

CSE4074 COMPUTER NETWORKS PROJECT REPORT

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1-2) IMPLEMENTATION DETAILS

SERVER:

To implement the first part of the project we created a class "Server". This server has a main method to run the server. First, we asked the user to write the port number. After the user enters the port number, we open a ServerSocket with the entered port number. When we open a socket, the server waits for the client to connect with a given port number. If the client connects, the server accepts the connect and calls run() method.

In the run() method, we created two variables for reading the client input and for the response to the client. If a request is null, the server returns without doing anything. If the request is not null, then we created a HTTPRequest to create an HTML file with the given size.

In the second run method, we did the same things but this part is for Proxy Server. For this purpose, this method takes a response buffer and request string as parameters.

HTTP REQUEST:

In this class, we created a bunch of variables to hold the necessary parts of the http request coming from the client. We called this class inside the server. In the splitRequestString() method we basically split the request to reach the size of the wanted file from the client. In sendRequest() method (we have called this method inside the Server class) first we check if the entered request contains any letter, if it contains we throw a "400 - BAD REQUEST" message to the client.

After checking the integer part, we looked for the http method. If the http method contains a GET, we checked for the limits of the document. If file size is less than 100 or greater than 20.000, we throw a "400 - BAD REQUEST" message to the client. If file size is valid, we create a HTML file with the given size and send the response to the client.

If the http method does not contain a GET, we throw a "501 - NOT IMPLEMENTED" message to the client.

HTTP RESPONSE:

In this class, we created a sendResponse() method to send a response to the client. Also we created a setHtmlString() method to call inside the HttpRequest class to set the HTML string and create the HTML file with a given size. We created a createHtmlFile() method to create the HTML file with given size. In sendFile() method, we send our created html file to the client.

PROXY:

In the main method of this class, we assigned a port number as 8888 because it is a proxy port number. Then we created a server socket with this port number because proxy is a server. Then Proxy server waits for the client to connect, when client connects it accepts the connection and calls its run() method.

In the run method, we simply read the request and call the createRequest() method of the Proxy.

In the createRequest() method, first we checked if the request is null or not. If it is null, then we return and do not send any request to the Server. If it is not null, then we split

the request message into variables. If this request message contains GET, then we checked for the given file size. If the file size is greater than 9.999 then we throw the "414 - REQUESTED URI IS TOO LONG" message to the client and do not send the request to the Server. If file size is valid, then we send the request to the Server and Server creates the file with the given size. If a requested file is already created, then Server does not create a new file (from its cache) and returns the old file. If the requested message does not contain GET, then we throw a "501 - NOT IMPLEMENTED" message to the client. If a request message contains any non-integer value, we throw "400 - BAD REQUEST" to the client.

INSIDE THE PROXY CLASS, TO TEST IN THE APACHE BENCH PROGRAM, WE HAVE TO COMMENT THIS PART OF THE CODE.

```
// if (!httpQueryString.contains("localhost")) {  
//     return;  
// }
```

3) Using ApacheBench Program

i) Time taken for tests (seconds)

c = 1

- 1 = 0.400

c = 5

- 1 = 0.244

c = 10

- 1 = 0.230

Time taken for tests decreases, while the concurrency level increases.

ii) Total transferred (bytes) and HTML transferred (bytes)

Total transferred (bytes)

c = 1

- 1 = 4400

c = 5

- 1 = 4400

c = 10

- 1 = 4400

Total transferred bytes do not change with concurrency level.

HTML transferred (bytes)

c = 1

- 1 = 2260

c = 5

- 1 = 2260

c = 10

- 1 = 2260

HTML transferred bytes do not change with concurrency level.

iii) Time per request (ms)

c = 1

- 1 = 39.950

c = 5

- 1 = 121.968

c = 10

- 1 = 230.212

Time per request increases, while the concurrency level increases.

iv) Requests per second (#/sec)

c = 1

- 1 = 25.03

c = 5

- 1 = 40.99

c = 10

- 1 = 43.44

Request per second increases, while the concurrency level increases.

v) Transfer rate (Kbytes/sec)

c = 1

- 1 = 10.76

c = 5

- 1 = 17.61

c = 10

- 1 = 18.66

Transfer rate increases, while the concurrency level increases.

vi) Connection times

c = 1

Connection Times (ms)					
	min	mean[+/-sd]	median	max	
Connect:	18	20 2.4	19	26	
Processing:	19	20 1.2	20	23	
Waiting:	19	20 1.3	20	23	
Total:	38	40 2.3	40	46	

c = 5

Connection Times (ms)					
	min	mean[+/-sd]	median	max	
Connect:	18	20 1.8	19	24	
Processing:	20	65 27.2	79	103	
Waiting:	20	53 23.9	59	83	
Total:	44	85 26.1	97	122	

c = 10

Connection Times (ms)					
	min	mean[+/-sd]	median	max	
Connect:	17	19 0.9	19	20	
Processing:	20	91 55.7	93	192	
Waiting:	20	73 46.5	74	150	
Total:	39	109 55.9	113	210	

Connection times increases, while the concurrency level increases.

i) Time taken for tests (seconds)

c = 1

31.794

c = 5

25.102

c = 10

15.301

Time taken for tests decreased by increasing c value.

ii) Total transferred (bytes) and HTML transferred (bytes)

c = 1

total = 52431560 , HTML = 52428800

c = 5

total => 52431560 , HTML = 52428800

c = 10

total = 52431560 , HTML = 52428800

Total transferred bytes and HTML transferred bytes do not change with the c value.

iii) Time per request (ms)

c = 1

3179.449

c = 5

13193.820

c = 10

24610.979

Time per request increased by increasing c value.

iv) Requests per second (#/sec)

c = 1

0.31

c = 5

0.40

c = 10

0.41

Requests per second increased by increasing c value.

v) Transfer rate (Kbytes/sec)

c = 1

1784.40

c = 5

1940.40

c = 10

2080.48

Transfer rate increased by increasing c value.

vi) Connection times

- c = 1

Connection Times (ms)					
	min	mean[+/-sd]	median	max	
Connect:	0	7 21.4	0	68	
Processing:	2390	3173 866.3	2877	4721	
Waiting:	68	71 3.2	70	77	
Total:	2390	3179 873.2	2877	4721	

- c = 5

Connection Times (ms)					
	min	mean[+/-sd]	median	max	
Connect:	0	37 38.8	71	79	
Processing:	8644	11472 2004.3	12041	14558	
Waiting:	69	78 7.6	80	90	
Total:	8715	11509 2020.9	12112	14637	

- c = 10

Connection Times (ms)					
	min	mean[+/-sd]	median	max	
Connect:	65	73 5.7	72	83	
Processing:	16895	21406 2075.1	21964	24391	
Waiting:	68	91 17.2	96	112	
Total:	16960	21479 2079.6	22041	24473	

Connection times increased by increasing c value.

For all cases, we noticed that when we use the -k option values getting worse.

4) TESTING OUR WEB SERVER USING APACHE BENCH PROGRAM

n = 10000 and c = 1

Time per request = 4.762

Request per second = 209.98

```
C:\Users\ardab\Desktop\ab\Apache24\bin>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:      Java
Server Hostname:      localhost
Server Port:          8080
```

```
Document Path:        /100
Document Length:       100 bytes
```

```
Concurrency Level:     1
Time taken for tests:   47.624 seconds
Complete requests:      10000
Failed requests:         0
Total transferred:      2090000 bytes
HTML transferred:       1000000 bytes
Requests per second:    209.98 [#/sec] (mean)
Time per request:       4.762 [ms] (mean)
Time per request:       4.762 [ms] (mean, across all concurrent requests)
Transfer rate:          42.86 [Kbytes/sec] received
```

```
Connection Times (ms)
```


n = 10000 and c = 2

Time per request = 4.118

Request per second = 485.66

```
C:\Users\ardab\Desktop\ab\Apache24\bin>ab -n 10000 -c 2 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:      Java
Server Hostname:      localhost
Server Port:          8080

Document Path:        /100
Document Length:      100 bytes

Concurrency Level:    2
Time taken for tests:  20.590 seconds
Complete requests:    10000
Failed requests:      0
Total transferred:    2089762 bytes
HTML transferred:     1000000 bytes
Requests per second:  485.66 [#/sec] (mean)
Time per request:     4.118 [ms] (mean)
Time per request:     2.059 [ms] (mean, across all concurrent requests)
Transfer rate:        99.11 [Kbytes/sec] received
```


n = 10000 and c = 3

Time per request = 4.802

Request per second = 624.78

```
C:\Users\ardab\Desktop\ab\Apache24\bin>ab -n 10000 -c 3 localhost:8080/100
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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:      Java
Server Hostname:      localhost
Server Port:          8080
```

```
Document Path:        /100
Document Length:       100 bytes
```

```
Concurrency Level:     3
Time taken for tests:   16.006 seconds
Complete requests:     10000
Failed requests:        49
  (Connect: 0, Receive: 0, Length: 49, Exceptions: 0)
```

```
Total transferred:    2081076 bytes
HTML transferred:      995100 bytes
Requests per second:   624.78 [#/sec] (mean)
Time per request:      4.802 [ms] (mean)
Time per request:      1.601 [ms] (mean, across all concurrent requests)
Transfer rate:         126.97 [Kbytes/sec] received
```

n = 10000 and c=4

Time per request = 5.726

Request per second = 698.53

```
C:\Users\ardab\Desktop\ab\Apache24\bin>ab -n 10000 -c 4 localhost:8080/100
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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:      Java
Server Hostname:      localhost
Server Port:          8080
```

```
Document Path:        /100
Document Length:      100 bytes
```

```
Concurrency Level:    4
Time taken for tests:  14.316 seconds
Complete requests:    10000
Failed requests:      810
```

```
(Connect: 0, Receive: 0, Length: 810, Exceptions: 0)
```

```
Total transferred:   2005266 bytes
HTML transferred:     919000 bytes
Requests per second:  698.53 [#/sec] (mean)
Time per request:     5.726 [ms] (mean)
Time per request:     1.432 [ms] (mean, across all concurrent requests)
Transfer rate:        136.79 [Kbytes/sec] received
```

n = 10000 and c = 5

Time per request = 7.545

Request per second = 662.69

```
C:\Users\ardab\Desktop\ab\Apache24\bin>ab -n 10000 -c 5 localhost:8080/100
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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:      Java
Server Hostname:      localhost
Server Port:          8080
```

```
Document Path:        /100
Document Length:       100 bytes
```

```
Concurrency Level:     5
Time taken for tests:   15.090 seconds
Complete requests:      10000
Failed requests:        1437
```

```
(Connect: 0, Receive: 0, Length: 1437, Exceptions: 0)
```

```
Total transferred:     1943018 bytes
HTML transferred:       856300 bytes
Requests per second:    662.69 [#/sec] (mean)
Time per request:       7.545 [ms] (mean)
Time per request:       1.509 [ms] (mean, across all concurrent requests)
Transfer rate:          125.74 [Kbytes/sec] received
```


n = 1000 and c = 10

Time per request = 15.253

Request per second = 655.59

```
C:\Users\ardab\Desktop\ab\Apache24\bin>ab -n 10000 -c 10 localhost:8080/100
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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:      Java
Server Hostname:      localhost
Server Port:          8080

Document Path:        /100
Document Length:      100 bytes

Concurrency Level:    10
Time taken for tests:  15.253 seconds
Complete requests:    10000
Failed requests:      1571
  (Connect: 0, Receive: 0, Length: 1571, Exceptions: 0)
Total transferred:    1929494 bytes
HTML transferred:     842900 bytes
Requests per second:  655.59 [#/sec] (mean)
Time per request:     15.253 [ms] (mean)
Time per request:     1.525 [ms] (mean, across all concurrent requests)
Transfer rate:        123.53 [Kbytes/sec] received
```

n = 10000 and c = 100
Time per request = 148.090
Request per second = 675.26

```
C:\Users\ardab\Desktop\ab\Apache24\bin>ab -n 10000 -c 100 localhost:8080/100
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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:        Java
Server Hostname:        localhost
Server Port:            8080

Document Path:          /100
Document Length:        100 bytes

Concurrency Level:      100
Time taken for tests:    14.809 seconds
Complete requests:      10000
Failed requests:         1792
    (Connect: 0, Receive: 0, Length: 1792, Exceptions: 0)
Total transferred:      1906680 bytes
HTML transferred:       820800 bytes
Requests per second:    675.26 [#/sec] (mean)
Time per request:       148.090 [ms] (mean)
Time per request:       1.481 [ms] (mean, across all concurrent requests)
Transfer rate:          125.73 [Kbytes/sec] received
```

n = 10000 and c = 800

Time per request = 1087.319 ms

Request per second = 735.75

```
C:\Users\ardab\Desktop\ab\Apache24\bin>ab -n 10000 -c 800 localhost:8080/100
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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:      Java
Server Hostname:      localhost
Server Port:          8080
```

```
Document Path:        /100
Document Length:       100 bytes
```

```
Concurrency Level:     800
Time taken for tests:   13.591 seconds
Complete requests:      10000
Failed requests:         2041
```

```
(Connect: 0, Receive: 0, Length: 2041, Exceptions: 0)
```

```
Total transferred:     1881408 bytes
HTML transferred:       795900 bytes
Requests per second:    735.75 [#/sec] (mean)
Time per request:       1087.319 [ms] (mean)
Time per request:       1.359 [ms] (mean, across all concurrent requests)
Transfer rate:          135.18 [Kbytes/sec] received
```


n = 10000 and c = 1000

Time per request = 1450.896

Request per second = 689.23

```
C:\Users\ardab\Desktop\ab\Apache24\bin>ab -n 10000 -c 1000 localhost:8080/100
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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:      Java
Server Hostname:      localhost
Server Port:          8080


Document Path:        /100
Document Length:      100 bytes


Concurrency Level:    1000
Time taken for tests:  14.509 seconds
Complete requests:    10000
Failed requests:      2032
  (Connect: 0, Receive: 0, Length: 2032, Exceptions: 0)
Total transferred:    1882080 bytes
HTML transferred:     796800 bytes
Requests per second:  689.23 [#/sec] (mean)
Time per request:     1450.896 [ms] (mean)
Time per request:     1.451 [ms] (mean, across all concurrent requests)
Transfer rate:        126.68 [Kbytes/sec] received
```


n = 10000 and c = 10000

Time per request = 17665.129

Request per second = 566.09

```
C:\Users\ardab\Desktop\ab\Apache24\bin>ab -n 10000 -c 10000 localhost:8080/100
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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:      Java
Server Hostname:      localhost
Server Port:          8080

Document Path:        /100
Document Length:       100 bytes

Concurrency Level:     10000
Time taken for tests:   17.665 seconds
Complete requests:     10000
Failed requests:        3010
  (Connect: 0, Receive: 0, Length: 3010, Exceptions: 0)
Total transferred:     1782064 bytes
HTML transferred:      699000 bytes
Requests per second:   566.09 [#/sec] (mean)
Time per request:      17665.129 [ms] (mean)
Time per request:      1.767 [ms] (mean, across all concurrent requests)
Transfer rate:          98.52 [Kbytes/sec] received
```

With the increasing values of concurrency level, time per request is also increasing and request per second unstable. After our research on the web we saw that, server response time of more than 1.1 seconds would put you in the worst 20% of sites. So, we took our threshold as 1.1 seconds. Our web server can handle approximately a maximum 800 concurrency level.

4) TESTING PROXY SERVER WITH APACHE BENCH PROGRAM

n = 10000 and c = 1

Time per request = 5.980 ms

Request per second = 167.23

```
C:\Users\ardab\Desktop\ab\Apache24\bin>ab -n 10000 -c 1 localhost:8888/100
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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:      Java
Server Hostname:      localhost
Server Port:          8888
```

```
Document Path:        /100
Document Length:       100 bytes
```

```
Concurrency Level:     1
Time taken for tests:   59.800 seconds
Complete requests:      10000
Failed requests:         0
Total transferred:      2090000 bytes
HTML transferred:       1000000 bytes
Requests per second:    167.23 [#/sec] (mean)
Time per request:       5.980 [ms] (mean)
Time per request:       5.980 [ms] (mean, across all concurrent requests)
Transfer rate:          34.13 [Kbytes/sec] received
```

Connection Times (ms)

	min	mean[+/-sd]	median	max
Connect:	0	0 0.4	0	1
Processing:	3	5 1.3	5	33
Waiting:	1	4 1.2	4	31
Total:	3	6 1.3	5	33

n = 10000 and c = 2

Time per request = 6.379 ms

Request per second = 313.55

```

C:\Users\ardab\Desktop\ab\Apache24\bin>ab -n 10000 -c 2 localhost:8888/100
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Copyright 1996 Adam Twiss, Zeus Technology Ltd, http://www.zeustech.net/
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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:        Java
Server Hostname:        localhost
Server Port:            8888


Document Path:          /100
Document Length:        100 bytes


Concurrency Level:      2
Time taken for tests:    31.893 seconds
Complete requests:      10000
Failed requests:         4
    (Connect: 0, Receive: 0, Length: 4, Exceptions: 0)
Total transferred:      2087930 bytes
HTML transferred:       999600 bytes
Requests per second:    313.55 [#/sec] (mean)
Time per request:       6.379 [ms] (mean)
Time per request:       3.189 [ms] (mean, across all concurrent requests)
Transfer rate:          63.93 [Kbytes/sec] received

```

n = 10000 and c = 3
Time per request = 6.183 ms
Request per second = 485.21


```
C:\Users\ardab\Desktop\ab\Apache24\bin>ab -n 10000 -c 3 localhost:8888/100
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:      Java
Server Hostname:      localhost
Server Port:          8888
```

```
Document Path:        /100
Document Length:       100 bytes
```

```
Concurrency Level:     3
Time taken for tests:   20.610 seconds
Complete requests:      10000
Failed requests:         304
```

```
(Connect: 0, Receive: 0, Length: 304, Exceptions: 0)
```

```
Total transferred:     2056622 bytes
HTML transferred:       969600 bytes
Requests per second:    485.21 [#/sec] (mean)
Time per request:        6.183 [ms] (mean)
Time per request:        2.061 [ms] (mean, across all concurrent requests)
Transfer rate:           97.45 [Kbytes/sec] received
```

n = 10000 and c = 4

Time per request = 6.224 ms

Request per second = 642.69

```
C:\Users\ardab\Desktop\ab\Apache24\bin>ab -n 10000 -c 4 localhost:8888/100
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:      Java
Server Hostname:      localhost
Server Port:          8888
```

```
Document Path:        /100
Document Length:       100 bytes
```

```
Concurrency Level:     4
Time taken for tests:   15.560 seconds
Complete requests:      10000
Failed requests:         1182
    (Connect: 0, Receive: 0, Length: 1182, Exceptions: 0)
Total transferred:      1967868 bytes
HTML transferred:       881800 bytes
Requests per second:    642.69 [#/sec] (mean)
Time per request:       6.224 [ms] (mean)
Time per request:       1.556 [ms] (mean, across all concurrent requests)
Transfer rate:          123.51 [Kbytes/sec] received
```

n = 10000 and c = 5

Time per request = 6.443 ms

Request per second = 776.00

```
C:\Users\ardab\Desktop\ab\Apache24\bin>ab -n 10000 -c 5 localhost:8888/100
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:      Java
Server Hostname:      localhost
Server Port:          8888
```

```
Document Path:        /100
Document Length:       100 bytes
```

```
Concurrency Level:     5
Time taken for tests:   12.887 seconds
Complete requests:      10000
Failed requests:         1635
    (Connect: 0, Receive: 0, Length: 1635, Exceptions: 0)
Total transferred:      1922556 bytes
HTML transferred:       836500 bytes
Requests per second:    776.00 [#/sec] (mean)
Time per request:        6.443 [ms] (mean)
Time per request:        1.289 [ms] (mean, across all concurrent requests)
Transfer rate:           145.69 [Kbytes/sec] received
```

n = 10000 and c = 10
Time per request = 13.486 ms
Request per second = 741.51


```

C:\Users\ardab\Desktop\ab\Apache24\bin>ab -n 10000 -c 10 localhost:8888/100
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:      Java
Server Hostname:      localhost
Server Port:          8888

Document Path:        /100
Document Length:       100 bytes

Concurrency Level:     10
Time taken for tests:   13.486 seconds
Complete requests:      10000
Failed requests:         1406
    (Connect: 0, Receive: 0, Length: 1406, Exceptions: 0)
Total transferred:      1945980 bytes
HTML transferred:       859400 bytes
Requests per second:    741.51 [#/sec] (mean)
Time per request:       13.486 [ms] (mean)
Time per request:       1.349 [ms] (mean, across all concurrent requests)
Transfer rate:          140.91 [Kbytes/sec] received

```

n = 10000 and c = 100

Time per request = 122.948 ms

Request per second = 813.35

```

C:\Users\ardab\Desktop\ab\Apache24\bin>ab -n 10000 -c 100 localhost:8888/100
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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:      Java
Server Hostname:      localhost
Server Port:          8888


Document Path:        /100
Document Length:      100 bytes


Concurrency Level:    100
Time taken for tests:  12.295 seconds
Complete requests:    10000
Failed requests:       1269
  (Connect: 0, Receive: 0, Length: 1269, Exceptions: 0)
Total transferred:    1959932 bytes
HTML transferred:     873100 bytes
Requests per second:  813.35 [#/sec] (mean)
Time per request:     122.948 [ms] (mean)
Time per request:     1.229 [ms] (mean, across all concurrent requests)
Transfer rate:        155.68 [Kbytes/sec] received

```

n = 10000 and c = 1000

Time per request = 1293.772 ms

Request per second = 772.96

```
C:\Users\ardab\Desktop\ab\Apache24\bin>ab -n 10000 -c 1000 localhost:8888/100
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:      Java
Server Hostname:      localhost
Server Port:          8888
```

```
Document Path:        /100
Document Length:       100 bytes
```

```
Concurrency Level:     1000
Time taken for tests:   12.937 seconds
Complete requests:      10000
Failed requests:        1544
```

```
(Connect: 0, Receive: 0, Length: 1544, Exceptions: 0)
```

```
Total transferred:    1931672 bytes
HTML transferred:      845600 bytes
Requests per second:    772.96 [#/sec] (mean)
Time per request:       1293.722 [ms] (mean)
Time per request:       1.294 [ms] (mean, across all concurrent requests)
Transfer rate:          145.81 [Kbytes/sec] received
```

n = 10000 and c = 10000

Time per request = 13388.458 ms

Request per second = 746.91

```

C:\Users\ardab\Desktop\ab\Apache24\bin>ab -n 10000 -c 10000 localhost:8888/100
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:      Java
Server Hostname:      localhost
Server Port:          8888


Document Path:        /100
Document Length:       100 bytes


Concurrency Level:     10000
Time taken for tests:   13.388 seconds
Complete requests:     10000
Failed requests:        2857
  (Connect: 0, Receive: 0, Length: 2857, Exceptions: 0)
Total transferred:     1798250 bytes
HTML transferred:      714300 bytes
Requests per second:    746.91 [#/sec] (mean)
Time per request:       13388.458 [ms] (mean)
Time per request:       1.339 [ms] (mean, across all concurrent requests)
Transfer rate:          131.17 [Kbytes/sec] received

```

With the increasing values of concurrency level, time per request is also increasing and request per second unstable. After our research on the web we saw that, server response time of more than 1.1 seconds would put you in the worst 20% of sites. So, we took our threshold as 1.1 seconds. Our web server can handle approximately a maximum 1000 concurrency level.