CS 553 – Assignment 1

Design document

Introduction

This assignment aims to benchmark different parts of computer system from the CPU, GPU, memory, disk and network. The experiments are performed on KVM virtual machine m1.medium (2 virtual processors with 4GB RAM and 40GB disk) and CentOS 7 Linux is used for the OS. This document describes the overall program design, and design tradeoffs considered and made, possible improvements and extensions to the programs.

Overall Program Design

All the programs are written in C language and Makefile is created to run all possible combinations of the parameters together saving the time to run commands individually for every experiment.

<u>CPU Benchmark</u>

CPU benchmark is written to measure the processor speed, in terms of double precision floating point operations per second (GFLOPS, 10^9 FLOPS) and integer operations per second (GIOPS, 10^9 IOPS) at varying level of concurrency for 1, 2, 4 and 8 threads. AVX instructions are also used to make sure that the performance is better. Theoretical performace of CPU is calculated and efficiency is measured. A separate experiment is performed which measures benchmark on double precision floating point and integer instructions and 8 threads for a 10-minute period for each one, and take samples every second. Linpack benchmark is performed and its result is then compared with the theoretical perfomance and the rsults we achieved.

<u>Memory Benchmark</u>

Memory benchmark is performed to measure the speed of memory in terms of throughput and latency. Speed is measured using different types of operations such as read/write, write sequential and write random with varying block sizes (8B, 8KB, 8MB, 80MB) and varying level of concurrency(1 thread, 2 threads, 4 threads, and 8 threads). Throughput is measured in MB/sec and latency is measured in microseconds. Theoretical performance is also calculated and its result is compared with the best performance that is achieved after running stream benchmark.

<u>Disk Benchmark</u>

Disk benchmark is performed to measure the disk speed in terms of throughput and latency. Speed is measured using different types of operations such as read/write, read sequential and read random with varying block sizes (8B, 8KB, 8MB, 80MB) and varying level of concurrency(1 thread, 2 threads, 4 threads, and

8 threads). Throughput is measured in MB/sec and latency is measured in milliseconds. Theoretical performance is also calculated and its result is compared with the best performance that is achived after running IOZone benchmark.

Network

Measure the network speed over the loopback interface card (1 node, between 2 processes on the same node); The parameter space should include the TCP protocol stack, UDP, fixed packet/buffer size (64KB), and varying the concurrency (1 thread, 2 threads, 4 threads, 8 threads); note that the multi-threaded support exists at both client and server. The metrics you should be measuring are throughput (Megabits per second, Mb/sec) and latency (ms); you should fix the amount of data you want to transfer (e.g. 8GB, 8K ping-pong messages), and perform your experiments accordingly using strong scaling

Design tradeoffs

Compiler optimizations are turned off.

Network speed is not measured over two nodes.

GPU Memory performance is not measured.

Improvements and extensions

Cache is not disabled for memory and disk.

Clock frequency can be used to get the exact running time.

GUI could have been designed.

All the programs were run on VM. More accurate results would have achieved If they were run on actual hardware.

More complicated operations could have been used.