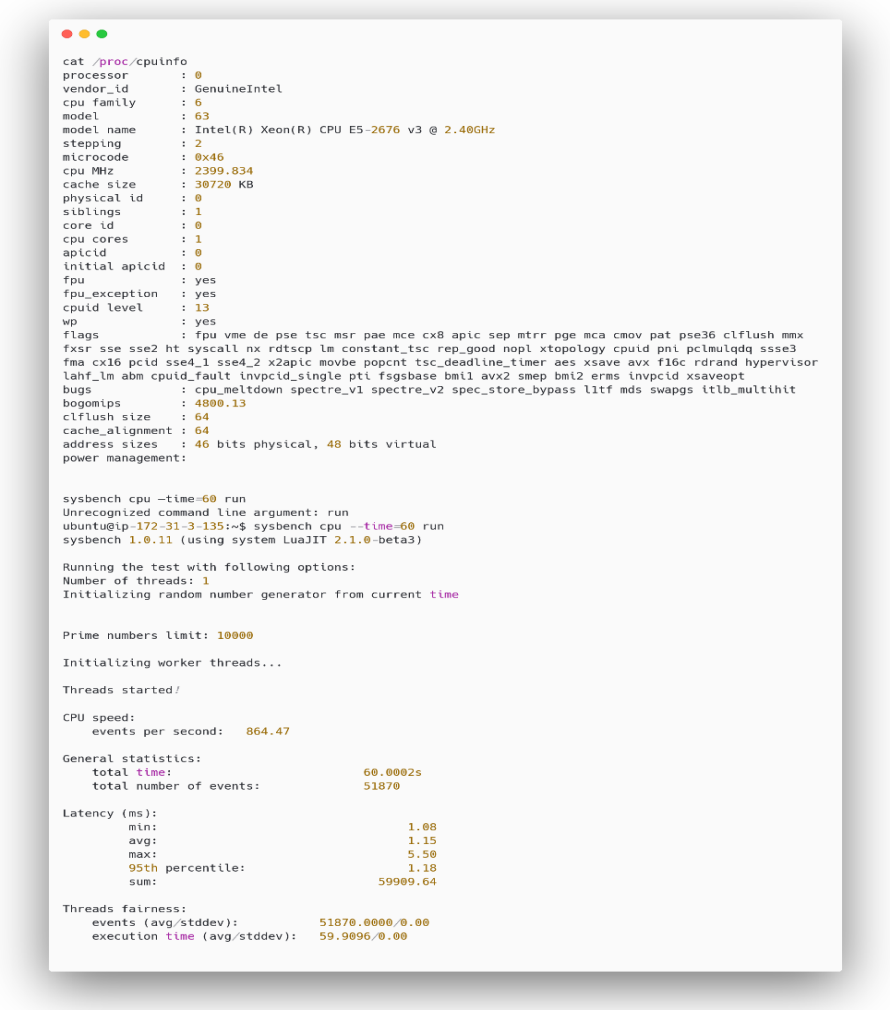
CPU benchmark questions:

1. Shortly describe, how sysbench performs CPU benchmark. What does the resulting events/s value represent?

When running with the CPU workload, sysbench will verify prime numbers by doing a standard division of the number by all numbers between 2 and the square root of the number. If any number gives a remainder of 0, the next number is calculated. However, this will put some stress on the CPU, but only on a very limited set of CPUs features.

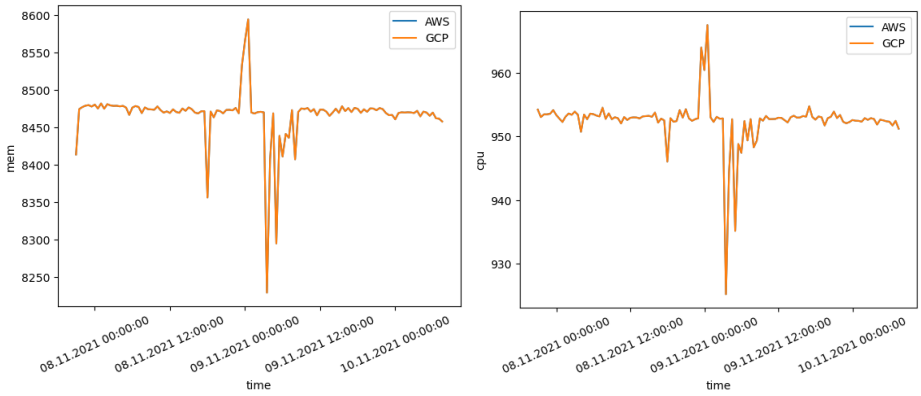


```
cat /proc/cpuinfo
processor       : 0
vendor_id       : GenuineIntel
cpu family      : 6
model           : 63
model name      : Intel(R) Xeon(R) CPU E5-2676 v3 @ 2.40GHz
stepping        : 2
microcode       : 0x46
cpu MHz         : 2399.834
cache size      : 30720 KB
physical id     : 0
siblings        : 1
core id         : 0
cpu cores       : 1
apicid          : 0
initial apicid  : 0
fpu             : yes
fpu_exception   : yes
cpuid level     : 13
wp              : yes
flags           : fpu vme de pse tsc msr pae mce cx8 apic sep mtrr pge mca cmov pat pse36 clflush mmx
fxsr sse sse2 ht syscall nx rdtscp lm constant_tsc rep_good nopl xtopology cpuid pni pclmulqdq ssse3
fma cx16 pcid sse4_1 sse4_2 x2apic movbe popcnt tsc_deadline_timer aes xsave avx f16c rdrand hypervisor
lahf_lm abm cpuid_fault invpcid_single pti fsgsbase bmi1 avx2 smep bmi2 erms invpcid xsaveopt
bugs            : cpu_meltdown spectre_v1 spectre_v2 spec_store_bypass l1tf mds swapgs itlb_multihit
bogomips        : 4800.13
clflush size    : 64
cache_alignment : 64
address sizes   : 46 bits physical, 48 bits virtual
power management:


sysbench cpu —time=60 run
Unrecognized command line argument: run
ubuntu@ip-172-31-3-135:~$ sysbench cpu --time=60 run
sysbench 1.0.11 (using system LuaJIT 2.1.0-beta3)

Running the test with following options:
Number of threads: 1
Initializing random number generator from current time


Prime numbers limit: 10000

Initializing worker threads...

Threads started!

CPU speed:
    events per second:   864.47

General statistics:
    total time:                          60.0002s
    total number of events:              51870

Latency (ms):
         min:                                    1.08
         avg:                                    1.15
         max:                                    5.50
         95th percentile:                        1.18
         sum:                                59909.64

Threads fairness:
    events (avg/stddev):           51870.0000/0.00
    execution time (avg/stddev):   59.9096/0.00
```

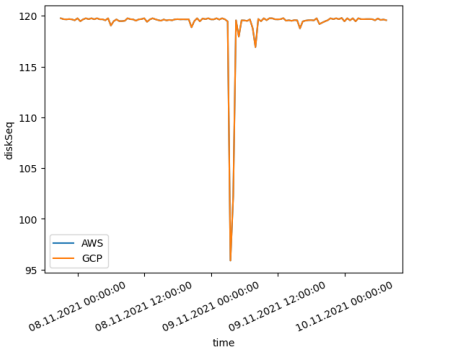
The above test represents the total time which is the duration from start to finish (so no culmination of individual times of the threads).

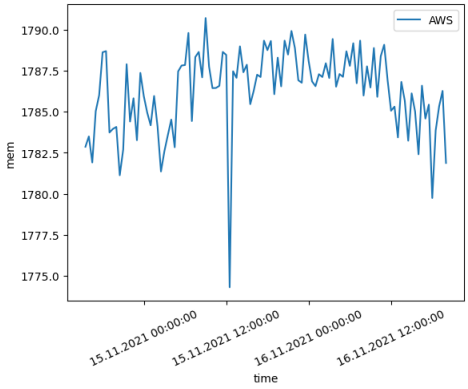
2. Look at the plots of your long-term measurements. Do you see any seasonal changes?

GCP: Performance Spike, followed by a Performance drop possibly caused by a migration of a VM, likely our VM because of a prolonged period of time, where the performance was not up to standards.

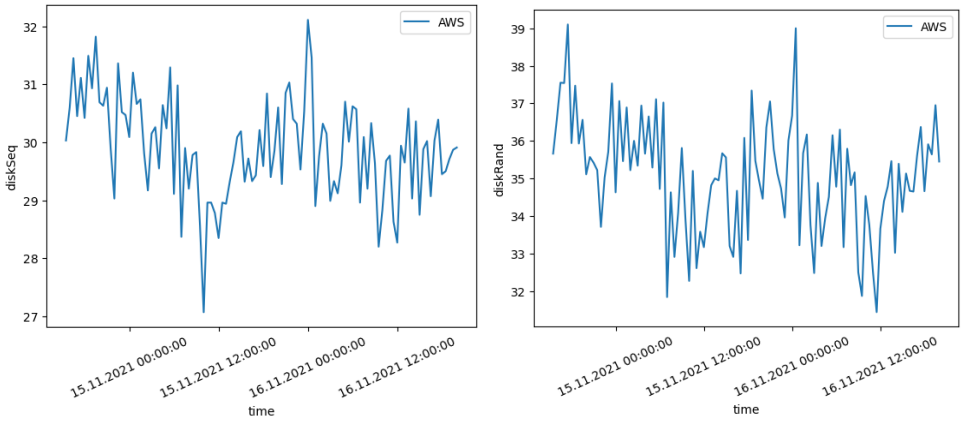


However, AWS and GCP performance drop in an observable way, especially out of business hours e.g. (11:00 pm to 5:00 am).





At the disk speeds of AWS, we can see a seasonal change between night and daytime. Moreover, at night time, the speed is lower than in the daytime.



Because of the limited CPU performance, the drop frequently appears when the bench.sh script is running.

Memory benchmark questions:

1. **Shortly describe, how sysbench measures memory performance.**

   When using the memory test in sysbench, the benchmark application will allocate a memory buffer and then read or write from it, each time for the size of a pointer (so 32bit or 64bit), and each execution until the total buffer size has been read from or written to. This is then repeated until the provided volume (--memory-total-size) is reached. It's possible to provide multiple threads (--num-threads), different sizes in buffer (--memory-block-size), and the type of requests (read or write, sequential or random).

2. **How would you expect virtualization to affect the memory benchmark? Why?**

   Only write operations that are negatively affected by virtualization. This is because the hypervisor has to validate all write requests before they can be performed to ensure isolation.

Disk benchmark questions:

1. **Shortly describe, how sysbench performs the disk benchmarks.**

   At the preparation stage, sysbench creates a specified number of files with a specified total size, then at the run stage, each thread performs specified I/O operations (for example, sequential or random read) on this set of files. This is followed by the cleanup stage, in which the created files are deleted again.

2. **Compare the results for the two operations (sequential, random). What are reasons for the differences?**

Comparing random versus sequential operations is one way of assessing application efficiency in terms of disk use. Accessing data sequentially is much faster than accessing it randomly because of the way in which the disk hardware works. Because reading randomly involves a higher number of seek operations than does sequential reading, random reads deliver a lower rate of throughput. The same is true for random writing.

General question:

1. **Compare the overall long-term measurement plots for the two platforms AWS and GCP. Name one type of application that you would expect to perform better on AWS, and one that would perform better on GCP, respectively. Shortly explain your decisions.**

   Because the AWS education license doesn't work, we must stick to an AWS free account which has prevented us from using the intended machine type, so we used a much less performant t2.micro instance.
   So it was difficult to compare it, for the reason of the very big performance difference, GCP was much more stable in every benchmark except the memory benchmark, where AWS was more stable than GCP because there was no fluctuation.