Apache web server performance evaluation on different AWS instance types

Setup

Test the apache web server performance on t2.micro:

- Create a new EC2 instance : http://aws.amazon.com/ec2/
- Connect to the new EC2 instance t2.xlarge with SSH
- Install Apache on both EC2 instance
  - $ sudo yum update
  - $ sudo yum install httpd24
  - $sudo /sbin/chkconfig --level 235 httpd on
- Obtain the ip address of original instance
  - $ ifconfig
- Run the apache benchmark test on the new instance by the ip address of original one
  - $ ab -c 100 -n 10000 http://172.31.39.221/index.html
- Monitor CPU and memory utilization on the server
  - $top

Test the apache web server performance on t2.xlarge:

- Connect to the original EC2 instance t2.micro with SSH
- Obtain the ip address of new instance
- Enabling web access to the new EC2 instance
  - Select security group on EC2 webpage
  - Click on the Inbound Tab
  - Add a new custom TCP rule with a port range of 80
  - Click add new rule
- Run the apache benchmark test on the original instance by the ip address of new one
  - $ ab -c 100 -n 10000 http://172.31.27.82/index.html
- Monitor CPU and memory utilization on the server
  - $top

Experiment Data

Concurrent request	Pages/sec	Mean time/request
100	5630.73	17.760ms
200	2977.47	67.171ms
300	2207.51	135.9ms
400	1484.36	269.476ms
500	745.69	670.522ms
600	2772.72	216.394ms
700	2749.95	249.058ms
800	2668.58	299.785ms
900	1392	646.518ms
1000	1282.65	779.636ms

Table1. Apache web server performance on t2.micro

Concurrent request	Pages/sec	Mean time/request
100	6826.39	14.65ms
200	5668.12	36.032ms
300	5442.66	55.12ms
400	4790.20	83.504ms
500	4698.34	85.677ms
600	5242.99	114.439ms
700	5217.79	134.156ms
800	5263.32	151.955ms
900	5107.44	176.214ms
1000	4935.81	202.601ms

Table2. Apache web server performance on t2.xlarge

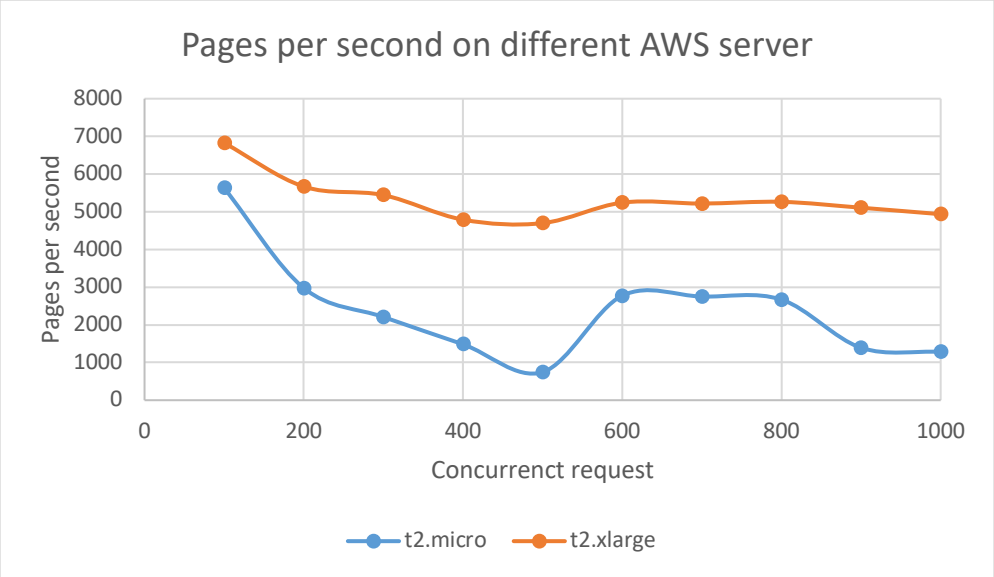


Figure 1. Pages per second on different AWS server

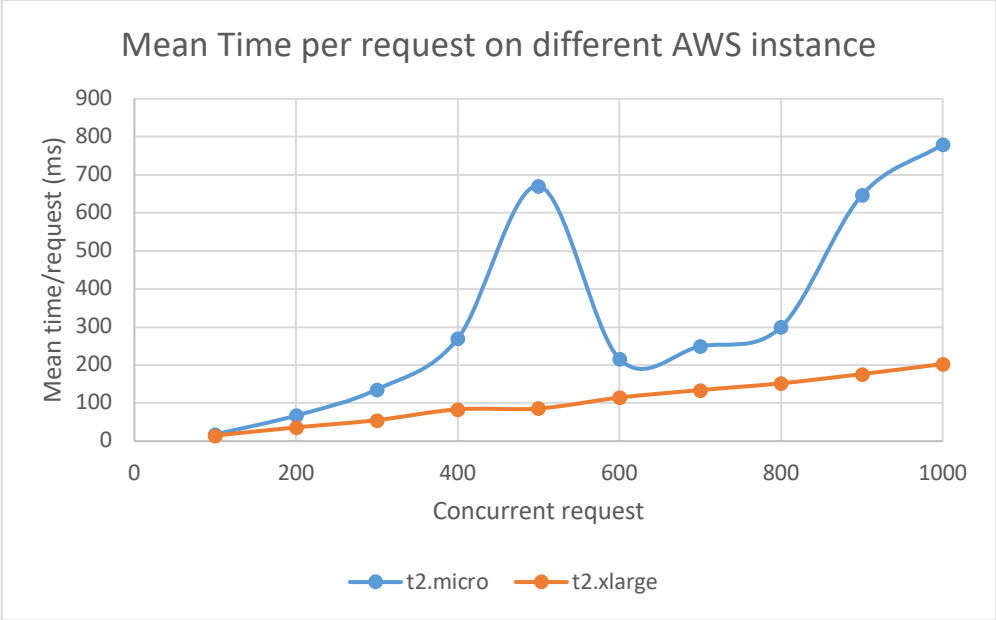


Figure 2. Mean Time per request on different AWS instance

Experiment Results

For all of the experiments, our group keep the number of requests to perform as constant in order to compare the number of multiple requests to make a time and mean time per request on different AWS instance types t2.micro and t2.xlarge. As we can see, AWS instance t2.xlarge can have a better performance than t2.micro in any tests.

Figure 1 illustrate the trend of pages per second on different AWS instance as the value of concurrent request increases. As is shown on the figure, we can conclude that Apache on t2.xlarge has a better performance to server more request per second to the machine running the ab tool and as the number of concurrent request becomes larger, the number of pages per second decreases slowly.

Figure 2 provides some data regarding mean time per request on the different AWS instance. It is clearly from the figure that t2.xlarge spent less mean time requesting than t2.micro. In addition, as the number of concurrent request becomes larger, the number of mean time per request increases gradually.

Bottleneck

- Initialization problem – need run a test several times to normalize the value
- Overload with request – test too much results in the outcome inaccurately

Hence, we need faster CPU and more memory to fix all these problems.

Recommendation

If we don't consider the cost of instance, I will recommend to use t2.xlarge since it really has a better performance on Apache benchmark test. However, if there are not too many request in your web and 1GB memory size is enough for your web application, t2.micro is a better option due to the price is much cheaper than t2.xlarge.

MySQL Performance evaluation on different AWS instance types

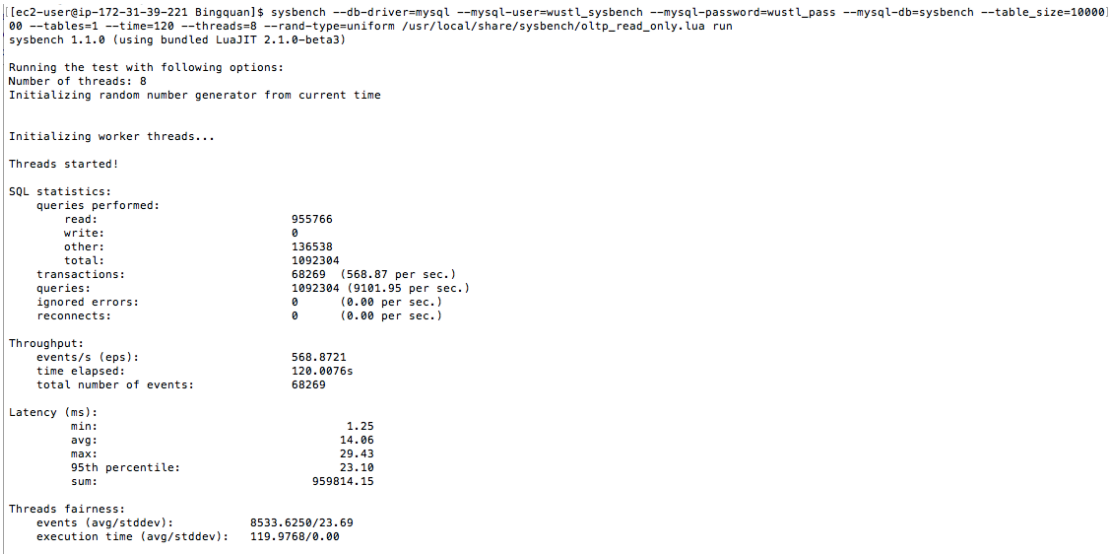
Setup

- Create a new EC2 instance : http://aws.amazon.com/ec2/
- Connect to the new EC2 instance t2.xlarge with SSH
- Install MySQL 5.7 on both EC2 instance
  - $ sudo yum update
  - $ sudo yum install mysql57-devel mysql57-server
- Install Sysbench on both EC2 instance
  - $ sudo yum install –y libtool
  - $ wget https://github.com/akopytov/sysbench/archive/master.zip
  - $ unzip master.zip
  - $ cd sysbench-master
  - $ ./autogen.sh
  - $ ./configure
  - $ make
  - $ sudo make install
- Create a new database
  - $ create database sysbench;
- Create a new user
  - $ create user 'wustl_sysbench'@'localhost' identified by 'wustl_pass';
- Grant Access
  - $ grant all on *.* to wustl_sysbench@'localhost' with grant option;
- Prepare a oltp-read-only test table
  - $ sysbench --db-driver=mysql --mysql-user=wustl_sysbench --mysql-password=wusl_pass --mysql-db=sysbench --table_size=1000000 --tables=1 --time=120 --threads=8 --rand-type=uniform /usr/local/share/sysbench/oltp_read_only.lua prepare
- Read-Only Test
  - $ sysbench --db-driver=mysql --mysql-user=wustl_sysbench --mysql-password=wusl_pass --mysql-db=sysbench --table_size=1000000 --tables=1 --time=120 --threads=8 --rand-type=uniform /usr/local/share/sysbench/oltp_read_only.lua run
- Cleanup the created table
  - $ sysbench --db-driver=mysql --mysql-user=wustl_sysbench --mysql-password=wusl_pass --mysql-db=sysbench --table_size=1000000 --tables=1 --time=120 --threads=8 --rand-type=uniform /usr/local/share/sysbench/oltp_read_only.lua cleanup
- Prepare a oltp-read-write test table
  - $ sysbench --db-driver=mysql --mysql-user=wustl_sysbench --mysql-password=wusl_pass --mysql-db=sysbench --table_size=1000000 --tables=1 --time=120 --threads=8 --rand-type=uniform /usr/local/share/sysbench/oltp_read_only.lua prepare

- Read-Write Test
  - $ sysbench --db-driver=mysql --mysql-user=wustl_sysbench --mysql-password=wusl_pass --mysql-db=sysbench --table_size=1000000 --tables=1 --time=120 --threads=8 --rand-type=uniform /usr/local/share/sysbench/oltp_read_only.lua run
- Cleanup the created table
  - $ sysbench --db-driver=mysql --mysql-user=wustl_sysbench --mysql-password=wusl_pass --mysql-db=sysbench --table_size=1000000 --tables=1 --time=120 --threads=8 --rand-type=uniform /usr/local/share/sysbench/oltp_read_only.lua cleanup
- Prepare a oltp-write-only test table
  - $ sysbench --db-driver=mysql --mysql-user=wustl_sysbench --mysql-password=wusl_pass --mysql-db=sysbench --table_size=1000000 --tables=1 --time=120 --threads=8 --rand-type=uniform /usr/local/share/sysbench/oltp_read_only.lua prepare
- Write-Only Test
  - $ sysbench --db-driver=mysql --mysql-user=wustl_sysbench --mysql-password=wusl_pass --mysql-db=sysbench --table_size=1000000 --tables=1 --time=120 --threads=8 --rand-type=uniform /usr/local/share/sysbench/oltp_read_only.lua run
- Cleanup the created table
  - $ sysbench --db-driver=mysql --mysql-user=wustl_sysbench --mysql-password=wusl_pass --mysql-db=sysbench --table_size=1000000 --tables=1 --time=120 --threads=8 --rand-type=uniform /usr/local/share/sysbench/oltp_read_only.lua cleanup

Experiment Data

- Oltp-Read-Only Test by different EC2 instances



```
[ec2-user@ip-172-31-39-221 Bingquan]$ sysbench --db-driver=mysql --mysql-user=wustl_sysbench --mysql-password=wustl_pass --mysql-db=sysbench --table_size=10000
00 --tables=1 --time=120 --threads=8 --rand-type=uniform /usr/local/share/sysbench/oltp_read_only.lua run
sysbench 1.1.0 (using bundled LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 8
Initializing random number generator from current time


Initializing worker threads...

Threads started!

SQL statistics:
    queries performed:
        read:                            955766
        write:                           0
        other:                           136538
        total:                           1092304
    transactions:                        68269  (568.87 per sec.)
    queries:                             1092304 (9101.95 per sec.)
    ignored errors:                      0      (0.00 per sec.)
    reconnects:                          0      (0.00 per sec.)

Throughput:
    events/s (eps):                      568.8721
    time elapsed:                        120.0076s
    total number of events:              68269

Latency (ms):
         min:                                    1.25
         avg:                                   14.06
         max:                                   29.43
         95th percentile:                       23.10
         sum:                               959814.15

Threads fairness:
    events (avg/stddev):           8533.6250/23.69
    execution time (avg/stddev):   119.9768/0.00
```

Figure1.1 Oltp-Read-Only Test by AWS instance t2.micro

```
[ec2-user@ip-172-31-27-82 ~]$ sysbench --db-driver=mysql --mysql-user=wustl_sysbench --mysql-password=wusl_pass --mysql-db=sysbench --table_size=10000
00 --tables=1 --time=120 --threads=8 --rand-type=uniform /usr/local/share/sysbench/oltp_read_only.lua run
sysbench 1.1.0 (using bundled LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 8
Initializing random number generator from current time


Initializing worker threads...

Threads started!

SQL statistics:
    queries performed:
        read:                            3709566
        write:                           0
        other:                           529938
        total:                           4239504
    transactions:                        264969 (2207.99 per sec.)
    queries:                             4239504 (35327.86 per sec.)
    ignored errors:                      0      (0.00 per sec.)
    reconnects:                          0      (0.00 per sec.)

Throughput:
    events/s (eps):                      2207.9912
    time elapsed:                        120.0046s
    total number of events:              264969

Latency (ms):
         min:                                    1.22
         avg:                                    3.62
         max:                                   31.60
         95th percentile:                        6.79
         sum:                               959340.64

Threads fairness:
    events (avg/stddev):           33121.1250/236.03
    execution time (avg/stddev):   119.9176/0.00
```

- Figure1.2 Oltp-Read-Only Test by AWS instance t2.xlarge

- Oltp-Read-Write Test by different EC2 instances

```
[ec2-user@ip-172-31-39-221 Bingquan]$ sysbench --db-driver=mysql --mysql-user=wustl_sysbench --mysql-password=wustl_pass --mysql-db=sysbench --table_size=10000
00 --tables=1 --time=120 --threads=8 --rand-type=uniform /usr/local/share/sysbench/oltp_read_write.lua run
sysbench 1.1.0 (using bundled LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 8
Initializing random number generator from current time


Initializing worker threads...

Threads started!

SQL statistics:
    queries performed:
        read:                            521850
        write:                           149100
        other:                           74550
        total:                           745500
    transactions:                        37275  (310.59 per sec.)
    queries:                             745500 (6211.76 per sec.)
    ignored errors:                      0      (0.00 per sec.)
    reconnects:                          0      (0.00 per sec.)

Throughput:
    events/s (eps):                      310.5882
    time elapsed:                        120.0142s
    total number of events:              37275

Latency (ms):
         min:                                    2.64
         avg:                                   25.75
         max:                                  437.43
         95th percentile:                       51.02
         sum:                               959963.17

Threads fairness:
    events (avg/stddev):           4659.3750/17.18
    execution time (avg/stddev):   119.9954/0.00
```

- Figure2.1 Oltp-Read-Write Test by AWS instance t2.micro

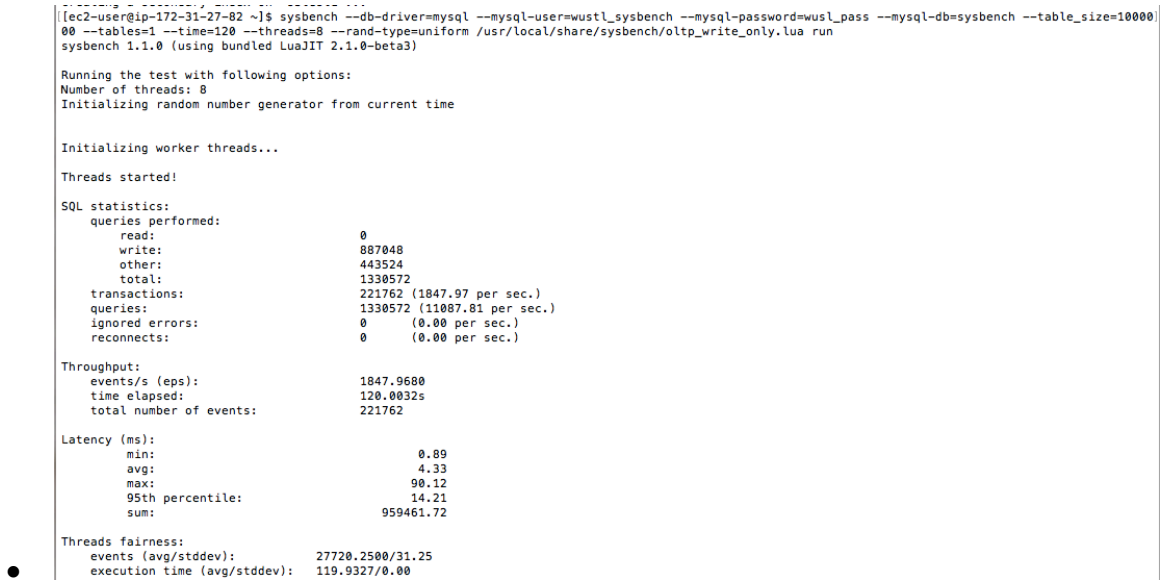
```
[ec2-user@ip-172-31-27-82 ~]$ sysbench --db-driver=mysql --mysql-user=wustl_sysbench --mysql-password=wusl_pass --mysql-db=sysbench --table_size=10000
00 --tables=1 --time=120 --threads=8 --rand-type=uniform /usr/local/share/sysbench/oltp_read_write.lua run
sysbench 1.1.0 (using bundled LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 8
Initializing random number generator from current time


Initializing worker threads...

Threads started!

SQL statistics:
    queries performed:
        read:                            1380218
        write:                           394348
        other:                           197174
        total:                           1971740
    transactions:                        98587  (821.50 per sec.)
    queries:                             1971740 (16430.06 per sec.)
    ignored errors:                      0      (0.00 per sec.)
    reconnects:                          0      (0.00 per sec.)

Throughput:
    events/s (eps):                      821.5029
    time elapsed:                        120.0081s
    total number of events:              98587

Latency (ms):
         min:                                    2.57
         avg:                                    9.74
         max:                                  160.54
         95th percentile:                       26.68
         sum:                                959769.21

Threads fairness:
    events (avg/stddev):           12323.3750/24.41
    execution time (avg/stddev):   119.9712/0.00
```

Figure2.2 Oltp-Read-Write Test by AWS instance t2.xlarge

- Oltp-Write-Only Test by different EC2 instances

```
[ec2-user@ip-172-31-39-221 Bingquan]$ sysbench --db-driver=mysql --mysql-user=wustl_sysbench --mysql-password=wustl_pass --mysql-db=sysbench --table_size=10000
00 --tables=1 --time=120 --threads=8 --rand-type=uniform /usr/local/share/sysbench/oltp_write_only.lua run
sysbench 1.1.0 (using bundled LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 8
Initializing random number generator from current time


Initializing worker threads...

Threads started!

SQL statistics:
    queries performed:
        read:                            0
        write:                           300276
        other:                           150138
        total:                           450414
    transactions:                        75069  (625.48 per sec.)
    queries:                             450414 (3752.88 per sec.)
    ignored errors:                      0      (0.00 per sec.)
    reconnects:                          0      (0.00 per sec.)

Throughput:
    events/s (eps):                      625.4792
    time elapsed:                        120.0184s
    total number of events:              75069

Latency (ms):
         min:                                    0.74
         avg:                                   12.79
         max:                                 1821.55
         95th percentile:                       56.84
         sum:                                959947.41

Threads fairness:
    events (avg/stddev):           9383.6250/111.54
    execution time (avg/stddev):   119.9934/0.00
```

Figure3.1 Oltp-Write-Only Test by AWS instance t2.micro



```
[ec2-user@ip-172-31-27-82 ~]$ sysbench --db-driver=mysql --mysql-user=wustl_sysbench --mysql-password=wusl_pass --mysql-db=sysbench --table_size=10000
00 --tables=1 --time=120 --threads=8 --rand-type=uniform /usr/local/share/sysbench/oltp_write_only.lua run
sysbench 1.1.0 (using bundled LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 8
Initializing random number generator from current time


Initializing worker threads...

Threads started!

SQL statistics:
    queries performed:
        read:                            0
        write:                           887048
        other:                           443524
        total:                           1330572
    transactions:                        221762 (1847.97 per sec.)
    queries:                             1330572 (11087.81 per sec.)
    ignored errors:                      0      (0.00 per sec.)
    reconnects:                          0      (0.00 per sec.)

Throughput:
    events/s (eps):                      1847.9680
    time elapsed:                        120.0032s
    total number of events:              221762

Latency (ms):
         min:                                    0.89
         avg:                                    4.33
         max:                                   90.12
         95th percentile:                       14.21
         sum:                                959461.72

Threads fairness:
    events (avg/stddev):           27720.2500/31.25
    execution time (avg/stddev):   119.9327/0.00
```

Figure3.2 Oltp-Write-Only Test by AWS instance t2.xlarge

Experiment Results

For all three experiments, our group keep the value of table size, time, threads and rand type as constant in order to compare MySQL performance on different AWS instance types t2.micro and t2.xlarge. As we can see, AWS instance t2.xlarge can have a better performance than t2.micro in any tests.

	T2.micro	T2.xlarge	Ratio(xlarge/xmicro)
Read queries	955766	3709566	3.88
Read queries/sec	7964.72	30913.05	3.88
Transaction	68269	264969	3.88
Transaction/sec	568.87	22077.99	3.88

Table1.

Table 1 illustrates the changing portion of read queries and transactions from t2.micro to t2.xlarge. It can be concluded that t2.xlarge performed more read queries and transactions than t2.micro in 120 seconds.

	T2.micro	T2.xlarge	Ratio(xlarge/xmicro)
Read queries	521850	1380218	2.64
Read queries/sec	4348.75	11501.81	2.64
Write queries	149100	394348	2.64
Write queries/sec	1242.5	3286.23	2.64
Transaction	37275	98587	2.64
Transaction/sec	310.59	821.50	2.64

Table2.

Table 2 shows that the difference between t2.micro and t2.xlarge on oltp-read-write test. It is clearly from the table that t2.xlarge can perform more read, write queries and transactions on this test.

	T2.micro	T2.xlarge	Ratio(xlarge/xmicro)
Write queries	300276	887048	2.95
Write queries/sec	2502.3	7392.07	2.95
Transaction	75069	221762	2.95
Transaction/sec	625.48	1847.97	2.95

Table3.

Table 3 provides some data regarding MySQL performance of t2.micro and t2.xlarge on oltp-write-only test. As is shown in the table, we can conclude that t2.xlarge query and transact more times than t2.micro in 120 seconds.

Bottleneck

The bottleneck of the system is the size of memory and faster CPU to perform more queries and transactions. Comparing with 16GB t2.xlarge, t2.micro only has 1 GB memory. If our database have an tremendous size of data, t2.micro might be too small to store our data. In addition, from all figures in experiment data, we can see clearly that the average latency of t2.micro is much longer than t2.xlarge's average latency. In other words, comparing with t2.micro, t2.xlarge can perform more queries or transactions in limited time.

Recommendation

The drawback of t2.xlarge is the cost of instance. The price of t2.micro instances starts at $0.0116 per hour ($8.47 per month) in the US east region. The price of t2.xlarge instances starts at $0.0928 per hour ($67.74 per month) in the US east region. The price of t2.xlarge is almost 8 times of t2.micro.

If we don't consider the cost of instance, I will recommend to use t2.xlarge since it has a larger memory size and better vCPU. However, if there are not too many read or write queries and transactions in your web and 1GB memory size is enough for your web application, t2.micro is a better option due to the price is much cheaper than t2.xlarge.