Lecture 3

# SOFTWARE.
# OPERATING SYSTEM.

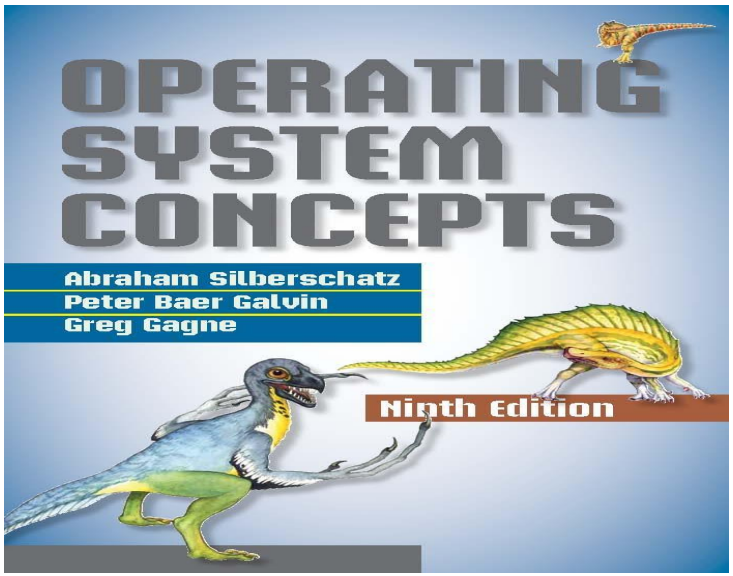
# Pl
# a

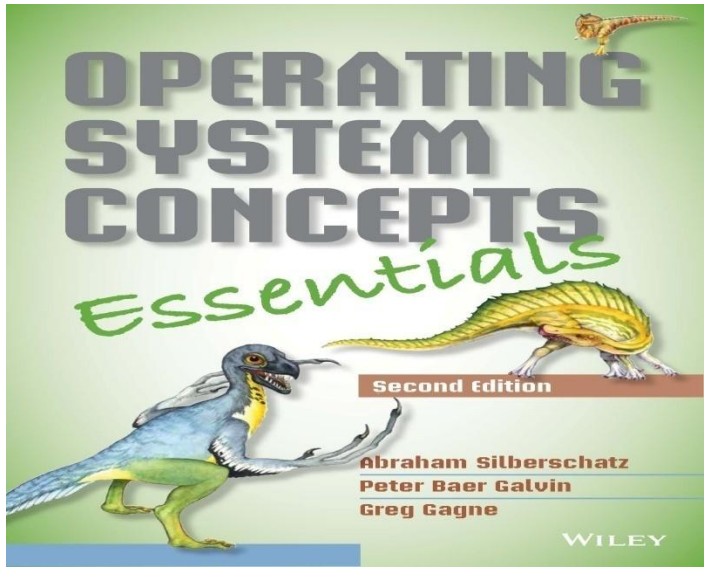
1. Software. Types of the software, purpose and characteristic. Basic concepts of OS.
2. Evolution of operating systems. Classification of operating systems, including for mobile devices. Classification of desktop applications.

# Main Bibliography

A. Silberschatz, P. B. Galvin, and G. Gagne, "Operating Systems Concepts (Essentials)", 9th Edition, John Wiley & Sons, 2012.

http://codex.cs.yale.edu/avi/os-book/



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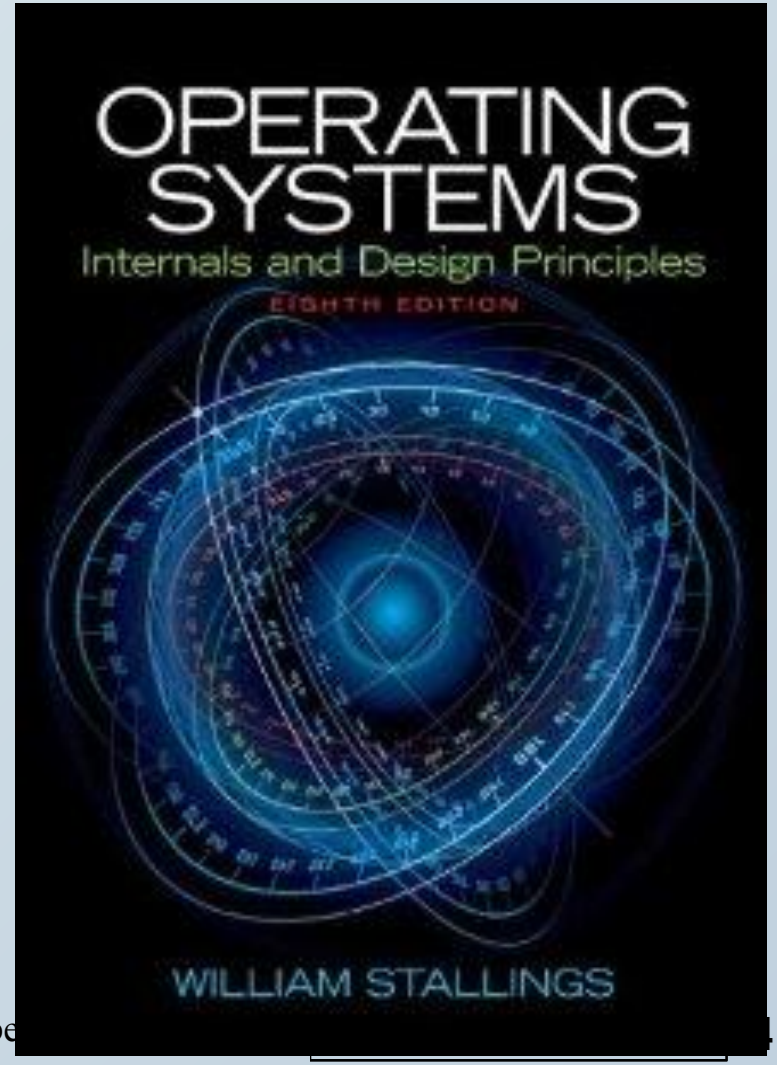

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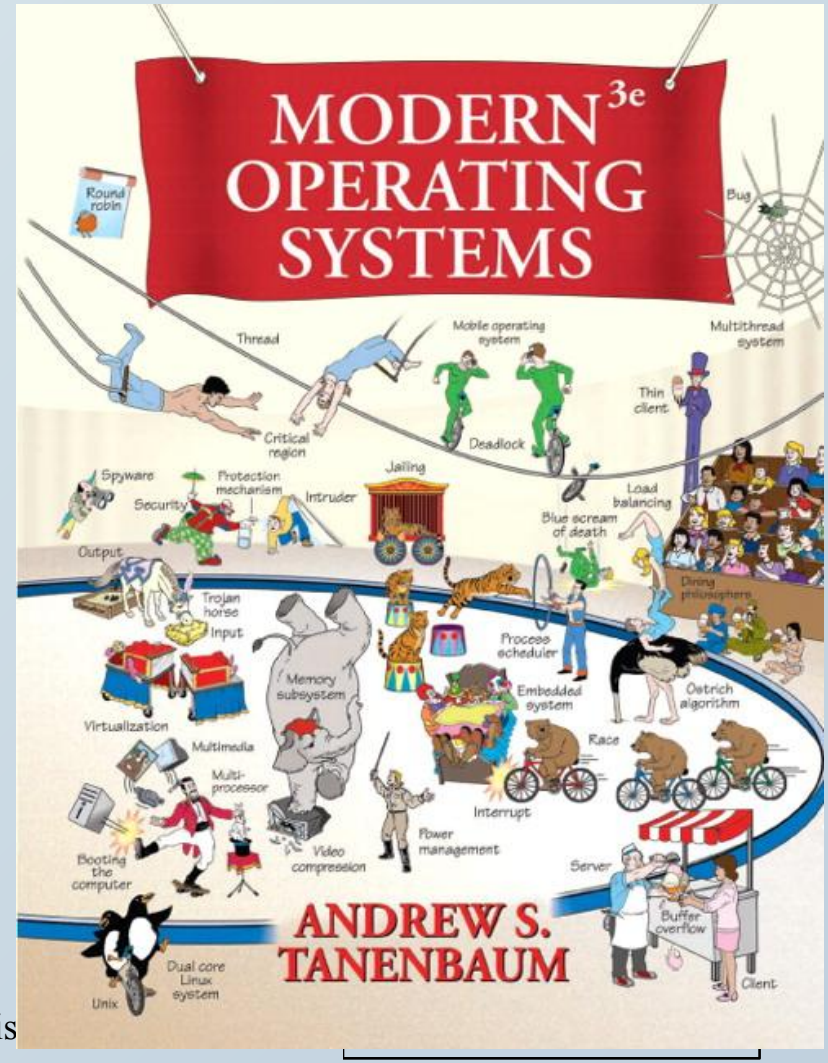

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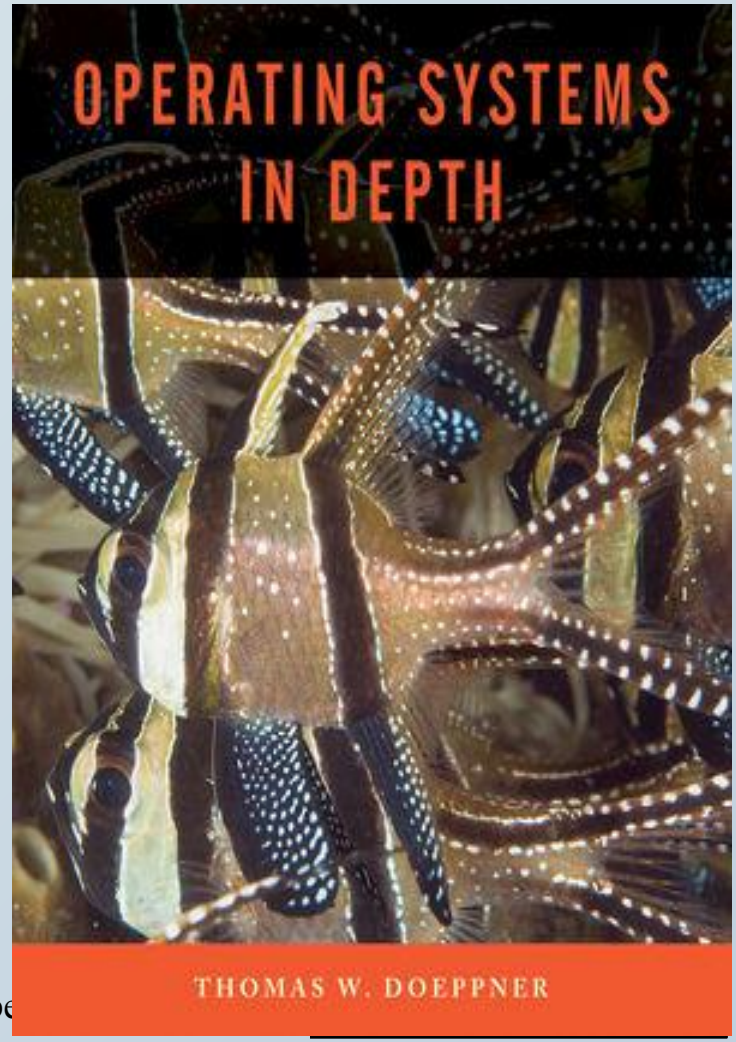


# 1. Computer Software

*What we'll cover for this lecture topic:*

- Software categories
  - **Applications** software
  - **Systems** software
    - What is an **operating system**?
      - What does it do for me?
      - What does it do for application programs?
    - What is a **translator**?

# * The Big Picture *

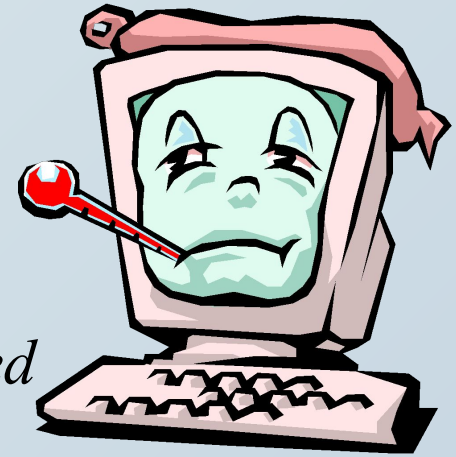
- **Application software**
  - It is the reason that one wants to buy a computer:
    - printout out paychecks
    - play Mortal Kombat
    - keep track of a stamp collection
    - do your taxes
    - generate a fancy newsletter
    - guide robots
    - keep a budget
    - draw a flowchart
    - browse the Web
    - design a car
- **System software**
  - Helps computer carry out its *basic tasks*.
  - Includes:
    - **Operating systems (OS)** - master control programs
      - BIOS (Basic Input/Output System)—see Rdg Handout!
      - Some utilities are built into OS
    - **Translators** (program language translators/compilers)

# Application software

- Includes many *executable* files and *data* files:
  - **Installer** program (eg: setup.exe)
  - **Uninstaller** program *(why important?)*
  - **Main** executable file (eg: winword.exe)
  - **Support** modules (eg: .dll files)
    - Called by the PROGRAM, not by the user
  - **Data** modules (eg: MS Word dictionary)

- "**Installing**" has gotten easy…most use **wizards**
- **Excellent** coverage in the textbook Chapter 3 Section D (and an interactive lab you can try).

# Digression



- Is *reliable software* an oxymoron?
  - *"They recall cars and toys for defects; you'd think a product with 3,000 bugs would be fixed for free"* John C. Dvorak
  - TODAY's QUOTABLES:
    - Origin of "bug"
    - Haventree Software's Warrantee ...

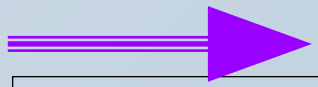
# SYSTEMS Software…
## I. The Operating System

- A type of *system* software that underlies *all other software.*
- It manages all software and hardware tasks.
- It provides a common set of **computer functions** such as input from a keyboard and output to a monitor.
- It provides the **user interface**……that is:
- How can something as *simple-minded* as a `processor` and `memory` present you with something as rich as the Mac or Windows GUI?

- What does an OS do for me? *LOTS!*

## In general terms……

- Provides ***user interface*** ...as we saw.
- Allows **applications** to run.
- What are some tasks you need done even when *no apps* are running?
- Does nearly ***half*** of what we ask an **application** *program* to do!
  - ***Common*** tasks useful to all programs —put those in the OS (the *most basic* are put in BIOS) so each app doesn't have to handle those tasks.
  - So what are some of these tasks?



What's in the box?

# System calls

- You ask **MS Word** to OPEN a document
  - File menu/Open…
  - WHAT WILL YOU SEE?
  - What *really* just happened *in the box*?

WORD called on **O.S.** to present you with that file list!

**O.S. must look at:**

1. Disk Directory (list of *filenames*)
2. File Allocation Table (**FAT**)…. (list of file *locations: starting cluster number on the disk)*

Allows ***consistency*** from app to app

# Input/output

***Reads from and writes to the I/O devices.***

- In the past, **application** programmers had to write control programs for I/O devices. Painful!
- Today, **O.S.** *reads from* and *writes to* the I/O devices: mouse, keyboard, printer, monitor…
- About **half** the instructions in today's OS are to manage **input** and **output operations**.

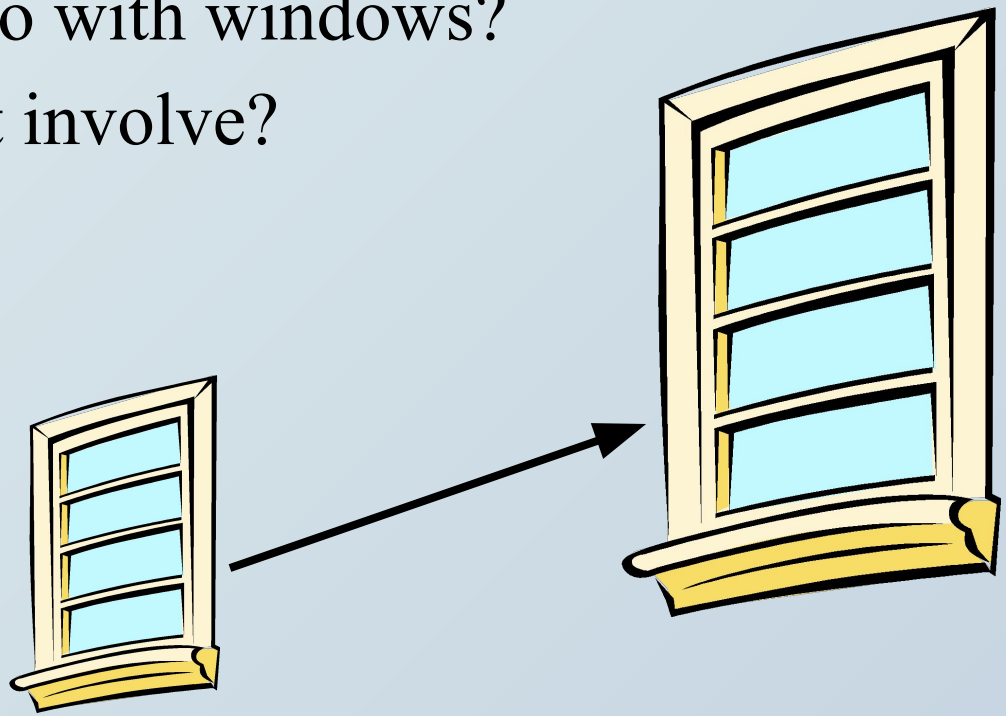
# EXAMPLES of I/O operations

- OS reads **mouse movement** and writes to display screen.
  - You *move the mouse*---what do you expect to happen?
  - What that involves…
    - Manage interrupt.
    - OS reads mouse wheels.
    - OS draws cursor arrow (changes pixel colors so arrow *appears* to be "moving").

- OS **identifies selected objects** on the desktop
  - You *select an icon*--what do you expect to see?
  - What that involves…!
    - FIRST: you move the cursor to point to icon…
      - Draws "moving cursor…"
    - OS keeps **table** of icon placements…
    - Looks at current *cursor placement* and compares it to that table.
    - NEXT: you single-click mouse button to SELECT it:
      - What do you expect to see?
      - OS does all this!

# Manages windows

- What do you do with windows?
- What does that involve?



# Manages files and folders

- *What do **you** do with files and folders?*
  - You **Create** a new file or folder….
  - You **Move** files and folders; you "nest" folders
  - You **Open** a document file… whoa! Let's see:
    - OS looks at file extension
    - OS checks if enough free memory space
    - **OS finds** and **loads** the APP *(if not loaded)*
    - *OS finds and loads the **document***
    - OS keeps track of what **data** goes with what **program** (all sharing same RAM)
    - OS turns **control** over to the APP

## IMPORTANT digression:

WHAT HAPPENS when you SHUT DOWN improperly? *Why should you care?*

"Shutting down incorrectly is a little like stopping your car by driving it into a wall. It works, but it can cause some damage."
(author unknown)

# Misc Services and Utilities

- **OS** does **system control ops** from **Start** **button:**
  - Shut down; Restart.
- **OS** does **universal ops** from the **Edit** **menu**:
  - Cut, Copy, Paste, Clear, Select All
  - Clipboard … (also between different apps)

**IMPORTANT**:

– Difference between a simple copy/paste, and **OLE** **= object linking & embedding**

- **OS** does **universal ops** from the **View menu**:
  - Show/Hide Toolbars & Status bar;
  - Large icons, Small icons;
  - List; Details;
  - Arrange Icons; etc.

- **OS also** has many built-in **UTILITIES** & goodies that are universally provided: *(**differs** from OS to OS; and version to version)*
  - **Taskbar** and **Start** button: unique to Win O.S.
    - Control panel, Find, Help, Format or Erase disk, Properties
  - **Right**-click menus
    - **Properties**; Rename; Shortcuts, and more
  - And lots more, depending on **OS** you use, and on the **version** you have.

- Lots of ***3rd-party*** **utilities** as well!

  READ about these utilities in the Reading handout.

  - Data recovery (unerase!)
  - Compression ***(NOTE: textbook pages 371-375—just know the general gist of how it works, not all the specifics!)***
  - Anti-virus protection *(included with Windows XP)*
  - Firewalls *(included with Windows XP)*
  - Diagnostics
  - Uninstall programs
  - Screen savers
  - File defragmentation
  - *and MORE!*

*Try the recommended*
**Book-on-CD labs!**

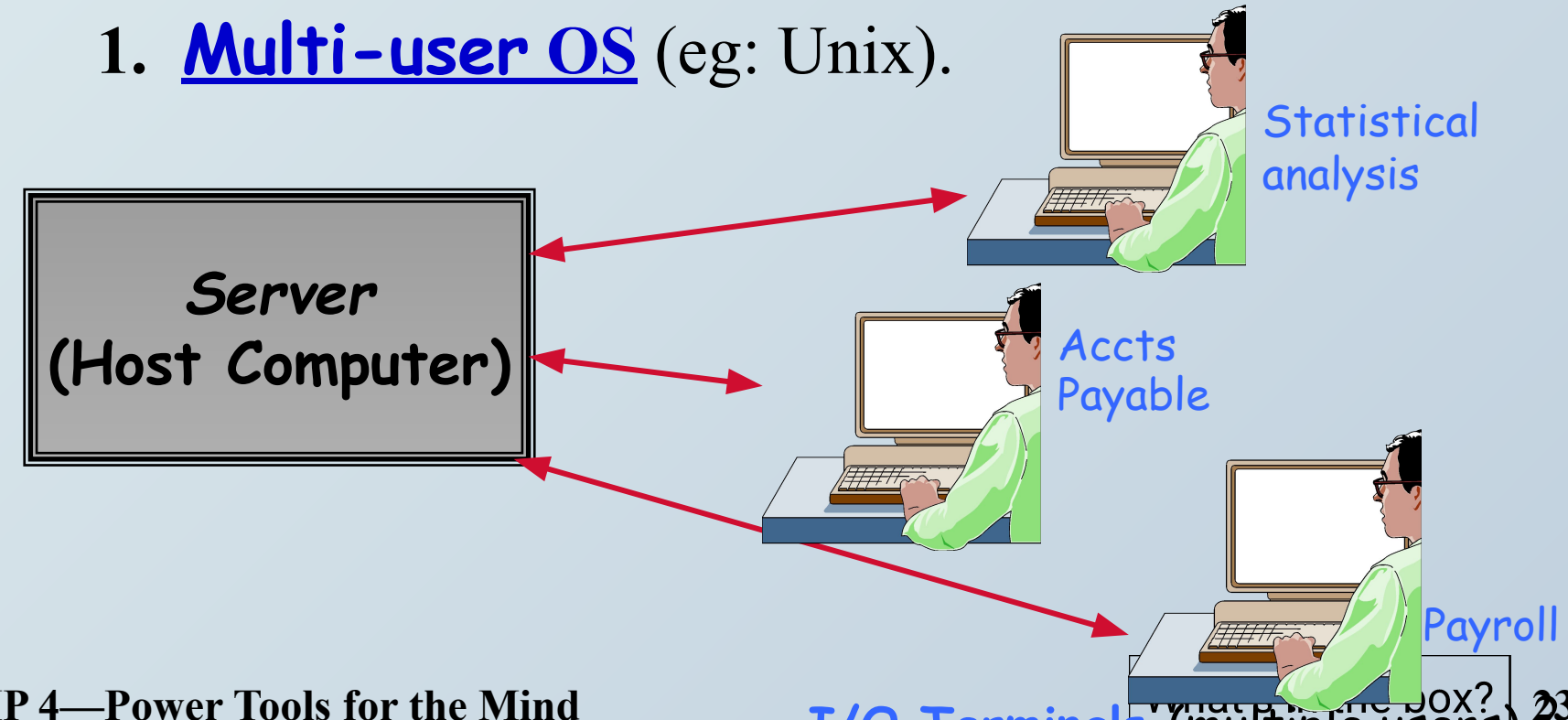
# Manages/allocates time & memory space

- **>1** program *or* person can share computer **resources**.
  - CPU is idle ~90% of time, waiting for user input !
  - **Multiprogramming**

    Run two or more programs *concurrently*.

    eg: Calculate payroll *and* Accts payable *and* WP *and* …

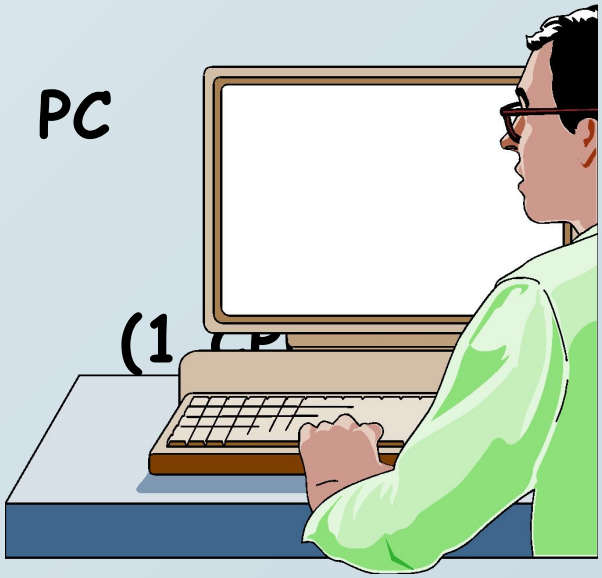
    1. **Multi-user OS** (eg: Unix).



## 2. Single-user OS (eg, Windows)

– Referred to as **multitasking,** which is multiprogramming for ***single*-user OS**.

– One active app; others run in the background




Payroll
Email
Web browser
Word Processing
Mortal Kombat

**OS** must protect each program's *memory area* to ensure that instructions and data don't "leak" into an area allocated to *another* program. If it fails, programs can **crash**…more shortly!

# Handles interrupts

- Mouse click; mail sound; alarm clock; app bombed...
  - OS breaks into current process and instructs CPU to do something else. *And keeps track!*

## Important Digression: software bombs

– **APP** freezes--"Program crash"

-- Windows OS usually allows you to continue working in other apps; try to close the confused app:

Right-click on the app's button on Taskbar, select Close.

– **OS** freezes-- "System crash"

-- Ctrl/Alt/Del: sometimes can Cancel current Task (Applications Tab, select End Task). If that fails, restart ("**Soft** boot") from Start button.

-- Power off button, wait, then Power on ("**Hard** boot"). LAST RESORT!

What's in the box?

# Provides (and loads) Device Drivers

- **Small programs that control a peripheral device** (printer, hard disk, tape drive, modem …)
  - Allow OS & applications to activate *(drive)* the hardware device.
  - The driver accepts commands from the operating system and converts them into a form that a *particular device* can understand.
  - Newer OSs: provide ***most*** device drivers.
  - Else: find and download device driver program from manufacturer's web site.

- **Digression: The Windows Registry**
  - **We saw that the OS** acts as *intermediary* between software and peripheral devices.
  - OS needs to know something *about* these devices (what is it, how installed, any special settings, etc.)
  - Windows **Registry**: keeps track of your computer's peripheral devices & software so the OS can access the information it needs to coordinate the computer's activities.
  - See associated text reading for much useful information.

**Something you should have learned from all this:**
**OS takes up a fair amount of memory….**
**But it's well worth it! It does a LOT.**

# SYSTEMS Software…cont'd

## II. Translators *(revisited!)*

- How do people write programs?
- Only language a **computer** understands?
- **A translator** (or **compiler**):
  - Program that converts high-level *source code* into low-level *machine language (object code)*-- can then be processed directly by the computer's binary circuits.
  - Running a **source** program is a **two-step process**:
    1. Execute the translator program first:
       - converts ASCII source into executable machine language
       - creates a new file containing the object code.
    2. Execute that NEW object code file.

In ENGLISH:

**Find and print the names of all freshmen who scored greater than 79% on the first exam.**

**High Level:** If Year = 1 and Score1 > 79 then put StName

**Low Level:**

Assembly: LDR A5FD R1 *More readable form of binary;*
CMP R1, 1 … *symbolic representation.*

ML: 00000010 10001100 01100000 00010001
00000111 ...

*Translation* will:

- chop up every *command* word into ~25+ *op codes*.
- convert *variable names* (Year, Score, StName ) into actual binary memory *address* numbers.

# 2. Operating Systems

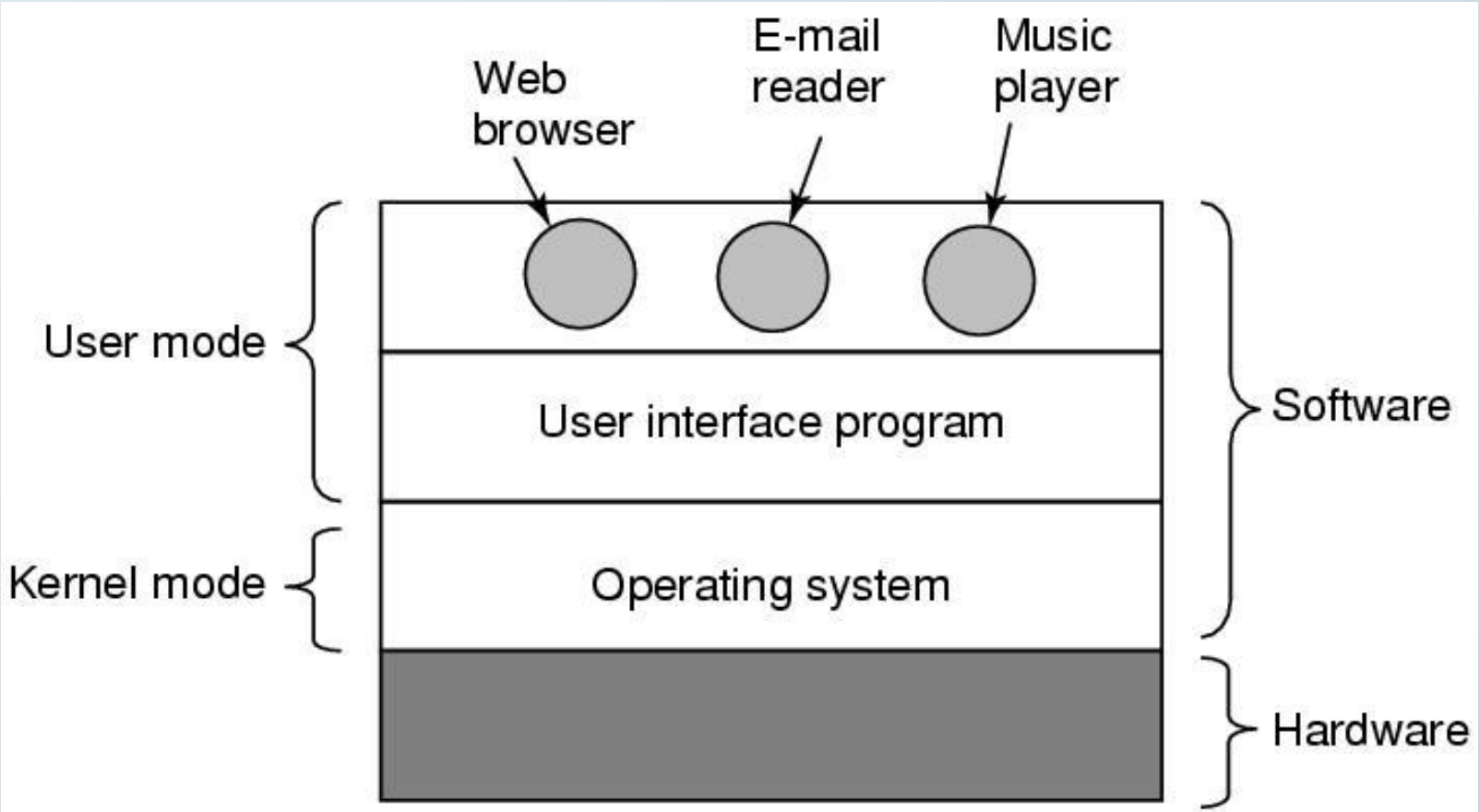
# What is an Operating System (1)?

- A modern computer consists of:
  - One or more processors
  - Main memory
  - Disks
  - Printers
  - Various input/output devices.
- Managing all these varied components requires a layer of software – the **Operating System (OS).**

# What is an Operating System (2)?

- An Operating System is a program that acts as an intermediary/interface between a user of a computer and the computer hardware.
- OS goals:
  - Control/execute user/application programs.
  - Make the computer system convenient to use.
  - Ease the solving of user problems.
  - Use the computer hardware in an efficient manner.

# Where does the OS fit in?



## Services provided by an OS

- Facilities for program creation
  - editors, compilers, linkers, debuggers, etc.
- Program execution
  - loading in memory, I/O and file initialization.
- Access to I/O and files
  - deals with the specifics of I/O and file formats.
- System access
  - resolves conflicts for resource contention.
  - protection in access to resources and data.

# Why are Operating Systems Important?

- Important to understand and know how to correctly use when writing user applications.
- Large and complex systems that have a high economic impact and result in interesting problems of management.
- Few actually involved in OS design and implementation but nevertheless many general techniques to be learned and applied.
- Combines concepts from many other areas of Computer Science: Architecture, Languages, Data Structures, Algorithms, etc.

# Evolution of Operating Systems

- The evolution of operating systems is directly dependent to the development of computer systems and how users use them. Here is a quick tour of computing systems through the past fifty years in the timeline.

# Early Evolution

- 1945: ENIAC, Moore School of Engineering, University of Pennsylvania.
- 1949: EDSAC and EDVAC
- 1949 BINAC - a successor to the ENIAC
- 1951: UNIVAC by Remington
- 1952: IBM 701
- 1956: The interrupt
- 1954-1957: FORTRAN was developed

# Operating Systems by the late 1950s

- By the late 1950s Operating systems were well improved and started supporting following usages :
- It was able to Single stream batch processing
- It could use Common, standardized, input/output routines for device access
- Program transition capabilities to reduce the overhead of starting a new job was added
- Error recovery to clean up after a job terminated abnormally was added.
- Job control languages that allowed users to specify the job definition and resource requirements were made possible.
-

# Operating Systems In 1960s

- 1961: The dawn of minicomputers
- 1962 Compatible Time-Sharing System (CTSS) from MIT
- 1963 Burroughs Master Control Program (MCP) for the B5000 system
- 1964: IBM System/360
- 1960s: Disks become mainstream
- 1966: Minicomputers get cheaper, more powerful, and really useful
- 1967-1968: The mouse
- 1964 and onward: Multics
- 1969: The UNIX Time-Sharing System from Bell Telephone Laboratories

# Supported OS Features by 1970s

- Multi User and Multi tasking was introduced.
- Dynamic address translation hardware and Virtual machines came into picture.
- Modular architectures came into existence.
- Personal, interactive systems came into existence.

# Control questions

- What is Software?
- Differentiate System software and Application software.
- What are the responsibilities of Operating Systems?
- Define the following with suitable examples.
- Single–user OS
- Multi-user OS
- What are utility programs? Define some tasks performed by them.
- What is meant by library programs?
- What are program language translators? Briefly describe three translating approaches.
- State the advantages and disadvantages of Bespoke Application Software.