**CHAPTER 2**

**2.1- History of Computers**

A close-up of a blue sign

AI-generated content may be incorrect.

**First Generation: Vacuum Tubes**

**Typical computers:ENIAC (Electronic Numerical Integrator And Computer)EDVAC (Electronic Discrete Variable Computer) and John Von NeumannIAS computer (Princeton Institute for Advanced Studies)Commercial Computers: UNIVAC ((Universal Automatic Computer)IBM Computers ( International Business Machines)ENIAC Computer  
 (Read by yourself)**ENIAC, the world’s first general-purpose electronic digital computer, was designed at the University of Pennsylvania by John Mauchly and John Eckert (1943–1946). Built for the U.S. Army’s Ballistics Research Laboratory to compute weapon trajectory tables, it was completed too late for WWII. Its first major task was **hydrogen bomb** feasibility calculations. ENIAC operated until 1955 before being disassembled.

**John von NeumannEDVAC (Electronic Discrete Variable Computer)**First publication of the idea was **in 1945**Stored program conceptAttributed to ENIAC designers, most notably the mathematician John von NeumannProgram represented in a form suitable for storing in memory alongside the data (program= data + instructions)IAS computerPrinceton Institute for Advanced StudiesPrototype of all subsequent general-purpose computersCompleted in 1952**(John von Neumann và nhóm của ông đã phát triển khái niệm lưu trữ chương trình, cho phép chương trình và dữ liệu được lưu chung trong bộ nhớ. Ý tưởng này được hiện thực hóa trong máy tính IAS (1952), trở thành nguyên mẫu cho tất cả các máy tính đa dụng về sau.)**

**Cấu trúc của máy John vom Neumann**

**Main memory**

**Arithmetic logic unit (CA)**

**I/O**

**Program control unit (CC)**

**Structure of IAS ComputerAC: AccumulatorMQ: Multiplier QuotientMBR: Memory Buffer RegisterIBR: Instruction Buffer RegisterPC: program counterIR: Instruction registerMAR: Memory Address RegisterCommercial Computers: UNIVAC (Read by yourself)**

* 1947: Eckert and Mauchly founded the Eckert-Mauchly Computer Corporation to produce commercial computers.
* UNIVAC I (Universal Automatic Computer): The first successful commercial computer, designed for both scientific and business applications.
* Used by the US Bureau of Census (1950) for calculations.
* Company merged into Sperry-Rand Corporation’s UNIVAC division.
* UNIVAC II (late 1950s): Improved memory, performance, and backward compatibility with UNIVAC I.

**IBM (Read by yourself)**

* IBM was a major manufacturer of punched-card processing equipment.
* IBM 701 (1953): First electronic stored-program computer, mainly for scientific applications.
* IBM 702 (1955): Designed with hardware features for business applications.
* The IBM 700/7000 series solidified IBM’s dominance in the computer industry.

**Second Generation: Transistors**Transistor = Transfer – resistor (vật có thể truyền-cản điện)It’s activity is similar to those in vacuum tubeSmaller, CheaperDissipates (phát tán) less heat than a vacuum tubeIs a solid state device made from siliconWas invented at **Bell Labs in 1947**It was not until the late 1950’s that fully transistorized computers were commercially availableTypical computers: IBM 700/7000 series

**Third Generation: Integrated Circuits (IC)**

* **1958** – the invention of the integrated circuit All components of a circuit are minimize to micro size. So, all of them are packed in a chip Discrete componentSingle, self-contained transistorManufactured separately, packaged in their own containers, and soldered or wired together onto masonite (like circuit boards)Manufacturing process was expensive and cumbersome (complex)The two most important members of the third generation were the IBM System/360 and the DEC PDP-8 **Integrated Circuits**Data storage – provided by memory cellsData processing – provided by gatesData movement – the paths among components are used to move data from memory to memory and from memory through gates to memoryControl – the paths among components can carry control signalsA computer consists of gates, memory cells, and interconnections among these elements**Moore Law**
* **Proposed by Gordon Moore in 1965**.
* **States that transistor density doubles approximately every two years**, increasing computing power.
* **Leads to exponential growth in processing speed and efficiency**.
* **Has driven rapid advancements in technology and computing**.

**DEC - PDP-8 Bus Structure**

DEC: Digital Equipment CorporationPDP: Programmed Data Processor

A diagram of a bus system

AI-generated content may be incorrect.

**Semiconductor Memory**

 **1970 - Fairchild Introduced Capacious Semiconductor Memory**

* The chip was about the size of a single core.
* Stored **256 bits** of memory.
* **Non-destructive** and much **faster** than core memory.

 **1974 - Semiconductor Memory Became Cheaper than Core Memory**

* Rapid decline in **memory cost** and increase in **memory density**.
* Advancements in memory and processor technology **transformed computing within a decade**.

 **Since 1970 - 13 Generations of Semiconductor Memory**

* Each generation provided **4x the storage density** of the previous one.
* Continuous **decline in cost per bit** and **faster access time**.

**Microprocessors**

**** Increasing Chip Density: More elements were integrated into single chips, reducing the number of chips needed for a processor.

 **1971** - Intel 4004: First chip with a complete CPU on a single chip, marking the birth of the microprocessor.

 **1972** - Intel 8008: First 8-bit microprocessor.

 **1974** - Intel 8080: First general-purpose microprocessor, offering:

* **Higher speed**
* **Richer instruction set**
* **Larger addressing capability**

**2.2- Designing for Performance** Desktop applications that require the great power of today’s microprocessor-based systems include • **Image processing • Speech recognition • Videoconferencing • Multimedia authoring • Voice and video annotation of files • Simulation modeling**

**Microprocessor Speed**Technique:

**Pipelining**

**Branch prediction**

**Data flow analysis**

**Speculative (suy đoán) execution**

**Performance Balance**Adjust the organization and architecture to compensate for the mismatch among the capabilities of the various components**Improvements in Chip Organization and Architecture**

**Increase hardware speed of processor**Fundamentally due to shrinking logic gate sizeMore gates, packed more tightly, increasing clock ratePropagation time for signals reduced**Increase size and speed of caches**Dedicating part of processor chip Cache access times drop significantly**Change processor organization and architecture**Increase effective speed of instruction executionParallelism**Problems with Clock Speed and Login Density**

**Power**Power density increases with density of logic and clock speedDissipating heat**RC (Resistance and Capacitance) delay**Speed at which electrons flow limited by resistance and capacitance of metal wires connecting themDelay increases as RC product increasesWire interconnects thinner, increasing resistanceWires closer together, increasing capacitance**Memory latency**Memory speeds lag (slow down) processor speeds

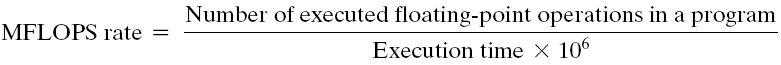
**2.3- Multicore, MICs, and GPGPUsMulticore CPU: CPU has some cores running concurrently.MIC: Many integrated coreGPGPU: General Purpose Graphical Processing Unit**

**Read by Yourself2.4- The Evolution of The Intel x86 Architecture2.5- Embedded Systems and the ARM**

**2.6- Performance AssessmentFactors affect on computer performance:Factors**Clock Speed and Instructions per SecondInstruction execution rate**Methods:** Benchmarks**Some laws**: Read by yourselfAmdahl’s LawLittle’s Law**System ClockThe rate of pulses is known as the clock rate, or clock speed. The time between pulses is the cycle time.Unit: cycles per second, Hertz (Hz)🡺 High clock rate -> High performance.**

**Instruction Execution Rate**

**Unit: MIPS (millions of instructions per second) Unit: MFLOPs (Floating-point performance is expressed as millions of floating-point operations per second)**



**Benchmark**

**A test used to measure hardware or software performance. Beginning in the late 1980s and early 1990s, industry and academic interest shifted to measuring the performance of systems using a set of benchmark programs**

**Benchmark suiteA collection of programs, defined in a high-level languageAttempts to provide a representative test of a computer in a particular application or system programming areaSPECAn industry consortiumDefines and maintains the best known collection of benchmark suitesPerformance measurements are widely used for comparison and research purposes**

**Amdahl’s Law  
Little’s Law**