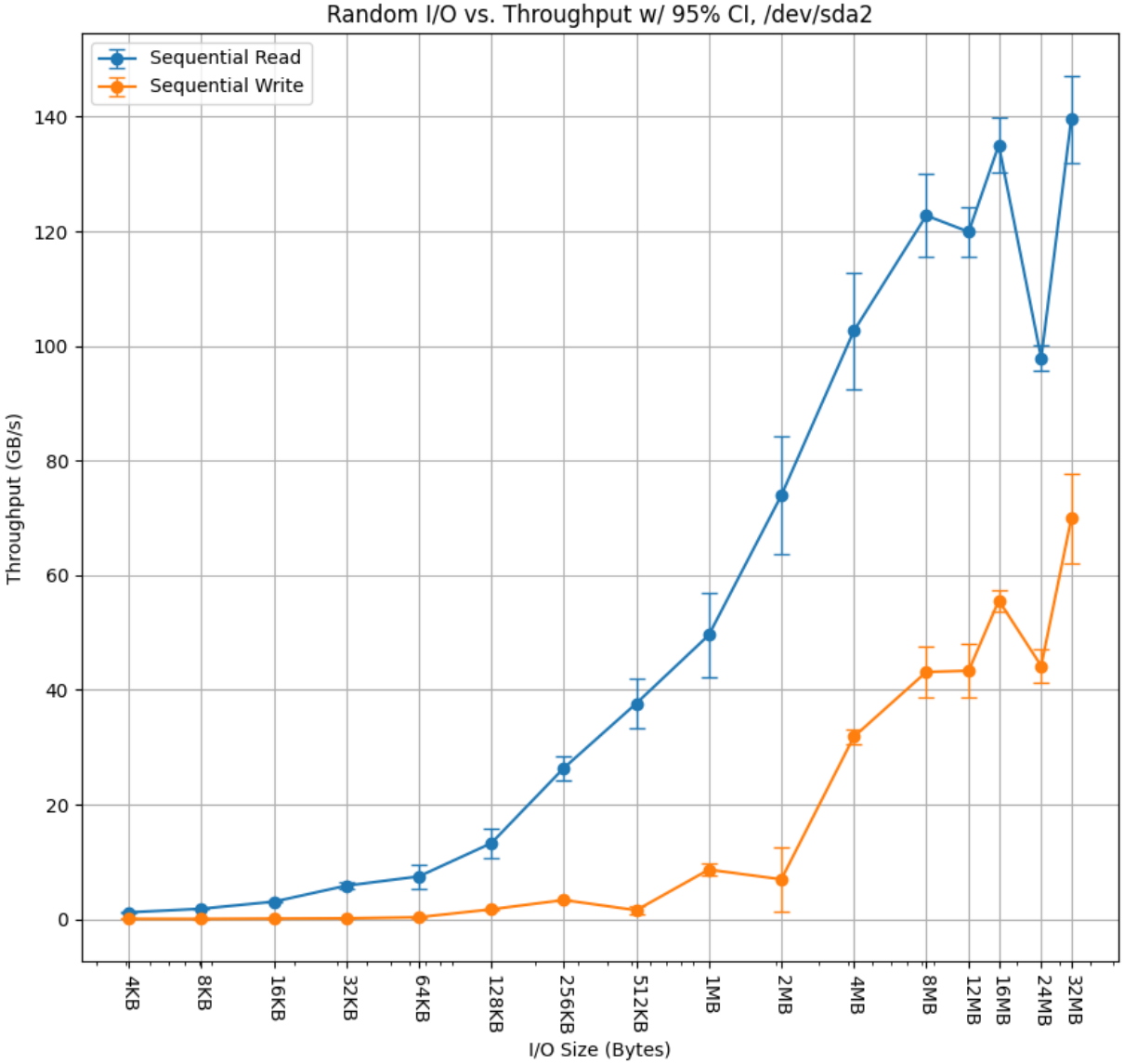
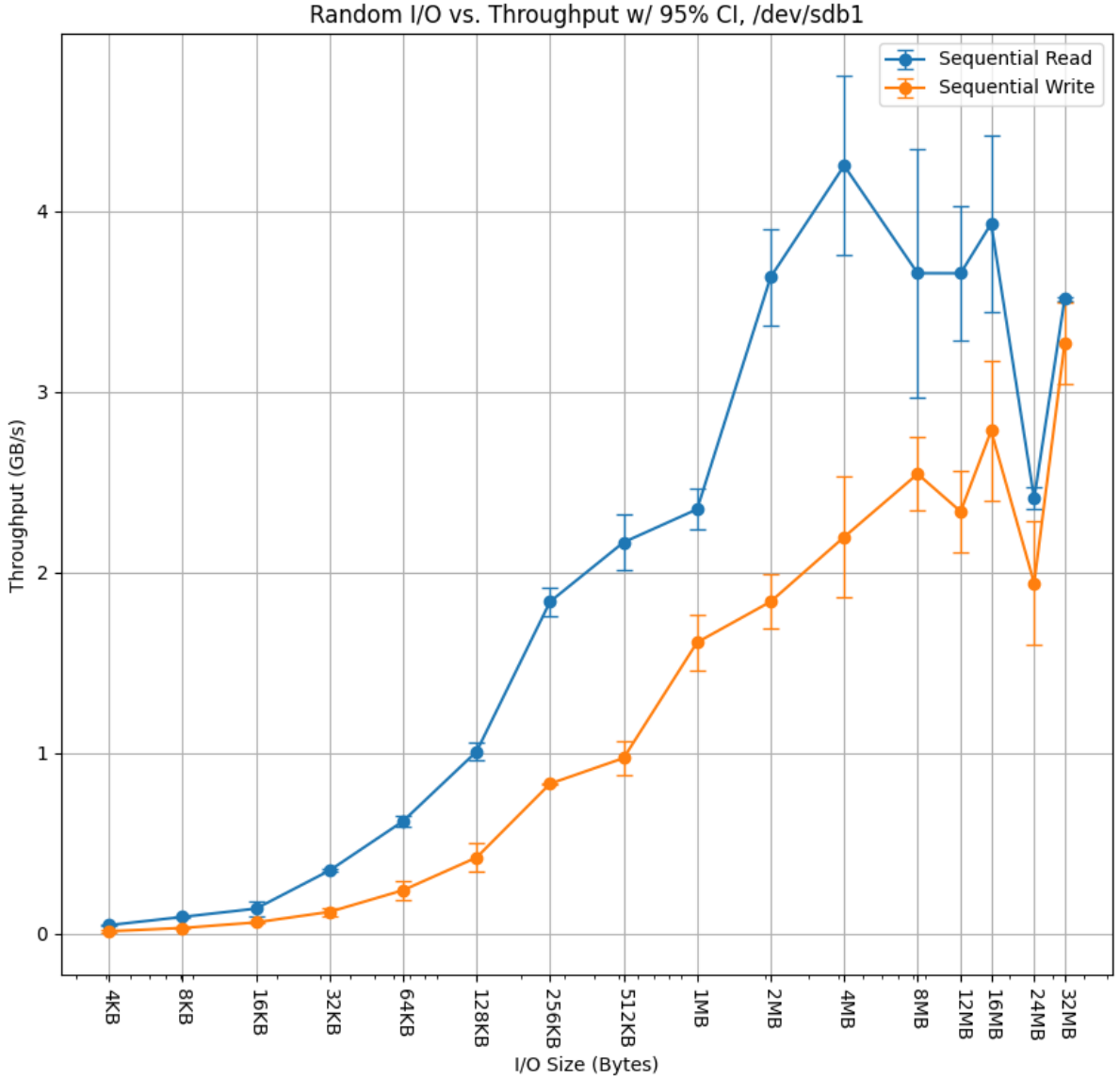
I/O Benchmark: Short Report

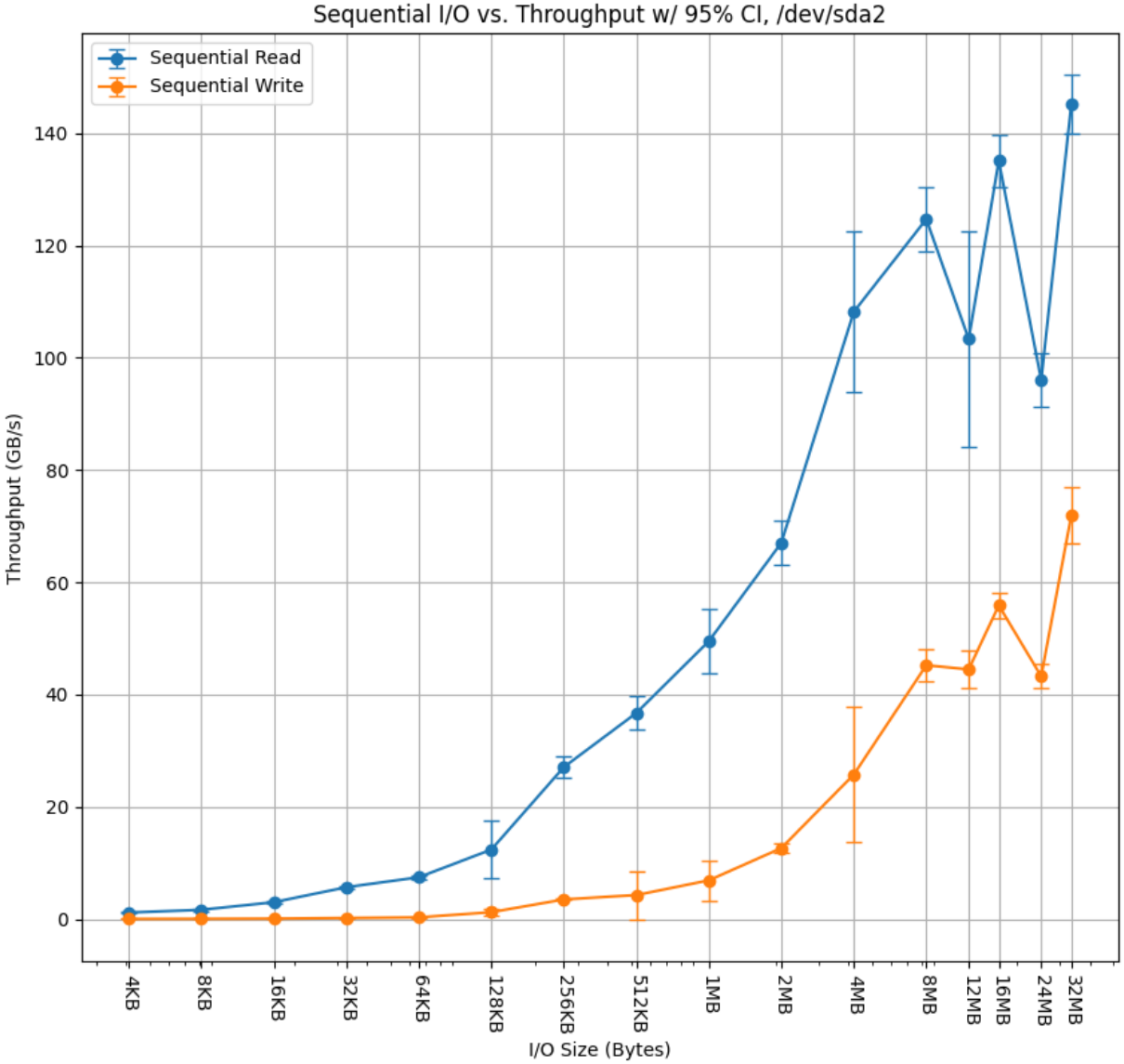
Following from the experiments comparing sequential and random reads and writes on SSDs and HDDs (hosted on gwion.cs.unc.edu, in devices /dev/sda2 and /dev/sdb1 respectively), several insights can be glanced by the output of our data. SSDs exhibit a notable increase in throughput as the I/O size grows larger, both for sequential and random operations; this suggests that SSDs can efficiently handle larger I/O sizes, making them well-suited for workloads involving large data transfers. In contrast, HDDs display a less pronounced increase in throughput with I/O size, indicating that their performance plateaus at a certain point, indicating diminishing returns. This suggests that HDDs may not be as efficient for handling large I/O sizes and are better suited for smaller, more frequent operations. When it comes to the stride data, a different pattern emerges. HDDs exhibit lower read throughputs as the stride distance increases, which can be attributed to the mechanical nature of hard disk drives. Otherwise, throughput is more or less constant regardless of stride, relatively speaking, per device/operation.

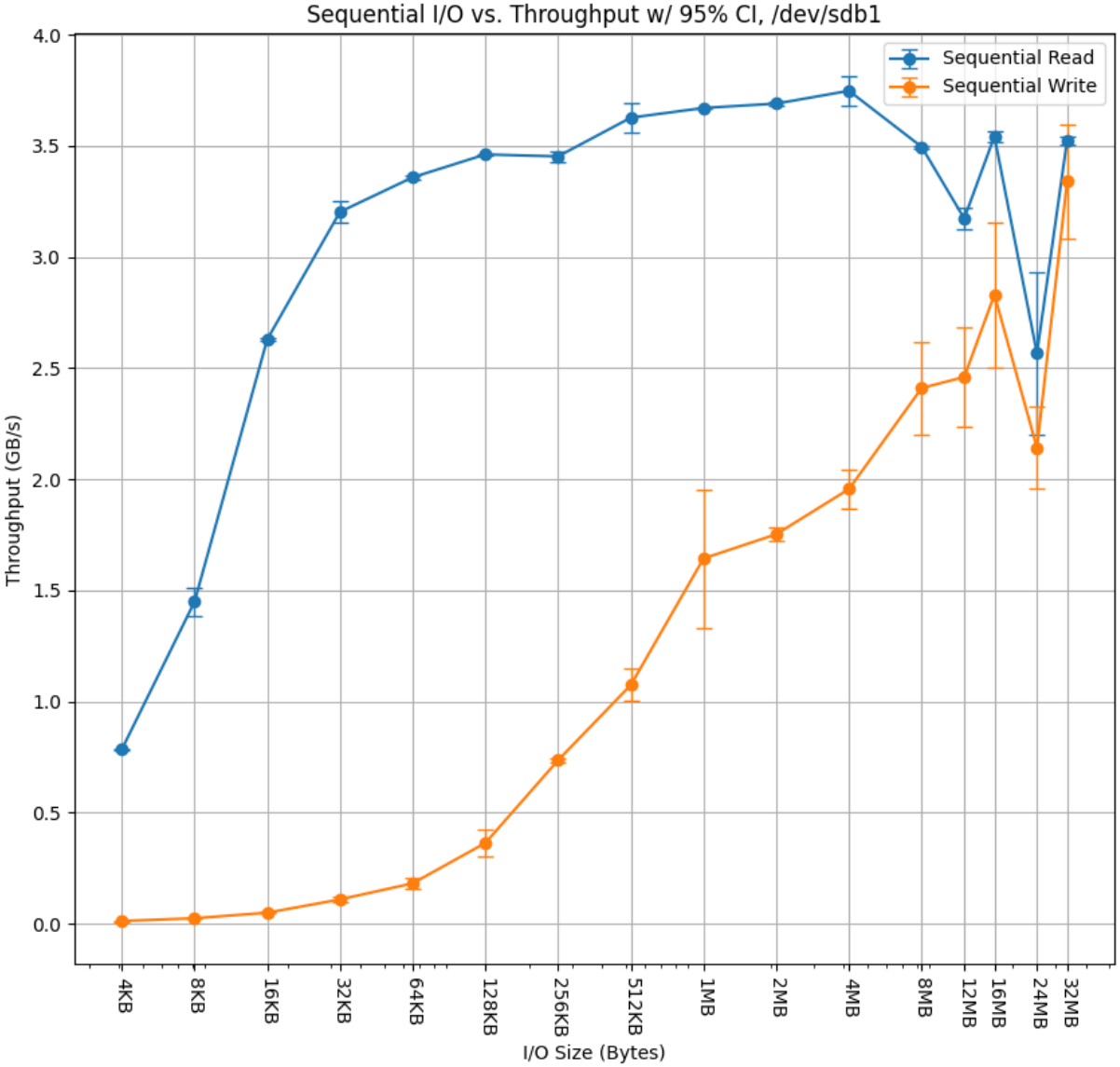
The results also highlight a key distinction between the two: sequential operations consistently yield higher throughput compared to random operations for both SSDs and HDDs, and that for the most part, SSDs are far superior in every respect when it comes to performance, offering considerably faster read/write speeds and responsiveness for both sequential and random workloads. This makes SSDs the preferred choice for applications demanding high-speed data access, such as databases and virtualization. On the other hand, HDDs still have their place in scenarios where cost per gigabyte is a primary concern, as they provide larger storage capacities at a lower cost, although with significantly lower performance; that, or if one is content enough with dealing with very small writes (<16kB). Considering the choice between one or the other will then evidently depend on one’s needs; however, SSDs are increasingly becoming the go-to option for systems and applications that prioritize speed and efficiency over raw storage capacity. HDDs can still be viable to an extent, like for archival/mass-storage solutions or as a cheaper alternative, but may not be as good for day-to-day, variable, and/or high-performance use. But SSDs are getting cheaper as time goes on; might as well fork it out for the performance!

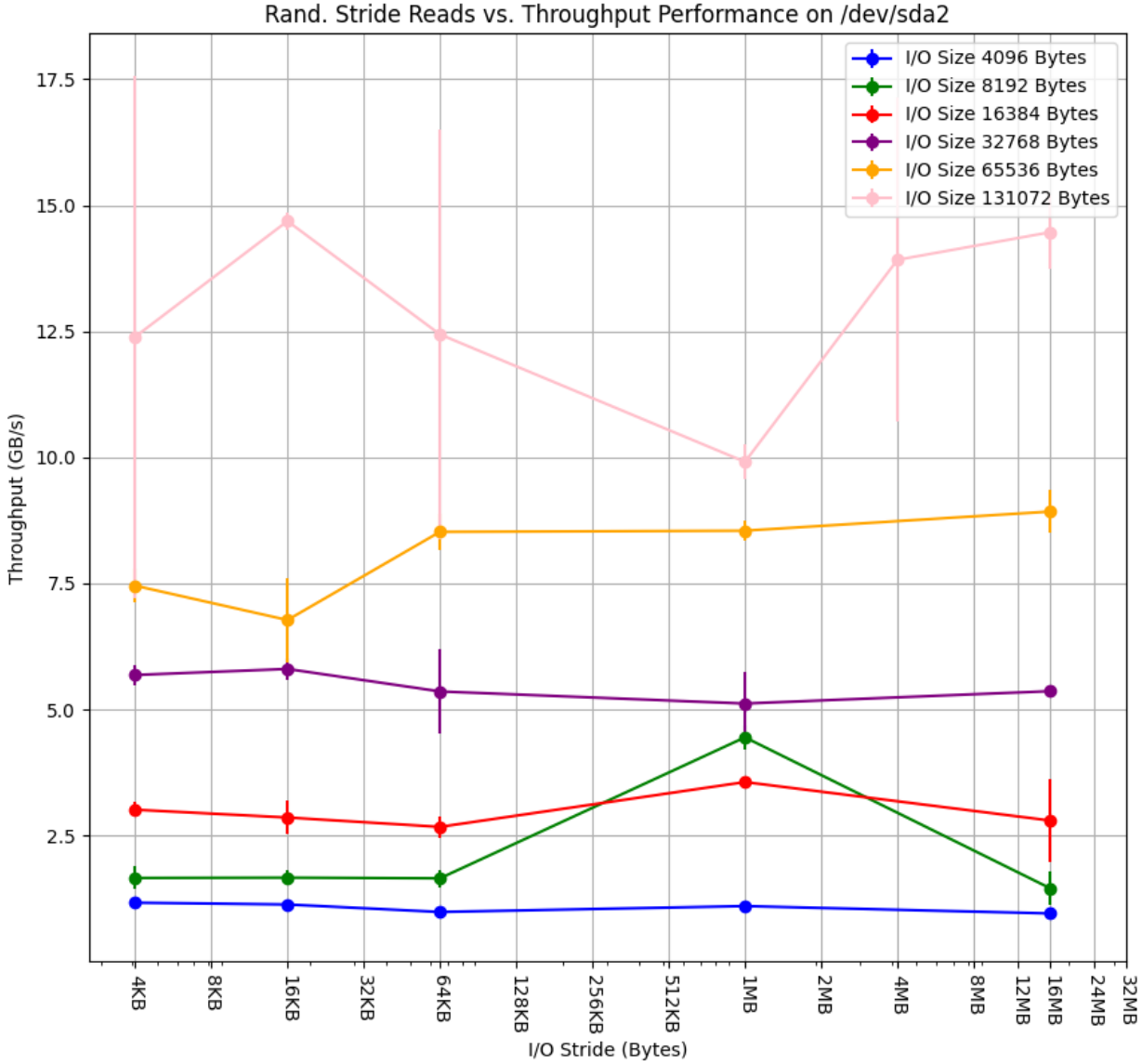
mattdo
730406661

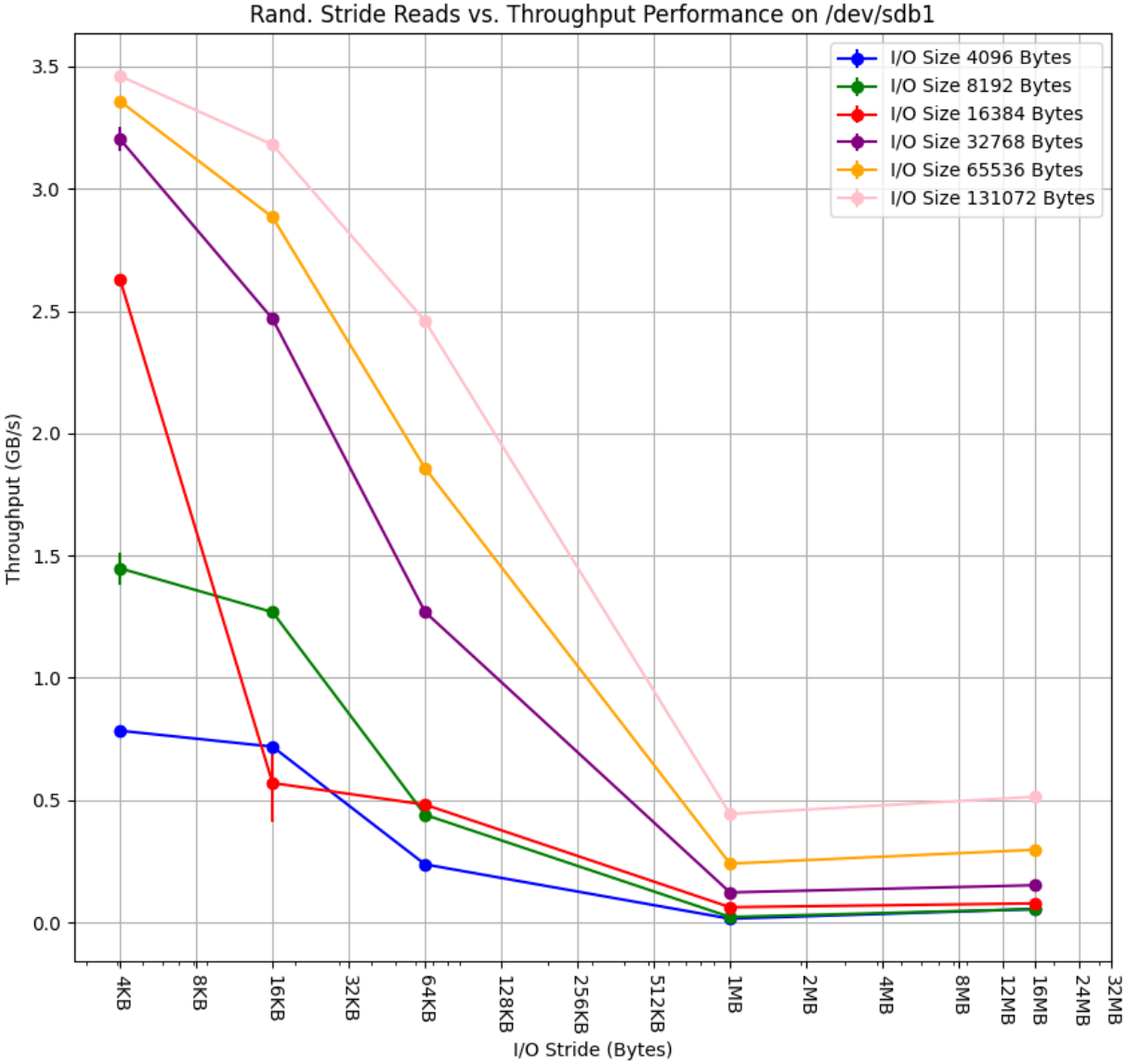

Random I/O vs. Throughput w/ 95% CI, /dev/sda2
Sequential Read
Sequential Write
Throughput (GB/s)
0
20
40
60
80
100
120
140
4KB
8KB
16KB
32KB
64KB
128KB
256KB
512KB
1MB
2MB
4MB
8MB
12MB
16MB
24MB
32MB
I/O Size (Bytes)

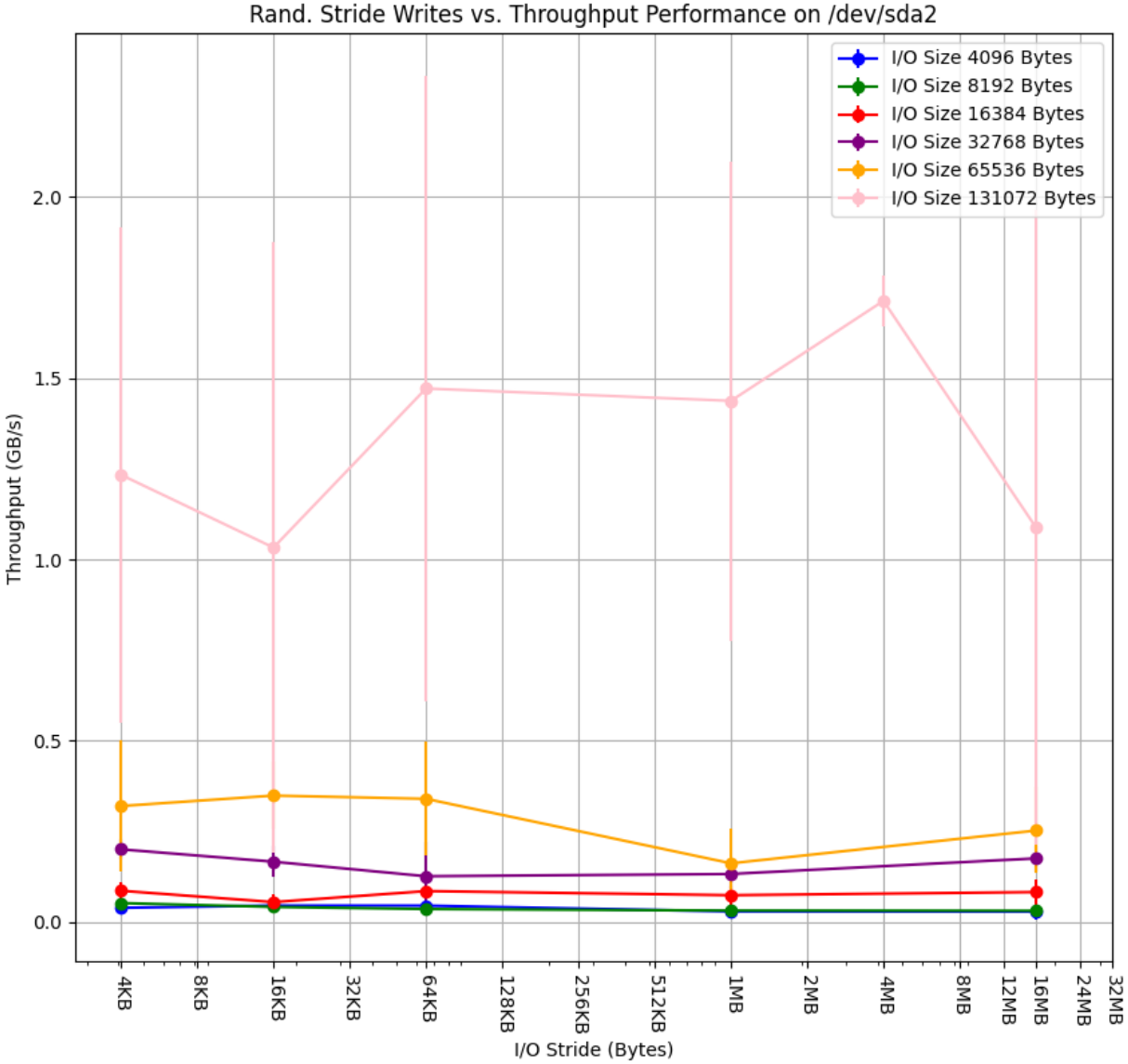

Random I/O vs. Throughput w/ 95% CI, /dev/sdb1
Sequential Read
Sequential Write
Throughput (GB/s)
0
1
2
3
4
4KB
8KB
16KB
32KB
64KB
128KB
256KB
512KB
1MB
2MB
4MB
8MB
12MB
16MB
24MB
32MB
I/O Size (Bytes)

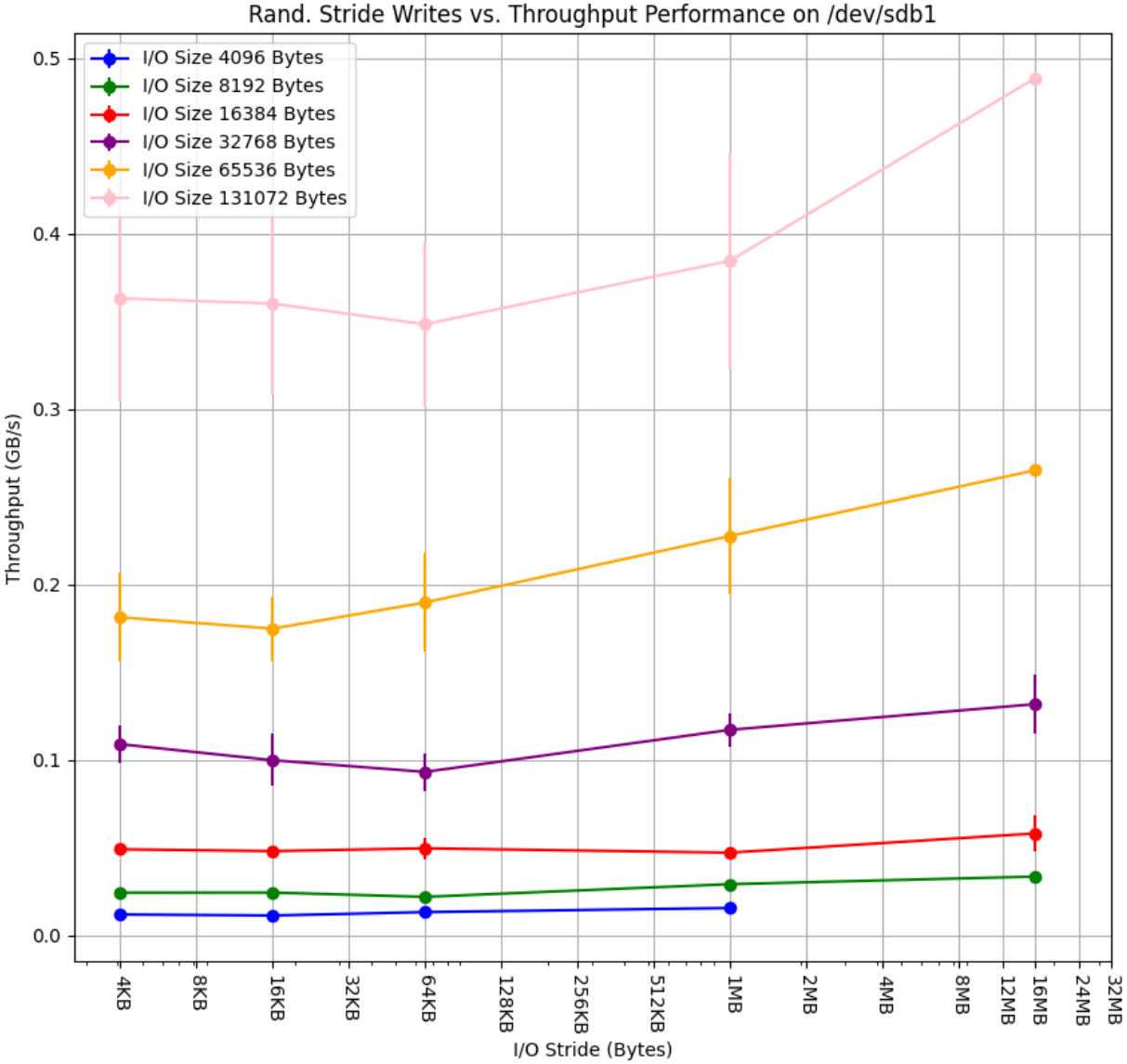

Sequential I/O vs. Throughput w/ 95% CI, /dev/sda2
Sequential Read
Sequential Write
Throughput (GB/s)
0
20
40
60
80
100
120
140
4KB
8KB
16KB
32KB
64KB
128KB
256KB
512KB
1MB
2MB
4MB
8MB
12MB
16MB
24MB
32MB
I/O Size (Bytes)


Sequential I/O vs. Throughput w/ 95% CI, /dev/sdb1
Sequential Read
Sequential Write
Throughput (GB/s)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
4KB
8KB
16KB
32KB
64KB
128KB
256KB
512KB
1MB
2MB
4MB
8MB
12MB
16MB
24MB
32MB
I/O Size (Bytes)


Rand. Stride Reads vs. Throughput Performance on /dev/sda2
I/O Size 4096 Bytes
I/O Size 8192 Bytes
I/O Size 16384 Bytes
I/O Size 32768 Bytes
I/O Size 65536 Bytes
I/O Size 131072 Bytes
Throughput (GB/s)
17.5
15.0
12.5
10.0
7.5
5.0
2.5
4KB
8KB
16KB
32KB
64KB
128KB
256KB
512KB
1MB
2MB
4MB
8MB
12MB
16MB
24MB
32MB
I/O Stride (Bytes)


Rand. Stride Reads vs. Throughput Performance on /dev/sdb1
I/O Size 4096 Bytes
I/O Size 8192 Bytes
I/O Size 16384 Bytes
I/O Size 32768 Bytes
I/O Size 65536 Bytes
I/O Size 131072 Bytes
Throughput (GB/s)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4KB
8KB
16KB
32KB
64KB
128KB
256KB
512KB
1MB
2MB
4MB
8MB
12MB
16MB
24MB
32MB
I/O Stride (Bytes)


Rand. Stride Writes vs. Throughput Performance on /dev/sda2
I/O Size 4096 Bytes
I/O Size 8192 Bytes
I/O Size 16384 Bytes
I/O Size 32768 Bytes
I/O Size 65536 Bytes
I/O Size 131072 Bytes
Throughput (GB/s)
0.0
0.5
1.0
1.5
2.0
4KB
8KB
16KB
32KB
64KB
128KB
256KB
512KB
1MB
2MB
4MB
8MB
12MB
16MB
24MB
32MB
I/O Stride (Bytes)


Rand. Stride Writes vs. Throughput Performance on /dev/sdb1
I/O Size 4096 Bytes
I/O Size 8192 Bytes
I/O Size 16384 Bytes
I/O Size 32768 Bytes
I/O Size 65536 Bytes
I/O Size 131072 Bytes
Throughput (GB/s)
0.0
0.1
0.2
0.3
0.4
0.5
4KB
8KB
16KB
32KB
64KB
128KB
256KB
512KB
1MB
2MB
4MB
8MB
12MB
16MB
24MB
32MB
I/O Stride (Bytes)