Computing Performance Benchmarks among CPU, Memory and Disk

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Abstract

The aim of this project is to conduct computing performance benchmarks on the different parts of a computer system, like CPU, Memory and Disk. The benchmarks have been written from scratch and have been tested on Amazon AWS Cloud EC2 t2.micro instance.

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1. Design

1.1. CPU

This involves measuring the processor speed in terms of GIGA FLOPS and GIGA IOPS, by running through multiple instructions concurrently. FLOPS is the floating point operations per second and IOPS is the integer operations per second. The process speed is measured at varying levels of concurrency i.e. for 1, 2 and 4 threads.

Benchmark Design:

The benchmark is written so it loops through 1 billion times and perform 23 operations such as addition and multiplication, keeping the system busy in computation of large equations. The execution time is calculated in seconds by subtracting startTime and stopTime obtained from gettimeofday(). Flops and Iops is calculated by dividing the numberOfOperation by time.

1.2. Memory

This involves measuring the memory speed in terms of throughput and latency, by performing read and write operations for both sequential access and random access through various block sizes concurrently. The memory speed is measured at varying levels of concurrency i.e. for 1 and 2 threads and for varying block sizes i.e. 1B, 1KB and 1MB.

Benchmark Design:

The benchmark is written so it loops through _____ times and perform memcpy operation which copies specified characters from source memory block to destination memory block, keeping the system busy. The latency is calculated in milli-seconds by subtracting startTime and stopTime obtained from gettimeofday(). The throughput is calculated in MB/sec by multiplying numberOfThreads to numOfBytes and dividing the result by time.

1.3.Disk

This involves measuring the disk speed in terms of throughput and latency, by performing read and write operations for both sequential access and random access through various block sizes concurrently. The memory speed is measured at varying levels of concurrency i.e. for 1 and 2 threads and for varying block sizes i.e. 1B, 1KB and 1MB.

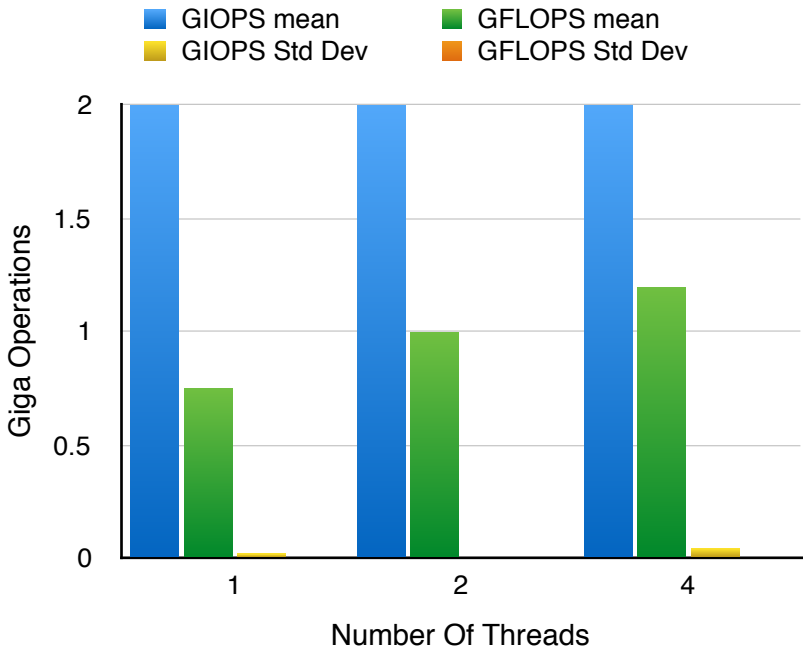
Benchmark Design:

The benchmark is written so it loops through 100000/size times and perform fread operation which reads data from the file to the buffer or fwrite operation which writes data from the buffer to the file, keeping the system busy. The latency is calculated in milli-seconds by subtracting startTime and stopTime obtained from gettimeofday(). The throughput is calculated in MB/sec by multiplying numberOfThreads to numOfBytes and dividing the result by time.

2. Performance

2.1.CPU

The benchmark results have been plotted on the graphs.

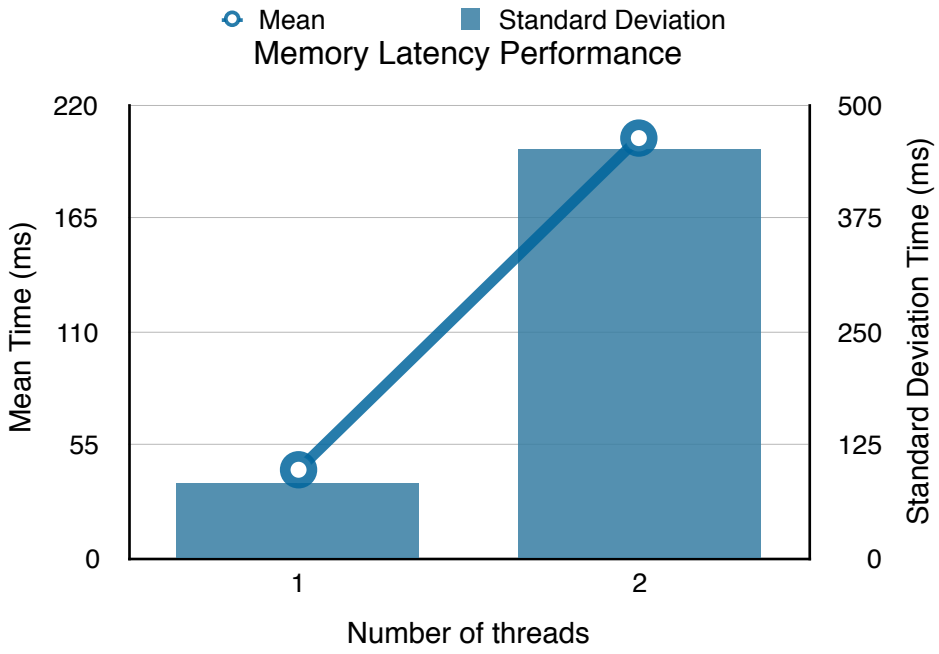


The best result of the Linpack Benchmark are:

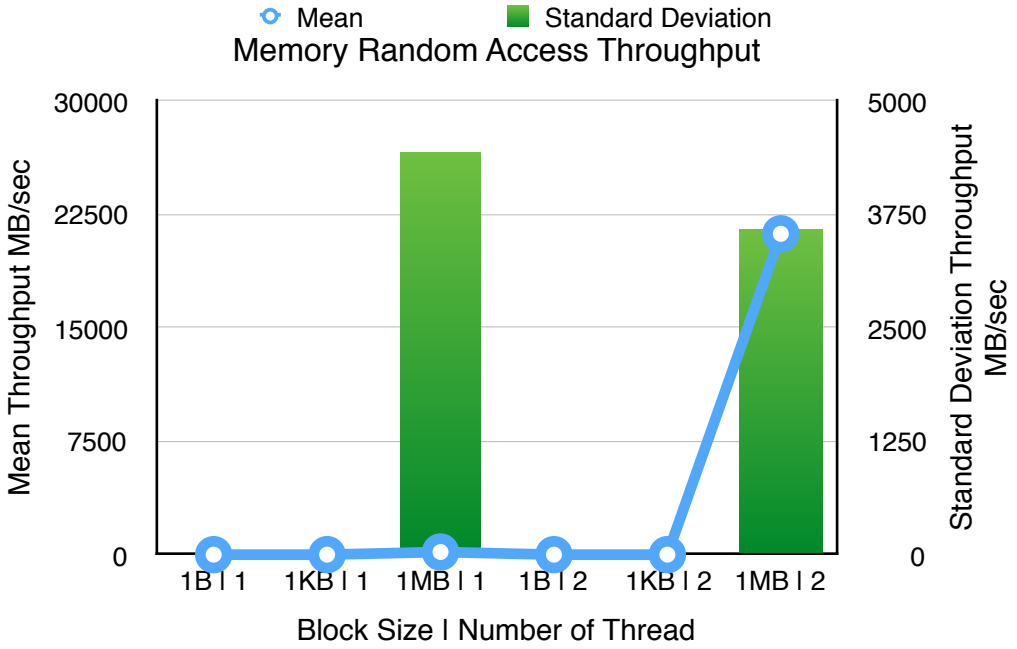
```
Performance Summary (GFlops)

Size   LDA    Align.  Average  Maximal
15000  15000  4       36.3534  36.3534
14000  14008  4       38.3452  38.5153
13000  13000  4       37.8683  38.0241
12000  12008  4       34.8409  36.5671
11000  11000  4       34.9892  36.1774
10000  10008  4       32.3719  34.2921
8000   8008   4       34.4494  35.1097
6000   6008   4       33.8808  35.1766
1000   1000   4       18.4909  19.2242
```

2.2.Memory

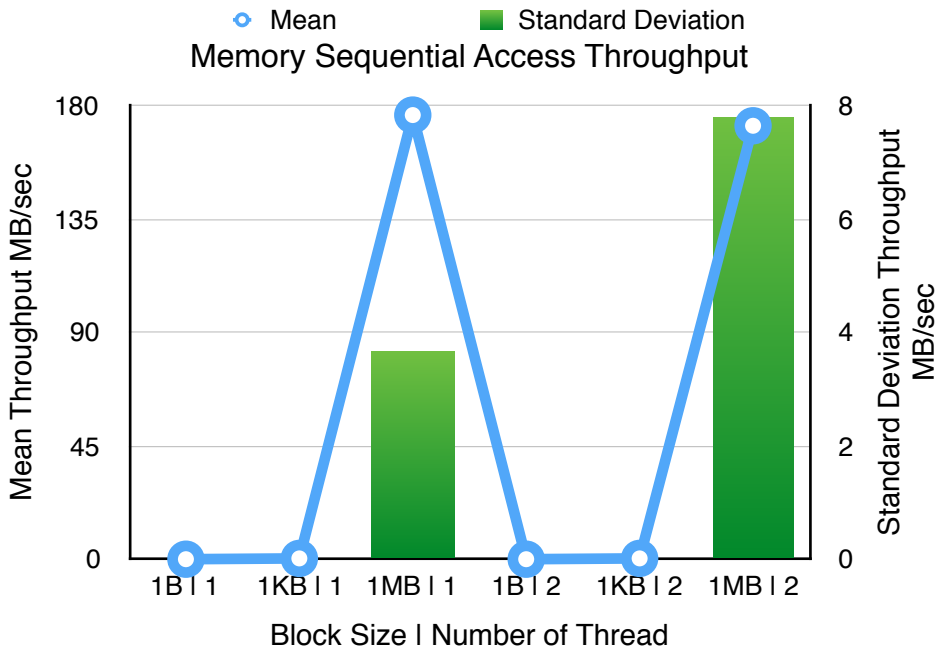
The benchmark results have been plotted on the graphs.



The above graph shows the disk latency performance for threads 1 and 2. The graph has been plotted across mean time calculated in milli seconds and the standard deviation time calculated in milli seconds.



The above graph shows the memory random access throughput performance for block size 1B, 1 KB and 1 MB and threads 1 and 2. The graph has been plotted across mean throughput calculated in MB/seconds and the standard deviation throughput calculated in MB/seconds.



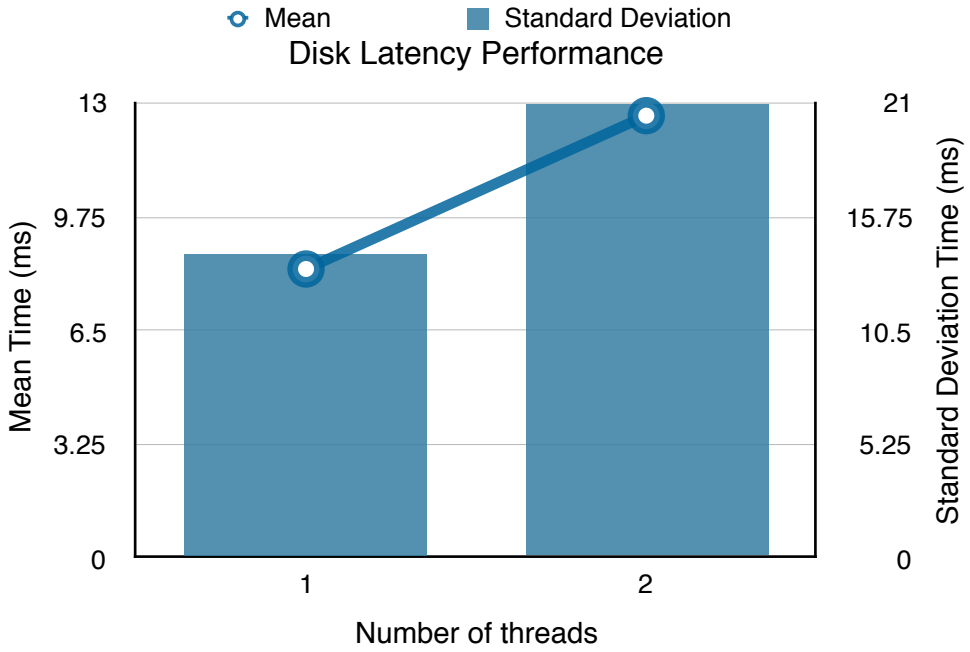
The above graph shows the memory sequential access throughput performance for block size 1B, 1 KB and 1 MB and threads 1 and 2. The graph has been plotted across mean throughput calculated in MB/seconds and the standard deviation throughput calculated in MB/seconds.

The best result of the Stream Benchmark (http://www.cs.virginia.edu/stream/) are :

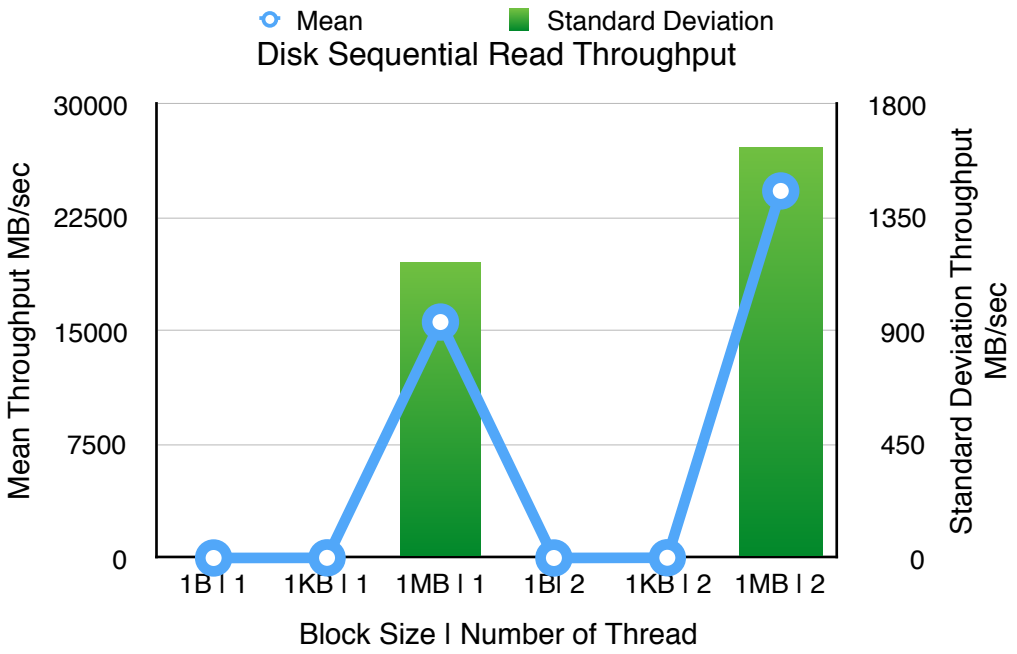
```
-------------------------------------------------------------
Function    Best Rate MB/s  Avg time     Min time     Max time
Copy:           5671.3     0.029385     0.028212     0.029902
Scale:          5458.9     0.030096     0.029310     0.030804
Add:            7710.9     0.031703     0.031125     0.032204
Triad:          7394.6     0.033103     0.032456     0.033466
-------------------------------------------------------------
```

2.3.Disk

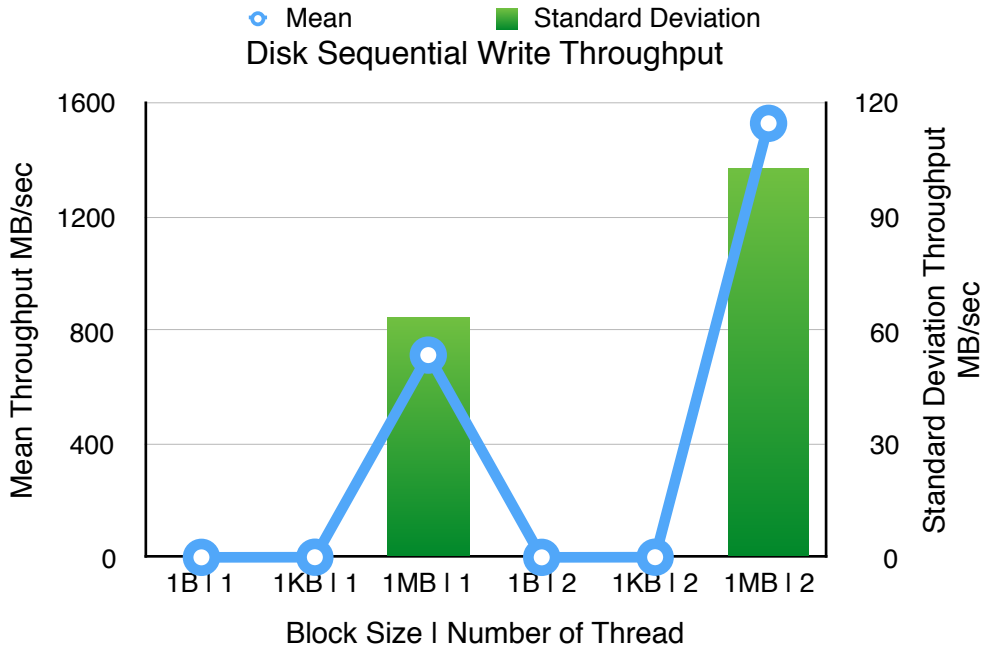
The benchmark results have been plotted on the graphs.



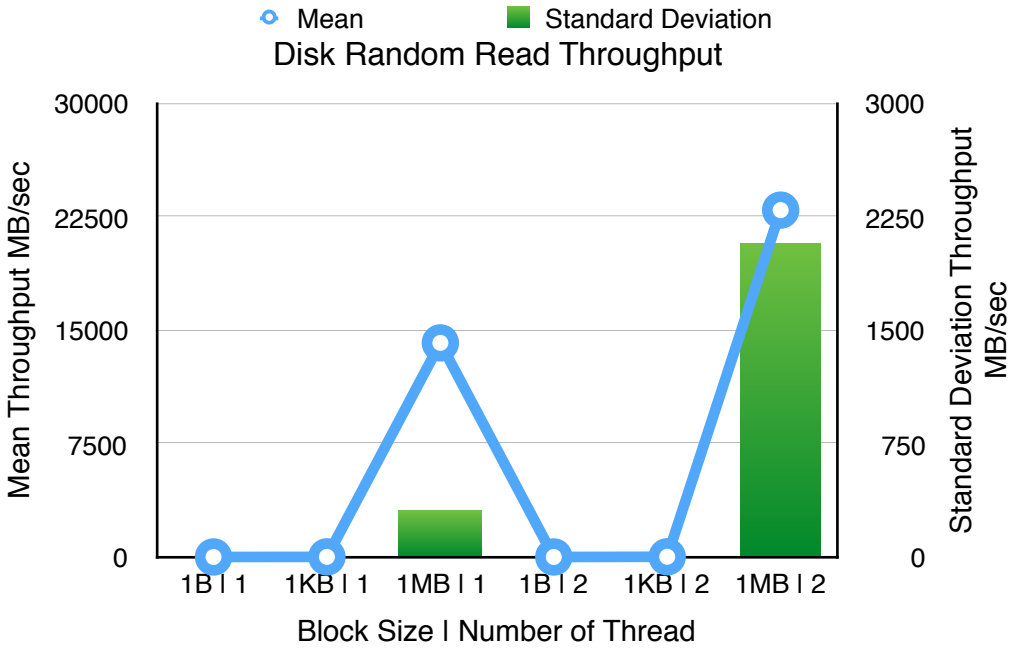
The above graph shows the disk latency performance for threads 1 and 2. The graph has been plotted across mean time calculated in milli seconds and the standard deviation time calculated in milli seconds.



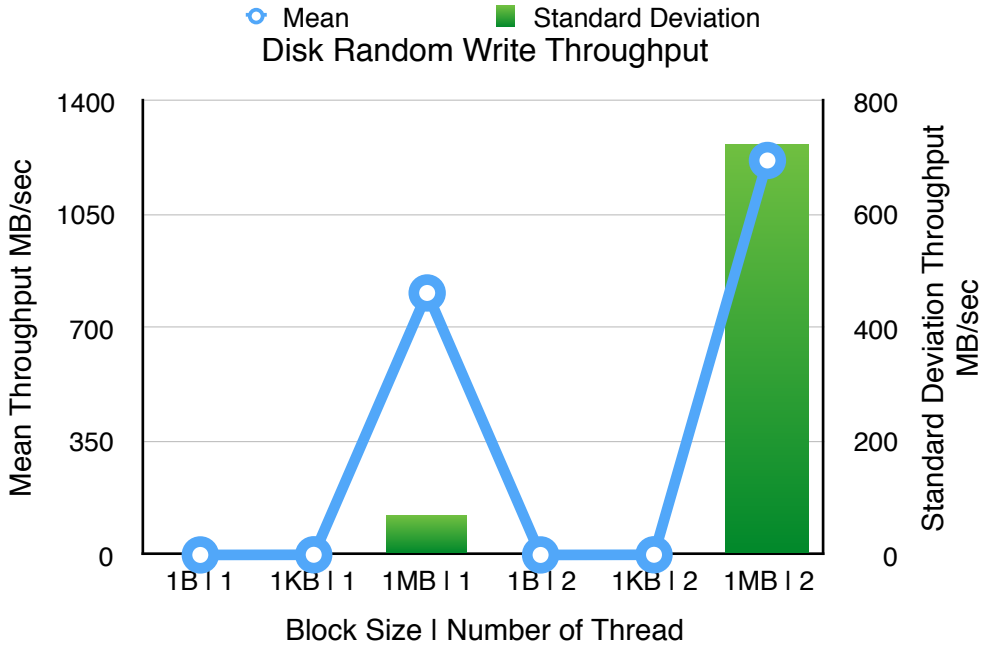
The above graph shows the disk sequential read throughput performance for block size 1B, 1 KB and 1 MB and threads 1 and 2. The graph has been plotted across mean throughput calculated in MB/seconds and the standard deviation throughput calculated in MB/seconds.



The above graph shows the disk sequential write throughput performance for block size 1B, 1 KB and 1 MB and threads 1 and 2. The graph has been plotted across mean throughput calculated in MB/seconds and the standard deviation throughput calculated in MB/seconds.



The above graph shows the disk random read throughput performance for block size 1B, 1 KB and 1 MB and threads 1 and 2. The graph has been plotted across mean throughput calculated in MB/seconds and the standard deviation throughput calculated in MB/seconds.



The above graph shows the disk random write throughput performance for block size 1B, 1 KB and 1 MB and threads 1 and 2. The graph has been plotted across mean throughput calculated in MB/seconds and the standard deviation throughput calculated in MB/seconds.