The Future of Chips and its Relation with Web Application Development

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Abstract

The experimentations conducted were to solely show how the chips differ in processing speeds and in web application programs. The first experiment conducted was tested while running localhost with a MAMP software. First, to run the test a snippet of PHP code was created with criteria and constraints in order for the computer to know what results were expected. Three trials were done, each on the Apple M1 Mac and on the Windows i7 core. The results indicated that the Windows i7 took less time which means that it was faster and more efficient in coding on a web development software.

The second experiment took place on a Safari and a Windows browser. The program used was called Speedometer 2.0. This allowed the user to see how fast the computer could load pages, do tasks, switch tabs/programs, and etc. Three trials were conducted for the first condition: it was having eight tabs open with one program open as well. Another three trials were conducted for the other conditions, which were having no tabs or software applications open at all. The result for both conditions was that the M1 beat the Intel i7 significantly. This concludes that the M1 was better in overall general speed and could do tasks easier and at faster speeds.

Both experiments showed that the chips were both good in their own unique way, however, since the M1 is new it still has to adapt to programmer applications. Programming still can be done on the M1, however the Intel i7 Core is built better for coding and slower processing times.

Review of Literature

Introduction

In today's world, we rely on the heart of technology, known as the chip, but as humans evolve we demand more powerful machines, which raises the question of what the chip industry will look like in the future? How powerful our devices are depends on the design of the chip and the materials. Researchers are trying to figure out why different chips work better because that is how we will continue to improve electronics. Chips designated for Windows computers are different from the ones Apple has designed. Depending on the user, they may choose a chip purposeful for them and that suits them. Chips are not just in computers, but they are implemented in tablets, cars, and possibly in human bones. Chip demand is increasing rapidly and before we know it, robots will be common. Although, before that happens the chip industry should be heavily focused on. The correlation between programming and coding has a dynamic that works together like a puzzle. In our time, coders are trying to write code more effectively and quickly instead of prioritizing the code so that it runs faster. However, if humans want to make advancements in robotics, artificial intelligence, and machine learning, then we will need huge amounts of computational power from chips. Each chip has semiconductors which can be laid out in different positions. Companies are trying to experiment with new materials like silicone to see if that provides faster speeds and efficiency. Chips in general are vital in any advanced technology. With new materials and design ideas, computing can be changed which will deeply impact the future.

M1 vs Intel Chips and Functionality of the Chips

The two leading companies in the chip industry are Microsoft and Apple. Intel has created different versions of chips like Intel i9, Intel i7 and etc, which are all used in different types of computers. Other popular chips used in devices are known as Quallcomm, AMD, Ryzen, etc. On the contrary, Apple has chips known as the M1 and the A series chips used in Ipads and Macs. The different functions and characteristics of the chips allows the computer to run in a certain way. This can affect many technology users who want the performance of their devices to be more efficient and speedy. Understanding the aspects and comparing both companies' chips shows society what's heading in the future and how semiconductors will need to improve.

The M1 silicone chip uses ARM architecture with less power consumption. The M1 has remarkable fast and efficient CPU and GPU performances, according to Apple. When comparing raw speeds with the M1 chip, it is faster than the 11th generation chips, although this does not mean it's faster overall. Tracy (2021) states, "Even when running the benchmark through an emulator, the MacBook Air with 16GB of RAM scored a 5,962, topping the latest XPS 13 (5,319) with 11th Gen chips" (para. 10). This was an overall system performance test using an emulator, but with other applications like Google Chrome and Microsoft Office favored the Intel i7 Chip. Because Microsoft mostly designates their users to use applications like Microsoft Office or Google Chrome, it makes sense why it runs faster on these apps. Since Apple mainly uses Safari and does not have a built-in Microsoft Office on the M1 computers, it will not be as fast as the i7 chip. "In general, we found the M1 to match or outperform rival Intel chips in the tests we ran" (Tracy 2021 para. 13). The comparisons between the chips are quite fascinating because they both work well in certain applications. Overall, the M1 is better in overall speed

testing, which makes it a better general buy. The disadvantage of the M1 is that there is a less variety of games due to Apple's Rosetta software. Many new release games won't run because the Mac does not support the requirements needed for the games. An AMD or Ryzen chip would be more purposeful and useful to a gamer that will allow there to be great graphics and FPS.

Due to the success of the M1 chip, in 2022 Apple released the M1 Pro and M1 Max with similar functions but better performances than their first generation. Many people appreciate the advancement and look forward to more emerging chips that will be better than the last. Manjoo (2022) explains, "Today's fastest phones are more powerful than computers from just a few years ago" (para. 16). Manjoo demonstrates how this is the start of what technologies are going to look like and how there is a long road ahead of many companies. Similarly Moorhead (2020) states, "It's good that this has reopened the conversation of silicon. I have always believed that silicon was strategic and the rest of the industry is starting to agree and act" (para. 5). This shows his opinion on silicone and how the industry should seek this and follow the example. The perfect chip has yet to exist. Furthermore, as companies progress and learn new ideas, a chip will emerge with all functions for all users needs.

Chip Interior Design and Companies Approach

In order to exceed and beat out all the past chips there needs to be extensive focus on the design/layout of the chips. Positioning the semiconductors and having the right type of materials will allow future technologies to advance. The type of elements that are used in semiconductors allow the chips to vary in performances. Material plays a big factor and even data proves that one company's chip can have better outcomes when compared to other materials that are being used.

Currently, silicone chips are the "new thing", but for the automobile industry they are trying to make their electric cars have longer ranges and faster charging times. Semiconductor

companies suggest Electric Vehicle manufacturers to use either silicone carbide or gallium nitride. “It does a better job as a power converter, meaning chips using the material can move energy around with less of it getting lost along the way. The same is true of gallium nitride, which is made of gallium and nitrogen and — like silicon carbide — has a distinct edge over traditional silicon. Proponents say it could cut charging time in half” (King and Coppola 2021 para. 3). The authors suggest that using a different material chip will save charging times and energy consumption will be less. Just because an electric car has a good battery or a good motor does not mean the vehicle is a good buy. Companies need to take their insight to semiconductor companies because the future is about optimization now.

As companies compete they try to create new ideas to position certain designs inside of the chip. AMD 3D chiplet technology was recently released in 2021 and has been a success on the gaming and PC side. Their approach is instead of having everything on one big chip they created chiplets which break smaller components and are merged into a large processor. AMD uses the term “packaging and stacking” to describe their method of the chiplet. Instead of the regular method of a chip spreading all the components widely. The CPU, logic units and cache memory are all stacked on each other perfectly fitting into the vertical area. This saves up more surface area on the chiplet because it is similar to the concept of skyscrapers. Everything is compact and tidy and there is more room for other components. Cache memory is vital for the processor, it stores the most important information and programming instructions for the device. “The larger the cache, the more data can be stored there so the processor doesn't have to fetch new data from RAM, which takes longer and slows down performance” (Loeffler 2021 para. 4). It's crucially important that data can be stored efficiently for users without having any flaws in the performance. Usually when a user is storing information and their cache memory is being

used, the performance is usually slow. However with the concept of stacking, less energy is being used.

Other companies are also approaching the vertical stacking methods. IBM and Samsung have partnered up and revealed a new microchip design in 2021. The challenge was that they wanted to make computers more powerful and faster, however to do that they need more transistors. At the same time they needed to make the chips micro, but the only way to do that was to keep packing them in the same region. The design allows them to stack transistor components vertically. This time the electrical current will be flowing up and down allowing more transistors to stack side to side. The design is efficient and allows batteries to last longer and computers will produce less heat. “Replacing silicon with other materials, such as graphene, might unleash big upgrades in performance, too” (Houser 2021 para 10). Silicon may not be the only way to increase power in computers. Although replacing silicon may take some time, using methods like stacking can be a great way to improve efficiency. Companies learning from each other helps increase new ideas to improve chips and it allows manufacturers to consider other options for the future.

Microchips Improving life

As humans seek to improve microchips, they will have a deep impact in human life. Soon we will see the newest microchips in cars, watches, GPS, robots and more. Each new advancement has a profound influence on other technologies and how they will make human life more simpler.

One of the biggest manufacturing companies for electric vehicles is Tesla. They are one of the first users of silicone carbide chips. Using silicone carbide chips allows Tesla an advantage because they are ahead of other electric vehicles. “It provides for longer ranges because there’s

less leakage — wasted power — as a car taps the energy needed to drive motors. Infineon Technologies AG, the biggest maker of automotive chips, expects silicon carbide to exceed more than 30% of the market in electric-vehicle power chips by 2025" (King and Coppola 2021 para. 3). With a non silicone-carbide chip power can be exceeded and used when unnecessary. Without even realizing, the chip Tesla is using puts people in a big advantage when saving power and money.

Osseosurface electronic devices are on its way and it's going to save many lives. With the help of microchips that are implemented in bones allows Doctors to monitor the bone through the chip. The chip placed is an ultra-thin device that is wireless and it will help practitioners help the patients to make clinical decisions like if they have to remove rods or screws. Muscles are pretty close to the bones, so it is important to make sure the chip does not cause the patient any iteration. "The bone basically thinks the device is part of it, and grows to the sensor itself," Gutruf said. "This allows it to form a permanent bond to the bone and take measurements over long periods of time" (Melore 2021, para 8). The chips basically become the bone and it helps the recovery process and therapy for the patient.

Web Application Development

Programming and chips definitely do have a correlation, it might not be easily seen. However, when looking in depth on how the type of chips can affect coding can show the vast improvements chips need.

The way it works is that when a coder writes a code it does not matter what language but when it gets processed (run by the computer) it will take time and output the result. "For decades programmers have been able to prioritize writing code quickly—rather than writing it so that it runs quickly—because smaller, faster computer chips have always been able to pick up the slack

(Shien 2020 para 4). Normally, coders don't really worry about how fast the code will run but, instead, make sure the code is written fast. However, researchers are still trying to improve performance so that the chips and programmers can work together and tackle any systematic issues.

Comparing processing speeds allows a programmer to get a gist of how fast their MAMP, WAMP or LAMP server will run. If a user has a different generation of an Intel chip, they may expect different speeds than someone with another chip. This also impacts the future of coding or running any application to get to the coding script. When writing a code, a person might hop onto a software such as Jupyter or Wordpress. Some might experience a slow transition to get on there or the individual can get there right away. "The i7 processors are Intel's high-performance models, the fastest of which runs at 3.8 GHz. Most of these processors have two or more cores, allowing several programs to run at the same time" (Papiewski 2016 para 30). Sometimes a programmer needs to run multiple softwares and this takes power consumption. When looking at what chips to use its best to focus on which one has the best performance. "Usually, AMD and INTEL are excellent for users, but AMD processors are considered better for Multitasking than Intel processors" (Mitra 2022 para 3). It's important to take note of what processor is good for multitasking because programmers look for flow and switching to applications swiftly. As chip creations are on the rise, programmers are eager to test out which chip will work best with their work.

Data Collection and Analysis

Methods

The First method that was used was to test the localhost process speeds. In order to test localhost, a MAMP software will have to run. After the program is running, the individual will

type localhost into Safari or a Windows browser to ensure everything is running. Localhost is used for web developers or administrators to test and create their sites. The code written to test the processing times was in PHP. However, the technique used in the code can be modified and by measuring a specific process should give more accurate relative response times. There are always a lot of processes running on a laptop, so it is not exact but by limiting the other processes and running a computationally intensive program, should allow a good result. By averaging the three trials, an estimate of the process times will be produced. This was done on both computers for comparing and contrasting.

The next experiment was testing the computer's ability to do tasks, commands, and browser speeds while carrying out the task. For the experimentation to start, a speedometer was used and opened on both computers' browsers. Three trials were conducted for both computers under two conditions. The first condition was with a bunch of tabs and some applications running and the second was with nothing running.

Experiment 1: Localhost Process Speed

```
<?php
/* PHP code that finds all prime numbers less than the target.
 * Code is not most efficient method because it is intended to
 * roughly compare processing times of two processing chips.
 */

// Driver code
$hits = 0; // sum of prime numbers found
$target = 100000; // upper limit to check
$number = 2; // initialize
$start_time = microtime(TRUE); // returns time in microsecondes
while ( ++$number < $target ) {
    $flag = primeCheck( $number );
    if ( 1 == $flag ) {
        // increment the number of prime hits
        ++$hits;
    }
}
$total_time = microtime(TRUE) - $start_time;
```

```
echo ('FINISHED<br>');
echo('Count of prime numbers < ' . $target . ' = ' . $hits . '<br>');
echo('<br>Processing time: ' . round( $total_time, 4 ) . ' seconds.' );

// Function to check whether the number is Prime
function primeCheck( $number ) {
    for ($i = 2; $i <= $number/2; $i++) {
        if ($number % $i == 0) {
            return 0;
        }
    }
    return 1;
}
```

This was the code used to get the results for the localhost processing speeds for each computer.

Computer/Chip make	Test Trials	Results	Final average
Apple Mac M1	1	8.23 seconds	
-	2	8.12 seconds	
-	3	8.31 seconds	8.22 seconds

Computer/Chip make	Test Trials	Results	Final average
Windows intel Core i7	1	7.22 seconds	
-	2	7.43 seconds	
-	3	7.42 seconds	7.35 seconds

Experiment Speedometer : Using speedometer 2.0

Condition: with 8 tabs open and 1 software application open

Computer/Chip make	Test Trials	Results	Final average
Apple Mac M1	1	107	

-	2	115	
-	3	119	113.6 runs/mins

Computer/Chip make	Test Trials	Results	Final average
Windows Intel Core i7	1	153	
-	2	152	
-	3	160	155 runs/mins

Condition: No Tabs and no software applications open

Computer/Chip make	Test Trials	Results	Final average
Apple Mac M1	1	67	
-	2	81	
-	3	88	58.6 runs/mins

Computer/Chip make	Test Trials	Results	Final average
Windows Intel Core i7	1	107	
-	2	120	
-	3	112	113 runs/mins

Data Analysis and Discussion

The localhost process speeds were an intricate and complicated code even though it was just a snippet of a code block. However, it took some time to create the loop that included the start time and the end time. The code includes requirements and that's how the computer programs the result. The computer was asked to use a target number of 100,000, which is a constraint and makes the programming get the result in a limited area. Furthermore, the Mac M1 averaged about 8.22 seconds with a targeted number of 100,00. The Windows Intel Core i7 had an average of 7.35 seconds. When comparing the numbers, it shows that the Intel chip has a lower number than the M1. This indicates that M1 has a slower response time for localhost applications " For example, content creators report that the latest Intel Core i7 11th generation processor is about 1.1-1.2 times faster than the Apple M1 in 4K files conversion. Intel Core i7 also outperforms the Apple M1 chip by a mile when using machine learning/AI programs" (Bohomolova 2021 para 7). Content creators have had similar data like the localhost experimentation. Since localhost is used for web development, it would be a better choice to use Intel; however, the difference between 8.22 and 7.35 is .9. This concludes that when using heavy duty software programs for programming Intel i7 takes the lead.

The second experimentation was a little more broader than the last experiment. The speedometer 2.0 tests out many things at once instead of just a processing time for a specific server. The test allows the user to see the overall performance of the computer. The data might be better to see how "fast" the browser/processor is for multiple tasks at once. Two conditions were conducted for this test. One with multiple tabs and applications running and one condition with nothing running. Three trials were done and for the M1 chip it received an average of 113.6 runs/mins with items running. For the Intel i7 Core chip it had an average of 155 runs/mins.

There is a significant difference in this experiment for speed testing. For the next condition with nothing running, this time the Intel i7 finally decreased and got 113 runs/mins and the M1 received 58.6 runs/mins average. “And even though Intel offers a higher base frequency, it still lags behind the M1. So, if we dismiss the software adaptation factor, M1 wins the Apple M1 chip vs Intel i7 standoff in speed and overall performance ” (Bohomolova 2021 para 6). The trials that were done are similar to what Bhomolovs is trying to say when talking about the hardware and ram storage components: Intel i7 Core is better but when just checking how fast a person can switch from browser to browser or to another program then the M1 is ahead.

Other experiments that could possibly be done is comparing another software program related to web application development similar to experiment one. By writing another block of code and then putting it into a Jupyter used in Python. Then both the MAMP experiment and the Jupyter results can be compared with processing speeds.

This does in fact show the room for improvement in both chips and how each chip has its own advantage and disadvantage depending on the user. The reason why the new silicon M1 can’t compete with Intel i7 in the web development realm is because the M1 is a new chip and there are not that many generations out yet unlike the Intel’s. Programmers are dependent on coding apps like Wordpress, Slack, Github etc which work better with Intel. It’s not that the M1 is incomparable but the reason being is the programs are still being optimized for the M1 chips since the generation is fairly new.

Conclusion

Without the advancement of microchips in the future, we are left with technology that will not be too powerful as predicted. Most of us don’t want our computers to be running slow as they age and chips are a big contribution in that. However, research shows that companies are

competing to make better microprocessors and that's essential because humans want technology that is efficient and effortless. Chips not only change the future but it changes how we are going to "use technology." Every minute counts from when a person codes or just checks their regular email but with the help of new designs and semiconductor layouts we will see more improved electronics than before. Companies will face head on trying to create the best chips for different purposes to satisfy customers needs. Investments are vital in the chip industry for the future because that is where we start in the advanced artificial intelligence era. Using technology like 3D vertical chiplet and the transistors stacked vertically will help change the future. New materials like silicone carbide and gallium nitrate will take a while to get to the top but it creates a way to have a powerful computer for all purposes. The data clearly show that currently both chips can be the best in different categories. However, the M1 is better when comparing the overall status with Intel i7 Core, but still it has a long way to go in order for it to work effectively in web development applications.

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