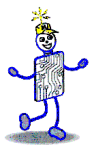

CHAPTER 1: Computers and Systems

The Architecture of Computer Hardware, Systems Software & Networking:

An Information Technology Approach

Irv Englander

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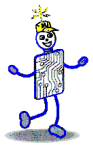
PowerPoint slides authored by Angela Clark, University of South Alabama

PowerPoint slides for the 4th edition were authored by Wilson Wong, Bentley University



Computing Devices – Old and New

Computer Devices, Old and New

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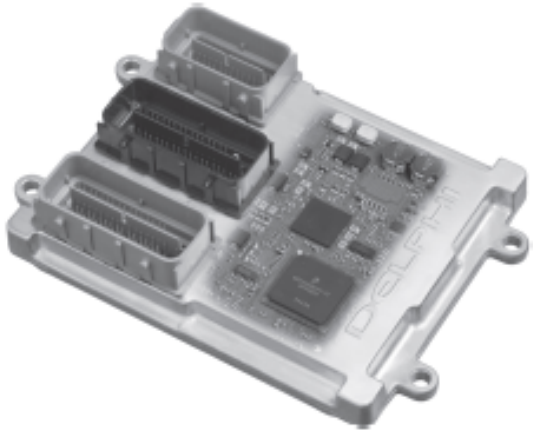
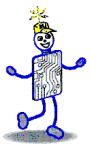
Photo by David Sheppard



Delphi Automotive

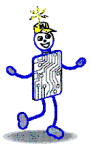
Modern Computing

- Computing is ubiquitous
  - It is everywhere and anywhere
  - No longer limited to a traditional ‘computer’
  - Greater variety of computing platforms exist now
- Computing is pervasive
  - Embedded in many other types of devices such as appliances and automobiles
  - Users no longer have to understand the details of how they work to operate the device



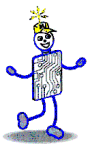
Why Study Computer System Architecture?

- User
  - Understand system capabilities, strengths, and limitations
  - Make better 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



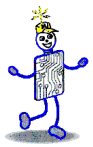
Why Study Computer System Architecture?

- Networking Professional
  - Design, maintain, support, and manage networks
  - Optimize equipment and network resources
- 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

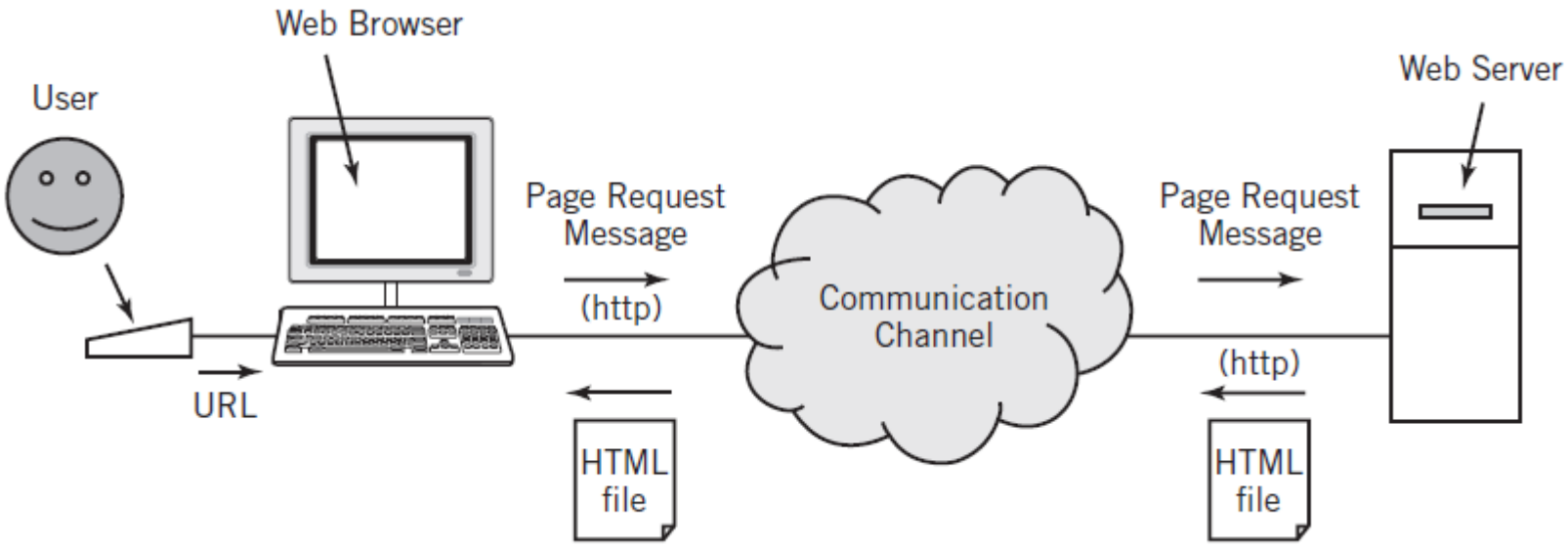


Why Study Computer System Architecture?

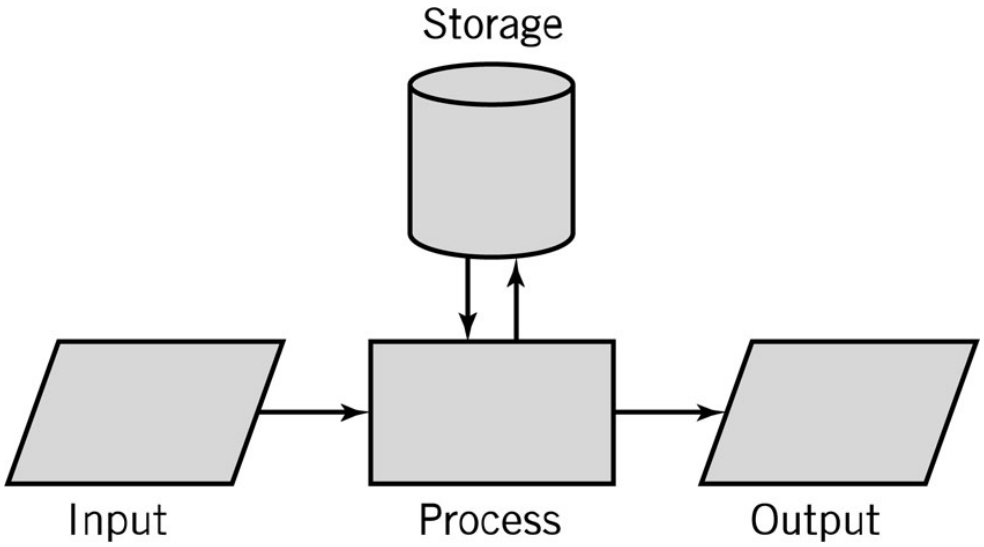
- System Administrator / Manager
  - Install, configure, maintain, and upgrade computer systems
  - Maximize system availability and efficiency
  - Optimize system performance
  - Select cloud services
  - Ensure system security



Web Browser Application Use

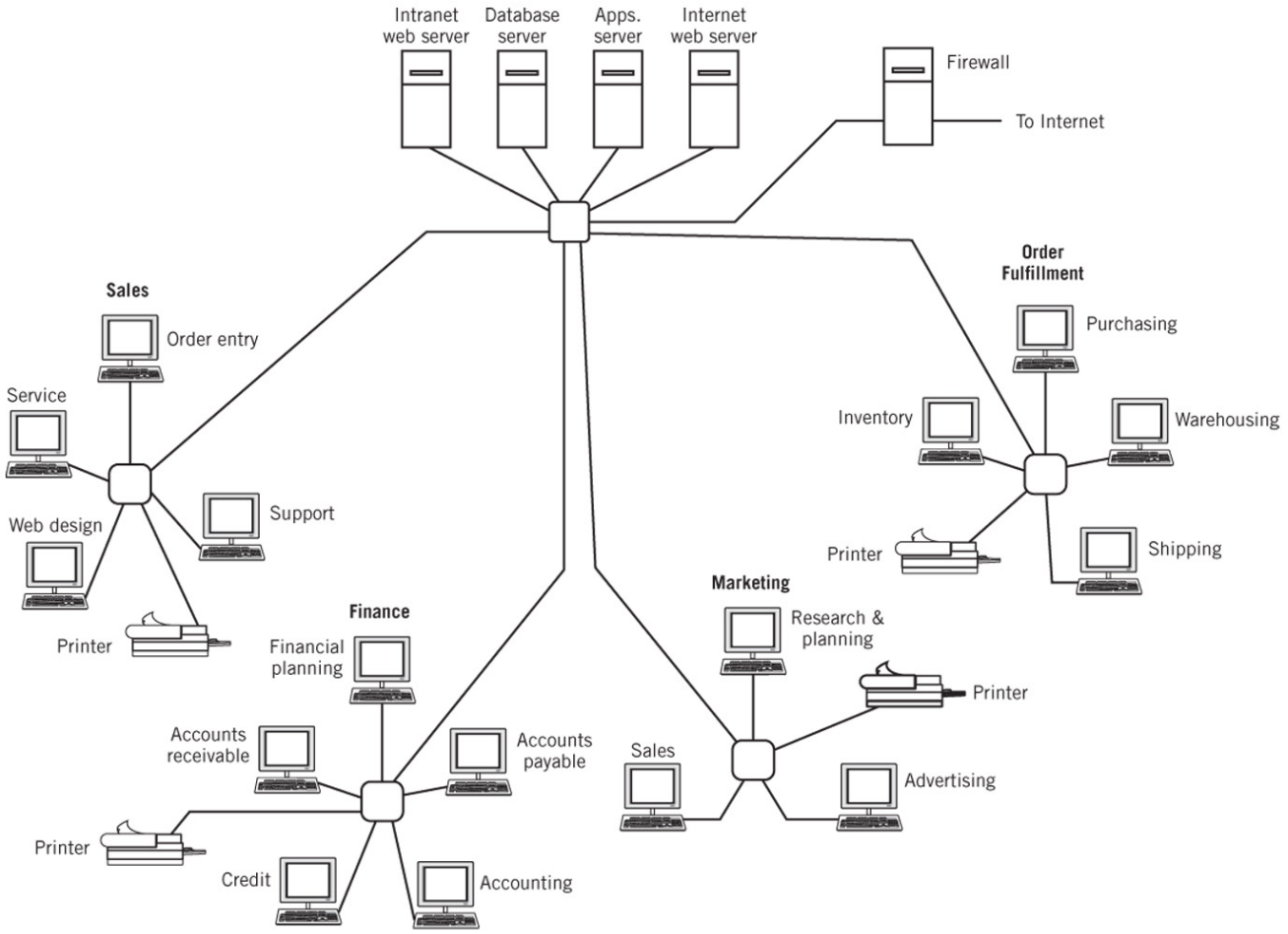


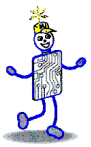
Input-Process-Output Model (IPO)



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

Simplified IT Computer System Layout



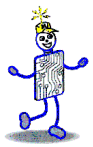


Computer System Components

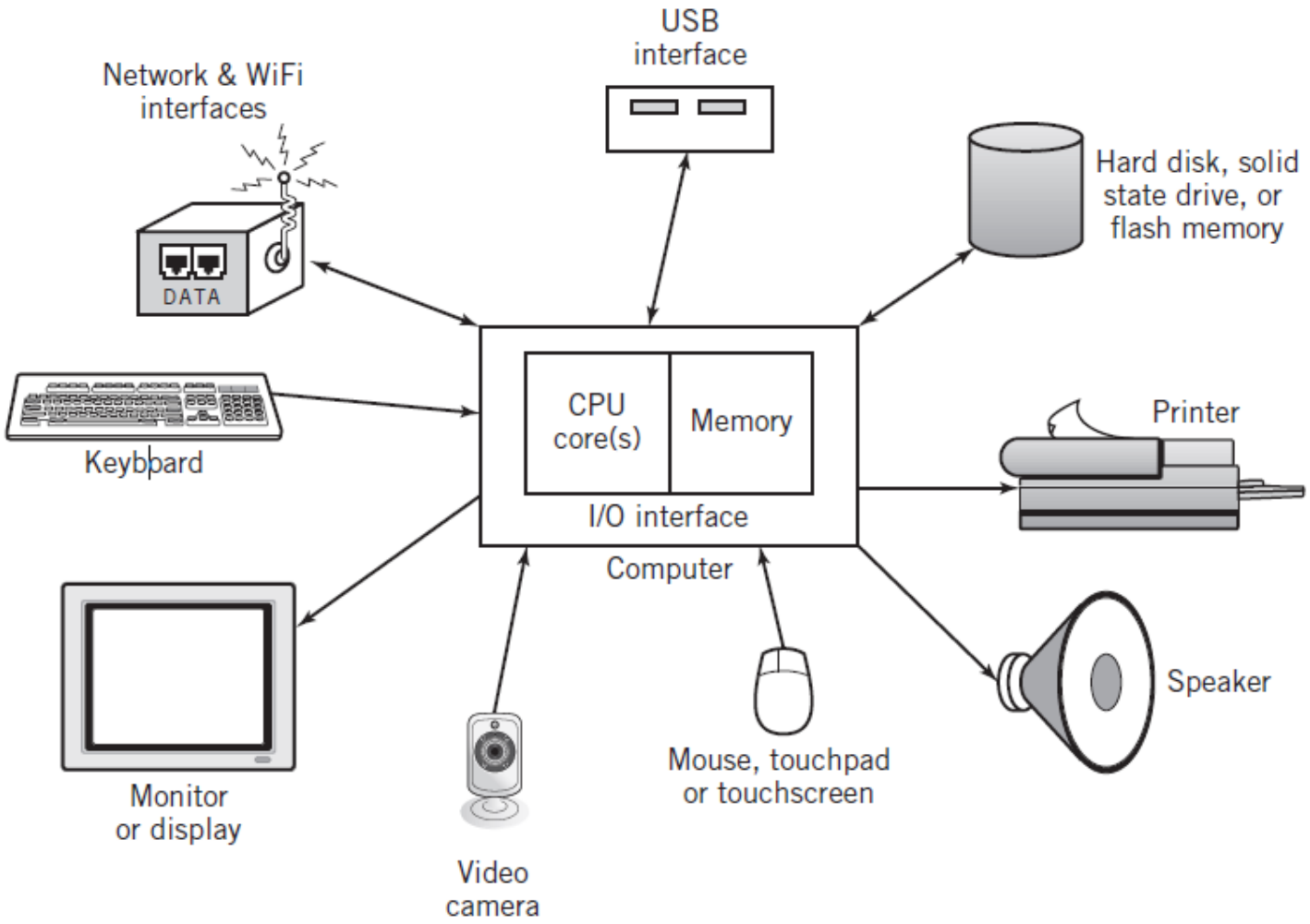
- *Hardware*
  - Processes data by executing instructions
  - Provides input and output
  - Control input, output, and storage components
- *Software*
  - Applications and system software
  - Instructions tell hardware exactly what tasks to perform and in what order
- *Data*
  - Fundamental representation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

Hardware Component

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



Typical Personal Computer System

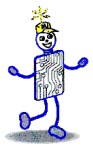


CPU: Central Processing Unit

- 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

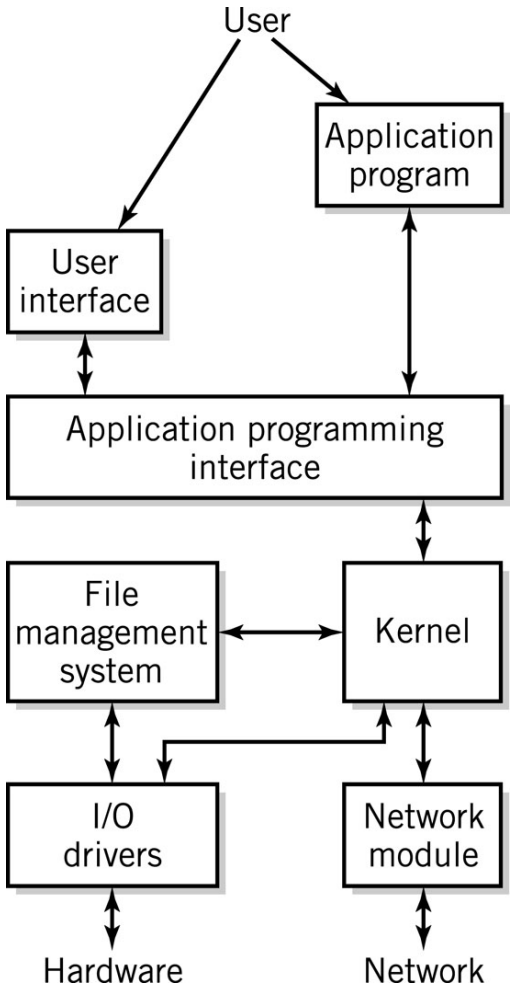
Memory

- 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*)



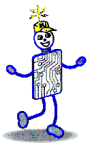
Software Component

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



Communication Component

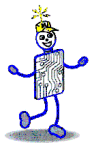
- Hardware
  - *Communication channels*
    - Physical connections between computer systems
    - Examples: wire cable, phone lines, fiber optic cable, infrared light, radio waves
  - Interface hardware
    - Handles communication between the computer and the communication channel
    - *Modem* or *network 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

Courtesy of Irv Englander

Virtualization

- Virtual (American Heritage Dictionary
  - Existing or result in essence or effect though not in actual fact, form or name
  - Created, simulated, or carried on by means of a computer or computer network
- Computer systems examples
  - Virtual memory
  - Virtual networks
  - Java Virtual Machine

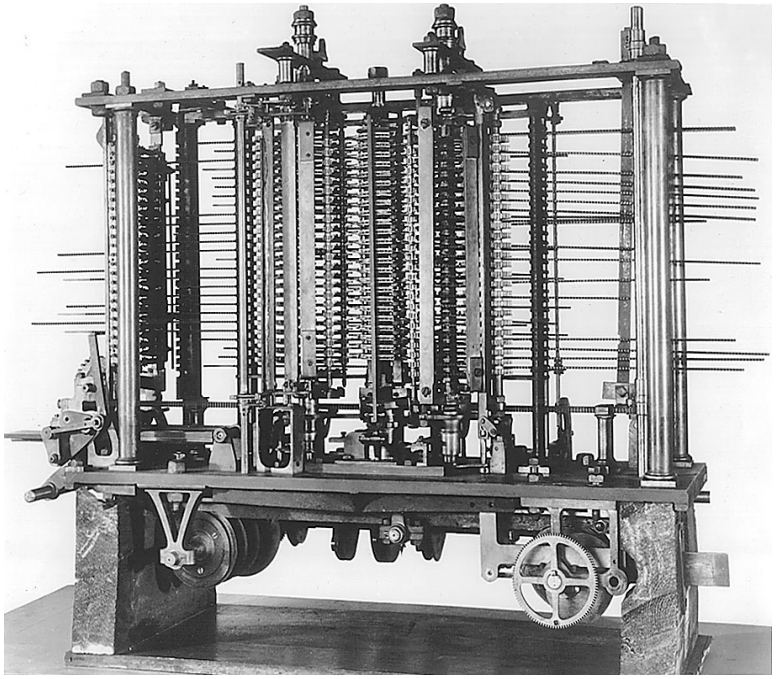
Standards

- 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, PNG
  - Character set standards: ASCII, Unicode, EBCDIC
  - Multimedia standards: MPEG-2, MPEG-4, MP3, DVD-ROM

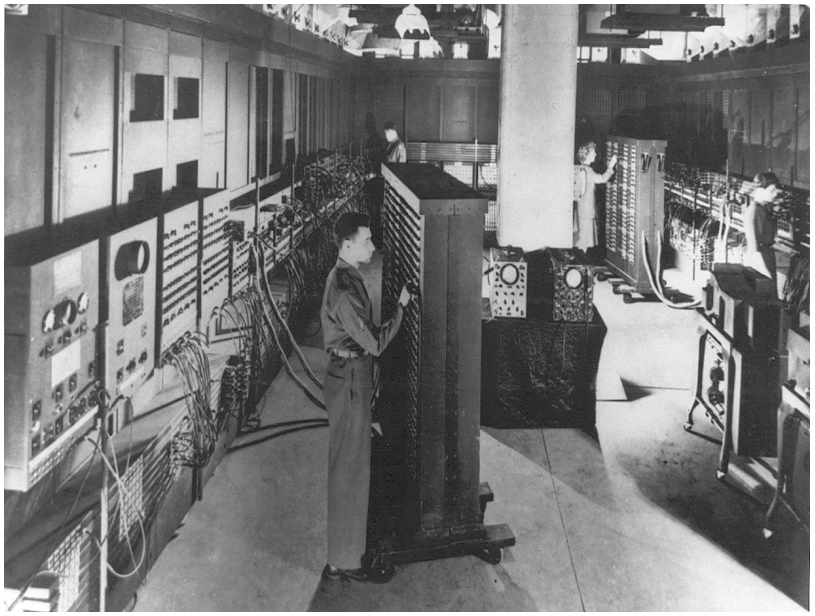
Protocols

- 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
  - SATA: between storage devices and computers
  - XML,RSS, SIP: new protocols developed to meet new demands

Early Computers



Babbage's Analytical Engine



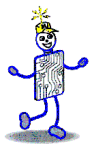
ENIAC

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)

UNIX

- 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 and 8

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