



Computer Systems

The Architecture of Computer Hardware and Systems Software: An Information Technology Approach

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Courtesy:

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**Wilson Wong, Bentley College
Linda Senne, Bentley College**



Typical Computer Ad



ONLY \$999



FASTCAT™ Desktop
Top Performance, Great Value!

- ◆ Intel® 2.7 GHz Pentium® 4 Processor
- ◆ 1 GB up to 2 GB DDRAM
- ◆ 120 GB Ultra ATA 7200 RPM HD 16 MB cache
- ◆ 10/100 PCI Ethernet card
- ◆ 64 MB GeForce 4x AGP Video
- ◆ DVD-ROM/RAM + CD-R/RW
- ◆ 2 USB-2, IEEE-1394 Firewire®
- ◆ 17" Non-Interlaced Full Flat Screen Monitor
.26dp (1024 x 768) Add \$300 for
17" TFT LCD (1280 x 1024)

- Is the computer fast enough to run necessary programs?
- Is the computer cost-effective?
- Will it be obsolete in 6 months?



Why Study Computer Architecture?

- User
 - Understand system capabilities and limitations
 - Make informed decisions
 - Improve communications with information technology professionals
- Systems Analyst
 - Conduct surveys, determine feasibility and define and document user requirements
 - Specify computer systems to meet application requirements
- Programmer
 - Create efficient application software for specific processing needs

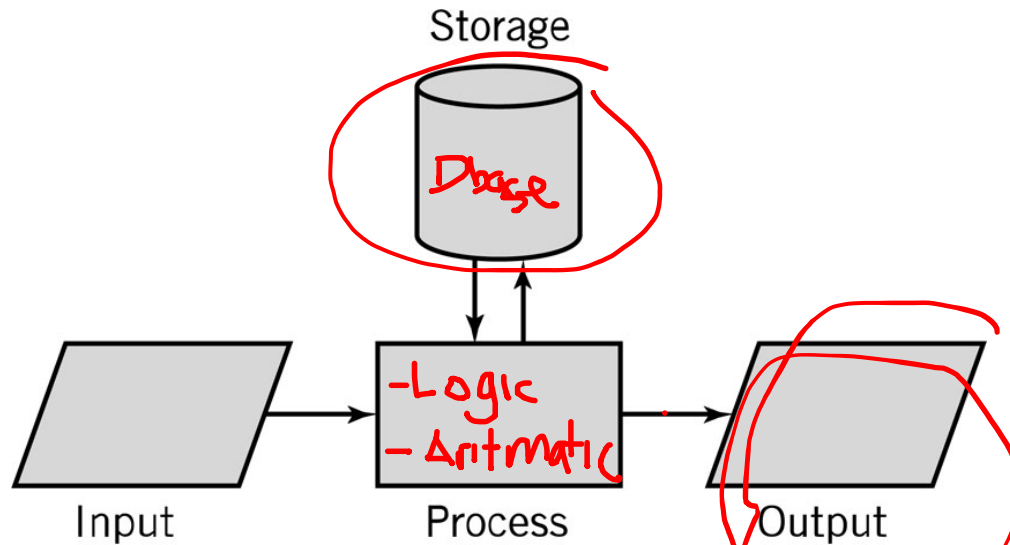


Why Study Computer Architecture?

- System Administrator / Manager
 - Install, configure, maintain, and upgrade computer systems
 - Maximize system availability
 - Optimize system performance
 - Ensure system security
- Web Designer
 - Optimize customer accessibility to Web services
 - System administration of Web servers
 - Select appropriate data formats
 - Design efficient Web pages



Input-Process-Output Model (IPO)



- Input: keyboard, mouse, (CPU), punch cards
- Processing: CPU executes the computer program
- Output: monitor, printer, fax machine
- Storage: hard drive, optical media, diskettes, magnetic tape



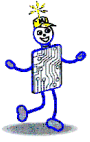
Architecture Components

- *Hardware*
 - Processes data by executing instructions
 - Provides input and output
- *Software*
 - Instructions executed by the system
- **Data**
 - Fundamental representation of facts and observations
- **Communications**
 - Sharing data and processing among different systems

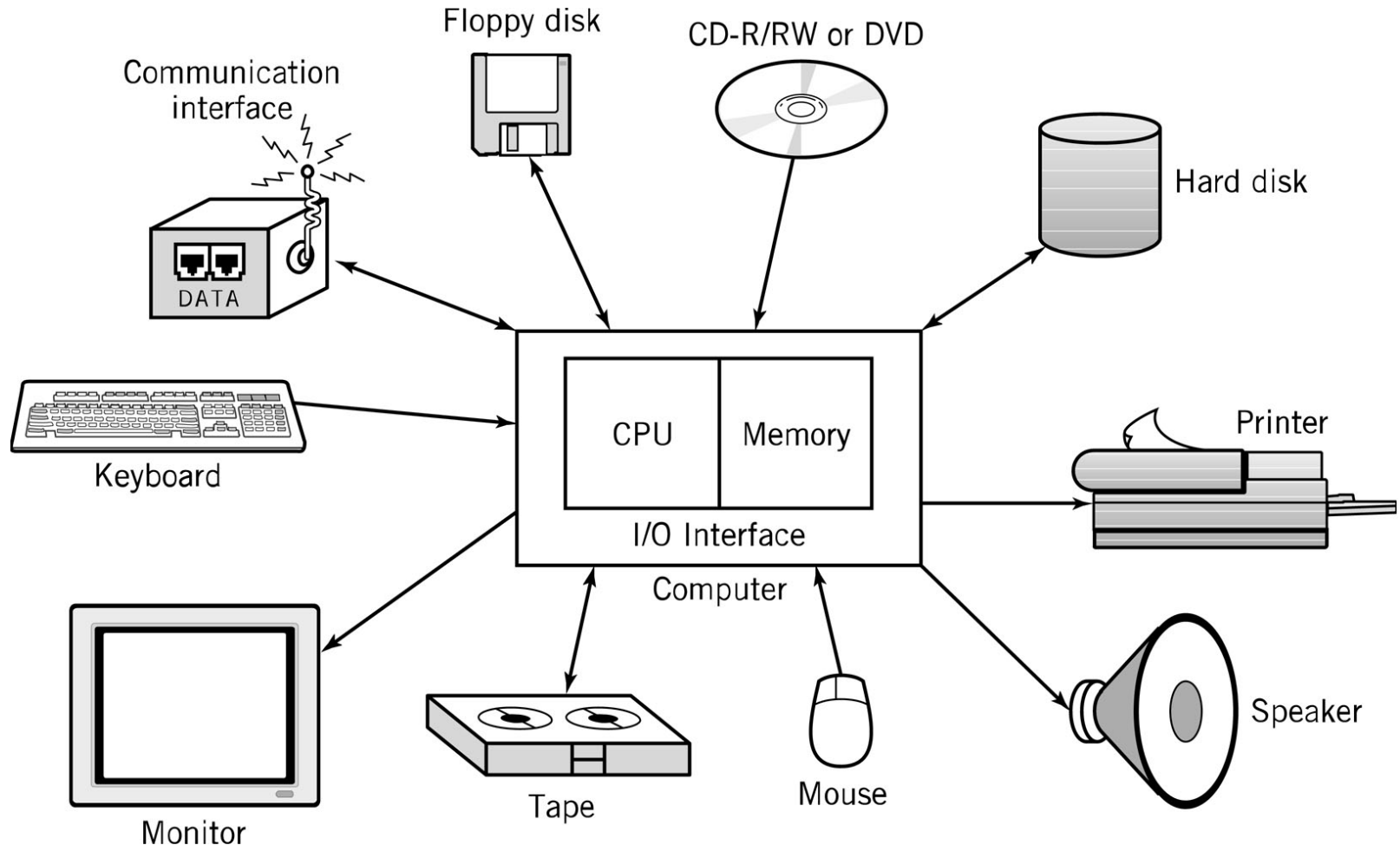


Hardware Component

- Input/Output devices
- Storage Devices
- CPU
 - *ALU: arithmetic/logic unit*
 - *CU: control unit*
 - *Interface unit*
- *Memory*
 - Short-term storage for CPU calculations



Typical Personal Computer System





CPU: Central Processing Unit

- ALU: arithmetic/logic unit
 - Performs arithmetic and Boolean logical calculations
- CU: control unit
 - Controls processing of instructions
 - Controls movement of data within the CPU
- Interface unit
 - Moves instructions and data between the CPU and other hardware components
 - *Bus*: bundle of wires that carry signals and power between different components



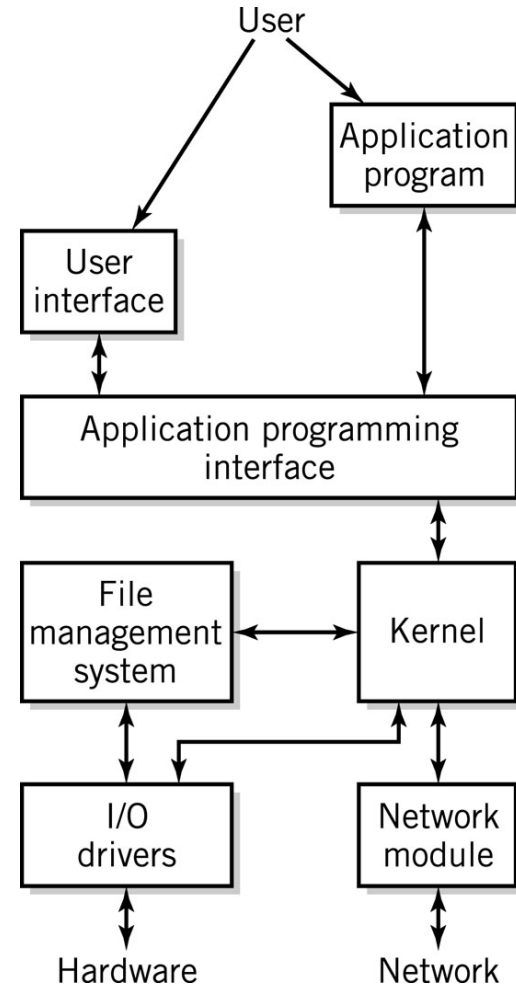
Memory

- Also known as *primary storage*, working storage, and *RAM (random access memory)*
- Consists of bits, each of which hold a value of either 0 or 1 (8 bits = 1 byte)
- Holds both instructions and data of a computer program (*stored program concept*)



Software Component

- Applications
- *Operating System*
 - API: application program interface
 - File management
 - I/O
 - Kernel
 - ▣ Memory management
 - ▣ Resource scheduling
 - ▣ Program communication
 - ▣ Security
 - Network Module





Communications Component

- Hardware
 - Communication *channels*
 - ▣ Physical connections between computer systems
 - ▣ Examples: wire cable, phone lines, fiber optic cable, infrared light, radio waves
 - Interface hardware
 - ▣ Handles communication between the computer and the communication channel
 - ▣ *Modem* or *network interface card (NIC)*
- Software
 - Network protocols: HTTP, TCP/IP, ATAPI



Computer Systems

All computer systems, no matter how complex, consists of the following:

- At least one CPU
- Memory to hold programs and data
- I/O devices
- Long-term storage



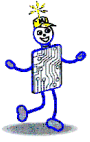
Protocols

- Common ground rules of communication between computers, I/O devices, and many software programs
- Examples
 - HTTP: between Web servers and Web browsers
 - TCP/IP: between computers on the Internet and local area networks
 - ATAPI: between a CPU and CD-ROMs



Standards

- Created to ensure universal compatibility of data formats and protocols
- May be created by committee or may become a de facto standard through popular use
- Examples:
 - Computer languages: Java, SQL, C, JavaScript
 - Display standards: Postscript, MPEG-2, JPEG, GIF
 - Character set standards: ASCII, Unicode, EBCDIC
 - Video standards: VGA, XGA, RGB



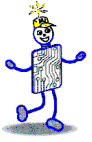
Early History

- 1642: Blaise Pascal invents a calculating machine
- 1801: Joseph Marie Jacquard invents a loom that uses punch cards
- 1800's:
 - Charles Babbage attempts to build an analytical engine (mechanical computer)
 - Augusta Ada Byron develops many of the fundamental concepts of programming
 - George Boole invents Boolean logic.

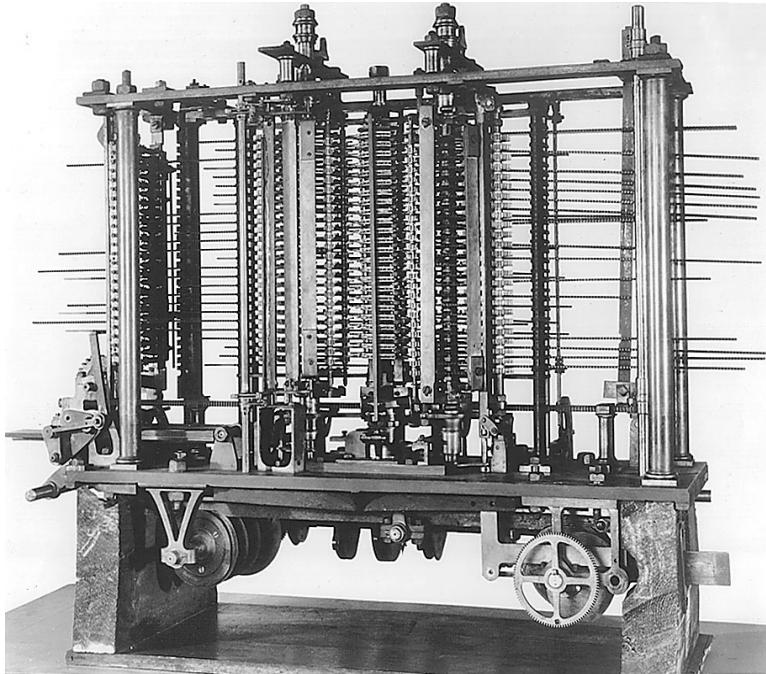


Modern Computer Development

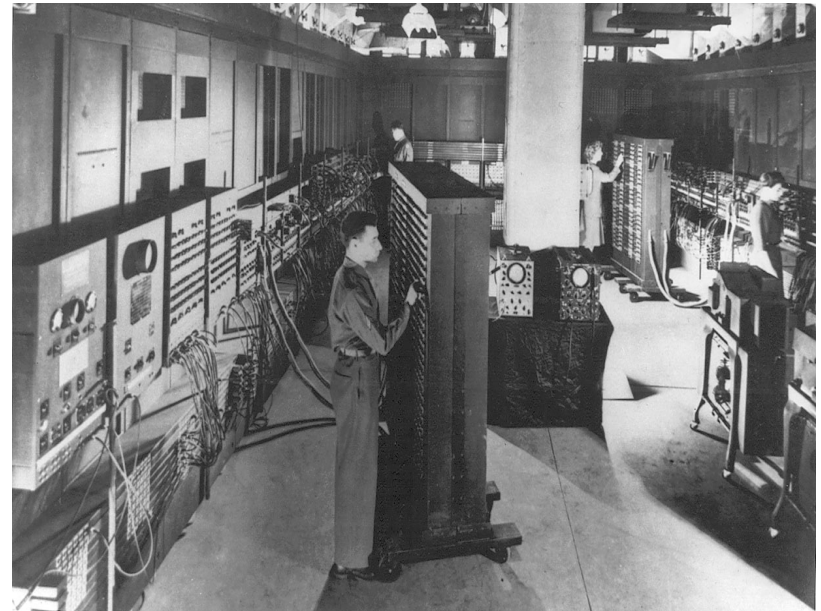
- 1937: Mark I is built (Aiken, Harvard University, IBM).
 - First electronic computer using relays.
- 1939: ABC is built
 - First fully electronic digital computer. Used vacuum tubes.
- 1943-46: ENIAC (Mauchly, Eckert, University of Pennsylvania).
 - First general purpose digital computer.
- 1945: Von Neumann architecture proposed.
 - Still the standard for present day computers.
- 1947: Creation of transistor
 - (Bardeen, Shockley, Brattain, Bell Labs).
- 1951: UNIVAC.
 - First commercially available computer.



Early Computers



Babbage's Analytical Engine



ENIAC



Textbook Overview

- Web site: <http://www.wiley.com/college/englander>
- Part 1 (Chapter 1)
 - Computer system overview
- Part 2 (Chapters 2-5)
 - Number systems and data formats
- Part 3 (Chapters 6-12)
 - Computer architecture and hardware operation
- Part 4 (Chapters 13-18)
 - Software – operating systems, applications, development environments
- Part 5 (Supplementary Chapters 1-3)
 - Digital logic, addressing modes, and communication channel technology



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