Networks & Server Structures

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Course Introduction

- The Networks and Server Structures Course explores computer operations, networking, and storage options. Students examine various operating systems, CPU and peripheral uses, and networked computer environments and their protocols. This course presents knowledge about communications within single and multiple computers, network communications, and communication protocols. A history of both computers and the Internet is also explored.

So why the hell do I need this course?

- As web professionals you need to know how client machines interact with servers and what the differences between them are
- Knowledge of this material will help you with backend and application development
- Know how to talk with other IT professionals

Tech Support Calls

- Tech support: What kind of computer do you have?
- Female customer: A white one...

Tech Support Calls

- Customer: I have problems printing in red...
- Tech support: Do you have a color printer?
- Customer: Aaaah.....thank you.

Tech Support Calls

- Tech support: What anti-virus program do you use?
- Customer: Netscape.
- Tech support: That's not an anti-virus program.
- Customer: Oh, sorry...Internet Explorer.

Tech Support Calls

- A woman customer called the Canon help desk with a problem with her printer.
- Tech support: Are you running it under windows?
- Customer: No, my desk is next to the door, but that is a good point. The man sitting in the cubicle next to me is under a window, and his printer is working fine.

How the WDD Program Works

- You are responsible for **learning** the material and **RETAINING** it throughout the program.
- We don’t have time to re-teach material and concepts that were covered in previous classes.

Attendance Policies

- Adhere to Full Sail attendance policies
- Up to 10% can be missed without makeup work
- Up to 20% can be missed with an excuse
- Over 20% not eligible for excuse

GPS

- Timeliness
- Respectfulness
- Preparation
- Attentiveness
- Compliance

GPS

- **Timeliness**
  - Tardies and absences
- **Respectfulness**
  - Disrupting class, food & drinks
- **Preparation**
  - Materials
- **Attentiveness**
  - Sleeping, off task
- **Compliance**
  - Cheating, stealing, drunk

Class Rules

- No food or drinks in the classroom.
- Mute your cell phones.
- All deadlines are final. No late work will be accepted.
- No talking during lecture!
- Pay attention!

Tests and Exams

- **2 Written Exams (a Midterm and a Final)**
  - Multiple choice / True or False / Fill in the Blank
  - 1st covering lectures 1 - 5
  - 2nd is cumulative
- **1 Practical Final Exam**
  - Terminal
- **Not everything will be covered in slides. You will be responsible for everything I say in class as well.**

Naming Conventions for Assignments

- All files that are turned in to me **MUST** follow this naming convention:
- [**Last Name**]_[**First Name**]_[**Lab #**]
- Also include the file name in the subject line of your emails if the assignment is emailed to me
- If this format is not followed you will lose points

Where Assignments Go

- All assignments, unless specified, should be submitted to my dropbox
- http://www.dropitto.me/jrobertknight
- Password = ?KNSS1

- **SAVE THIS INFORMATION**

Course Twitter Account

- For information and links to course materials (slides, lab assignments, etc)
- http://twitter.com
- @wdd_nss

Assumed Knowledge

- How to navigate in Mac OS X
- Know how to use a web browser efficiently
- Basic understanding of files and folders
  - If you download something you should be able to find it

Basic Course Outline

- History of Computers
- Anatomy of a Computer
- Modern Operating Systems
- Terminal Commands
- Network Terminology
- Network Topologies
- Origin of the Internet
- Addressing
- Domain Naming System
- Packet Anatomy
- Network Hardware
- Network Communication Methods
- OSI Model
- Network Protocols
- TCP/IP
- Ethernet
- File Systems
- Ports
- Servers
- FTP
- LAMP Servers
- Security
- Remote Access & VPN's
- Virtualization Software
- Cloud Computing

A Brief History of Computers

How we stopped using our fingers to count

What is a Computer

- A programmable machine that receives input, stores and manipulates data, and provides output in a useful format.
- Term first used in 1613, referring to a person who carried out calculations, or computations

Antikythera Mechanism

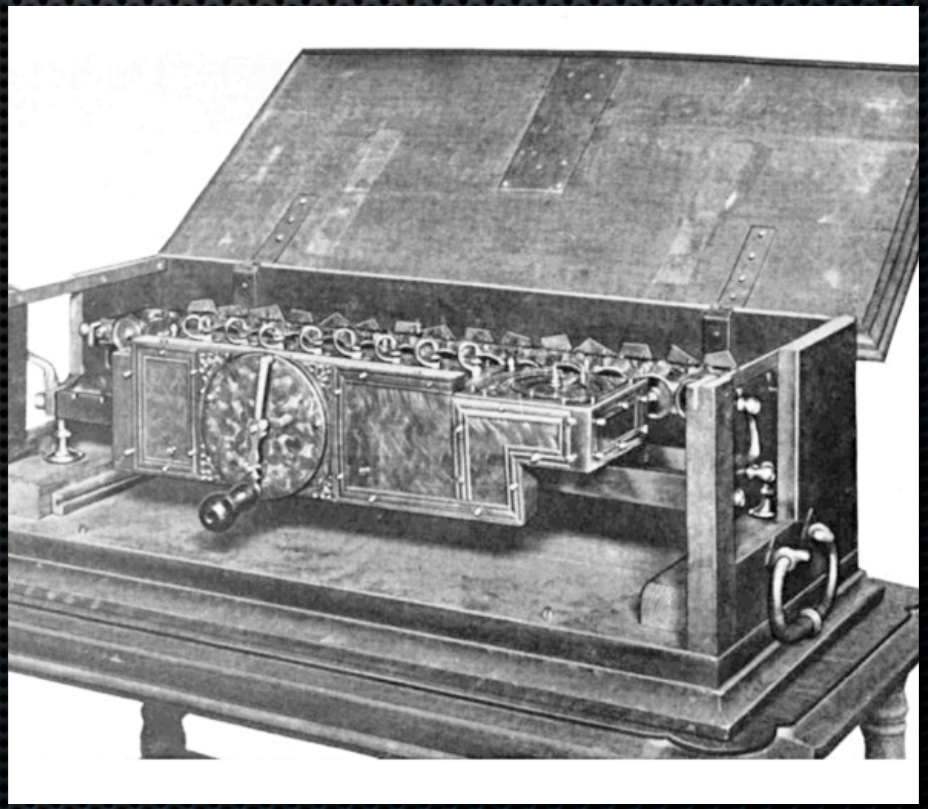
- Built in 150 BC
- Oldest known complex scientific calculator
- Designed to calculate astronomical positions
- Recovered in 1900 from the Antikythera wreck
- Sophistication comparable to a 19th century Swiss clock

Abacus

Pascaline Machine - 1642

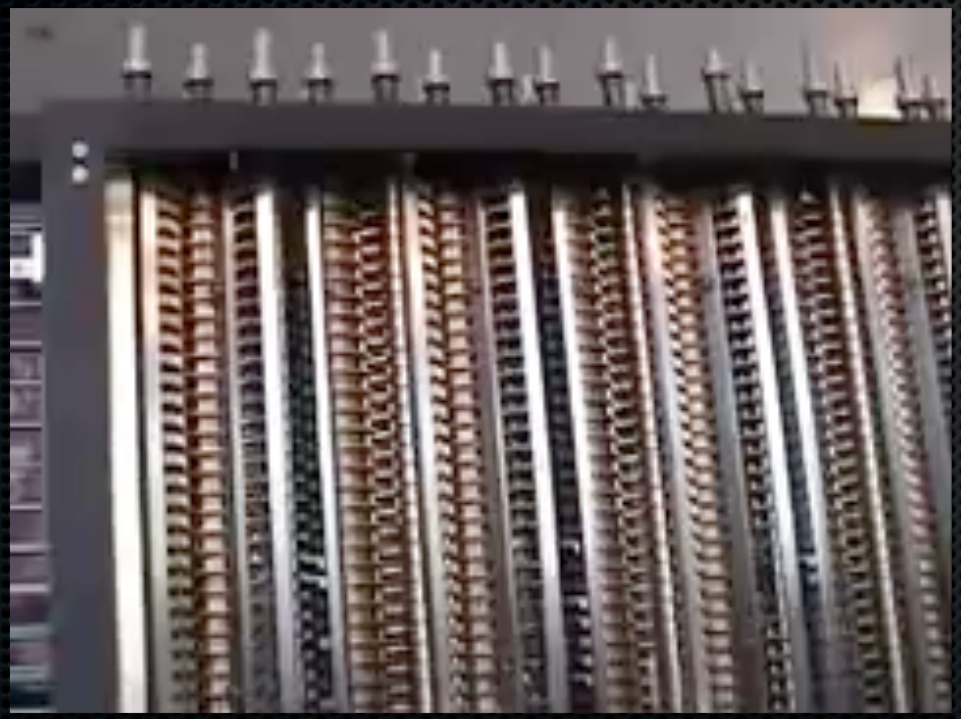
Stepped Reckoner - 1673

- Developed by Gottfried Von Leibnez
- Could perform addition, subtraction, multiplication and division



Jacquard Loom - 1801

Analytical Engine - 1837



- Charles Babbage realized these punched cards could be used in mathematical computations.
- Never completed

Herman Hollerith - 1889

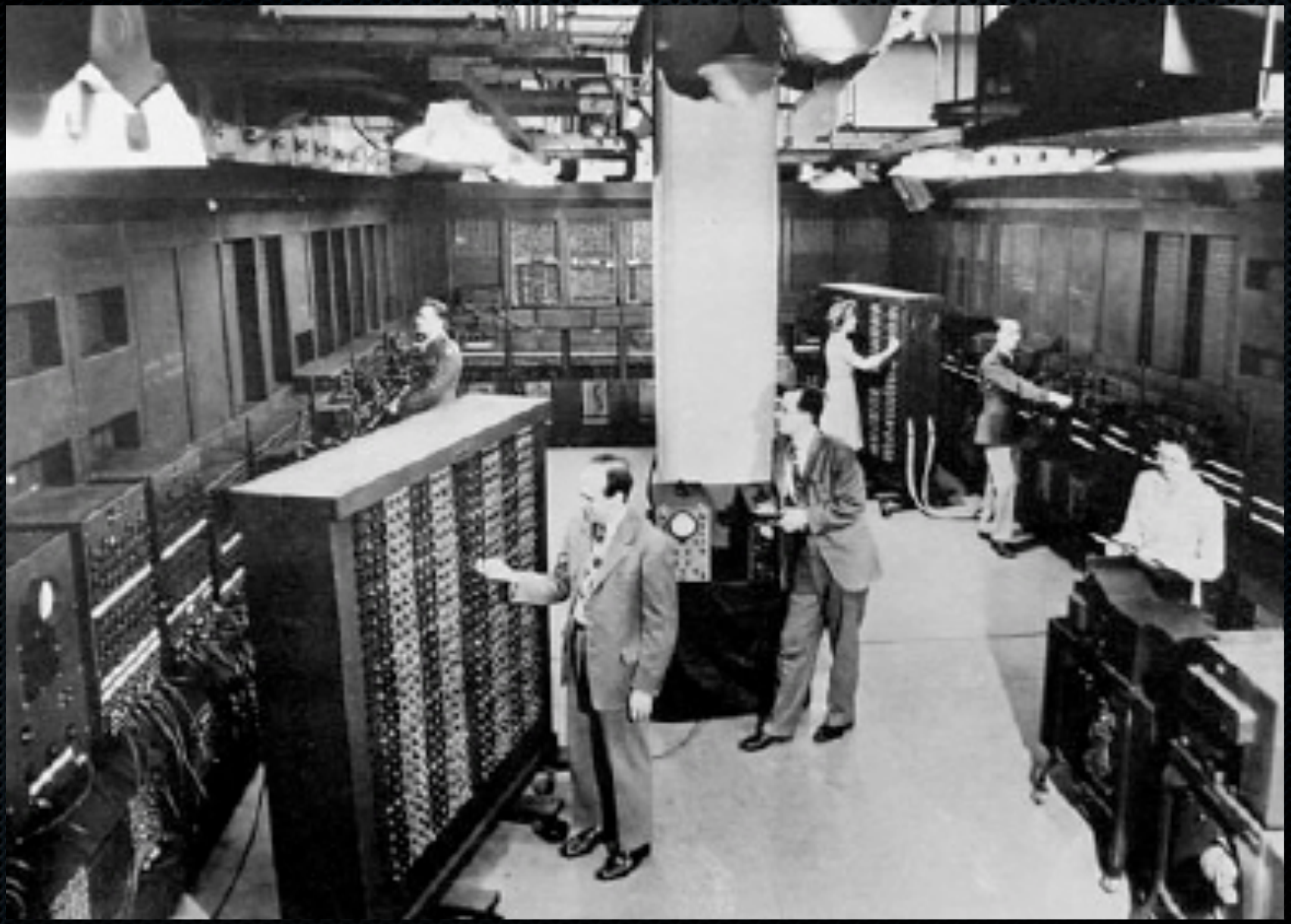
- Tabulated 1890 US census results in only 2.5 years.
- In 1896 started Tabulating Machine Company

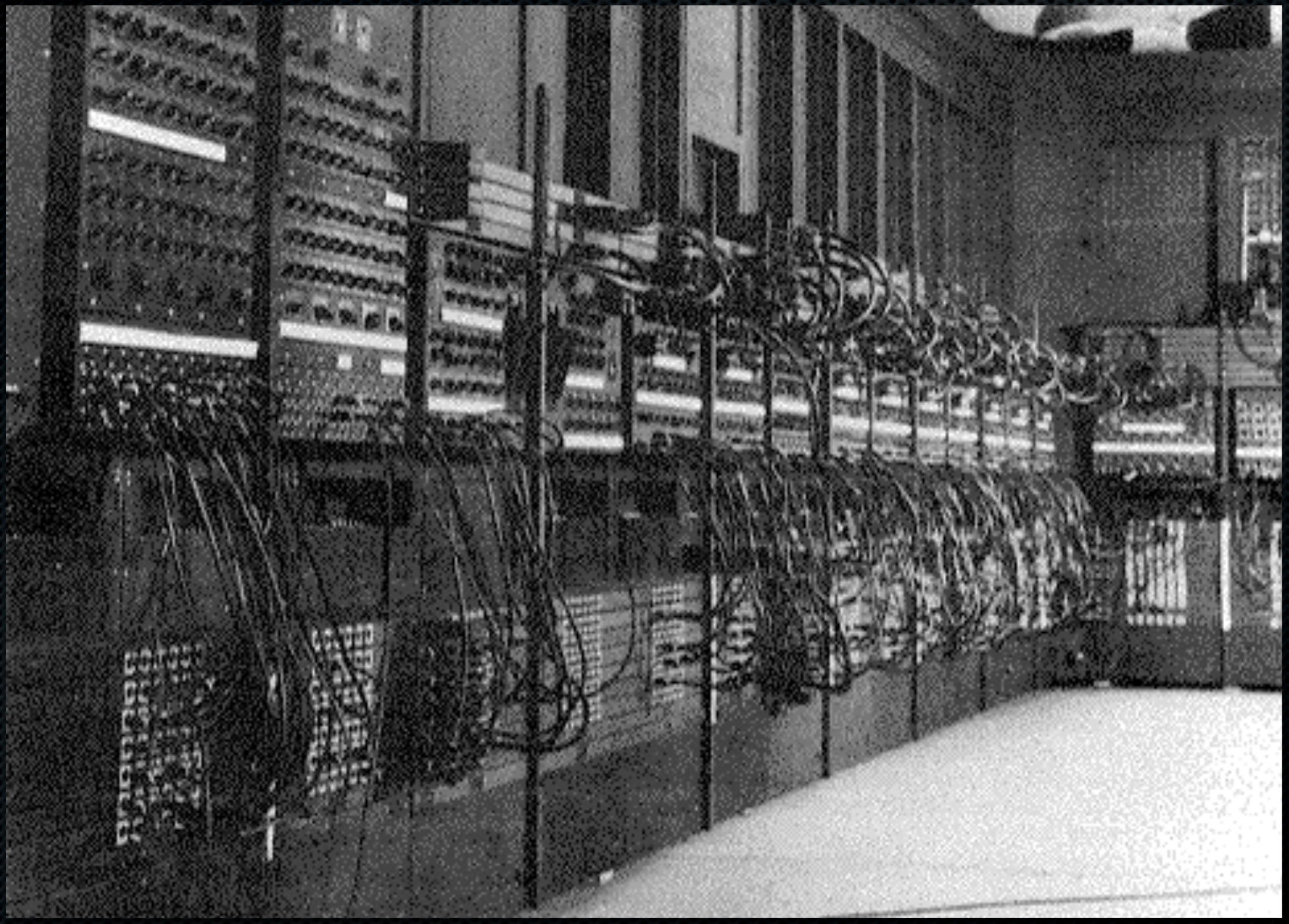
Vacuum Tubes

- A device used to amplify, switch, otherwise modify, or create an electrical signal by controlling the movement of electrons in a low-pressure space
- Large, hot & unreliable

ENIAC - 1942

- Electronic Numerical Integrator and Computer
- 1st successful high-speed electronic digital computer
- Built by Dr. John Mauchly & J. Presper Eckert to aid the US in WW2
- 18,000 vacuum tubes
- 500,000 hand soldered connections



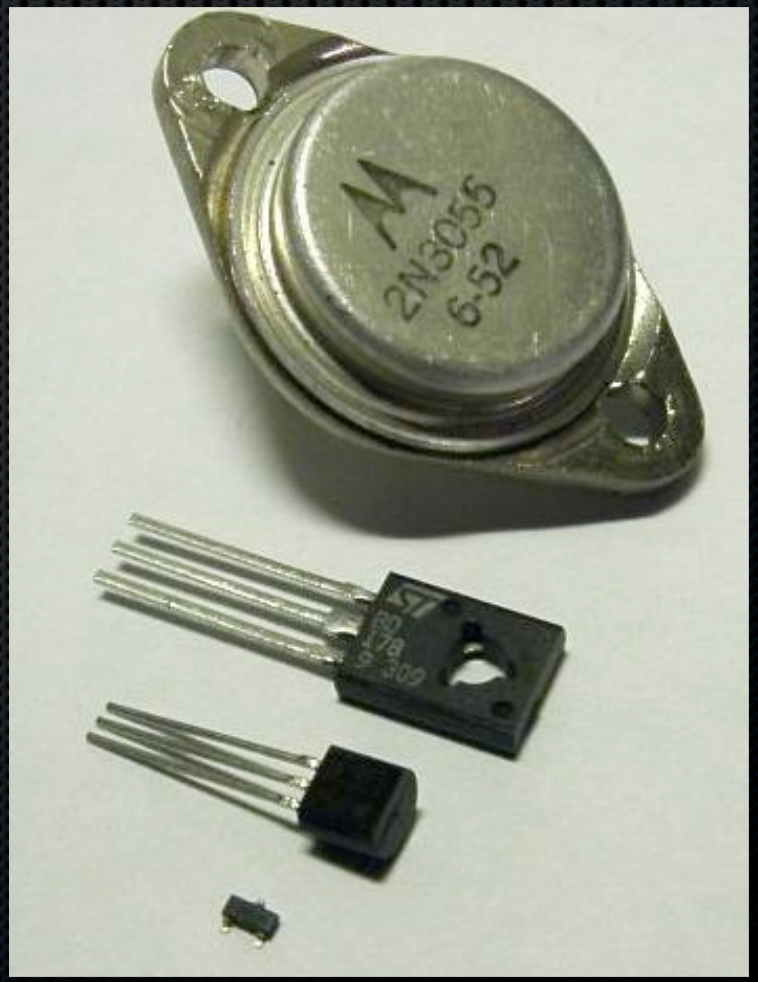


UNIVAC - 1951

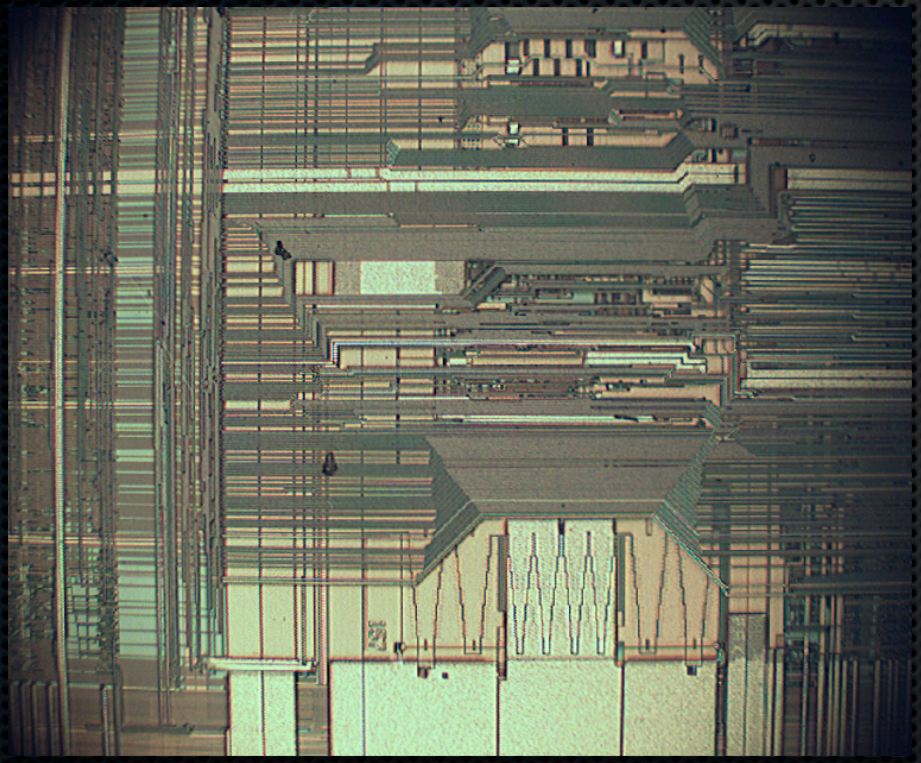
- Universal Automatic Computer
- First commercially successful computer
- Built by Eckert-Mauchly Computer Corporation
- First to use magnetic tape

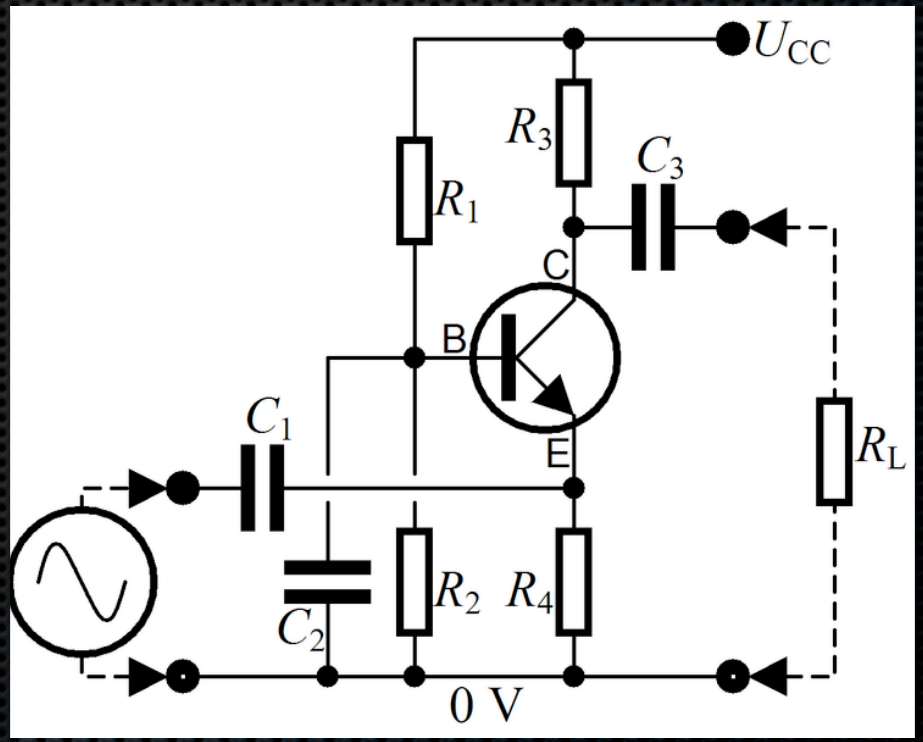
The Transistor - 1925

- Considered by many to be the greatest invention of the twentieth century
- Key active component in practically all modern electronics
- Invented by William Shockley
- Same function as vacuum tube
- No heat
- Extremely reliable



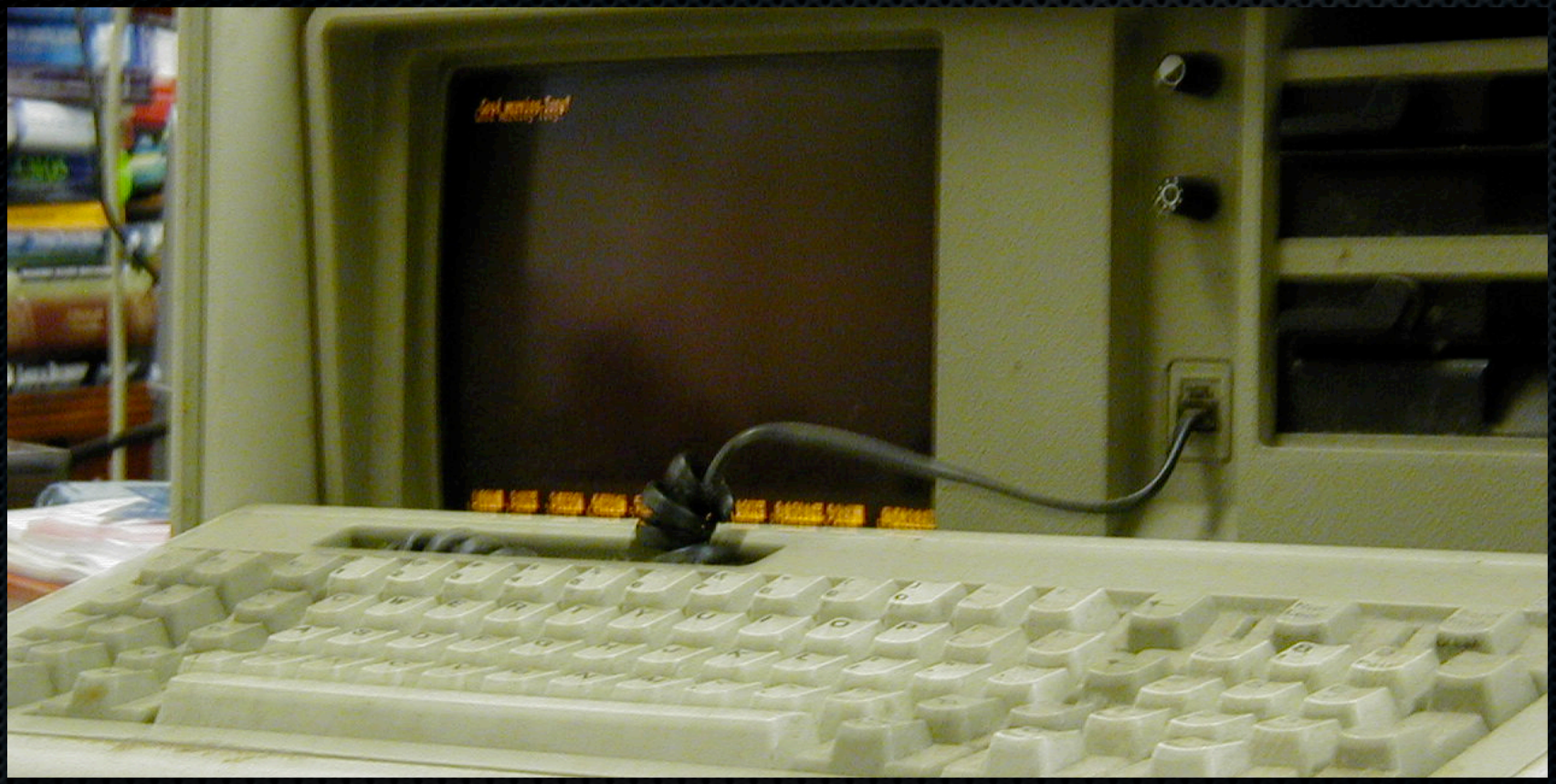
The Integrated Circuit





Intel 4004 - 1971

- Developed by Ted Hoff
- Intel's first processor
- 1st CPU to be on one chip
- 2300 transistors
- Opened the door for microcomputing



The Rise of the Personal Computer

Altair 8800 - 1974

- First popular personal computer
- Developed by MITS in 1974

Apple

April 1, 1976

Apple 1 - 1976

- Hobby computer like the Altair
- No keyboard or voltage inputs
- Had to wire your own video outputs
- $666.66

APPLE
COMPUTER
CO.

Apple II - 1977

- Instant success
- Color graphics and open architecture
- 5 1/4 inch floppy drive
- First mass produced microcomputer

IBM PC

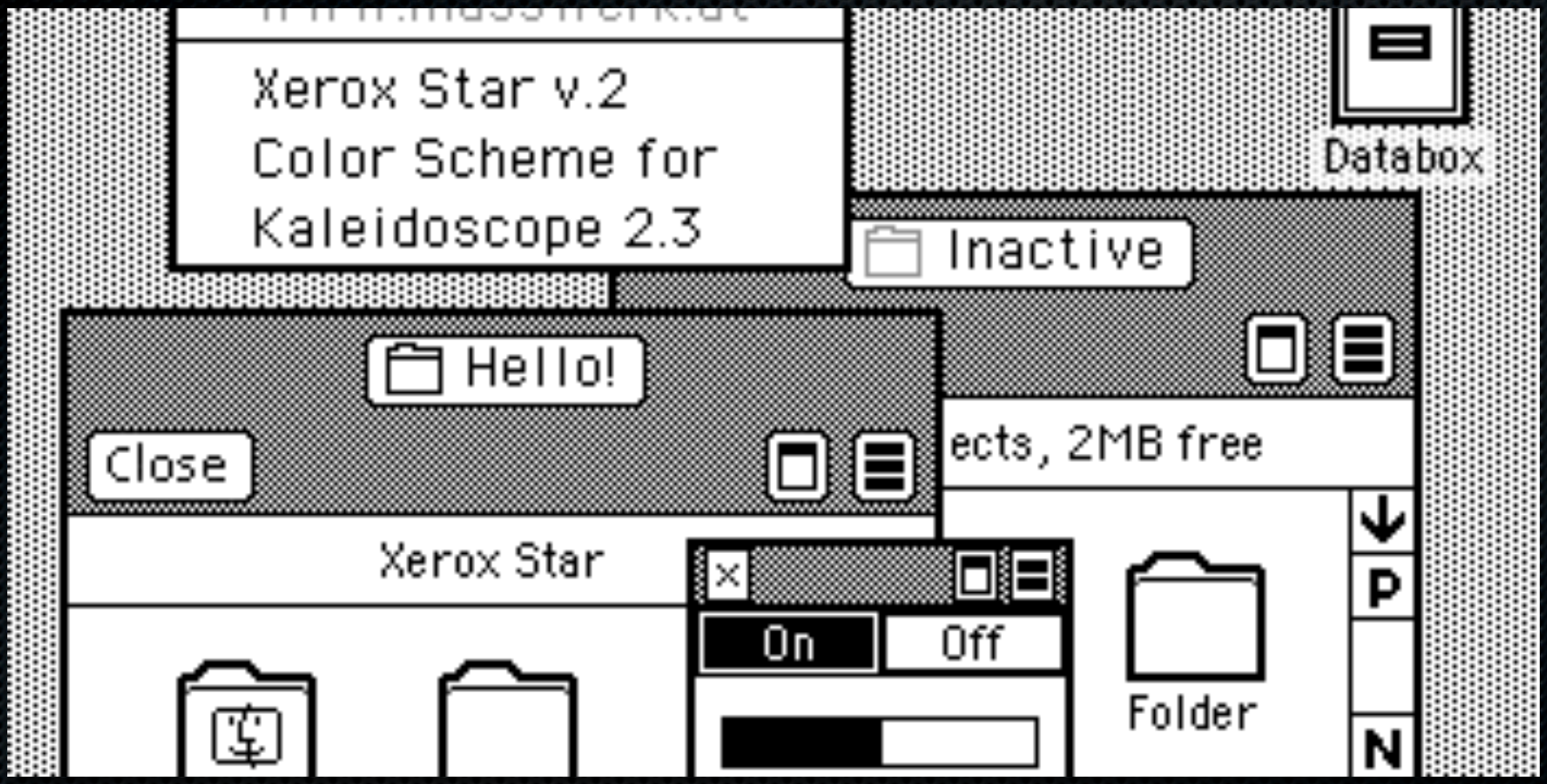
1981

IBM PC - 1981

- Designed in one year by using “off the shelf” parts from various equipment manufacturers
- Don Estridge led the development
- $1,565

PC Clones

- AST Research
- Compaq
- Epson
- Hewlett-Packard
- NEC
- Tandy
- Olivetti
- WYSE
- Zenith Data Systems

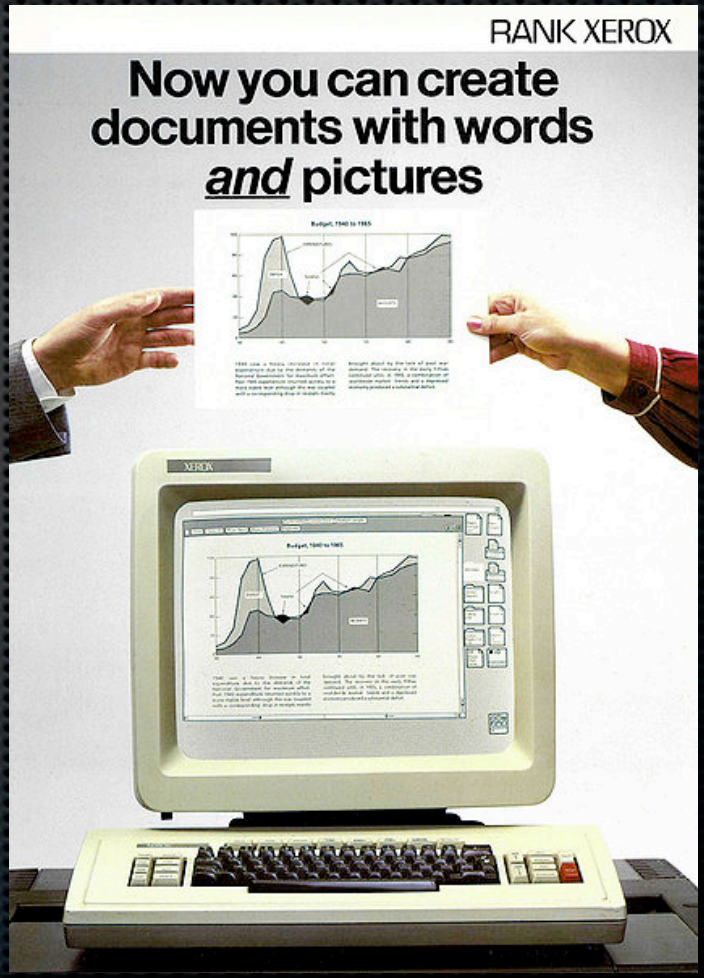


The Birth of the GUI

Xerox Star - 1981

Xerox Star - 1981

- First computer to feature a Graphical User Interface
- $16,000
- Commercial failure



Apple Lisa - 1983

- Apple's first computer with a GUI
- Named after Jobs' estranged daughter
- Very advanced for its time
- $10,000
- Commercial failure

Apple Macintosh

1984

IBM PS/2 - 1987

- IBM's attempt to recapture the PC market from the clones
- Proprietary architecture
- 3.5" disk drive
- VGA graphics
- PS/2 ports

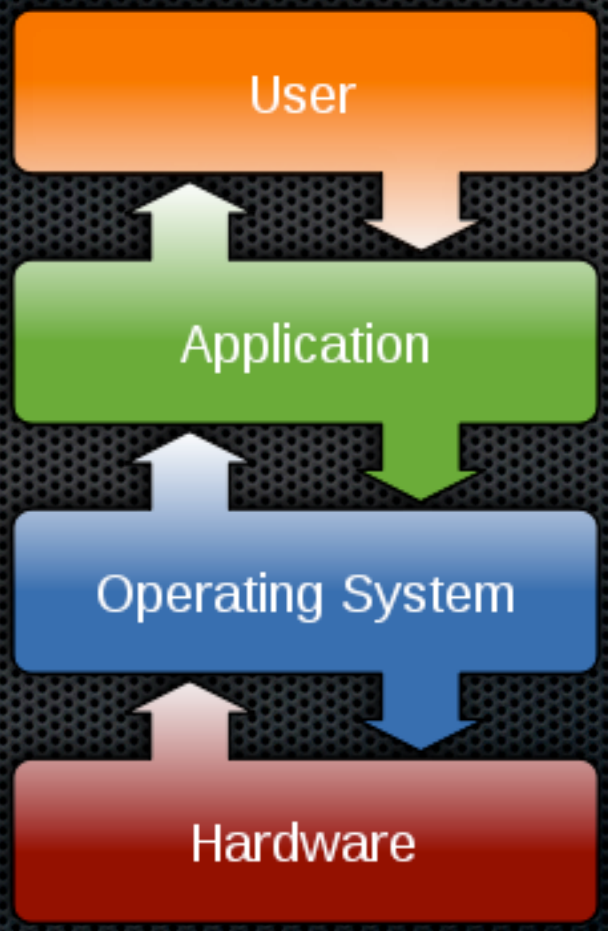
```
6087 ?? IW     0:00.04 bash /home/users/t/ta/tanders/src/net-snmp-main/dist/ns
6200 ?? DW     0:00.00 grep -v ^ *+ conftest.er1
6610 ?? IW     0:04.82 /bin/bash /home/users/t/ta/tanders/src/net-snmp-V5-1-pa
6929 ?? I      0:00.16 sh Compile cvs/RELEASE wxGTK
7066 ?? I      0:00.00 sh Compile cvs/RELEASE wxGTK
7686 ?? IW     0:00.03 bash /home/users/t/ta/tanders/src/net-snmp-main/dist/ns
7774 ?? IW     0:06.28 /bin/bash /home/users/t/ta/tanders/src/net-snmp-V5-3-pa
8239 ?? I      0:00.00 sh Compile cvs/RELEASE wxGTK
9497 ?? IWs    0:00.12 sshd: tanders@notty
3894 ?? S      0:00.07 gmake
4011 ?? S      2:09.33 snmpd -d -r -U -p /tmp/snmp-test-31-11960/snmpd.pid.num
4544 ?? S      0:00.00 /bin/sh ../../../.././bk-deps g++ -c -o ogledit_view.o
6353 ?? IW     0:00.04 bash /home/users/t/ta/tanders/src/net-snmp-main/dist/ns
7935 ?? DE     0:00.01 (bash)
8366 ?? IWs    0:00.13 sshd: tanders@notty
9812 ?? IWs    0:00.03 bash /home/users/t/ta/tanders/src/net-snmp-main/dist/ns
2336 p0 R+     0:00.00 ps ax
1906 p0 Is     0:00.01 -bash
4304 p0 S      0:00.03 sh
 697 00 IWs+   0:00.01 /usr/libexec/getty Pc console
 639 E1 IWs+   0:00.01 /usr/libexec/getty Pc ttyE1
 734 E2 IWs+   0:00.01 /usr/libexec/getty Pc ttyE2
 762 E3 IWs+   0:00.01 /usr/libexec/getty Pc ttyE3
```

Operating Systems

Operating Systems

- The master control program of a computer
- Manages resources
- Interfaces between users & applications and the hardware
- Controls the execution of applications
- Control program that decides what a PC does and how it does it.

Operating Systems



3 Components of an OS

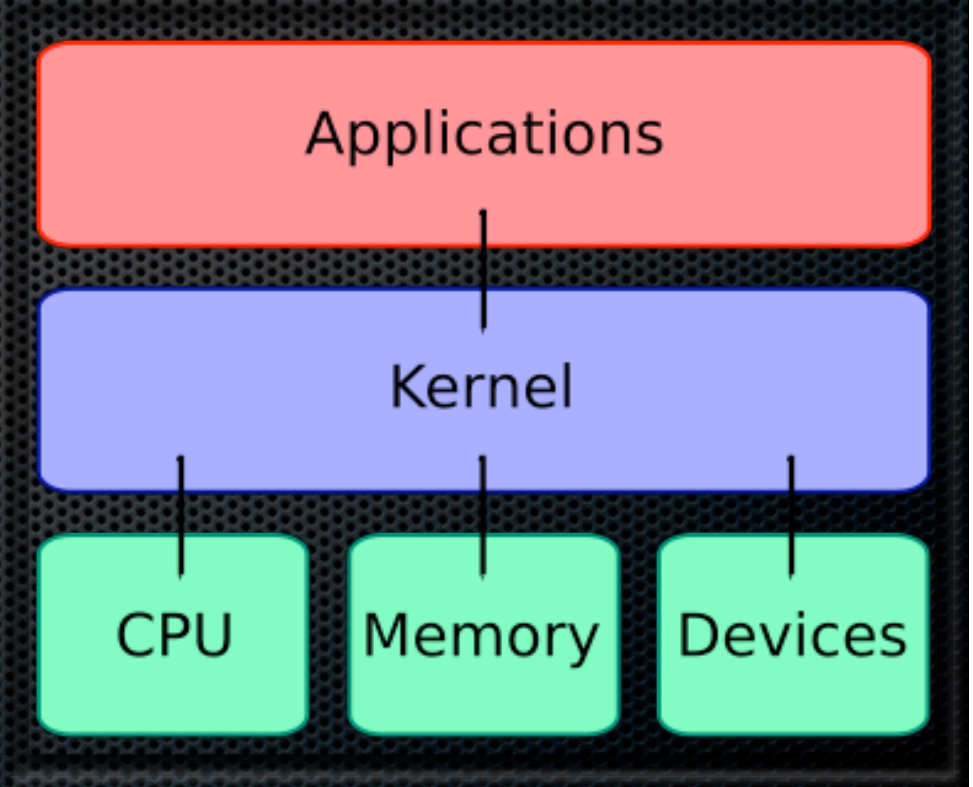
- Application Program Interface (API)
- Kernel
- Device Drivers

API

- The interface between the OS and the software
- A set of predefined commands that an operating system can perform for an application
  - Eg; open a file, read a keystroke, end a program

Kernel

- Central component of the operating system
- Manages the system resources
- Performs the system calls that the API allows



Device Drivers

- The software that controls the hardware
- Liaison between the kernel and the hardware
- Can be updated without having to update the entire OS
- To make hardware compatible with an OS all one has to do is create a device driver

Unix - 1969

- Command line interface (CLI)
- Developed by AT&T
- Rewritten in C in 1973, not assembly language
- Split into various branches

CP/M - 1974

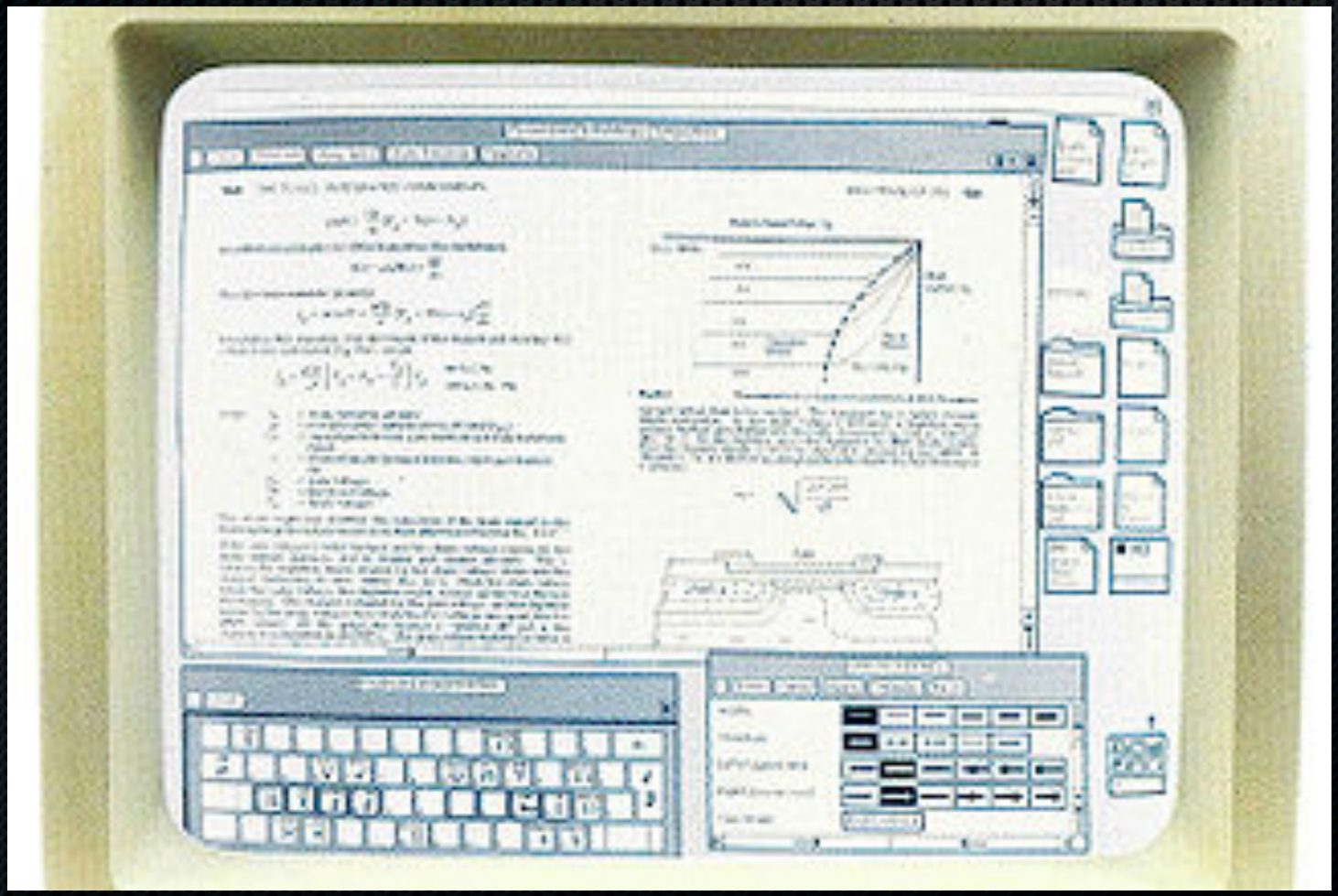
- Written by Gary Kindall
- First standard operating system for PC’s

DOS - 1981

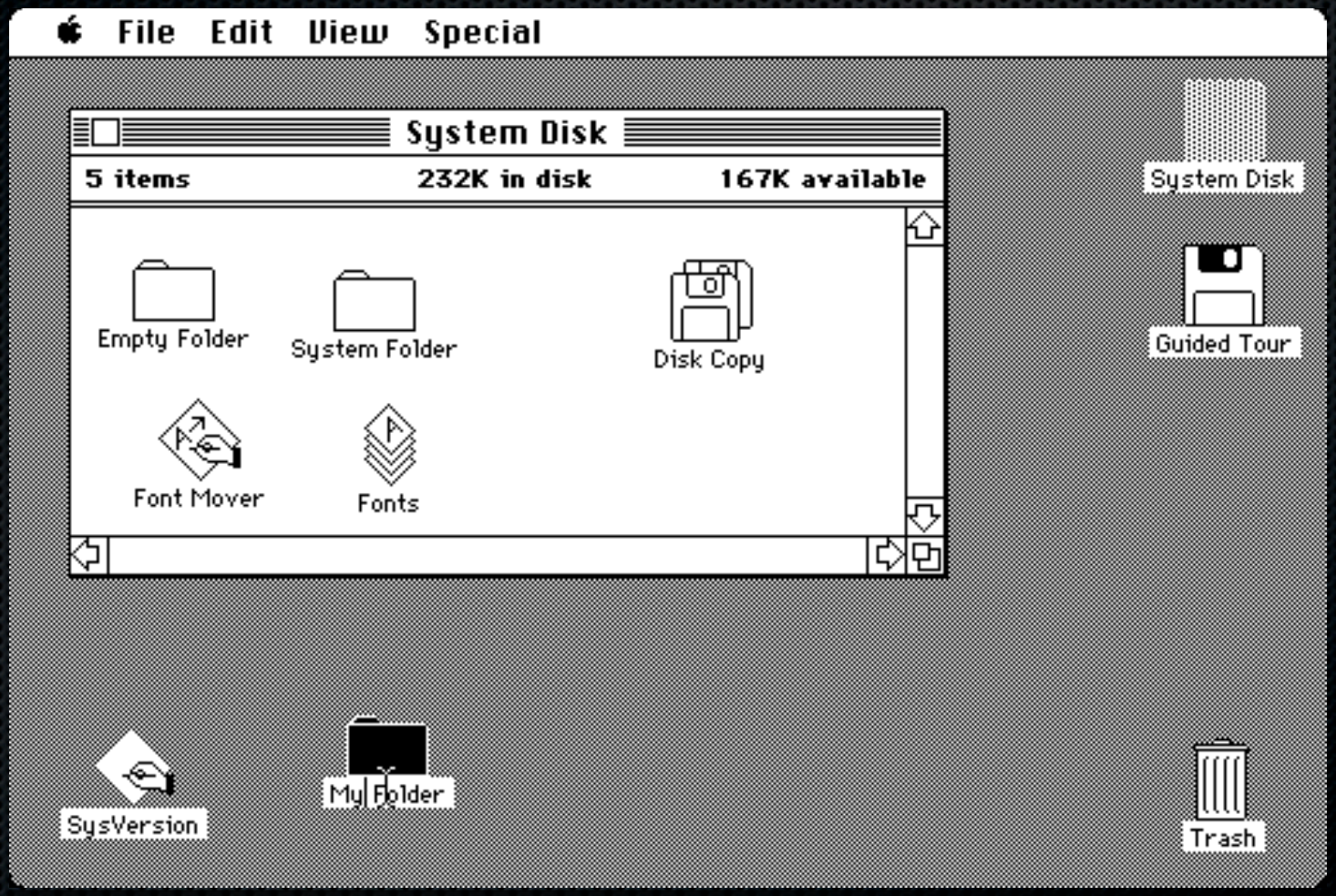
- Disk Operating System
- In use from 1981 to 1995
- Included with IBM PC (PC DOS)

```
Current date is Tue  1-01-1980
Enter new date:
Current time is  7:48:27.13
Enter new time:


The IBM Personal Computer DOS
Version 1.10 (C)Copyright IBM Corp 1981, 1982

A>dir/w
COMMAND  COM    FORMAT   COM    CHKDSK   COM    SYS      COM    DISKCOP
DISKCOMP COM    COMP     COM    EXE2BIN  EXE    MODE     COM    EDLIN
DEBUG    COM    LINK     EXE    BASIC    COM    BASICA   COM    ART
SAMPLES  BAS    MORTGAGE BAS    COLORBAR BAS    CALENDAR BAS    MUSIC
DONKEY   BAS    CIRCLE   BAS    PIECHART BAS    SPACE    BAS    BALL
COMM     BAS
       26 File(s)
A>dir command.com
COMMAND  COM     4959   5-07-82  12:00p
        1 File(s)
A>
```

Xerox Star - 1981



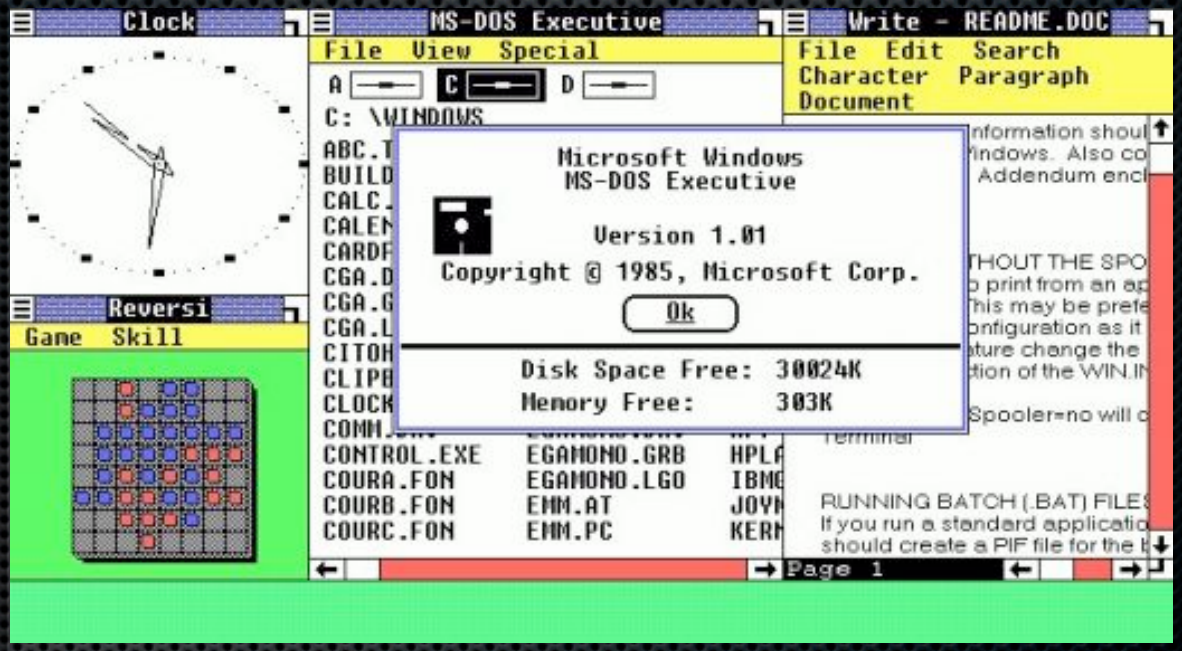
Apple MacOS - 1984



Windows

1985

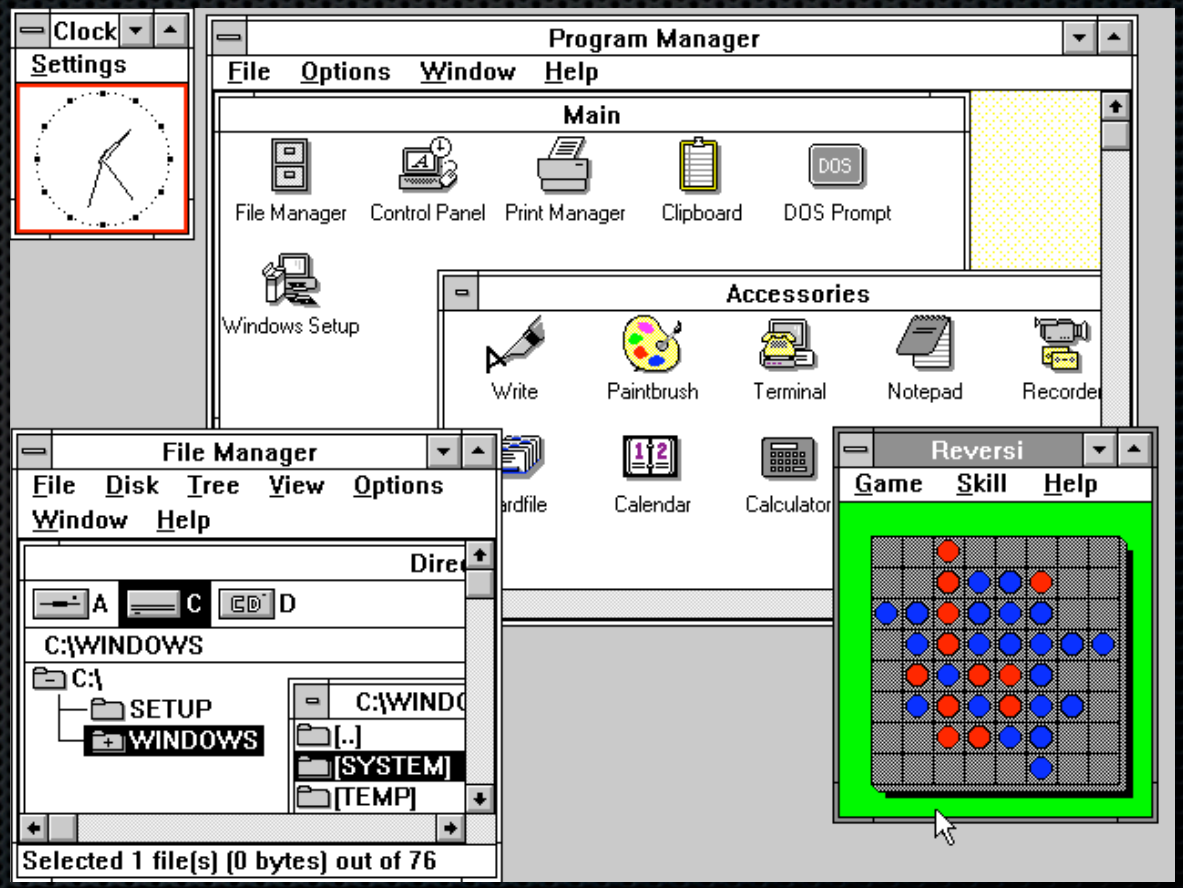
Windows



- 1.0 - 1985
- 2.0 - 1987
- Neither was a full OS but a DOS shell

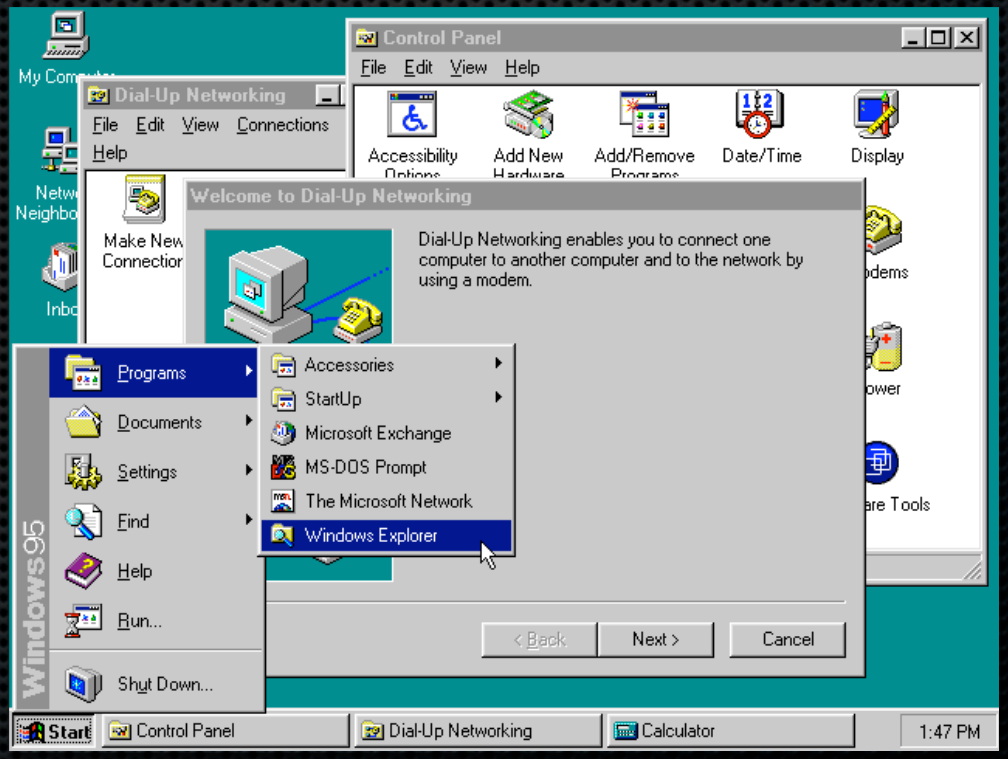
Windows

- 3.0 - 1990
- 3.1 - 1992

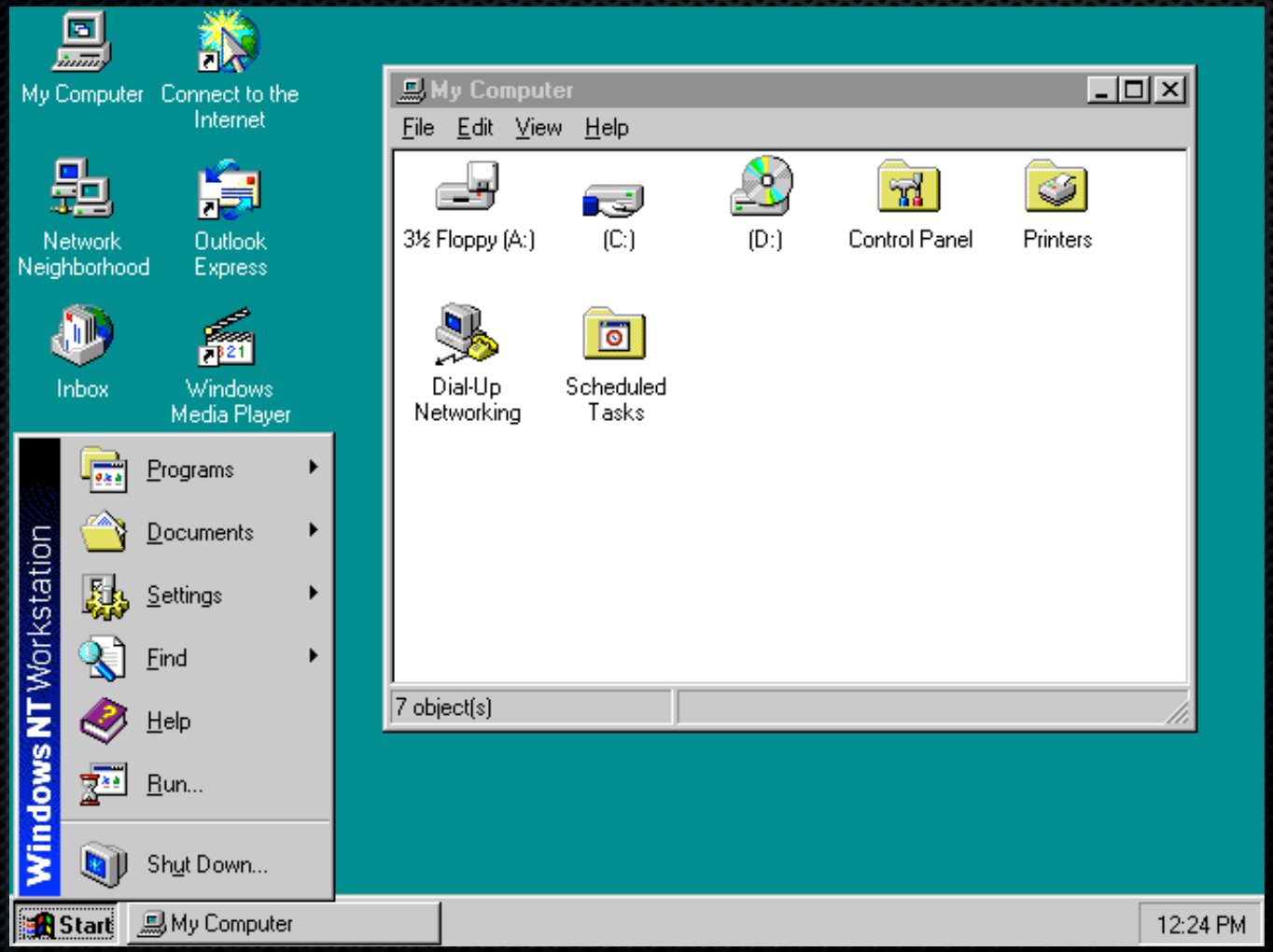


Windows 95

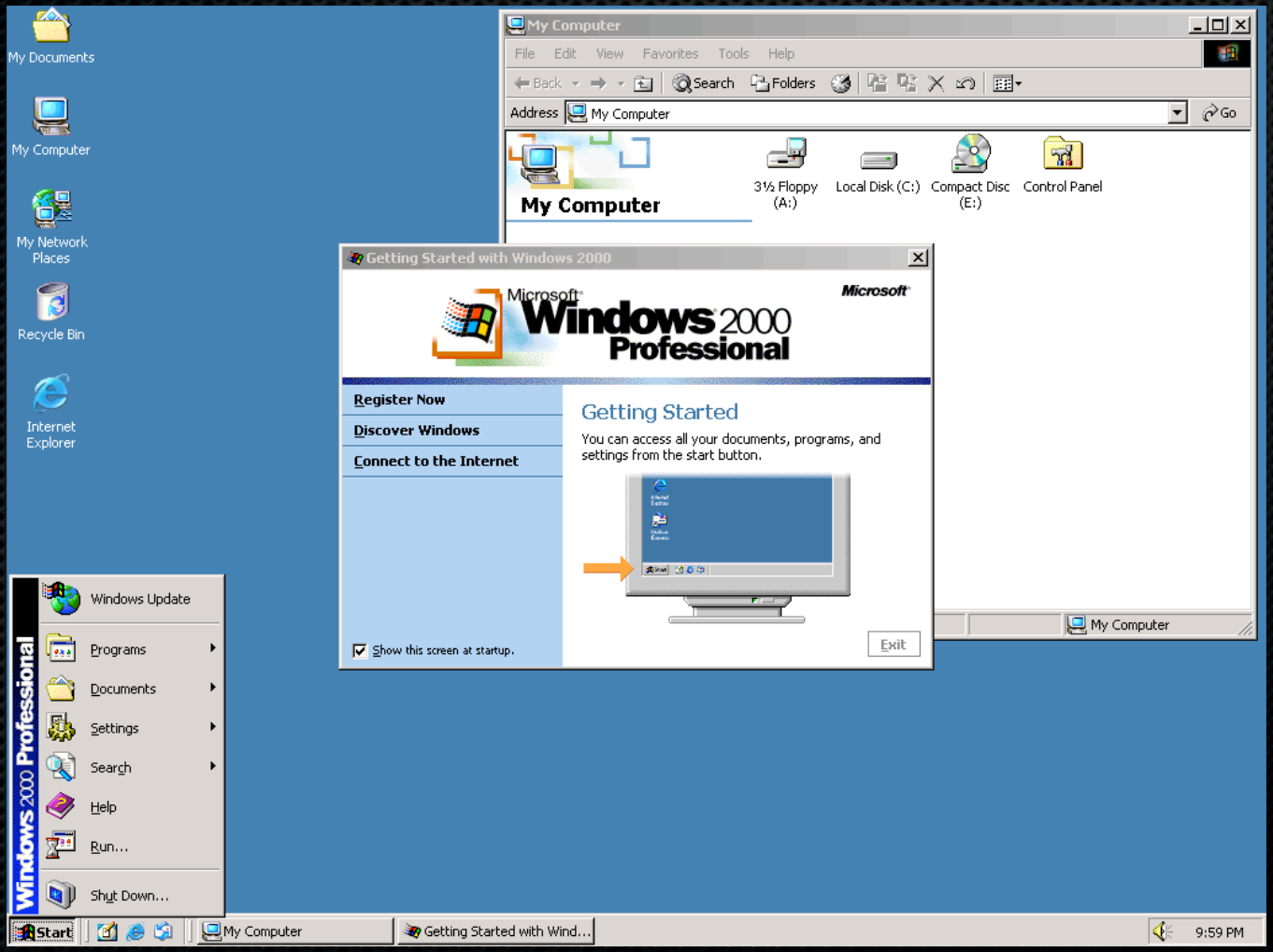
- Separate from DOS
- Kicked off the 9x series of Windows
  - 95
  - 98
  - 98 S.E.
  - ME



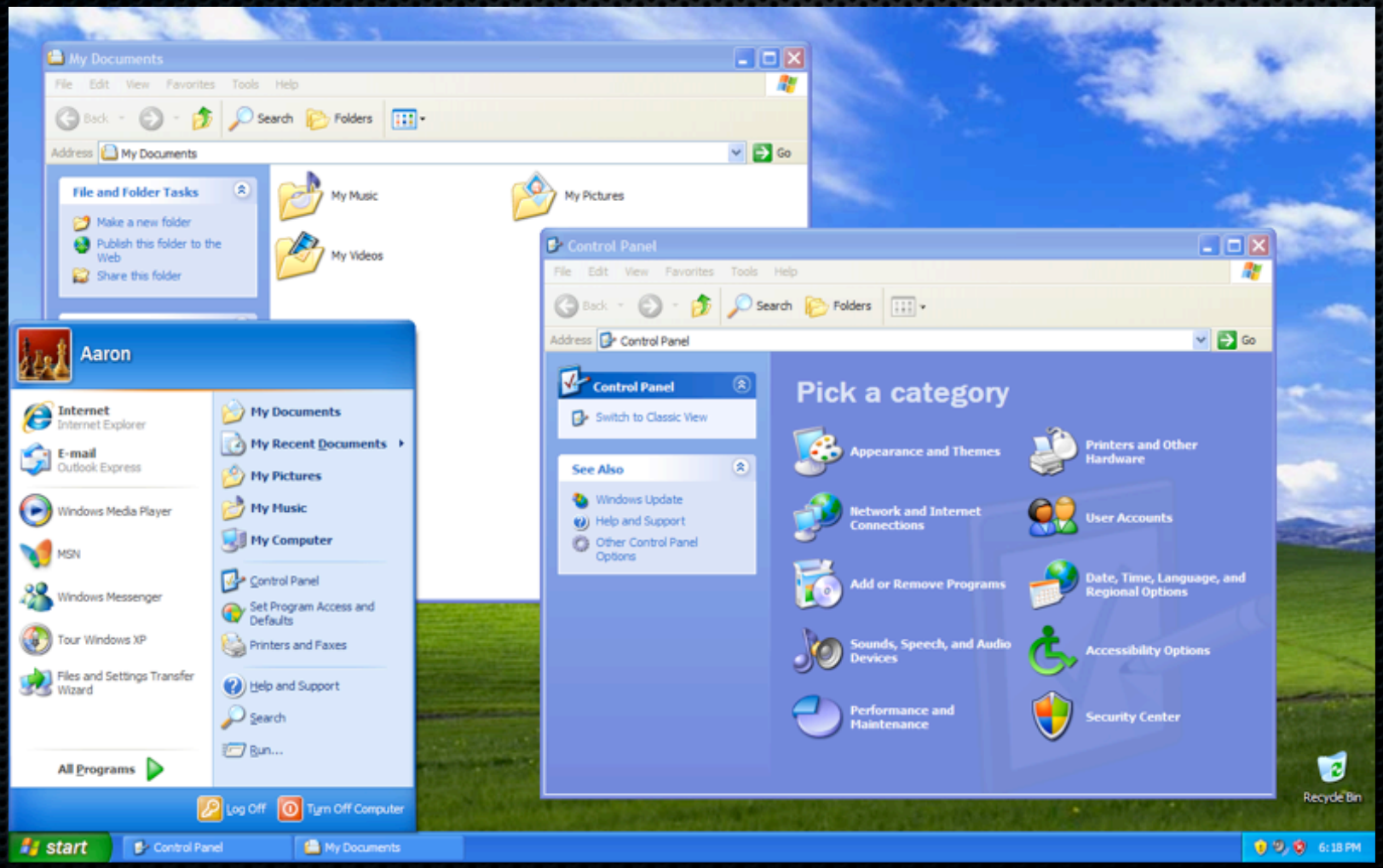
Windows NT - 1993



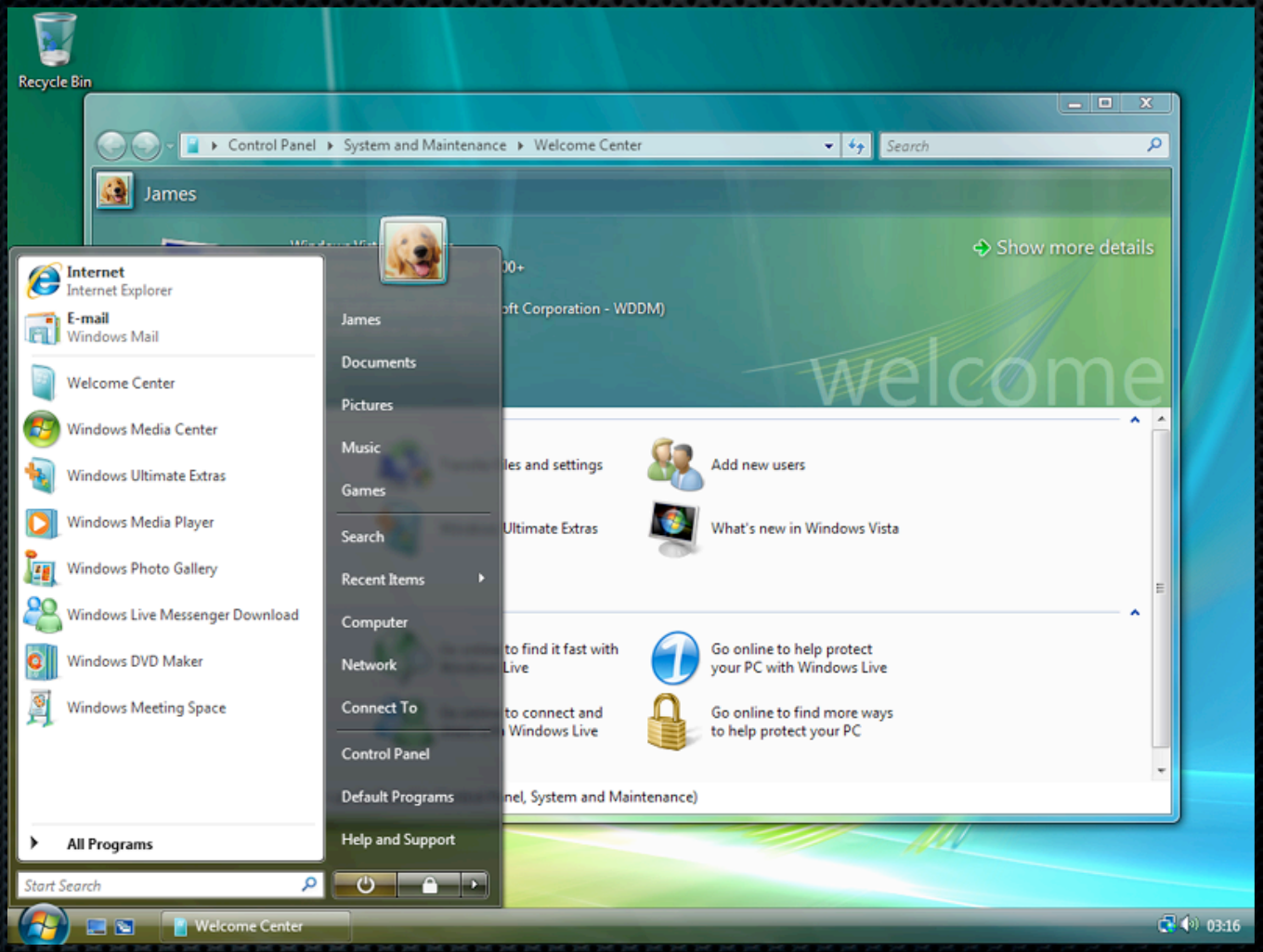
Windows 2000



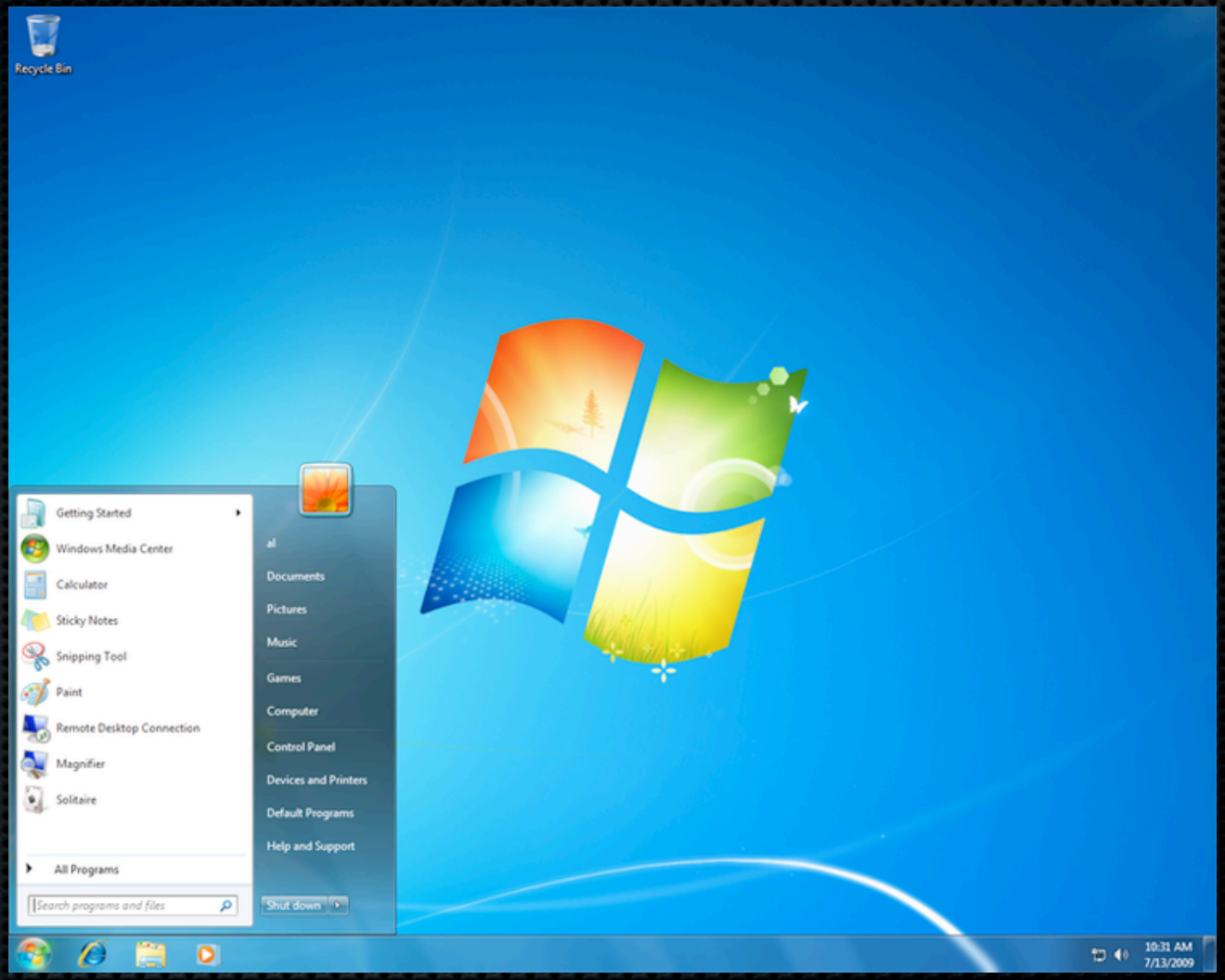
Windows XP


My Documents
File Edit View Favorites Tools Help
Back Search Folders
Address My Documents Go
File and Folder Tasks
Make a new folder
Publish this folder to the Web
Share this folder
My Music
My Pictures
My Videos
Control Panel
Address Control Panel
Control Panel
Switch to Classic View
See Also
Windows Update
Help and Support
Other Control Panel Options
Pick a category
Appearance and Themes
Printers and Other Hardware
Network and Internet Connections
User Accounts
Add or Remove Programs
Date, Time, Language, and Regional Options
Sounds, Speech, and Audio Devices
Accessibility Options
Performance and Maintenance
Security Center
Aaron
Internet
Internet Explorer
E-mail
Outlook Express
Windows Media Player
MSN
Windows Messenger
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
Recycle Bin
start
Control Panel
My Documents
6:18 PM

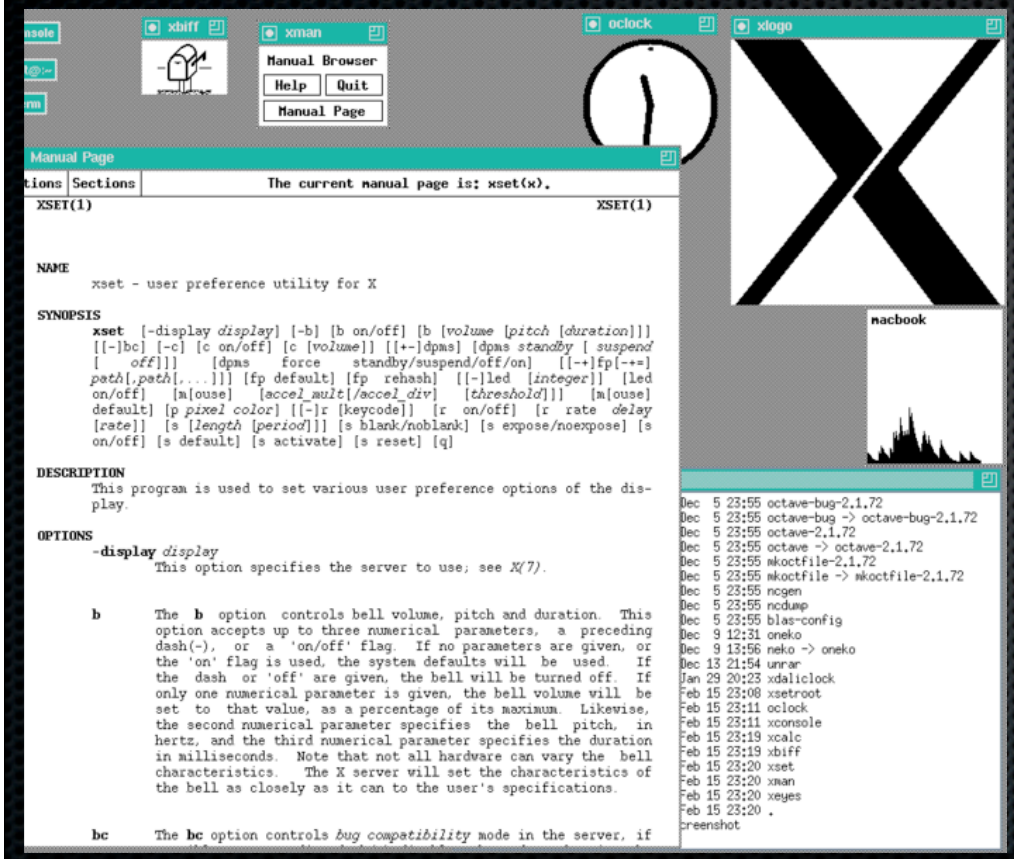
Windows Vista



Windows 7


Recycle Bin
Getting Started
Windows Media Center
Calculator
Sticky Notes
Snipping Tool
Paint
Remote Desktop Connection
Magnifier
Solitaire
All Programs
Search programs and files
al
Documents
Pictures
Music
Games
Computer
Control Panel
Devices and Printers
Default Programs
Help and Support
Shut down
10:31 AM
7/13/2009

X Window System - 1984



- AKA X11
- GUI for Unix systems
- Designed specifically for networked computers

NeXT

- 1985 - Steve Jobs kicked out of Apple
- Creates NeXT
- Decided to build high-end systems for large clients

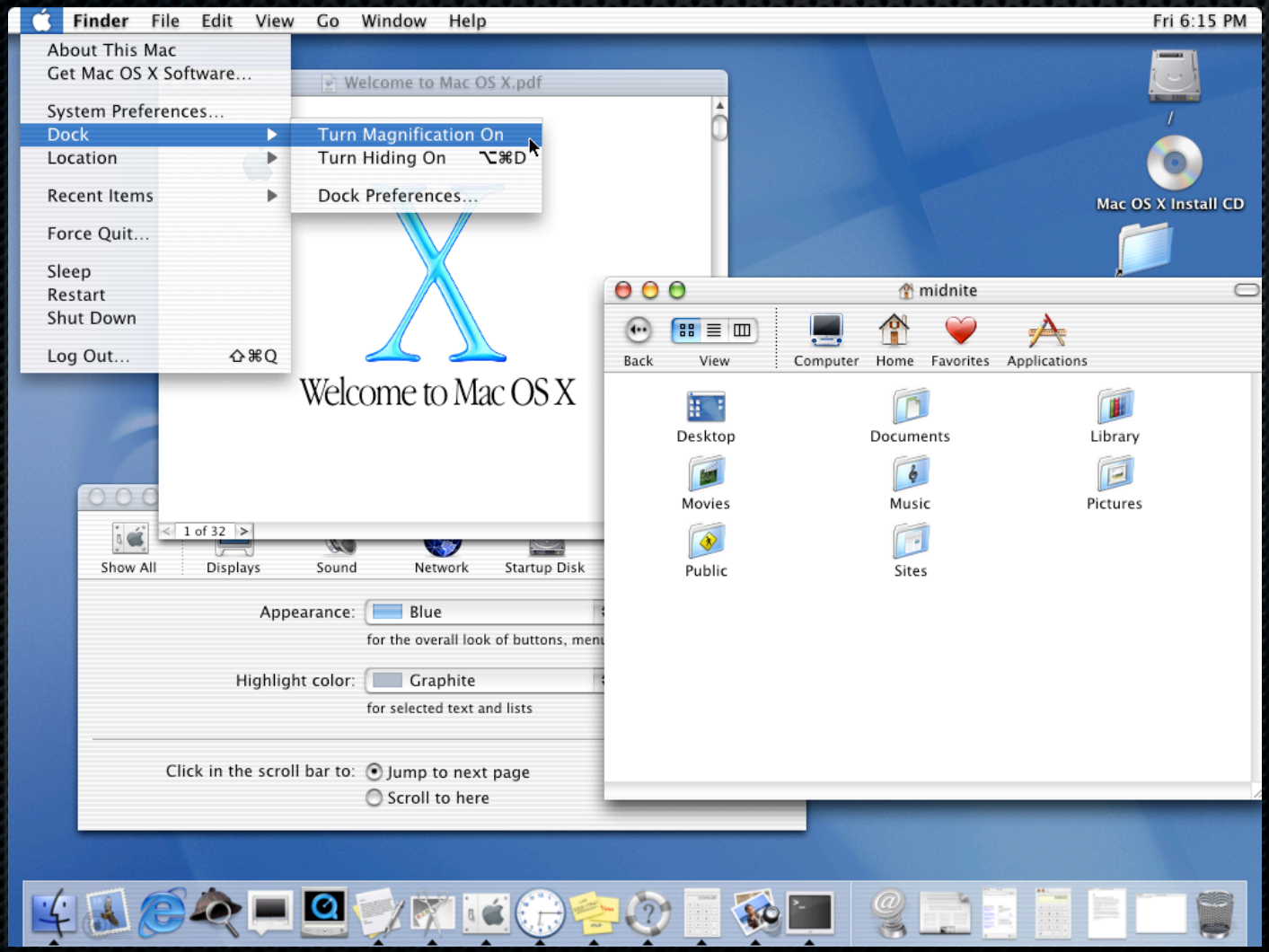
NeXTstep

- Based on BSD Unix
- Web was invented on NeXTstep

Apple in Trouble

- 1996 - Apple announces its intention to purchase NeXT
- Wanted to use NeXTstep as the basis of its new operating system
- Apple paid $400M and 1.5 million shares of stock to Jobs.
- Jobs became interim CEO
- Became full CEO in 2000

Mac OS X

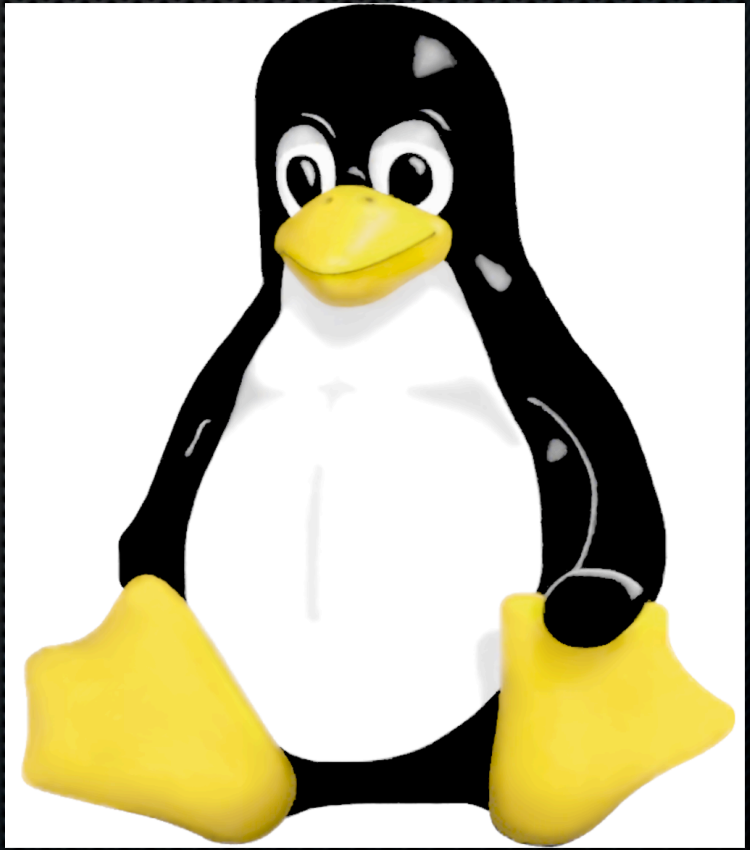

Finder File Edit View Go Window Help
Fri 6:15 PM
About This Mac
Get Mac OS X Software...
System Preferences...
Dock
Location
Recent Items
Force Quit...
Sleep
Restart
Shut Down
Log Out...
Turn Magnification On
Turn Hiding On
Dock Preferences...
Welcome to Mac OS X.pdf
Welcome to Mac OS X
1 of 32
Mac OS X Install CD
midnite
Back
View
Computer
Home
Favorites
Applications
Desktop
Documents
Library
Movies
Music
Pictures
Public
Sites
Show All
Displays
Sound
Network
Startup Disk
Appearance:
Blue
for the overall look of buttons, menu
Highlight color:
Graphite
for selected text and lists
Click in the scroll bar to:
Jump to next page
Scroll to here

GNU - 1983

- Complete Unix-compatible software system
- Stands for **G**NU is **N**ot **U**nix
- Developed by Richard Stallman
- Very similar to Unix
- Had an incomplete kernel
- Built with the idea that it would be completely free

Linux - 1991

- Linux Kernel written in 1991 by Linus Torvalds
- Has split into several different distributions
  - RedHat, SuSE, Fedora, Debian, Ubuntu
- User Interfaces
  - Gnome
  - KDE

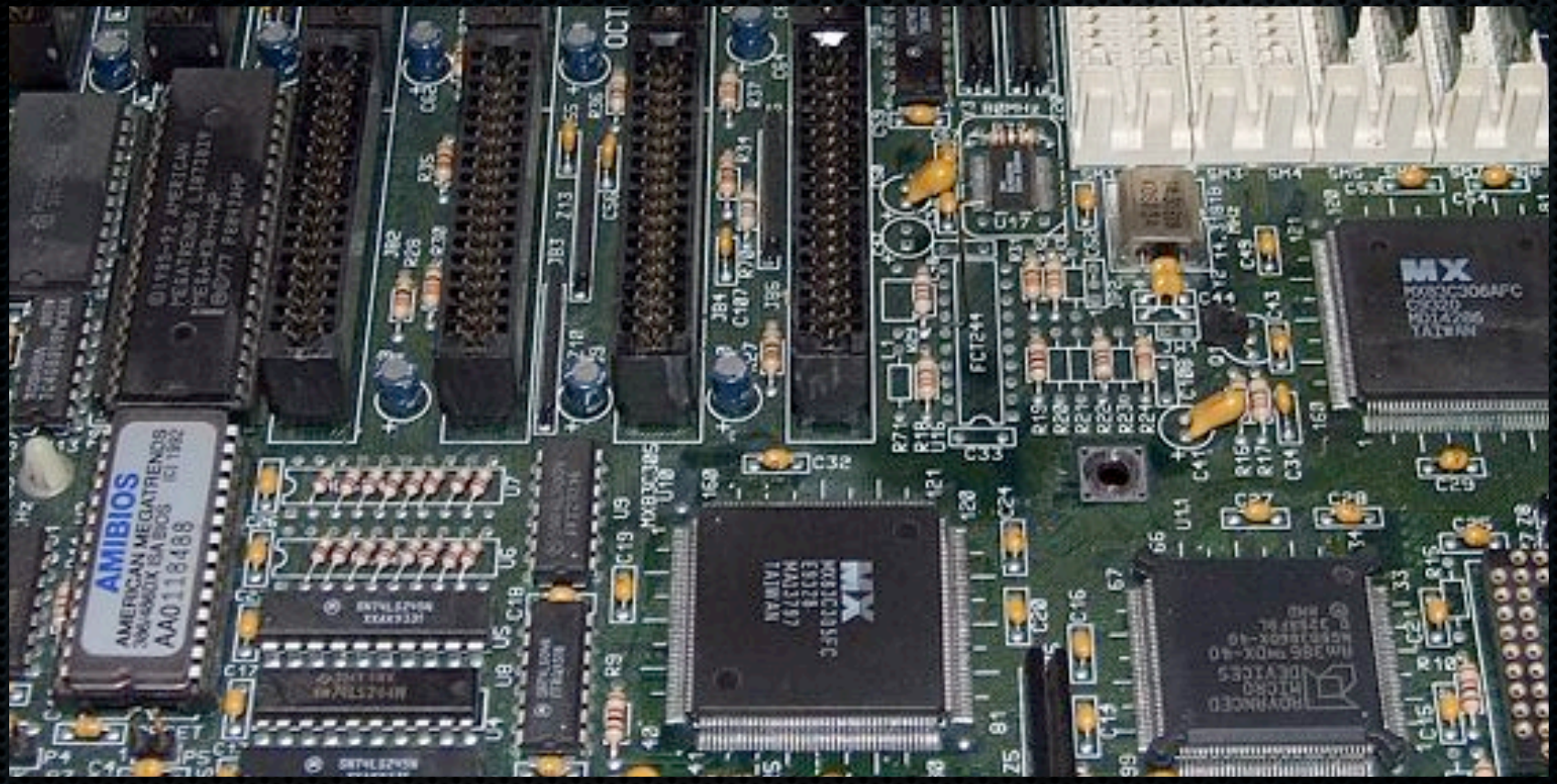


Open Source

- The source code to a program, application or operating system is made available to the public for collaboration
- Anyone can develop or modify the code

GNU General Public License

- Grants the recipients of a computer program the rights of the free software definition and ensures the freedoms are preserved, even when the work is changed or added to
- Can change it, distribute it, even charge for it, but cannot close it

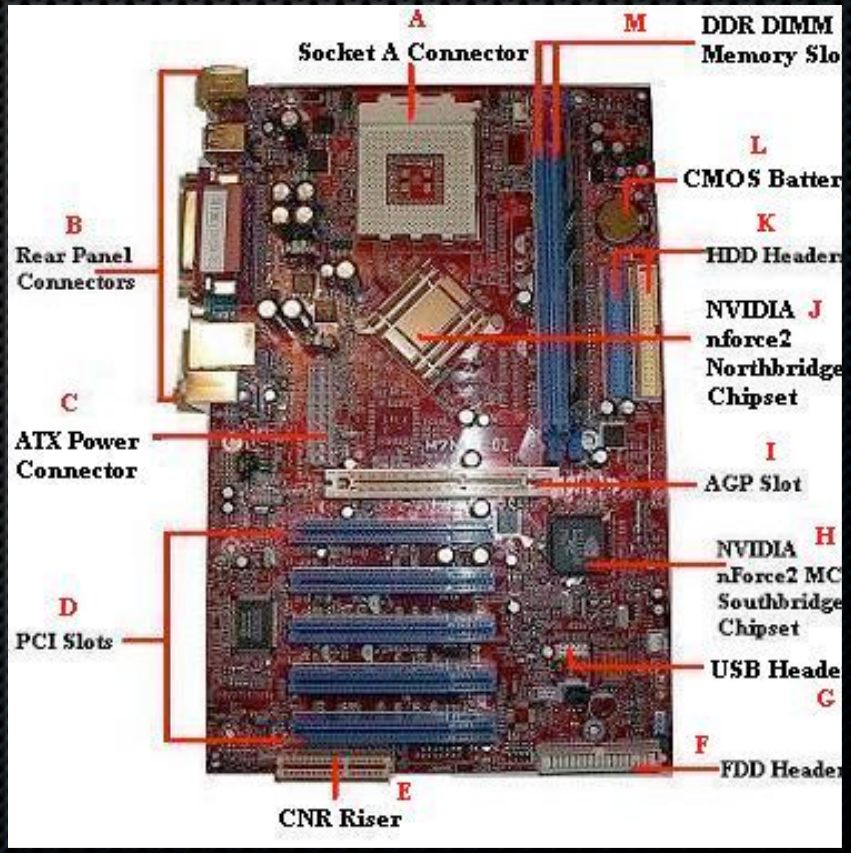


Computer Anatomy

What makes it work?

Motherboard

- Large circuit board that connects all the components together



Central Processing Unit

- The component of a computer system that performs the basic operations (as processing data) of the system, that exchanges data with the system's memory or peripherals, and that manages the system's other components

Central Processing Unit

- 32 bit processor can handle 32 bits of data at one time
- 64 bit processor can handle 64 bits of data at one time
  - Needs specific software

Central Processing Unit

- Dual processor / multi processor
  - Two or more separate CPU chips
- Dual core / multi core
  - Two or more CPU cores housed on 1 single chip

Memory

- **RAM**
  - Computer can both read and write data into the memory
  - Can be accessed without disturbing other data. It has random access to the data.
  - Requires a constant source of electricity - volatile
- **ROM**
  - Permanent memory used to store programs that boot the computer and perform diagnostics
  - Non-volatile

BIOS

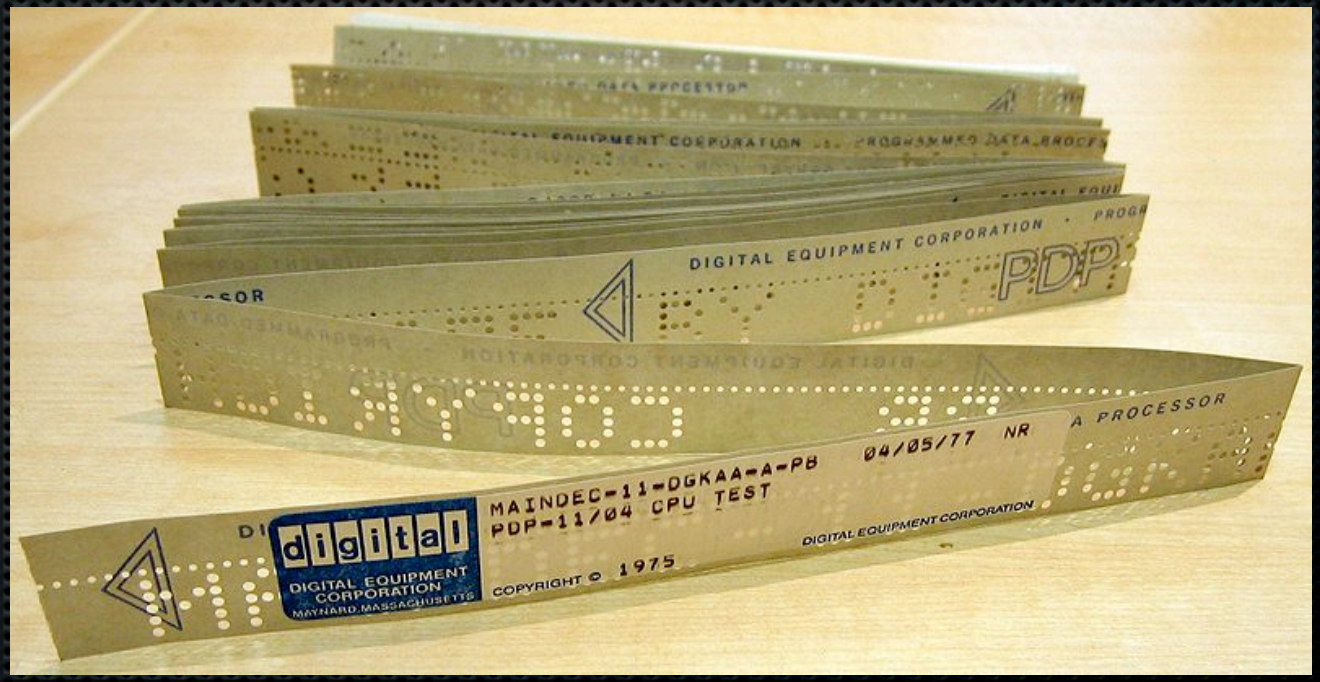
- Basic Input/Output System
- Program on the computer's ROM chip that acts as the intermediary between the hardware, processor and operating system.
- Primary function is to identify and initialize system hardware
- EFI on Apple Mac systems

Adapter Cards

- Printed circuit board that you install into a slot on the computer's motherboard to expand the functionality of a computer
  - Video, sound, network, etc
- Most functionality automatically built into the motherboard these days
- Different cards correspond to different bus technologies
  - ISA, PCI, AGP, PCI Express

Storage Devices

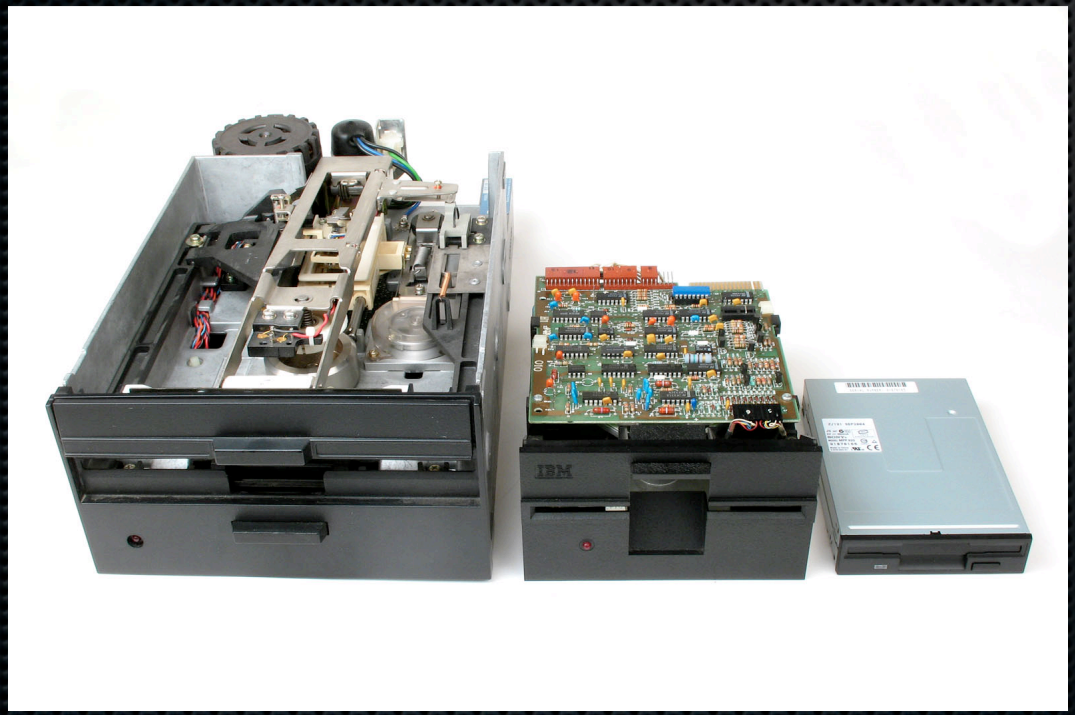
- **Punched Cards and punched tape**



Storage Devices

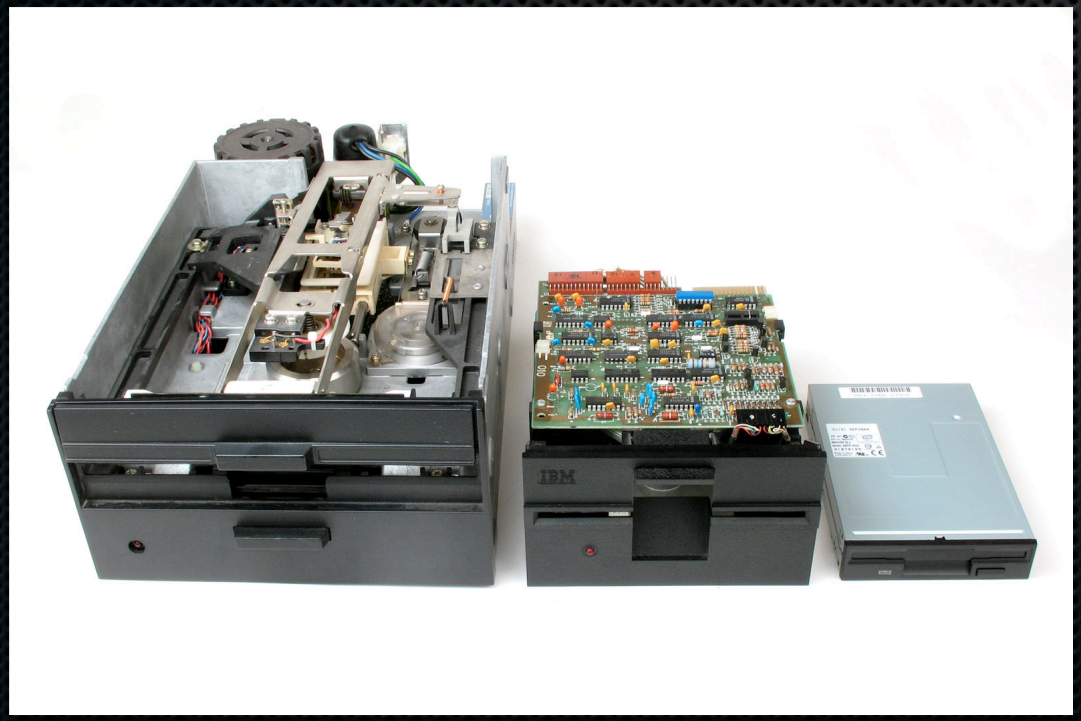
- **Magnetic tape**

Storage Devices



- **Floppy Disk**
  - Direct access to data
  - Low cost
  - 8” > 5 1/4” > 3 1/2”

Storage Devices

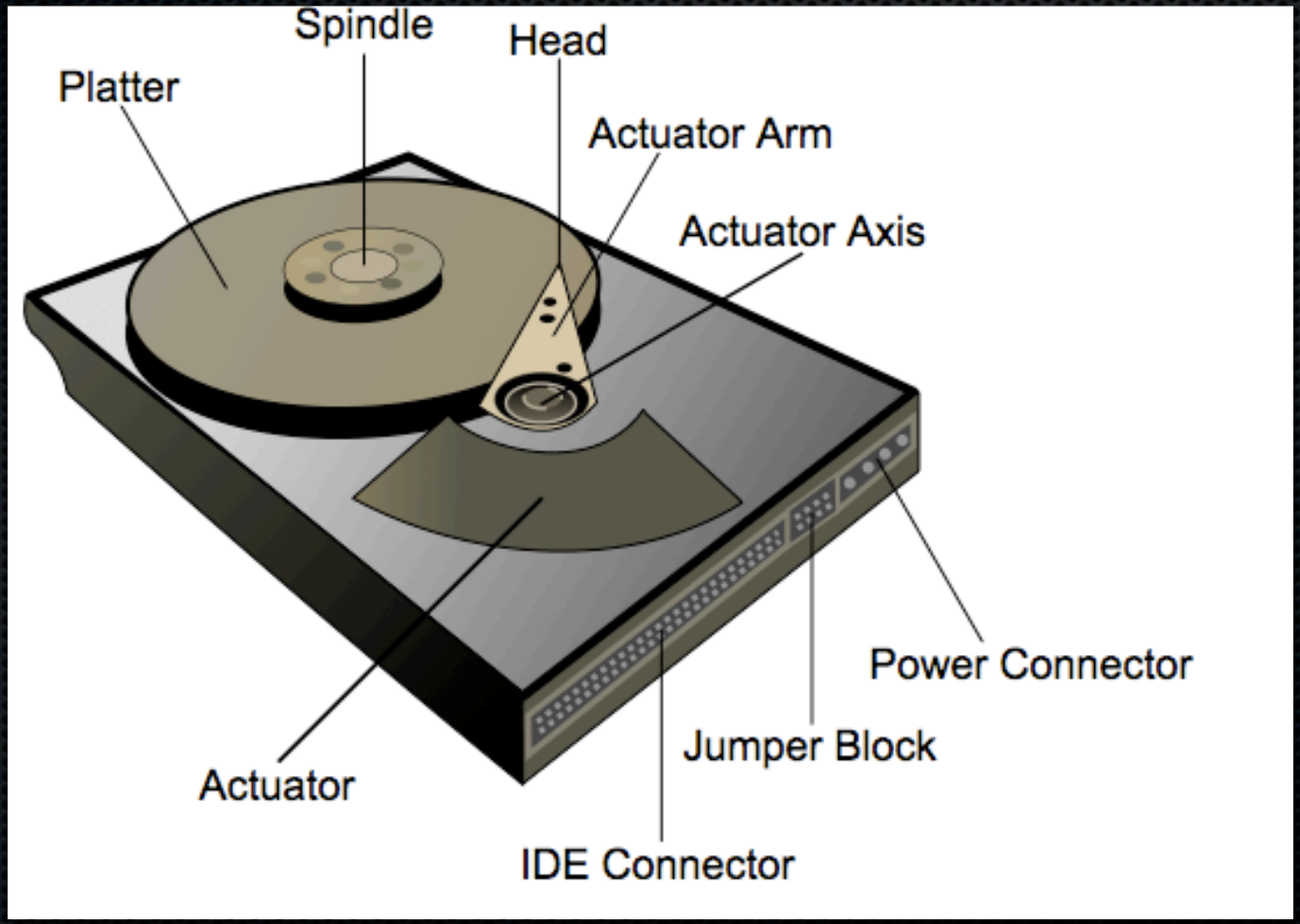


- **Floppy Disk**
  - Direct access to data
  - Low cost
  - 8” > 5 1/4” > 3 1/2”

Hard Drive

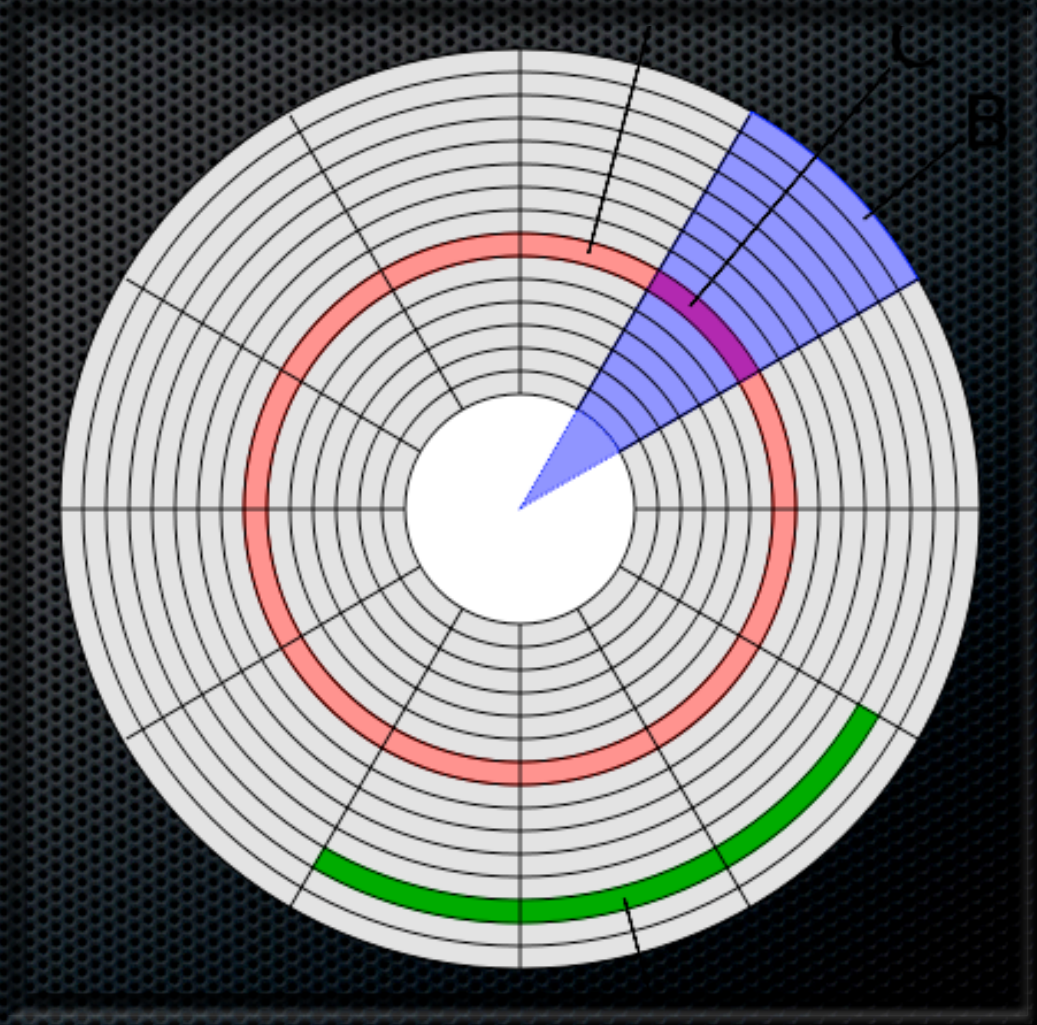
- Stores data on rigid circular platters
- Non-volatile
- Introduced in 1956
- Used in PC’s in mid 1980’s

Hard Drive


Spindle
Head
Platter
Actuator Arm
Actuator Axis
Power Connector
Jumper Block
Actuator
IDE Connector

Hard Drive

- **Track**
- **Sector**
- **Track Sector**
- **Cluster**



CD-ROM

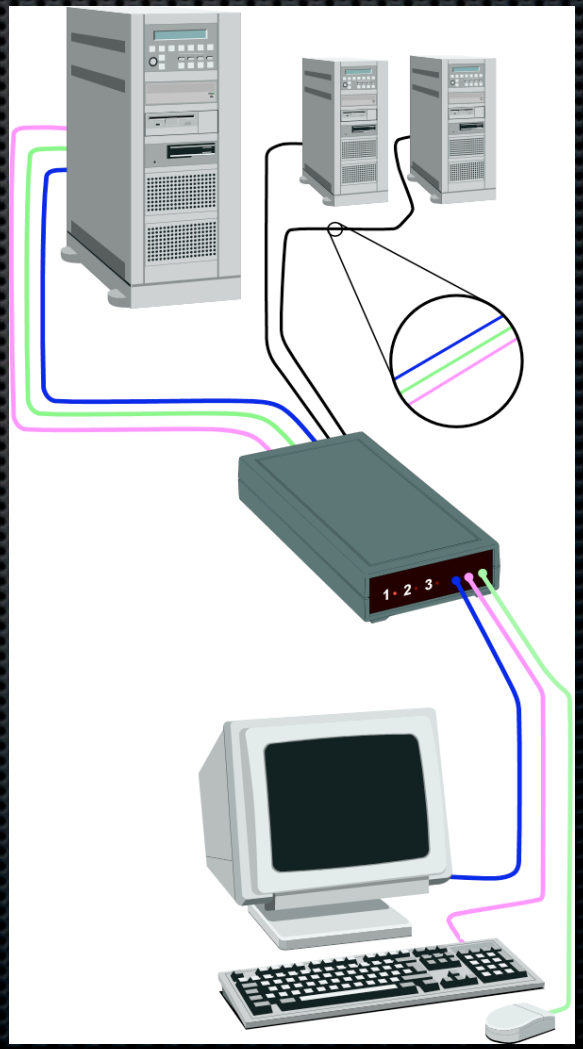
- Compact Disk - 1982
- Used to store data - 1985
- CD-R & CD-RW - 1985

Input / Output Devices

- **Input device** - used to put data into the machine
  - Keyboard
  - Mouse
  - Scanner
  - Microphone
  - Webcam
- **Output device** - used to present data to the user
  - Monitor
  - Printer
  - Speaker
  - Projector

Input / Output Devices

- KVM Switch
  - Keyboard
  - Video Display Unit
  - Mouse



Cables & Ports

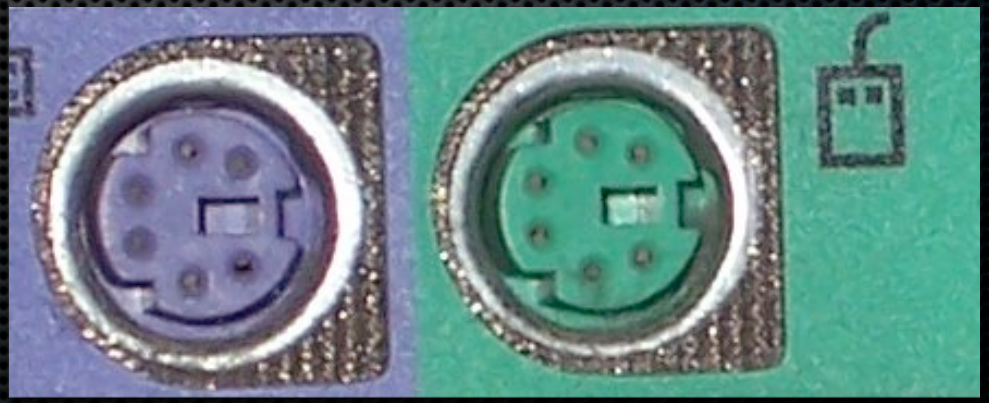
- Serial
  - One bit sent at a time

Cables & Ports

- Parallel
  - Eight bits sent at a time

Cables & Ports

- PS/2
  - Introduced with IBM PS/2
  - Still used as a standard



Cables & Ports

- Universal Serial Bus (USB)
  - 1.0 - 12 Mbps
  - 2.0 - 480 Mbps
  - 3.0 - 3 to 5 Gbps

Cables & Ports

- Firewire
  - IEEE 1394
  - Ilink
  - 400 Mbps
  - 800 Mbps
  - 3.2 Gbps

Cables & Ports

- Light Peak
  - Designed by Intel
  - Uses optical cable interface
  - 10 Gbps
  - 100 Gbps by 2020

FIN

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