



**UNIVERSITI TEKNOLOGI
MALAYSIA**

COMPUTER ORGANIZATION AND ARCHITECTURE (SECR1033)

GROUP PROJECT

Computer Performance Benchmarking

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Section : 2

Video Link : [Demo on CPU benchmarking using Freeware tools](#)
: [Demo on CPU benchmarking using ASM code](#)
: [Presentation Video](#)

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1.0 Introduction

The Central Processing Unit (CPU) serves as the core engine of any computer system which responsible for executing instructions, managing operations, and handling all logical calculations required by software and applications. In an era where users rely heavily on fast and responsive digital devices, evaluating CPU performance has come to be crucial in determining how well a computer system to handle multiple workloads effectively.

CPU benchmarking is a practical technique used to measure and compare the effectiveness of different processors. It involves performing regular tasks or stress testing to observe how a CPU respond to different load conditions. These results can help users make better decisions regarding software compatibility, hardware upgrades, and overall system planning.

This project focuses on conducting CPU and hardware performance benchmarking using several free tools. The main objectives are to observe how different CPUs perform under low, medium, and high processing demands, and to gain experience for using benchmarking software. In addition, this project entails developing an assembly language program to evaluate CPU performance through iterative mathematical computations using a polynomial equation.

Four Windows-based laptops with different CPU models are selected for testing:

1. Intel Core i5-1235U
2. Intel Core i5-1035G1
3. Intel Core i5-1135G7
4. Intel Core i7-12650H

To carry out the benchmarking, we used the following freeware:

- **CPU-Z**: To extract and record system hardware specifications.
- **Geekbench**: To conduct single-core and multi-core CPU stress tests.
- **Windows Task Manager**: To monitor CPU performance under different levels of system load.
- **MiniTool Partition Wizard Free 12.8**: To evaluate disk read/write performance.

Apart from using tools, we have also developed an assembly language program that evaluates a polynomial equation:

$$y = (a * x^3) + (b * x^2) + c * x + d$$

where a, b, c, d are coefficients delay and x is an integer input values. The program captures execution time to simulate different workload levels using multiple loop iterations. This dual-method approach combining software tools with low-level programming and helps students develop a well-rounded understanding of CPU performance, benchmarking methodology, and system performance analysis.

2.0 Flowchart of the Project

2.1 CPU-Z Benchmarking

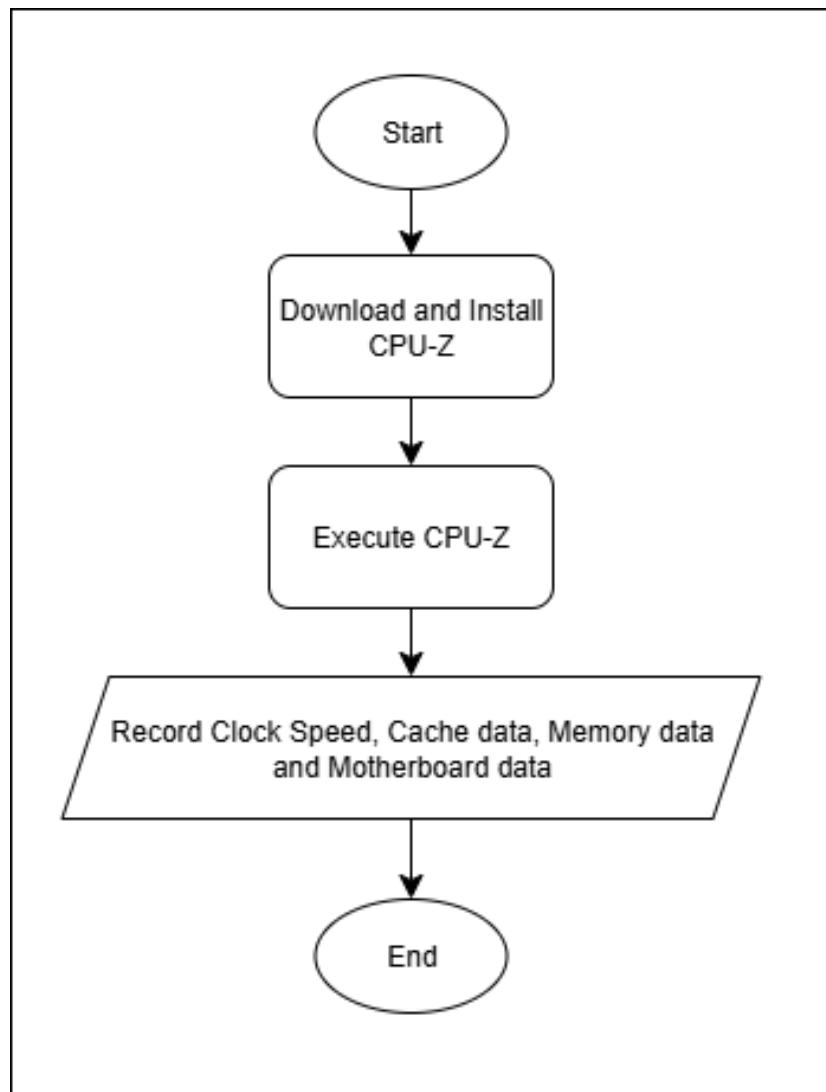


Figure 2.1.1: Flowchart of CPU-Z Benchmarking

2.2 Geekbench Benchmarking

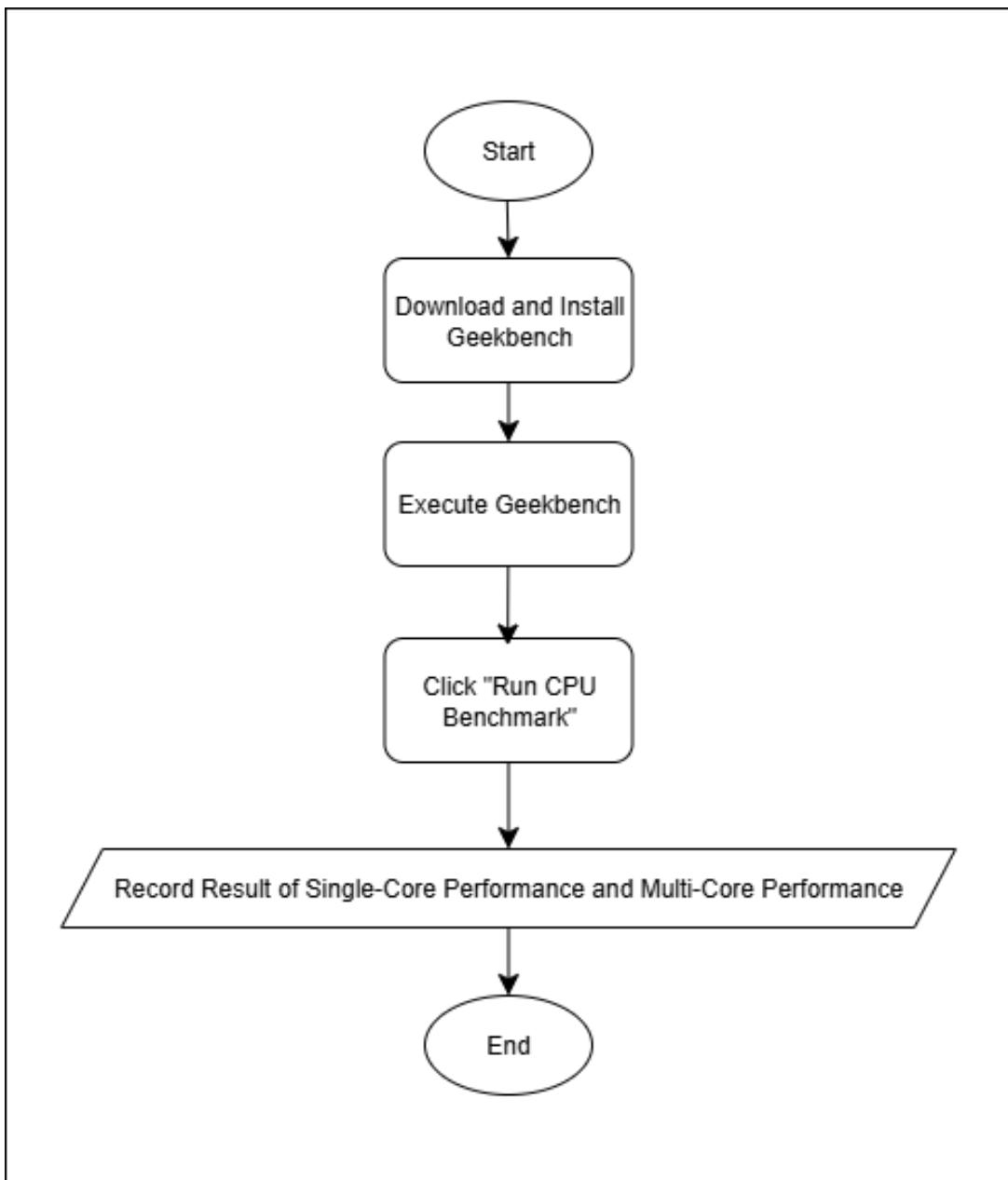


Figure 2.2.1: Flowchart of Geekbench Benchmarking

2.3 Task Manager Benchmarking

2.3.1 Low Load Task Manager Benchmarking

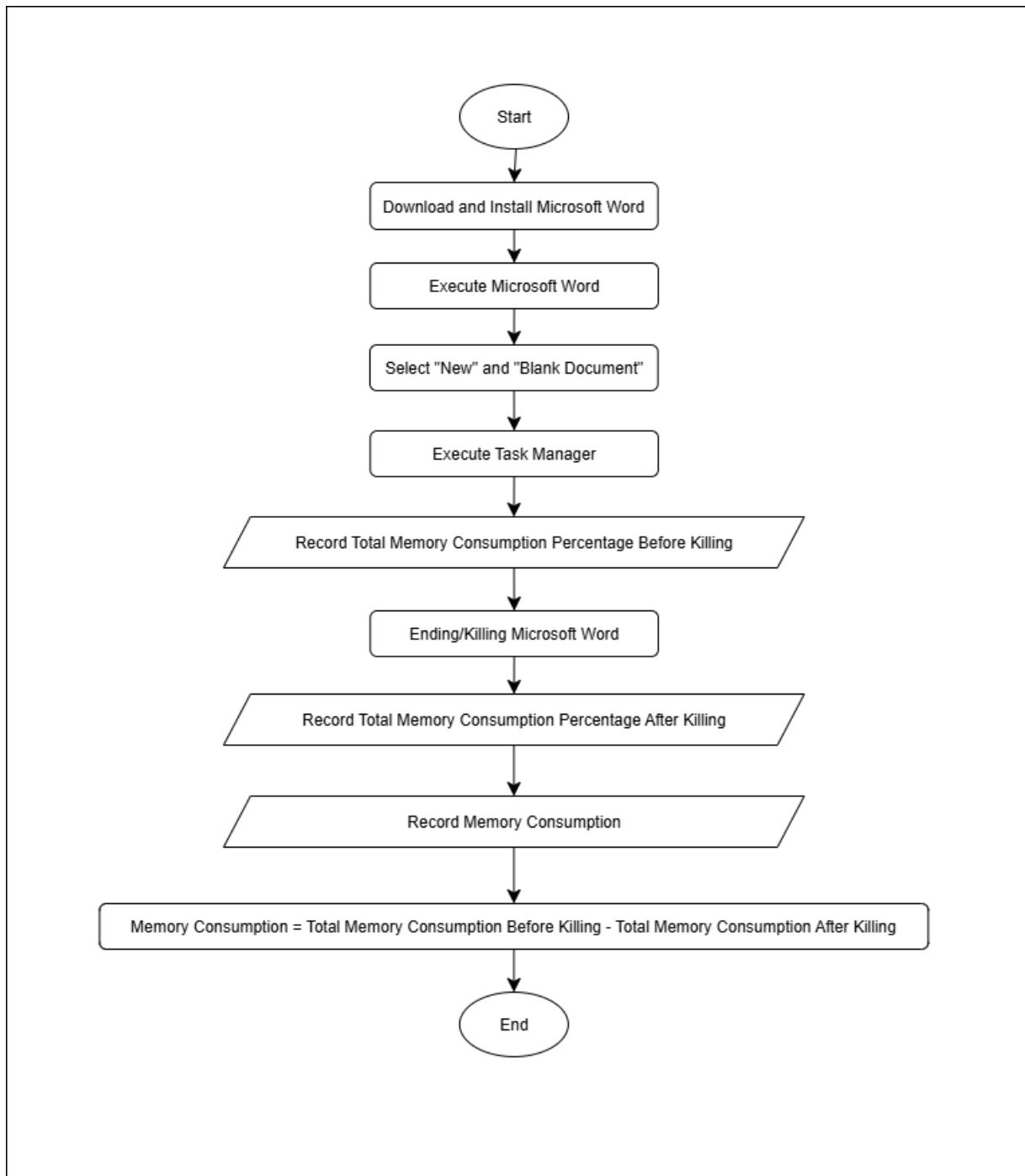


Figure 2.3.1.1: Flowchart of Low Load Task Manager Benchmarking

2.3.2 Middle Load Task Manager Benchmarking

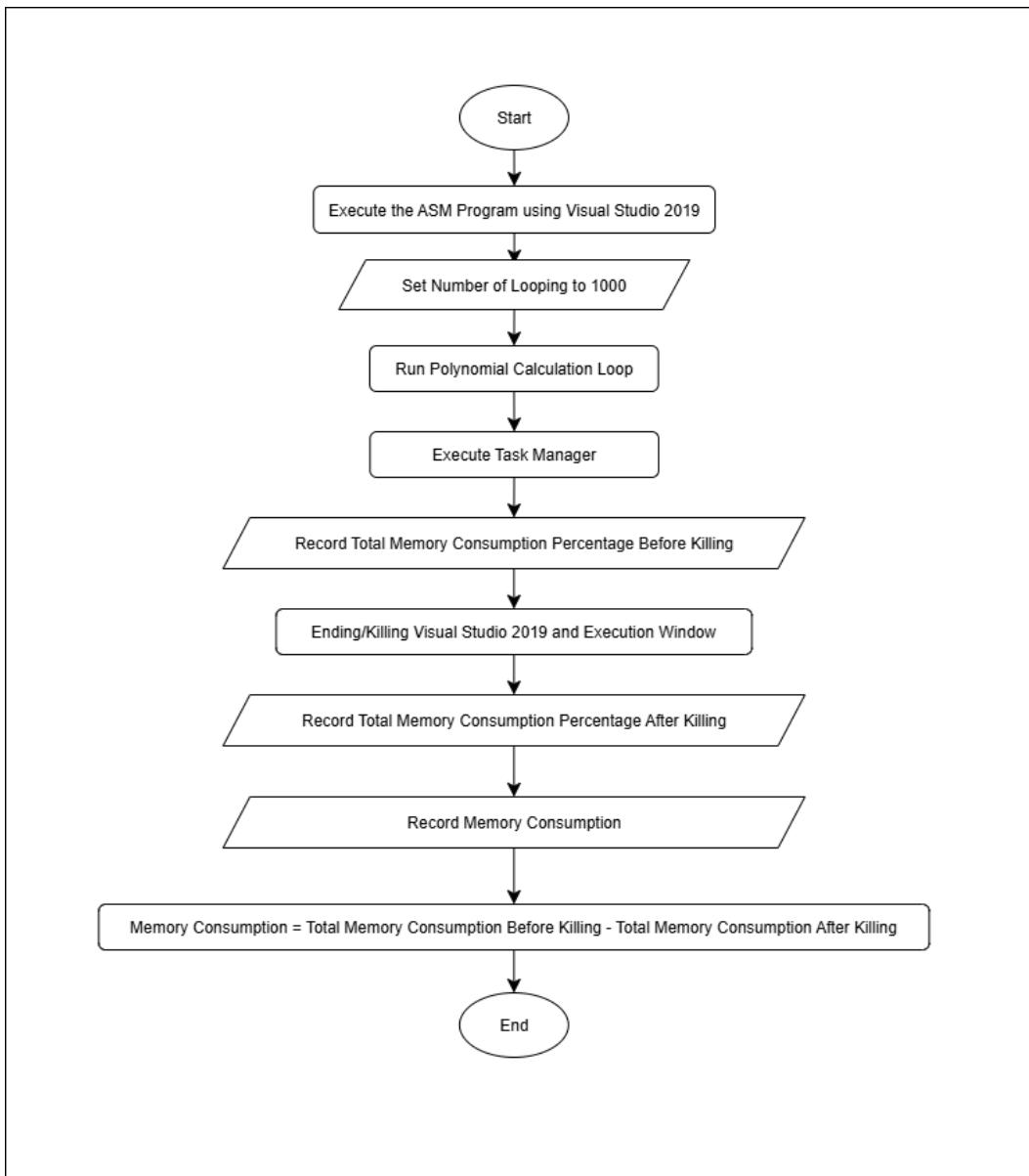


Figure 2.3.2.1: Flowchart of Middle Load Task Manager Benchmarking

2.3.3 High Load Task Manager Benchmarking

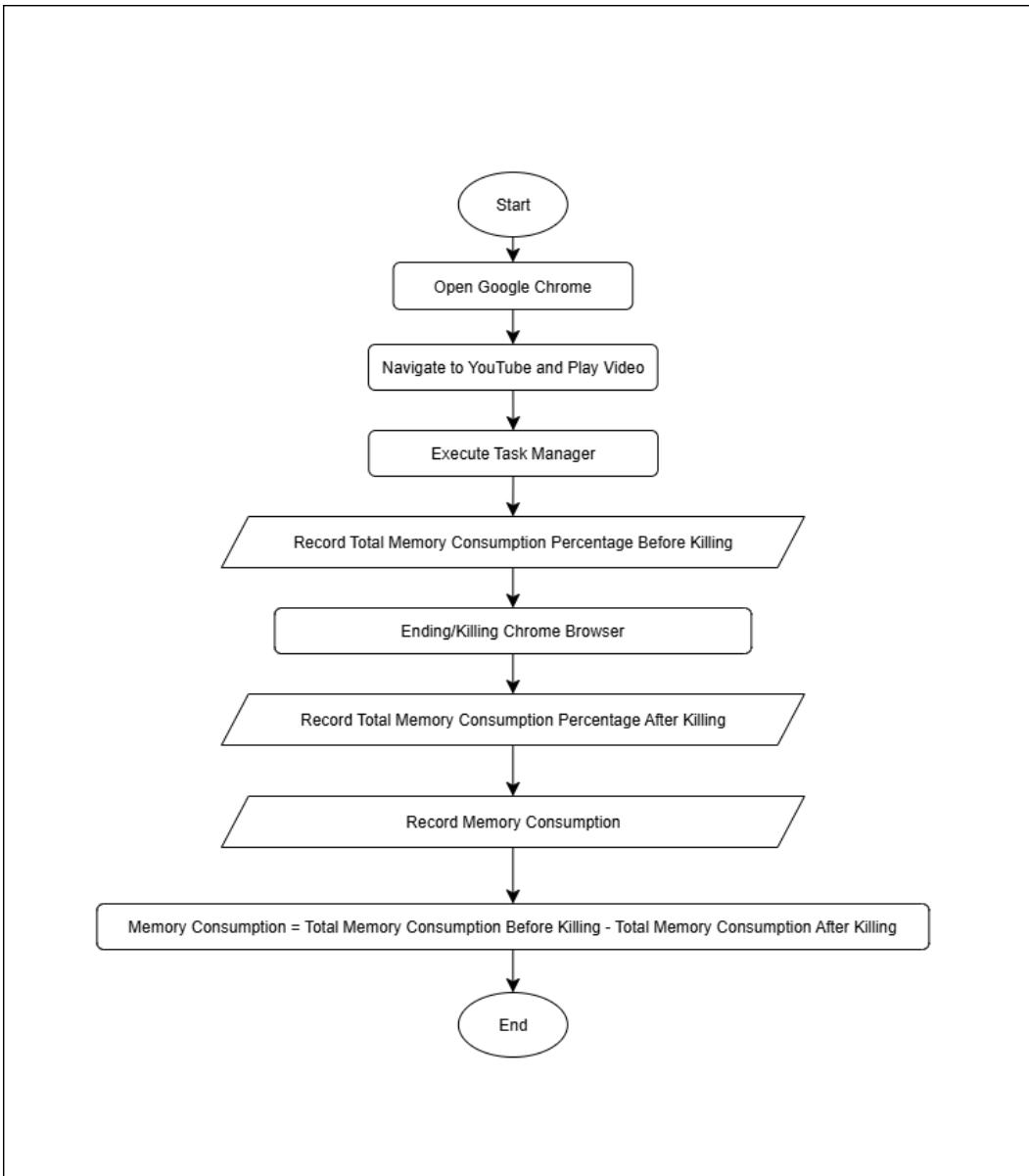


Figure 2.3.3.1: Flowchart of High Load Task Manager Benchmarking

2.4 MiniTool Partition Wizard Free 12.8 Benchmarking

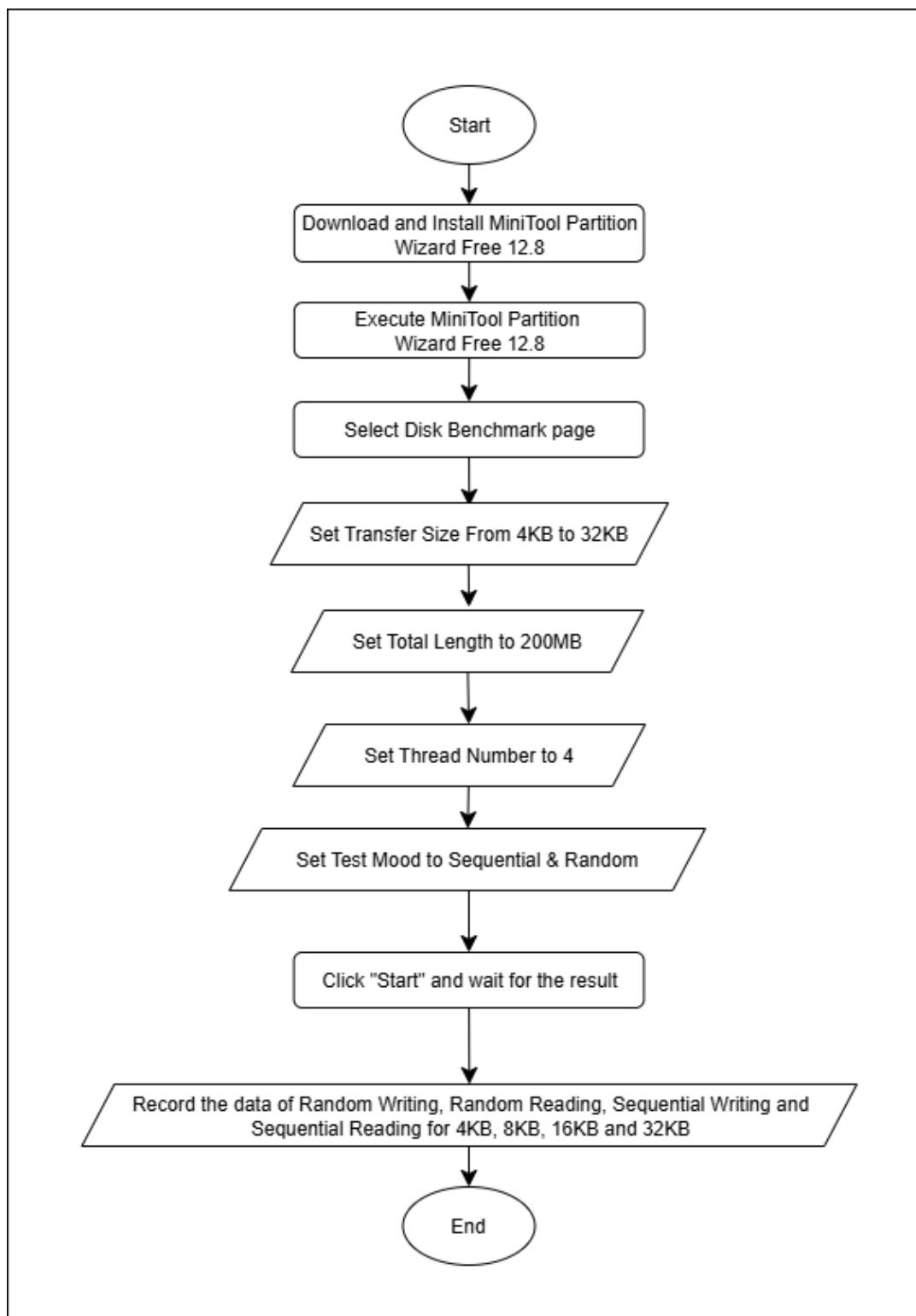


Figure 2.4.1: Flowchart of MiniTool Partition Wizard Free 12.8 Benchmarking

2.5 ASM Program Benchmarking

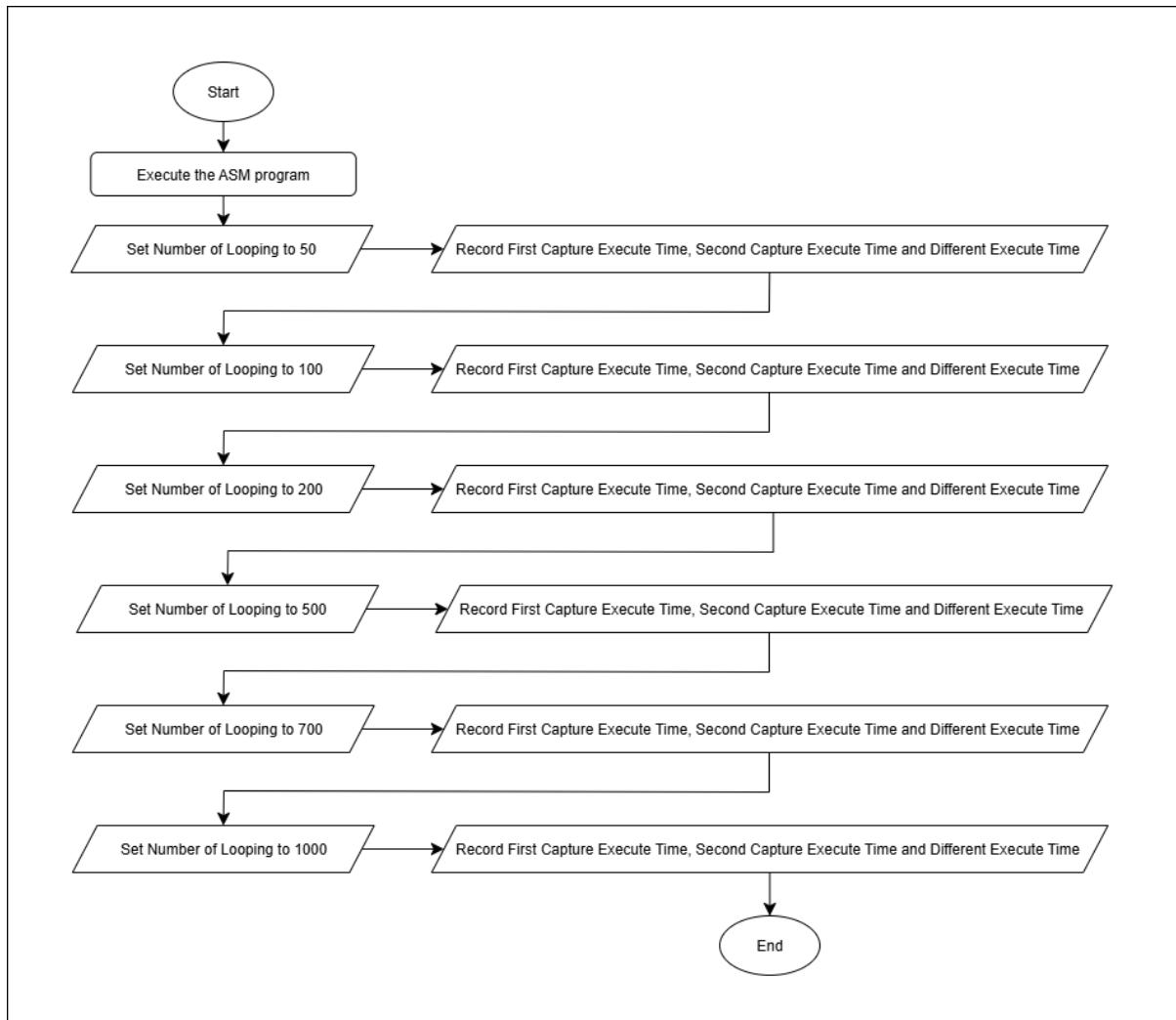


Figure 2.5.1: Flowchart of ASM Program Benchmarking

3.0 Benchmarking Results

3.1 CPU Benchmarking Using Free Tools (CPUZ)

Table 3.1.1: CPU Benchmarking Result using CPUZ

Test	Computer A	Computer B	Computer C	Computer D
Processor Name	Intel Core i5 1235U	Intel Core i5 1035G1	Intel Core i5 1135G7	Intel Core i7 12650H
Code Name	Alder Lake	Ice Lake	Tiger Lake-U	Alder Lake
Technology	10 nm	10 nm	10 nm	10 nm
Cores	2P + 8E	4	4	6P + 4E
Threads	12	8	8	16
Core Speed (Clock Frequency)	3990.24 MHz	2793.84 MHz	1497.32 MHz	1197.07 MHz
Memory Size	8 GBytes	8 GBytes	8 GBytes	16 GBytes
Memory Type	DDR4	DDR4	DDR4	-
Memory (Channel)	1 x 64-bit	Single	1 x 64 bit	-
Memory (Speed)	1596.1 MHz	1064.3 MHz	1597.3 MHz	-
Memory (Module Size)	Slot #1: 8 GBytes Slot #2: -	Slot #1: 8 GBytes Slot #2: -	Slot #1: 8 GBytes Slot #2: -	Slot #1: 8 GBytes Slot #2: 8GBbytes
L1 Data Cache	2 x 48 KB + 8 x 32 KB	4 x 48 KBytes	4 x 48 KBytes	6 x 48 KB + 4 x 32 KB
L1 Instruction Cache	2 x 32 KB + 8 x 64 KB	4 x 32 Kbytes	4 x 32 KBytes	6 x 32 KB + 4 x 64 KB
L2 Cache	2 x 1.25MB + 2 x 2 MB	4 x 512 KBytes	4 x 1.25 MBytes	6 x 1.25 MB + 2 MBytes
L3 Cache	12 MBytes	6 MBytes	8 MBytes	24 MBytes
Motherboard	Ganymede_ADU V1.08	X515JAB 1.0	OPCVD6	LNVNB161216
Motherboard (Bus)	PCI-Express 3.0 (8.0 GT/s)	PCI-Express 3.0 (8.0 GT/s)	PCI-Express 4.0 (16.0 GT/s)	PCI-Express 4.0 (16.0 GT/s)

3.2 CPU Benchmarking Using Free Tools (Geekbench)

Table 3.2.1: CPU Benchmarking Result using Geekbench

Test	Computer A	Computer B	Computer C	Computer D
CPU Information				
Processor Name	Intel Core i5-1235U	Intel Core i5-1035G1	Intel Core i5-1135G7	Intel Core i7-12650H
Code Name	Alder Lake	Ice Lake	Tiger Lake-U	Alder Lake
Cores	10	4	4	10
Threads	12	8	8	16
Base Frequency	2.49 GHz	1.20 GHz	2.40 GHz	2.69 GHz
Cluster 1	2 Cores	4 Cores	4 Cores	6 Cores
Cluster 2	8 Cores	-	-	4 Cores
Maximum Frequency	4389 MHz	3591 MHz	4192 MHz	4588 MHz
Package	Socket 1744 FCBGA	Socket 1526 FCBGA	Socket 1449 FCBGA	Socket 1744 FCBGA
L1 Instruction Cache	32.0 KB x 6	32.0 KB x 4	32.0 KB x 4	32.0 KB x 8
L1 Data Cache	48.0 KB x 6	48.0 KB x 4	48.0 KB x 4	48.0 KB x 8
L2 Cache	1.25 MB x 1	512 KB x 4	1.25 MB x 4	1.25 MB x 2
L3 Cache	12.0 MB x 1	6.00 MB x 1	8.00 MB x 1	24.0 MB x 1
Memory Information				
Size	8.00 GB	7.75 GB	8.00 GB	16.00 GB
Transfer Rate	3192 MT/s	2128 MT/s	3194 MT/s	-
Type	DDR4 SDRAM	DDR4 SDRAM	DDR4 SDRAM	-
Channels	1	1	1	-

Single-Core Performance				
Score	1382	1120	1226	1371
File Compression	171.0 MB/s	137.3 MB/s	135.7 MB/s	182.7 MB/s
Navigation	8.88 routes/s	6.94 routes/s	5.25 routes/s	7.68 routes/s
HTML 5 Browser	24.7 pages/s	15.3 pages/s	15.0 pages/s	29.9 pages/s
PDF Renderer	32.3 Mpixels/s	29.1 Mpixels/s	21.4 Mpixels/s	31.5 Mpixels/s
Photo Library	19.1 images/s	16.9 images/s	13.5 images/s	17.8 images/s
Clang	7.12 Klines/s	6.89 Klines/s	8.99 Klines/s	6.29 Klines/s
Text Processing	119.4 pages/s	108.7 pages/s	121.9 pages/s	103.8 pages/s
Asset Compression	31.6 MB/s	43.8 MB/s	41.4 MB/s	39.2 MB/s
Object Detection	44.8 images/s	37.4 images/s	44.6 images/s	39.9 images/s
Background Blur	9.32 images/s	6.42 images/s	7.87 images/s	7.17 images/s
Horizon Detection	56.6 Mpixels/s	43.3 Mpixels/s	59.1 Mpixels/s	52.0 Mpixels/s
Object Remover	85.6 Mpixels/s	57.3 Mpixels/s	95.9 Mpixels/s	99.8 Mpixels/s
HDR	48.8 Mpixels/s	32.3 Mpixels/s	47.4 Mpixels/s	38.5 Mpixels/s
Photo Filter	13.0 images/s	9.17 images/s	14.2 images/s	17.0 images/s
Ray Tracer	1.72 Mpixels/s	713.7 Kpixels/s	769.5 Kpixels/s	1.20 Mpixels/s
Structure from Motion	38.3 Kpixels/s	30.3 Kpixels/s	43.9 Kpixels/s	46.5 Kpixels/s
Multi-Core Performance				
Score	3719	2194	3498	4235
File Compression	160.7 MB/s	84.3 MB/s	227.6 MB/s	650.5 MB/s
Navigation	25.7 routes/s	12.4 routes/s	28.5 routes/s	51.8 routes/s
HTML 5 Browser	85.5 pages/s	42.7 pages/s	66.3 pages/s	76.1 pages/s
PDF Renderer	78.7 Mpixels/s	63.6 Mpixels/s	95.0 Mpixels/s	127.2 Mpixels/s

Photo Library	52.6 images/s	40.7 images/s	56.7 images/s	76.7 images/s
Clang	29.9 Klines/s	17.0 Klines/s	27.8 Klines/s	31.2 Klines/s
Text Processing	111.7 pages/s	73.1 pages/s	160.9 pages/s	67.2 pages/s
Asset Compression	241.3 MB/s	142.1 MB/s	171.6 MB/s	205.0 MB/s
Object Detection	49.2 images/s	42.3 images/s	59.5 images/s	80.4 images/s
Background Blur	25.1 images/s	14.4 images/s	20.6 images/s	19.9 images/s
Horizon Detection	157.6 Mpixels/s	100.0 Mpixels/s	137.8 Mpixels/s	145.4 Mpixels/s
Object Remover	431.8 Mpixels/s	151.5 Mpixels/s	260.8 Mpixels/s	375.6 Mpixels/s
HDR	118.4 Mpixels/s	81.8 Mpixels/s	104.9 Mpixels/s	139.3 Mpixels/s
Photo Filter	28.1 images/s	21.7 images/s	20.7 images/s	26.2 images/s
Ray Tracer	9.63 Mpixels/s	3.32 Mpixels/s	5.20 Mpixels/s	4.02 Mpixels/s
Structure from Motion	151.7 Kpixels/s	73.5 Kpixels/s	121.5 Kpixels/s	140.6 Kpixels/s

3.3 CPU Benchmarking Using Free Tools (Task Manager)

Table 3.3.1: CPU Benchmarking Result using Task Manager

Test	Memory (%)	Computer A	Computer B	Computer C	Computer D
Low Load (Microsoft Word)	Before Closing	79	73	64	48
	After Closing	77	70	62	45
	Memory Usage	2	3	2	3
Middle Load (Visual Studio 2019)	Before Closing	84	83	71	52
	After Closing	76	77	64	46
	Memory Usage	8	6	7	6
High Load (Youtube)	Before Closing	86	82	74	58
	After Closing	68	63	63	44
	Memory Usage	18	19	11	14

3.4 CPU Benchmarking Using Free Tools (MiniTool Partition Wizard Free 12.8)

Table 3.4.1: CPU Benchmarking Result using MiniTool Partition Wizard Free 12.8

Mode	Test	Size	Computer A	Computer B	Computer C	Computer D
Sequential	Reading	4KB	739.68	459.261	675.925	905.553
		8KB	765.799	551.503	705.802	1604.54
		16KB	1115.86	643.239	762.291	1854.99
		32KB	1715.29	1085.46	1222.89	1994.46
	Writing	4KB	144.863	671.476	187.343	405.272
		8KB	216.83	512.596	292.036	686.074
		16KB	282.983	213.677	327.107	1138.44
		32KB	325.9	562.73	253.93	1598.08
Random	Reading	4KB	659.87	440.846	454.176	889.396
		8KB	437.646	419.168	376.957	1458.35
		16KB	834.827	817.561	694.617	1787.92
		32KB	1418.37	962.051	987.112	1929.44
	Writing	4KB	202.773	627.771	141.142	402.151
		8KB	197.777	1076.13	212.514	705.026
		16KB	206.546	1529.43	288.523	1140.84
		32KB	274.24	1568.88	285.01	1687.3

3.5 CPU Benchmarking Using ASM Code

Table 3.5.1: CPU Benchmarking Result using ASM Code

No of Loop (N)	Capture_msec (Before)	Capture_msec (After)	CPU_msec (Difference)
Computer A			
50	84645886	84650548	4662
100	68943285	68958247	14962
200	68996474	69015083	18609
500	69073150	69119697	46547
700	71491697	71556936	65239
1000	69187337	69280601	93264
Computer B			
50	70294033	70298706	4673
100	70498822	70508417	9595
200	70562399	70581381	18982
500	70649836	70697812	47976
700	71837700	71904772	67072
1000	71989141	72085081	95940
Computer C			
50	70114163	70118817	4654
100	70074936	70084228	9292
200	70130254	70148841	18587
500	70220253	70266990	46737
700	72225043	72292120	67077
1000	72305838	72401694	95856

Computer D			
50	79848622	79853275	4653
100	79951134	79960432	9298
200	79999483	80018092	18609
500	80068507	80114998	46491
700	80181658	80246847	65189
1000	80261714	80354890	93176

4.0 Analysis, Comparison, Discussion

4.1 CPU-Z

Table 4.1.1: CPU Benchmarking Result using CPUZ

Test	Computer A	Computer B	Computer C	Computer D
Processor Name	Intel Core i5 1235U	Intel Core i5 1035G1	Intel Core i5 1135G7	Intel Core i7 12650H
Code Name	Alder Lake	Ice Lake	Tiger Lake-U	Alder Lake
Technology	10 nm	10 nm	10 nm	10 nm
Cores	2P + 8E	4	4	6P + 4E
Threads	12	8	8	16
Core Speed (Clock Frequency)	3990.24 MHz	2793.84 MHz	1497.32 MHz	1197.07 MHz
Memory Size	8 GBytes	8 GBytes	8 GBytes	16 GBytes
Memory Type	DDR4	DDR4	DDR4	-
Memory (Channel)	1 x 64-bit	Single	1 x 64 bit	-
Memory (Speed)	1596.1 MHz	1064.3 MHz	1597.3 MHz	-
Memory (Module Size)	Slot #1: 8 GBytes Slot #2: -	Slot #1: 8 GBytes Slot #2: -	Slot #1: 8 GBytes Slot #2: -	Slot #1: 8 GBytes Slot #2: 8GBytes
L1 Data Cache	2 x 48 KB + 8 x 32 KB	4 x 48 KBytes	4 x 48 KBytes	6 x 48 KB + 4 x 32 KB
L1 Instruction Cache	2 x 32 KB + 8 x 64 KB	4 x 32 Kbytes	4 x 32 KBytes	6 x 32 KB + 4 x 64 KB
L2 Cache	2 x 1.25MB + 2 x 2 MB	4 x 512 KBytes	4 x 1.25 MBytes	6 x 1.25 MB + 2 MBytes
L3 Cache	12 MBytes	6 MBytes	8 MBytes	24 MBytes
Motherboard	Ganymede_ADU V1.08	X515JAB 1.0	OPCVD6	LNVNB161216
Motherboard (Bus)	PCI-Express 3.0 (8.0 GT/s)	PCI-Express 3.0 (8.0 GT/s)	PCI-Express 4.0 (16.0 GT/s)	PCI-Express 4.0 (16.0 GT/s)

4.1.1 Processor (CPU)

Table 4.1.1.1: Processor Result of CPUZ

Test	Computer A	Computer B	Computer C	Computer D
Processor Name	Intel Core i5 1235U	Intel Core i5 1035G1	Intel Core i5 1135G7	Intel Core i7 12650H
Code Name	Alder Lake	Ice Lake	Tiger Lake-U	Alder Lake
Technology	10 nm	10 nm	10 nm	10 nm
Cores	2P + 8E	4	4	6P + 4E
Threads	12	8	8	16
Core Speed (Clock Frequency)	3990.24 MHz	2793.84 MHz	1497.32 MHz	1197.07 MHz

Core Speed (Clock Frequency):

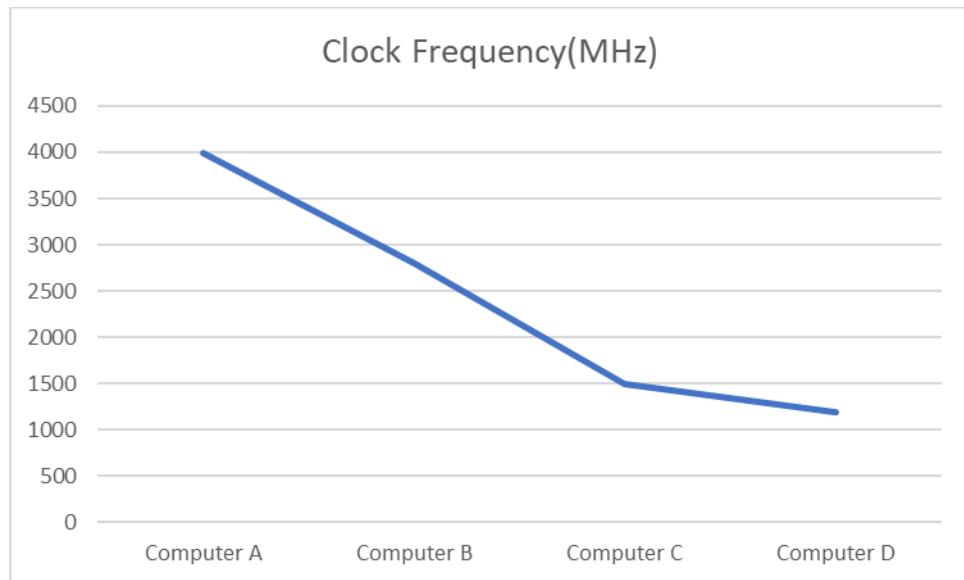


Figure 4.1.1.1: Comparison for Clock Frequency

According to Figure 4.1.1.1, Computer A has highest clock speed.

Discussion:

Computer D offers the best processor performance among the options, featuring 6 performance cores and 4 efficiency cores, making it highly effective for multitasking and managing demanding workloads smoothly. Its 16-thread capability enables the CPU to handle multiple tasks concurrently, which is especially beneficial for intensive activities such as programming, video editing, or running several applications at once. In comparison, Computer A stands out with the highest clock speed, which is advantageous for single-threaded tasks like web browsing or basic productivity use. Overall, Computer D provides more powerful and reliable performance, making it well-suited for a broader range of tasks.

4.1.2 Memory (RAM)

Table 4.1.2.1: Memory Result of CPUZ

Test	Computer A	Computer B	Computer C	Computer D
Memory Size	8 GBytes	8 GBytes	8 GBytes	16 GBytes
Memory Type	DDR4	DDR4	DDR4	-
Memory (Channel)	1 x 64-bit	Single	1 x 64 bit	-
Memory (Speed)	1596.1 MHz	1064.3 MHz	1597.3 MHz	-
Memory (Module Size)	Slot #1: 8 GBytes Slot #2: -	Slot #1: 8 GBytes Slot #2: -	Slot #1: 8 GBytes Slot #2: -	Slot #1: 8 GBytes Slot #2: 8GBytes

Analysis:

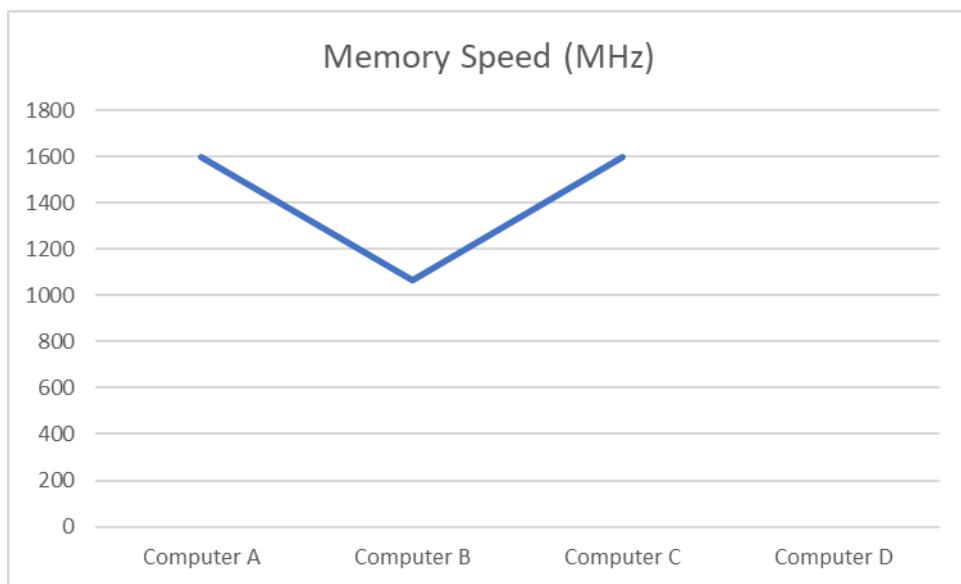


Figure 4.1.2.1: Comparison for memory speed

According to Figure 4.1.2.1, Computer A and Computer C has the almost same memory speed.

Discussion:

Computer D offers the best memory setup, with 16 GB RAM across two slots, likely enabling dual-channel performance for faster multitasking and data handling. In contrast, Computers A, B, and C have only 8 GB in a single-channel setup, which limits memory bandwidth and overall efficiency.

In terms of speed, Computers A and C perform well with around 1596 MHz, while Computer B has the slowest at 1064.3 MHz.

Overall, Computer D offers the best memory configuration for current performance, especially in multitasking and heavier workloads, due to its higher memory size. Computers A and C follow closely with decent memory speed but limited capacity, while Computer B falls behind due to its lower memory speed.

4.1.3 Cache Memory

Table 4.1.3.1: Cache Memory Result of CPUZ

Test	Computer A	Computer B	Computer C	Computer D
L1 Data Cache	2 x 48 KB + 8 x 32 KB	4 x 48 KBytes	4 x 48 KBytes	6 x 48 KB + 4 x 32 KB
L1 Instruction Cache	2 x 32 KB + 8 x 64 KB	4 x 32 Kbytes	4 x 32 KBytes	6 x 32 KB + 4 x 64 KB
L2 Cache	2 x 1.25MB + 2 x 2 MB	4 x 512 KBytes	4 x 1.25 MBytes	6 x 1.25 MB + 2 MBytes
L3 Cache	12 MBytes	6 MBytes	8 MBytes	24 MBytes

Table 4.1.3.2: Cache Memory Conversion Result of CPUZ

Test	Computer A	Computer B	Computer C	Computer D
L1 Data Cache	352 KB	192 KB	192 KB	416 KB
L1 Instruction Cache	608 KB	128 KB	128 KB	544 KB
L2 Cache	6 656 KB	2 048 KB	5 120 KB	9 728 KB
L3 Cache	12 288 KB	6 144 KB	8 192 KB	24 576 KB

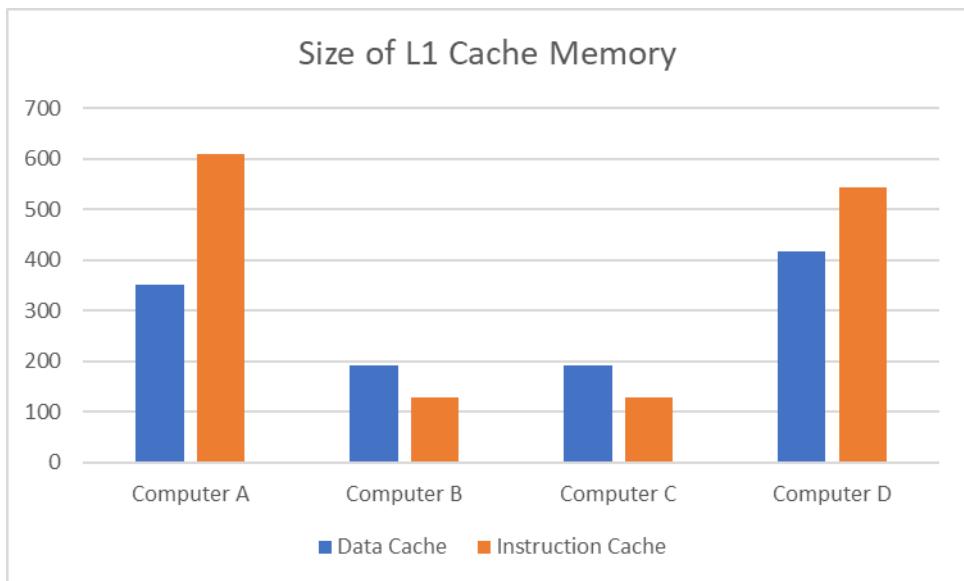


Figure 4.1.3.1: Size of L1 cache memory

According to Figure 4.1.3.1, Computer D has the highest total size of L1 cache memory (416 KB data and 544 KB instruction), followed by Computer A (352 KB data and 608 KB instruction). A larger L1 cache allows the processor to access frequently used data and instructions more quickly. This results in faster execution of lightweight and repetitive tasks such as browsing, running background services, and basic application use.

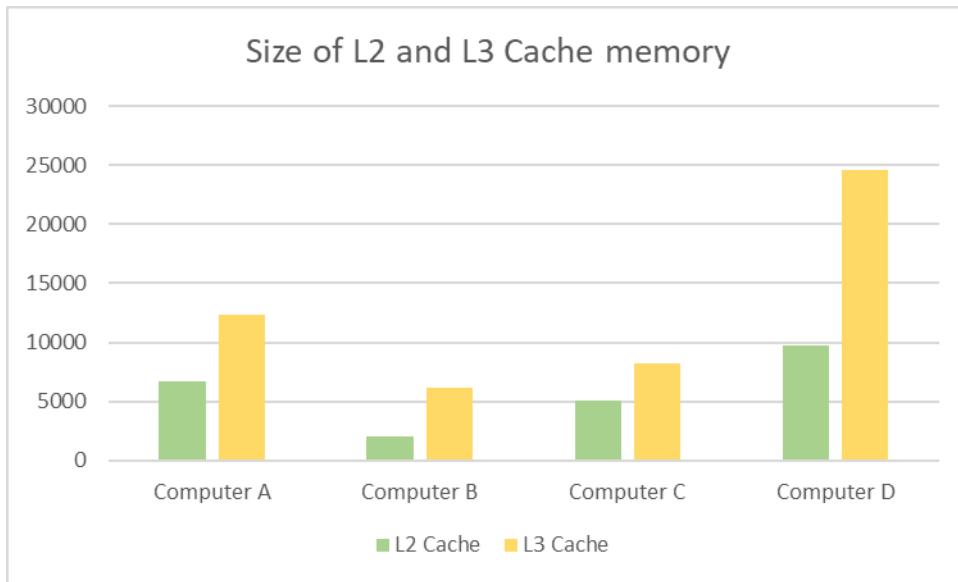


Figure 4.1.3.2: Size of L2 and L3 cache memory

According to Figure 4.1.3.2, Computer D stands out with a leading L2 cache size of 9728 KB. This larger L2 cache enhances application-level performance, particularly during multitasking and when handling larger datasets. Additionally, Computer D features the largest L3 cache at 24,576 KB, which significantly improves multi-core performance and the efficiency of data sharing between CPU cores.

4.1.4 Motherboard and Bus

Table 4.1.4.1: Motherboard and Bus Result of CPUZ

Test	Computer A	Computer B	Computer C	Computer D
Motherboard	Ganymede_ADU V1.08	X515JAB 1.0	OPCVD6	LNVN161216
Motherboard (Bus)	PCI-Express 3.0 (8.0 GT/s)	PCI-Express 3.0 (8.0 GT/s)	PCI-Express 4.0 (16.0 GT/s)	PCI-Express 4.0 (16.0 GT/s)

Discussion:

Computer C and D with PCI-Express 4.0 have a clear performance advantage in terms of bus speed and data throughput. PCI-Express 4.0 doubles the bandwidth of PCI-Express 3.0, which enables faster communication between the CPU and components like the GPU or SSD. Also, this translates to faster load times, better data performance, and support high-speed devices.

4.1.5 Overall Result for CPU-Z

Based on the analysis across processor performance, memory (RAM), cache memory, and motherboard bus configuration, Computer D emerges as the strongest overall performer, followed closely by Computer C. Computer D delivers top performance across all tested components, making it the most capable system among the options. It features a powerful processor with 6 performance cores, 4 efficiency cores, and 16 threads, enabling smooth multitasking and efficient handling of demanding workloads. Its 16 GB RAM, configured across two slots, allows for higher memory bandwidth and better multitasking support. Additionally, Computer D has the largest cache memory capacity (L1: 960 KB, L2: 9728 KB, L3: 24,576 KB), which improves data access speed and overall system responsiveness, especially during repetitive or intensive tasks. With PCIe 4.0 support, it also offers superior data transfer rates and compatibility with high-speed components like NVMe SSDs and modern GPUs. These features make Computer D ideal for users engaged in heavy multitasking, programming, video editing, virtualization, or other performance-intensive operations.

4.2 Geekbench

4.2.1 System Info

Table 4.2.1.1: System Info of Computer using Geekbench

Test	Computer A	Computer B	Computer C	Computer D
CPU Information				
Cluster 1	2 Cores	4 Cores	4 Cores	6 Cores
Cluster 2	8 Cores	-	-	4 Cores
Maximum Frequency	4389 MHz	3591 MHz	4192 MHz	4588 MHz
Package	Socket 1744 FCBGA	Socket 1526 FCBGA	Socket 1449 FCBGA	Socket 1744 FCBGA
L1 Instruction Cache	32.0 KB x 6	32.0 KB x 4	32.0 KB x 4	32.0 KB x 8
L1 Data Cache	48.0 KB x 6	48.0 KB x 4	48.0 KB x 4	48.0 KB x 8
L2 Cache	1.25 MB x 1	512 KB x 4	1.25 MB x 4	1.25 MB x 2
L3 Cache	12.0 MB x 1	6.00 MB x 1	8.00 MB x 1	24.0 MB x 1
Memory Information				
Size	8.00 GB	7.75 GB	8.00 GB	16.00 GB
Transfer Rate	3192 MT/s	2128 MT/s	3194 MT/s	-
Type	DDR4 SDRAM	DDR4 SDRAM	DDR4 SDRAM	-
Channels	1	1	1	-

Computer D has the most powerful configuration overall, with the highest core count, frequency, L1 and L3 cache sizes. While Computer A has more total cores than B and C due to its eight efficiency cores, but fewer high-performance cores. Meanwhile, Computer C has the largest L2 cache, which may benefit certain applications that rely heavily on mid-level cache. By contrast, Computer B is the weakest in every CPU aspect like lowest core count, frequency, and cache sizes. On the memory side, Computer D has a clear memory size advantage with 16 GB, which is double that of the others. Both Computers A and C offer faster memory transfer rates (around 3192–3194 MT/s) compared to Computer B (2128 MT/s), which may impact performance in data-heavy tasks. Lastly, all computers are single channels except Computer D's channel is undefined.

4.2.2 Single-Core Performance

Table 4.2.2.1: Single-Core Performance of Computer using Geekbench

Test	Computer A	Computer B	Computer C	Computer D
File Compression	171.0 MB/s	137.3 MB/s	135.7 MB/s	182.7 MB/s
Navigation	8.88 routes/s	6.94 routes/s	5.25 routes/s	7.68 routes/s
HTML 5 Browser	24.7 pages/s	15.3 pages/s	15.0 pages/s	29.9 pages/s
PDF Renderer	32.3 Mpixels/s	29.1 Mpixels/s	21.4 Mpixels/s	31.5 Mpixels/s
Photo Library	19.1 images/s	16.9 images/s	13.5 images/s	17.8 images/s
Clang	7.12 Klines/s	6.89 Klines/s	8.99 Klines/s	6.29 Klines/s
Text Processing	119.4 pages/s	108.7 pages/s	121.9 pages/s	103.8 pages/s
Asset Compression	31.6 MB/s	43.8 MB/s	41.4 MB/s	39.2 MB/s
Object Detection	44.8 images/s	37.4 images/s	44.6 images/s	39.9 images/s
Background Blur	9.32 images/s	6.42 images/s	7.87 images/s	7.17 images/s
Horizon Detection	56.6 Mpixels/s	43.3 Mpixels/s	59.1 Mpixels/s	52.0 Mpixels/s
Object Remover	85.6 Mpixels/s	57.3 Mpixels/s	95.9 Mpixels/s	99.8 Mpixels/s
HDR	48.8 Mpixels/s	32.3 Mpixels/s	47.4 Mpixels/s	38.5 Mpixels/s
Photo Filter	13.0 images/s	9.17 images/s	14.2 images/s	17.0 images/s
Ray Tracer	1.72 Mpixels/s	713.7 Kpixels/s	769.5 Kpixels/s	1.20 Mpixels/s
Structure from Motion	38.3 Kpixels/s	30.3 Kpixels/s	43.9 Kpixels/s	46.5 Kpixels/s



Figure 4.2.2.1: Single-Core Performance of Computer using Geekbench

According to Figures 4.2.2.1 above, Computer A (Intel Core i5-1235U) is the most powerful single-core performance in which it wins 7 out of 16 tests. It is followed by Computer D (Intel Core i7-12650H)

in second place with 5 wins. Furthermore, Computer C (Intel Core i5-1135G7) ranks third, securing 3 wins out of 16 tests.

4.2.3. Multi-Core Performance

Table 4.2.3.1: Multi-Core Performance of Computer using Geekbench

Test	Computer A	Computer B	Computer C	Computer D
File Compression	160.7 MB/s	84.3 MB/s	227.6 MB/s	650.5 MB/s
Navigation	25.7 routes/s	12.4 routes/s	28.5 routes/s	51.8 routes/s
HTML 5 Browser	85.5 pages/s	42.7 pages/s	66.3 pages/s	76.1 pages/s
PDF Renderer	78.7 Mpixels/s	63.6 Mpixels/s	95.0 Mpixels/s	127.2 Mpixels/s
Photo Library	52.6 images/s	40.7 images/s	56.7 images/s	76.7 images/s
Clang	29.9 Klines/s	17.0 Klines/s	27.8 Klines/s	31.2 Klines/s
Text Processing	111.7 pages/s	73.1 pages/s	160.9 pages/s	67.2 pages/s
Asset Compression	241.3 MB/s	142.1 MB/s	171.6 MB/s	205.0 MB/s
Object Detection	49.2 images/s	42.3 images/s	59.5 images/s	80.4 images/s
Background Blur	25.1 images/s	14.4 images/s	20.6 images/s	19.9 images/s
Horizon Detection	157.6 Mpixels/s	100.0 Mpixels/s	137.8 Mpixels/s	145.4 Mpixels/s
Object Remover	431.8 Mpixels/s	151.5 Mpixels/s	260.8 Mpixels/s	375.6 Mpixels/s
HDR	118.4 Mpixels/s	81.8 Mpixels/s	104.9 Mpixels/s	139.3 Mpixels/s
Photo Filter	28.1 images/s	21.7 images/s	20.7 images/s	26.2 images/s
Ray Tracer	9.63 Mpixels/s	3.32 Mpixels/s	5.20 Mpixels/s	4.02 Mpixels/s
Structure from Motion	151.7 Kpixels/s	73.5 Kpixels/s	121.5 Kpixels/s	140.6 Kpixels/s

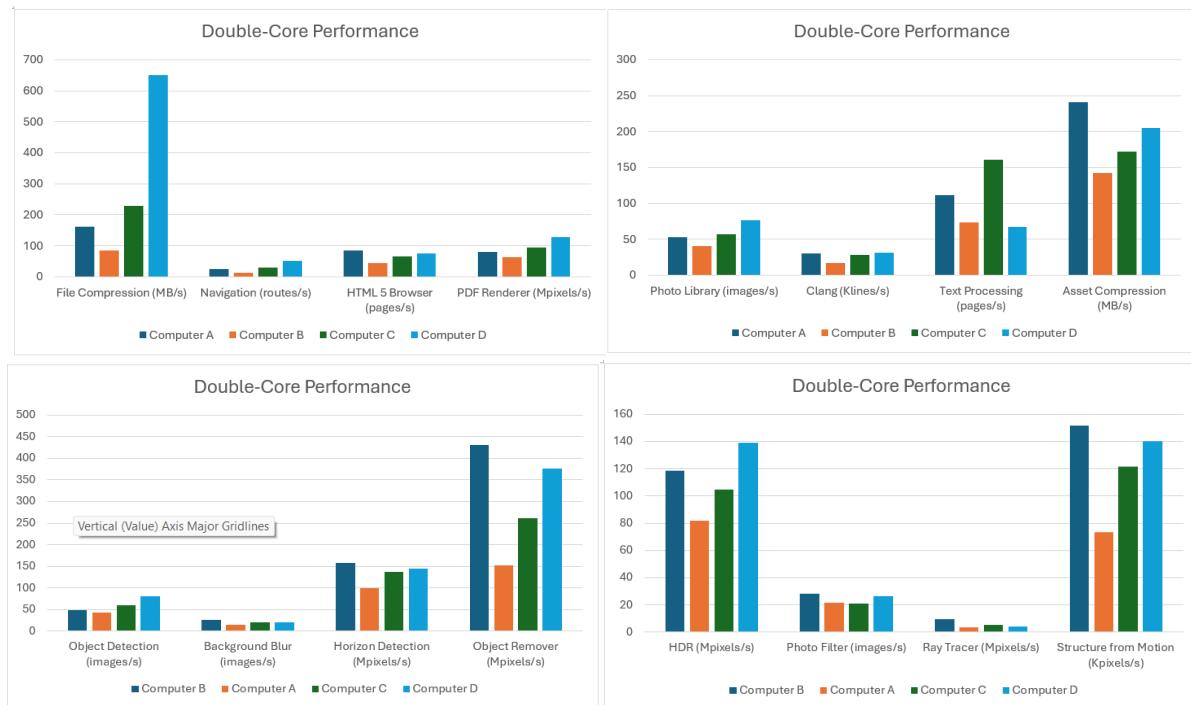


Figure 4.2.3.1: Multi-Core Performance of Computer using Geekbench

According to Figure 4.2.3.1, Computer A (Intel Core i5-1235U) is the most powerful multi-core performance in which it wins 8 out of 16 tests. Close behind, Computer D (Intel Core i7-12650H) secured 7 wins, making it the second-best in multi-core performance. At the same time, Computer C (Intel Core i5-1135G7) is excellent in Text Processing performance.

4.3 Task Manager

Table 4.3.1: CPU Benchmarking Result using Task Manager

Test	Memory (%)	Computer A	Computer B	Computer C	Computer D
Low Load (Microsoft Word)	Before Closing	79	73	64	48
	After Closing	77	70	62	45
	Memory Usage	2	3	2	3
Middle Load (Visual Studio 2019)	Before Closing	84	83	71	52
	After Closing	76	77	64	46
	Memory Usage	8	6	7	6
High Load (Youtube)	Before Closing	86	82	74	58
	After Closing	68	63	63	44
	Memory Usage	18	19	11	14

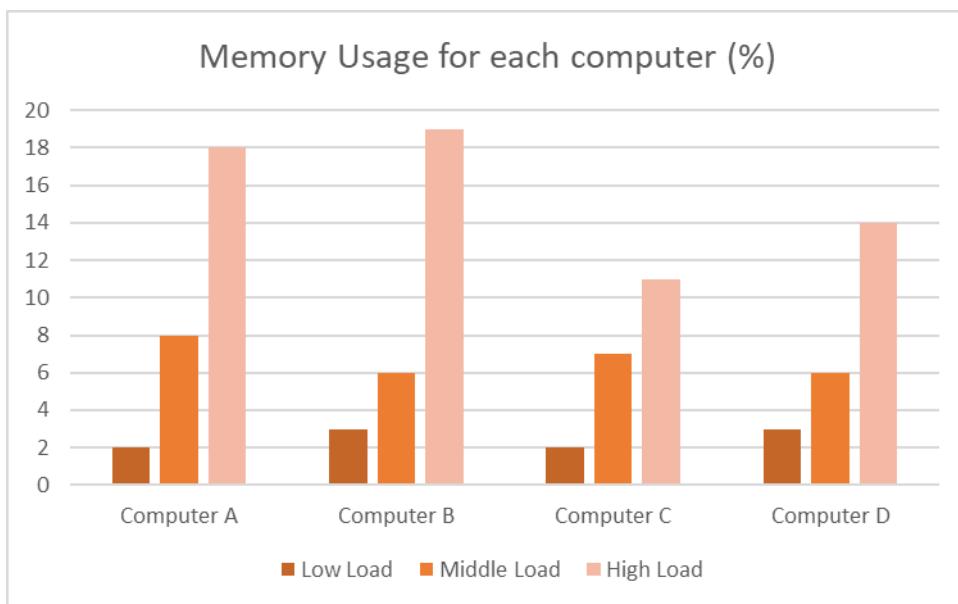


Figure 4.3.1: Memory Usage for Each Computer

For low load, all computers show minimal memory usage which is 2% to 3%. These differences are small and not significant at this level.

For middle load, the memory usage rises across the board. Computer A has the highest usage at 8%, while Computer B and D use 6%, Computer C uses 7%. This suggests that Computer A is less efficient under medium workloads, while D handles it best.

For high load, Computer B peaks at 19% usage, followed closely by Computer A at 18%, indicating poor memory management under stress. Computer C performs the best (11%), and Computer D follows (14%), showing stronger efficiency under heavy tasks.

4.3.1 Overall Result for Task Manager

For middle load, as workload intensity increases, the memory usage differences become more pronounced. Computer A shows the highest memory usage (8%), indicating it may have more background processes, poorer memory optimization, or weaker multitasking capability. Computer B and D use less memory (6%), implying better handling of development tools. Computer C performs moderately (7%), still within acceptable range. Overall, Computer D stands out as the most memory-efficient under moderate load, which is important for users working with development environments or multiple applications.

In high-demand scenarios, the differences become more significant. Computer B peaks at 19%, and Computer A at 18%, suggesting inefficiency and poor memory management under stress. In contrast, Computer C (11%) and D (14%) maintain relatively lower memory usage, indicating better optimization and more effective RAM utilization. This shows that C and D are more reliable for intensive multitasking and real-time content streaming, while A and B may lag or slow down during such tasks.

Overall, Computer C and D are better suited for heavier workloads, it shows more efficient memory usage, particularly under high-load conditions such as video streaming or running development environments. In contrast, Computer A and Computer B shows the limitations under medium and high workloads, with noticeably higher memory usage percentages. This suggests they may be less capable of handling multitasking or resource-intensive applications without slowdowns.

4.4 MiniTool Partition Wizard Free 12.8

Table 4.4.1: CPU Benchmarking Result using MiniTool Partition Wizard Free 12.8

Mode	Test	Size	Computer A	Computer B	Computer C	Computer D
Sequential	Reading	4KB	739.68	459.261	675.925	905.553
		8KB	765.799	551.503	705.802	1604.54
		16KB	1115.86	643.239	762.291	1854.99
		32KB	1715.29	1085.46	1222.89	1994.46
	Writing	4KB	144.863	671.476	187.343	405.272
		8KB	216.83	512.596	292.036	686.074
		16KB	282.983	213.677	327.107	1138.44
		32KB	325.9	562.73	253.93	1598.08
Random	Reading	4KB	659.87	440.846	454.176	889.396
		8KB	437.646	419.168	376.957	1458.35
		16KB	834.827	817.561	694.617	1787.92
		32KB	1418.37	962.051	987.112	1929.44
	Writing	4KB	202.773	627.771	141.142	402.151
		8KB	197.777	1076.13	212.514	705.026
		16KB	206.546	1529.43	288.523	1140.84
		32KB	274.24	1568.88	285.01	1687.3

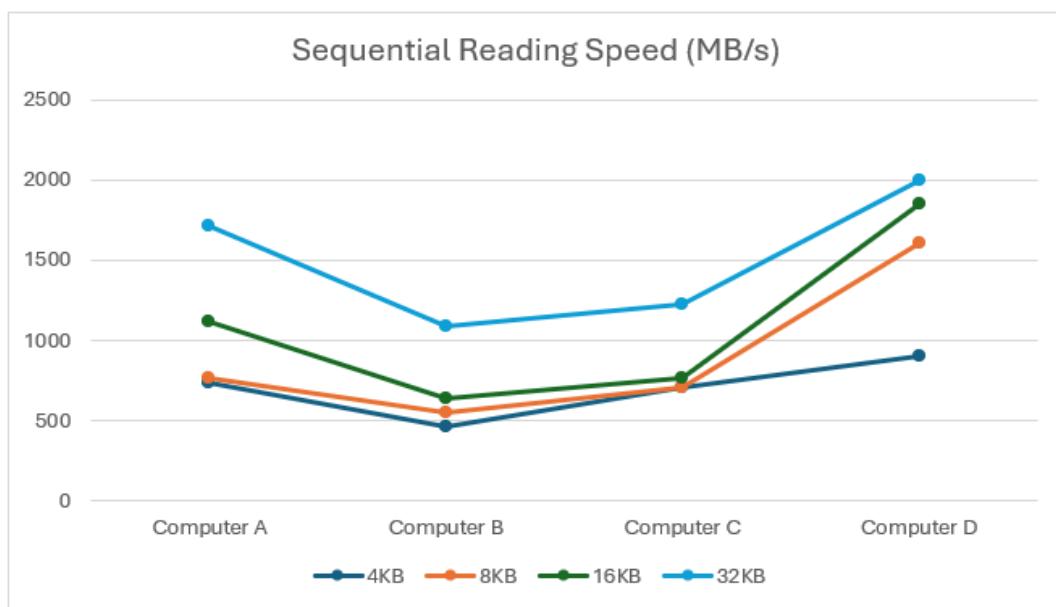


Figure 4.4.1: Comparison of Sequential Reading Speed (MB/s) between Four Computers

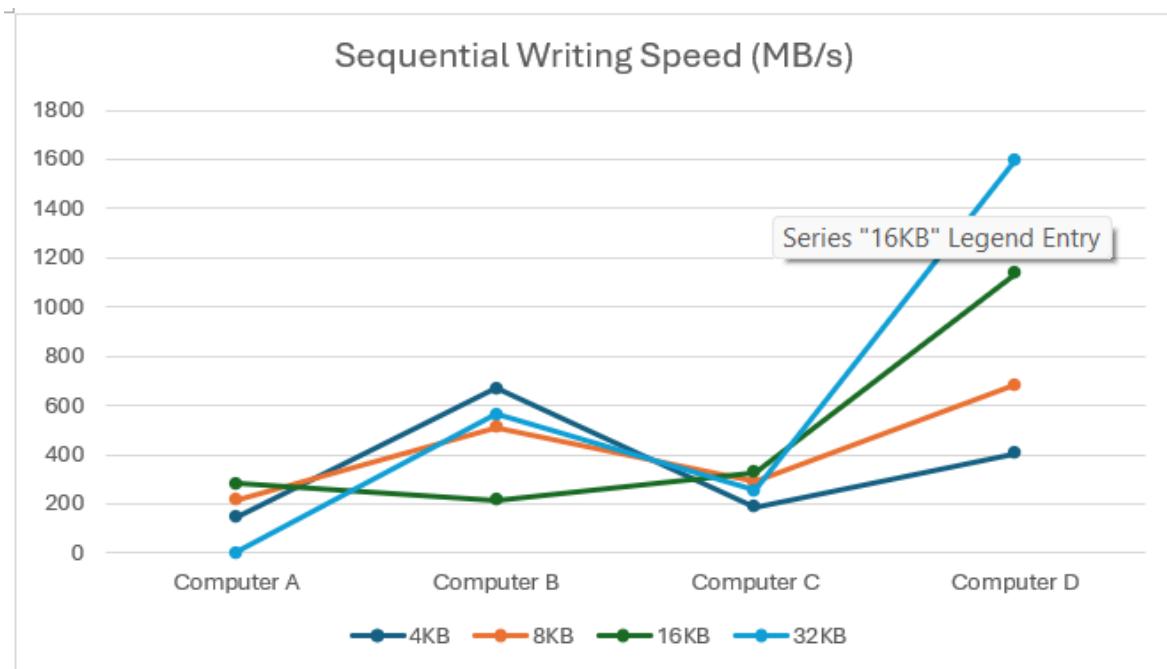


Figure 4.4.2: Comparison of Sequential Writing Speed (MB/s) between Four Computers

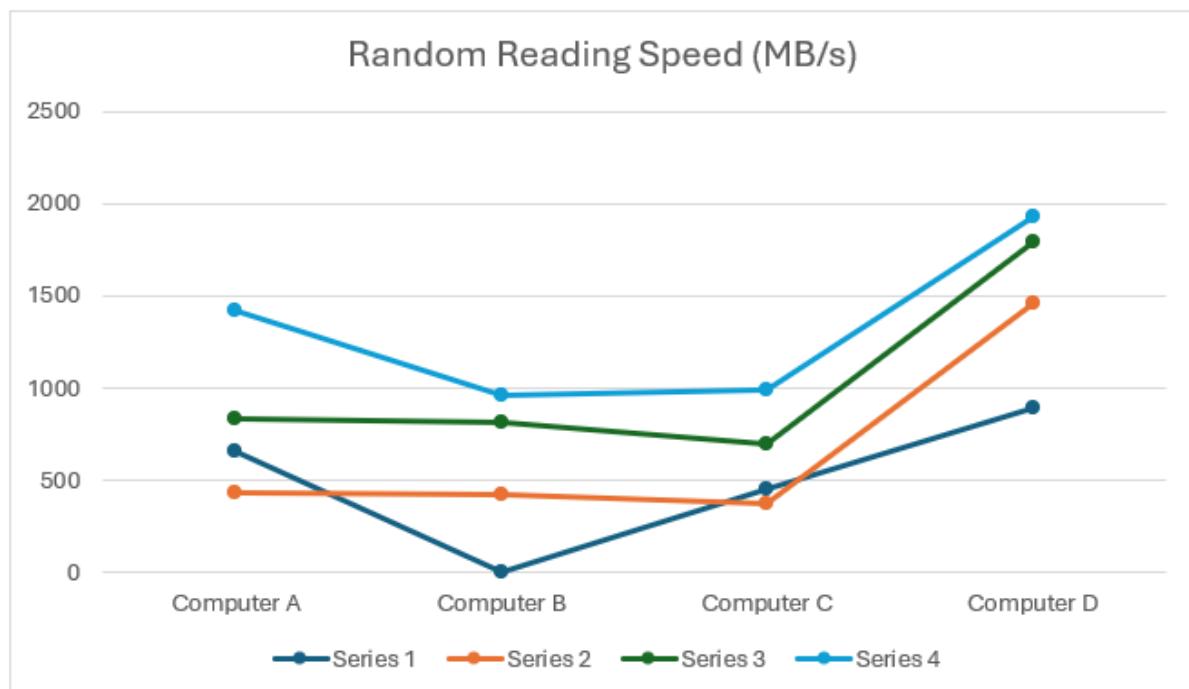


Figure 4.4.3: Comparison of Random Reading Speed (MB/s) between Four Computers

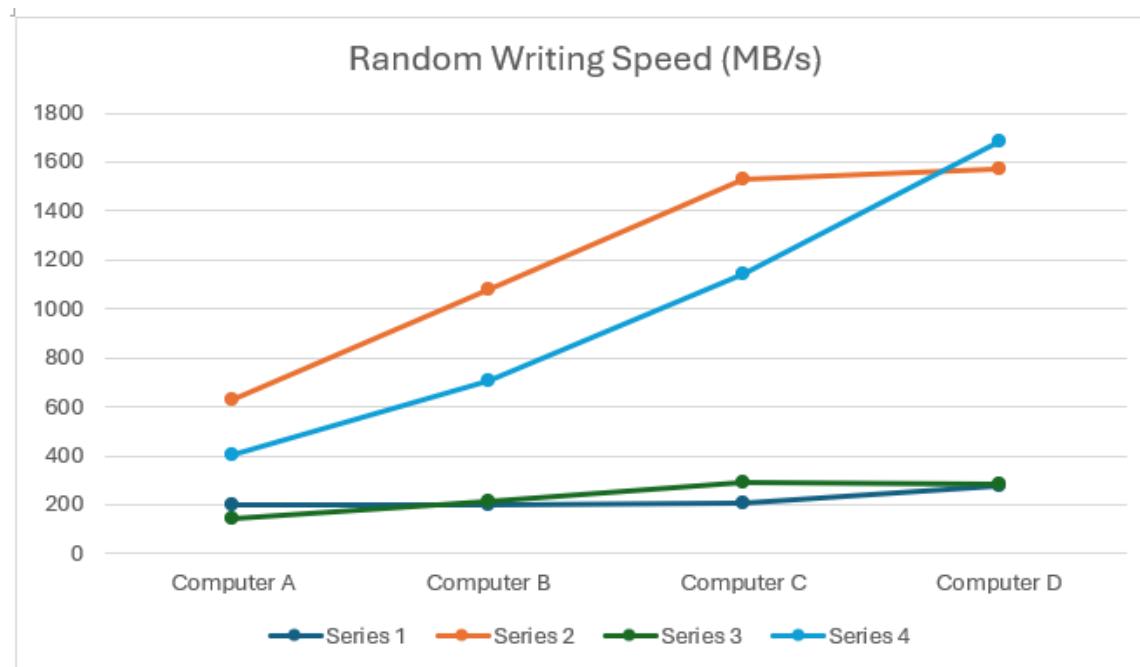


Figure 4.4.4: Comparison of Random Writing Speed (MB/s) between Four Computers

Based on the MiniTool Partition Wizard disk benchmarking results across four test categories, Random Writing, Random Reading, Sequential Writing, and Sequential Reading, and four block sizes (4 KB, 8 KB, 16 KB, and 32 KB), Computer D (Intel Core i7-12650H) stands out as the clear overall winner. It achieved the highest performance in 12 out of 16 tests. Its strongest advantage is its consistent top performance in both random and sequential reading across all block sizes. Computer D also performs strongly in sequential writing, ranking first in three out of four block sizes. Its only relative weakness is in the 4 KB block size category, where Computer B (Intel Core i5-1035G1) takes the lead. Meanwhile, Computer B excels in random writing, securing the top position at 4 KB, 8 KB, and 16 KB block sizes, although it slightly lags behind Computer D at 32 KB.

4.5 CPU Benchmarking Using ASM Code

This test compares the CPU performance of 4 computers by measuring the execution time for increasing numbers of loop iterations. The CPU time (CPU_msec) reflects how efficiently each system handles repetitive processing tasks under different levels of load.

Table 4.5.1: CPU Benchmarking Result using ASM Code

No of Loop (N)	Capture_msec (Before)	Capture_msec (After)	CPU_msec (Difference)
Computer A			
50	84645886	84650548	4662
100	68943285	68958247	14962
200	68996474	69015083	18609
500	69073150	69119697	46547
700	71491697	71556936	65239
1000	69187337	69280601	93264
Computer B			
50	70294033	70298706	4673
100	70498822	70508417	9595
200	70562399	70581381	18982
500	70649836	70697812	47976
700	71837700	71904772	67072
1000	71989141	72085081	95940
Computer C			
50	70114163	70118817	4654
100	70074936	70084228	9292
200	70130254	70148841	18587
500	70220253	70266990	46737
700	72225043	72292120	67077
1000	72305838	72401694	95856
Computer D			
50	79848622	79853275	4653
100	79951134	79960432	9298
200	79999483	80018092	18609
500	80068507	80114998	46491
700	80181658	80246847	65189
1000	80261714	80354890	93176

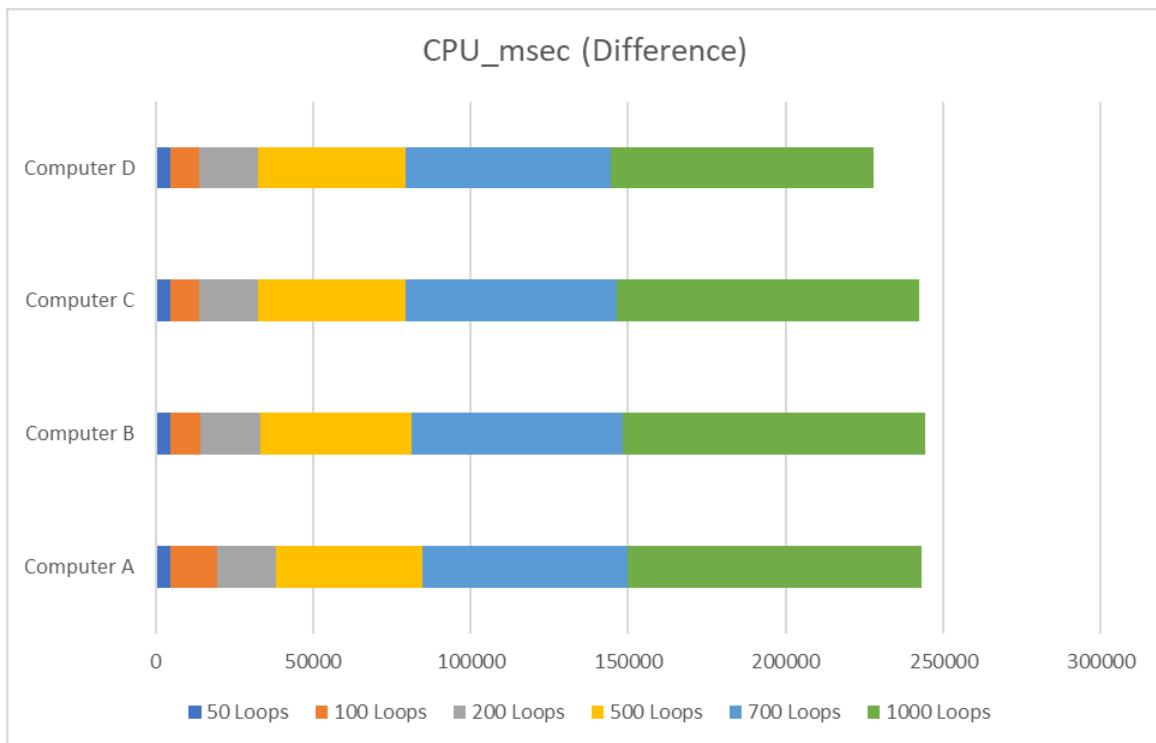


Figure 4.5.1 Comparison of CPU_msec (Difference) between Four Computers

For low load which is 50 Loops, all computers perform nearly identically which is around 4650 to 4673 ms.

For moderate load which is 100-500 Loops, Computer A shows unexpected spike at 100 Loops which is 14962 ms, significantly slower than Computer B, C and D which all around 9300 to 9600 ms.

For high load which is 700-1000 Loops, Computer D perform slightly better than other computers. Computer B and C takes longest time which is around 95940 ms.

4.5.1 Overall result for CPU benchmarking using ASM code

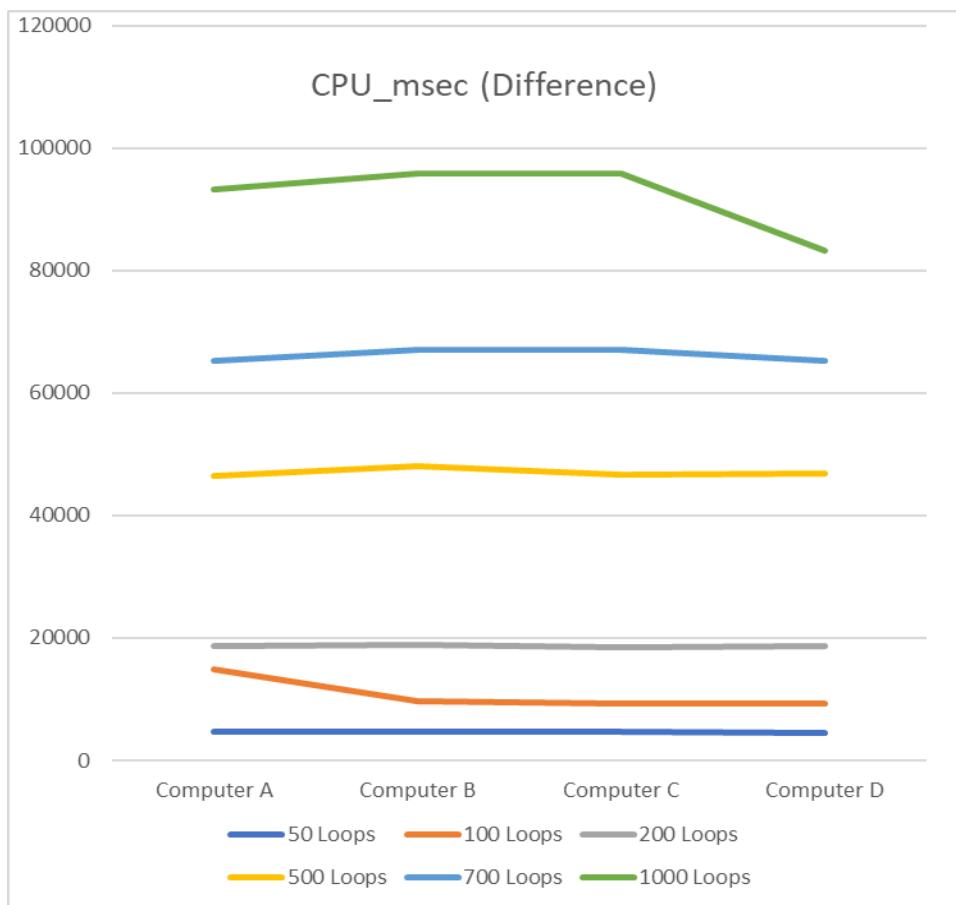


Figure 4.5.1.1 Line Chart for CPU_msec (difference)

Based on Figure 4.5.1.1, Computer A shows decent performance at high loads but inconsistent at lower workloads. This may point to software inefficiencies or background processes affecting performance. For Computer B, it demonstrates the weakest performance especially under high-load conditions, with the highest execution times among all systems. This may be due to slower memory, lower CPU performance, or inefficient thermal and background process management.

In contrast, Computer C and Computer D stand out as the efficient and reliable system for handling processing tasks across all workload levels. For Computer C, it manages to maintain stable execution times with minimal spikes. This indicates strong CPU optimization, making it a cost-effective alternative for users who want solid performance without high hardware specifications. For Computer D, it consistently delivers the lowest and most stable execution times, even under heavy load (1000 loops). It will provide smoother multitasking without lag or slowdown and most suitable for long-duration and real-time tasks such as video editing, compiling code, and running virtual machines.

In summary, Computers C and D offer the most efficient and reliable performance across all workload levels, with Computer D leading in stability and speed. Computer C provides a great balance between performance and hardware cost, while Computers A and B show limitations that may require optimization or upgrades. For demanding tasks, Computer D is the most suitable choice, ensuring smooth multitasking and consistent processing.

4.6 Winner

Table 4.6.1: Comparison Result among All Tests

Test	Computer A	Computer B	Computer C	Computer D
CPUZ				
CPU Cores	2P + 8E	4	4	6P + 4E
CPU Core Speed (Clock Frequency)	3990.24 MHz	2793.84 MHz	1497.32 MHz	1197.07 MHz
Memory Size	8 GBytes (DDR4)	8 GBytes (DDR4)	8 GBytes (DDR4)	16 GBytes
Memory (Channel)	1 x 64-bit	Single	1 x 64 bit	-
Memory (Speed)	1596.1 MHz	1064.3 MHz	1597.3 MHz	-
Memory (Module Size)	Slot #1: 8 GBytes Slot #2: -	Slot #1: 8 GBytes Slot #2: -	Slot #1: 8 GBytes Slot #2: -	Slot #1: 8 GBytes Slot #2: 8GBytes
L1 Data Cache	352 KB	192 KB	192 KB	416 KB
L1 Instruction Cache	608 KB	128 KB	128 KB	544 KB
L2 Cache	6 656 KB	2 048 KB	5 120 KB	9 728 KB
L3 Cache	12 288 KB	6 144 KB	8 192 KB	24 576 KB
Motherboard (Bus)	PCI-Express 3.0 (8.0 GT/s)	PCI-Express 3.0 (8.0 GT/s)	PCI-Express 4.0 (16.0 GT/s)	PCI-Express 4.0 (16.0 GT/s)
Geekbench				
Single-Core Performance	7/16	1/16	3/16	5/16
Multi-Core Performance	8/16	0/16	1/16	7/16
Task Manager				
Low Load	2	3	2	3
Middle Load	8	6	7	6
High Load	18	19	11	14
MiniTool Partition Wizard				
Sequential Reading	0/0	0/0	0/0	4/4
Sequential Writing	0/0	1/4	0/0	3/4
Random Reading	0/0	0/0	0/0	4/4
Random Writing	0/0	3/4	0/0	1/4
ASM Code				
ASM Loop	0/0	0/0	2/6	4/6

- Best Overall Performance: **Computer D** leads to disk performance, cache sizes, and strong results in both single and multi-core tasks.
- Best CPU Performance: **Computer A** is excellent in both single-core and multi-core processing.

- Most Efficient Under Load: **Computer C** shows the lowest high-load score and good ASM performance.
- Best In Random Write: **Computer B**, despite its weak specs, it performs best in random write tests.

5.0 Conclusion and Reflection

In conclusion, this project successfully analyzed and compared the CPU performance of four different computers using different types of system benchmarks tools and ASM program. The benchmarking tools used are CPU-Z, Geekbench, Windows Task Manager, MiniTool Partition Wizard and also the ASM code provided comprehensive insights such as CPU specifications, single-core and multi-core performance, disk performance, memory consumption, and the performance of loop execution. This had proved that different computers will have different strength in particular domains.

Among all the tested computers, Computer D (Intel Core i7-12650H) has the most consistent and high-end performance across almost all test. It leads to multi-core processing, cache memory, memory capacity and disk read/write performance. Its 16 GBytes RAM and high thread count make it ideal for multitasking and consistent processing for real-time tasks and demanding workloads. Meanwhile, Computer A (Intel Core i5-1235U) also stood out with the highest single-core clock speed, making it well-suited for light and single-threaded applications such as word processing and general browsing. It also demonstrated strong multi-core performance in several GeekBench tests.

Other than that, Computer C (Intel Core i5-1135G7) provided a well-balanced overall performance, especially in memory speed and ASM loop execution test. It consistently performed with stable response time which making it a cost-effective choice for users who need reliable computing without high-end specifications. On the other hand, Computer B (Intel Core i5-1035G1) was the least powerful computer, but it showed surprisingly good results in several tasks such as random write performance in MiniTool and its ability to use memory efficient under middle load.

This project has allowed us to develop a strong understanding of how hardware specifications such as CPU architecture, memory speed, and the cache size directly affect the system performance of computers. We also discovered that different systems may excel in different areas. Thus choosing a computer should based on the users' needs whether they want balanced overall performance, high-speed multitasking or efficient memory usage. This benchmarking experience not only taught us how to critically evaluate system performance but also provided invaluable experience in bringing theoretical knowledge with real-world applications in the field of computer organization and architecture.

6.0 References

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7.0 Appendices

1. Benchmarking Tool 1: CPU-Z

<https://www.cpuid.com/softwares/cpu-z.html>

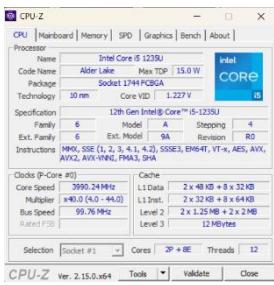
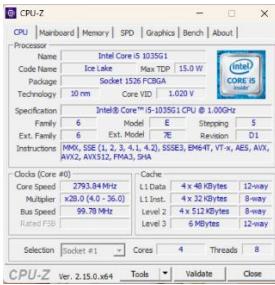
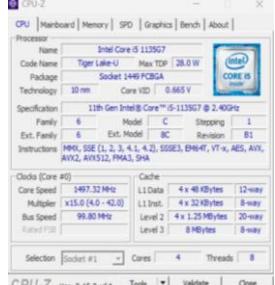
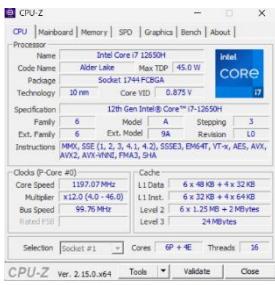
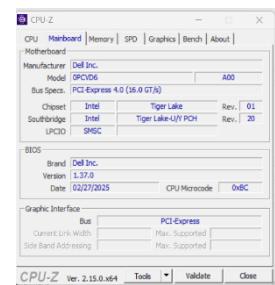
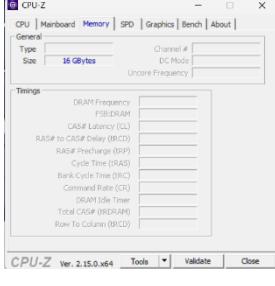
2. Benchmarking Tool 2: Geekbench

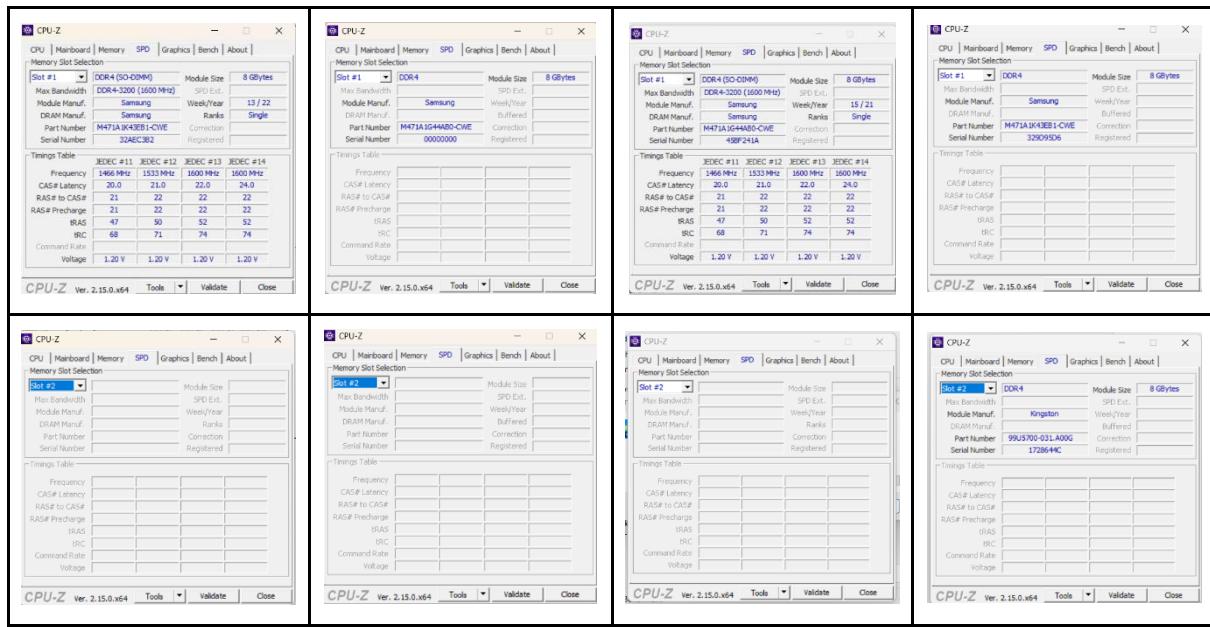
<https://www.geekbench.com/>

3. Benchmarking Tool 3: MiniTool Partition Wizard Free 12.8

<https://www.partitionwizard.com/free-partition-manager.html>

4. Result of CPU-Z

Computer A	Computer B	Computer C	Computer D
			
			
			



5. Result of Geekbench

Computer A	Computer B																																																																						
Acer Aspire A515-57 <table border="1" style="margin-top: 10px;"> <tr> <td style="text-align: center;">1382 Single-Core Score</td> <td style="text-align: center;">3719 Multi-Core Score</td> </tr> <tr> <td colspan="2" style="text-align: center; padding-top: 5px;">Geekbench 6.4.0 for Windows AVX2</td> </tr> <tr> <td colspan="2" style="text-align: center; padding-top: 5px;">Valid</td> </tr> </table> <p>Result Information</p> <table border="1" style="margin-top: 10px;"> <tr> <td>Upload Date</td> <td>July 01 2025 08:15 AM</td> </tr> <tr> <td>Views</td> <td>1</td> </tr> </table>	1382 Single-Core Score	3719 Multi-Core Score	Geekbench 6.4.0 for Windows AVX2		Valid		Upload Date	July 01 2025 08:15 AM	Views	1	ASUSTeK COMPUTER INC. VivoBook_ASUSLaptop X515JAB_A516JA <table border="1" style="margin-top: 10px;"> <tr> <td style="text-align: center;">1120 Single-Core Score</td> <td style="text-align: center;">2194 Multi-Core Score</td> </tr> <tr> <td colspan="2" style="text-align: center; padding-top: 5px;">Geekbench 6.4.0 for Windows AVX2</td> </tr> <tr> <td colspan="2" style="text-align: center; padding-top: 5px;">Valid</td> </tr> </table> <p>Result Information</p> <table border="1" style="margin-top: 10px;"> <tr> <td>Upload Date</td> <td>July 01 2025 08:47 AM</td> </tr> <tr> <td>Views</td> <td>1</td> </tr> </table>	1120 Single-Core Score	2194 Multi-Core Score	Geekbench 6.4.0 for Windows AVX2		Valid		Upload Date	July 01 2025 08:47 AM	Views	1																																																		
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Computer C		Computer D	
Dell Inc. Inspiron 3501		LENOVO 82SA	
1226 Single-Core Score	3498 Multi-Core Score	1371 Single-Core Score	4235 Multi-Core Score
Geekbench 6.4.0 for Windows AVX2	Valid	Geekbench 6.4.0 for Windows AVX2	Valid
Result Information		Result Information	
Upload Date	July 01 2025 11:12 AM	Upload Date	July 01 2025 01:15 PM
Views	1	Views	1

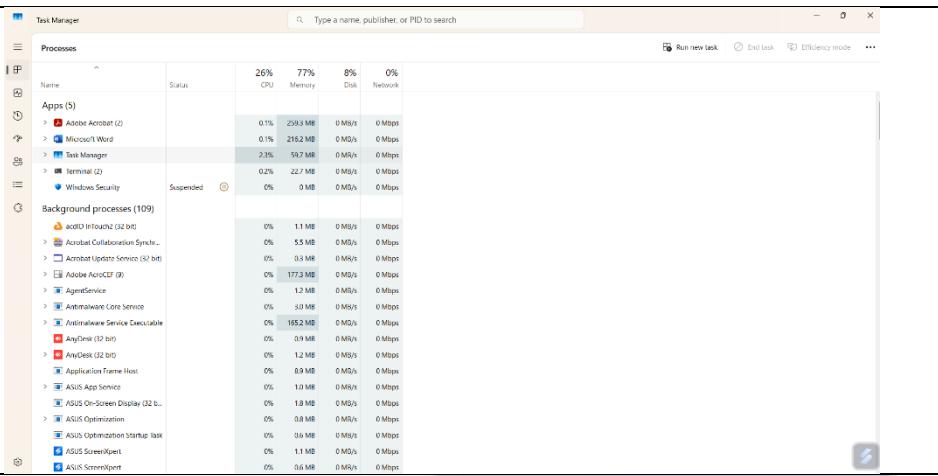
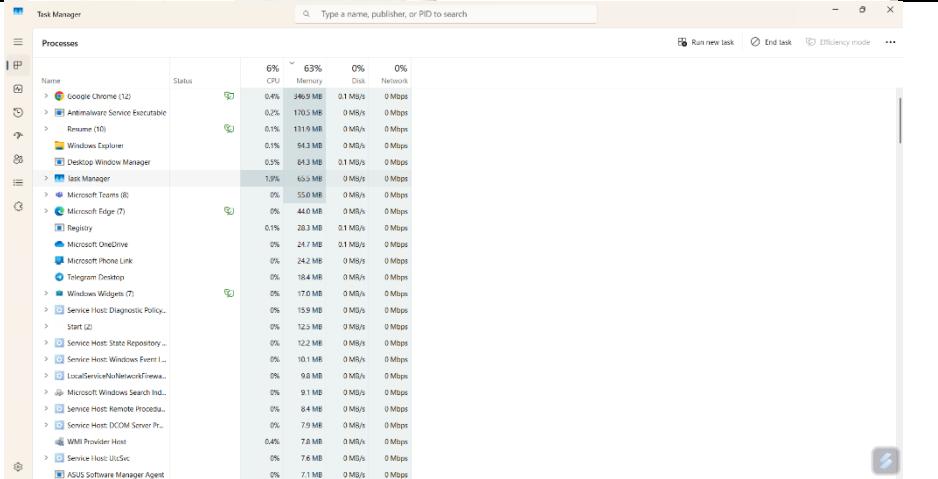
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Background Blur	4974																																																																														
Horizon Detection	4427																																																																														
Object Remover	3393																																																																														
HDR	3576																																																																														
Photo Filter	2091																																																																														
Ray Tracer	5375																																																																														
Structure from Motion	3838																																																																														
Multi-Core Score																																																																															
File Compression	4530																																																																														
Navigation	8590																																																																														
HTML5 Browser	3719																																																																														
PDF Renderer	5517																																																																														
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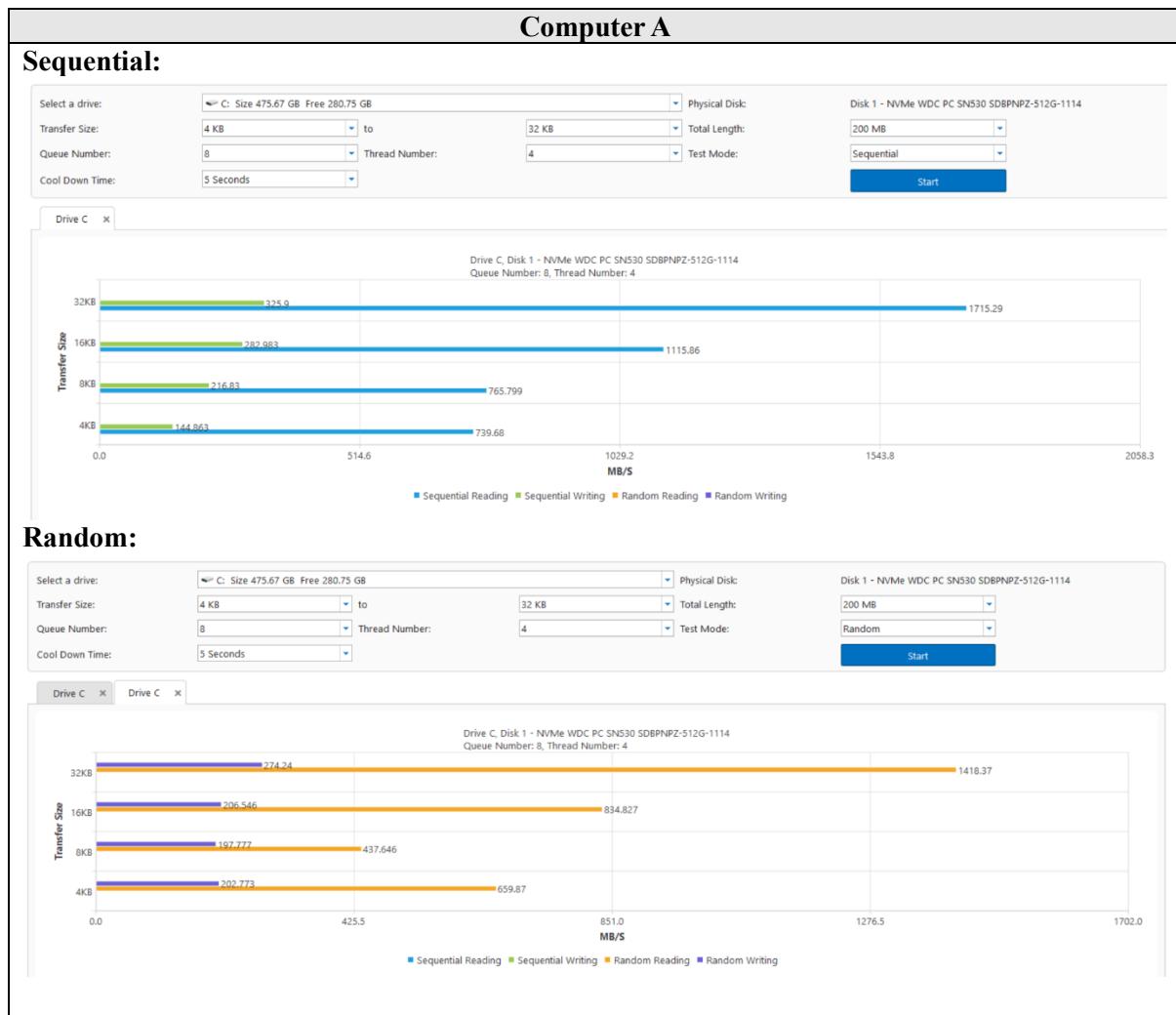
	After Closing	
High Load	Before Closing	
	After Closing	

High Load	Before Closing	<p>Task Manager (Processes tab) shows high CPU usage (~26%) for Google Chrome (10). A YouTube video player is running, showing a video titled "竹宿 Wu Bai/China Blue【最后的舞林】Norwegian forest【最后的森林】Official Music Video(HD)".</p>
	After Closing	<p>Task Manager (Processes tab) shows significantly reduced CPU usage (~6%). The application that was previously using ~26% CPU has been closed, resulting in a much lower overall system load.</p>
Low Load	Before Closing	<p>Task Manager (Processes tab) shows very low CPU usage (~5%). A Microsoft Word document titled "Document1 - Word" is open, displaying a large amount of placeholder text.</p>
	After Closing	<p>Task Manager (Processes tab) shows significantly reduced CPU usage (~5%). The application that was previously using ~5% CPU has been closed, resulting in a much lower overall system load.</p>

	After Closing	<p>Task Manager</p> <table border="1"> <thead> <tr> <th>Name</th> <th>Status</th> <th>CPU</th> <th>Memory</th> <th>Disk</th> <th>Network</th> </tr> </thead> <tbody> <tr> <td>Task Manager</td> <td>Running</td> <td>0.3%</td> <td>80.5 MB</td> <td>0 MB/s</td> <td>0 Mbps</td> </tr> <tr> <td>Background processes (98)</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Apps (1)</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>	Name	Status	CPU	Memory	Disk	Network	Task Manager	Running	0.3%	80.5 MB	0 MB/s	0 Mbps	Background processes (98)						Apps (1)																		
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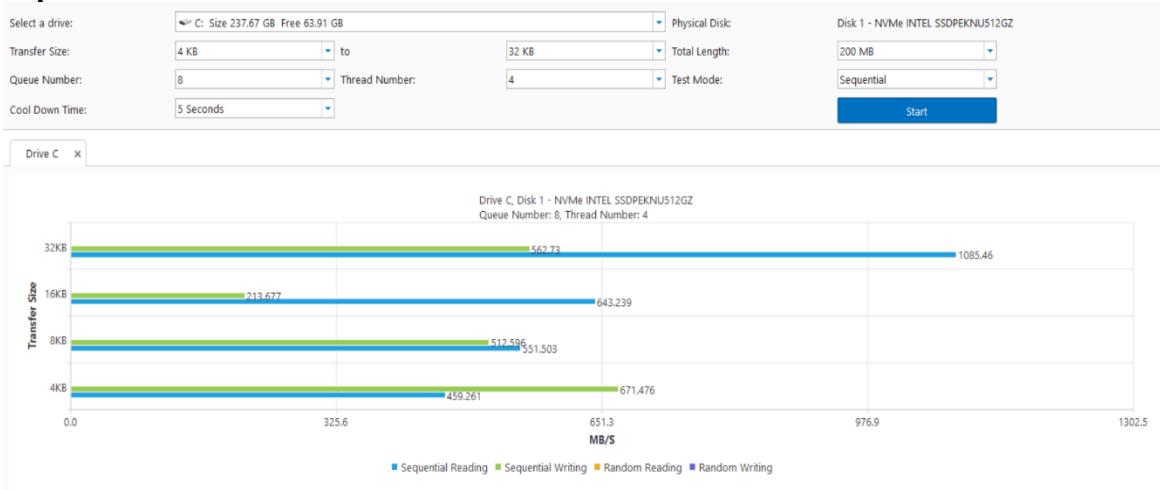
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7. Result MiniTool Partition Wizard Free 12.8

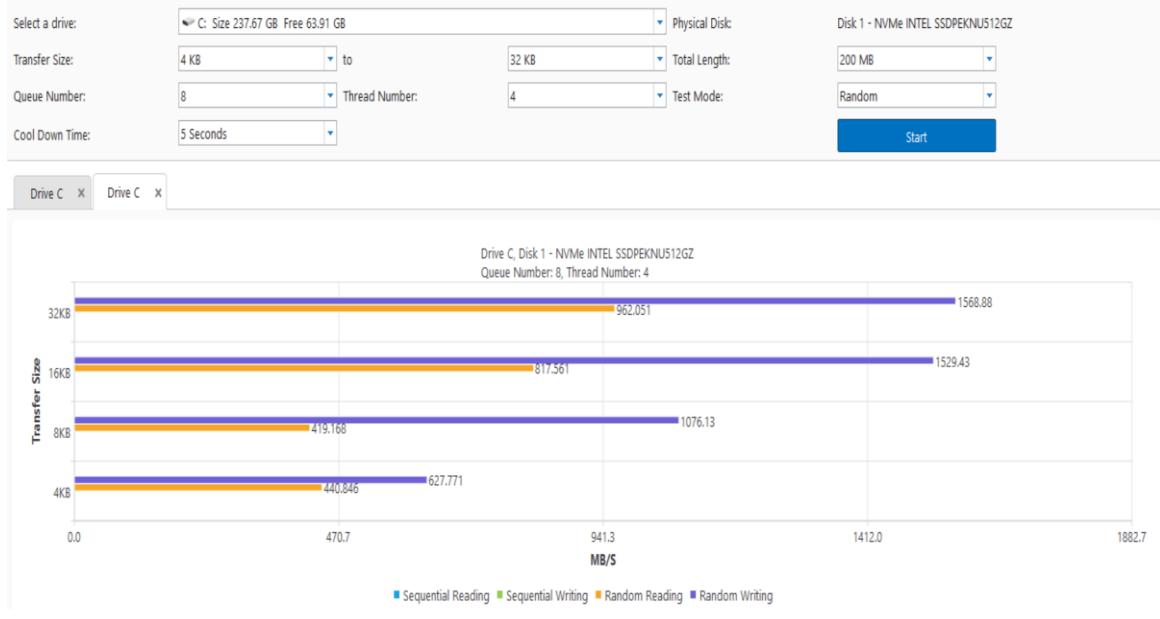


Computer B

Sequential:

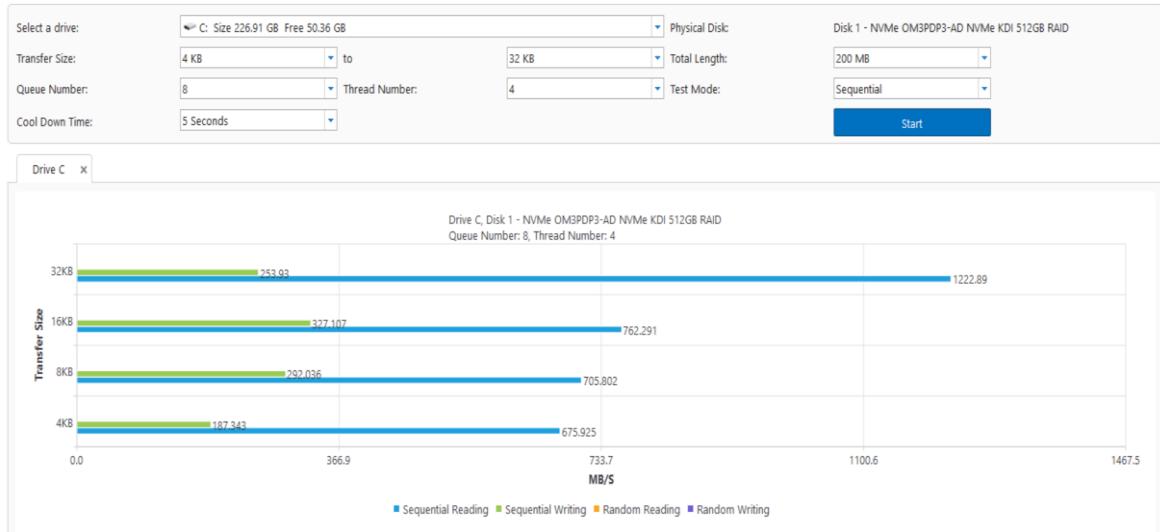


Random:

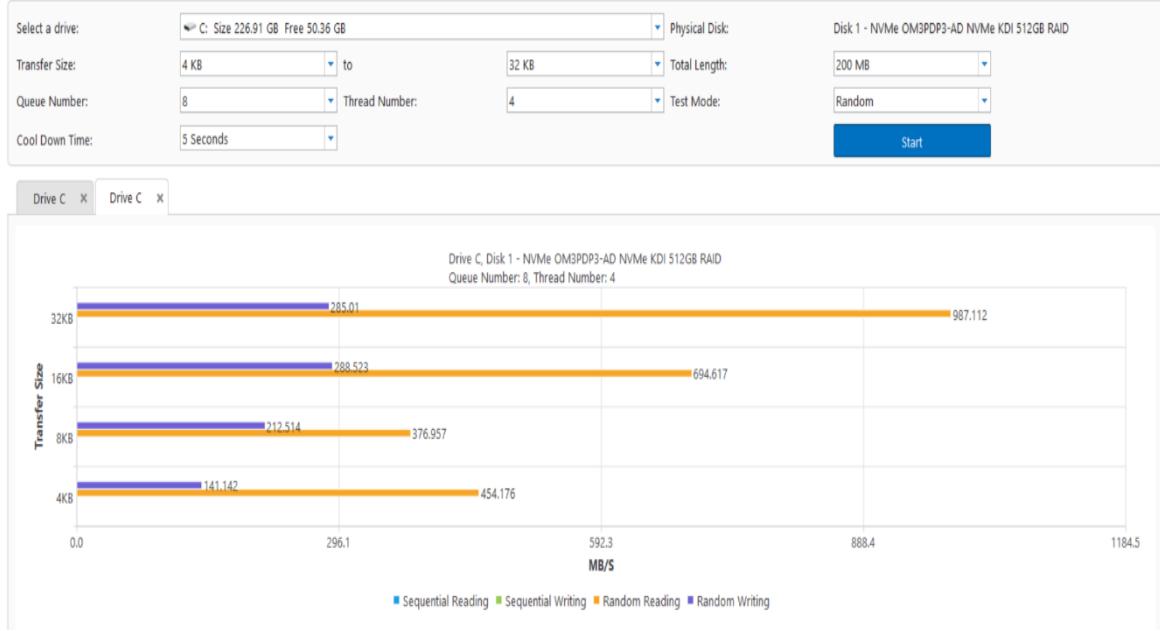


Computer C

Sequential:

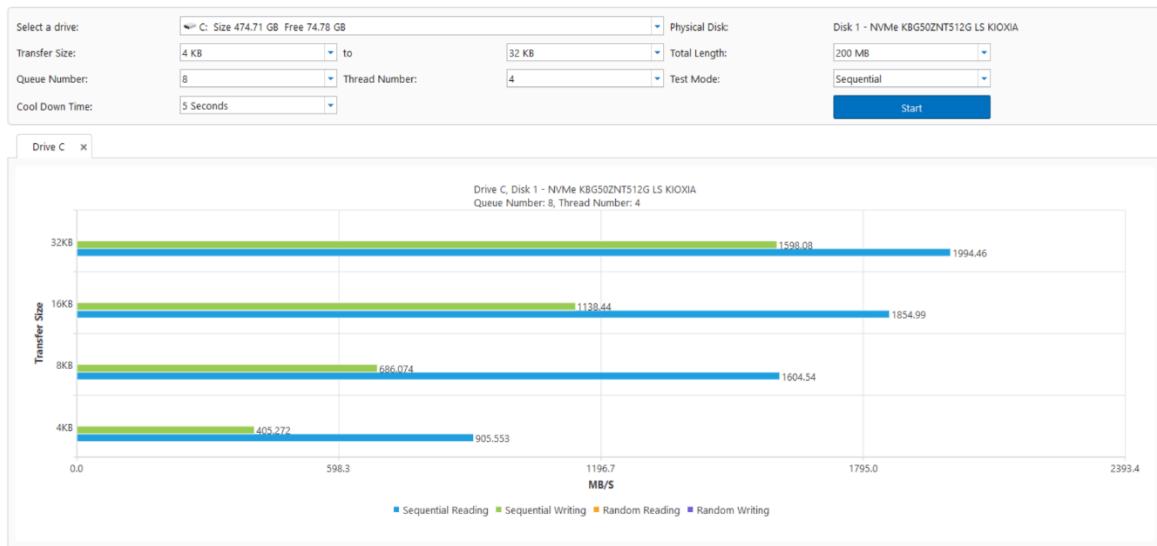


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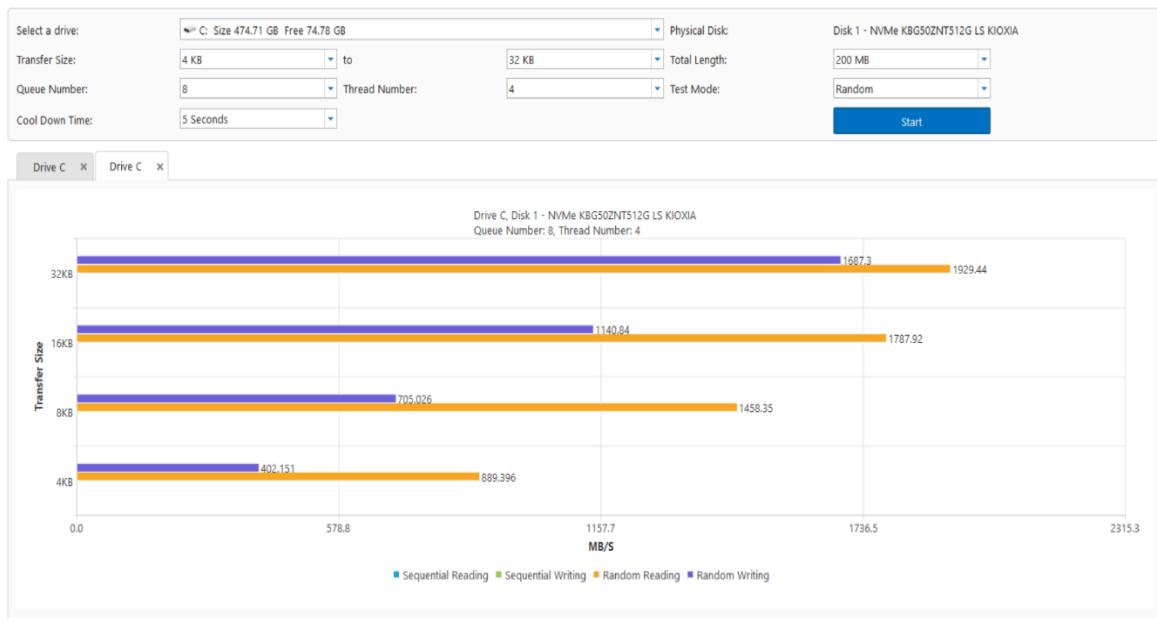


Computer D

Sequential:



Random:



8. Result ASM Code:

No. Loop	Output
Computer A	
50	Welcome to CPU Benchmark Program Benchmark CPU time Using Equation $y = 4*x^3 + 10*x^2 + 23*x + 24$ (with delay coef1, coef2, coef3, coef4 = 4, 10, 23, 24 msec) Enter Number of Looping (N) = 50 CPU time Stress Test in progress... Result: First Capture Execution time in millisecond: 84645886 Second Capture Execution time in millisecond: 84650548 Different Execution time in millisecond: 4662 Value of Sum from the Stress Test (polynomial) = 6962275
100	Welcome to CPU Benchmark Program Benchmark CPU time Using Equation $y = 4*x^3 + 10*x^2 + 23*x + 24$ (with delay coef1, coef2, coef3, coef4 = 4, 10, 23, 24 msec) Enter Number of Looping (N) = 100 CPU time Stress Test in progress... Result: First Capture Execution time in millisecond: 68943285 Second Capture Execution time in millisecond: 68958247 Different Execution time in millisecond: 14962 Value of Sum from the Stress Test (polynomial) = 105512050
200	Welcome to CPU Benchmark Program Benchmark CPU time Using Equation $y = 4*x^3 + 10*x^2 + 23*x + 24$ (with delay coef1, coef2, coef3, coef4 = 4, 10, 23, 24 msec) Enter Number of Looping (N) = 200 CPU time Stress Test in progress... Result: First Capture Execution time in millisecond: 68996474 Second Capture Execution time in millisecond: 69015083 Different Execution time in millisecond: 18609 Value of Sum from the Stress Test (polynomial) = 1643374100
500	Welcome to CPU Benchmark Program Benchmark CPU time Using Equation $y = 4*x^3 + 10*x^2 + 23*x + 24$ (with delay coef1, coef2, coef3, coef4 = 4, 10, 23, 24 msec) Enter Number of Looping (N) = 500 CPU time Stress Test in progress... Result: First Capture Execution time in millisecond: 69073150 Second Capture Execution time in millisecond: 69119697 Different Execution time in millisecond: 46547 Value of Sum from the Stress Test (polynomial) = 3041518106

700	<pre>Welcome to CPU Benchmark Program Benchmark CPU time Using Equation y = 4*x^3 + 10*x^2 + 23*x + 24 (with delay coef1, coef2, coef3, coef4 = 4, 10, 23, 24 msec) Enter Number of Looping (N) = 700 CPU time Stress Test in progress... Result: First Capture Execution time in millisecond: 71491697 Second Capture Execution time in millisecond: 71556936 Different Execution time in millisecond: 65239 Value of Sum from the Stress Test (polynomial) = 1419765774</pre>
1000	<pre>Welcome to CPU Benchmark Program Benchmark CPU time Using Equation y = 4*x^3 + 10*x^2 + 23*x + 24 (with delay coef1, coef2, coef3, coef4 = 4, 10, 23, 24 msec) Enter Number of Looping (N) = 1000 CPU time Stress Test in progress... Result: First Capture Execution time in millisecond: 69187337 Second Capture Execution time in millisecond: 69280601 Different Execution time in millisecond: 93264 Value of Sum from the Stress Test (polynomial) = 328523236</pre>
Computer B	
50	<pre>Welcome to CPU Benchmark Program Benchmark CPU time Using Equation y = 4*x^3 + 10*x^2 + 23*x + 24 (with delay coef1, coef2, coef3, coef4 = 4, 10, 23, 24 msec) Enter Number of Looping (N) = 50 CPU time Stress Test in progress... Result: First Capture Execution time in millisecond: 70294033 Second Capture Execution time in millisecond: 70298706 Different Execution time in millisecond: 4673 Value of Sum from the Stress Test (polynomial) = 6962275</pre>
100	<pre>Welcome to CPU Benchmark Program Benchmark CPU time Using Equation y = 4*x^3 + 10*x^2 + 23*x + 24 (with delay coef1, coef2, coef3, coef4 = 4, 10, 23, 24 msec) Enter Number of Looping (N) = 100 CPU time Stress Test in progress... Result: First Capture Execution time in millisecond: 70498822 Second Capture Execution time in millisecond: 70508417 Different Execution time in millisecond: 9595 Value of Sum from the Stress Test (polynomial) = 105512050</pre>
200	<pre>Welcome to CPU Benchmark Program Benchmark CPU time Using Equation y = 4*x^3 + 10*x^2 + 23*x + 24 (with delay coef1, coef2, coef3, coef4 = 4, 10, 23, 24 msec) Enter Number of Looping (N) = 200 CPU time Stress Test in progress... Result: First Capture Execution time in millisecond: 70562399 Second Capture Execution time in millisecond: 70581381 Different Execution time in millisecond: 18982 Value of Sum from the Stress Test (polynomial) = 1643374100</pre>

500	<p>Welcome to CPU Benchmark Program</p> <p>Benchmark CPU time Using Equation $y = 4*x^3 + 10*x^2 + 23*x + 24$ (with delay coef1, coef2, coef3, coef4 = 4, 10, 23, 24 msec)</p> <p>Enter Number of Looping (N) = 500 CPU time Stress Test in progress...</p> <p>Result:</p> <p>First Capture Execution time in millisecond: 70649836 Second Capture Execution time in millisecond: 70697812 Different Execution time in millisecond: 47976 Value of Sum from the Stress Test (polynomial) = 3041518106</p>
700	<p>Welcome to CPU Benchmark Program</p> <p>Benchmark CPU time Using Equation $y = 4*x^3 + 10*x^2 + 23*x + 24$ (with delay coef1, coef2, coef3, coef4 = 4, 10, 23, 24 msec)</p> <p>Enter Number of Looping (N) = 700 CPU time Stress Test in progress...</p> <p>Result:</p> <p>First Capture Execution time in millisecond: 71837700 Second Capture Execution time in millisecond: 71904772 Different Execution time in millisecond: 67072 Value of Sum from the Stress Test (polynomial) = 1419765774</p>
1000	<p>Welcome to CPU Benchmark Program</p> <p>Benchmark CPU time Using Equation $y = 4*x^3 + 10*x^2 + 23*x + 24$ (with delay coef1, coef2, coef3, coef4 = 4, 10, 23, 24 msec)</p> <p>Enter Number of Looping (N) = 1000 CPU time Stress Test in progress...</p> <p>Result:</p> <p>First Capture Execution time in millisecond: 71989141 Second Capture Execution time in millisecond: 72085081 Different Execution time in millisecond: 95940 Value of Sum from the Stress Test (polynomial) = 328523236</p>

Computer C

50	<pre>Welcome to CPU Benchmark Program Benchmark CPU time Using Equation y = 4*x^3 + 10*x^2 + 23*x + 24 (with delay coef1, coef2, coef3, coef4 = 4, 10, 23, 24 msec) Enter Number of Looping (N) = 50 CPU time Stress Test in progress... Result: First Capture Execution time in millisecond: 70114163 Second Capture Execution time in millisecond: 70118817 Different Execution time in millisecond: 4654 Value of Sum from the Stress Test (polynomial) = 6962275 Press 'y' to continue or 'n' to exit the benchmark :</pre>
100	<pre>Welcome to CPU Benchmark Program Benchmark CPU time Using Equation y = 4*x^3 + 10*x^2 + 23*x + 24 (with delay coef1, coef2, coef3, coef4 = 4, 10, 23, 24 msec) Enter Number of Looping (N) = 100 CPU time Stress Test in progress... Result: First Capture Execution time in millisecond: 70074936 Second Capture Execution time in millisecond: 70084228 Different Execution time in millisecond: 9292 Value of Sum from the Stress Test (polynomial) = 105512050 Press 'y' to continue or 'n' to exit the benchmark : </pre>
200	<pre>Welcome to CPU Benchmark Program Benchmark CPU time Using Equation y = 4*x^3 + 10*x^2 + 23*x + 24 (with delay coef1, coef2, coef3, coef4 = 4, 10, 23, 24 msec) Enter Number of Looping (N) = 200 CPU time Stress Test in progress... Result: First Capture Execution time in millisecond: 70130254 Second Capture Execution time in millisecond: 70148841 Different Execution time in millisecond: 18587 Value of Sum from the Stress Test (polynomial) = 1643374100 Press 'y' to continue or 'n' to exit the benchmark : </pre>
500	<pre>Welcome to CPU Benchmark Program Benchmark CPU time Using Equation y = 4*x^3 + 10*x^2 + 23*x + 24 (with delay coef1, coef2, coef3, coef4 = 4, 10, 23, 24 msec) Enter Number of Looping (N) = 500 CPU time Stress Test in progress... Result: First Capture Execution time in millisecond: 70220253 Second Capture Execution time in millisecond: 70266990 Different Execution time in millisecond: 46737 Value of Sum from the Stress Test (polynomial) = 3041518106 Press 'y' to continue or 'n' to exit the benchmark : </pre>

700	<pre>Welcome to CPU Benchmark Program Benchmark CPU time Using Equation y = 4*x^3 + 10*x^2 + 23*x + 24 (with delay coef1, coef2, coef3, coef4 = 4, 10, 23, 24 msec) Enter Number of Looping (N) = 700 CPU time Stress Test in progress... Result: First Capture Execution time in millisecond: 72225043 Second Capture Execution time in millisecond: 72292120 Different Execution time in millisecond: 67077 Value of Sum from the Stress Test (polynomial) = 1419765774 Press 'y' to continue or 'n' to exit the benchmark :</pre>
1000	<pre>Welcome to CPU Benchmark Program Benchmark CPU time Using Equation y = 4*x^3 + 10*x^2 + 23*x + 24 (with delay coef1, coef2, coef3, coef4 = 4, 10, 23, 24 msec) Enter Number of Looping (N) = 1000 CPU time Stress Test in progress... Result: First Capture Execution time in millisecond: 72305838 Second Capture Execution time in millisecond: 72401694 Different Execution time in millisecond: 95856 Value of Sum from the Stress Test (polynomial) : = 328523236 Press 'y' to continue or 'n' to exit the benchmark : </pre>
Computer D	
50	<pre>Welcome to CPU Benchmark Program Benchmark CPU time Using Equation y = 4*x^3 + 10*x^2 + 23*x + 24 (with delay coef1, coef2, coef3, coef4 = 4, 10, 23, 24 msec) Enter Number of Looping (N) = 50 CPU time Stress Test in progress... Result: First Capture Execution time in millisecond: 79848622 Second Capture Execution time in millisecond: 79853275 Different Execution time in millisecond: 4653 Value of Sum from the Stress Test (polynomial) = 6962275</pre>
100	<pre>Welcome to CPU Benchmark Program Benchmark CPU time Using Equation y = 4*x^3 + 10*x^2 + 23*x + 24 (with delay coef1, coef2, coef3, coef4 = 4, 10, 23, 24 msec) Enter Number of Looping (N) = 100 CPU time Stress Test in progress... Result: First Capture Execution time in millisecond: 79951134 Second Capture Execution time in millisecond: 79960432 Different Execution time in millisecond: 9298 Value of Sum from the Stress Test (polynomial) = 105512050</pre>

200	<pre>Welcome to CPU Benchmark Program Benchmark CPU time Using Equation y = 4*x^3 + 10*x^2 + 23*x + 24 (with delay coef1, coef2, coef3, coef4 = 4, 10, 23, 24 msec) Enter Number of Looping (N) = 200 CPU time Stress Test in progress... Result: First Capture Execution time in millisecond: 79999483 Second Capture Execution time in millisecond: 80018092 Different Execution time in millisecond: 18609 Value of Sum from the Stress Test (polynomial) = 1643374100</pre>
500	<pre>Welcome to CPU Benchmark Program Benchmark CPU time Using Equation y = 4*x^3 + 10*x^2 + 23*x + 24 (with delay coef1, coef2, coef3, coef4 = 4, 10, 23, 24 msec) Enter Number of Looping (N) = 500 CPU time Stress Test in progress... Result: First Capture Execution time in millisecond: 80068507 Second Capture Execution time in millisecond: 80114998 Different Execution time in millisecond: 46491 Value of Sum from the Stress Test (polynomial) = 3041518106</pre>
700	<pre>Welcome to CPU Benchmark Program Benchmark CPU time Using Equation y = 4*x^3 + 10*x^2 + 23*x + 24 (with delay coef1, coef2, coef3, coef4 = 4, 10, 23, 24 msec) Enter Number of Looping (N) = 700 CPU time Stress Test in progress... Result: First Capture Execution time in millisecond: 80181658 Second Capture Execution time in millisecond: 80246847 Different Execution time in millisecond: 65189 Value of Sum from the Stress Test (polynomial) = 1419765774</pre>
1000	<pre>Welcome to CPU Benchmark Program Benchmark CPU time Using Equation y = 4*x^3 + 10*x^2 + 23*x + 24 (with delay coef1, coef2, coef3, coef4 = 4, 10, 23, 24 msec) Enter Number of Looping (N) = 1000 CPU time Stress Test in progress... Result: First Capture Execution time in millisecond: 80261714 Second Capture Execution time in millisecond: 80354890 Different Execution time in millisecond: 93176 Value of Sum from the Stress Test (polynomial) = 328523236</pre>

9. Task Distribution:

Group Member	Task
EVELYN ANG	<ul style="list-style-type: none">• Benchmark Computer B• Conclusion and Reflection• Video Editing
ANGELA NGU XIN YI	<ul style="list-style-type: none">• Writing ASM Code Program• Benchmarking Result
TAN XIN TIAN	<ul style="list-style-type: none">• Benchmark Computer D• Introduction• Flowchart of the Project
TEOH XIN YEE	<ul style="list-style-type: none">• Benchmark Computer C• Analysis Result from Geekbench and MiniTool and summaries all analysis
TOH SHEE THONG	<ul style="list-style-type: none">• Benchmark Computer A• Analysis Result from CPU-Z, Task Manager and ASM Code

10. Group Picture: