



Facultatea de
Automatică și
Calculatoare



HDD BENCHMARK

Project realised by *Ovi & the Mystery Team*

Students:

**Ovidiu-Raul Călin
Răzvan Cîrciu
Alin-Devis Costuț
Raul-Andrei Dabu
Lăcrămioara-Larisa Dan
Denis-Daniel Drăghici**

Timișoara
May, 2023

Chapter 1

Introduction

1.1 What?

- Our team has chosen to implement an application which measures the performance of a HDD/SSD. This is done by checking the read/write speed of the drive.

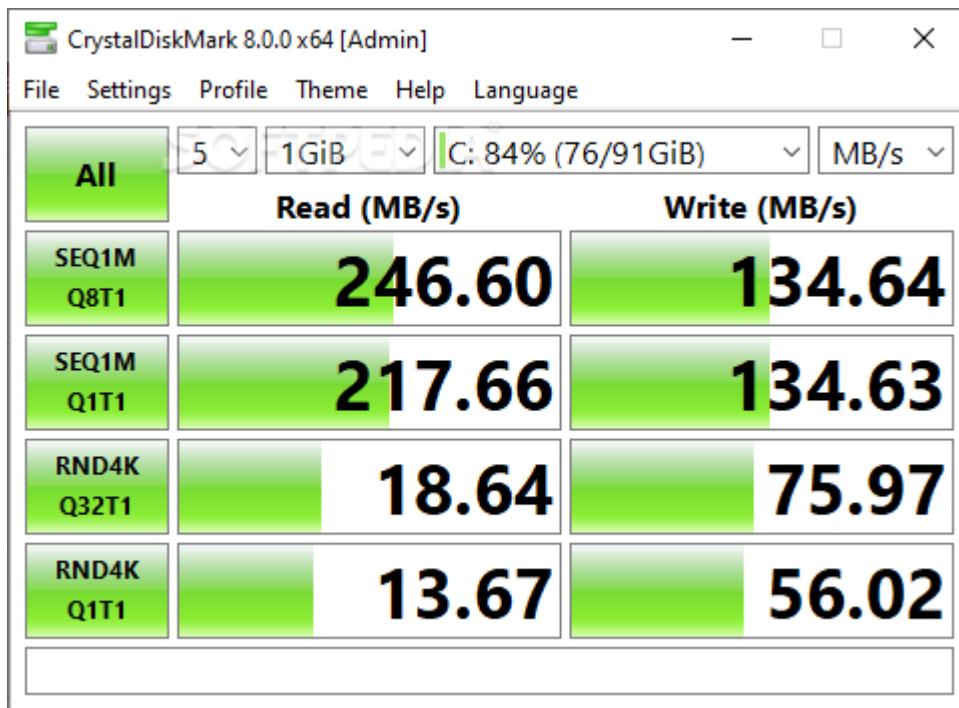
1.2 Why?

- We chose to benchmark drives since the methods to measure their performance were easier to implement.
- Also, we took inspiration from other benchmarking software and brought more features into the application, such as checking the size of the drive in addition to measuring its read/write speeds.

Chapter 2

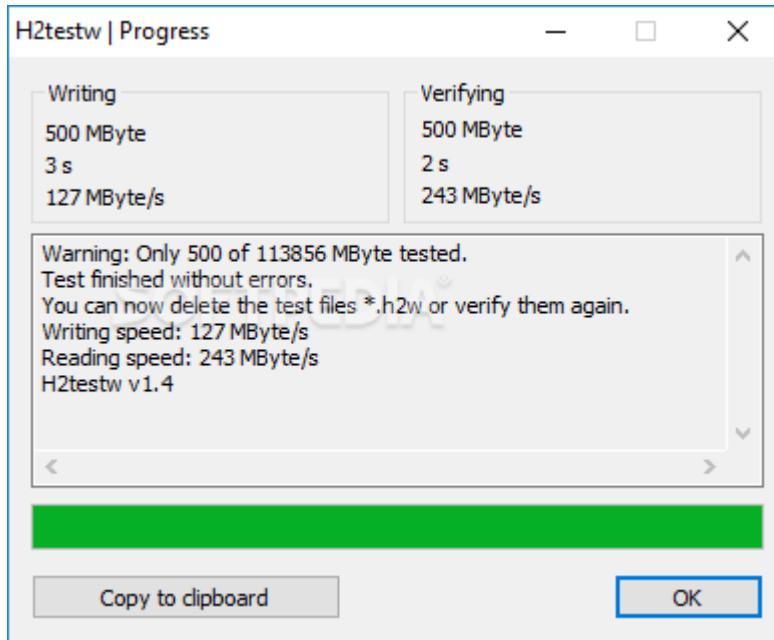
State of the art

One of our inspirations was CrystalDiskMark, which we took the basic functionalities from.



CrystalDiskMark tests performance of local and external hard drives and solid state drives, including NVMe SSDs. It tests: Sequential read/write speeds, Random read/write speeds. There are three different modes to run benchmarks: Peak, Real World, and Demo.

Another program we took inspiration from is H2testw, which returns the actual size of a drive.



The main advantage of our application compared to others is the concentration of multiple features into one which both previously mentioned programs lack, such as a true size check in the case of CrystalDiskMark and speed measurements in the case of h2testw.

Aside from that, what our application lacks in comparison with the others is the rigorosity of the testing performed(such as h2testws verification options or CrystalDiskMarks ability to specify the amount of tests performed), since both apps perform a more thorough check of the capabilities of the drive.

Chapter 3

Design and implementation

Our software contains 5 benchmarks which measures various abilities of the drive. The measurements offered are the read/write speeds and actual size of the drive.

3.0.1 Write Benchmarks

The two write benchmarks measure the speed at which the drive can fill a file with information.

SequentialWrite

The Sequential Write benchmark will use a buffer to fill a file with info in sequence, until the user-inputted amount is reached.

```
long bytesToWrite = fileSize;
while (bytesToWrite > 0) {
    int bytesToWriteNow = (int) Math.min(bytesToWrite, buffer.length);
    fos.write(buffer, 0, bytesToWriteNow);
    bytesToWrite -= bytesToWriteNow;
}
```

RandomWrite

The Random Write benchmark will use a buffer to fill a file info in random spots, until the user-inputted amount is reached.

```
long bytesToWrite = fileSize;
while (bytesToWrite > 0) {
    long pos = (long) (Math.random() * fileSize);
    raf.seek(pos);
    raf.write(buffer);
    bytesToWrite -= buffer.length;
}
```

3.0.2 Read Benchmarks

The two read benchmarks measure the speed at which the drive can read information from a file.

SequentialRead

The Sequential Read benchmark first fills a file with data which it then uses to measure the sequential read speed.

```
long bytesToRead = fileSize;
while (bytesToRead > 0) {
    int bytesRead = raf.read(buffer, 0, buffer.length);
    if (bytesRead < 0) {
        break;
    }
    bytesToRead -= bytesRead;
}
```

RandomRead

The Random Read benchmark fills a file with data which it then uses to measure the random read speed.

```
long bytesToRead = fileSize;
while (bytesToRead > 0) {
    long pos = (long) (Math.random() * fileSize);
    raf.seek(pos);
    int bytesRead = raf.read(buffer, 0, buffer.length);
    if (bytesRead < 0) {
        break;
    }
    bytesToRead -= bytesRead;
}
```

3.0.3 Size Benchmark

The size benchmark gets the size of the drive and checks for any duplicated blocks before returning the real size.

```
    ...
    if (hardDrive.exists() && hardDrive.isDirectory()) {
        try {
            long realSize = FileUtils.sizeOfDirectory(hardDrive);
            long realSizeInGB = convertBytesToGB(realSize);
        } catch (IOException e) {
            e.printStackTrace();
        }
    } else {
        System.out.println("Drive not found.");
    }
}
```

Aside from that, our software also offers background music which the user can control the volume of, along with a history function upon completion of a measurement.

To see the full implementation of the program, please check [1].

Chapter 4

Usage

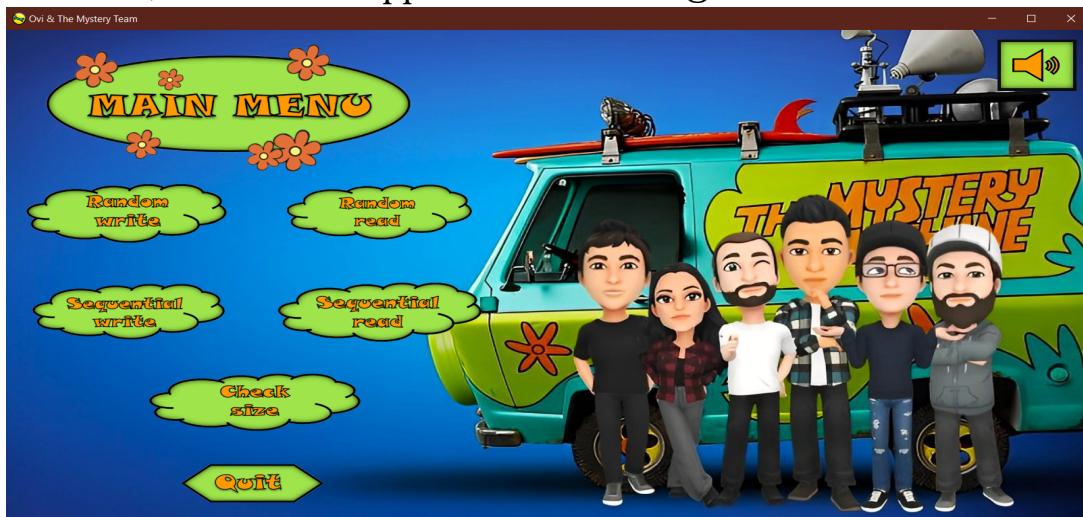
4.0.1 Main Menu

Upon running the program, the user will experience the main menu page, from which the user is able to select one of the following benchmarks:

- Random Write
- Random Read
- Sequential Write
- Sequential Read

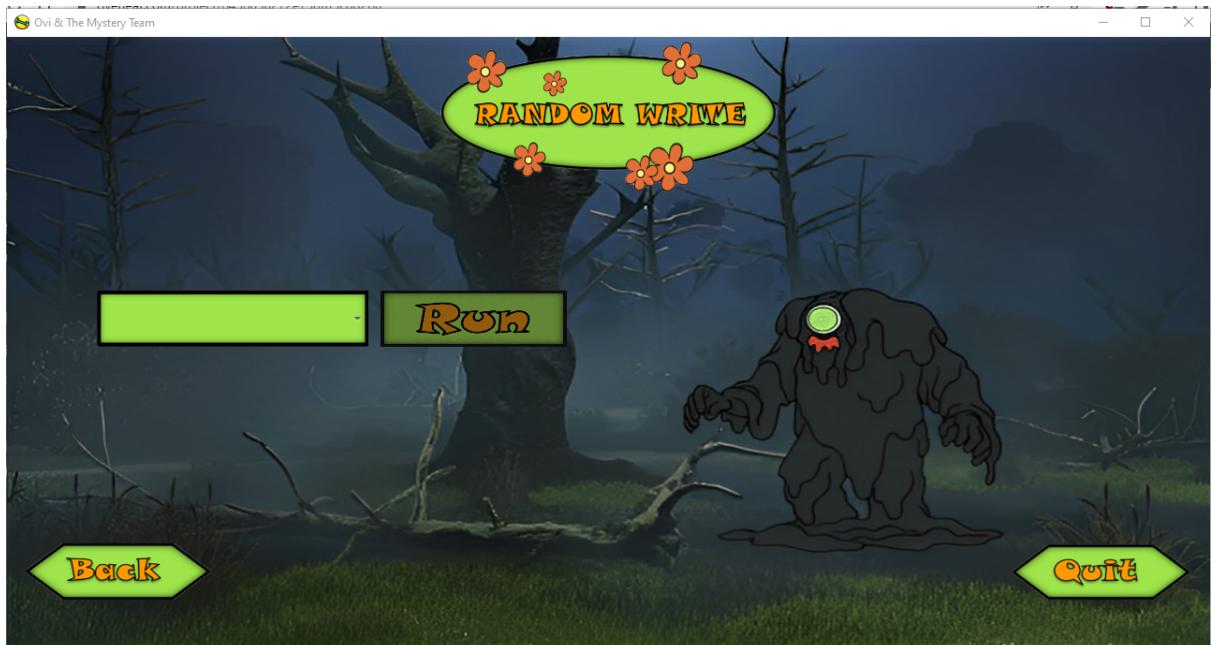
Also, using the Check Size function, the size of a selected drive will be displayed.

The user may change the volume of the background song using the top right button, and exit the application with the QUIT button.



Function Screen

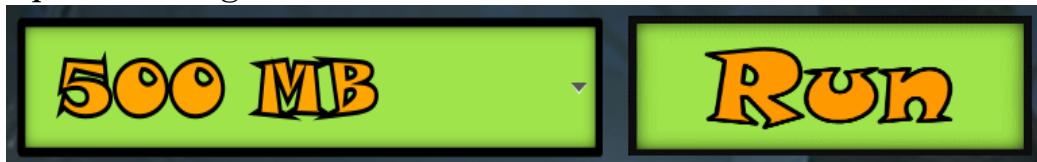
By choosing a function, the function screen is displayed.



Once the user reaches the function screen, the run button is disabled until a value is chosen via dropdown. The dropdown allows for 100, 500 MB and 1 GB tests for all functions, aside from the CheckSize function, which shows the current existing partitions on the system.



Upon choosing a value, the run button is enabled.



A BACK button, which returns the user to the main screen, and a QUIT button are also available.

Loading Screen



After clicking on RUN, while the benchmark is executed, a loading screen will be displayed. To indicate progress, an animated loading bar has been included.

Result Screen



Upon completion, the result screen will be displayed. The score and time it took for the benchmark to run will be displayed, with the score consisting of the result of the benchmark.

In addition, a HOME button, which will return the user to MAIN SCREEN is located on the left, while a QUIT button is located on the right.

An additional HISTORY function has been added in the center, which, upon being clicked, will display a table with all previous results of the benchmark.

Nr.	Option	Score	Run Time	HDD/SSD	Test Time
2	100 MB	497.09 MB/s	2.06 s	SSD	May 21 01:14:03 2023
1	500 MB	254.73 MB/s	4.02 s	SSD	May 21 14:08:37 2023

Within, you'll see each option with a score, run time, which type of drive the partition belongs to, and the time of the test. The user is able to sort the values by clicking on their corresponding label, with the highest score being displayed first as default.



A CLEAR button is offered if the user wishes to remove previous scores.

Chapter 5

Results

For the following measurements, the program's 500MB option was chosen and they were all conducted on Windows 10.

Running measurement benchmarks for drives can yield wildly different results. These variations can be attributed to a range of factors, including the system configuration, the testing methodology, and even the firmware version of the SSD being tested. Additionally, different SSD models and manufacturers may have varying performance characteristics, leading to disparities in benchmark results.

As such, we recommend looking into various benchmark results for any drive that you'd purchase.

Sequential Write

CPU	SSD/HDD	Speed (Mb/s)	Time(s)
Intel Core i7-1065G7	KIOXIA Intel 82801 SSD	293.41	0.35
AMD Ryzen 5 5600H	INTEL SSDPEKNU512GZ SSD	263.24	0.39
Intel Core i5-8300H	WDC SDAPNTW-512G-1101 SSD	165.70	0.70
AMD Ryzen 5 4600H	KINGSTON SNV2S 1000G SSD	441.38	0.23
Intel Core i7-1185G7	NVMe PC SN530 NVMe WDC 512 GB SSD	278.87	0.42
Intel Core i7-1065G7	SAMSUNG MZVLB512HBJQ-000L2 SSD	191.40	0.44
Intel Core i5-3230M	ADATA SU650 SSD	129.13	0.79
Intel Core i5-11400	Toshiba DT01ACA 1TB HDD	553.51	0.93
Intel Core i5-8265U	SAMSUNG MZALQ256HAJD-000L1 SSD	196.24	2.61
Intel Core i7-10510U	SAMSUNG MZVLQ512HALU-00007 SSD	105.92	4.83

Sequential Read

CPU	SSD/HDD	Speed(Mb/s)	Time(s)
Intel Core i7-1065G7	KIOXIA Intel 82801 SSD	2844.44	0.17
AMD Ryzen 5 5600H	INTEL SSDPEKNU512GZ SSD	746.90	3.94
Intel Core i5-8300H	WDC SDAPNTW-512G-1101 SSD	775.76	0.65
AMD Ryzen 5 4600H	KINGSTON SNV2S 1000G SSD	1089.36	0.26
Intel Core i7-1185G7	NVMe PC SN530 NVMe WDC 512 GB SSD	925.86	0.22
Intel Core i7-1065G7	SAMSUNG MZVLB512HBJQ-000L2 SSD	691.89	0.32
Intel Core i5-3230M	ADATA SU650 SSD	564.50	24.90
Intel Core i5-11400	Toshiba DT01ACA 1TB HDD	1309.46	2.37
Intel Core i5-8265U	SAMSUNG MZALQ256HAJD-000L1 SSD	368.08	10.30
Intel Core i7-10510U	SAMSUNG MZVLQ512HALU-00007 SSD	340.88	6.01

Random Write

CPU	SSD/HDD	Speed(Mb/s)	Time(s)
Intel Core i7-1065G7	KIOXIA Intel 82801 SSD	636.82	0.80
AMD Ryzen 5 5600H	INTEL SSDPEKNU512GZ SSD	88.73	12.23
Intel Core i5-8300H	WDC SDAPNTW-512G-1101 SSD	126.89	0.80
AMD Ryzen 5 4600H	KINGSTON SNV2S 1000G SSD	197.84	2.58
Intel Core i7-1185G7	NVMe PC SN530 NVMe WDC 512 GB SSD	99.01	5.17
Intel Core i7-1065G7	SAMSUNG MZVLB512HBJQ-000L2	397.82	1.28
Intel Core i5-3230M	ADATA SU650 SSD	15.23	67.22
Intel Core i5-11400	Toshiba DT01ACA 1TB HDD	540.37	1.90
Intel Core i5-8265U	SAMSUNG MZALQ256HAJD-000L1 SSD	37.04	27.65
Intel Core i7-10510U	SAMSUNG MZVLQ512HALU-00007 SSD	184.17	2.78

Random Read

CPU	SSD/HDD	Speed(Mb/s)	Time(s)
Intel Core i7-1065G7	KIOXIA Intel 82801 SSD SSD	628.99	0.70
AMD Ryzen 5 5600H	INTEL SSDPEKNU512GZ SSD	252.22	0.92
Intel Core i5-8300H	WDC SDAPNTW-512G-1101 SSD	254.03	4.03
AMD Ryzen 5 4600H	KINGSTON SNV2S 1000G SSD	269.47	1.9
Intel Core i7-1185G7	NVMe PC SN530 NVMe WDC 512 GB SSD	278.87	1.83
Intel Core i7-1065G7	SAMSUNG MZVLB512HBJQ-000L2	233.47	2.19
Intel Core i5-3230M	ADATA SU650 SSD	58.02	28.53
Intel Core i5-11400	Toshiba DT01ACA 1TB HDD	404.90	2.53
Intel Core i5-8265U	SAMSUNG MZALQ256HAJD-000L1 SSD	54.58	18.76
Intel Core i7-10510U	SAMSUNG MZVLQ512HALU-00007 SSD	153.16	3.34

Chapter 6

Conclusions

Please also focus on this chapter! I know that sometimes while writing a document, conclusions are the last thing to write, but remember that they are also the last thing to read and might change the reader's overall perspective of the document. I would want you to answer to the following questions and, why not, even some added by yourself.

- What did we learn?**

(e.g.) During this semester, we learned X and Y.

- What mark would I give to me? How much did I contribute to the teamwork (project, application, presentation)? What mark do I think my colleagues deserve?**

(e.g.) If it were up to me, I would give myself ..., because even if the project is pretty good, I did (not) help as much as my colleagues. (e.g.) I consider 20% of the final project is because of me. Also, I want to add that we did (not) indeed work as a team and I think all of us should get the same mark. (or not)

Remember each one of you will have to upload the documentation on Campus, but the answers to these questions have to be unique. (this one in particular).

- What was hard, what did we enjoy, what did we hate, what did we like and dislike about the CO project?**

- How would you change (improve) the project meetings for the next generation of students?**

I will definitely take into consideration your feedback and I will consider applying your suggestions as I did with most of the ideas gained last year.

Bibliography

- [1] *Git repository.* https://github.com/OvidiuCalin123/C0_Project, 2021.
[Online; Accesat: 13.05.2023].