AL MUSTAQBAL UNIVERSITY

College of Sciences
Intelligent Medical System Department

Lecture 2

Performance Issues (Part I)

Subject: Computer Fundamentals

Level: First

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Introduction

In the previous lecture, students learned the basic concepts of computers and their historical development. In this lecture, the focus moves to an important concept known as **computer performance**. Computer performance is one of the most critical aspects of modern computer systems, as it directly affects how fast and efficiently tasks can be completed.

Understanding performance helps students recognize why computers differ in speed and capability, even when they appear similar from the outside.

Computer Performance Concept

Computer performance refers to the ability of a computer system to execute instructions and complete tasks within a certain period of time. A computer with high performance can process data faster, respond more quickly to user requests, and handle multiple tasks efficiently.

Performance does not depend on a single factor. Instead, it is influenced by several components working together, such as the processor, memory, and internal architecture of the system.

Designing for Performance

Designing for performance means planning and building computer systems in a way that minimizes execution time and maximizes efficiency. Computer engineers aim to design systems where all components work in harmony, without unnecessary delays or bottlenecks.

A well-designed system ensures that no single component becomes a limiting factor. Even if one part is very fast, the system's overall performance will suffer if other parts cannot operate at a compatible speed.

Microprocessor Speed

The microprocessor, also known as the CPU, is the central unit responsible for executing instructions. It performs calculations, controls data flow, and manages system operations. One of the most important characteristics of the CPU is its *speed*.

Microprocessor speed is measured using clock speed, which represents the number of cycles the processor can perform per second. Clock speed is expressed in Hertz, commonly in gigahertz (GHz). A higher clock speed generally allows the processor to execute more instructions in a shorter time. However, clock speed alone does not determine overall performance.
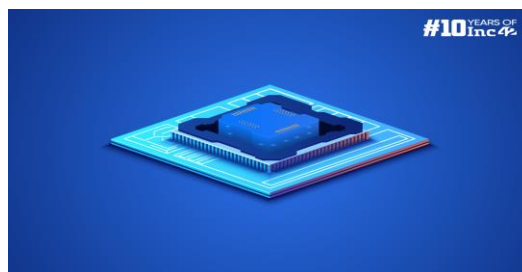
Performance Balance

Performance balance refers to the coordination between all components of a computer system. The processor, memory, and storage devices must operate in balance to achieve optimal performance.

If the processor is very fast but the memory is slow, the processor will spend time waiting for data. This waiting reduces the system's efficiency. Therefore, balanced system design is essential for achieving high performance.

Improvements in Chip Organization and Architecture

Modern computer systems achieve higher performance due to improvements in chip organization and architecture. These improvements include better internal structures, more efficient data paths, and enhanced control mechanisms.

Computer architecture determines how instructions are executed and how data moves within the processor. Advances in architecture allow modern processors to execute instructions faster and more efficiently than older systems.

Multicore Processors

Earlier computer systems used single-core processors, meaning that only one processing unit handled all tasks. Modern computers use multicore processors, which contain two or more cores within a single chip.

Each core can execute instructions independently. This allows the system to perform multiple tasks together, improving overall performance and responsiveness.

Many Integrated Cores (MICs)

Many Integrated Core systems contain a large number of simple processing cores. These systems are designed to handle tasks that can be divided into smaller parts and processed in parallel. MIC architectures are commonly used in high-performance computing environments.

General-Purpose Graphics Processing Units (GPGPUs)

Graphics Processing Units were originally designed to handle graphical tasks. However, modern GPUs are capable of performing general-purpose computations. These processors can execute many simple operations simultaneously, making them suitable for tasks such as data processing and scientific calculations.

Basic Measures of Computer Performance

Computer performance is commonly measured using basic metrics such as clock speed and instruction execution rate. Clock speed indicates how fast the processor operates, while instruction execution rate measures how many instructions the system can complete within a given time.

These measures help engineers compare systems and evaluate design efficiency.