CS 553 Cloud Computing
Programming Assignment 1

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Performance Evaluation

CPU Benchmarking:

System Configuration:

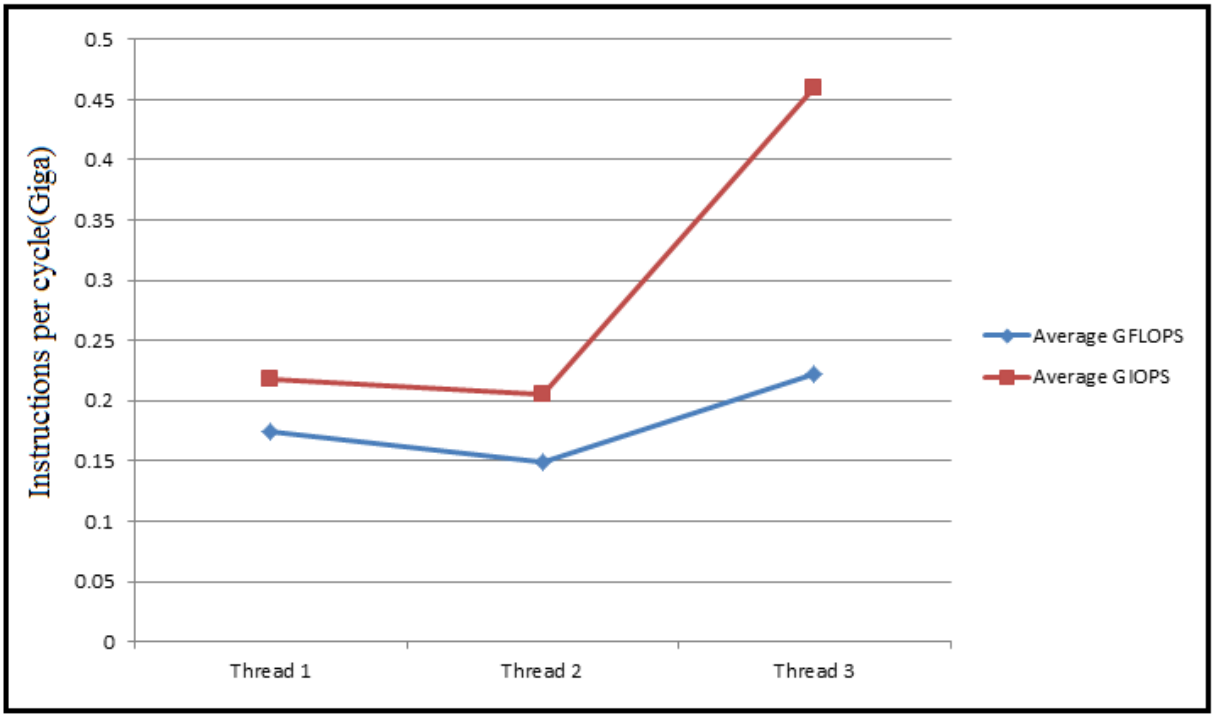
- Operating System: Ubuntu 14.4
- RAM: 8 GB
- No of Physical cores: 4
- No of logical cores: 8.

No. of Threads	Average GFLOPS	Average GIOPS
1	0.174785	0.217382
2	0.149712	0.205318
4	0.221784	0.459432

Graph for CPU Benchmarking:

- X Axis: Number of Threads
- Y Axis: Instructions per cycle in giga [GFLOPS and GIOPS]

The X axis is number of threads and Y axis is instructions per cycle having both GFLOPS and GIOPS. The minimum numbers of threads are 1 and maximum are 4. From the graph we can observe that the FLOPS and IOPS are highest when we run on a 4 thread.



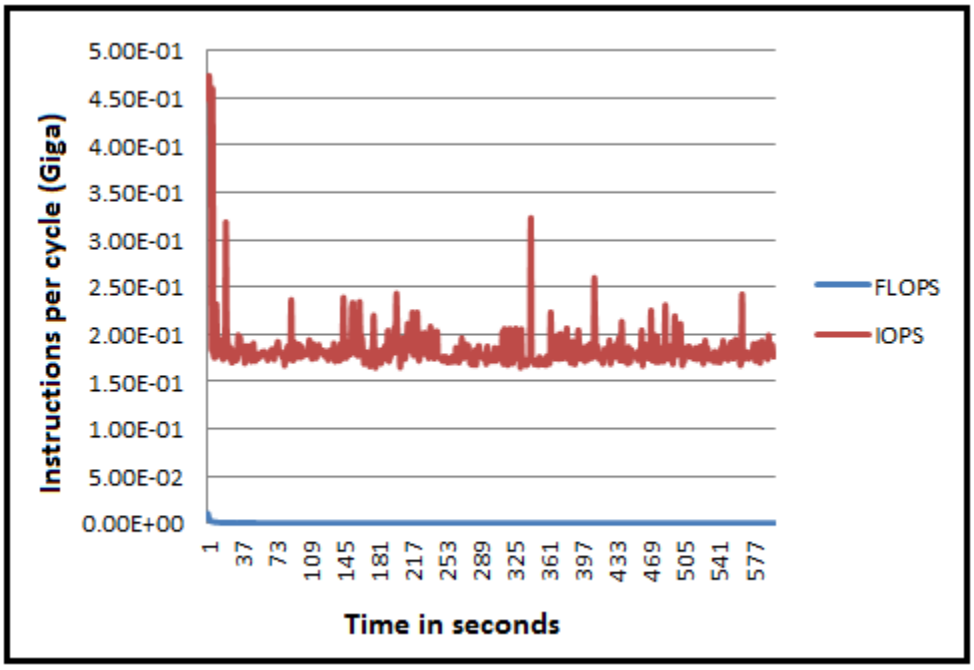
Where: X Axis: Number of Threads

Y Axis: Instructions per cycle in giga

Graph for CPU Benchmarking for 600 samples using thread 4:

- X Axis: Time (0 to 10min)
- Y Axis: Instructions per cycle in giga [GFLOPS and GIOPS]

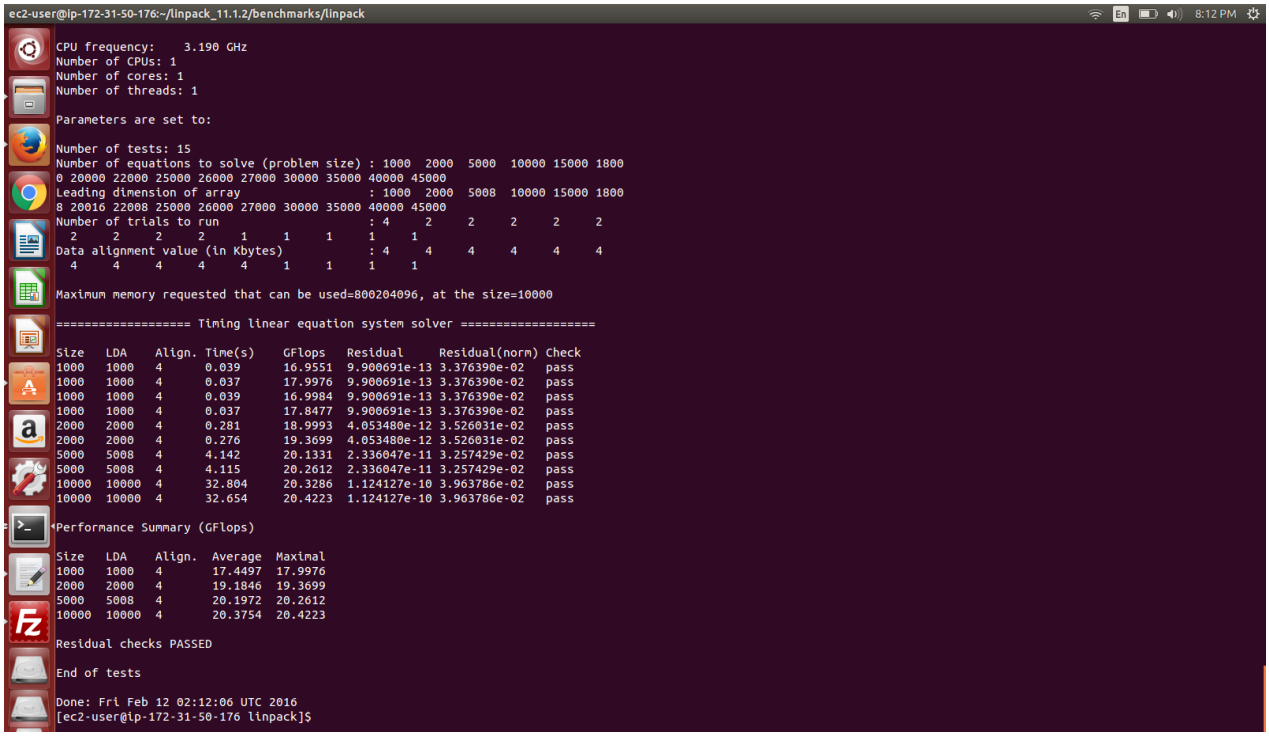
The X axis is Time in seconds for 600 seconds and Y axis is instructions per cycle having both GFLOPS and GIOPS. The thread used is 4. From the graph we can observe that the FLOPS has hig readings and IOPS as a constant flow.



Where: X Axis: Time in 600 seconds
Y Axis: Instructions per cycle in giga

Theoretical Performance: Number of cores * Number of Instructions per cycle * Clock Speed = 76.8 GFLOPS
Efficiency achieved compared to theoretical value: 40.69%

Linpack Results:



The maximum GFLOPS achieved 20.4223

The efficiency of the results from Linpack when compared with theoretical performance is 49.18%

DISK Benchmarking:

- All the experiments were performed on a VM of 20GB hard disk. The read and write operations to and from the memory are performed using this file system.
- The accuracy of the result could have been increased if we had a dual boot or the entire system running on Ubuntu. The following results are based on above configuration.
- The 1 MB access speeds are from cached space. Thus, we consider theoretical speed(max) of 3Gbps.

1 Byte

Threads	Seq Read	Seq Write	Ran Read	Ran Write	Seq Read Latency	Seq Write Latency	Ran Read Latency	Ran Write Latency
1	0.040291	0.041210	0.040041	0.033062	0.236698	0.231252	0.238176	0.288446
2	0.035598	0.032814	0.036175	0.032814	0.267901	0.290627	0.263626	0.334745

1 KB

Threads	Seq Read	Seq Write	Ran Read	Ran Write	Seq Read Latency	Seq Write Latency	Ran Read Latency	Ran Write Latency
1	1261.708656	193.532006	2977.324695	161.361946	0.774000	5.046000	0.328000	6.052000
2	1163.960072	356.995979	1266.618029	206.614302	0.839000	2.735500	0.771000	4.726500

1 MB

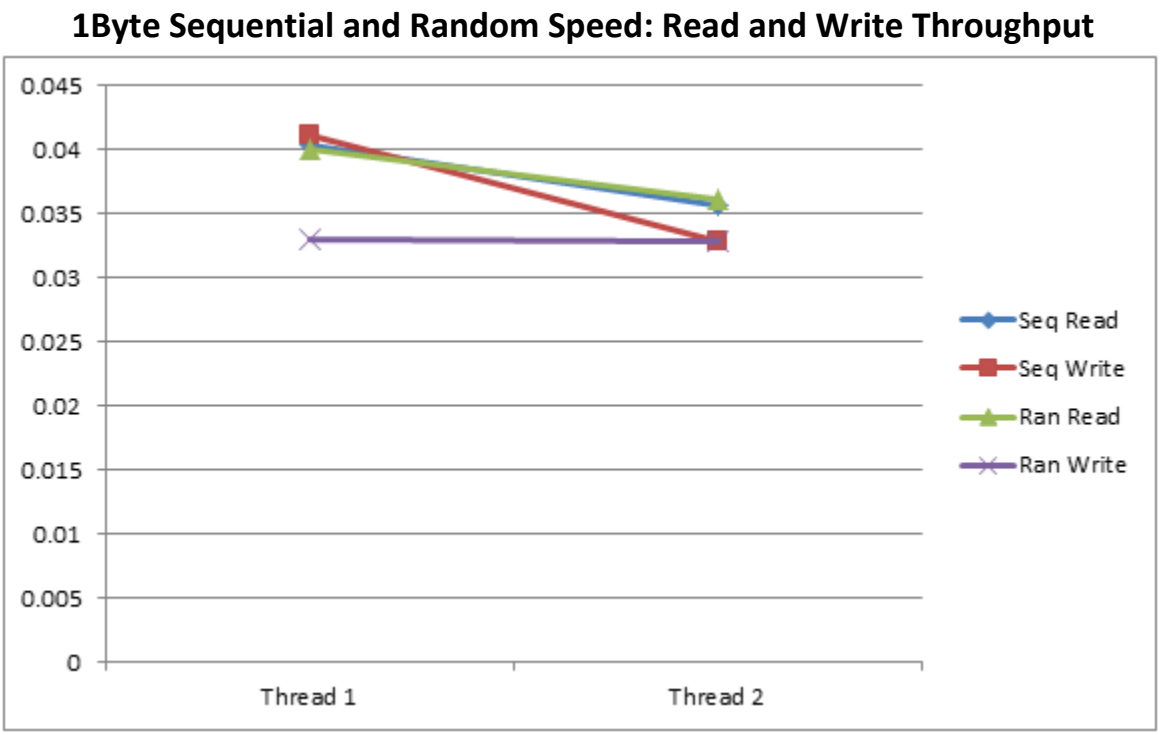
Threads	Seq Read	Seq Write	Ran Read	Ran Write	Seq Read Latency	Seq Write Latency	Ran Read Latency	Ran Write Latency
1	8568.980291	490.436488	3447.087211	450.673751	1.167000	20.390000	2.901000	22.189000
2	8960.573477	415.541242	3770.028275	564.461504	1.116000	24.065000	2.652500	17.716000

Seq Read: Sequential read in Mbps
Seq Write: Sequential write in Mbps
Ran Read: Random read in Mbps
Ran Write: Random write in Mbps
Seq Latency: Sequential Latency in ms
Ran Latency: Random Latency in ms

Graph for DISK Benchmarking:

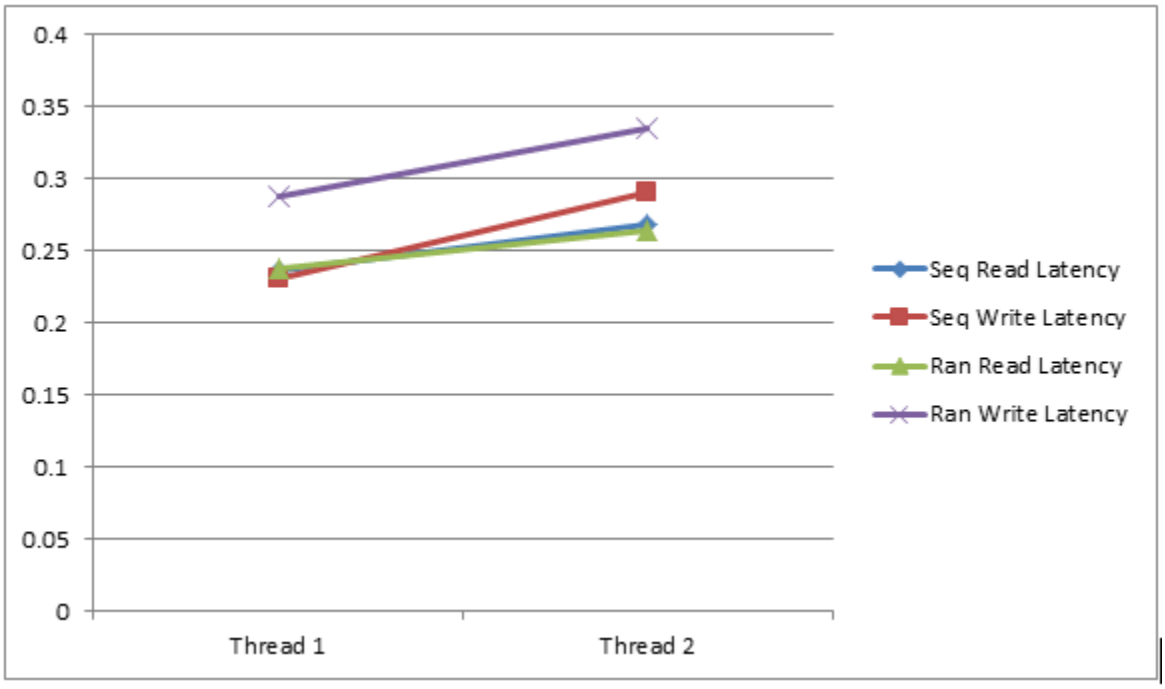
For each of 1BYTE, 1KB, 1MB we plot graphs for sequential read, sequential write, random read, random write and latency for 1 and 2 threads. The latency has both values of random and sequential read and write in it. From the graphs we notice that the performance is best for 1 thread.

1 BYTE:



- **X Axis:** Number of Threads
- **Y Axis:** Speed in MBPS

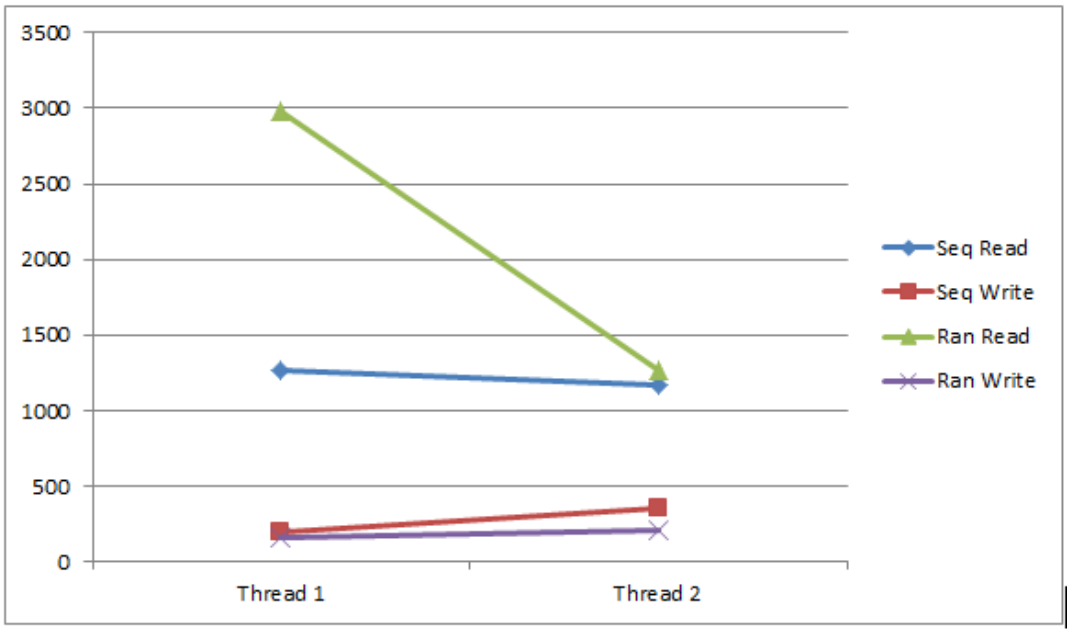
1Byte Sequential and Random Speed: Read and Write Latency



- **X Axis:** Number of Threads
- **Y Axis:** Latency in milliseconds

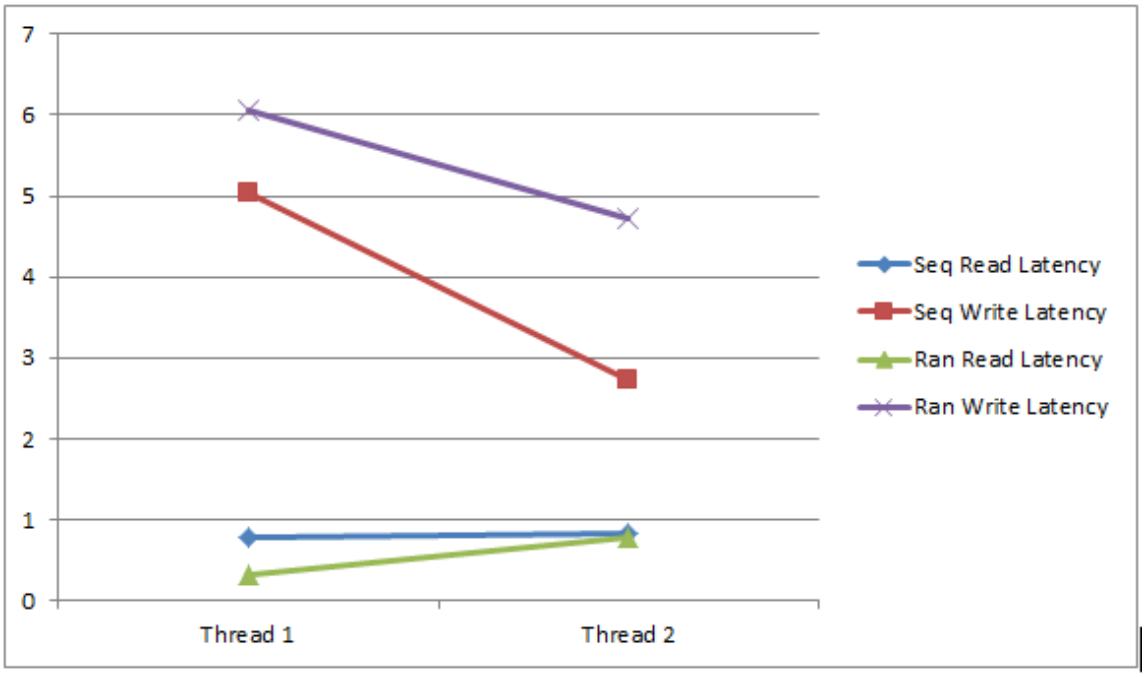
1 KILOBYTE:

1KiloByte Sequential and Random Speed: Read and Write Throughput



- **X Axis:** Number of Threads
- **Y Axis:** Speed in MBPS

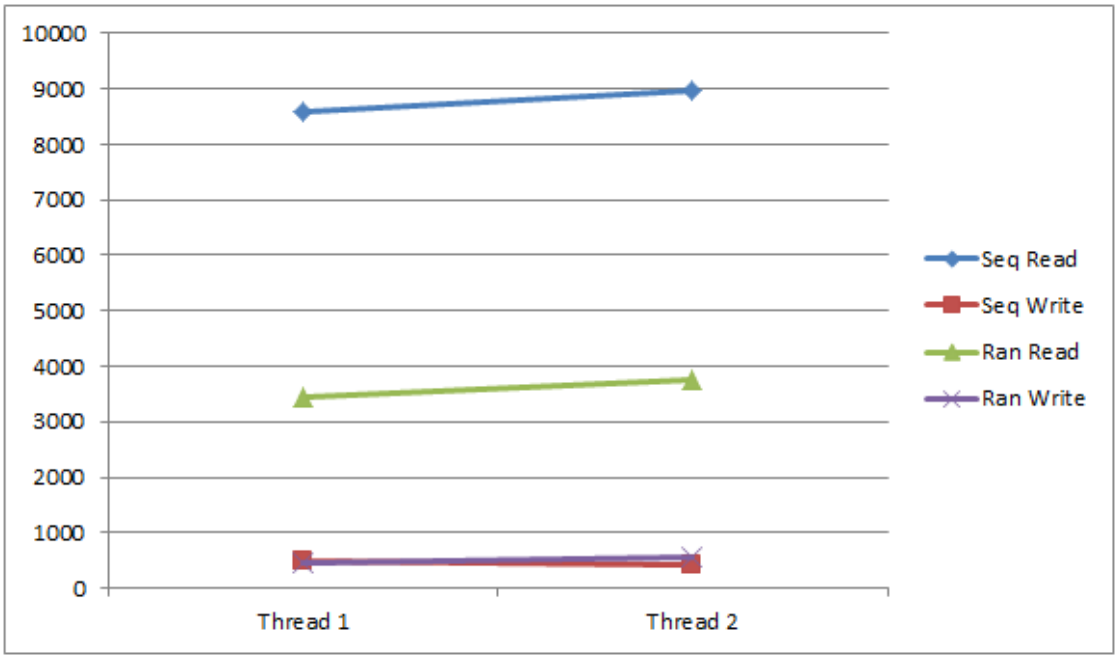
1KiloByte Sequential and Random Speed: Read and Write Latency



- **X Axis:** Number of Threads
- **Y Axis:** Latency in milliseconds

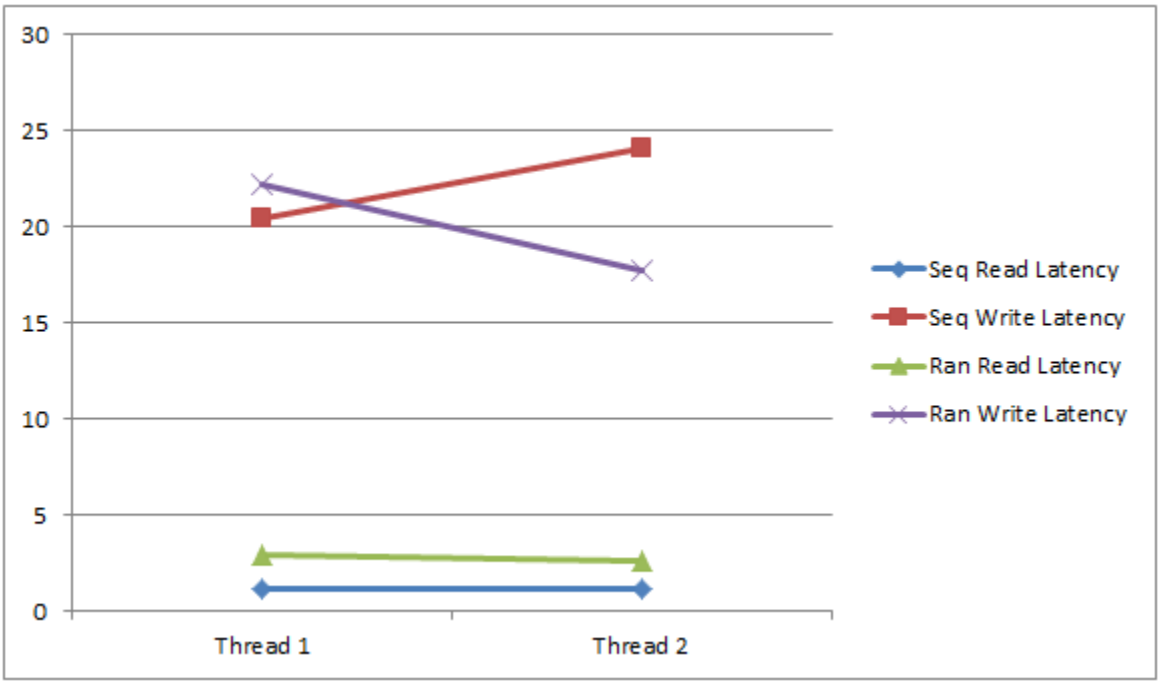
1 MEGABYTE:

1MegaByte Sequential and Random Speed: Read and Write Throughput



- **X Axis:** Number of Threads
- **Y Axis:** Speed in MBPS

1MegaByte Sequential and Random Speed: Read and Write Latency



- **X Axis:** Number of Threads
- **Y Axis:** Latency in milliseconds

Memory Benchmarking:

System Configuration:

- Operating System: Ubuntu 14.4
- RAM: 8 GB
- No of Physical cores: 4
- No of logical cores: 8

1 Thread:

Random Access:

Block size	1 Byte	1 KiloByte	1 MegaByte
Speed	24.035342 MB/sec	10393.385483 MB/sec	2824.061000 MB/sec
Latency	0.0396780 ms	0.0093960 ms	0.0354100 ms

Sequential Access:

Block size	1 Byte	1 KiloByte	1 MegaByte
Speed	71.904872 MB/sec	13828.412631 MB/sec	5705.482969 MB/sec
Latency	0.01326300 ms	0.00706200 ms	0.01752700 ms

2 Threads:

Random Access:

Block size	1 Byte	1 KiloByte	1 MegaByte
Speed	22.020234 MB/sec	8637.559703 MB/sec	5108.426349 MB/sec
Latency	0.0433090 ms	0.0113060 ms	0.01957550 ms

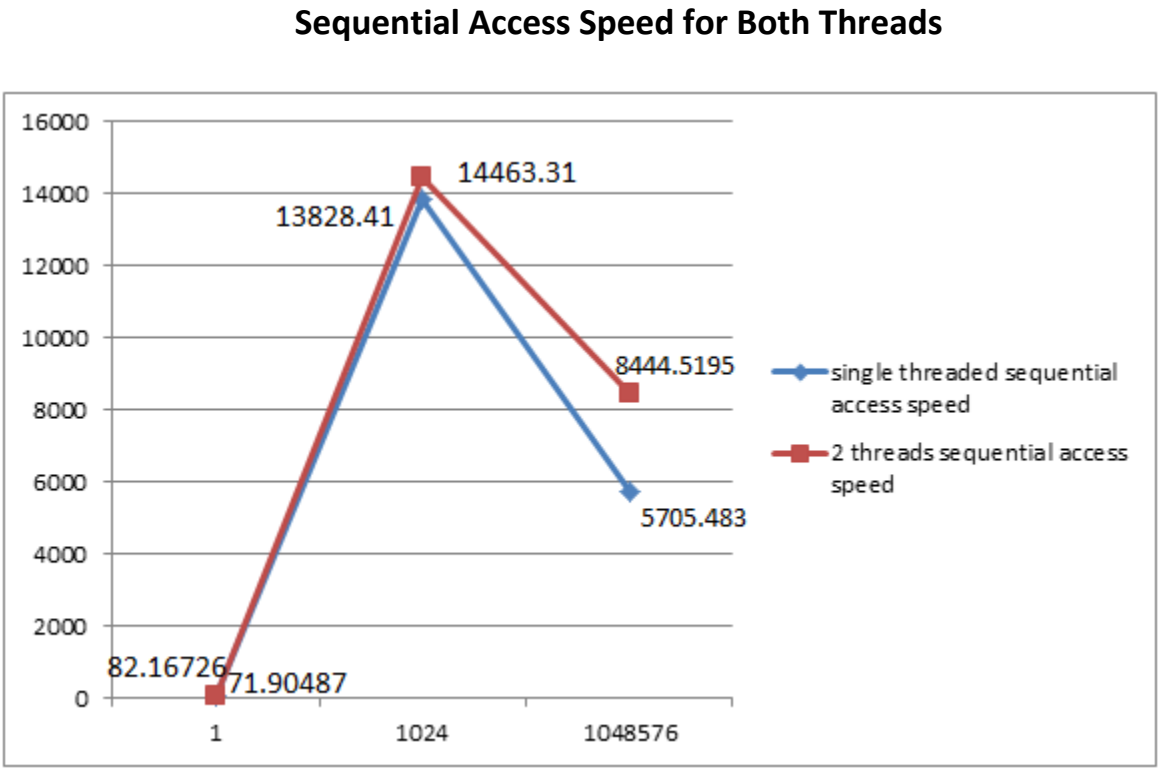
Sequential Access:

Block size	1 Byte	1 KiloByte	1 MegaByte
Speed	82.167261 MB/sec	14463.307168 MB/sec	8444.519507 MB/sec
Latency	0.011606500 ms	0.00675200 ms	0.01184200 ms

Graph for Memory Benchmarking:

For each of 1BYTE, 1KB, 1MB we plot graphs for sequential read + write, random read + write and latency for 1 and 2 threads. The latency has both values of random and sequential in it. From the graphs we notice that the performance is best for 1 thread.

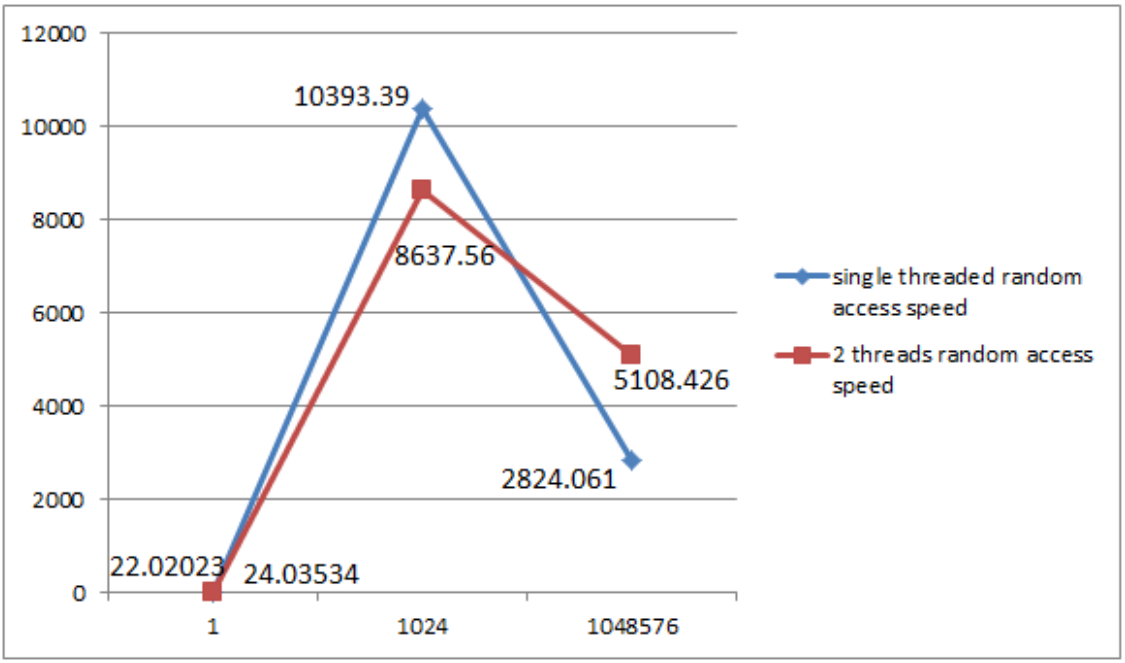
Sequential Access Speed:



- **X Axis:** Size of block
- **Y Axis:** Speed in MBPS

Random Access Speed:

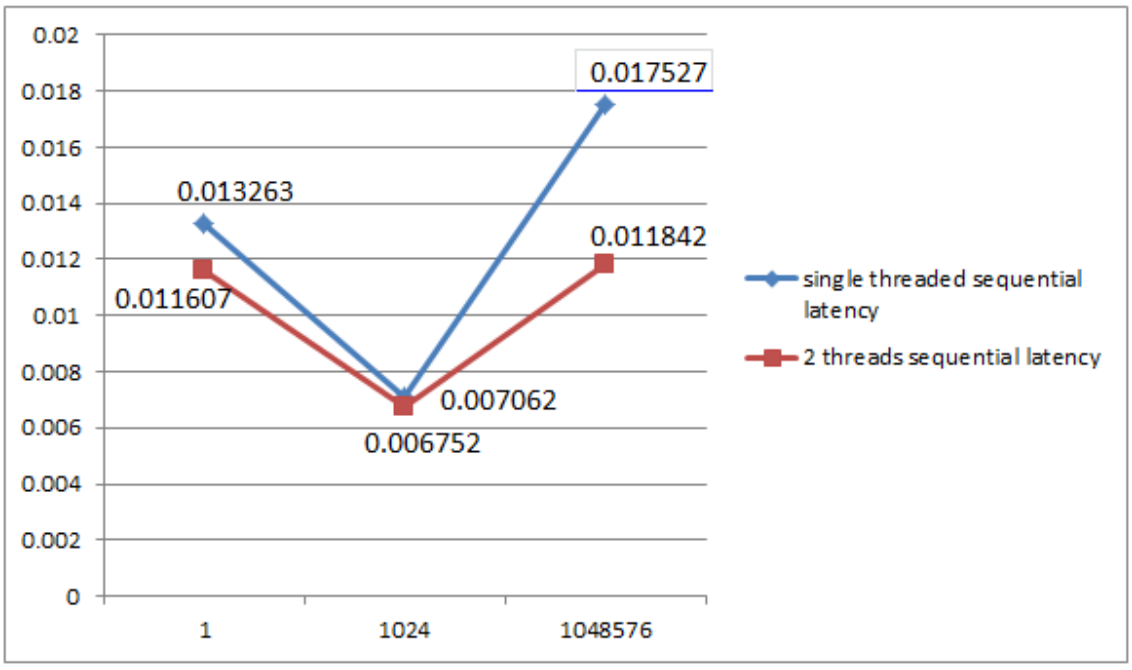
Random Access Speed for Both Threads



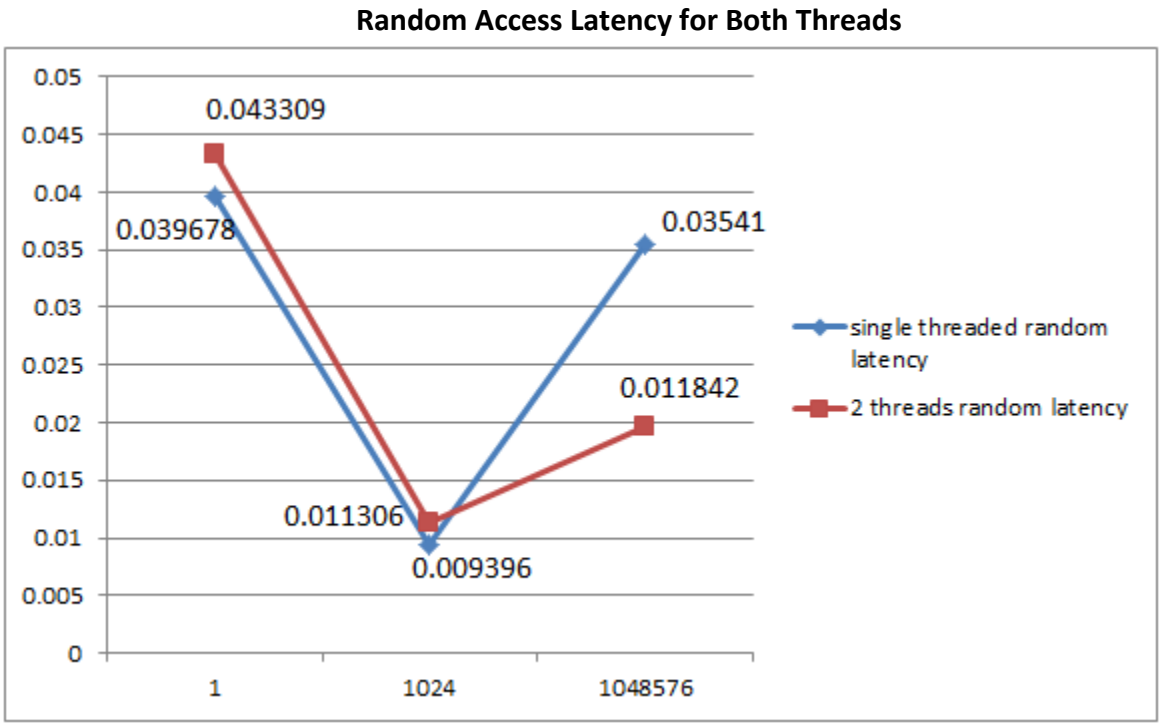
- **X Axis:** Size of block
- **Y Axis:** Speed in MBPS

Latency graph:

Sequential Access Latency for Both Threads



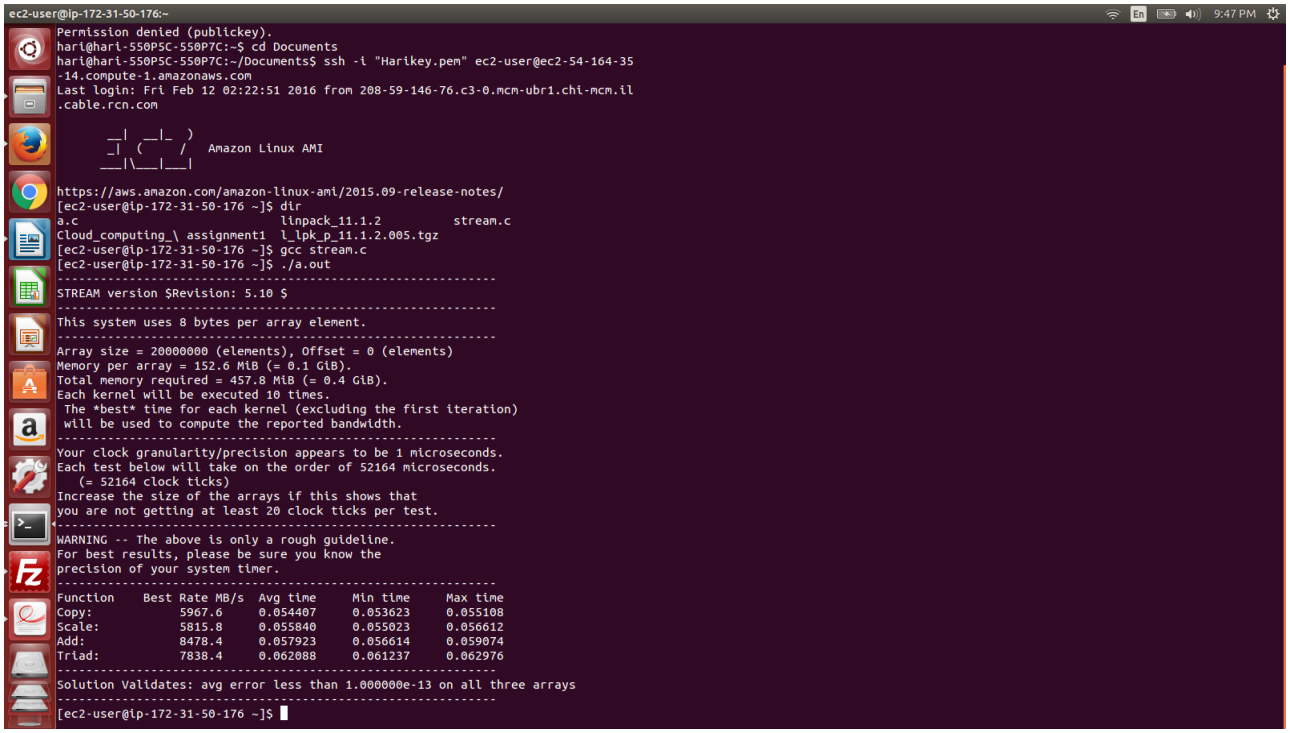
- **X Axis:** Size of block
- **Y Axis:** Latency in milliseconds



- **X Axis:** Size of block
- **Y Axis:** Latency in milliseconds

Theoretical Performance: Base DRAM clock frequency * No. of data transfer per clock * Memory Bus width * No. of Interfaces: 1600*2*64*2
Memory Bandwidth: 51.2 GB/s

STREAM Results:



The result of stream benchmark tool gives the memory bandwidth as 32.68 divided into 4 micro benchmarks: COPY, SCALE, SUM, and TRIAD. The efficiency achieved by STREAM benchmark tool when compared with our theoretical performance is 61.8%