# Project status report.

**Milestone: Review of all necessary specifications for Apple M2 and Intel i3 8130U microprocessors.**

**Table-I**

|  |  |  |  |
| --- | --- | --- | --- |
| **S. No** | **Parameter** | **Apple M2** | **Intel i3-8130U** |
| 1 | Architecture | “Avalanche” and “Blizzard” | “Kaby-Lake U Refresh” |
| 2 | Instruction Set | ARM V8.5-a | X86-amd64 |
| 3 | Max CPU Clock | 3.49GHz | 3.40GHz |
| 4 | Number of Cores | 8 (4 Performance cores, 4 Efficiency cores) | 2 |
| 5 | Multi-threading | No | Yes (2 per core) |
| 6 | L1 Cache | 192kB+128kB per core for  performance cores and 192kB+64kB per core for efficiency cores. | 128kB per core |
| 7 | L2 Cache | 16MB (Performance cores), 4MB (Efficiency cores) | 512kB per core |
| 8 | L3 Cache | 8MB Shared | 2MB |
| 9 | Memory | 8GB LPDDR4X Unified Memory | 4GB LPDDR3 Memory |
| 10 | TDP (Max) | 20W | 15W |

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From Table-I, upon a preliminary examination of the abovementioned specifications, the Apple M2 microprocessor appears to be the more advanced and more powerful in comparison to its Intel counterpart. The greater number of cores, higher TDP, higher cache and a marginally faster peak clock speed all contribute to us coming to an initial conclusion of the Apple M2 processor being the better one.

**Milestone: Measurement and comparison of clock speed.**

A highly sequential load was simulated on both the processors using the exact same program, programming language and compiler. For the purpose of reference, the same code was run on a remote server. The methodology is discussed in detail in the subsequent paragraphs.

* The task assigned to the processors was to estimate the first one million digits of π using the Lebniz theorem.
* The number of clock cycles passed to perform the above task was then determined.
* This quantity is a factor of the CPU clock speed and the CPU instruction set.
* To have a clear picture of the relative performance of the CPUs, the above program was run repeatedly for 6 iterations and then an average value of the number of clock cycles was considered for comparison.
* Table-II contains a detailed overview of this process.

**Table-II**

|  |  |  |
| --- | --- | --- |
| **S. No.** | **Parameter** | **Value** |
| 1 | Programming Language | C |
| 2 | Operating System | MacOS Ventura (M2), Windows 11(i3), Linux Mint 20.04 (i3) |
| 3 | Compiler | GNU C Compiler |
| 4 | Online Compiler | Online GDB |

Table-III highlights the results obtained upon running our test

**Time-III**

|  |  |  |
| --- | --- | --- |
| **S. No** | **Machine** | **Number of Cycles (Average) (Based on wall-clock time)** |
| 1 | Server | 19575 |
| 2 | I3 (Windows) | 17044 |
| 2.1 | I3 (Linux) | 28605 |
| 3 | M2 | 10843 |

**Inference:** Upon continuously testing and re-testing the machines, it was found that the Apple M2 microprocessor was consistently faster than Intel i3. The execution time required by the Apple processor was significantly lower than its Intel counterpart.

Moving forward, the next aim of the project is to compare the relative cache performances of the microprocessors such as hit-time, miss-time, hit-rate, miss-rate, read-write performance and security. The comparison will be done by using both standard tools like CACTI/ChampSim and our own custom script.

**References**

1. <https://en.wikipedia.org/wiki/Apple_M2>
2. <https://en.wikichip.org/wiki/intel/core_i3/i3-8130u>
3. <https://ark.intel.com/content/www/us/en/ark/products/137977/intel-core-i38130u-processor-4m-cache-up-to-3-40-ghz.html>
4. <https://proofwiki.org/wiki/Leibniz's_Formula_for_Pi#:~:text=%CF%80%3D4%E2%88%91k%E2%89%A5,k12k%2B1>
5. <https://www.onlinegdb.com/online_c_compiler>

**Code:** <https://github.com/ShreyasMaitreya/Term-Project-Devasish-Shreyas/commit/03f81c9802b6150688434c363c5288b8dc8c8dc8>