Pengantar dan Struktur Sistem Operasi

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Agenda

- What is an operating systems?
- Sasaran Sistem Operasi
- Fungsi Sistem Operasi
- Evolusi Sistem Operasi
- Process Management
- Memory Management
- File Systems Management
- Mass Storage Management
- I/O Systems Management

What is an Operating System?

- A program that acts as an intermediary between a user of a computer and the computer hardware
- Operating system goals:
  - Execute user programs and make solving user problems easier
  - Make the computer system convenient to use
  - Use the computer hardware in an efficient manner

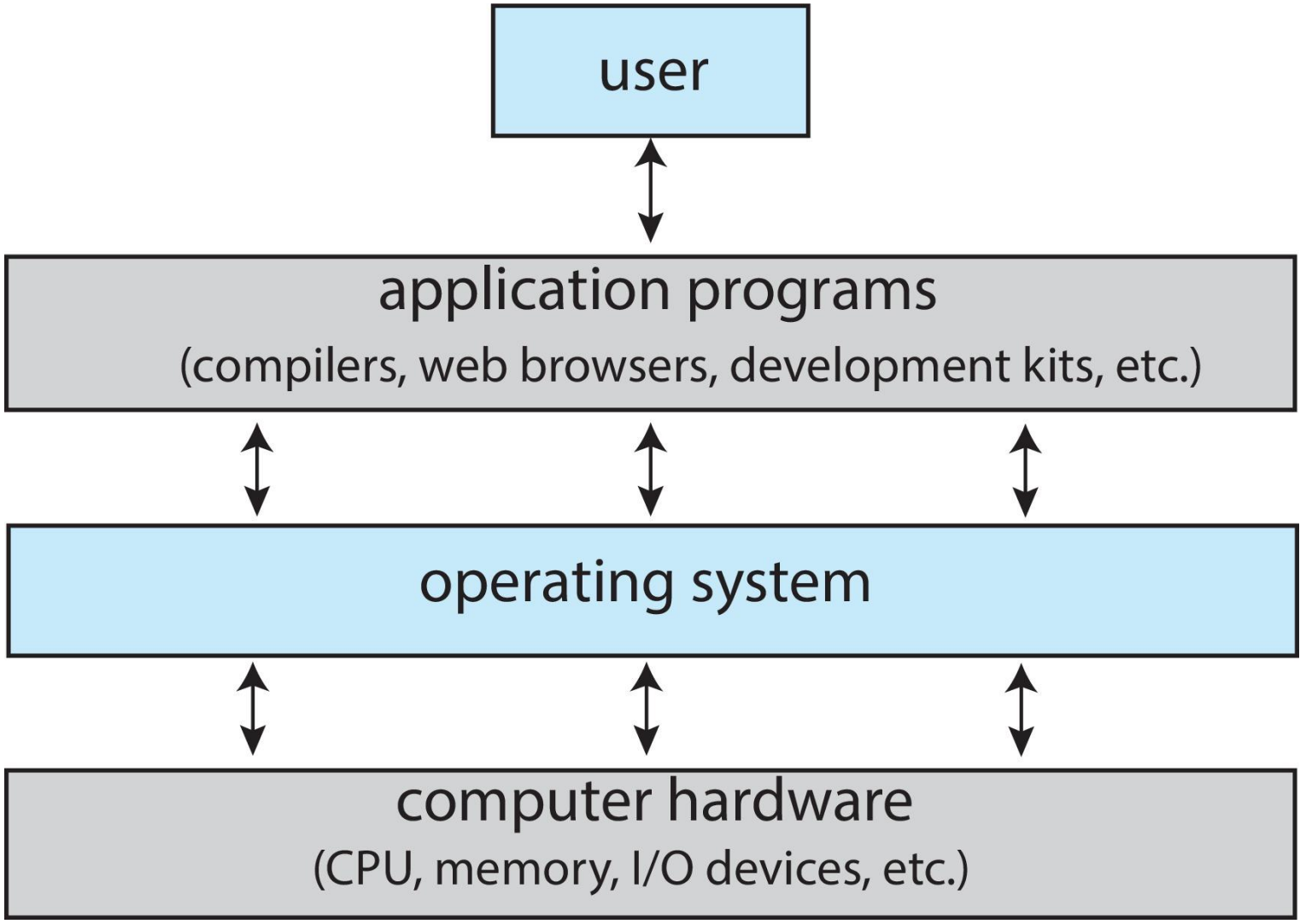
Sasaran Sistem Operasi

- Menjalankan program-program dari user dan membantu user dalam menggunakan komputer
- Menyediakan sarana sehingga pemakaian komputer menjadi mudah (convenient)
- Memanfaatkan perangkat keras komputer yang terbatas secara efisien (resource manager)

Computer System Structure

- Computer system can be divided into four components:
  - Hardware – provides basic computing resources
    - CPU, memory, I/O devices
  - Operating system
    - Controls and coordinates use of hardware among various applications and users
  - Application programs – define the ways in which the system resources are used to solve the computing problems of the users
    - Word processors, compilers, web browsers, database systems, video games
  - Users
    - People, machines, other computers

Abstract View of Components of Computer



What Operating Systems Do

- Depends on the point of view
- Users want **convenience**, **ease of use** and **good performance**
  - Don't care about **resource utilization**
- But shared computer such as **mainframe** or **minicomputer** must keep all users happy
  - Operating system is a **resource allocator** and **control program** making efficient use of HW and managing execution of user programs
- Users of dedicate systems such as **workstations** have dedicated resources but frequently use shared resources from **servers**
- Mobile devices like smartphones and tables are resource poor, optimized for usability and battery life
  - Mobile user interfaces such as touch screens, voice recognition
- Some computers have little or no user interface, such as embedded computers in devices and automobiles
  - Run primarily without user intervention

Defining Operating Systems

- Term OS covers many roles
  - Because of many designs and uses of OSes
  - Present in ships, spacecraft, game machines, TVs and industrial control systems
  - Born when fixed use computers for military became more general purpose and needed resource management and program control
- No universally accepted definition
- "The one program running at all times on the computer" is the kernel, part of the operating system
- Everything else is either
  - A *system program* (ships with the operating system, but not part of the kernel) , or
  - An *application program*, all programs not associated with the operating system
- Today's OSes for general purpose and mobile computing also include *middleware* – a set of software frameworks that provide additional services to application developers such as databases, multimedia, graphics

Evolution of Operating Systems

- Early Systems (1950)
- Simple Batch Systems (1960)
- Multiprogrammed Batch Systems (1970)
- Time-Sharing and Real-Time Systems (1970)
- Personal/Desktop Computers (1980)
- Multiprocessor Systems (1980)
- Networked/Distributed Systems (1980)
- Web-based Systems (1990)

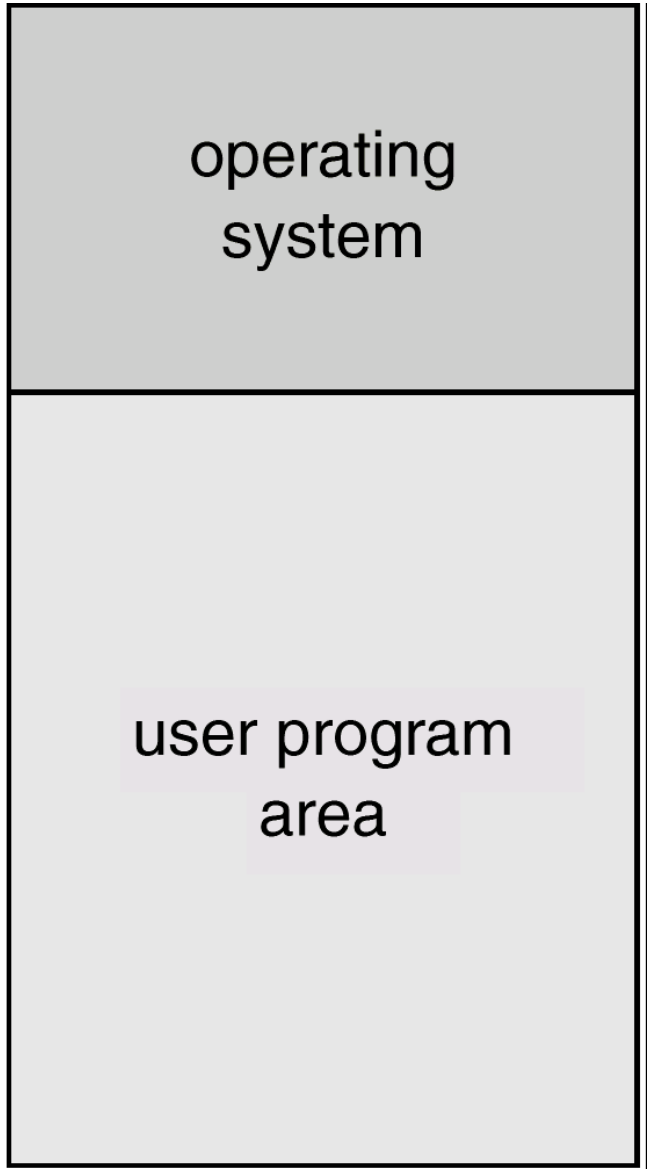
Early Systems

- OS Sederhana
- Program tunggal, satu user, satu mesin komputer (CPU)
- interaksi sederhana
- Problem: terbatas pemakaiannya
- Electronic Numerical Integrator and Calculator (ENIAC)

Simple Batch Systems

- In this type of system, there is no direct interaction between user and the computer.
- The user has to submit a job (written on cards or tape) to a computer operator.
- Then computer operator places a batch of several jobs on an input device.
- Jobs are batched together by type of languages and requirement.
- Then a special program, the monitor, manages the execution of each program in the batch.
- The monitor is always in the main memory and available for execution.
- Advantages:
  - No interaction between user and computer.
  - No mechanism to prioritise the processes.

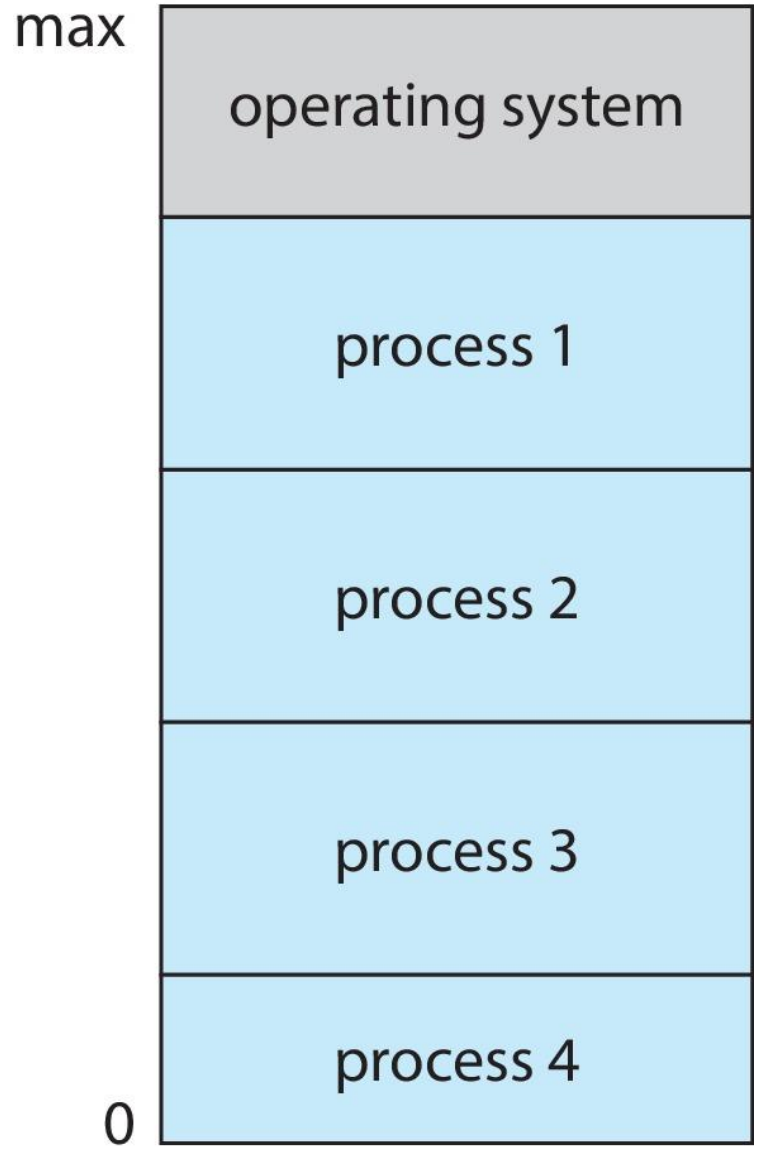
Simple Batch Systems



Multiprogramming (Batch system)

- Single user cannot always keep CPU and I/O devices busy
- Multiprogramming organizes jobs (code and data) so CPU always has one to execute
- A subset of total jobs in system is kept in memory
- One job selected and run via job scheduling
- When job has to wait (for I/O for example), OS switches to another job

Memory Layout for Multiprogrammed System



Fitur OS yang dibutuhkan dalam Multiprogramming

- I/O routine yang dikendalikan oleh system
- Memory management – Sistem harus mengalokasikan memory pada beberapa job
- CPU scheduling –System harus memilih job yang akan dijalankan dari beberapa job yang ada
- Mengalokasikan devices

Multitasking (Timesharing)

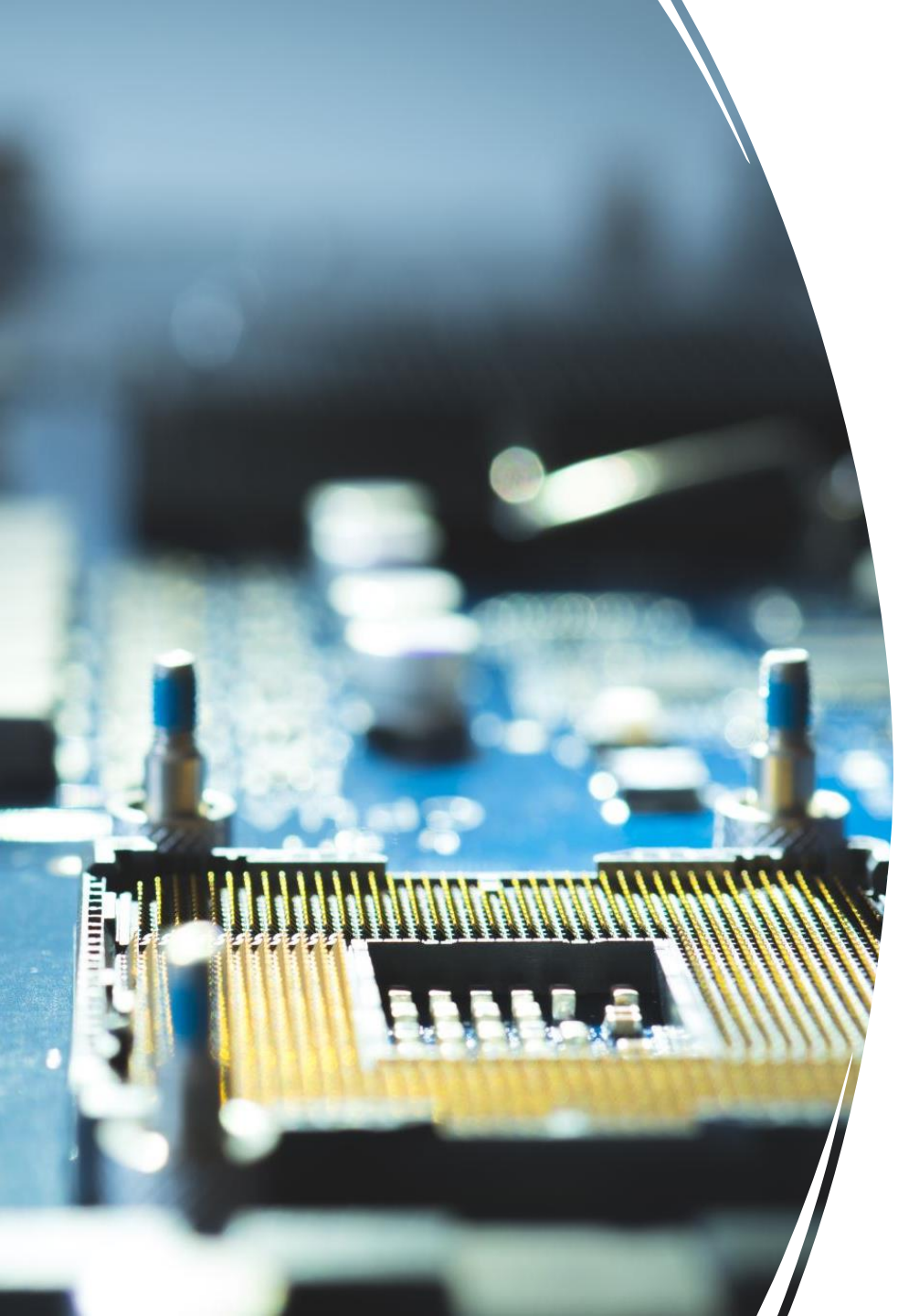
- A logical extension of Batch systems– the CPU switches jobs so frequently that users can interact with each job while it is running, creating **interactive** computing
- In Time sharing systems the prime focus is on **minimizing the response time**, while in multiprogramming the prime focus is to **maximize the CPU usage**.
  - **Response time** should be < 1 second
  - Each user has at least one program executing in memory ⇨ **process**
  - If several jobs ready to run at the same time ⇨ **CPU scheduling**
  - If processes don't fit in memory, **swapping** moves them in and out to run
  - **Virtual memory** allows execution of processes not completely in memory

Timer

- Timer to prevent infinite loop (or process hogging resources)
  - Timer is set to interrupt the computer after some time period
  - Keep a counter that is decremented by the physical clock
  - Operating system set the counter (privileged instruction)
  - When counter zero generate an interrupt
  - Set up before scheduling process to regain control or terminate program that exceeds allotted time

Desktop Systems

- Personal computers
  - Sistem komputer yang dirancang khusus untuk single user
- Earlier, CPUs and PCs lacked the features needed to protect an operating system from user programs.
- PC operating systems therefore were neither multiuser nor multitasking.
- However, the goals of these operating systems have changed with time; instead of maximizing CPU and peripheral utilization, the systems opt for maximizing user convenience and responsiveness.
- These systems are called Desktop Systems and include PCs running Microsoft Windows and the Apple Macintosh.

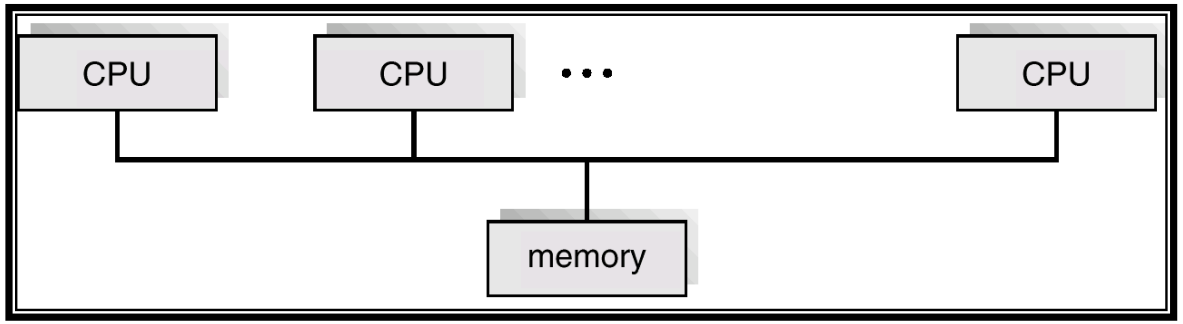


Parallel Systems

- Sistem multiprosesor di mana terdapat lebih dari 1 CPU yang terhubung secara dekat
- *Tightly coupled system*
  - processors share memory and a clock;
  - Komunikasi biasanya melalui shared memory.
- Keuntungan:
  - Increased *throughput*
  - Economical
  - Increased reliability

Parallel Systems (2)

- *Symmetric multiprocessing (SMP)*
  - Setiap prosesor menjalankan “identical copy” dari OS
  - Beberapa proses dapat berjalan secara serentak
  - Beberapa modern operating systems mendukung SMP
- *Asymmetric multiprocessing*
  - Setiap prosesor telah ditentukan untuk menjalankan task tertentu
  - Master processor mengontrol, menjadwalkan dan mengalokasikan task ke slave processors
  - Biasanya pada sistem yang sangat besar



Distributed Systems

- Mendistribusikan komputasi di antara beberapa prosesor
- Loosely coupled system
  - Tiap prosesor memiliki local memory
  - Komunikasi procesor melalui jalur yang variative: high-speed buses or telephone lines.
- Keuntungan
  - Resources Sharing
  - Computation speed up – load sharing
  - Reliability
  - Communications
- Membutuhkan Infrastruktur jaringan.
  - Local Area Networks (LAN) atau Wide Area Networks (WAN)
  - Sistem bisa berbentuk client-server atau peer-to-peer .

Real-Time Systems

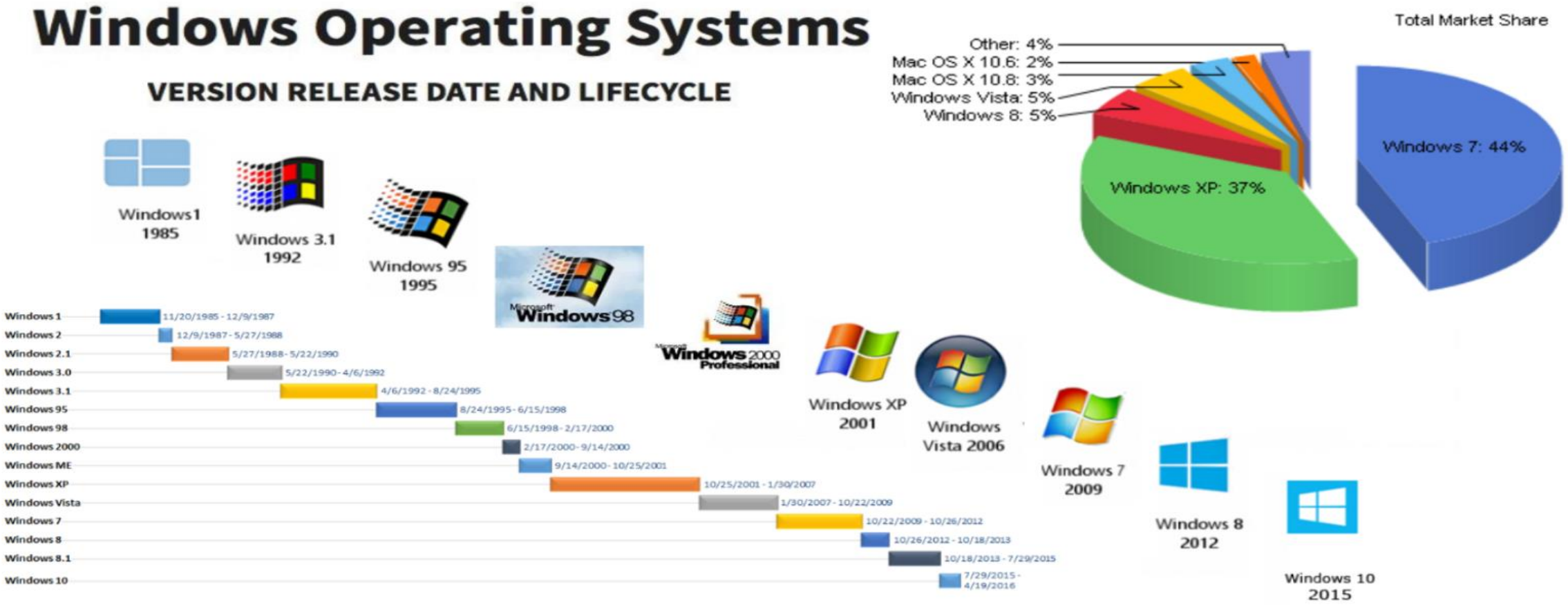
- Biasanya digunakan untuk control device pada dedicated application
  - scientific experiments, medical imaging systems, industrial control systems, and some display systems.
- Batasan waktu telah ditentukan secara pasti
- Jenis real time systems:
  - *Hard real-time system*
    - Secondary storage sangat terbatas atau tidak ada (menggunakan ROM, flash RAM).
    - Task dapat diprediksi/ditentukan:
      - waktu selesai dan response.
    - Contoh: deteksi jantung, dll.
  - *Soft real-time system*
    - Lebih leluasa batasan waktu dari “hard real-time system”.
    - Lebih umum digunakan di industri, aplikasi multimedia (video streaming, virtual reality)

Web-based Systems

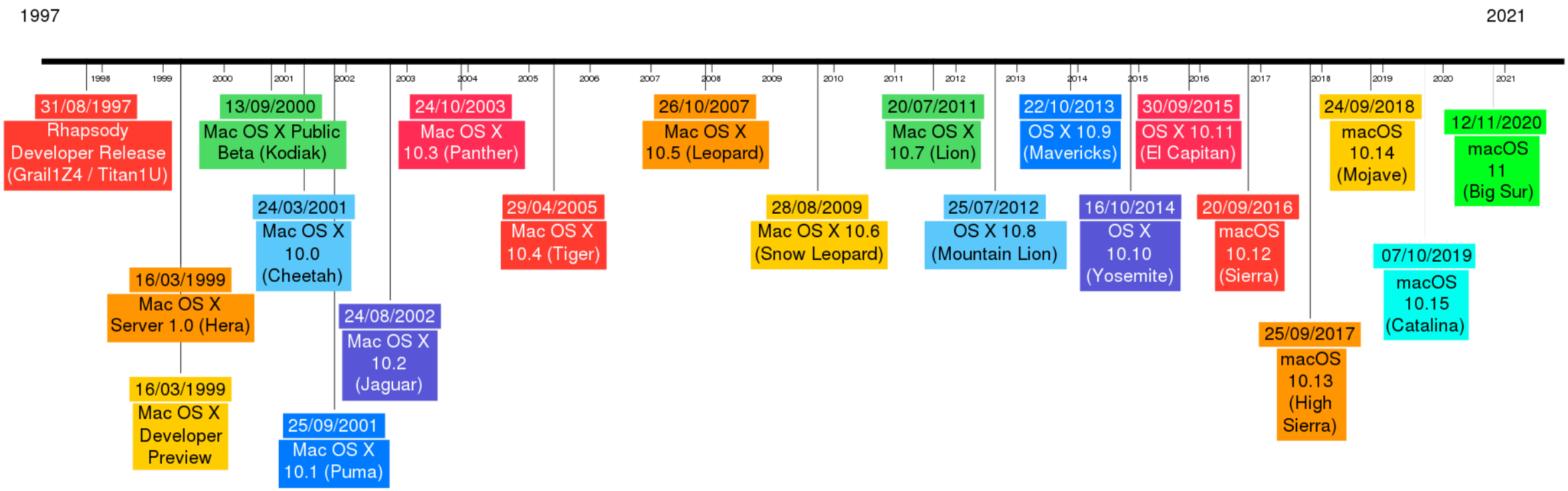
- A Web Operating System is an internet based user interface that allows people to access applications not stored on their computers but completely or partly on Internet. It is a dummy operating system that does not directly interact with computer hardware and depends on traditional operating system to work. In other words, it is an interface for distributed computing system such as cloud.
- Approach used to make a web operating system work
- Web operating system are majorly created using AJAX and Flash.
- AJAX (Asynchronous Javascript And XML) is a set of technologies used to create asynchronous web applications. These web applications can send and retrieve data from a server in background without disturbing any other web page, in form of small bits of information.

History of Windows Operating Systems

Source: https://kavindi-herath.medium.com/evolution-of-windows-os-9e6a0c96a3f2



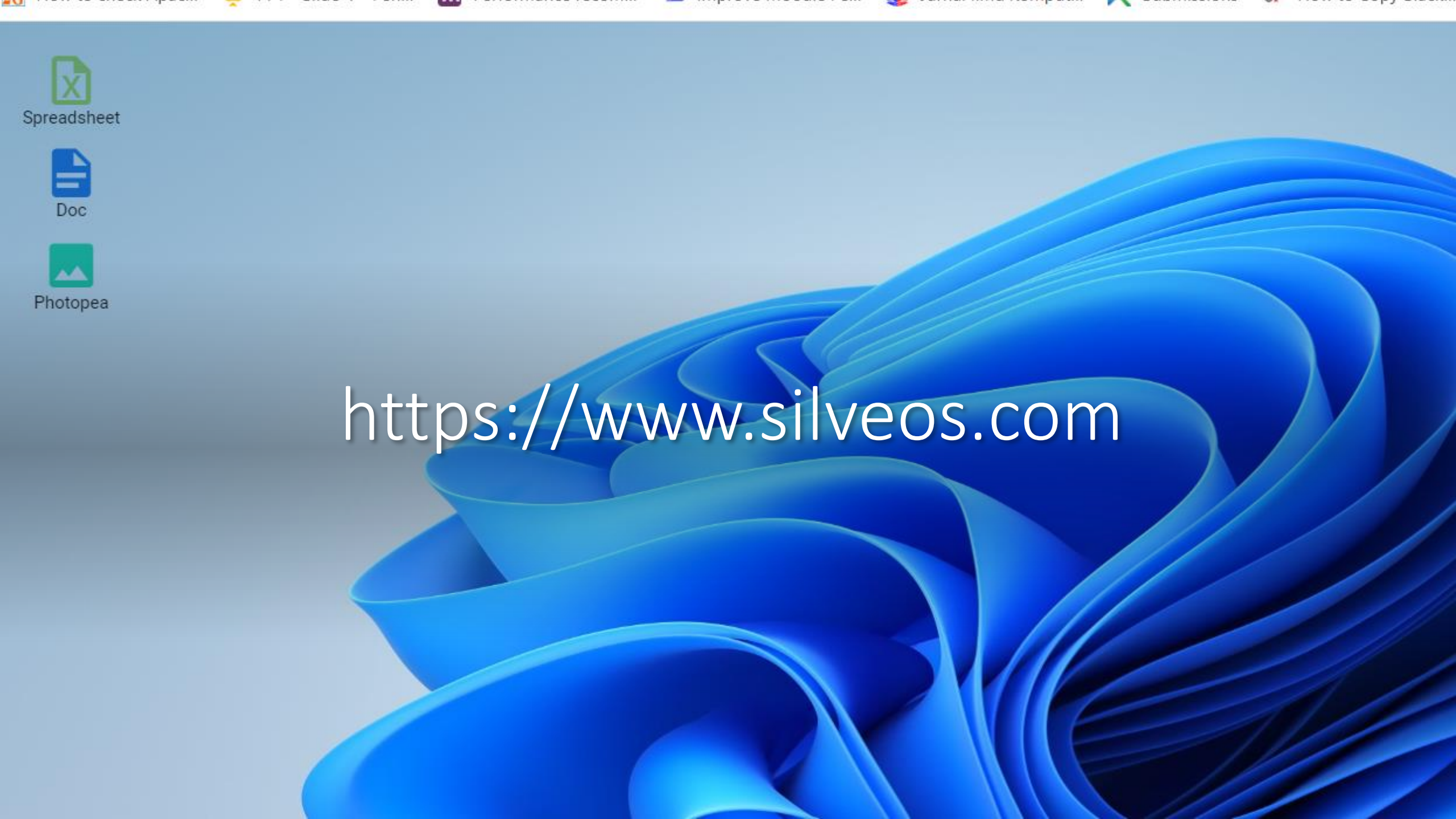
History of Mac OS



https://en.wikipedia.org/wiki/MacOS_version_history

GNU/Linux Timeline

http://futurist.se/gldt/wp-content/uploads/12.02/gldt1202.svg


Spreadsheet
Doc
Photopea
https://www.silveos.com

Process Management

- A process is a program in execution. It is a unit of work within the system. Program is a passive entity; process is an active entity.
- Process needs resources to accomplish its task
  - CPU, memory, I/O, files
  - Initialization data
- Process termination requires reclaim of any reusable resources
- The operating system is responsible for the following activities in connection with process management:
  - Creating and deleting both user and system processes
  - Suspending and resuming processes
  - Providing mechanisms for process synchronization, communication, and deadlock handling

Memory Management

- Memori sebagai tempat penyimpanan instruksi/data dari program
  - Media penyimpanan yang dapat dapat diakses secara cepat oleh CPU dan I/O devices
  - Address digunakan untuk mengakses data (shared oleh CPU dan I/O devices)
- To execute a program all (or part) of the instructions must be in memory
- All (or part) of the data that is needed by the program must be in memory
- Memory management determines what is in memory and when
  - Optimizing CPU utilization and computer response to users
- Memory management activities
  - Keeping track of which parts of memory are currently being used and by whom
  - Deciding which processes (or parts thereof) and data to move into and out of memory
  - Allocating and deallocating memory space as needed

File-Systems Management

- OS provides uniform, logical view of information storage
  - Abstracts physical properties to logical storage unit - file
  - Each medium is controlled by device (i.e., disk drive, tape drive)
    - Varying properties include access speed, capacity, data-transfer rate, access method (sequential or random)
- File-System management
  - Files usually organized into directories
  - Access control on most systems to determine who can access what
  - OS activities include
    - Creating and deleting files and directories
    - Primitives to manipulate files and directories
    - Mapping files onto secondary storage
    - Backup files onto stable (non-volatile) storage media

Mass Storage (Secondary) Management

- Usually disks used to store data that does not fit in main memory or data that must be kept for a “long” period of time
- Proper management is of central importance
- Entire speed of computer operation hinges on disk subsystem and its algorithms
- OS activities
  - Mounting and unmounting
  - Free-space management
  - Storage allocation
  - Disk scheduling
  - Partitioning
  - Protection

Characteristics of Various Types of Storage

Level	1	2	3	4	5
Name	registers	cache	main memory	solid-state disk	magnetic disk
Typical size	< 1 KB	< 16MB	< 64GB	< 1 TB	< 10 TB
Implementation technology	custom memory with multiple ports CMOS	on-chip or off-chip CMOS SRAM	CMOS SRAM	flash memory	magnetic disk
Access time (ns)	0.25-0.5	0.5-25	80-250	25,000-50,000	5,000,000
Bandwidth (MB/sec)	20,000-100,000	5,000-10,000	1,000-5,000	500	20-150
Managed by	compiler	hardware	operating system	operating system	operating system
Backed by	cache	main memory	disk	disk	disk or tape

I/O Systems Management

- One purpose of OS is to hide peculiarities of hardware devices from the user
- I/O subsystem responsible for
  - Memory management of I/O including buffering (storing data temporarily while it is being transferred), caching (storing parts of data in faster storage for performance), spooling (the overlapping of output of one job with input of other jobs)
  - General device-driver interface
  - Drivers for specific hardware devices

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