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# Information Systems ISM 3011

Fall 2003  
Unit 3A

Dr. Martin Hepp

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## Assignment for Next Class

- Read and prepare the case studies 1 and 2 (p. 127-128).

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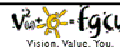
  
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## Hardware: Input, Processing, and Output Devices

Chapter 3

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## Principles and Learning Objectives

- Assembling an effective, efficient computer system requires an understanding of its relationship to the information system and the organization. The computer system objectives are subordinate to, but supportive of, the information system and the needs of the organization.
  - Describe how to select and organize computer system components to support information system objectives and business organization needs.

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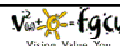
  
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## Principles and Learning Objectives

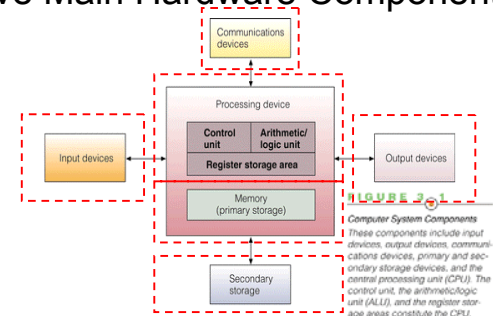
- When selecting computer devices, you also must consider the current and **future needs** of the information system and the organization. Your choice of a particular computer system device should always **allow for later improvements**.
  - Describe the power, speed, and capacity of central processing and memory devices.
  - Describe the access methods, capacity, and portability of secondary storage devices.
  - Discuss the speed, functionality, and importance of input and output devices.

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## Five Main Hardware Components



The diagram illustrates the five main hardware components of a computer system. At the center is the 'Processing device', which contains the 'Control unit', 'Arithmetic/logic unit', and 'Register storage area'. Below the processing device is 'Memory (primary storage)'. Below memory is 'Secondary storage'. To the left of the processing device is 'Input devices', and to the right is 'Output devices'. 'Communications devices' are shown at the top, connected to the input/output path. A dashed red box encloses the input devices, processing device, output devices, and communications devices. Another dashed red box encloses the processing device, memory, and secondary storage. A third dashed red box encloses the output devices, secondary storage, and communications devices. The diagram is labeled 'FIGURE 3-1 Computer System Components'.

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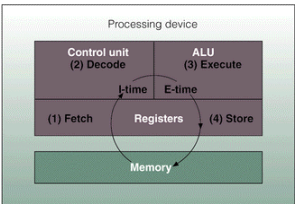
## Machine Language

<b>CLEAR A</b>	000: 100
<b>LOAD A, 7</b>	001: 200 7
<b>LOAD B, 5</b>	003: 201 5
<b>SUB A, B</b>	005: 150
<b>JUMP TO 034 IF ZERO</b>	006: 170 034
	008:
Assembler	...
(Mnemonics)	034: ...

Machine Language

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## Hardware Components in Action



*Step 1:* Fetch instruction

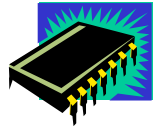
*Step 2:* Decode instruction

*Step 3:* Execute the instruction

*Step 4:* Store results

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## Processing & Memory Devices



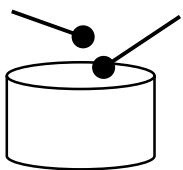
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## Processing Characteristics and Functions

- Clock speed:** electronic pulses affecting machine cycle time
  - Hertz: one cycle (pulse) per second
  - Megahertz (MHz): millions of cycles per second
- Microcode:** internal, predefined elementary operations in a CPU

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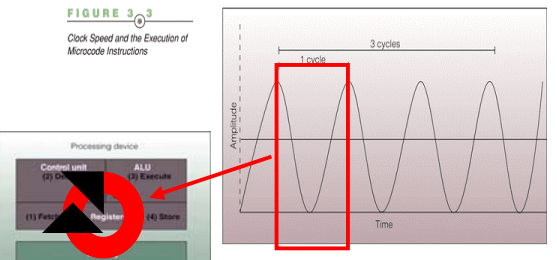
## Clock Speed – The Computer’s Drum Beat



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## Clock Speed

**FIGURE 3.2**  
Clock Speed and the Execution of Microcode Instructions



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## Processing Characteristics and Functions

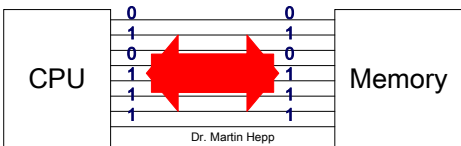
- **Machine cycle time is measured in:**
  - Microseconds (1 millionth)
  - Nanoseconds (1 billionth)
  - Picoseconds (1 trillionth)
  - MIPS (Millions of Instructions Processed per Second)

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## Wordlength and Bus Line Width

- **Bits (Binary Digits):** smallest form of data in a computer
- **Wordlength:** number of bits that can be processed as a unit
- **Bus lines:** electrical paths of data flow



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## Physical Characteristics of the CPU

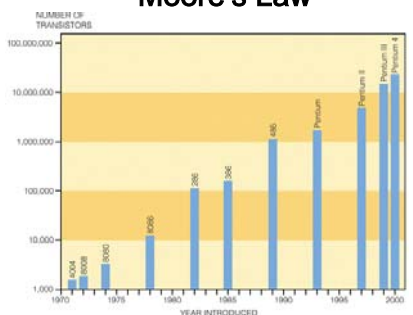
- Digital circuits on chips
- Electrical current flows through silicon
- “Moore’s Law” - transistor density of chips will double every 18 months

...Human capabilities do not double every 18 months!

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## Moore’s Law



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FIGURE 3-4  
Moore’s Law  
(Source: Data from Moore’s Law Overview, Intel Web site, www.intel.com/research/technology/moorelaw.htm, accessed July 23, 2003.)

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## Complex and Reduced Instruction Set Computing

- **Complex instruction set computing (CISC)** - places as many microcode instructions into the central processor as possible  
(French Restaurant ☺)
- **Reduced instruction set computing (RISC)** - involves reducing the number of microcode instructions built into a chip to an essential set of common microcode instructions  
(Fast food ☺)

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## Memory Characteristics and Functions



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## Storage Capacity

Name	Abbreviation	Number of Bytes
Byte	B	1
Kilobyte	KB	1,024 Bytes
Megabyte	MB	1,024 Kilobytes (about 1 million)
Gigabyte	GB	1,024 Megabytes (about 1 billion)
Terabyte	TB	1,024 Gigabytes (about 1 trillion)
Petabyte	PB	1,024 Terabytes (about 1 quadrillion)

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## Types of Memory

**FIGURE 3.5**  
Basic Types of Memory Chips

```

graph TD
    MT[Memory types] --> V[Volatile]
    MT --> NV[Nonvolatile]
    V --> RAM[RAM]
    NV --> ROM[ROM]
    RAM --> SDRAM[SDRAM]
    RAM --> DRAM[DRAM]
    RAM --> EDO[EDO]
    ROM --> PROM[PROM]
    ROM --> EPROM[EPROM]
    
```

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## Cache Memory

**FIGURE 3.6**

**Cache Memory**  
Processors can access this type of high-speed memory faster than main memory. Located near the CPU, cache memory works in conjunction with main memory. A cache controller determines how often the data is used and transfers frequently used data to cache memory, then deletes the data when it goes out of use.

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## Massively Parallel Processing

**FIGURE 3.7**

**Massively Parallel Processing**  
Massively parallel processing involves breaking a problem into various subproblems or parts, then processing each of these parts independently. The most difficult aspect of massively parallel processing is not the simultaneous processing of the subproblems but the logical structuring of the problem into independent parts.

```

graph TD
    PJ[Processing job] --> PA[Part A]
    PJ --> PB[Part B]
    PJ --> PC[Part C]
    PJ --> PD[Part D]
    PJ --> PE[Part E]
    PA --> PRA[Processor A]
    PB --> PRB[Processor B]
    PC --> PRC[Processor C]
    PD --> PRD[Processor D]
    PE --> PRE[Processor E]
    PRA --> SA[Solution A]
    PRB --> SB[Solution B]
    PRC --> SC[Solution C]
    PRD --> SD[Solution D]
    PRE --> SE[Solution E]
    SA --> FR[Final results]
    SB --> FR
    SC --> FR
    SD --> FR
    SE --> FR
    
```

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## Secondary Storage

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## Secondary Storage

- Offers the advantages of **nonvolatility**, greater capacity, and greater economy
- Access methods, storage capacities, and portability required are determined by the information system's objectives

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## Access Methods

- **Sequential:** records must be retrieved in order
  - Devices used are called sequential access storage devices (SASD)
- **Direct:** records can be retrieved in any order
  - Devices used are called direct access storage devices (DASDs)

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## Devices

- Magnetic tapes
- Magnetic disks
- RAID
- Storage area networks (SAN)
- Optical disks
- Magneto-optical (MO) disks
- Digital versatile disks (DVDs)

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## Magnetic Disks



**FIGURE 3-10**

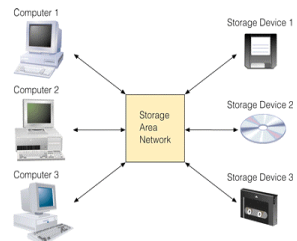
**Hard Disk**  
Hard disks give direct access to stored data. The read/write head can move directly to the location of a desired piece of data, dramatically reducing access times, as compared with magnetic tape.  
(Source: Courtesy of Seagate Technology.)

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## Storage Area Network

**FIGURE 3-11**  
**Storage Area Network**  
SAN provides high-speed connections between data storage devices and computers over a network using the Fibre Channel communications protocol.



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## Comparison of Secondary Storage Devices

**TABLE 3-1**  
Comparison of Secondary Storage Devices

Storage Device	Year First Introduced	Maximum Capacity
3.5-inch diskette	1987	1.44 MB
CD-ROM	1990	650 MB
Zip	1995	100-250 MB
DVD	1996	17 GB

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## Characteristics and Functionality

- **Data** - can be human or machine readable
- **Data entry** - converts human readable data into machine-readable form
- **Data input** - transfers machine-readable data into the system
- **Source data automation** - capturing and editing data at its source

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# Input and Output Devices



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## Input Devices

- Personal computer input devices
  - Keyboard
  - Mouse
- Voice-recognition devices
- Digital cameras
- Terminals

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## What's that?



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## Thank you!

Any questions? Please send an e-mail to [mhepp@computer.org](mailto:mhepp@computer.org)!

<http://ruby.fgcu.edu/courses/mhepp/>  
(-> CRN80999)

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