Main notions. Subject area of the course. History of Computer Architecture. Introduction to computer components.

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Course objectives

- To develop an understanding of the fundamentals of hardware and software technologies that underlie contemporary computer-based information systems

- To develop an understanding of the underlying structure and theories of computers and programming

- To provide the skills needed to develop algorithms for programming solutions

Learning outcomes

- Identify the basic elements of hardware
- Explain how data is represented, manipulated and stored within a computer system
- Read an assembly code
- Explain how internal components of computer operate
- Design basic computer schemes
- Program microcontrollers

What is the Computer Architecture?

- Description of the requirements for the various parts of a computer
- Attributes of the system visible to programmer that have a direct impact on the execution of a program

History of Computer Architecture

History of Computer Architecture

- **There are four generations of in computer architecture history:**
  - The first generation (1945-1958)
  - The second generation (1958-1964)
  - The third generation (1964-1974)
  - The fourth generation (1974-present)

The first generation (1945-1958)

- **Features**
  - Vacuum tubes
  - Machine code, assembly language
  - Use of magnetic core memory
    - Data were loaded using paper tape or punch cards
  - 2 Kb memory
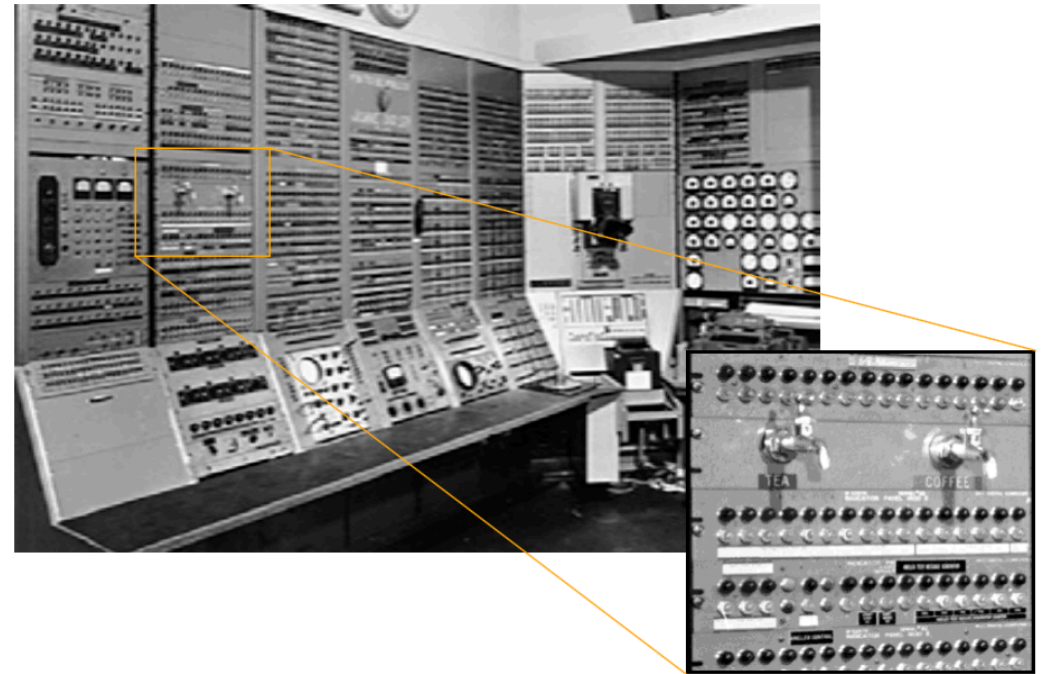
The first generation (1945-1958) cont.

- **Two types of models for a computing machine:**
  - Harvard architecture
  - Von Neumann architecture

The first generation (1945-1958) cont.

- **1943-46, ENIAC (Electronic Numerical Integrator and Calculator)**
  - Developed by by J. Mauchly and J. Presper Eckert
  - The first general purpose electronic computer.
  - Built to calculate trajectories for ballistic shells during WWII, programmed by setting switches and plugging & unplugging cables.
  - Could perform 5000 additions and 357 multiplications per second
  - Weighted 30 tons

The first generation (1945-1958) cont.

- **1949, Whirlwind computer by Jay Forrester (MIT)** with 5000 vacuum tubes
  - main innovation - magnetic core memory

The first generation (1945-1958) cont.

- 1951 UNIVAC (Universal Automatic Computer)
  - the first commercial computer
  - built by Eckert and Mauchly

Inside the UNIVAC

The second generation (1958-1964)

- Features
  - **Transistors** – small, low-power, low-cost, more reliable than vacuum tubes,
  - Floating point arithmetic
  - Reduced the computational time from milliseconds to microseconds
  - High level languages
  - The first Operating Systems: handled one program at a time

The second generation (1958-1964)

- IBM 7090
  - the most powerful data processing system at that time
  - fully-transistorized system has computing speeds six times faster than those of its vacuum-tube predecessor, the IBM 709
  - contains more than 50,000 transistors plus extremely fast magnetic core storage

The third generation (1964-1974)

- Features
  - Introduction of integrated circuits combining thousands of transistors on a single chip
  - Semiconductor memory
  - Timesharing, graphics, structured programming
  - 2 Mb memory
  - Use of cache memory

The third generation (1964-1974) cont.

- IBM System/360 Model 91:
  - was introduced in **1966** as the fastest, most powerful computer then in use
  - designed in scientific purposes
  - could solve more than **1,000 problems** involving about **200 billion calculations**.

The fourth generation (1974 - present)

- Features
    - Introduction of **Very Large-Scale Integration (VLSI)/Ultra Large Scale Integration (ULSI)** - combines millions of transistors
    - Single-chip processor and the single-board computer emerged
    - Smallest in size because of the high component density
    - Creation of the **Personal Computer (PC)**
    - Wide spread use of data communications
    - **Object-Oriented programming:** Objects & operations on objects
    - **Artificial intelligence:** Functions & logic predicates

Fourth generation (1974 - present) cont.

- **1974 – 1977** the first personal computers introduced on the market as kits (major assembly required).
  - Scelbi (SCientific, ELectronic and BIological) and designed by the Scelbi Computer Consulting Company, based on Intel's 8008 microprocessor, with 1K of programmable memory,
  - Mark-8 (also Intel 8008 based) designed by Jonathan Titus.
  - Altair (based on the the new Intel 8080 microprocessor), built by MITS (Micro Instrumentation Telemetry Systems). The computer kit contained an 8080 CPU, a 256 Byte RAM card

Fourth generation (1974 - present) cont.

- **1976** - Steve Wozniak and Steve Jobs released the Apple I computer and started Apple Computers.
  - Apple I was the first single circuit board computer. It came with a video interface, 8k of RAM and a keyboard.
- **1977** - Apple II computer model was released, also based on the 6502 processor, but it had color graphics, and used an audio cassette drive for storage.
  - Its original configuration came with 4 kb of RAM, but a year later this was increased to 48 kb of RAM and the cassette drive was replaced by a floppy disk drive.

Computer components

Major computer components

- Input devices
  - Keyboard
  - Mouse, etc.
- Output devices
  - Monitor
  - Speakers, etc.
- Central Processing Unit (CPU) and memory
- Motherboard
- Expansion cards
  - Video card
  - Sound card
- Hard Drive Ports and Connections
  - USB
  - Firewire, etc.

Central Processing Unit

- A device that interprets and runs the commands that you give to the computer

- Also referred to as the processor

- Two major brands are Intel and AMD

- Examples
  - Intel Core 2 Duo
  - AMD Turion X2

Memory

- Memory is where information is stored and retrieved by the CPU.
- There are two main types of memory:
  - Random Access Memory (RAM)
    - It is the main memory and allows you to temporarily store commands and data.
  - Read Only Memory (ROM)
    - It is the memory that retains its contents even after the computer is turned off.

Motherboard

- It is the main circuit board inside the computer
- Has tiny electronic circuits and other components on it
- Connects input, output, and processing devices together (CPU, Memory, Hard Drive)
- Tells the CPU how to run

Expansion Cards

- **Video Card**
    - is connected to the computer monitor and is used to display information on the monitor
- **Sound Card**
    - converts audio signals (microphone or audio tape) which can be stored as a computer audio file

Ports and Connections

- Universal Serial Bus (USB) Port
- FireWire (similar to USB) but faster
- Network Port (Ethernet)
- Display adapter
- Power

Thank you for attention!