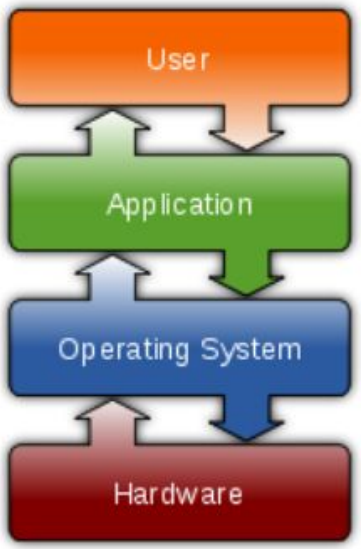
# Unit 1 - Hardware

## Operating Systems

# What is an Operating System (OS)?

An operating system is software that manages computer hardware and software resources and provides common services for computer programs.




1. Control Hardware access
2. Manage files and directories.
3. Provide a user interface.
4. Manage applications.

Common operating systems include Windows, OS X, Linux, and UNIX.

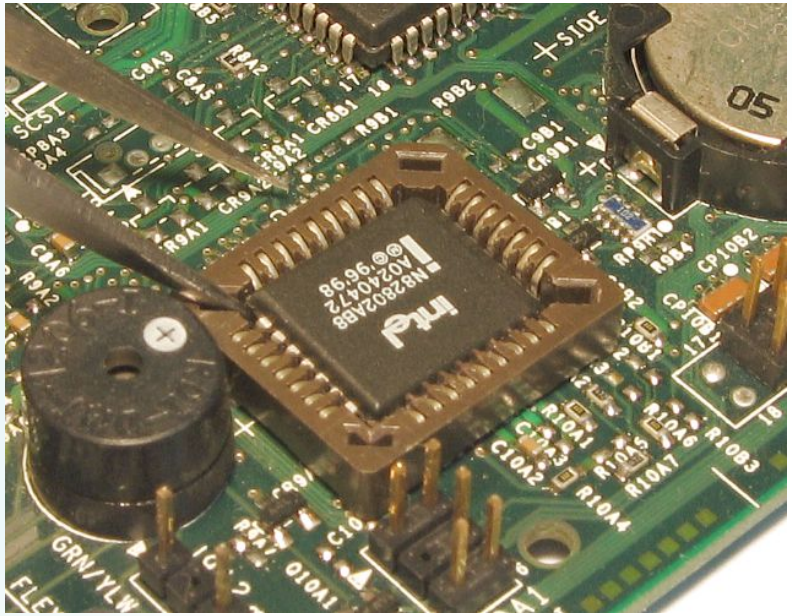
# How is the operating system started?

- Most programs have to be executed by the user *or* scheduled to be executed. But we can't click the operating system without being in the operating system.  It is loaded in a special way…

- The boot-up sequence of a computer is complex, but we'll try to break it down.

# Boot-Up Sequence: BIOS

- First, the BIOS (Basic Input Output System) is loaded. The BIOS is stored in a ROM chip on the motherboard. It is removable, but we generally do not replace it.



# Boot-Up Sequence: BIOS

- The BIOS also performs a Power-On Self Test (POST). The POST is a small computer program within the BIOS that checks for hardware failures. A single beep after the POST signals that everything's okay. Other beep sequences signal a hardware failure, and PC repair specialists compare these sequences with a chart to determine which component has failed.

- Next, the BIOS tells the computer to look in a fixed address in memory for a special program called the *boot loader.*

# Boot-Up Sequence: Boot Loader

- The boot loader is pulled into memory and its instructions are executed by the CPU. The sole purpose of the boot loader is to load the operating system.

- The boot loader for modern Windows operating systems is called Windows Boot Manager (BOOTMGR). You will likely *never* use it directly.

# Boot-Up Sequence: Boot Loader

- The BIOS tells the computer to look in a fixed address in memory for a special program called the *boot loader.*
- The boot loader is pulled into memory and its instructions are executed by the CPU. The sole purpose of the boot loader is to load the operating system.
- The boot loader loads the operating system's *kernel* into memory and transfers execution to it.

# Boot-Up Sequence: The kernel

- The *kernel* of an operating system is a software program that manages I/O (input/output) requests from software, and translates them into data processing instructions for the central processing unit and other electronic components of a computer.

- The first job of the kernel is to detect all of the installed hardware. It does this by checking a fixed set of known addresses. This is called *autoprobing*.

- Once autoprobing has completed, the OS loads up as we know it (it's more complicated, but we'll stop there).

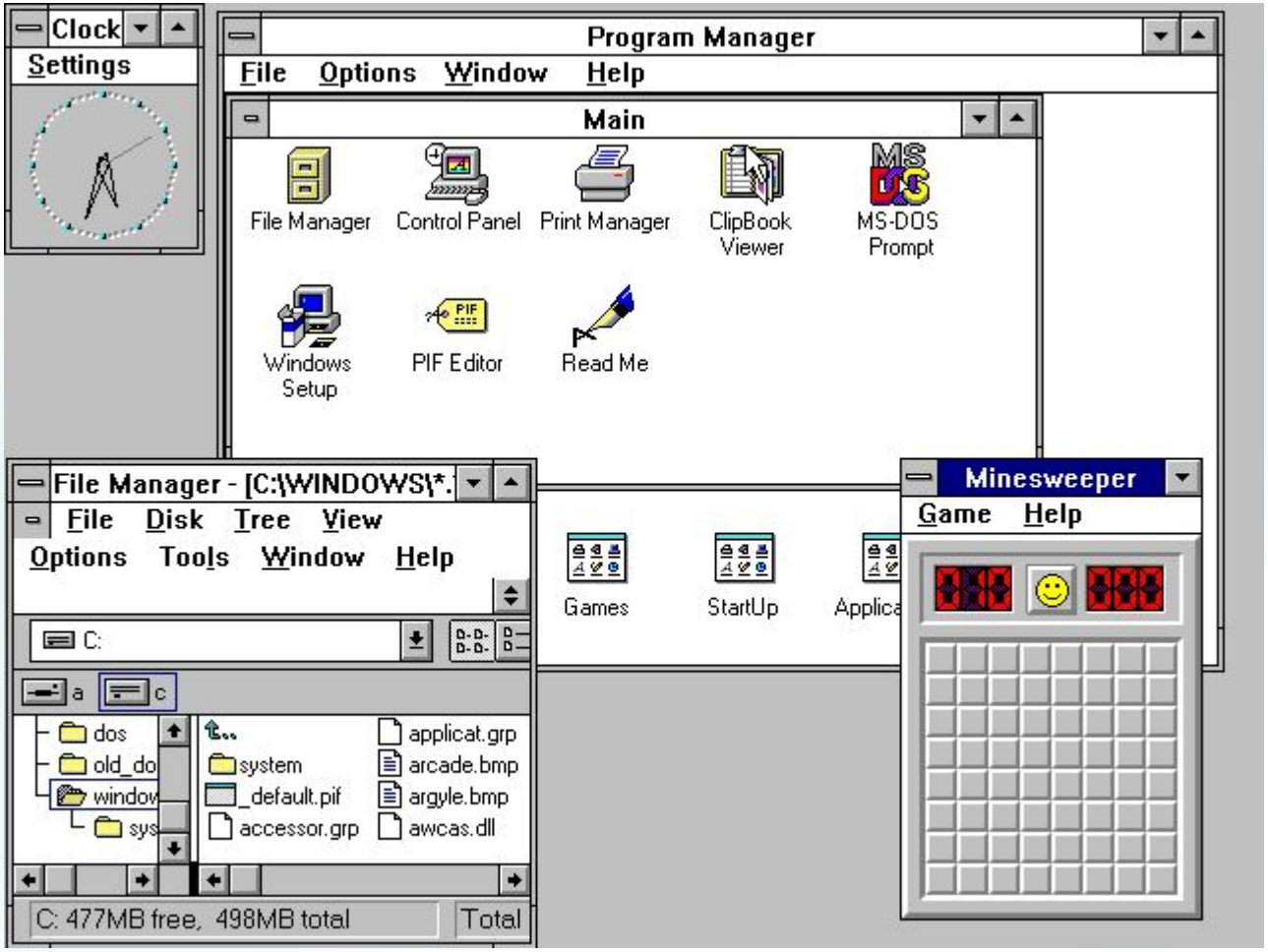
# Interacting with the OS

- In the past, the OS was used only with a keyboard (no mouse). This was known as a terminal interface. You had to know your stuff back then!

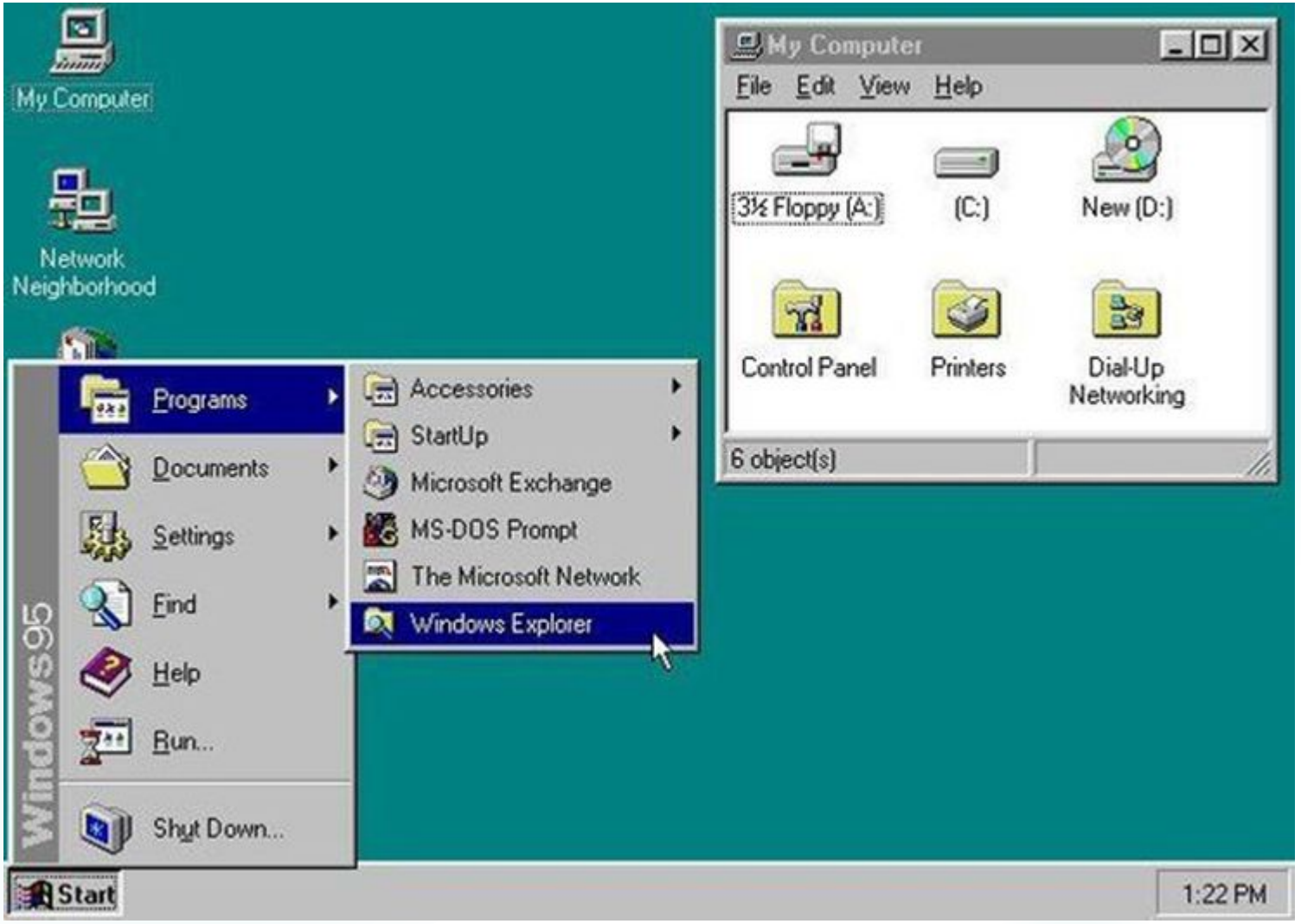
- Nowadays, the OS provides a graphical user interface (GUI) and we interact using a mouse (or touch).

- Terminal interfaces are still widely used today. The Windows OS has a terminal interface called the *command prompt*. This can be accessed by Start -> Run -> *cmd*.

# Windows 3.1


Clock
Settings
Program Manager
File Options Window Help
Main
File Manager
Control Panel
Print Manager
ClipBook Viewer
MS-DOS Prompt
Windows Setup
PIF Editor
Read Me
File Manager - [C:\WINDOWS*.
File Disk Tree View
Options Tools Window Help
C:
a
c
dos
old_do
windov
sys
system
_default.pif
accessor.grp
applicat.grp
arcade.bmp
argyle.bmp
awcas.dll
C: 477MB free, 498MB total
Total
Games
StartUp
Minesweeper
Game Help

# Windows 95


My Computer
Network Neighborhood
My Computer
File Edit View Help
3½ Floppy (A:)
(C:)
New (D:)
Control Panel
Printers
Dial-Up Networking
6 object(s)
Programs
Documents
Settings
Find
Help
Run...
Shut Down...
Windows95
Accessories
StartUp
Microsoft Exchange
MS-DOS Prompt
The Microsoft Network
Windows Explorer
Start
1:22 PM

# Windows XP


wikiHow
Internet
Internet Explorer
E-mail
Outlook Express
Windows Media Player
Tour Windows XP
Files and Settings Transfer Wizard
All Programs
My Documents
My Recent Documents
My Pictures
My Music
My Computer
Control Panel
Set Program Access and Defaults
Printers and Faxes
Help and Support
Search
Run...
Log Off
Turn Off Computer
start
8:50 PM
Recycle Bin

# Windows 7 Basic

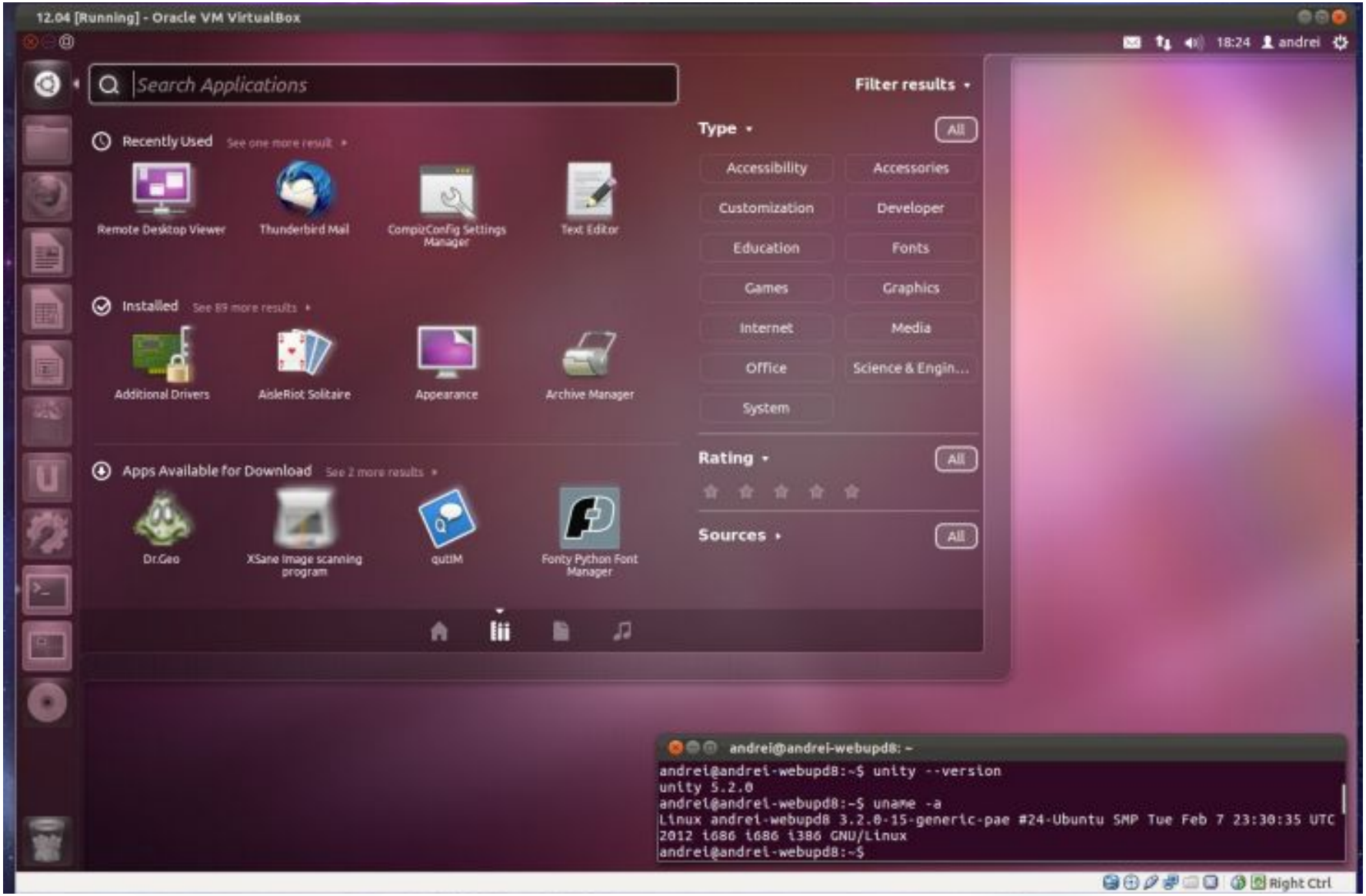
# Windows 8


Start
Ben
Martens
Sanjay Jacob
RE: Let's go see a movie this weekend?
Sounds like a good plan to me. I don't ...
Mail
8
Cricket team practice
The Field
4:30 PM - 7:00 PM
8
Friday
Internet Explorer
Store
Unmanned commercial rocket
the International Space Station
Roxanne Kenison also
commented on Lesley
Allan's post.
4
Photos
Maps
SkyDrive
68°
Sydney, Australia
Sunny 51° / 65°
Weather
Desktop
Messaging
Now playing
Extreme paragliding on the
south coast of Australia
Music
Xbox LIVE Games

# Windows 10


Miranda Vance
Most used
Word
Mail
People
News
OneDrive
Calculator
Suggested
Cars: Fast as Lightning
File Explorer
Settings
Power
All Apps
New
Life at a glance
Bruce Vandiver
Mail
10
Monday 13
Maps
Store
Work
Entertainment
Xbox
HALO
Search the web and Windows

# Ubuntu Linux (basic)



# Managing Resources: The kernel

- The kernel of the operating system is responsible for managing resources for the entire computer.
- The two primary resources for which it's responsible:
  - CPU usage
  - memory allocation (RAM)
- EVERY program that runs on the system must work through the kernel. If *Call of Duty* needs more RAM to run smoothly, it must request it from the kernel.
- The kernel services requests as it deems fit.

# Multitasking: The kernel

- Many programs can be running at one time. These are called *processes* in OS terminology.
  - The operating system is a program, too!
  - Running any other program, such as Microsoft Word, means that the OS must balance its own execution with MS Word's execution.
- The execution state of a process is represented by a *thread*. A thread consists of the processor's CPU state (current instructions loaded) and the address space (where variables are loaded to/from).
- The kernel is responsible for all thread scheduling and ensuring that resources are not overwritten.