document Length:      100 bytes

Concurrency Level:     1
Time taken for tests:   9.945 seconds
Complete requests:     10000
Failed requests:        0
Total transferred:     1190000 bytes
HTML transferred:      1000000 bytes
Requests per second:   1005.53 [#/sec] (mean)
Time per request:      0.994 [ms] (mean)
Time per request:      0.994 [ms] (mean, across all concurrent requests)
Transfer rate:         116.85 [Kbytes/sec] received


Connection Times (ms)
              min  mean[+/-sd] median   max
Connect:     0    0   0.4      0      4
Processing:   0    1   0.6      1     20
Waiting:     0    1   0.6      1     19
Total:       0    1   0.5      1     20


Percentage of the requests served within a certain time (ms)
 50%    1
 66%    1
 75%    1
 80%    1
 90%    1
 95%    1
 98%    2
 99%    2
100%   20 (longest request)
```

```
C:\Users\Garip\Desktop>ab -n 10000 -c 10 http://127.0.0.1:8080/100
This is ApacheBench, Version 2.3 <$Revision: 1879490 $>
Copyright 1996 Adam Twiss, Zeus Technology Ltd, http://www.zeustech.net/
Licensed to The Apache Software Foundation, http://www.apache.org/
```

Benchmarking 127.0.0.1 (be patient)

```
Completed 1000 requests
Completed 2000 requests
Completed 3000 requests
Completed 4000 requests
Completed 5000 requests
Completed 6000 requests
Completed 7000 requests
Completed 8000 requests
Completed 9000 requests
Completed 10000 requests
Finished 10000 requests
```

Server Software:

Server Hostname: 127.0.0.1

Server Port: 8080

Document Path: /100

Document Length: 100 bytes

Concurrency Level: 10

Time taken for tests: 4.668 seconds

Complete requests: 10000

Failed requests: 0

Total transferred: 1190000 bytes

HTML transferred: 1000000 bytes

Requests per second: 2142.25 [#/sec] (mean)

Time per request: 4.668 [ms] (mean)

Time per request: 0.467 [ms] (mean, across all concurrent requests)

Transfer rate: 248.95 [Kbytes/sec] received

Connection Times (ms)

	min	mean[+/-sd]	median	max
Connect:	0	0 0.4	0	1
Processing:	1	4 1.8	4	33
Waiting:	0	4 1.9	4	33
Total:	1	5 1.9	4	33

Percentage of the requests served within a certain time (ms)

50%	4
66%	5
75%	5
80%	5
90%	6
95%	7
98%	9
99%	11
100%	33 (longest request)

```
C:\Users\Garip\Desktop>ab -n 10000 -c 100 http://127.0.0.1:8080/100
This is ApacheBench, Version 2.3 <$Revision: 1879490 $>
Copyright 1996 Adam Twiss, Zeus Technology Ltd, http://www.zeustech.net/
Licensed to The Apache Software Foundation, http://www.apache.org/
```

Benchmarking 127.0.0.1 (be patient)

```
Completed 1000 requests
Completed 2000 requests
Completed 3000 requests
Completed 4000 requests
Completed 5000 requests
Completed 6000 requests
Completed 7000 requests
Completed 8000 requests
Completed 9000 requests
Completed 10000 requests
Finished 10000 requests
```

Server Software:

Server Hostname: 127.0.0.1
Server Port: 8080

Document Path: /100
Document Length: 100 bytes

Concurrency Level: 100
Time taken for tests: 23.548 seconds
Complete requests: 10000
Failed requests: 0
Total transferred: 1190000 bytes
HTML transferred: 1000000 bytes
Requests per second: 424.67 [#/sec] (mean)
Time per request: 235.475 [ms] (mean)
Time per request: 2.355 [ms] (mean, across all concurrent requests)
Transfer rate: 49.35 [Kbytes/sec] received

Connection Times (ms)

	min	max	mean[+/-sd]	median	max
Connect:	0	2	31.6	0	502
Processing:	2	233	246.1	35	619
Waiting:	1	199	237.1	31	581
Total:	3	235	246.5	35	619

Percentage of the requests served within a certain time (ms)

50%	35
66%	533
75%	534
80%	535
90%	537
95%	542
98%	547
99%	554
100%	619 (longest request)

```
C:\Users\Garip\Desktop>ab -n 10000 -c 1000 http://127.0.0.1:8080/100
This is ApacheBench, Version 2.3 <$Revision: 1879490 $>
Copyright 1996 Adam Twiss, Zeus Technology Ltd, http://www.zeustech.net/
Licensed to The Apache Software Foundation, http://www.apache.org/
```

Benchmarking 127.0.0.1 (be patient)

```
Completed 1000 requests
Completed 2000 requests
Completed 3000 requests
Completed 4000 requests
Completed 5000 requests
Completed 6000 requests
Completed 7000 requests
Completed 8000 requests
Completed 9000 requests
Completed 10000 requests
Finished 10000 requests
```

Server Software:

```
Server Hostname: 127.0.0.1
Server Port: 8080
```

Document Path: /100

Document Length: 100 bytes

Concurrency Level: 1000

Time taken for tests: 16.625 seconds

Complete requests: 10000

Failed requests: 0

Total transferred: 1190000 bytes

HTML transferred: 1000000 bytes

Requests per second: 601.51 [#/sec] (mean)

Time per request: 1662.469 [ms] (mean)

Time per request: 1.662 [ms] (mean, across all concurrent requests)

Transfer rate: 69.90 [Kbytes/sec] received

Connection Times (ms)

	min	mean[+/-sd]	median	max
Connect:	0	2 25.5	0	502
Processing:	62	1513 486.6	1363	2866
Waiting:	0	971 591.5	1131	2783
Total:	62	1514 487.0	1363	2866

Percentage of the requests served within a certain time (ms)

50%	1363
66%	1845
75%	1860
80%	1864
90%	1875
95%	2361
98%	2365
99%	2807
100%	2866 (longest request)

```
C:\Users\Garip\Desktop>ab -n 10000 -c 5000 http://127.0.0.1:8080/100
This is ApacheBench, Version 2.3 <$Revision: 1879490 $>
Copyright 1996 Adam Twiss, Zeus Technology Ltd, http://www.zeustech.net/
Licensed to The Apache Software Foundation, http://www.apache.org/
```

Benchmarking 127.0.0.1 (be patient)

```
Completed 1000 requests
Completed 2000 requests
Completed 3000 requests
Completed 4000 requests
Completed 5000 requests
Completed 6000 requests
Completed 7000 requests
Completed 8000 requests
Completed 9000 requests
Completed 10000 requests
Finished 10000 requests
```

Server Software:

Server Hostname: 127.0.0.1

Server Port: 8080

Document Path: /100

Document Length: 100 bytes

Concurrency Level: 5000

Time taken for tests: 20.916 seconds

Complete requests: 10000

Failed requests: 0

Total transferred: 1190000 bytes

HTML transferred: 1000000 bytes

Requests per second: 478.11 [#/sec] (mean)

Time per request: 10457.762 [ms] (mean)

Time per request: 2.092 [ms] (mean, across all concurrent requests)

Transfer rate: 55.56 [Kbytes/sec] received

Connection Times (ms)

	min	mean[+/-sd]	median	max
Connect:	0	2 28.7	0	502
Processing:	557	6828 3879.2	6391	14144
Waiting:	1	5106 3713.6	4068	14027
Total:	558	6830 3880.0	6391	14144

Percentage of the requests served within a certain time (ms)

50%	6391
66%	8658
75%	10053
80%	10538
90%	12702
95%	13208
98%	13666
99%	14130
100%	14144 (longest request)

```
C:\Users\Garip\Desktop>ab -n 10000 -c 10000 http://127.0.0.1:8080/100
This is ApacheBench, Version 2.3 <$Revision: 1879490 $>
Copyright 1996 Adam Twiss, Zeus Technology Ltd, http://www.zeustech.net/
Licensed to The Apache Software Foundation, http://www.apache.org/
```

Benchmarking 127.0.0.1 (be patient)

```
Completed 1000 requests
Completed 2000 requests
Completed 3000 requests
Completed 4000 requests
Completed 5000 requests
Completed 6000 requests
Completed 7000 requests
Completed 8000 requests
Completed 9000 requests
Completed 10000 requests
Finished 10000 requests
```

Server Software:

Server Hostname: 127.0.0.1

Server Port: 8080

Document Path: /100

Document Length: 100 bytes

Concurrency Level: 10000

Time taken for tests: 24.977 seconds

Complete requests: 10000

Failed requests: 0

Total transferred: 1190000 bytes

HTML transferred: 1000000 bytes

Requests per second: 400.37 [#/sec] (mean)

Time per request: 24976.593 [ms] (mean)

Time per request: 2.498 [ms] (mean, across all concurrent requests)

Transfer rate: 46.53 [Kbytes/sec] received

Connection Times (ms)

	min	mean	mean[+/-sd]	median	max
Connect:	0	2	32.0	0	502
Processing:	1514	12569	6849.8	12160	24046
Waiting:	1	11774	7075.0	11341	23722
Total:	1514	12571	6849.9	12161	24047

Percentage of the requests served within a certain time (ms)

50%	12161
66%	16495
75%	18672
80%	19754
90%	22403
95%	23472
98%	24019
99%	24032
100%	24047 (longest request)

-N	-C	T.P.Request	R.P.Second	Time
10000	1	0.994	1005.53	9.945
10000	10	0.467	2142.25	4.668
10000	100	2.355	424.67	23.548
10000	1000	1.662	601.51	16.625
10000	5000	2.092	478.11	20.916
10000	10000	2.498	400.37	24.977
-	-	Avg=1,678	Avg=842,073	Avg=16,78

How do these values change by increasing level of concurrency? Maximum of how many concurrent requests do your server handle in a reasonable time?

Most of the time the increase of the concurrency causes the increase of time per request and decrease of request per second. If the reasonable is 20 seconds, then the number of concurrent requests can be 1000 or 1500.