CSC443 Assignment 1.1 2017
CDF: hioefeli,
CDF: Habiberf, 1000668208

3.1 Experiment 1: Optimal Block Size

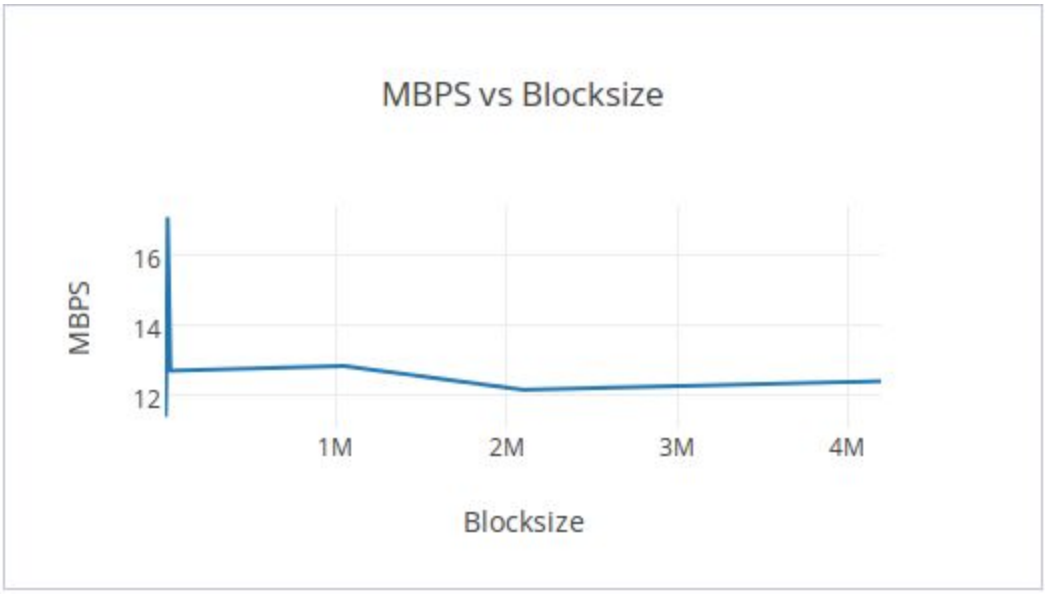
System Disk Block Size

Filesystem	Type	Size	Used	Avail	Use%	Mounted on
/dev/sda1	ext4	20G	14G	5.2G	72%	/

Write Blocks Sequential Data

First Experiment	Second Experiment	Third Experiment
Data rate: 11.919 MBPS	Data rate: 13.102 MBPS	Data rate: 14.872 MBPS
Data rate: 10.420 MBPS	Data rate: 11.649 MBPS	Data rate: 14.941 MBPS
Data rate: 9.208 MBPS	Data rate: 11.892 MBPS	Data rate: 13.836 MBPS
Data rate: 7.818 MBPS	Data rate: 14.470 MBPS	Data rate: 14.627 MBPS
Data rate: 9.642 MBPS	Data rate: 11.999 MBPS	Data rate: 15.222 MBPS
Data rate: 10.770 MBPS	Data rate: 14.792 MBPS	Data rate: 14.125 MBPS
Data rate: 11.291 MBPS	Data rate: 15.771 MBPS	Data rate: 15.046 MBPS
Data rate: 9.995 MBPS	Data rate: 15.325 MBPS	Data rate: 13.195 MBPS
Data rate: 11.752 MBPS	Data rate: 15.347 MBPS	Data rate: 14.289 MBPS

Fourth Experiment	Fifth Experiment	Block Sizes Used
Data rate: 11.648 MBPS	Data rate: 11.485 MBPS	Blocksize 1: 512
Data rate: 11.020 MBPS	Data rate: 11.739 MBPS	Blocksize 2: 1024
Data rate: 11.245 MBPS	Data rate: 10.695 MBPS	Blocksize 3: 4096
Data rate: 12.349 MBPS	Data rate: 12.541 MBPS	Blocksize 4: 8192
Data rate: 11.091 MBPS	Data rate: 12.586 MBPS	Blocksize 5: 16384
Data rate: 11.230 MBPS	Data rate: 12.567 MBPS	Blocksize 6: 32768
Data rate: 13.579 MBPS	Data rate: 8.464 MBPS	Blocksize 7: 1048576
Data rate: 12.664 MBPS	Data rate: 9.583 MBPS	Blocksize 8: 2097152
Data rate: 13.973 MBPS	Data rate: 6.612 MBPS	Blocksize 9: 4194304



Blocksize Average 1: 12.605 MBPS
Blocksize Average 2: 11.954 MBPS
Blocksize Average 3: 11.375 MBPS
Blocksize Average 4: 12.361 MBPS
Blocksize Average 5: 17.096 MBPS
Blocksize Average 6: 12.697 MBPS
Blocksize Average 7: 12.830 MBPS
Blocksize Average 8: 12.152 MBPS
Blocksize Average 9: 12.395 MBPS
(512, 12.605), (1024, 11.954), (4096,11.375), (8192, 12.361), (16384, 17.096) (32768, 12.697), (1048576, 12.83), (2097152, 12.152), (4194304, 12.395)

What is the optimal block size according to your experiment?
The optimal block size is 16384 according to the experiment.

Does it correspond to the system disk block size?
No, it does not correspond to the system block size.

Is there a block size when further increase does not contribute to better performance?
Yes, after and on block size 32768 the performance stays relatively the same at around 12 MBPS.

Write Lines Data
Data rate: 14.423 MBPS
Data rate: 14.695 MBPS
Data rate: 15.146 MBPS
Data rate: 13.936 MBPS

Data rate: 14.045 MBPS

Is there a difference?
Yes, there is a difference between writing lines and writing blocks sequentially. Writing lines takes an even rate of approximately 14 MBPS to write to the file, while the rate with writing blocks sequentially varies with the input block size.

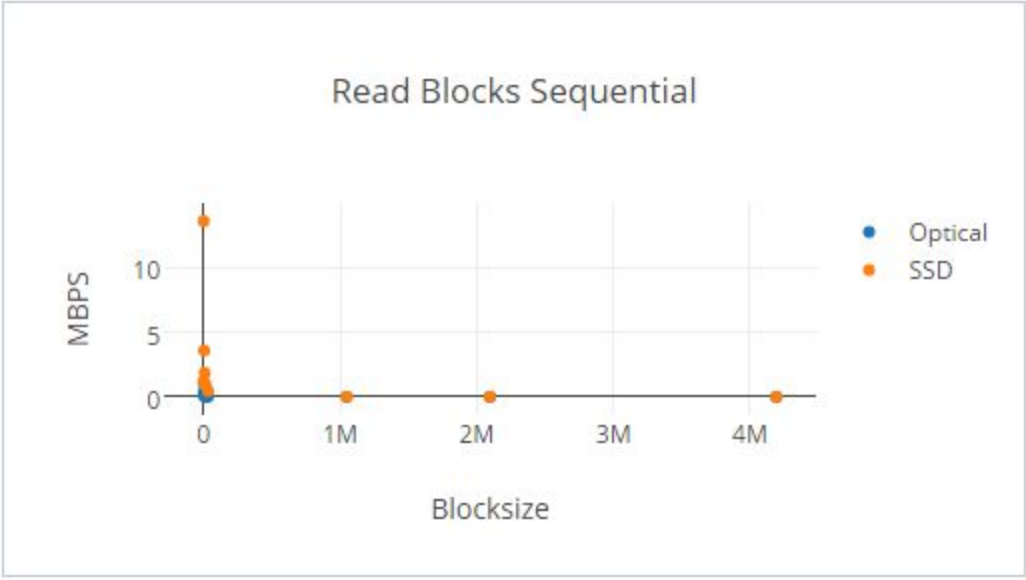
What is more efficient - writing in blocks or writing in lines? Why?
If we use the optimal blocksize for write_blocks_seq, then writing blocks would be more efficient. However, if we do not use the optimal blocksize, then writing lines would be more efficient. This is because of the I/Os used for writing. In write lines, each line needs an I/O call. However for write blocks, an I/O is called per block instead, which generally makes for a better performance since a lower amount of calls are being made. Though after a certain threshold, write blocks can have a worse performance than write lines, due to the buffer amount.

3.2 Experiment 2: Sequential vs. Random Read rate
Read Blocks Sequential Data
Optical Hard Drive Data

./read_blocks_seq big.dat 512 Total Records: 255870600 Unique Users: 26297226 Average: 9 Max Followers: 214276 Data rate: 1.075 MBPS	./read_blocks_seq big.dat 1024 Total Records: 255870600 Unique Users: 26297226 Average: 9 Max Followers: 214276 Data rate: 0.333 MBPS	./read_blocks_seq big.dat 4096 Total Records: 255870600 Unique Users: 26297226 Average: 9 Max Followers: 214276 Data rate: 0.111 MBPS
./read_blocks_seq big.dat 8192 Total Records: 255870600 Unique Users: 26297226 Average: 9 Max Followers: 214276 Data rate: 0.037 MBPS	./read_blocks_seq big.dat 16384 Total Records: 255870600 Unique Users: 26297226 Average: 9 Max Followers: 214276 Data rate: 0.019 MBPS	./read_blocks_seq big.dat 32768 Total Records: 255870600 Unique Users: 26297226 Average: 9 Max Followers: 214276 Data rate: 0.018 MBPS
./read_blocks_seq big.dat 1048576 Total Records: 255870600 Unique Users: 26297226 Average: 9 Max Followers: 214276 Data rate: 0.001 MBPS	./read_blocks_seq big.dat 2097152 Total Records: 255870600 Unique Users: 26297226 Average: 9 Max Followers: 214276 Data rate: 0.000 MBPS	./read_blocks_seq big.dat 4194304 Total Records: 255870600 Unique Users: 26297226 Average: 9 Max Followers: 214276 Data rate: 0.000 MBPS

SSD Data

./read_blocks_seq big.dat 512 Total Records: 255933054 Unique Users: 26301626 Average: 9 Max Followers: 214329 Data rate: 1.210 MBPS	./read_blocks_seq big.dat 1024 Total Records: 255933054 Unique Users: 26301626 Average: 9 Max Followers: 214329 Data rate: 13.584 MBPS	./read_blocks_seq big.dat 4096 Total Records: 255933054 Unique Users: 26301626 Average: 9 Max Followers: 214329 Data rate: 3.578 MBPS
./read_blocks_seq big.dat 8192 Total Records: 255933054 Unique Users: 26301626 Average: 9 Max Followers: 214329 Data rate: 1.860 MBPS	./read_blocks_seq big.dat 16384 Total Records: 255933054 Unique Users: 26301626 Average: 9 Max Followers: 214329 Data rate: 0.923 MBPS	./read_blocks_seq big.dat 32768 Total Records: 255933054 Unique Users: 26301626 Average: 9 Max Followers: 214329 Data rate: 0.470 MBPS
./read_blocks_seq big.dat 1048576 Total Records: 255933054 Unique Users: 26301626 Average: 9 Max Followers: 214329 Data rate: 0.016 MBPS	./read_blocks_seq big.dat 2097152 Total Records: 255933054 Unique Users: 26301626 Average: 9 Max Followers: 214329 Data rate: 0.008 MBPS	./read_blocks_seq big.dat 4194304 Total Records: 255933054 Unique Users: 26301626 Average: 9 Max Followers: 214329 Data rate: 0.003 MBPS

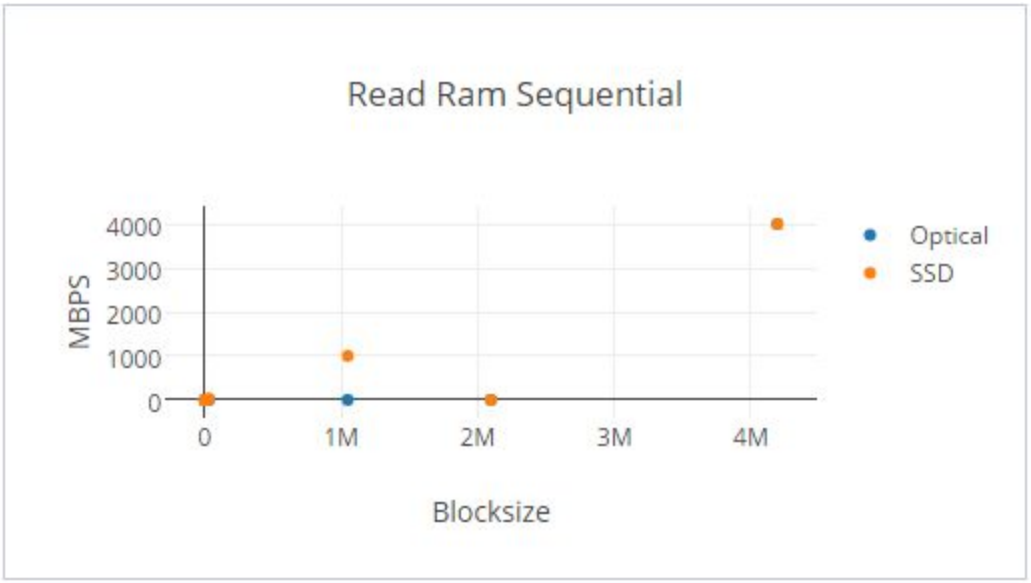


Read Ram Sequential Data
Optical Hard Drive Data

./read_ram_seq big.dat 512 Total Records: 64 Unique Users: 3 Average: 21 Max Followers: 51 Data rate: inf MBPS	./read_ram_seq big.dat 1024 Total Records: 128 Unique Users: 4 Average: 32 Max Followers: 64 Data rate: inf MBPS	./read_ram_seq big.dat 4096 Total Records: 512 Unique Users: 4 Average: 128 Max Followers: 64 Data rate: inf MBPS
./read_ram_seq big.dat 8192 Total Records: 1024 Unique Users: 4 Average: 256 Max Followers: 64 Data rate: inf MBPS	./read_ram_seq big.dat 16384 Total Records: 2048 Unique Users: 4 Average: 512 Max Followers: 64 Data rate: inf MBPS	./read_ram_seq big.dat 32768 Total Records: 4096 Unique Users: 10 Average: 409 Max Followers: 1996 Data rate: inf MBPS
./read_ram_seq big.dat 1048576 Total Records: 131072 Unique Users: 404 Average: 324 Max Followers: 8566 Data rate: inf MBPS	./read_ram_seq big.dat 2097152 Total Records: 262144 Unique Users: 865 Average: 303 Max Followers: 8566 Data rate: inf MBPS	./read_ram_seq big.dat 4194304 Total Records: 524288 Unique Users: 1723 Average: 304 Max Followers: 8566 Data rate: 3999.992 MBPS

SSD Data

./read_ram_seq big.dat 512 Total Records: 64 Unique Users: 5 Average: 12 Max Followers: 42 Data rate: inf MBPS	./read_ram_seq big.dat 1024 Total Records: 128 Unique Users: 8 Average: 16 Max Followers: 64 Data rate: inf MBPS	./read_ram_seq big.dat 4096 Total Records: 512 Unique Users: 24 Average: 21 Max Followers: 171 Data rate: inf MBPS
./read_ram_seq big.dat 8192 Total Records: 1024 Unique Users: 48 Average: 21 Max Followers: 171 Data rate: inf MBPS	./read_ram_seq big.dat 16384 Total Records: 2048 Unique Users: 98 Average: 20 Max Followers: 171 Data rate: inf MBPS	./read_ram_seq big.dat 32768 Total Records: 4096 Unique Users: 201 Average: 20 Max Followers: 234 Data rate: 31.242 MBPS
./read_ram_seq big.dat 1048576 Total Records: 131072 Unique Users: 595 Average: 220 Max Followers: 8569 Data rate: 999.992 MBPS	./read_ram_seq big.dat 2097152 Total Records: 262144 Unique Users: 1056 Average: 248 Max Followers: 8569 Data rate: inf MBPS	./read_ram_seq big.dat 4194304 Total Records: 524288 Unique Users: 1914 Average: 273 Max Followers: 8569 Data rate: 3999.992 MBPS



What is the ratio of sequential read rate for secondary storage and for RAM?
For secondary storage:
In regards to a block size of 16384,
Sequential Read Rate for Primary: 0.019 MBPS
Sequential Read Rate for Secondary : 0.923 MBPS

Ratio = Secondary/Primary = 0.923 MBPS/0.019 MBPS = 48.58

For RAM:
In regards to a block size of 4194304,
Sequential Read Rate for Primary: 3999.992 MBPS
Sequential Read Rate for Secondary :3999.992 MBPS

Ratio = Secondary/Primary = 3999.992 MBPS / 3999.992 MBPS = 1

Does it correspond to the ratio discussed in class? If not, what do you think is the reason?
The ratio discussed in class indicates the ratio should be significantly larger, so no, it doesn't correspond to the ratio in class. It should be noted that there are problems with the timing function and the source code for ram, so the data above is inaccurate. Though, if the data was accurate, the ratio would still not correspond to the ones discussed in class due to Moore's Law.

Read Blocks Random Data
Optical Hard Drive Data

Blocksize 1: 512 Blocksize 2: 1024	1. Data rate: 0.001 MBPS 2. Data rate: 0.001 MBPS

Blocksize 3: 4096 Blocksize 4: 8192 Blocksize 5: 16384 Blocksize 6: 32768 Blocksize 7: 1048576 Blocksize 8: 2097152 Blocksize 9: 4194304	3. Data rate: 0.001 MBPS 4. Data rate: 0.001 MBPS 5. Data rate: 0.000 MBPS 6. Data rate: 0.001 MBPS 7. Data rate: 0.000 MBPS 8. Data rate: 0.000 MBPS 9. Data rate: 0.000 MBPS

SSD Data

Blocksize 1: 512 Blocksize 2: 1024 Blocksize 3: 4096 Blocksize 4: 8192 Blocksize 5: 16384 Blocksize 6: 32768 Blocksize 7: 1048576 Blocksize 8: 2097152 Blocksize 9: 4194304	1.Data rate: 0.031 MBPS 2. Data rate: 0.025 MBPS 3. Data rate: 0.032 MBPS 4. Data rate: 0.032 MBPS 5. Data rate: 0.031 MBPS 6. Data rate: 0.029 MBPS 7. Data rate: 0.010 MBPS 8. Data rate: 0.006 MBPS 9. Data rate: 0.003 MBPS

Read Ram Random Data
Optical Hard Drive Data

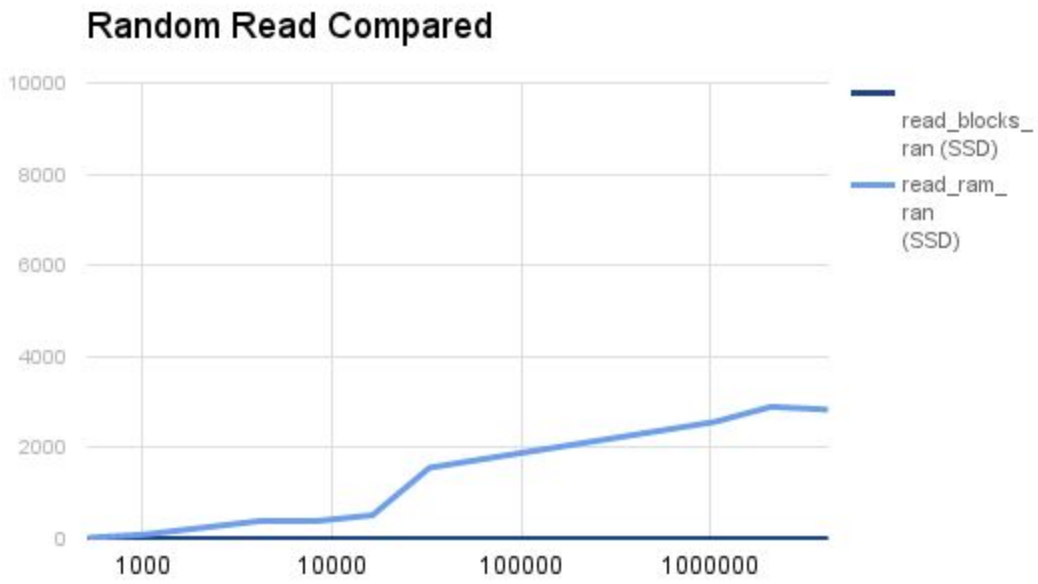
Blocksize 1: 512 Blocksize 2: 1024 Blocksize 3: 4096 Blocksize 4: 8192 Blocksize 5: 16384 Blocksize 6: 32768 Blocksize 7: 1048576 Blocksize 8: 2097152 Blocksize 9: 4194304	1. Data rate: 48.828 MBPS 2. Data rate: 97.656 MBPS 3. Data rate: 390.625 MBPS 4. Data rate: 3.488 MBPS 5. Data rate: 97.656 MBPS 6. Data rate: 781.250 MBPS 7. Data rate: 2222.222 MBPS 8. Data rate: 2127.660 MBPS 9. Data rate: 3076.923 MBPS

SSD Data

Blocksize 1: 512 Blocksize 2: 1024 Blocksize 3: 4096 Blocksize 4: 8192 Blocksize 5: 16384 Blocksize 6: 32768 Blocksize 7: 1048576 Blocksize 8: 2097152 Blocksize 9: 4194304	1. Data rate: 24.414 MBPS 2. Data rate: 97.656 MBPS 3. Data rate: 390.625 MBPS 4. Data rate: 390.625 MBPS 5. Data rate: 520.833 MBPS 6. Data rate: 1562.500 MBPS 7. Data rate: 2564.103 MBPS 8. Data rate: 2898.551 MBPS 9. Data rate: 2836.879 MBPS

Discuss differences in speed and make a conclusion about reading rates (sequential and random reads) for different memories.

Random ram access seems to be significantly faster in SSD than an Optical Hard Drive. While sequential access is also faster in SSD than an Optical Hard Drive. Reading sequentially generally has a better performance than reading randomly. This could be due to the random functions having to read the entire file first, then processing it, rather than reading and processing on the fly.



3.3. Experiment 3: Sequential vs. Random Write Rate

Write Blocks Random Data

Optical Hard Drive Data

Blocksize 1: 512 Blocksize 2: 1024 Blocksize 3: 4096 Blocksize 4: 8192 Blocksize 5: 16384 Blocksize 6: 32768 Blocksize 7: 1048576 Blocksize 8: 2097152 Blocksize 9: 4194304	1. Data rate: 0.042 MBPS 2. Data rate: inf MBPS 3. Data rate: inf MBPS 4. Data rate: inf MBPS 5. Data rate: inf MBPS 6. Data rate: inf MBPS 7. Data rate: 0.007 MBPS 8. Data rate: 0.005 MBPS 9. Data rate: 0.006 MBPS

SSD Data

Blocksize 1: 512 Blocksize 2: 1024 Blocksize 3: 4096 Blocksize 4: 8192 Blocksize 5: 16384 Blocksize 6: 32768 Blocksize 7: 1048576 Blocksize 8: 2097152 Blocksize 9: 4194304	1. Data rate: 0.191 MBPS 2. Data rate: inf MBPS 3. Data rate: 0.763 MBPS 4. Data rate: inf MBPS 5. Data rate: 0.254 MBPS 6. Data rate: 0.254 MBPS 7. Data rate: 0.005 MBPS 8. Data rate: 0.019 MBPS 9. Data rate: 0.006 MBPS

Write Ram Random Data

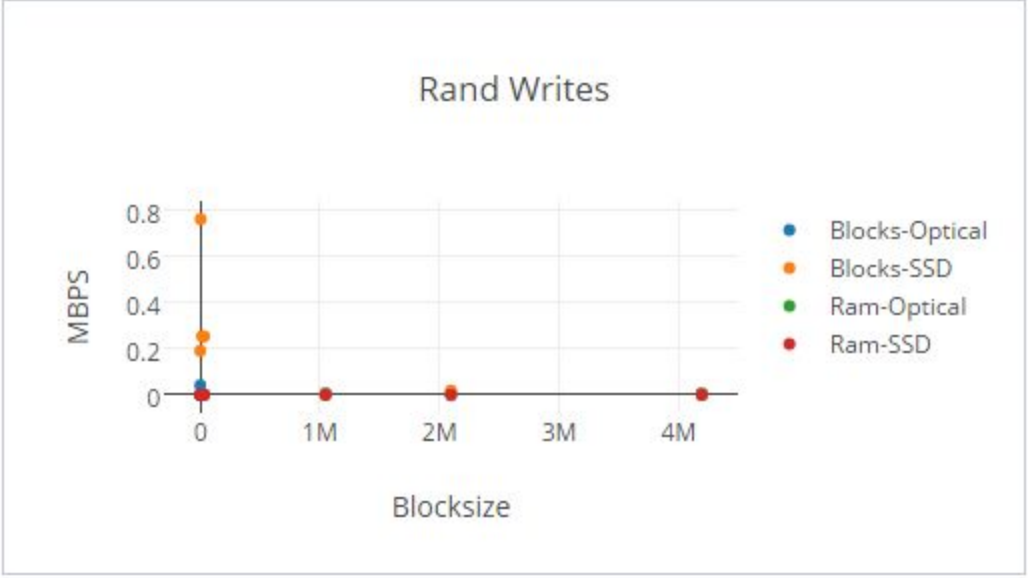
Optical Hard Drive Data

Blocksize 1: 512 Blocksize 2: 1024 Blocksize 3: 4096 Blocksize 4: 8192 Blocksize 5: 16384 Blocksize 6: 32768 Blocksize 7: 1048576 Blocksize 8: 2097152 Blocksize 9: 4194304	1. Data rate: inf MBPS 2. Data rate: inf MBPS 3. Data rate: inf MBPS 4. Data rate: inf MBPS 5. Data rate: inf MBPS 6. Data rate: inf MBPS 7. Data rate: inf MBPS 8. Data rate: inf MBPS 9. Data rate: inf MBPS

SSD Data

Blocksize 1: 512 Blocksize 2: 1024 Blocksize 3: 4096	1. Data rate: inf MBPS 2. Data rate: inf MBPS 3. Data rate: inf MBPS 4. Data rate: inf MBPS

Blocksize 4: 8192 Blocksize 5: 16384 Blocksize 6: 32768 Blocksize 7: 1048576 Blocksize 8: 2097152 Blocksize 9: 4194304	5. Data rate: inf MBPS 6. Data rate: inf MBPS 7. Data rate: inf MBPS 8. Data rate: inf MBPS 9. Data rate: inf MBPS



Finally, write summary for your report, discuss what have you learned about access patterns for different memory types. Did these experiment persuade you that we need to design different algorithms for primary and for secondary storage?

Sequential access patterns prove to be faster in the memory types tested, while random access tends to be significantly slower depending on the memory type. Yes, different algorithms should be designed for primary and secondary storage primarily because each is faster in one aspect but slower in another. For example, reading from RAM is significantly faster than reading from secondary storage, but storage on RAM is significantly smaller than secondary storage.