Chapter 3 (Operating Systems)

Functions of Operating systems

* Oversee operation of computer
* Store and retrieve files
* Schedule programs for execution
* Coordinate the execution of programs

Evolution of shared computing

* Batch processing: execution of jobs by collecting them in a single batch, then executing them
* Interactive processing: requires real-time processing (execute tasks under a deadline) (15)
* Time-sharing/multitasking: implemented by multiprogramming, provided service to multiple users at the same time (multitasking: one user executing numerous tasks simultaneously)
* Multiprogramming: time intervals that execute each job restricted to only one interval at a time
* Multiprocessor machines

Types of software

* Application software: performs specific tasks for users
* System software: provides infrastructure for application software & consists of operating system and utility software

Operating System Components

* User interface: communicates with users (text based (Shell) & graphical user interface (GUI))
* Kernel: performs basic required functions (file manager, device drivers, memory manager, scheduler and dispatcher)

File Manager

* Directory (folder): user-created bundle of files and other directories (subdirectories)
* Directory path: sequence of directories within directories

Memory manager

* Allocates space in main memory
* May create the illusion that the machine has more memory than it actually does (virtual memory) by playing a “shell game” in which blocks of data (pages) are shifted back and forth between main memory and mass storage

Bootstrapping

* Boot loader: program in ROM (ex in firmware)
* Run by the cpu when power is turned on
* Transfers operating system from mass storage to main memory
* Executes jump to operating system

Processes  
- process: the activity of executing a program

* Process state: current status of the activity (program counter, general purpose registers, related portion of main memory)

Process Administration

* Scheduler: adds new processes to the process table and removes completed processes from the process table
* Dispatcher: controls the allocation of time slices to the processes in the process table
* The end of a time slice is signaled by an interrupt

Handling Competition for Resources

* Semaphore: a “control flag”
* Critical region: a group of instructions that should be executed by only one process at a time
* Mutual exclusion: requirement for proper implementation of a critical region

Deadlock

* Processes block each other from continuing
* Conditions required for deadlock

1. Competition for non-sharable resources
2. Resources requested on a partial basis
3. An allocated resource can not be forcibly retrieved

Security

* Attacks from outside (problems: insecure passwords & sniffing software, counter measures: auditing software)
* Attacks from within (problem: unruly processes, counter measurers: control process activities via privileged modes and privileged instructions)

Ch 4 (Networking and the Internet)

Network Classifications

* Scope
* Personal area network (PAN): used for short range communications less than a few meters (wireless mouse & PC)
* Local area network (LAN): collection of computers in a single building or building complex
* Metropolitan area network (MAN): network of intermediate size (local community)
* Wide area network (WAN): links machines over a greater distance (neighboring cities or opposite sides of the world)
* Ownership
* Closed (proprietary) network (network of the latter type) versus open network (network of the former type)

< open network designs are freely circulated and grow in popularity to a point

* Topology (configuration) (pg159)
* Bus (Ethernet): machines all connected to a common communication line
* Star (Wireless networks with central Access Point): one machine serves as a central focal point to which all the others are connected

Protocols (159-160)

* Rules that determine the format and transmission of data
* CSMA/CD: controls the right to transmit a message in a network
* Used in Ethernet
* Silent bus provides right to introduce new message
* CSMA/CA
* Used in WiFi
* Hidden terminal problem

Connecting Networks (162)

* Repeater: Extends a network
* Bridge: connects two compatible networks
* Switch: connects several compatible networks
* Router: connects two incompatible networks resulting in a network of networks called an internet

Inter-process Communication (164)

* Client-server
* One server, many clients
* Server must execute continuously
* Client initiates communication
* Peer-to-peer (P2P)
* Two processes communicating as equals
* Peer processes can be short-lived
* P2P popular means of distributing files such as music recordings & motion pictures
* Collection of peers in the distribution is called a swarm
* P2P over client/server is that it distributes the service tasks over many peers rather than concentrating it into a server
* Lack of a central server makes legal efforts to enforce copyright laws more difficult

Distributed Systems (166)

* Systems with parts that run on different computers
* Cluster computing: many independent computers work closely together to provide computation or services comparable to a much larger machine
* Grid computing: loosely coupled than cluster but still work together to accomplish large tasks, involve specialized software to make it easier to distribute data and algorithms to the machines participating in a grid (University of Wisconsin’s Condor System or BOINC
* Cloud computing: huge pools of shared computers on the network can be allocated for use by clients as needed
* Cloud: portion of the Internet lying outside one’s domain
* Packet: message segment that is transmitted over the Internet independently

< Amazon’s Elastic Compute Cloud

< Google Drive

* Distributed systems are used to provide high-availability (More likely that at least 1 member will be able to answer the request) and load-balancing (workload can shift automatically from over-worked members to little-worked members)

The Internet (167)

* The Internet: An internet that spans the world
* Original goal was to develop a means of connecting networks that would not be disrupted by local disasters
* Today a commercial undertaking that links a worldwide combination of PANs, LANs, MANs, and WANs involving millions of computers
* Sponsored by DARPA

Internet Architecture

* Internet Service Provider (ISP)
* Tier-1: high speed, high-capacity, international WANs (backbone of the Internet)
* Typically operated by large companies
* Tier-2: regional and less potent and also operated by companies
* Access or tier-3 ISP: Provides connectivity to the Internet, independent intranet operated by a single authority that supplies Internet access to individual homes and businesses (cable and telephone companies that charge for their service)
* Hot spot (wireless): area within the AP or group
* Telephone lines
* Cable/Satellite systems DSL
* Fiber optics

Internet2

Internet Addressing (169)

* IP address: pattern of 32 or 128 bits often represented in dotted decimal notation, identifies a host, machine, or device on the Internet
* Dotted decimal: notational system for representing long bit patterns
* Domain: name registered with ICANN for identification purposes
* Top-level domains (TLDs)
* Mnemonic address:
* Domain names
* Top-Level Domains
* Domain name system (DNS): translate between IP addresses and domain names
* Name servers
* DNS lookup

Internet Corporation for Assigned Names & Numbers (ICANN) 170

* Allocates IP addresses to ISPs who then assign those addresses within their regions
* Oversees the registration of domains and domain

Early Internet Applications 171

* Network News Transfer Protocol (NNTP)
* File Transfer Protocol (FTP)
* Telnet and SSH
* Hypertext Transfer Protocol (HTTP)
* Electronic Mail (email)
* Domain mail server collects incoming mail and transmits outing mail
* Mail server delivers collected incoming mail to clients via POP3 or IMAP

More Recent Applications (175)

* Voice Over IP (VoIP)
* Internet Multimedia Streaming
* N-unicast
* Multicast
* On-demand streaming
* Content delivery networks (CDNs)
* 3G and 4G

WWW (176)

* Hypertext combines internet tech with concept of linked documents
* Embeds hyperlinks to other documents
* Browsers present materials to the user
* Webservers provide access to documents
* Documents are identified by URLs and transferred using HTTP

Hypertext Markup Language (HTML) 178

* Encoded as text file
* Contains tags to communicate with browser
* Appearance

<h1> to start a level one heading

<p> to start a new paragraph

* Links to other documents and content

<a href = …>

* Insert images

<img src = …>

Extensible Markup Language (XML) 180

* XML: a language for constructing markup languages similar to HTML
* A descendant of SGML
* Opens door to a world wide Semantic web

Client Side Versus Server Side 183

* Client-side activities
* Javascript
* Macromedia Flash
* Server-side activities: connecting to database
* Common Gateway Interface (CGI)
* Servlets
* JavaServer Pages (JSP)/Active Server Pages (ASP)
* PHP

Internet Software Layers 185

* Application: constructs message with address
* Transport: chops message into packets
* Network: handles routing through the Internet
* Link: handles actual transmission of packets

TCP/IP Protocol Suite 189

* Transport layer
* Transmission Control Protocol (TCP)
* User Datagram Protocol (UDP)
* Network Protocol (IP)
* IPv4
* IPv6

Unit 6

Security 191

* Attacks from outside
* Problems

< Insecure passwords

< Sniffing software: records keystokes/etc in order to steal sensitive info

* Counter measures

< auditing software: a tool used to monitor and analyze a computer system’s activities

* Attacks from within
* Problem: unruly processes
* Counter measures: control process activities via privileged modes and privileged instructions
* Privileged machine language instruction: set the address of an interrupt handler
* Attacks
* Malware

< viruses: malicious software that inserts itself into other programs

Eliminate by format the hard drive and reinstall the OS

< worms: an independent program that transmits itself over a network

< trojan horses: harmful software that ppl willingly install and/or execute

< spyware

< phishing software: technique of obtaining info by simply asking for it

* Denial of service (DoS)
* Spam
* Protection
* Firewalls: hardware device or software application that filters network traffic
* Spam filters
* Proxy Servers: acts as an intermediary host between a client and a server
* Antivirus software

CIA Triad

Confidentiality, Integrity, Availability

* Privilege levels: a means of restricting the capabilities of different processes
* A password policy too complex could allow users to undermine the security of the system

Encryption

* HTTPS (uses Secure Sockets Layer to ensure that the server’s identity is verified, all requests and responses are encrypted, and the domain’s public key has not expired) and SSL
* HTTPS avoids phishing, sniffing, and spoofing
* Public-key Encryption
* Public key: Used to encrypt messages, decrypt messages encrypted by a private key
* Private key: Used to decrypt messages encrypted by a public key
* Certificates and Digital Signatures
* Digital signature is possible with one public private key pair
* Certificate authorities

CERT: not an application of the Internet

Server is not a means of connecting network

In a wired network, hosts should use collision detection to know when it’s okay to transmit a message. In a wireless network, hosts should use collision avoidance to limit interference with others