

History of Operating Systems

- First generation 1945 - 1955
 - vacuum tubes, plug boards
- Second generation 1955 - 1965
 - transistors, batch systems
- Third generation 1965 – 1980
 - ICs and multiprogramming
- Fourth generation 1980 – present
 - personal computers

History of Operating Systems

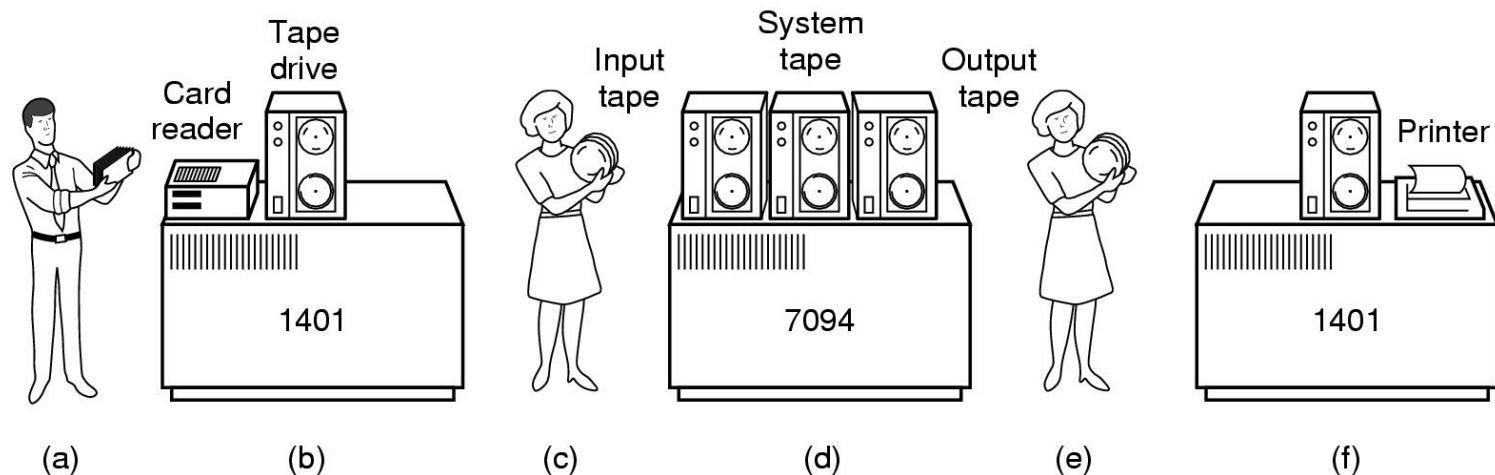
- First Generation(1945-1955): Vacuum Tubes and Plugboards
 - A single group of people designed, built, programmed, operated, and maintained each machine
 - All programming was done in absolute machine language, often by wiring up plugboards to control the machine's basic functions
 - No prog. Language, no operating system
 - Usual mode of operation
 - A programmer signs up for a block of time on the signup sheet on the wall,
 - Comes down to the machine room,
 - Inserts his plugboard into the computer, and performs the calculations
 - Later, punched cards used instead of plugboards

History of Operating Systems

- Second Generation(1955-1965): Transistors and Batch Systems
 - Introduction of transistors
 - Computers(mainframes) could be manufactured and sold to paying customers
 - Separation between designers, builders, operators, programmers, and maintenance personnel
 - To run a job
 - A programmer writes the program on paper, then punches it on cards
 - He brings the card deck to operator in the input room
 - When the job is finished, the operator gets the output from the printer and puts it in the output room, so that the programmer can collect it later

History of Operating Systems

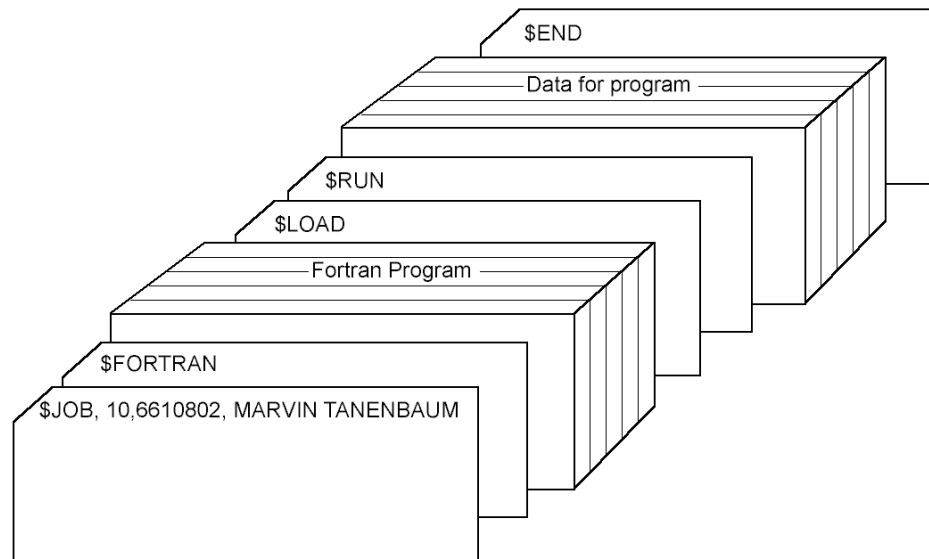
- Second Generation(1955-1965): Transistors and Batch Systems
 - Batch system



- After each job is finished, the operating system automatically read the next job from the tape and began running it.

History of Operating Systems

- Second Generation(1955-1965): Transistors and Batch Systems
 - Structure of a typical FMS job

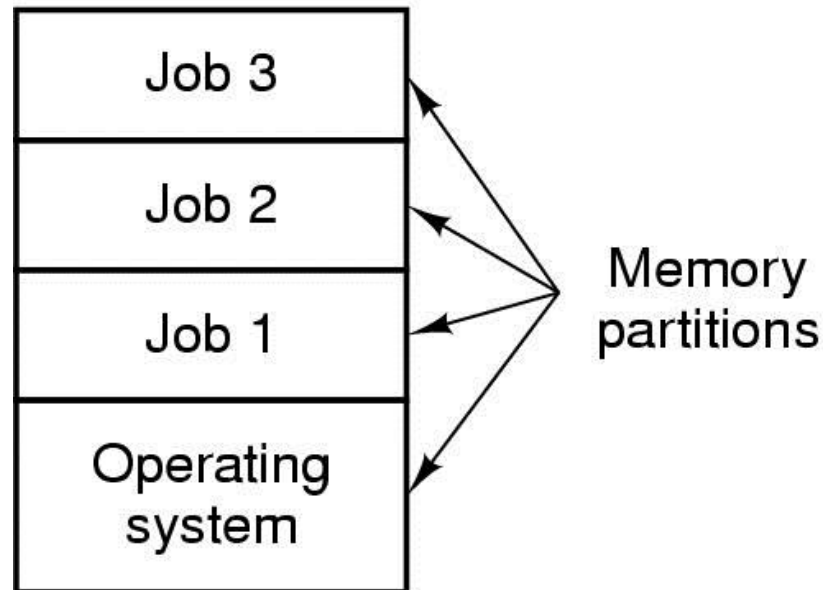


History of Operating Systems

- Third Generation(1965-1980): IC s and Multiprogramming
 - Two product lines
 - Scientific computers: numerical calculation
 - Commercial computers: sorting and printing
 - IBM System/360
 - A series of software-compatible machines
 - same architecture and instruction set
 - different price and performance(maximum memory, processor speed, number of I/O devices permitted)
 - Used Integrated Circuits(ICs)
 - Enormous and too complex operating systems

History of Operating Systems

- Third Generation(1965-1980): IC s and Multiprogramming
 - Multiprogramming
 - To avoid having the CPU be idle too much
 - Partition memory into several pieces, with a different job in each partition
 - While one job was wating for I/O to complete, another job could be using the CPU



History of Operating Systems

- Third Generation(1965-1980): IC s and Multiprogramming
 - Spooling(Simultaneous Peripheral Operation On Line)
 - Reads jobs from cards onto the disk as soon as they were brought to the computer room
 - Was also used for output
 - Timesharing
 - Each user has an online terminal
 - CPU can be allocated in turn to the jobs that want service
 - CTSS(Compatible Time Sharing System)
 - First serious timesharing system developed at M.I.T.

History of Operating Systems

- Third Generation(1965-1980): IC s and Multiprogramming
 - MULTICS(MULTiplexed Information and Computing Service)
 - MIT, Bell Labs, and General Electric
 - Machine that support hundreds of simultaneous timesharing users
 - Minicomputers
 - DEC PDP-1 in 1961
 - \$120,000 < 5% of 7094 price
 - UNIX
 - Developed by Ken Thomson in Bell Labs from MULTICS project
 - Stripped-down, one-user version of MULTICS running on PDP-7 minicomputer
 - Source code became widely available
 - Two major versions
 - System V from AT&T
 - BSD(Berkeley Software Distribution) from the University of California at Berkeley
 - POSIX standard by IEEE
 - MINIX for education purposes
 - Linux
 - Free production version of MINIX
 - Developed by Finnish student, Linus Torvalds

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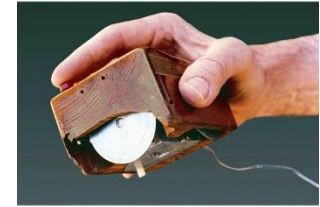
- Fourth Generation(1980-Present): Personal Computers
 - LSI(Large Scale Integration) circuits
 - Personal Computers(initially called Microcomputers)
 - 8080
 - First general-purpose 8-bit CPU made by Intel in 1974
 - CP/M(Control Program for Microcomputers)
 - Developed by Gary Kildall who later founded Digital Research
 - MS-DOS(Microsoft Disk Operating System)
 - Kildall refused to meet with IBM
 - Bill Gates hired Tim Paterson to revise DOS (from Seattle Computer Products)
 - Developed for 8088-based IBM PC in 1981
 - Quickly dominated the IBM PC market
 - Gates' decision vs. Kildall's attempt
 - Later used on IBM PC/AT with Intel 80286 CPU
 - Many advanced features were taken from UNIX

History of Operating Systems

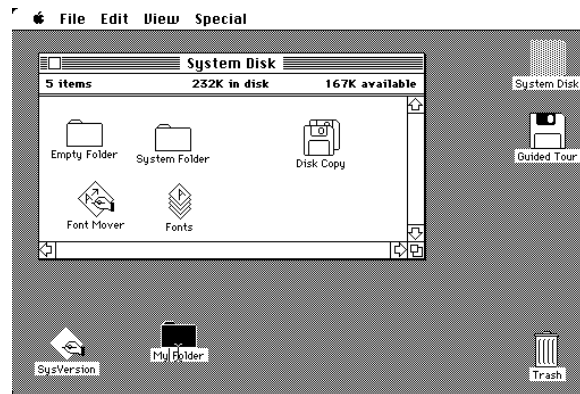
- Fourth Generation(1980-Present): Personal Computers

- GUI(Graphical User Interface): pronounced “gooey”

- CP/M, MS-DOS, and other OS for early microcomputers
 - Users type in commands from the keyboard
 - Windows, icons, menus, mouse
 - Invented by Doug Engelbart in SRI(Stanford Research Institute) in 1960s
 - Adopted by researchers at Xerox PARC
 - Lisa by Apple in 1983 : First personal computer with GUI. Too expensive.
 - Macintosh by Apple in 1984 : Also with GUI. Cheaper than Lisa. Huge success



First Mouse



Macintosh



Macintosh Mouse

- Windows 1.0 by Microsoft in 1985
 - Graphical environment on top of MS-DOS : lasted until 1995 for 10 years
 - Windows 2.0 for PC/AT released 1987, 3.0 for 386 released in 1990, 3.1, 3.11

History of Operating Systems

- Fourth Generation(1980-Present): Personal Computers
 - Classic Mac OS
 - Up to major revision 9 (1984-2001)
 - “System”(integral to the original Macintosh), “System 6”, “System 7”, ...
 - Version 7.6 rebranded as “Mac OS”
 - Mac OS 8.1 is the last version running on a Motorola 68k-family Macintoshes
 - OS X
 - Introduced as “Mac OS X” in 2001, Renamed “OS X” in 2012, Announced to be renamed “macOS” in 2016
 - Successor to the classic Mac OS (Mac OS 9)
 - Unix operating system based on the NeXTSTEP operating system which Apple acquired after purchasing Steve Jobs’ NeXT Computer
 - NeXTSTEP operating system
 - Unix OS based on the Mach kernel, and some BSD components
 - Original platform for the development of the Electronic AppWrapper, the first commercial electronic software distribution catalog, a forerunner of the modern “App Store” concept
 - Platform on which Tim Berners-Lee created the first web browser

History of Operating Systems

- Fourth Generation(1980-Present): Personal Computers
 - OS X
 - Supported only PowerPC processors
 - OS X 10.0 “Cheetah”(2001), 10.1 “Puma”(2001)
 - 10.2 “Jaguar”(2002) : Address Book, iChat
 - 10.3 “Panther”(2003) : New Finder, Exposé (Window manager), Safari, iChat AV
 - Supported both PowerPC and Intel processors
 - 10.4 “Tiger”(2005) : Spotlight, Dashboard, Smart Folders, QuickTime 7, Safari 2, Automator, VoiceOver
 - 10.5 “Leopard”(2007) : Time Machine, Spaces (virtual desktop), Boot Camp, full support for 64-bit applications
 - Supported only Intel processors
 - 10.6 “Snow Leopard”(2009) : Mac App Store
 - 10.7 “Lion”(2011) : Brought developments from iOS. Launchpad. Greater use of Multi-touch gestures. Mission Control.
 - 10.8 “Mountain Lion”(2012) : Incorporates features in iOS 5, including Game Center, iMessage, Reminders.Storing iWork docs in iCloud. Notification Center
 - 10.9 “Mavericks”(2013) : Maps, iBooks.
 - 10.10 “Yosemite”(2014) : Redesigned UI skin similar to iOS7. Handoff which enables users with iPhones to answer phone calls, receive/send SMS messages, and complete unfinished iPhone emails on their Mac.
 - 10.11 “El Capitan”(2015): The most recent OS X. Metal API
 - Used as the basis for iOS which is, in turn, the basis of watchOS on Apple Watch and tvOS on Apple TV
 - macOS Sierra (version 10.12)
 - Continuity, iCloud, support for Apple Pay and Siri
 - Will be available to end users in fall 2016

History of Operating Systems

- Fourth Generation(1980-Present): Personal Computers

- Windows 95/98
 - Transferred nearly all the features from the MS-DOS part to the Windows part
- Windows NT (New Technology)
 - Lead designer: David Cutler (one of the designers of the VAX VMS operating system)
 - For mission-critical business applications as well as for home users
 - Full 32-bit system
 - Windows NT 3.1 released in 1993, 4.0 in 1996
- Windows 2000
 - Windows NT 5.0
 - Was intended to be the successor to the Windows 98 and Windows NT 4.0
 - Plug-and-play devices, USB bus, IEEE 1394(FireWire), IrDA, power management, etc.
- Windows Me (Millennium edition)
 - Yet another version of Windows 98
- Windows XP
 - Released in 2001. Slightly upgraded version of Windows 2000
- Windows Vista
 - Released in 2007. Successor to Windows XP. New GUI(Aero,etc.). Drop of performance. Longer boot time.
- Windows 7
 - Released in 2009. Multi-touch support. Redesigned Windows shell. Performance improvements.
- Windows 8
 - Released in 2012. UI based on Microsoft's Metro design language with optimizations for touch-based devices such as tablets and all-in-one PCs. Start screen, which uses large tiles. Removal of Start Menu.
- Windows 10
 - Released in 2015. Return of the Start Menu. Virtual desktop system

History of Operating Systems

- Fourth Generation(1980-Present): Personal Computers
 - UNIX
 - Strongest on workstations and other high-end computers, such as network servers
 - Popular on machines powered by high-performance RISC chips
 - On Pentium-based computers, Linux is becoming a popular alternative to Windows
 - X Windows system
 - Windowing system developed at M.I.T.
 - GUI such as Motif is available to run on top of the X Windows system
 - Network operating systems
 - Users are aware of the existence of multiple computers and can log in to remote machines and copy files between machines.
 - Distributed operating systems
 - The users should not be aware of where their programs are being run or where their files are located

History of Operating Systems

- Fifth Generation(1990-Present): Mobile Computers

- Nokia 9000 Communicator

- Introduced in 1996
- First smarthphone in the market
- Literally combined a phone and a PDA
- Intel 24MHz i386 CPU, 8 MB memory, GEOS 3.0
- Picture of the later model Nokia 9110 to the right →
- Later model Nokia 9210 Communicator used Symbian OS



- RIM(Research In Motion) Blackberry 850 →

- Introduced in 1999
- Two-way pager with thumb keyboard
- Supported email and limited HTML browsing
- Later model Blackberry 5810 (in 2002) added phone capabilities →



- iPhone and Android

- will be covered later



The Operating System Zoo

- Mainframe operating systems
- Server operating systems
- Multiprocessor operating systems
- Personal computer operating systems
- Real-time operating systems
- Embedded operating systems
- Smart card operating systems

The Operating System Zoo

- Mainframe operating systems
 - Heavily oriented toward processing many jobs at once, most of which need large amounts of I/O
 - High-end Web servers, servers for large-scale electronic commerce sites, and servers for business-to-business transactions
 - Three kinds of service
 - Batch
 - Processes routine jobs without any interactive user present
 - Claims processing in an insurance company or sales reporting for a chain of stores
 - Transaction processing
 - Each unit of work is small, but the system must handle hundreds or thousands per second
 - Check processing at a bank or airline reservations
 - Timesharing
 - Allows multiple remote users to run jobs on the computer at once
 - Querying a big database
 - Mainframe operating systems often perform all of them.
 - IBM OS/390

The Operating System Zoo

- Server operating systems
 - Run on servers (very large personal computers, workstations, or even mainframes)
 - Serve multiple users at once over a network and allow users to share hardware and software resources
 - Print service, file service, Web service
 - UNIX, Windows
- Multiprocessor operating systems
 - Connect multiple CPUs into a single system to get a major-league computing power
 - Variations on the server operating systems, with features for communication and connectivity
- Personal computer operating systems
 - To provide a good interface to a single user
 - Used for word processing, spreadsheets, and Internet access
 - Windows, Macintosh, and Linux

The Operating System Zoo

- Real-time operating systems
 - Time is a key parameter
 - Hard real-time system
 - The action absolutely must occur within the deadline.
 - E.g. car assembly line, flight control, military device
 - Soft real-time system
 - Missing an occasional deadline is acceptable.
 - E.g. digital audio, multimedia systems
 - VxWorks, QNX

The Operating System Zoo

- Handheld computer operating systems
 - PDA(Personal Digital Assistant)
 - Palm OS, Windows Mobile
 - Smartphones
 - Symbian OS, iOS, Android, Windows Phone
- Embedded operating systems
 - TV sets, microwave ovens, cars, DVD recorders, cell phones, MP3 players
 - some characteristics of real-time systems
 - restrictions on size, memory, and power
 - QNX, VxWorks

The Operating System Zoo

- Sensor node operating systems
 - Networks of tiny sensor nodes are being deployed
 - The nodes are tiny computers that communicate with each other and with a base station using wireless communication
 - Protects the perimeters of buildings, guards national borders, gleans info. about enemy movements on battlefields, etc.
 - TinyOS
- Smart card operating systems
 - Run on smart cards, which are credit card-sized devices containing a CPU chip
 - Very severe processing power and memory constraints
 - Single function(e.g. electronic payments) or multiple functions on the same smart card
 - Some smart cards have JVM on which multiple applets run at the same time.



The First iPhone

History of Android



The First Android Phone HTC Dream

- Android, Inc. was founded in Palo Alto, California, United States in October, 2003 by Andy Rubin, Rich Miner, Nick Sears, and Chris White.
- Google purchased the initial developer of the software, Android Inc., in 2005.
- Google's Android prototype was similar to BlackBerry phone, with no touch screen, and a physical keyboard.
- Apple released its first iPhone(multi-touch gestures, HTML email, Safari web browser, threaded text messaging, YouTube) in January, 2007.
- Google immediately began on re-engineering Android to compete with the iPhone.
- The unveiling of the Android distribution in November, 2007 was announced with the founding of the Open Handset Alliance, a consortium of 86 hardware, software, and telecommunication companies devoted to advancing open standards for mobile devices. Google releases the Android code as open-source, under the Apache License.
- Apple released the iPhone 3G (Assisted GPS, 3G data, App Store) in July, 2008.
- The first Android smartphone called HTC Dream (HTC G1) was released on October, 2008.
- HTC collaborated with Google to release the first Nexus smartphone called Nexus One in January, 2010.
- The Nexus 6P smartphone co-developed by Google and Huawei was released in September, 2015.
- The Nexus 5X smartphone co-developed by Google and LG was released in September, 2015.
- Each major release of Android is named in alphabetical order after a dessert or sugary treat; for example, version 1.5 Cupcake, version 1.6 Donut.
- The latest released version of Android is 7.0 Nougat, which was released in August 22, 2016.
- The iPhone 7 with iOS 10 will be unveiled on September 7, 2016.