Microchips empower our society, microchips empower you. Microchips are everywhere, they are in your computer, in your television, and even in your oven! Microchips are little electrical devices that process commands depending on information the Microchip has. Microchips, depending on their commands, control other devices. It can range from controlling a light to conversing with another microchip to even controlling weapons, microchips are very diverse when it comes to their functionality. Microchips have a pretty interesting and fast paced history, they also have really interesting scientific principles, and they matter in our day-to-day lives.

Before microchips, there were huge computers, such as the ENIAC that was a colossal 2'x2'x8'. The ENIAC was the first Electronic Computer, unveiled in 1946. Before Microchips computers relied on Vacuum Tubes. Vacuum Tubes were Electric Gates of the past. Vacuum tubes were huge, they varied between 1.5 inches to 6 inches each! Although they required plenty of requirements they were very fickle. The ENIAC used an estimated 17,468 vacuum tubes, which may seem like a lot but today a computer that costs a couple of bucks has millions of transistors! Transistors are Vacuum Tubes successor, discovered in 1947, they were the revolution that led to the first microchip! Transistors work by taking in electricity, and only letting it through if the gate has a small voltage! The first commercially available transistors were around 1 centimeter(~0.4 inches), which is a huge step from Vacuum Tubes but huge compared to today's standards. Jack Kilby created the first microchip in 1958! The early 1960's marked the end of computers using Vacuum tubes.

Microchips have had many milestones since their invention in 1958. Jack Kilby created the first microchip on Germanium, a rare element, it was a huge step forward for electronic computers! It was simple and consisted of only a transistor and other components on a slice of

Germanium. Although the first microchip was very weak in terms of processing power, it created a new standard for computers.

Microchips had a very important use in the first moon landing. In 1966 the Apollo Guidance Computer(AGC), a 70lb computer, flew the first unmanned Apollo test mission! Although the AGC was not considered a microchip, it consisted of silicone microchips! The AGC had 4.096 kilobytes of RAM. Although that is merely any RAM today, back then it was a significant amount. Because of the AGC the first moon landing was possible.

In 1971, the Intel 4004 was unveiled. It was the first commercially available Central Processing Unit(CPU) and had 640 bytes of RAM! Although It was a step back from the 4 kilobytes of RAM of the AGC that was released 5 years prior, the Intel 4004 cost $479.9(Adjusted for inflation) compared to the AGC's 2 million dollar price tag(Adjusted for inflation). The Intel 4004 was originally made for Nippon Calculating Machine Corp. for the Busicom 141-PF calculator.

The CPU is not the only microchip unveiled in the 20th century. Right before Y2K, in the year 1999, the NVIDIA GeForce 256, which is the first GPU, was released! It marked the beginning of more realistic graphics, leading to realistic computer animations and games that look more realistic! It was a step forward because professional movie studios can make more realistic animations faster! It was also revolutionary because games could look way more realistic, and way more detailed while rendering in real time!

Microchips have had many upgrades and gone through great innovation to be what they are today! One year after the invention of microchips, Robert Noyce created the first silicon chip, a huge advancement for Microchips. The upgrade to silicon paved the way for smaller, more compact, and more powerful chips such as those in modern computers!

One way to make silicon microchips, Photolithography, was invented in 1965. Photolithography became the standard method of creating Microchips. It works by taking a

silicon wafer, then a light sensitive chemical is added, then you use a stencil to shine a UV light into the chemical in the pattern desired. Next, parts of the chemical that was exposed to the light dissolves or the other part dissolves(depending on the chemical), then plasma etches the part where the chemical is not present. Then that is repeated around a thousand times, creating more layers. Each layer can take 10 minutes all the way to more than an hour! It is how we make very complex microchips, even more than half a century later!

Although Photolithography was invented very early in the history of the microchip, two decades later, in 1998 the first 1 Gigabyte Ram Module developed by Hitachi was announced. It was assembled using 36 32 Megabyte(256 Megabits) Modules, which initially cost $6000($11,925.50 adjusted for inflation)! Today you can get 768 times that worth of Ram for $11,971.14! Although 1 Gigabyte of ram is tiny today and low end phones can get twice that, perhaps 27 years in the future 768 Gigabytes will probably seem tiny too!

Another great upgrade, came in 2007 with the invention of the iPhone. It was the first of its kind, a computer that can fit in your pocket while having many functions! It set a new high standard for the smartphone and it had an integrated System on Chip(SoC) that combines many electronic components into one chip. Although it carried 128 Megabytes of Ram, which is small compared to today's smartphones, it was very little to the 2gb standard for full sized computers at the time! The invention of this and subsequent other smart phones revolutionized our society and access to computers.

Microchips have come a long way since their debut 67 years ago, and smartphones have additionally come a long way in 18 years. In late 2025, the cheapest new smartphone, the Samsung Galaxy A26 5G comes with at least 4 Gigabytes of Ram while costing just under $200! Today for computers the standard is 16-32 gigabytes of Ram while having a Graphical Processing Unit. Today small computers are in nearly every teen and adult's pockets. Also many adults have at least one computer to work on. Microchips are everywhere, from inside phone

chargers to in everyday objects and even in household appliances and are very easy to implement into projects. Today 128 gigabytes of ram can fit inside a small form factor, and in the near future you can inevitably fit more into an even smaller form factor.

However the progression of the microchip has hit a roadblock. The problem is that the transistors that make Microchips can only get so small. We are very close to the line between performance and lots of errors. We want to get the most out of transistors but if they are too small electrons will become fickle, and break through intended barriers. Today transistors are 3 nanometers wide, that is more than 2500 times less than a human hair!

Microchips have another problem that may halt progression. Microchips use rare earth metals such as Gold, Yttrium, Lanthanum, Cerium, Europium, Gadolinium, and Neodymium. Some of them are very hard to find, such as Gadolinium and Europium. Gold is a very popular rare earth metal but very little gold is used, only a few cents worth.

Although there are barriers preventing the growth of Microchips, it is inevitable to break modern barriers and grow a lot. Microchips need to improve to satisfy the requirements for many new technologies. Microchips need to improve for more realistic movies or nicer gaming both faster and better. The demand for better microchips is growing and growing. As we create better programs for computers or smartphones, the need for power grows, both for home users and for industrial purposes. Microchips would have to take a different approach to get so much more powerful, such as using quantum computing.

Microchips have many associated technologies, including itself! Microchips are made in different ways, including Photolithography, Electron-Beam Lithography, Focused Ion Beam, Nanoimprint Lithography, and more. Microchips are not one type of technology, they can vary from graphical processors to math machines to single purpose parts, to math maniacs! Microchips take in data, whether it is sensor data, internal data, or code and Microchips process it to generate an outcome!

Photolithography is the most popular way to create a microchip. Photolithography takes a thin wafer, coats it in a light sensitive film called photoresist. Then you shine UV light in the desired pattern. Next you develop the photoresist, parts that were light exposed stay and the rest dissolves(or vice versa)! Then you remove parts without photoresist and repeat for every layer(around 1000 times). The costly machines needed to do Photolithography are only made by one company, ASML, and they can cost hundreds of millions of dollars!

There are many types of Microchips, the simplest is an ASIC. ASIC stands for ‘Application-Specific Integrated Circuit”, and are single purpose microchips. They do repeated tasks faster, and more efficiently than other types of Microchips. ASICs can be used in cars for collision detection, they can be used as devices that can be implanted into your body, they can mine crypto, and do much more!

There are more complicated microchips but also have a wider range of use cases. Processing Units are the main part of any computer. They come in 3 main flavors: CPUs are known as the brains of computers and they process data, GPUs are used for faster and better computer graphics and also for training AI models, and NPUs run trained Artificial Intelligence models quickly and efficiently. CPUs, also known as Central Processing Units, fetch instructions from memory, decode them, and run them. CPUs take in and output information and have multiple cores for multitasking! GPUs, also known as Graphical Processing Units, excel in rendering graphics and training AI models, they run thousands of calculations at the same time! NPUs, also known as Neural Processing Units, make AI tasks better, faster, and stronger by specializing in optimizing Neural Networks, which is a way to create AI!

But every person who codes microchips must start somewhere. Microcontrollers, also known as Programmable Devboards, are what hobbyists usually use to make projects come to life with simple commands. There are many different Programmable devboards, ranging from a couple of bucks to $20. You use a software called an Integrated Development Environment

(IDE) to write the code, check for errors, convert to computer code and then upload the code to the devboard!

Microchips work using many scientific principles, one example is Band theory. Band theory is a way to understand why electricity passes through some objects and not others. Conductivity is based on how many valence electrons an atom has, the less valence electrons there are the more conductive it is. Think of it as a bridge, conductors are a full and stable bridge, allowing for the flow of cars. Insulators are a bridge that has been blocked not allowing cars to pass to the other side. Semiconductors are more dynamic, think of them as a moving bridge, sometimes allowing the flow of cars sometimes not, and in semiconductors when a separate current is on the bridge allows cars to pass through and when off it does not allow cars to pass, but in Microchips the change is nearly instant. Microchips take advantage of semiconductor properties to complete calculations and many more. Without semiconductor properties, microchips would not be possible.

Ohm's law also describes how electrons flow. Voltage, measured in Volts, is the force to drive electrons from point A to point B. Voltage is calculated by multiplying the resistance of electrons (measured in Ohms) and how many electrons pass through a point at a unit of time (Measured in Amps). Let's use a highway analogy. Voltage is how strong the engine of a car is, it's the push that drives the cars forward. Resistance is similar to lane closure, which forces cars to merge which slows cars down. Current, measured in Amps, is how many cars pass through a point in a unit of time. The cars represent electrons flowing. Microchips run on electricity, but too much electricity means something sometimes breaks, too little and it wont run correctly.

Microchips use Photochemical change in the production process. Photochemical change is when a chemical reaction occurs when something absorbs light, for example Photosynthesis. Photosynthesis takes light and acts as energy to convert molecules into other molecules. In

Microchips, Photochemical change is used in photolithography, a popular way to make Microchips.

Microchips also use other components to work better and more reliably. One example is a P-N Junction. It is where a P-type atom has an excess electron, so it chooses to leave to find a more stable condition inside of a N-type atom. Then the electron is pushed out of the N-type atom and that causes current. And the P-type electron is refilled so that the electron cannot go back.

How do you know a microchip is better than others? You need data to compare different types of microchips to find the superior one. There are many types of data that can be collected for Microchips, one is RAM. RAM, which stands for Random Access Memory, is quick temporary storage that allows the computer to do computations. RAM is faster than other types of storage but loses data as it loses power. RAM is a type of digital storage and therefore is measured in the same unit regular storage is measured in (ie. Gigabytes).

Computing power, which is usually mistaken for RAM, is the speed of which calculations can be done. Computing power is measured in Clock Speed(GHz) and Cores. The Ram is the temporary storage, which allows more computations to be stored and fetched. Computing power is generally overlooked in videos, but it is a very important data point.

After all the operating systems, how much computing power is left for software to use? Single/Multi core benchmarks are ways to measure how much computing power a CPU has, it measures speed and efficiency. The difference between Single and Multi core is if it is measuring a single core or all available cores. A core is essentially a mini-processor inside the whole processor. The result of the test is not only influenced by the chip, but by how good the software is. The more optimized the software is the better result will come out for both Single and Multi core benchmarks. The result is a point based system, but there is no single unit, it varies depending on the testing software.

A Microchip uses that power to process, both code and an “Input”. The code is the instructions and the input can vary a lot, whether it is an internal sensor, a simple button, a complex set of data, or written instructions. A microprocessor takes inputs, processes them in accordance with the code, then they produce and output. The output can be a light, a screen, or text for the human to understand what is going on.

Microchips created phenomenal improvements in both the past and the present. Microchips helped make previously complicated tasks easy. Prior to microchips, typewriters were the way to make documents, but today typewriters are obsolete due to microchips. Typewriters were purely mechanical, which was limiting, but today digital software such as Google docs are the modern typewriter while having significantly more and better features. Microchips made it so that you can have a shared document with anyone in the world while hundreds of thousands of documents can exist on your computer.

You can share anything with the world by harnessing the Internet, powered by many microchips, and used by microchips. The internet is a way to connect two microchips over vast distances, or with people in the same room. The internet is one of the biggest advancements ever achieved by Mankind. Microchips use the internet to send sensor data from one device to another, allowing people to hear each other in real time. You can also download software with a microchip, or to book an appointment at the hair salon. The internet has helped people make massive discoveries that are used today, and is powered by Microchips.

Using the internet, you can share new types of documents that are not possible without microchips. The new types of documents are created using a digital workspace called Software. Software is a program that does something, whether it is playing games to creating types of media, software is very distinctive. You can also create software with software to solve a problem or make something for fun.

Microchips don't just help for creation, they additionally help people track where something is from across the world. Using RFID two microchips talk to each other over short distances and one main chip can log where it was last detected. This allows people to know where their package is without a person rummaging through a pile to find where the package is. Using the same technology, a microchip inside of a lost pet gives an ID which on the internet is searched to find the owner of the lost pet. In our society, we want to know where everything is and who something belongs to, Microchips help us do that.

There are many new types of technology that are only possible using microchips. One example is Artificial Intelligence. Artificial Intelligence is an emerging technology. Despite how emerging it is, it's already unbelievably powerful. Artificial Intelligence, as the name suggests, is mimicking a human in terms of thinking while being significantly faster. The problem is that AI uses a ton of water and electricity. New types of microchips already exist just for AI, but we need to improve more if we don't want AI to bankrupt our supply of water and electricity

You can also harness AI and better microchips to help research medicine. Both already do help research medicine, but we could benefit if microchips research medicine without human intervention. A microchip can search through many types of medicines and find the best one for the patient or for everyone. Microchips have already helped researchers in finding really good chemicals for their specific job, so in the future it may not just help, but do it.

Helping us from the inside in a different way, Brain Computer Interfaces are microchips that read data from your brain and interpret it as computer commands. Sometimes BCIs can talk to your brain directly. This is powerful because instead of needing a device in your pocket, you just have one 24/7 in your brain, and it cannot be stolen. It also improves the speed of our connection to technology. Instead of typing at 50 words per minute, we can harness BCIs and do the same at 150 wpm or more! There are two main categories of BCIs, non-invasive and invasive, which sit on top of your head and invasive sits inside your skull.

Microchips must improve drastically for security, accuracy, and better results in Brain computer interfaces. We need security to be better so that someone's mind literally is not up for grabs because of a security flaw. We also need better accuracy for better results, because if something extra important gets misinterpreted when you are sending an email, it can be job or no job sometimes.

Another field Microchips can benefit is the field of Robotics. Robotics is a field of technology where people make robots and it is already powered by Microchips. It uses motors that move, cameras that capture images, sensors that sense the environment, and more. All of that is run by a microchip, the brain of the robot. The microchips, and the software that tells the microchip how to move will definitely improve. When they do improve, it will be easier and faster to make robots while making them more reliable.

Microchips have a very fascinating and relatively short history, extremely intriguing scientific principles, and affect our everyday lives. Although Microchips did not even exist a century ago, we already are finding some hurdles on the road of innovation. Microchips are needed because of the technological shift in our society. But microchips are definitely going to break more barriers, because as Gordon Moore, a co-founder of Intel said: “The number of transistors and resistors on a chip doubles every 24 months.” That means microchips are certain to continue to break barriers we think we can't pass.