CUHK(SZ) CSC4160 Cloud Computing

Assignment 1 Report
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Preparation:
Different instances are built as required in the assignments:

NO.	Inst. Name	vCPU	Memory	Region
1	t2.micro	1	1	N. Virginia
2	t3.medium	2	4	N. Virginia
3	m5.large	2	8	N. Virginia
4	c5d.large	2	4	N. Virginia
5	t3.medium	2	4	N. Virginia
6	m5.large	2	8	N. Virginia
7	c5n.large	2	5.3	N. Virginia
8	c5n.large	2	5.3	N. Virginia
9	c5.large	2	4	N. Virginia
10	c5.large	2	4	Oregon
11	c5.large	2	4	N. Virginia
12	c5.large	2	4	Oregon

Table 1. Build Instances

Question 1: Measure the EC2 CPU and Memory performance

I choose **SysBench** as the tool of measurements, as it's explained in the slides.
Steps:

1. Single Test (Instance: test1)
   (1) CPU Test
   Check for package manager:
   `sudo apt-get update`
   Install SysBench:
   `sudo apt-get install sysbench`
   For CPU performance testing, SysBench can simulate CPU stress by calculating prime numbers.
   `sysbench --test=cpu --cpu-max-prime=<Max prime number>--num-threads=<number of threads> run`
   --cpu-max-prime=<Max prime number>: Specify the maximum prime value. The larger the value, the greater the pressure on the CPU. Use 10000 because I think it's suitable.
   --num-threads=<number of threads>: The number of vCPU of Virtual Machine, only one thread is provided for t2.micro.
   I choose to run:

```
sysbench --test=cpu --cpu-max-prime=10000
--num-threads=1 run
```

for three times, the results in average include:

CPU speed (events per second): Average 2341.85 events/s. This means that the CPU processes about 2342 prime number calculation tasks per second. The larger this value is, the faster the CPU processes tasks.

Total time (total time): Average 10.0009 seconds. The time it takes for each test to run shows that the test time is very stable, indicating that the CPU performs consistently.

Total number of events (total number of events): Average 23425 events. Represents the total number of tasks processed by the CPU during the test, measuring the amount of work the CPU can complete in a given time.

Minimum latency (min latency): Average 0.33 milliseconds. The shortest processing time for each task is fixed at 0.33 milliseconds, indicating that some tasks are completed almost instantly.

Average latency (avg latency): Average 1.7 milliseconds. The average processing time for each task is 1.7 milliseconds, indicating that most tasks have a short processing time.

Maximum latency (max latency): Average 22.11 milliseconds. The maximum latency is 22.11 milliseconds, indicating that some tasks take longer to process, possibly due to thread scheduling or other system overhead.

Latency sum: 39884.44 milliseconds on average. It is the sum of the latencies of all tasks, with an average of 39884.44 milliseconds. Latency sum is a measure of the total time the CPU spends processing these tasks.

Summary: Which means that in avg 10 seconds, the **CPU can calculate for avg 23000 times, about 0.4 ms per time**.

(2) Memory Test:

Memory testing can be done by using SysBench to perform large data read and write operations.

```
sysbench --test=memory --num-threads=<threads number>
--memory-block-size=<Block Size>
--memory-total-size=<Memory Size> --memory-oper=write
--memory-scope=global run
```

--memory-block-size=<Block Size>: the data block size for each operation.

--num-threads=<threads number>: the number of threads vCPU used to test the Memory. I choose 1 for higher performance.

--memory-total-size=<Memory Size>: the total memory operation size, which can be adjusted according to the memory size, choose 1G because t2.micro only have 1GB memory.

I choose to run:

```
sysbench --test=memory --num-threads=1
--memory-block-size=1M --memory-total-size=1G
--memory-oper=write --memory-scope=global run
```

the result include:

Total operations: 1024 memory write operations, each write block size is 1 MiB. 1024 memory write operations were completed during the test.

Operations per second: 18614.74 MiB/sec indicates the rate of write operations completed per second. 18614.74 MiB of data can be written per second, which reflects that the memory write speed is very fast.

Amount of data transferred: 1024 MiB of data was transferred in total, which is the specified test data amount.

Total time: 0.0533 seconds, which means that the test ran for about 53 milliseconds, which is very fast.

Latency:

Minimum latency (min): 0.04 milliseconds.

Average latency (avg): 0.05 milliseconds.

Maximum latency (max): 1.24 milliseconds.

95th percentile: 0.05 ms, indicating that 95% of the operations were delayed within 0.05 ms.

Total latency: 50.88 ms, the total latency of all operations.

Summary: The memory write speed is very high, **with 18614.74 MiB transferred per second**, reflecting the high performance write capability of the system memory. The latency is very low, with most operations delayed within 0.05 ms, indicating that the memory is responsive. The total test time is very short, only about 53 ms, indicating that the memory operation is very efficient.

2. Different instances test2 (Instance: test2/3/4)

Performance differences between instances.

Instances:

Test2: t3.medium

Test3: m5.large

Test4: c5d.large

Size	CPU Performance (Single/Multi)	Memory Performance(MB/sec)
t3.medium	7850/13596	15112
m5.large	10576/16351	17667
c5d.large	12306/19098	20091

Figure 2. Performance differences between instances

Similar like the process of test1, the data shown in figure 2 are the results.

CPU performance is measured by calculating the number of prime numbers in 10000. The mark is how many times it can calculate in 10s. Both with 2 cores, the higher CPU mark is, the better single core performance and multi-core performance the instance will be.

Memory Performance is measured by the write speed. The higher speed means better performance.

Question 2: Measure the EC2 Network performance

1. Compare network performance between instances (Instance: test2/3/5/6/7/8)

Connect via local Command Line:

```
ssh -i "D:\server\key1.pem" ubuntu@<Address>
```

Update and install **iPerf**. I choose **iPerf** as mentioned in the Tutorial.

```
sudo apt-get update
sudo apt-get install iperf
```

Set the first Instance as server, and second as client.

For server, input this command below to ask them waiting for connection:

```
iperf -s -w 256K
```

-s means server, -w stand for UDP buffer size.

For client, input this command below to connect to the server:

```
iperf -c <Server's IP Address> -w 256K
```

-c stands for client, for the non-local instance, <Server's IP Address> CAN'T be the IP address shown in the command line, it should be the **PUBLIC** IP.

If permission declined, it's useful to adjust the inbound rules for the Client to allow the necessary TCP & ICMP.

Repeat for several times and report the maximum value.

ping <Server's IP Address>

Repeat for several times and report the reasonable minimum value.

Type	Inst. Num	TCP b/w (Gbps)	RTT (ms)
`t3.medium`-`t3.medium`	2-5	2.79	0.323
`m5.large`-`m5.large`	3-6	9.52	0.084
`c5n.large`-`c5n.large`	7-8	3.91	0.158
`t3.medium`-`c5n.large`	2-7	2.87	0.417
`m5.large`-`c5n.large`	3-7	2.42	0.480
`m5.large`-`t3.medium`	2-3	3.48	0.260

Figure 3. Network performance between instances

In the figure, we can see that the maximum TCP speed depends on the minimum bandwidth in-between the instances, which equals to the TCP speed test results of two identical instances.

The RTT result depends on the instance.

2. Compare network performance for instances deployed in different regions (Instance: test9/10/11/12)

Type	Inst. Num	TCP b/w (Mbps)	RTT (ms)
N. Virginia-Oregon	9-10	12.9	64.7
N. Virginia-N. Virginia	9-11	804	0.966
Oregon-Oregon	10-12	3174.4	0.147

Figure 4. Network performance for instances deployed in different regions

Similar like the process of test1, the data shown in figure 4 are the results. Please notice that the unit of TCP speed is Mbps.

For instances in the same region, the speed is significantly faster than the offsite result, the RTT time are the same.

The results suggest that we should choose instances in same region to achieve better

performance.

==========END OF ASSIGNMENT 1==========