Course Project #3: Memory and Storage Performance Profiling

Due date: Feb. 24

1. Introduction

The objective of this project is to develop first-hands knowledge and deeper understanding on the performance of modern memory and storage devices. You do not need to write any code for this project. Instead, you will use publicly available software packages to carry out comprehensive experiments to measure the read/write latency/throughput of your memory and storage devices under various data access throughput. You should observe a clear trade-off between access latency and throughput (as revealed by queueing theory discussed in class): As you increase the memory/storage access queue depth (hence increase data access workload stress), memory/storage devices will achieve higher resource utilization and hence higher throughput, but meanwhile the latency of each data access request will be longer.

2. Requirement

For this project, your Github site only needs to host a detailed report that describes your experiment environment/settings/results and presents your analysis and conclusions. Your experiments should cover a wide range of settings in terms of read vs. write intensity ratio (e.g., read-only, write-only, 70%:30% read vs. write), data access size (e.g., 64B/256B for memory and 4KB/32KB/128KB for SSD), throughput vs. latency. Your report must include some discussions that use queuing theory to explain the throughput vs. latency results you have captured. Below are two software packages you may use:

- Cache and memory: Intel Memory Latency Checker, and you can find details and download at https://software.intel.com/content/www/us/en/develop/articles/intelr-memory-latency-checker.html
- Storage: Flexible IO tester (FIO), which is available at https://github.com/axboe/fio It may be already included in your Linux distribution, and the man page is https://linux.die.net/man/1/fio **Warning**: FIO may overwrite the entire drive partition, so you may want to create an empty partition on your SSD just for FIO testing. Carelessly running FIO on your existing partition may destroy your data!

The specification of Intel Data Center NVMe SSD D7-P5600 (1.6TB) lists a random write-only 4KB IOPS of 130K. Compare your results with this Intel enterprise-grade SSD, and try to explain any unexpected observation (e.g., your client-grade SSD may show higher IOPS than such expensive enterprise-grade SSD, why?).