



CHAPTER 1: Computers and Systems

The Architecture of Computer Hardware, Systems Software & Networking: An Information Technology Approach

4th Edition, Irv Englander

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PowerPoint slides authored by Wilson Wong, Bentley University

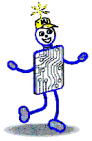
PowerPoint slides for the 3rd edition were co-authored with Lynne Senne, Bentley University

PowerPoint slides modified by Gianluca Amato, Univ. di Chieti-Pescara



Why Study Computer System Architecture?

- User
 - Understand system capabilities and limitations
 - Make informed decisions
 - Improve communications with information technology professionals
- Programmer
 - Create efficient application software for specific processing needs
- Systems Architect or Systems Analyst
 - Specify computer systems and architecture to meet application requirements
 - Make intelligent decisions about system strategy



Typical Computer Ad

**TECHNOLOGY CHOICES
TO BUILD YOUR BUSINESS**



New! Vostre 400 Mini Tower

Only Drex delivers this combination of performance and expandability in a system designed exclusively for Small Businesses—the Vostre 400.

- Intel Core 2 Duo Processor
- Genuine Home Basic Operating System
- 2GB DDR2 SDRAM
- 160GB SATA Hard Drive
- 16x DVD+/-RW Drive
- 256MB PCI Express Graphics Card
- 1-Yr Limited Warranty, Next Business Day On-Site Service, and Hardware Warranty Support
- 20" Widescreen Flat Panel Display

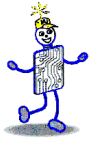
ON SALE NOW! NEW! Lower-priced upgrades: Upgrade to 4GB Memory, 250GB Hard Drive, and 22" Widescreen Flat Panel Display for only \$90!!

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

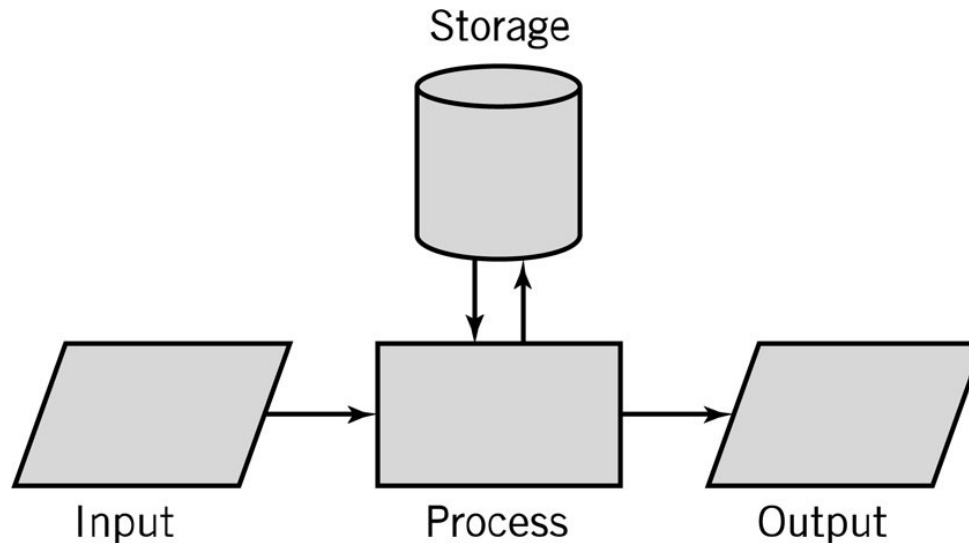


Why Study Computer System Architecture?

- System Administrator / Manager
 - Install, configure, maintain, and upgrade computer systems
 - Maximize system availability and efficiency
 - Optimize system performance
 - Ensure system security
- Web Services Designer
 - Optimize customer accessibility to Web services
 - Optimize web system configurations
 - Select appropriate data formats, page designs and scripting languages
 - Design efficient Web pages



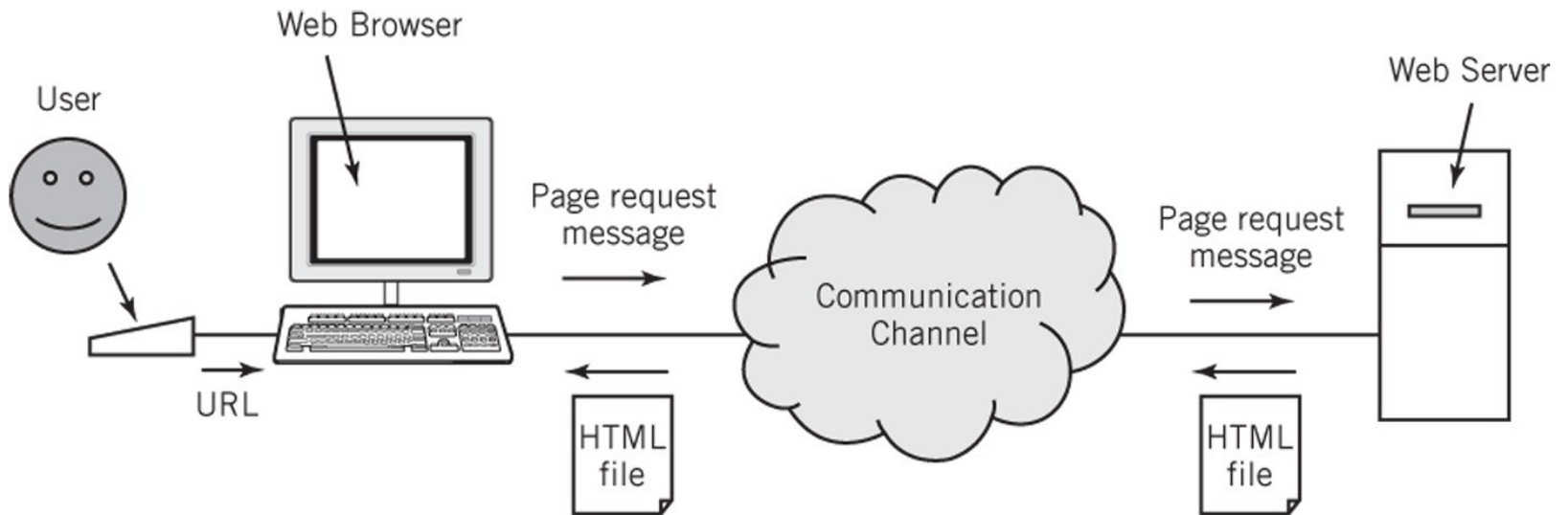
Input-Process-Output Model (IPO)



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

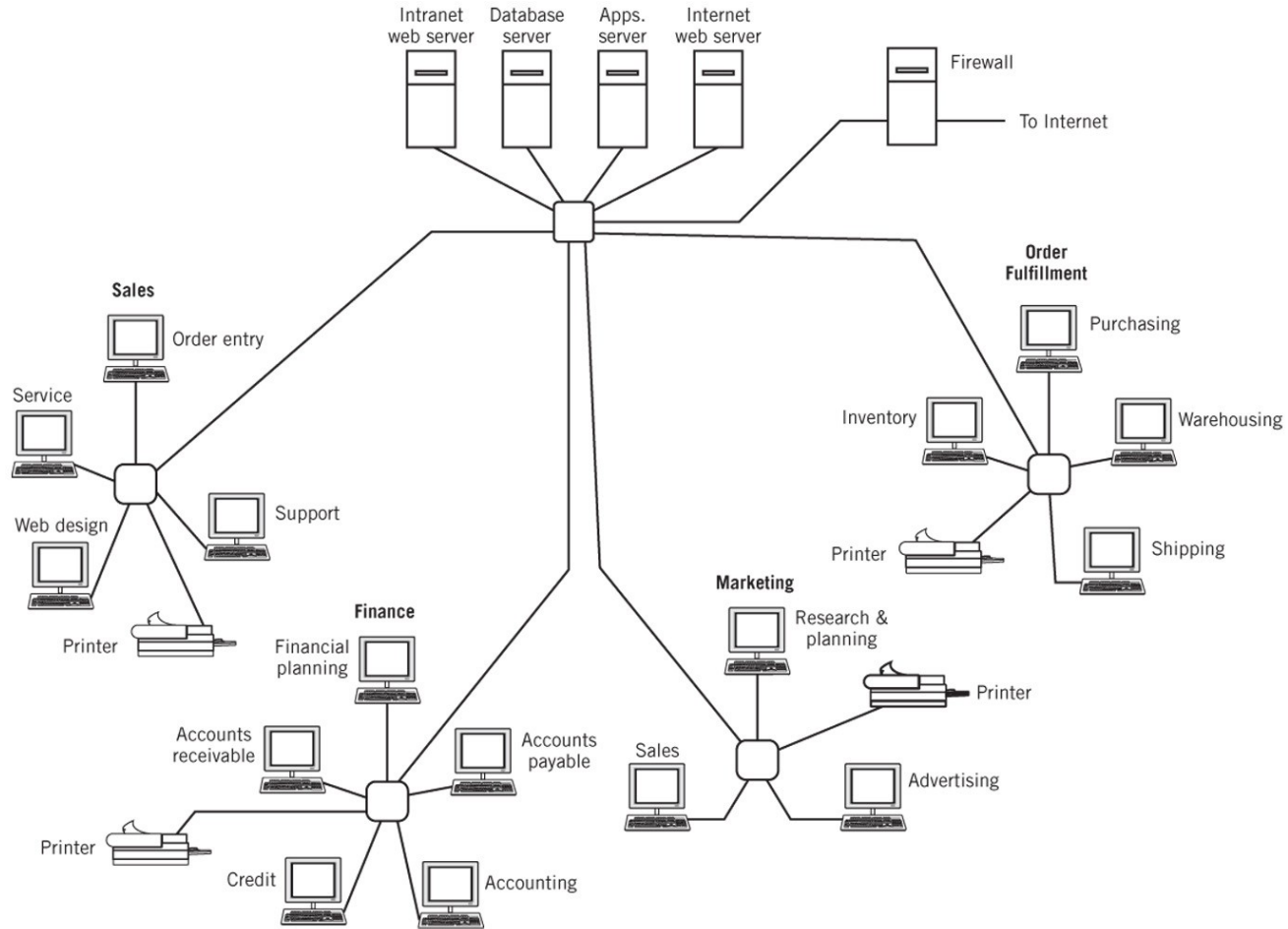


Web Browser Application Use





Simplified IT Computer System Layout





Computer System Components

- *Hardware*
 - Processes data by executing instructions
 - Provides input and output
 - Control input, output and storage components
- *Software*
 - Applications and system software
 - Instructions tell hardware exactly what tasks to perform and in what order
- *Data*
 - Fundamental representation of facts and observations
- *Communications*
 - Sharing data and processing among different systems

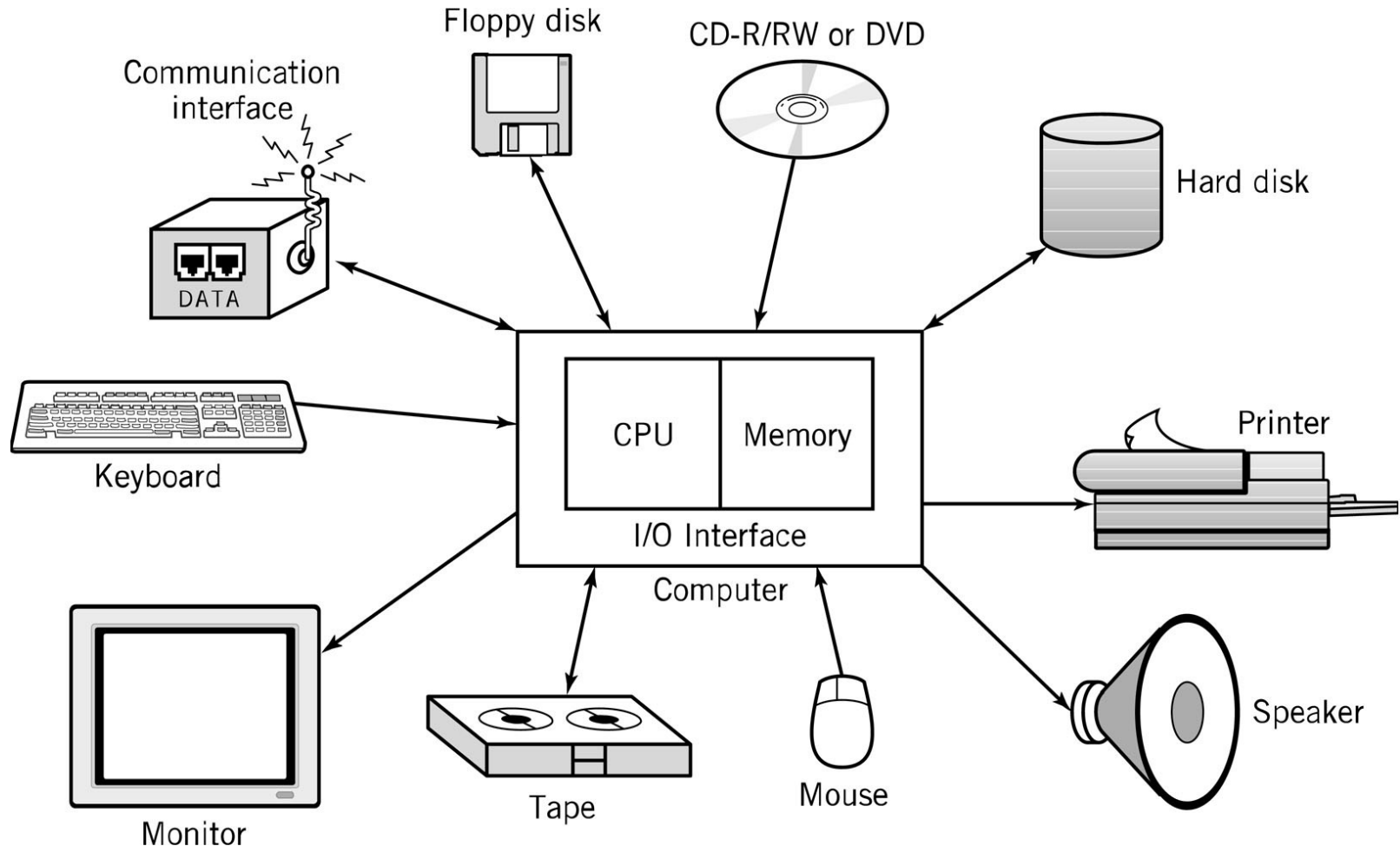


Hardware Component

- CPU – Central Processing Unit
- Memory
 - Short-term storage for CPU calculations
- Storage Devices
- Input/Output devices



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



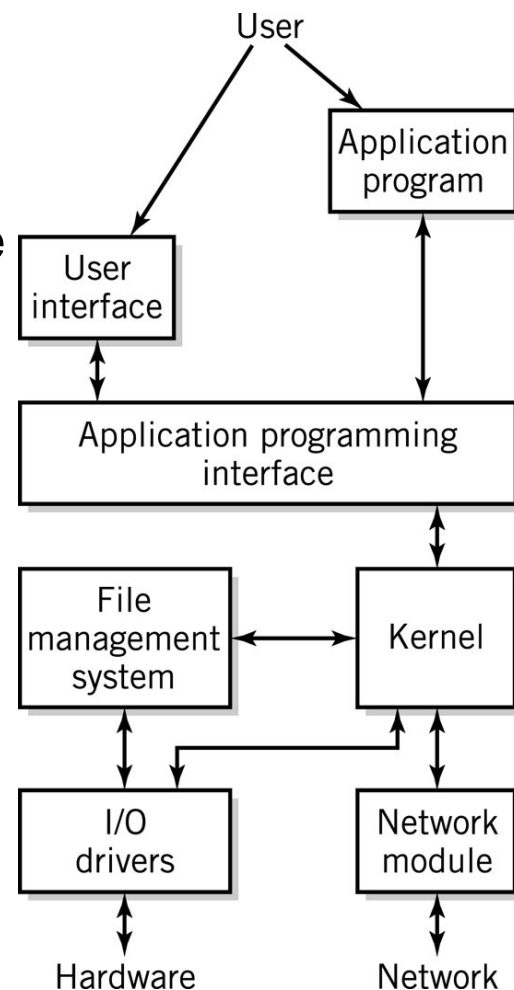
Memory

- 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)
- Amounts of primary storage has increased enormously in the last 30 year
- 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
- Bootstrap





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
 - Establish connections
 - Control flow of data
 - Directs data to the proper applications for use



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



Computer Systems Examples



IBM System z10 EC Mainframe



HP Laptop Computer



Virtualization

- **Physic system example**
 - Virtual image in a mirror
- **Computer systems examples**
 - Virtual memory
 - Virtual networks
 - Java Virtual Machine



Virtualization

- If it's there and you can see it - it's real.
- If it's there and you can't see it - it's transparent.
- If it's not there and you can see it - it's virtual.
- If it's not there and you can't see it - you erased it!

Scott Hammer



Protocols

- Common ground rules of communication between computers, I/O devices, and many software programs
- Human protocols:
 - Phone talk
- Computer protocols:
 - HTTP: between Web servers and Web browsers
 - TCP/IP: between computers on the Internet and local area networks
 - SATA: between storage devices and computers
 - XML, RSS, SIP: new protocols



Standards

- Agreements among parties, to assure that various system will work together
 - Data formats or protocol
- May be created by committee or may become a de facto standard through popular use
- Examples:
 - Document standards: PDF, OpenDocument, DOC
 - Computer languages: Java, SQL, C, JavaScript
 - Character set standards: ASCII, Unicode, EBCDIC
 - Multimedia standards: MPEG-2, MPEG-4, DivX, MP3



Textbook Overview

- Web site: <http://www.wiley.com/college/englander>
- Part 1 (Chapters 1-2)
 - Overview of computer systems
- Part 2 (Chapters 3-5)
 - Number systems and data formats
- Part 3 (Chapters 6-11)
 - Computer architecture and hardware operation
- Part 4 (Chapters 12-14)
 - Networks and data communications
- Part 5 (Chapters 15-18)
 - Software component – operating systems
- Part 6 (Supplementary Chapters S1-S4)
 - Digital logic, systems examples, instruction addressing modes, programming tools



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.

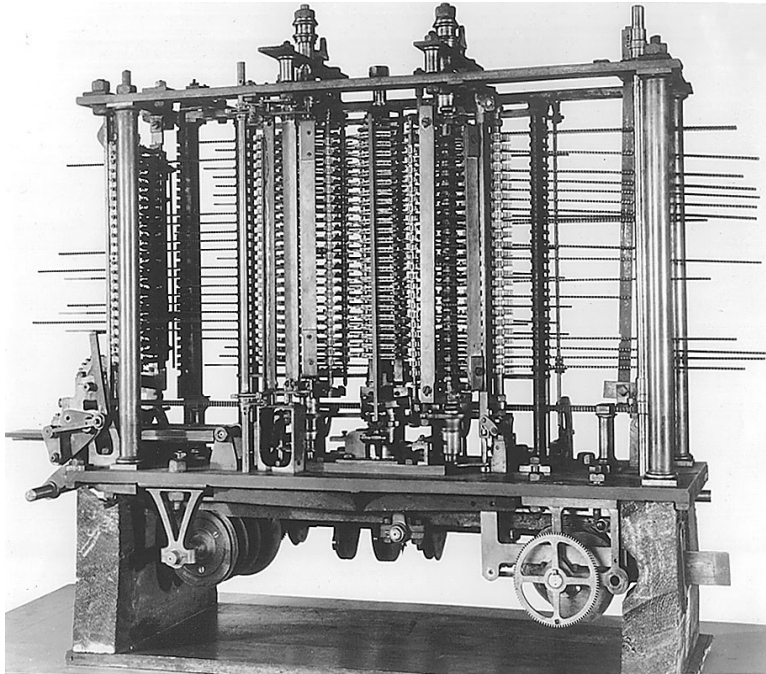


Modern Computer Development

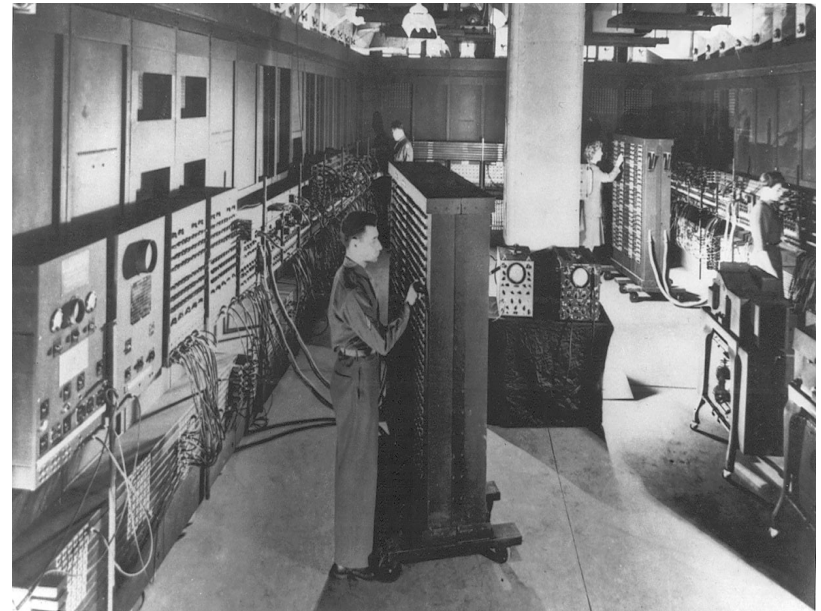
- 1937: Mark I is built (Aiken, Harvard University, IBM).
 - First electronic computer using relays.
- 1939: ABC is built
 - First fully electronic digital computer. Used vacuum tubes.
- 1943-46: ENIAC (Mauchly, Eckert, University of Pennsylvania).
 - First general purpose digital computer.
- 1945: Von Neumann architecture proposed.
 - Still the standard for present day computers.
- 1947: Creation of transistor
 - (Bardeen, Shockley, Brattain, Bell Labs).
- 1951-2: EDVAC and IAS



Early Computers



Babbage's Analytical Engine



ENIAC



System Software History

- Early computers had no operating systems and were single user systems
 - Programs were entered using switches for each bit or by plugging wires into a panel
- 1953-54: First operating system was built by General Motors Research Laboratories for their IBM 701 computer
- Other early systems
 - FORTRAN Monitor System (FMS)
 - IBSYS
 - Share Operating System (SOS)



Operating System Development

- 1963: Master Control Program (MCP) by Burroughs. Included many modern OS features.
- 1964: OS/360 by IBM. Included batch processing of programs.
- 1962: MIT Project MAC created a time-sharing OS called CTSS. Shortly afterwards, MIT, Bell Labs, and GE developed Multics (Multiplexed Information and Computing Services).



UNIX

- After Bell Labs withdrew from the Multics project, Ken Thompson developed a personal operating system called UNIX using assembly language.
- Dennis Ritchie developed the programming language C which was used to rewrite much of UNIX in a high-level language.
- UNIX introduced
 - A hierarchical file system
 - The shell concept
 - Document production and formatting
 - Tools for networked and distributed processing



Graphical User Interfaces

- 1960s: Doug Englebart (Stanford Research Institute)
 - Invented windows and a mouse interface
- 1970s: Xerox PARC
 - Creates a practical windowing system for the Dynabook project
- 1980s: Steve Jobs (Apple)
 - Developed the Apple Lisa and Macintosh



IBM PC

- 1982: Stand-alone, single user computer
- PC-DOS, MS-DOS (disk operating system)
- Later versions of DOS added
 - Hierarchical directory file storage
 - File redirection
 - Better memory management
- Windowing systems
 - Windows 2.0, Windows 3.1, Windows 95
 - Windows NT, Windows XP, Windows Vista
 - Windows 7



Communications

- 1960s and 1970s: users communicated on multiterminal computer systems using talk and email facilities
- 1971: Ray Tomlinson creates the standard username@hostname email standard
- Modems permitted users to login to office systems, electronic bulletin board systems, Comuserve, AOL, and Prodigy
- 1969: ARPANET begun
- 1985: First TCP-IP wide area network
- 1991: Tim Berners Lee develops the concepts that become the World Wide Web
- 1993: Max Andreessen develops Mosaic, the first graphical browser



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