CSE 503S Performance Evaluation Study

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1. Apache and Nginx comparison on the same AWS instance type:

a. Experiment Method:

Apache and Nginx are the two most common open source web servers in the world. To compare the performances of Apache and Nginx, I use a simple html file:

```
<!DOCTYPE html>
 <html lang="en">
<head>
    <meta charset="UTF-8">
    <meta name="viewport" content="width=device-width, initial-scale=1.0">
    <meta http-equiv="X-UA-Compatible" content="ie=edge">
    <title>Document</title>
</head>
<body>
    Hello World!
</body>
</html>
```

Using the commond line:

```
ab -kc 100 -n 1000 http://ec2-18-188-41-39.us-east-
2.compute.amazonaws.com/~h.wan/public_html/module8/the.html
```

It will connect to the 100 concurrent connections 10.000 times. The result shows below:

```
This is ApacheBench, Version 2.3 <$Revision: 1843412 $>
Copyright 1996 Adam Twiss, Zeus Technology Ltd, http://www.zeustech.net/
Licensed to The Apache Software Foundation, http://www.apache.org/

Benchmarking ec2-18-188-41-39.us-east-2.compute.amazonaws.com (be patient)
Completed 100 requests
Completed 200 requests
Completed 300 requests
Completed 400 requests
Completed 500 requests
Completed 600 requests
Completed 700 requests
Completed 800 requests
Completed 900 requests
Completed 1000 requests
Finished 1000 requests


Server Software:        Apache/2.4.39
Server Hostname:        ec2-18-188-41-39.us-east-2.compute.amazonaws.com
Server Port:            80

Document Path:          /~h.wan/public_html/module8/testhtml.html
Document Length:        238 bytes

Concurrency Level:      100
```

```
Time taken for tests:   6.817 seconds
Complete requests:      1000
Failed requests:        13
   (Connect: 0, Receive: 0, Length: 13, Exceptions: 0)
Non-2xx responses:      987
Keep-Alive requests:    987
Total transferred:      459040 bytes
HTML transferred:       234906 bytes
Requests per second:    146.68 [#/sec] (mean)
Time per request:       681.749 [ms] (mean)
Time per request:       6.817 [ms] (mean, across all concurrent requests)
Transfer rate:          65.75 [Kbytes/sec] received

Connection Times (ms)
              min  mean[+/-sd] median   max
Connect:        0    1   2.1      0       8
Processing:     0  447 1454.4      1    6807
Waiting:        0  386 1359.0      1    6807
Total:          0  448 1456.2      1    6815

Percentage of the requests served within a certain time (ms)
  50%      1
  66%      1
  75%      1
  80%      1
  90%      7
  95%   5001
  98%   5769
  99%   5791
 100%   6815 (longest request)
```

The result show the data of Apach running on the instance of AWS.
Then we can use this line to install the Nginx and change the server:

```
sudo yum install epel-release
sudo yum install nginx
sudo apachectl stop
sudo nginx
```

Run the same ab commend to get the result.

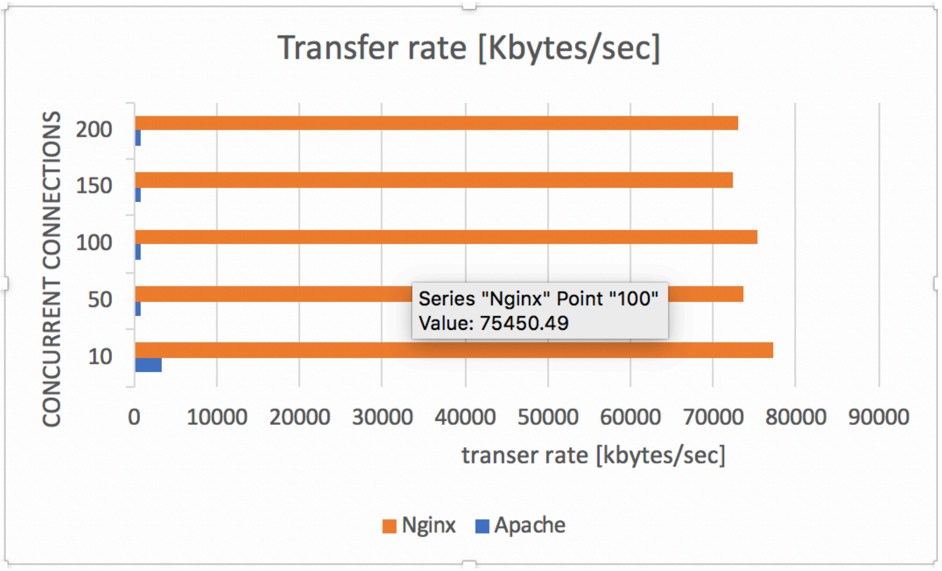
b. Set up:

In this experiment, I send the different concurrent connections (10, 50, 100, 150, 200) and 10000 requests in total. And the result is shown below.

c. Result:

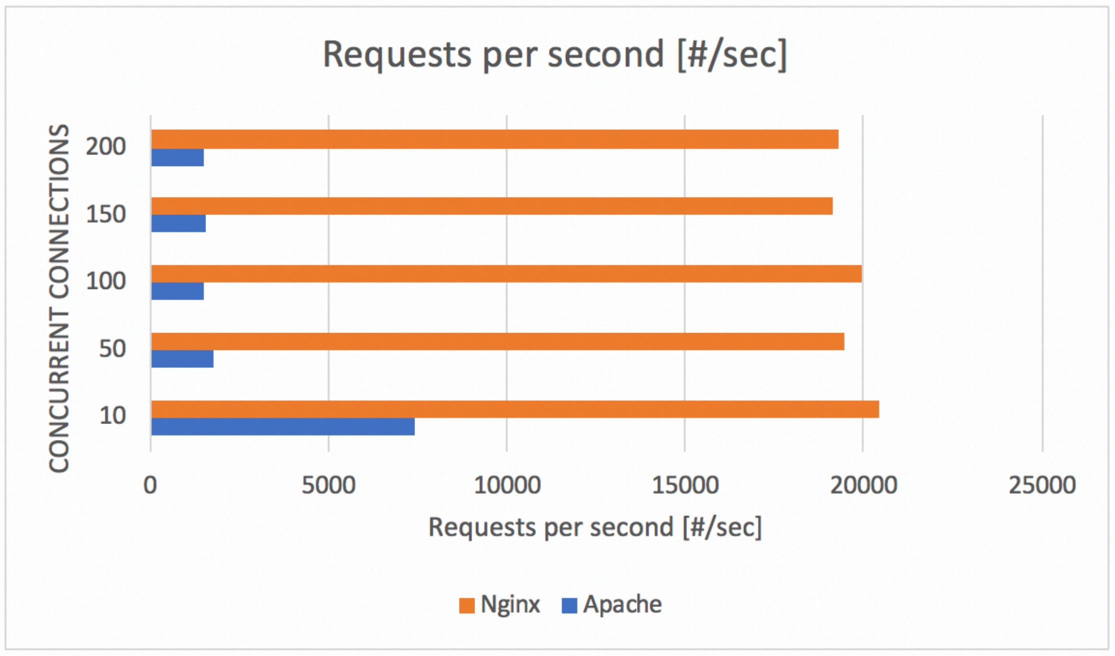
Transfer rate [Kbytes/sec]:

kc	n	Apache	Nginx
10	10000	3366.3	77372.44
50	10000	795.18	73574.11
100	10000	684.15	75450.49
150	10000	693.69	72477.24
200	10000	691.66	73081.51



Requests per second [#/sec]:

kc	n	Apache	Nginx
10	10000	7419.4	20451.82
50	10000	1752.68	19447.76
100	10000	1509.9	19943.76
150	10000	1530.84	19157.64
200	10000	1530.06	19317.36



d. Conclusion:

Transfer rate analysis:

The data transfer rate (DTR) is the amount of digital data that is moved from one place to another in a given time. The data transfer rate can be viewed as the speed of travel of a given amount of data from one place to another. In general, the greater the bandwidth of a given path, the higher the data transfer rate. According to the result, we can find that the transfer rate is much better when we used the Nginx than Apache. With the concurrent connects getting large, the performance of Apache is getting slower.

Requests per second analysis:

requests per second is a measurement of how fast the server can process requests, the more requests per second the server can handle, the more capable the server is to handle a lot of requests. According to the result, we can find that the requests per second of Nginx is better than Apache. With the concurrent connects getting large, the performance of Apache is getting slower.

Bottlenecks:

The reason why Nginx is better is because Nginx came onto the scene after Apache, with more awareness of the concurrency problems that would face sites at scale. Leveraging this knowledge, Nginx was designed from the ground up to use an asynchronous, non-blocking, event-driven connection handling algorithm.

Recommendation:

According to the result and analysis above, when facing the high-traffic situation. I strongly suggest users to choose Nginx, which is much better than the Apache for this situation.

2. Node.js and Apache+PHP comparison on the same AWS instance type

a. Experiment Method:

In this experiment, I decide to compare the Apache+php and Node.js in the same instance. I create simple php file and the node.js file to test the performance:

```
<?php
$loop=10000000;
while($loop>0){
    $loop--;
}
echo "loop=10000000"
?>
```

```
let http = require('http');
let app = http.createServer(function(req, res){
    let loop=10000000;
    while(loop>0){
        loop--;
    }
    res.writeHead(200);
    res.end('10000000');
});
app.listen(3456);
```

Then I can use the commend line to test the performances of them:

```
ab -n 25000 -c 100 http://ec2-18-188-41-39.us-east-
2.compute.amazonaws.com/~h.wan/public_html/module8/testphp.php
```

The result is shown below:

```
This is ApacheBench, Version 2.3 <$Revision: 1843412 $>
Copyright 1996 Adam Twiss, Zeus Technology Ltd, http://www.zeustech.net/
Licensed to The Apache Software Foundation, http://www.apache.org/

Benchmarking ec2-18-188-41-39.us-east-2.compute.amazonaws.com (be patient)
Completed 2500 requests
Completed 5000 requests
Completed 7500 requests
Completed 10000 requests
Completed 12500 requests
Completed 15000 requests
Completed 17500 requests
Completed 20000 requests
Completed 22500 requests
Completed 25000 requests
Finished 25000 requests

```

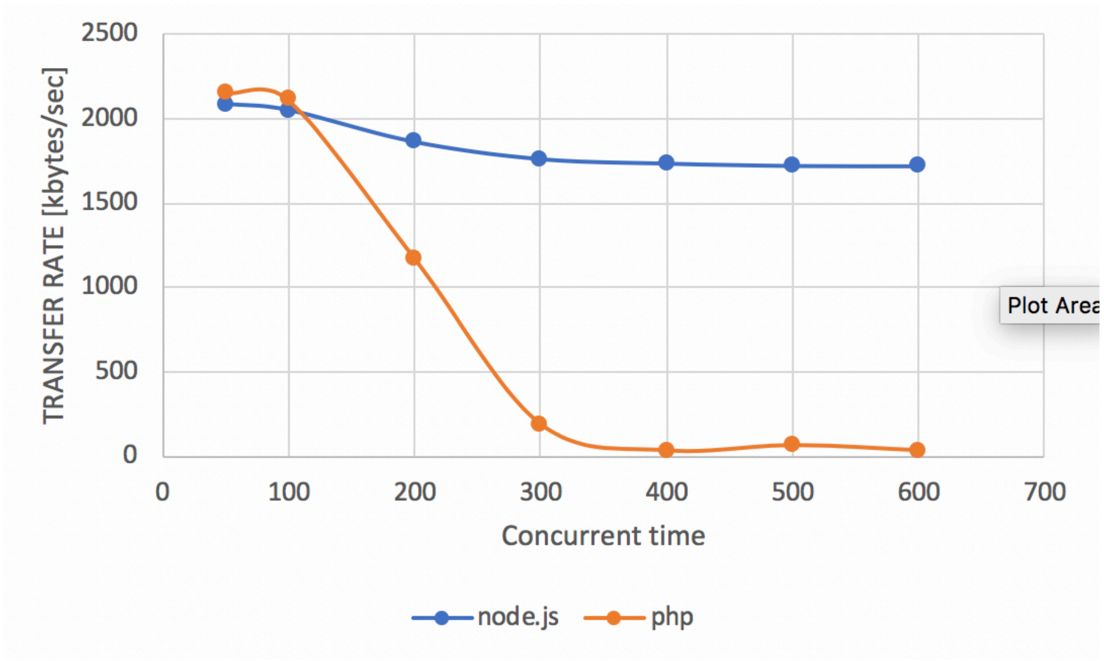
```

Server Software:        Apache/2.4.39
Server Hostname:        ec2-18-188-41-39.us-east-2.compute.amazonaws.com
Server Port:            80

Document Path:          /~h.wan/public_html/module8/testphp.php
Document Length:        236 bytes

Concurrency Level:      100
Time taken for tests:   4.808 seconds
Complete requests:      25000
Failed requests:        0
Non-2xx responses:      25000
Total transferred:      10675000 bytes
HTML transferred:       5900000 bytes
Requests per second:    5199.38 [#/sec] (mean)
Time per request:       19.233 [ms] (mean)
Time per request:       0.192 [ms] (mean, across all concurrent requests)
Transfer rate:          2168.10 [Kbytes/sec] received

Connection Times (ms)
              min  mean[+/-sd] median   max
Connect:        0    0   0.3      0       3
Processing:     2   19   0.7     19      20
Waiting:        0   18   0.7     18      20
Total:          2   19   0.6     19      22

Percentage of the requests served within a certain time (ms)
  50%     19
  66%     19
  75%     19
  80%     19
  90%     19
  95%     20
  98%     20
  99%     20
 100%     22 (longest request)
```

b. set up:
   In this experiment, we fixed the total request is 10000 and use different concurrency levels: 50, 100, 200, 300, 400, 500, 600. The file is shown above (testphp.php and test.js)

c. Result:

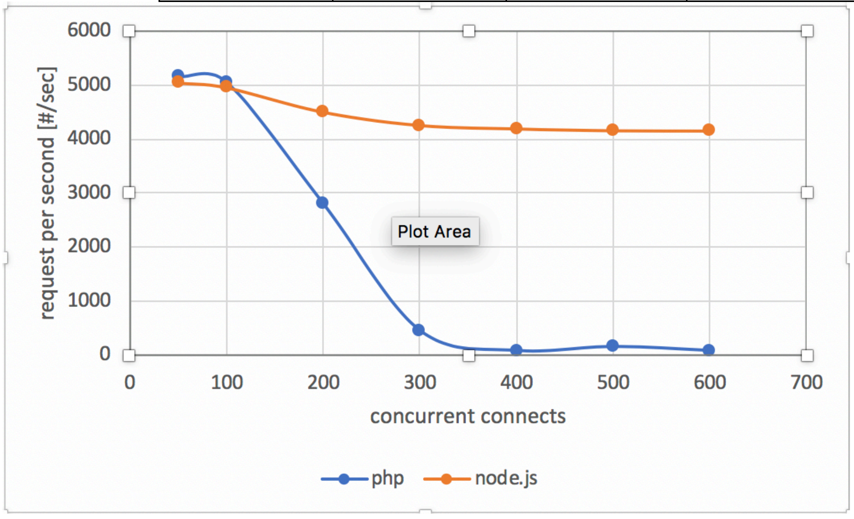
Transfer rate [Kbytes/sec]:

kc	n	php	node.js
50	10000	2152.26	5040.83
100	10000	2113	4955.2
200	10000	*1173.57*	4506.43
300	10000	189.99	4262.83
400	10000	34.21	4199.99
500	10000	65.29	4166.3
600	10000	34.44	4161.97



Requests per second [#/sec]:

kc	n	php	node.js
50	10000	*5161.4*	5040.83
100	10000	5067.25	4955.2
200	10000	2814.37	4506.43
300	10000	455.65	4262.83
400	10000	82.23	4199.99
500	10000	156.73	4166.3
600	10000	82.81	4161.97



d. Conclusion:

Transfer rate analysis:
According to the result of transfer, the performance of Node.js and Apache+PHP is basically same at lower concurrency. After 100, the PHP's performance is getting worse and worse while the Node.js keep the same performance as the lower concurrency.

Request per second analysis:
According to the result of transfer, the performance of Node.js and Apache+PHP is basically same at lower concurrency. After 100, the PHP's performance is getting worse and worse while the Node.js keep the same performance as the lower concurrency.

Bottlenecks:
Node.js and PHP differ in their approach to concurrency, with Node.js using a non-blocking event loop (running in a single process) and the standard PHP Zend runtime using a blocking process. For this reason, multiple PHP processess are often launched from the web server to be able to keep serving web requests. In Apache, you can set the maximum number of PHP processess allowed to run, and this works fine for many types of web applications.

Recommendation:
According the analysis, I found that the Apache+PHP is not suitable for the high-traffic situations. With the concurrent connects keeping lower, users can use both of them, while in other situation, Node.JS is a better choices.