Deadline: 23:59, 2019, Feb 15th(Friday)

CS 4296/5296 Spring 2019 Assignment 1 (2 questions, 5 marks)

1. (2 marks) Measure EC2 **CPU** and **Memory** performance

Implement measurement on general purpose **m4.large, m4.xlarge, m4.2xlarge and m4.4xlarge** linux instances, respectively, and find the performance differences among these instances. Does the performance of EC2 instances increase commensurate with the increase of the number of ECUs* and memory resource? In order to answer this question, you need to complete the following table by filling out blanks with the measurement results corresponding to each instance type.

CPU performance measurement command: sysbench --test=cpu --num-threads=4 -–cpu-max-prime=10000 run

Memory performance measurement command: sysbench --test=memory --num-threads=4 -- memory-total-size=10G --memory-oper=write --memory-scope=global run

Size	CPU performance -- total time (s)	Memory performance -- transfer speed MB/s
m4.large	6.4231	971.41
m4.xlarge	3.2434	1571.49
m4.2xlarge	2.9442	1602.60
m4.4xlarge	2.7723	1640.76

* Region: US East (N. Virginia)

Measurement Analysis: The cpu and memory performance are positively correlated with vcpu and memory size. However, The growth rate is getting lower with the increase of vcpu and memory size because of more overload.

2. (3 marks) Measure EC2 network performance.
   1) The metrics of network performance include **TCP bandwidth (throughput)** and **RTT** (Round Trip Time). Within the same region, what network performance is experienced between instances of the same type and different types? In order to answer this question, you need to complete the following table. You can use the instances in US East region, and specify the TCP window size to 256K for bandwidth measurement.

Type	TCP bandwidth (Mbps)	Average RTT (ms)
t2.micro - t2.micro	985	0.463
t2.micro - m4.large	566	0.799
t2.micro - m4.4xlarge	999	0.823
m4.large - m4.large	566	0.267
m4.large - m4.4xlarge	566	0.113
m4.4xlarge - m4.4xlarge	2242	0.115

   2) What about the network performance (bandwidth) with different window sizes? In order to answer this question, you can use two t2.micro instances, and vary the window size to measure the performance, and complete the following table.

Window Size	TCP bandwidth (Mbps)
128K	718
256K	961
512K	980

***The real window size is the 2 times of request window size, so the parameter should be half**

*** The limit of window size is 416K. So the data of 512K is actually the data of 416K.(means not accurate)**

   3) What about the network performance with one server and multiple clients? In order to answer this question, you need to set one server, and multiple clients. After initiating the listening mode on the server, run throughput measurement command on all clients **simultaneously** and record the bandwidth in the following table. Window size is set to 256K. (Try to use batch processing to run the commands simultaneously).

Number of Clients	Client1 TCP bandwidth (Mbps)	Client2 TCP bandwidth (Mbps)	Client3 TCP bandwidth (Mbps)
2	205	203	none
3	160	158	165

For RTT, ping from different instances (clients) to the same instance (server) **simultaneously**, and complete the following table.

Number of Clients	Client1 Average RTT (ms)	Client2 Average RTT (ms)	Client3 Average RTT (ms)
2	0.617	0.545	none
3	0.644	0.582	0.661

4) What about the network performance for instances deployed in different regions? In order to answer this question, you need to complete the following table.

Type	TCP bandwidth (Mbps)	Average RTT (ms)
N. Virginia - N. Virginia	412	0.632
N. Virginia - Oregon	21.8	69.380
N. Virginia - Tokyo	10	155.423
Oregon - Oregon	438	0.492
Oregon - Tokyo	15.4	101.042
Tokyo - Tokyo	529	0.556

* N. Virginia- US East (N. Virginia); Oregon – US West (Oregon); Tokyo - Asia Pacific (Tokyo); Type: t2.micro - t2.micro

***For controlling Variable, all use public IP even in the same area.**

5) Is the network performance consistent over time? In order to answer this question, you need to complete the following table.

Time (HKT)	TCP bandwidth (Mbps)	Average RTT (ms)
Morning (~10:00am)	998	0.565
Afternoon (~4:00pm)	1024	0.578
Evening (~10:00pm)	993	0.653

*Region: US East (N. Virginia); Instance Type: t2.micro - t2.micro

(Remember to stop or terminate your instances after measurement)

6) Open-ended question: In the above sub-questions, you have measured network performance in different scenarios. Observe the values in each table, and try to explain why the network performance varies in different scenarios?

(1) The network performance is determined by the worse node of two.

(2) The larger window size, the better network performance

(3) The more clients simultaneously connect to one server, the worse network performance

Each client share the whole bandwidth and cause more latency.

(4) The farther distance between two server, the worse network performance

(5) The time when users are less, the better network performance