CPU, GPU, and Memory Assignment

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Instructions

Pick a CPU or Central Processing Unit, GPU or Graphics Processing Unit, and computer memory (Random Access Memory, or RAM) and define each one and discuss each one thoroughly. *The following choices are based on a computer I helped build for a close friend.*

Remember to include **AT LEAST** the following for CPU, GPU, and memory (RAM):

1. Definition
2. Purpose
3. Examples
4. Pros
5. Cons
6. Cost
7. Companies that manufacture each one
8. What are they used for
9. Differences between desktop versions
10. Laptop versions
11. Smartphone versions
12. How they function together
13. What the future looks like for each one
14. Advances made in technology for each one
15. Capabilities for each one
16. What each one can accomplish.

Central Processing Unit (CPU)

Intel Core i9-13900KF Desktop Processor 24 cores (8 P-cores + 16 E-cores) 36M Cache, up to 5.8 GHz

1. Definition:
    a. Often called the “brain,” the CPU is the primary processor of the computer. It is responsible for executing instructions from software and hardware, while performing arithmetic, logic, and control operations.
2. Purpose, Use, Capability Measurement, and End Goal/Accomplishment:
    a. The primary purpose of the CPU is to receive, interpret, understand, and execute instructions that run a computer's operating system and applications. It handles a wide range of tasks, from general computing to managing system resources and from simple text processing to complex simulations.
    b. The capabilities of a CPU are measured by its clock speed, core count, and cache size.
3. Examples:
    a. The Intel Core i9-13900KF is an example of a CPU with a hybrid design that includes 24 cores (8 P-cores and 16 E-cores) and 32 threads. Other examples include CPUs from the Intel Core series and AMD Ryzen series.
4. Pros:
    a. CPUs are highly versatile and are excellent at sequential processing tasks. Modern CPUs have multiple cores, enabling them to handle various tasks simultaneously, in contrast to older home-use/personal models from two decades ago.
5. Cons:
    a. CPUs are not as efficient at parallel processing as GPUs, which is a disadvantage for tasks like rendering graphics or machine learning that require many simultaneous calculations. Thus, many modern-day computer builders and users buy a separate GPU for their computer to handle the additional workload without sacrificing processing power and speed.
6. Cost:
    a. The cost of the Intel Core i9-13900KF can be roughly around $459.00, but prices can vary.
7. Companies that manufacture each one:
    a. The leading manufacturers of consumer CPUs are Intel and AMD. Other companies in the processor market include Qualcomm and Apple.
8. Differences between desktop versions:
    a. Desktop CPUs are generally larger and more powerful, designed to fit into a motherboard socket with robust cooling. They have higher clock speeds, more cache, and higher thermal design power (TDP).
9. Laptop versions:
    a. Laptop CPUs are designed for efficiency over performance due to thermal and battery life constraints. They are typically smaller and may be soldered directly to the motherboard.

10. Smartphone versions:
    a. Smartphone CPUs are highly integrated Systems-On-A-Chip (SoCs) optimized for extreme power efficiency to maximize battery life.
11. How they function together:
    a. The CPU, GPU, and RAM form the core of a computer system. The CPU sends instructions and data to RAM for temporary Storage and quick access. It processes this data and can offload graphical calculations to the GPU for parallel processing. The GPU sends the final rendered images to the display.
12. The future of CPUS and advancements in technology:
    a. The future of CPUs will involve continued improvements in efficiency and performance through new packaging technologies like 2.5D and 3D stacking. AI-specific processors and custom instruction sets (like RISC-V) will also become more common.
    b. Recent advances in CPU technology include new materials beyond silicon, 3D stacking technology, and the use of Extreme Ultraviolet (EUV) lithography for creating smaller, more efficient components. Companies like ASML create tools (i.e., EUV Lithography Machines) for chip manufacturers, like Intel and AMD, to produce higher quality products.

Graphics Processing Unit (GPU)

ASUS TUF Gaming NVIDIA GeForce RTX 4080 SUPER OC Edition Gaming Graphics Card (PCIe 4.0, 16GB GDDR6X, HDMI 2.1a, DisplayPort 1.4a) TUF-RTX4080S-O16G-GAMING

1. Definition:
    a. The Graphics Processing Unit is an electronic hardware component for making images, movies, or animations for display. It is designed for parallel computation, allowing thousands of computations to be performed simultaneously, and is used to make graphics more efficient. A GPU utilizes a specialized type of memory known as Video Random Access Memory (VRAM), primarily to store and process the visual data required by the computer for image production on a screen or monitor, such as textures, shaders, and high-polygon models.
2. Purpose, Use, Capability Measurement, and End Goal/Accomplishment:
    a. The purpose of a GPU is to offload graphics-intensive tasks from the CPU to increase speed and efficiency. Its design is highly effective at performing the same mathematical calculations repeatedly, which is ideal for functions like controlling and accelerating frame rates by rendering pixels on a screen.
    b. GPUs are employed in gaming, video editing, 3D modeling, and professional visualization. With their parallel processing power, they're necessary for intense simulations, machine learning, data science, and AI development (such as deep learning and real-time analytics).
3. Examples:
    a. The ASUS TUF Gaming NVIDIA GeForce RTX 4080 SUPER OC Edition is an example of a GPU. Other examples include GPUs from AMD's Radeon series and Intel's Arc series.
4. Pros:
    a. GPUs are highly efficient at parallel processing, making them superior to CPUs for tasks such as 3D rendering, video editing, and artificial intelligence.
5. Cons:
    a. GPUs are less versatile than CPUs because their specialized design and purpose are not designed for the wide range of sequential, general-purpose tasks that a CPU handles.
6. Cost:
    a. The ASUS TUF Gaming NVIDIA GeForce RTX 4080 SUPER OC Edition costs around $1,099.99.
7. Companies that manufacture each one:
    a. The primary manufacturers of standalone GPUs are NVIDIA and AMD. Intel is also a growing player in the market with their Intel Arc series.
8. Differences between desktop versions:
    a. Desktop GPUs are large, discrete cards with their own cooling systems and VRAM. They have higher power limits and can consume more power.
9. Laptop versions:
    a. Laptop GPUs are designed for lower power consumption and are often less powerful than their desktop counterparts. They usually share fans with the CPU.
10. Smartphone versions:

    a. In smartphones, the GPU is part of the SoC, designed for maximum power efficiency to conserve battery life.

11. The future of GPUS and advancements in technology:
    a. AI and machine learning will heavily influence the future of GPUs. We can expect GPUs with enhanced AI cores and improved real-time ray tracing.
    b. Recent advances include the development of specialized tensor cores for AI and deep learning and the introduction of real-time ray tracing technology.

Random Access Memory (RAM, aka. computer memory)

CORSAIR Vengeance RGB 64GB (2 x 32GB) 288-Pin PC RAM DDR5 6400 (PC5 51200) Desktop Memory Model CMH64GX5M2B6400C32

1. Definition:
    a. Random Access Memory (RAM) is a type of electronic memory that can be accessed in any order, allowing data to be quickly read from and written to. It is a volatile memory: it requires power to maintain the stored information, and all data is lost when the computer is turned off. In comparison, VRAM is a dedicated type of memory primarily used by the GPU to handle visual data. At the same time, RAM is the general-purpose memory used by the entire system, including the CPU.
2. Purpose, Use, Capability Measurement, and End Goal/Accomplishment:
    a. The purpose of RAM is to provide a high-speed, temporary storage area for quick access to data and programs that are actively being used by the CPU. It is significantly faster than long-term Storage, such as an SSD or HDD, and helps prevent data bottlenecks and improve multitasking.
    b. RAM is used for tasks such as running the operating system, browsing the web, editing documents, and playing games.
    c. RAM's capability is measured by its capacity (in gigabytes) and its speed (in megahertz or MT/s). Higher capacity allows for better multitasking.
3. Examples:
    a. The CORSAIR Vengeance RGB 64GB DDR5 Desktop Memory is a specific example of RAM. Other examples include RAM from manufacturers such as Kingston and SK Hynix.
4. Pros:
    a. RAM allows the CPU to have access to data at high speeds, which is essential in being able to multitask and run demanding applications in a fast machine. Adding more RAM can lead to significant performance improvement.
5. Cons:
    a. The primary disadvantage of RAM is that it is volatile, meaning it cannot store data permanently. It is also more expensive per gigabyte than physical Storage. To resolve this issue, computer users purchase separate physical storage devices, such as Solid-State Drives (SSDs) and Hard Disk Drives (HDDs), to permanently store their data and retrieve it after their computer is turned off. Thus, RAM is the “middleman” or “workbench” between the Storage (also known as the “warehouse”) and the CPU (also known as the “worker”).
6. Cost:
    a. The cost of the CORSAIR 64GB DDR5 memory kit is around $181.99 to $300.00.
7. Companies that manufacture each one:
    a. The primary manufacturers of the memory chips themselves are companies like Samsung, SK Hynix, and Micron. These chips are then sold to companies like Corsair and Kingston Technology, which assemble them into the final RAM modules that are sold to consumers.

8. Differences between desktop versions:
    a. Desktop RAM modules are larger (DIMMs) and are designed for easy installation and upgrading in a motherboard's memory slots.
9. Laptop versions:
    a. Laptop RAM is smaller (SO-DIMM) to fit into the compact space of a laptop.
10. Smartphone versions:
    a. Smartphone RAM is soldered directly onto the motherboard as part of the SoC, making it highly integrated and not user replaceable.
11. The future of RAM and advancements in technology:
    a. The future of RAM will see increased capacities, with modules potentially reaching up to 256GB. New technologies and materials will continue to improve speed and efficiency.
    b. Recent advances in memory technology include the transition from DDR4 to DDR5, which offers higher bandwidth and improved power efficiency. Researchers have also made advances in SOT-MRAM technology, which is more energy-efficient and could potentially replace cache memory in the future.

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