

Name: Qazi Faseeh Ud Din

Roll no: BCSF21M562

Why We Need Parallel Computing

Parallel computing has developed into an essential component in modern computing, allowing for effective management of complex and large tasks by breaking down such tasks into less complex sub-tasks carried out concurrently on various processors.

1. Accelerated Processing Speeds

By executing multiple operations concurrently, parallel computing significantly reduces the time required for data processing and complex computations. This is particularly advantageous in fields like scientific research and data analysis, where handling vast datasets swiftly is crucial. For instance, climate modeling and weather forecasting rely on parallel processing to analyze extensive environmental data in real-time.

2. Efficient Management of Large-Scale Data

In today's data-driven world, the ability to process massive volumes of information efficiently is paramount. Parallel computing addresses this need by distributing data processing tasks across multiple processors, ensuring that large datasets are handled effectively. This capability is vital in big data analytics, where insights are derived from analyzing complex and sizable data collections.

3. Enhanced Performance and Resource Utilization

Parallel computing optimizes the use of available computing resources by balancing workloads across multiple processors. This leads to improved performance and ensures that computational power is utilized effectively, reducing idle times and increasing overall system efficiency. High-performance computing (HPC) systems, which tackle intensive computational tasks, heavily rely on parallel architectures to achieve their performance goals.

4. Solving Complex and Computationally Intensive Problems

Certain problems, such as simulations in astrophysics or molecular modeling, require substantial computational power that single processors cannot provide. Parallel computing enables the tackling of these complex problems by dividing the workload among multiple processors, making it feasible to perform intricate simulations and analyses. For example, astrophysical simulations modeling star formations or galaxy dynamics utilize parallel computing to manage the extensive calculations involved.

5. Cost-Effectiveness and Scalability

Employing multiple standard processors in a parallel configuration can be more cost-effective than investing in specialized, high-speed processors. Additionally, parallel computing systems offer scalability; as computational demands grow, more processors can be added to the system to

handle increased workloads efficiently. This scalability is essential for businesses and research institutions that anticipate expanding computational needs.

6. Energy Efficiency

Reducing the time required for computations through parallel processing can lead to lower energy consumption. By completing tasks more quickly, systems spend less time in high-power states, contributing to energy savings and making parallel computing an environmentally friendly option for large-scale data centers and computing facilities.

In summary, parallel computing is indispensable in addressing the demands of modern computational tasks. Its ability to enhance processing speeds, manage large datasets efficiently, optimize resource utilization, solve complex problems, offer cost-effective scalability, and improve energy efficiency makes it a cornerstone of contemporary computing solutions.

References

Builtin: <https://builtin.com/hardware/parallel-processing-example>

Run.ai: <https://www.run.ai/guides/distributed-computing/parallel-computing>

Manning LiveBook: <https://livebook.manning.com/book/parallel-and-high-performance-computing/chapter-1>

Wikipedia: <https://en.wikipedia.org/wiki/HPX>

Geekboots: <https://www.geekboots.com/story/parallel-computing-and-its-advantage-and-disadvantage>

Heavy.AI: <https://www.heavy.ai/technical-glossary/parallel-computing>