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COMP 262

GPU and CPU: Two peas in a pod

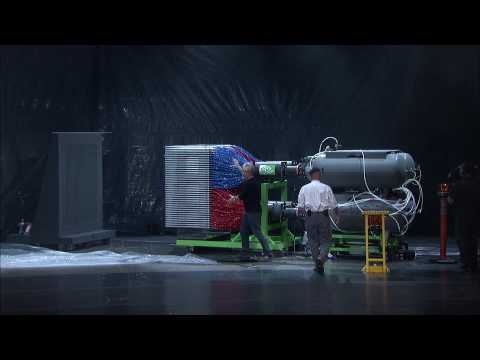
As time goes on, Technology seems to keep increasing at a vast pace. Most people have played or play some sort of game on their computer, or cell phone. Also, most people have taken videos, weather that be on a high-resolution camera or your cell phone. As technology keeps increasing, games and video editing, and many programs have become very data dependent. The CPU (central processing unit) has often been known as the brains of the PC. A CPU is expected to process a task as fast as possible. The only problem with this, is as games and videos and programs are becoming more and more data dependent, CPU chips alone cannot handle the significant data flowing through. This usually makes them only provide basic graphics that can usually only produce application like Microsoft PowerPoint, and low-resolution videos and games. This is where the GPU (graphics processing unit) comes to play. As the CPU is the brains of the PC, the GPU could be considered the soul of the CPU. The GPU goes way further than the basic graphics that are performed by the CPU. It is a programmable power computation device in its own right. The GPU is capable of processing a maximum of tasks on a large scale of data. GPUs are evolving very fast. Keep in mind, the priority of the two are not the same, but both parts are important as technology keeps advancing, and the increasing demand for processing large scales of data make GPU very important.[1]

When GPU’s were originally created, they were created for 3D game rendering. But they have now evolved to process large amount of data. As Nathan Brookwood said in his interview with BusinessWeek, “GPUs are optimized for taking huge batches of data and performing the same operations over and over very quickly, unlike PC microprocessors, which tend to skip all over the place.” [2] If we look at the architecture side of a CPU versus a GPU, the CPU is composed of a few cores with a lot of cache memory, or very expensive but fast way to process data. This makes running smaller size applications very efficient and fast, but on a larger scale it can process the whole application in the cache alone because it can’t store enough memory. The GPU is composed of hundreds of cores that can handle thousands of threads simultaneously. This can help increase speed of some software by a huge gap over a CPU. We like to consider the GPU as a highly parallel processing unit. [1]



As we see in the picture above, the GPU has an increased number of processing units (cores) and the CPU have a expanded cache with a control unit. If we compare a modern GPU like the Nvidia GTTX 1080, which has 2560 cores! This means it can execute 2560 instructions during one clock cycle. When comparing that to a Intel i7 CPU which can only execute six instructions per clock cycle. So why don’t we just always use GPU’s in computers if they are so much more efficient? This would seem logical, but remember, CPUs are much more flexible than GPUs. Where GPUs fall short is in programs which cannot be parallelized, and programs that require more features. These programs usually have complex operations that they have to work through, like your operating system.[3] CPU have a lot larger instruction set, which means they can perform a wider range of tasks. CPUs also run at a higher clock speed and are capable of managing the input and output for your computer. A good way to look at is a CPU is a swiss army pocket tool, where the GPU is a very sharp knife. Some days you will need the bottle opener for a beer, or the screwdriver or hex wrench to perform a task, but some days you need a very sharp knife, not the weak one included in the multi tool.

In conclusion, the combination of a CPU with a GPU are best friends. They work together to give your PC the most optimization and power for the price. Even most phones are built in with GPUs, so most people have experience with GPUs even if you don’t even know this. What I found most interesting is that CPUs and GPUs have similar purposes but are optimized for different tasks. Therefore, an efficient computer needs both to run in an efficient way. CPUs are for general purpose processing with lots of cache memory and one huge control module that can handle a few threads at a time. The clock on the CPU is very high. The GPU has a huge amount of ALUs, that contain miniscule control modules and cache compared to the CPU. GPU is optimized for parallel operations. The best video I have found that does a great explanation of GPUs vs CPUs is one of my favorite shows, as Adam and Jamie on Mythbuster’s show a great example of CPU vs GPU in one certain task. [4] This task is painting. <https://youtu.be/-P28LKWTzrl> you can watch this video on this link.

[](https://www.youtube.com/watch?v=-P28LKWTzrI)

In this video it shows how powerful a GPU can be when performing a single task. The sheer numbers of cores can perform a single task in one single clock cycle, as the CPU would take multiple clock cycles to perform the same task. CPUs and GPUs are a match made in heaven.

Sources

[1] - <https://www.cs.uaf.edu/2007/fall/cs441/proj1notes/favier/>

[2] - <https://blogs.nvidia.com/blog/2009/12/16/whats-the-difference-between-a-cpu-and-a-gpu/>

[3] - <https://www.maketecheasier.com/difference-between-cpu-and-gpu/>

[4] - <https://youtu.be/-P28LKWTzrl>