What the GPU Does

If you only use your computer for the basics---to browse the web, or use office software and desktop applications---there's not much more you need to know about the GPU. It's the part of the PC that's responsible for what you see on your monitor, and that's it.

However, for gamers or anyone who does work that can be GPU-accelerated, like 3D rendering, video encoding, and so on, the GPU does much more work. Those folks need to get a lot more out of their GPU, so let's dive in further.

The Different Types of GPUs

There are two primary kinds of GPUs you can get for a modern PC: integrated and discrete. The latter has nothing to do with avoiding attention. Discrete in this sense means it's separate or distinct.

AMD's Radeon RX 5700 XT

Graphics cards are typically big, bulky drop-in components for desktop PCs that have one, two, or sometimes, three fans. These cards contain the actual graphics processor chip, as well as RAM to handle higher graphics loads, like video games. Fans keep the components cool.

Desktop graphics cards are some of the easiest components to upgrade. You just drop the card into a PCIe x16 slot, connect a cable to the power supply (if required), and then install the drivers.

Laptops can also have discrete GPUs. Instead of a bulky card, though, a discreet laptop GPU is just a chip soldered on the motherboard. Unlike those on a desktop, these aren't as easy to upgrade.

Then, there are integrated graphics, which are built right into the processor. Not all CPUs have this. AMD's flagship desktop Ryzen CPUs, for example, are famous for lacking any integrated graphics at all. However, the company does make desktop processors with integrated graphics called Accelerated Processing Units (APUs.)

Intel's desktop Core chips with model numbers that end in an "F" also lack graphics, as do the Core X-Series CPUs with model numbers that end with an "X." Because these processors don't have a GPU, they're sold at a lower price.

A processor without graphics is only a concern for desktops. Again, laptops are sold as a package deal, so they require either a discrete GPU or integrated graphics built into the processor.

Modern processors with integrated graphics can be surprisingly powerful. Some are capable of running select older AAA titles at playable frame rates when the graphics settings are lowered.

They are a cost-effective choice for those who can't yet afford the graphics card of their dreams. Anyone who wants to do some serious gaming, however, will need a separate GPU.

What a GPU Does

WB Games

The easiest way to understand what a GPU does is to talk about video games. In a game, we might see a computer-generated image of a person, a landscape, or an intricately detailed model of a 3D object. Whatever it is we're seeing, it's all thanks to the graphics processing unit.

Video games are complex undertakings that require a lot of mathematical calculations happening in parallel to display images on-screen. A GPU is purpose-built to process graphics information including an image's geometry, color, shading, and textures. Its RAM is also specialized to hold a large amount of information coming into the GPU and video data, known as the framebuffer, that's headed to your screen.

The GPU gets all the instructions for drawing images on-screen from the CPU, and then it executes them. This process of going from instructions to the finished image is called the rendering or graphics pipeline.

The basic unit to start creating 3D graphics is the polygon. More specifically, triangles. Nearly everything you see in a typical video game starts as a massive collection of triangles. There can be other shapes used, as well, but the vast majority are triangles.

These basic shapes, in addition to other lines and points, are known as "primitives." They're built up to make recognizable objects, like a table, tree, or wizard holding a staff. The more polygons you use for an object, the more detailed your finished images can become.

Each object has its own set of coordinates to be set in a scene. If a human were drawing a picture of a dining room, for example, we'd use our own judgment as to where the table and chairs should be, or how close these objects should be to the wall.

A computer can't make these judgment calls and requires coordinates for placement. That's one reason why, sometimes, things will go very wrong in video games, and you'll suddenly see an object in midair.

Once the scene is set, the GPU starts figuring out perspective based on where the "camera" is looking at the scene. A battle on a street, for example, is going to look very different if your character is standing on top of a parked bus looking out at the chaos versus stealing furtive glances while crouched behind an overturned taxi. Again, there's a lot of math going on to figure out viewing angles.

After a little more refinement, the images get the textures, shadows, color, and shading that makes it all come to life.

All of this graphics processing is happening at lightning-fast speeds, requiring heavy calculations, which is why a separate processing unit is needed in the first place.

The GPU is built specifically for graphics processing, which requires a lot of math calculations that happen in parallel. That heavier focus on calculation and parallel operations is why early Bitcoin advocates turned to rigs filled with GPUs to generate the math required to mine cryptocurrency coins. CPUs, meanwhile, aren't as specialized and are more general purpose.

You could, technically, rely on a CPU for the graphics, but it wouldn't be efficient and the end result would never be as visually impressive. The CPU simply doesn't have the resources for most games. It's already running your operating system, other programs and background processes. It's also helping to run the game with physics calculations, AI operations, and other tasks.

Which GPU Do You Need?

Alienware

Now you know the basics of what a GPU does and the different kinds that are out there. So, how do you know which one you need? If you're playing games on a desktop, you need a graphics card, and there's a whole world of reviews out there to help you choose the best one.

Generally, be sure to get a graphics card that's appropriate for your monitor's resolution, such as 1080p, 1440p, or 4K. Video game features are constantly advancing and requiring new hardware. This means graphics cards tend to become obsolete faster than other components. Desktop owners should purchase something released in the last two to three years.

For gaming on a laptop, be very, very careful. Many gaming laptops have discrete GPUs that are up to two generations old and cost just as much (or nearly as much) as a laptop with a newer GPU.

If you're focused on enthusiast video editing, a powerful CPU is more important, but a discrete graphics card (even one that's a few generations old) is also needed.

For everyone else, integrated graphics will do. There's no need to get a graphics card for video streaming, basic web games, or even basic photo editing. Just make sure your CPU actually has an integrated GPU. Otherwise, you might be in for a frustrating surprise when you try to boot up that new desktop build.

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