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Group 6 MW 10:30 - 12:00

BSCS - 1

Comparative Study on Different Types of Computers

Introduction:

Computers change how humans interact with technology and they offer multiple types for different needs and purposes. Special features and capabilities are possessed by each type of computer including supercomputers, mainframes, minicomputers, servers, workstations and microcomputers. These computers differ in processing power, size, usage and cost for multiple fields like research and business and personal use. Supercomputers excel in their unmatched computational capabilities and mainframes are experts in managing enormous quantities of transactions. For small to medium organizations, a balance between cost and power is struck by minicomputers. Servers manage and distribute resources in networking. Professionals need advanced hardware for specialized tasks, so workstations are designed accordingly. Finally, everyday usage is dominated by microcomputers or personal computers because they are affordable and flexible. By understanding the differences between these types, you can identify their best use cases and the importance of their technology. The special characteristics, strengths, and applications are explored by this study and these aspects are examined together. The development of industries and society at large is also contributed to by them.

Discussion

The invention of computers goes back to the early centuries in the 19th century, with Charles Babbage having a concept of the Analytical Engine, which most probably started the idea of modern computing. The first electronic computers were developed around the mid-20th century, including ENIAC, created to be able to compute large-scale calculations in military and scientific procedures. Over the years, computers evolved from massive room-sized machines to compact devices that can fit into a pocket with the development of microprocessors and semiconductor technology. The core working of all computers is based on processing information as binary data, i.e., information can be represented in the form of sequences of 0s and 1s. This binary data is manipulated by the hardware components such as CPU, memory, and storage, coordinated through software that performs a computer's tasks.

There are various types of computers, each addressing different needs. Supercomputers use parallel processing, in which thousands of processors work on different parts of a calculation simultaneously to accomplish the desired results. They are thus particularly suited for complex simulations. Mainframes focus mainly on multitasking and transaction management, relying on redundant systems to ensure reliability. Minicomputers were introduced in the 1960s as affordable alternatives to mainframes, focusing on smaller-scale applications for businesses. Servers evolved to support networking needs, distributing resources and services to client devices within local or global systems. Workstations were designed to meet the needs of professionals, featuring powerful graphics and computational capabilities for intensive applications. Microcomputers revolutionized personal and small business computing, offering an affordable and user-friendly option for everyday tasks.

Each of these computers shares principles in operation but is engineered differently to meet specific functions, manifesting the diversity and adaptability of computing technology. Their history reflects humanity's increasing dependence on machines to process information and drive innovation.

Tables:

| <i>Supercomputers</i> | |
|------------------------------|---|
| Name/Brand | Cray, IBM Blue Gene, NVIDIA GDX, IBM Summit, Fugaku, etc |
| Build | Largely sized, typically occupying entire rooms or halls |
| CPU | Multi-core processors, with millions of cores; clock speed varies (~1-4 GHz); transistors in billions; advanced parallel processing with high-speed interconnects |
| Memory | Petabytes of high-speed RAM |
| Processing Speed | Measured in petaflops (quadrillions of floating-point operations per second) |
| Calculating Power | Can perform up to exaFLOPS; MIPS in the trillions |
| Working Principle | Parallel processing of massive datasets using thousands of processors working in unison. Data is divided into smaller tasks distributed across cores |
| Energy Consumption | Requires megawatts of power; often uses advanced cooling systems |
| Field of Use | Weather forecasting (simulating hurricanes), molecular modeling, astrophysics (mapping the universe), AI research |

Mainframe Computers

| | |
|---------------------------|--|
| Name/Brand | IBM Z-series, Unisys ClearPath, Fujitsu GS21 |
| Build | Usually cabinet-sized; scalable depending on needs. Large and robust systems designed for high availability |
| CPU | Multi-core processors optimized for I/O operations; ~2-5 GHz; transistors in billions; massive caching systems |
| Memory | Terabytes of ECC RAM |
| Processing Speed | Capable of processing billions of transactions per second |
| Calculating Power | Trillions of instructions per second (TIPS); heavy focus on throughput rather than raw computational speed |
| Working Principle | Batch and transaction processing; designed for reliability, scalability, and security in handling enormous I/O tasks |
| Energy Consumption | Hundreds of kilowatts |
| Field of Use | Banking systems (processing millions of transactions daily), airline reservation systems, government data processing |

Minicomputers

| | |
|---------------------------|--|
| Name/Brand | DEC PDP-11, IBM AS/400, HPE Integrity |
| Build | Mid-sized, typically rack-mounted |
| CPU | Multi-core processors, ~1-3 GHz; optimized for medium-scale operations |
| Memory | Tens to hundreds of gigabytes of RAM |
| Processing Speed | Performs tasks at speeds of tens of billions of operations per second |
| Calculating Power | TeraFLOPS or lower; sufficient for specific industrial or business operations |
| Working Principle | Task-oriented systems designed for specific industrial or departmental functions. Can support multiple users simultaneously |
| Energy Consumption | Tens of kilowatts |
| Field of Use | Small businesses for inventory control, engineering computations, or hospital management systems |

Servers

| | |
|---------------------------|---|
| Name/Brand | Dell PowerEdge, HPE ProLiant, Lenovo ThinkSystem |
| Build | Rack-mounted or tower form factor; scalable |
| CPU | Multi-core processors, typically with higher thread counts; ~2-4 GHz clock speed |
| Memory | Dozens to hundreds of gigabytes, with expandable configurations |
| Processing Speed | Handles millions of requests per second in a networked environment |
| Calculating Power | Focused on multitasking and high IOPS (Input/Output Operations Per Second) |
| Working Principle | Processes requests and data management tasks over a network. Serves multiple users by managing and distributing resources |
| Energy Consumption | Tens to hundreds of kilowatts, depending on load |
| Field of Use | Web hosting (running websites), database management, cloud storage, enterprise applications |

Workstations

| | |
|---------------------------|--|
| Name/Brand | Apple Mac Pro, Dell Precision, HP ZBook |
| Build | Desktop-sized, often heavier-duty than typical PCs. |
| CPU | High-end processors with multiple cores; ~2-5 GHz; optimized for rendering and scientific tasks |
| Memory | 16 GB to 1 TB of RAM |
| Processing Speed | Gigaflops to low teraflops, optimized for professional-grade applications. |
| Calculating Power | Mid-range computational power for specialized tasks. |
| Working Principle | Runs high-demand applications like 3D rendering or simulation software, typically used in engineering, design, or media production |
| Energy Consumption | Around 200-800 watts |
| Field of Use | CAD (designing architecture), animation rendering, video editing, or scientific modeling |

Microcomputers

| | |
|---------------------------|---|
| Name/Brand | Apple MacBook, Dell Inspiron, Raspberry Pi |
| Build | Compact, from laptops to handheld devices. |
| CPU | Dual or quad-core processors; ~1-4 GHz; consumer-grade efficiency |
| Memory | 4 GB to 64 GB of RAM |
| Processing Speed | Moderate speeds for everyday tasks; usually in gigaflops |
| Calculating Power | Millions to billions of instructions per second (MIPS) |
| Working Principle | Designed for personal use, executing a variety of general-purpose tasks like word processing, browsing, and entertainment |
| Energy Consumption | Low power consumption, ~15-90 watts for laptops |
| Field of Use | Home computing, education (online classes), gaming, and office productivity |

Categories

| | |
|--------------------|--|
| Name/Brand | Manufacturer/brand/make/model of the type of computer |
| Build | Size/Dimension |
| CPU | Clock Frequency/Instruction per second /Multi Core Processing / Number of Transistors/Front Side Bus and Cache |
| Memory | Size and Speed |
| Processing Speed | Processor cores and clock speed |
| Calculating Power | Flop Units and MIPS units |
| Working Principle | Answer how does this type of computer work or processes information? |
| Energy Consumption | Total Energy Consumption |
| Field of Use | Where does this type of computer uses, give an example scenario. |

Examples

| Types of Computers | Sample Image | Description | Usage |
|---------------------|---|--|--|
| Supercomputer |  | <p>Supercomputers are the most powerful computers, designed to perform complex calculations at extremely high speeds. They consist of thousands of processors working in parallel to solve massive computational problems. These machines are optimized for tasks requiring immense processing power and memory.</p> | <p>They are used in scientific research, such as simulating nuclear reactions or studying the universe. They also support advanced weather forecasting, climate modeling, and large-scale data analysis in fields like genomics and artificial intelligence.</p> |
| Mainframe Computers |  | <p>Mainframes are high-performance computers designed to process vast amounts of data reliably. They are known for their durability, scalability, and ability to handle multiple tasks simultaneously. Mainframes typically run critical applications and operate continuously without failure.</p> | <p>Mainframes are widely used in industries such as banking, healthcare, and government for managing databases, financial transactions, and enterprise resource planning. Airlines also use them to handle ticketing and reservations efficiently.</p> |
| Mini Computers |  | <p>Minicomputers are mid-sized machines, smaller and less powerful than mainframes but more capable than microcomputers. They are designed to support</p> | <p>Minicomputers are used in business environments to manage production processes, control industrial machinery, or run departmental operations. They also</p> |

| | | |
|--------------|---|--|
| | <p>multiple users and specific tasks within smaller organizations. These systems are cost-effective and provide good processing power for medium-scale applications.</p> | <p>serve as servers in smaller organizations, offering computing resources to multiple users.</p> |
| Server |  <p>Servers are computers designed to provide services, data, or resources to other computers over a network. They prioritize reliability and efficiency, often running specialized software to manage requests from client devices. Servers can range from small devices to large systems depending on their purpose.</p> | <p>Servers are used to host websites, store and share files, and manage applications for businesses. They play a critical role in networking environments, ensuring smooth communication and data exchange between devices.</p> |
| Workstations |  <p>Workstations are powerful personal computers designed for professional use, with high-performance processors and graphics capabilities. They are optimized for tasks such as 3D rendering, video editing, and scientific computing. Workstations often support advanced hardware configurations and multiple monitors.</p> | <p>Workstations are used by engineers, architects, and designers for CAD (computer-aided design), animation, and other resource-intensive applications. They are also preferred in laboratories and research settings for running complex simulations.</p> |

Micro Computers



Microcomputers, also known as personal computers, are compact and affordable systems designed for individual use. They include desktops, laptops, and tablets, featuring processors suitable for everyday tasks like word processing, browsing, and multimedia. These are the most common types of computers.

Microcomputers are used in homes, schools, and businesses for activities like creating documents, accessing the internet, and managing basic office tasks. They also serve as gaming systems and tools for light software development.

Compare and Contrast the following according to processing speed, memory capacity, power consumption, minimum and usage.

Mini computers, microcomputers, workstations, and servers are quite different from one another regarding processing speed, memory capacity, power consumption, and usage. Mini computers provide a moderate level of processing capability with limited memory capacity for the management of tasks involving small to medium-sized businesses but use less power than servers. Microcomputers or personal computers have the lowest processing speed and memory of the four, but they are optimized for individual tasks, making them highly energy-efficient and affordable. With a larger processing speed and memory than microcomputers, workstations outperform microcomputers and can execute resource-heavy tasks like 3D rendering and data analysis, but consume much more power due to their powerful hardware components.

These have the highest processing speed and amount of memory among these; however, they can manage numerous client requests at a time, albeit at the cost of significant power consumption. Servers and mini computers are multi-user systems and not geared toward single users like microcomputers and workstations. Mini computers often act as a bridge between personal and enterprise computing, whereas servers dominate networking and resource distribution. Workstations are generally made use by professionals in specific fields, but microcomputers usually for generalized use in personal undertakings. Servers require high-end processors, large storage and continuous power, whereas microcomputers call for a much more minimal requirement. The selection between the two actually depends on their intended application, balancing speed, memory and energy needs, accordingly.

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