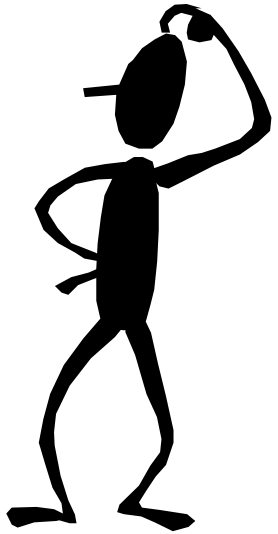
IF2230
Pengantar Sistem Operasi

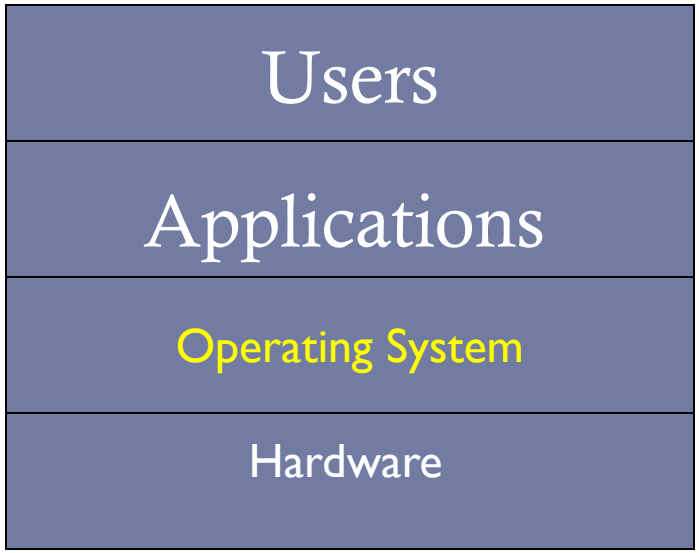
Intro OS

Apakah Operating System?

- Perangkat lunak, interface antara perangkat keras dan penggunanya

- Operating systems:
  - Menjalankan program user dan system
  - Mengelola dan mengatur perangkat keras komputer
  - Berfungsi sebagai resource allocators
  - Seringkali berupa interrupt-driven





- Operating Systems: Software yang mengubah hardware menjadi bentuk yang berguna untuk aplikasi

Peran Operating Systems

- Abstraksi: menyediakan standard library untuk resources
  - Resources: semua yang diperlukan aplikasi untuk berjalan: CPU, memory, disk, network, etc.
  - Abstraksi resource:
    - CPU: process & thread
    - Memory: address space
    - Disk: files
  - Mengapa?
    - Memungkinkan aplikasi menggunakan fasilitas Bersama
    - Menyediakan cara yang sama untuk berbagai perangkat yang berbeda
  - Tantangan:
    - Abstraksi seperti apa yang tepat?
    - Seberapa besar perangkat keras harus diakses langsung oleh aplikasi?

Peran Operating System

- Pengelolaan Resource
  - Membagi bersama resource dengan baik
- Mengapa?
  - Memproteksi aplikasi dari satu dengan yang lain
  - Menyediakan akses yang efisien ke resource (cost, time, energy)
  - Menyediakan akses yang fair ke resource
- Tantangan:
  - Mekanisme seperti apa yang tepat?
  - Kebijakan seperti apa yang tepat?

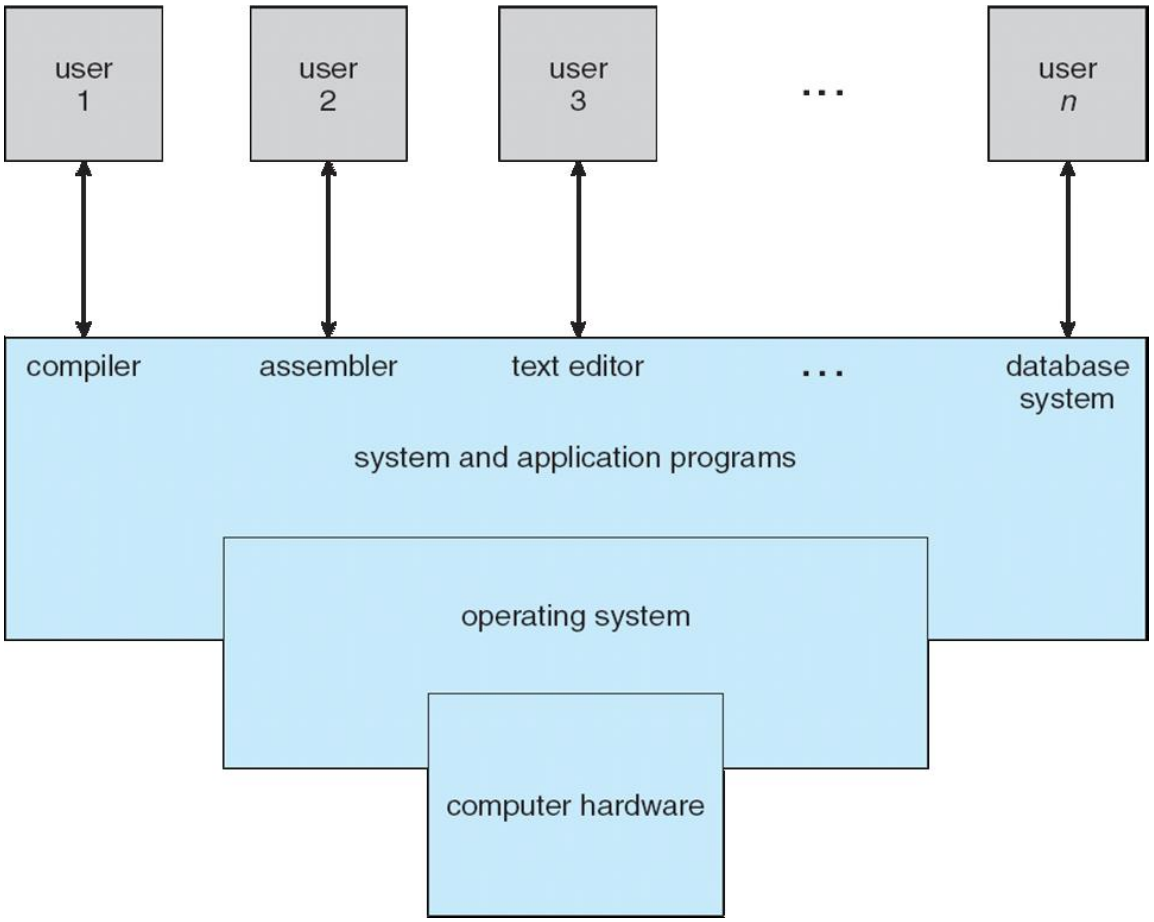
3 aspek utama Operating Systems

- Virtualization
  - Menyediakan abstraksi sehingga aplikasi seakan-akan melihat hardware hanya untuk aplikasi itu sendiri
- Concurrency
  - Event akan berjalan secara konkuren satu sama lain, dan perlu berinteraksi/berkoordinasi
  - OS harus dapat menangani event konkuren dengan benar dan efisien
- Persistence
  - Penyimpanan informasi secara permanen
  - Bagaimana menyediakan abstraksi sehingga aplikasi tidak perlu aware dengan bagaimana data disimpan: file, direktori, link
  - Correctness saat terjadi kegagalan
  - Performance: akses disk (I/O) sangat lambat

Struktur Sistem Komputer

- Sistem komputer dapat dibagi menjadi 4 komponen:
  - Hardware – menyediakan resource komputasi
    - CPU, memory, I/O devices
  - Operating system
    - Mengendalikan dan mengatur penggunaan hardware di antara beragam aplikasi dan user
  - Application programs – mendefinisikan cara bagaimana resource digunakan untuk menyelesaikan problem komputasi users
    - Word processors, compilers, web browsers, database systems, video games
  - Users
    - People, machines, other computers

Komponen Sistem Komputer



Apa yang dilakukan Operating Systems

- Bergantung sudut pandang
- Users ingin kenyamanan, **kemudahan penggunaan**
  - Tidak peduli **resource utilization**
- Namun fasilitas komputer bersama seperti **server** harus membuat semua user puas
- Laptop atau handphone umumnya tidak memiliki resource berlimpah, dan dioptimasi untuk usability dan battery life
- Komputer tertentu tidak memiliki user interface, seperti embedded computers pada perangkat dan automobiles

Definisi Operating System

- OS adalah **resource allocator**
  - Mengelola semua resources
  - Menentukan pengaturan conflicting requests agar penggunaannya efficient dan fair
- OS adalah **control program**
  - Mengatur eksekusi programs untuk menghindari errors dan penggunaan yang tidak benar dari komputer

Definisi Operating System

- No universally accepted definition
- "Everything a vendor ships when you order an operating system" is good approximation
  - But varies wildly
- "The one program running at all times on the computer" is the **kernel**. Everything else is either a system program (ships with the operating system) or an application program.

System software

- What is system software?
  - Computer programs that directly *control* the operations of the computer and its devices
- Operating systems:
  - Coordinate and orchestrate all activities of the hardware devices in a computer
  - Provide both a *Graphical User Interface* (*GUI*) and a *Command-Line Interface* (*CLI*) for its users

Operating system design goals

- From a user's perspective:
  - easy to use
  - easy to learn
  - reliable
  - safe
  - fast
  - etc.

- System goals:
  - reliability
  - flexibility
  - extensibility
  - speed(y)
  - efficiency
  - maintainability
  - etc.

Operating system services (i)

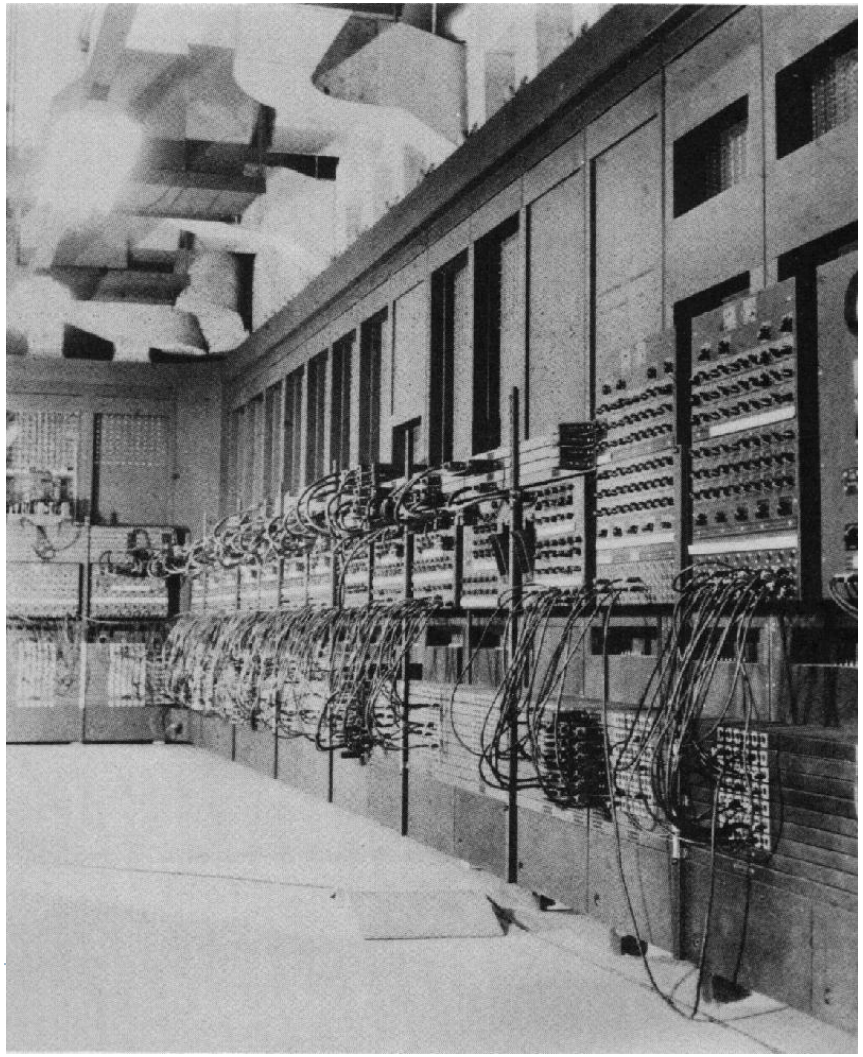
- An operating system provides *services*:
  - Program execution
    - Load programs into memory, run/suspend/halt programs, handle/display errors
  - I/O operations
    - Seamlessly interact with I/O devices, including disks, networks connection, etc.
  - Filesystem manipulation
    - Read/write/traverse filesystem directories, read/write files, enforce permissions, search for files

Operating system services (ii)

- Other operating system *services*:
  - Inter-Process Communications (IPC)
    - Processes exchange information via shared memory, message passing, sockets, pipes, files, etc.
    - Often spans multiple computers and networks
  - Error detection and recovery
    - Detect errors in CPU, memory, I/O devices, processes, network connections, etc.
    - Recover from errors gracefully, ensuring correct and consistent operations

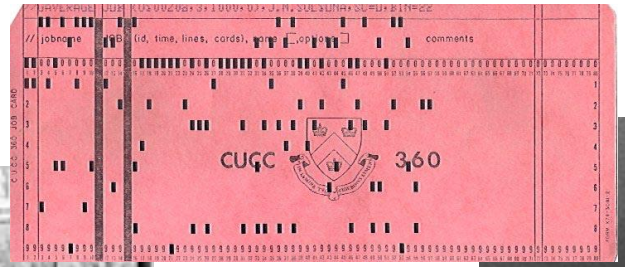
History of operating systems (i)

- In the beginning...
  ...the 1940s



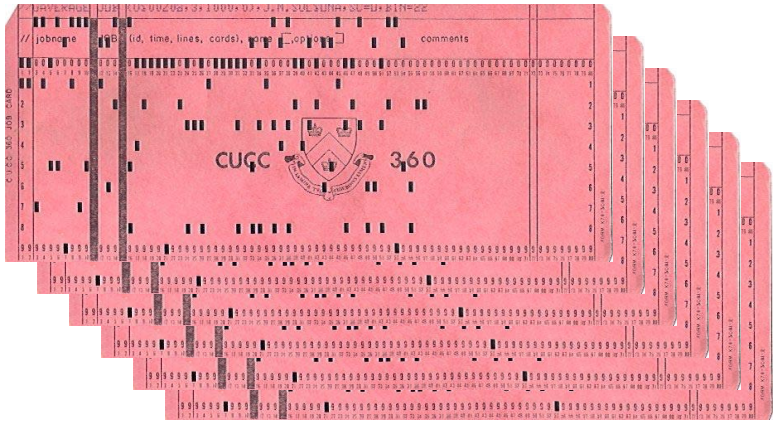
History of operating systems (ii)

- Automation in the 1950s with punch cards



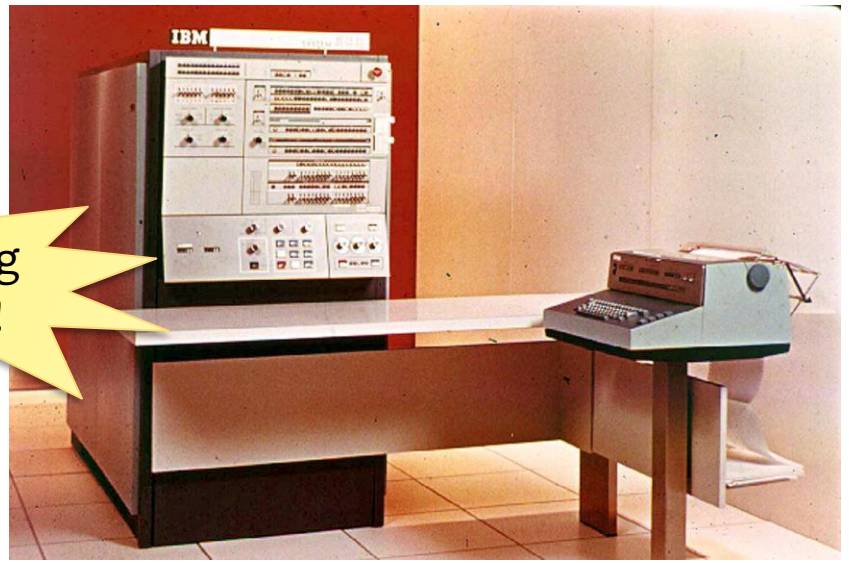
Batch jobs

- A *job* is a unit of work submitted by a user to the operating system
- Jobs typically consist of:
  - a program either in a source language or in "executable" binary form
  - input data used by the program when it executes



History of operating systems (iii)

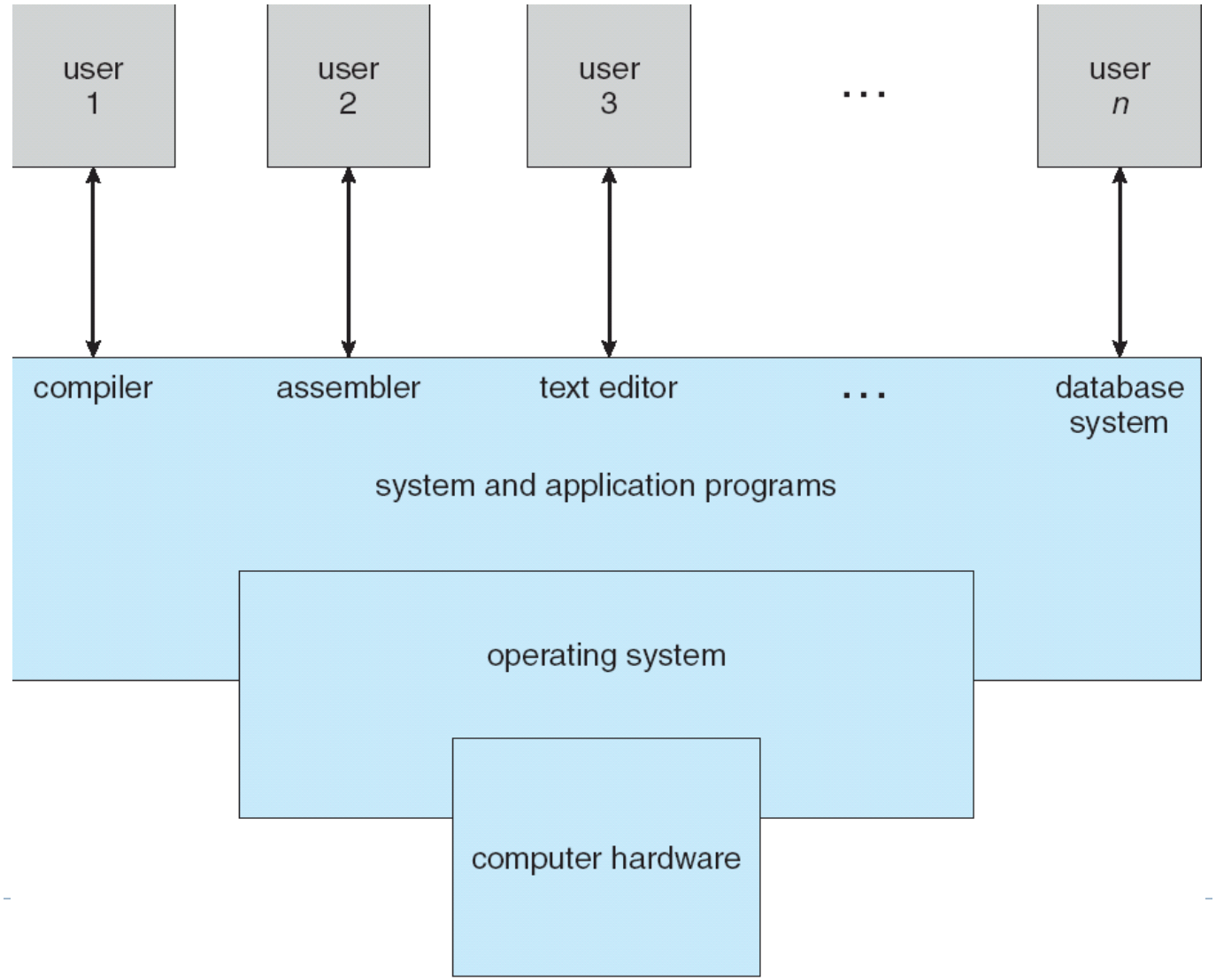
- IBM 360 introduced (in 1964)



a computing revolution!

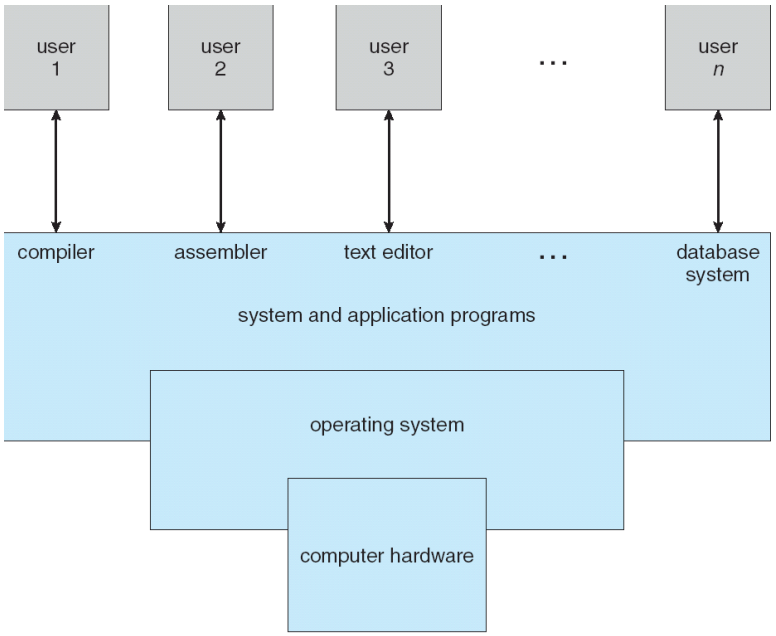
what's so revolutionary?

Multiprogramming (i)



Multiprogramming (ii)

- In multiprogramming, several jobs reside in memory simultaneously
  - CPU use is shared and managed by the operating system

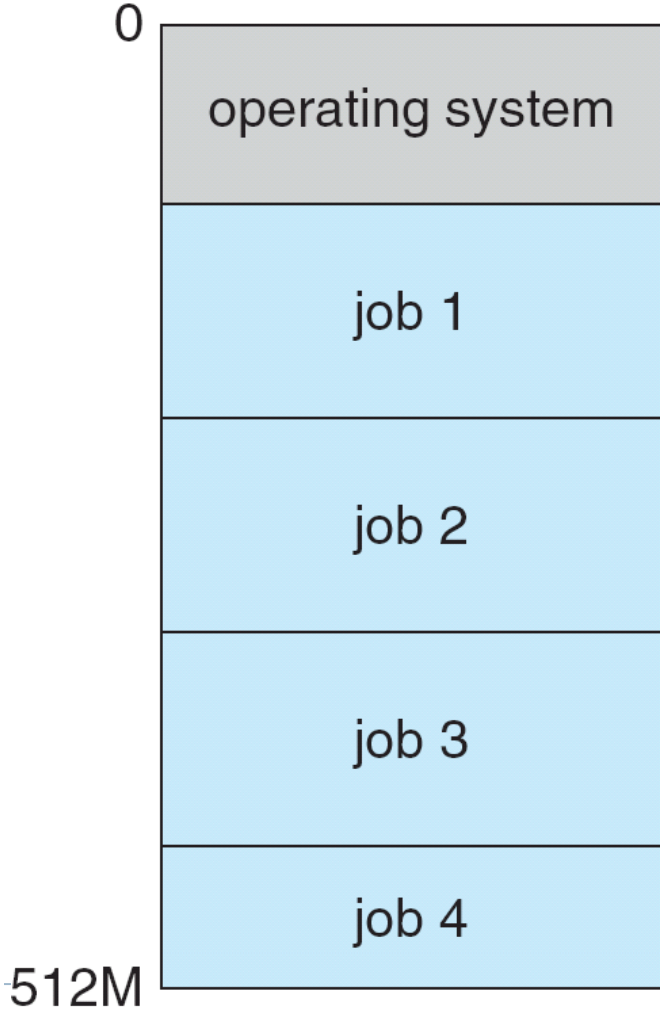


Multiprogramming (iii)

- Multiprogramming provides efficient use of the computer (CPU) and its resources (I/O)
  - One user cannot keep the CPU and I/O devices busy at all times
  - Multiprogramming organizes jobs such that the CPU always has exactly one to execute

Multiprogramming (iv)

- Computer is often idle – why?
  - CPU and hardware *significantly* faster than I/O
  - When a user or process is blocked waiting for I/O, the operating system switches to another job
  - A subset of jobs is stored in memory, awaiting CPU or I/O

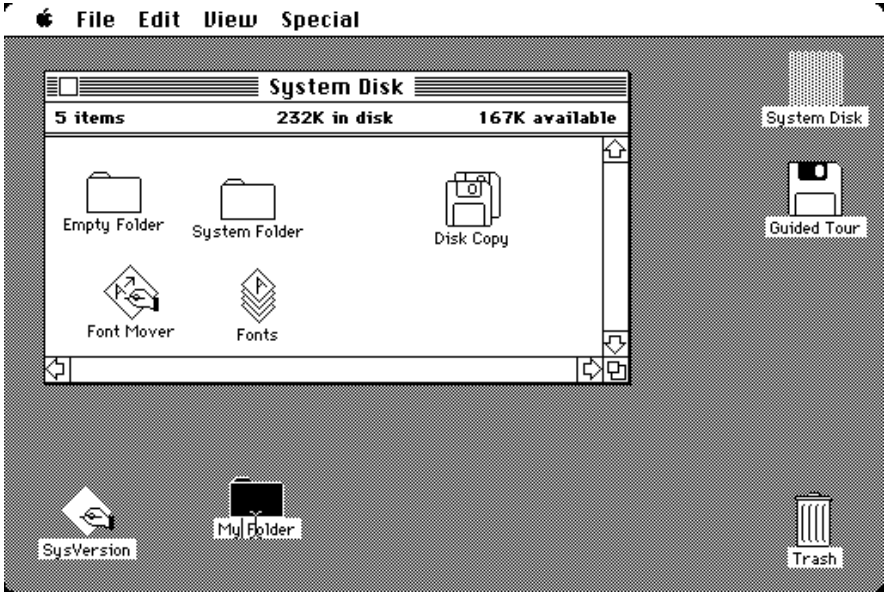


Timesharing and multitasking

- To ensure fairness, use a *timesharing scheme* in which the CPU cycles through all jobs
  - Each job is given a fixed amount of CPU time
  - Switching from one running job (or process) to another is called a *context switch*
  - A process may relinquish its time if blocked on an I/O request

History of operating systems (iv)

- Text CRTs (1970s) to an early Mac (1984)



History of operating systems (v)

- Personal computer revolution (1970s/80s)

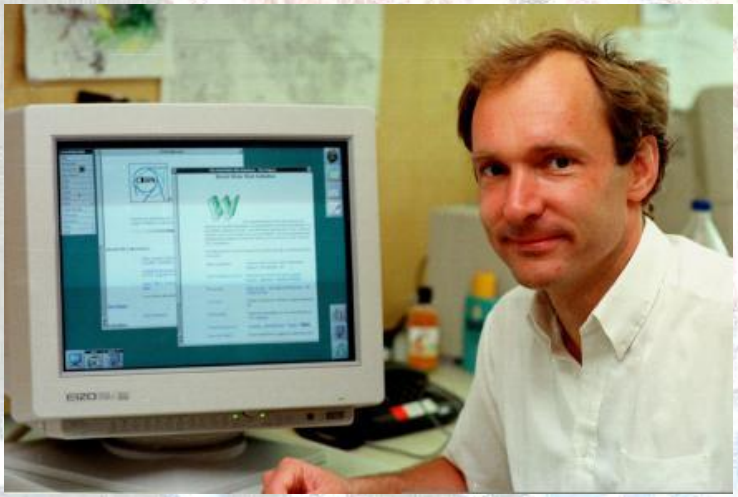
History of operating systems (vi)

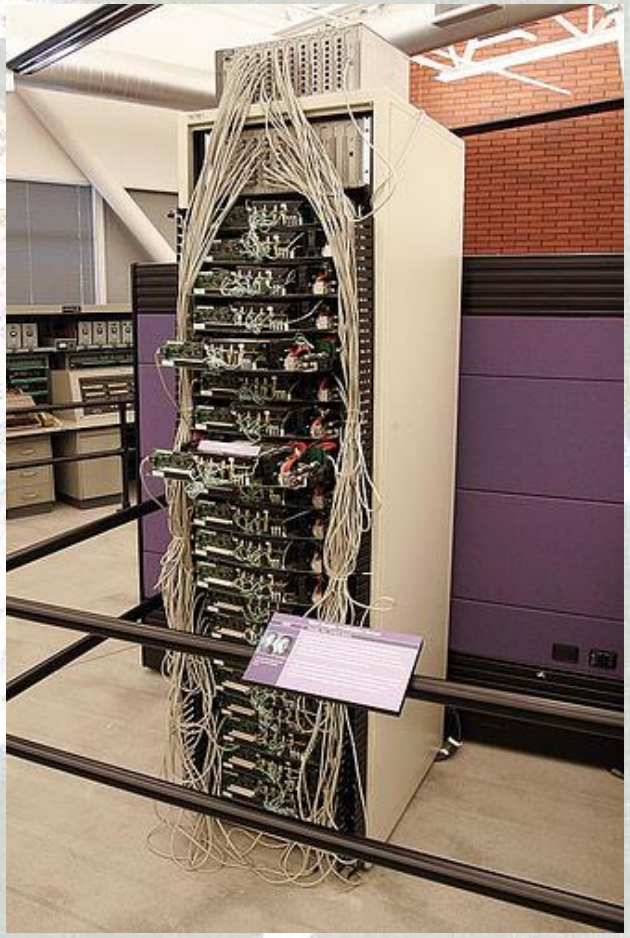
- The war begins...

sell your stock....

History of operating systems (vii)

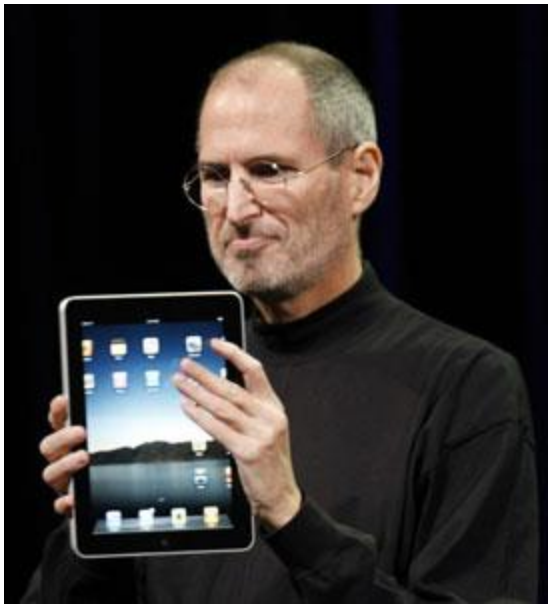
- World Wide Web and Internet revolution (1990s/2000s)





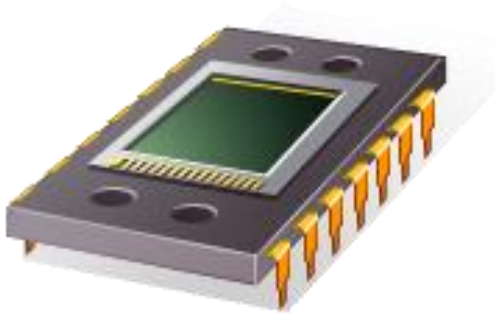
History of operating systems (viii)

- Mobile revolution (2010s)



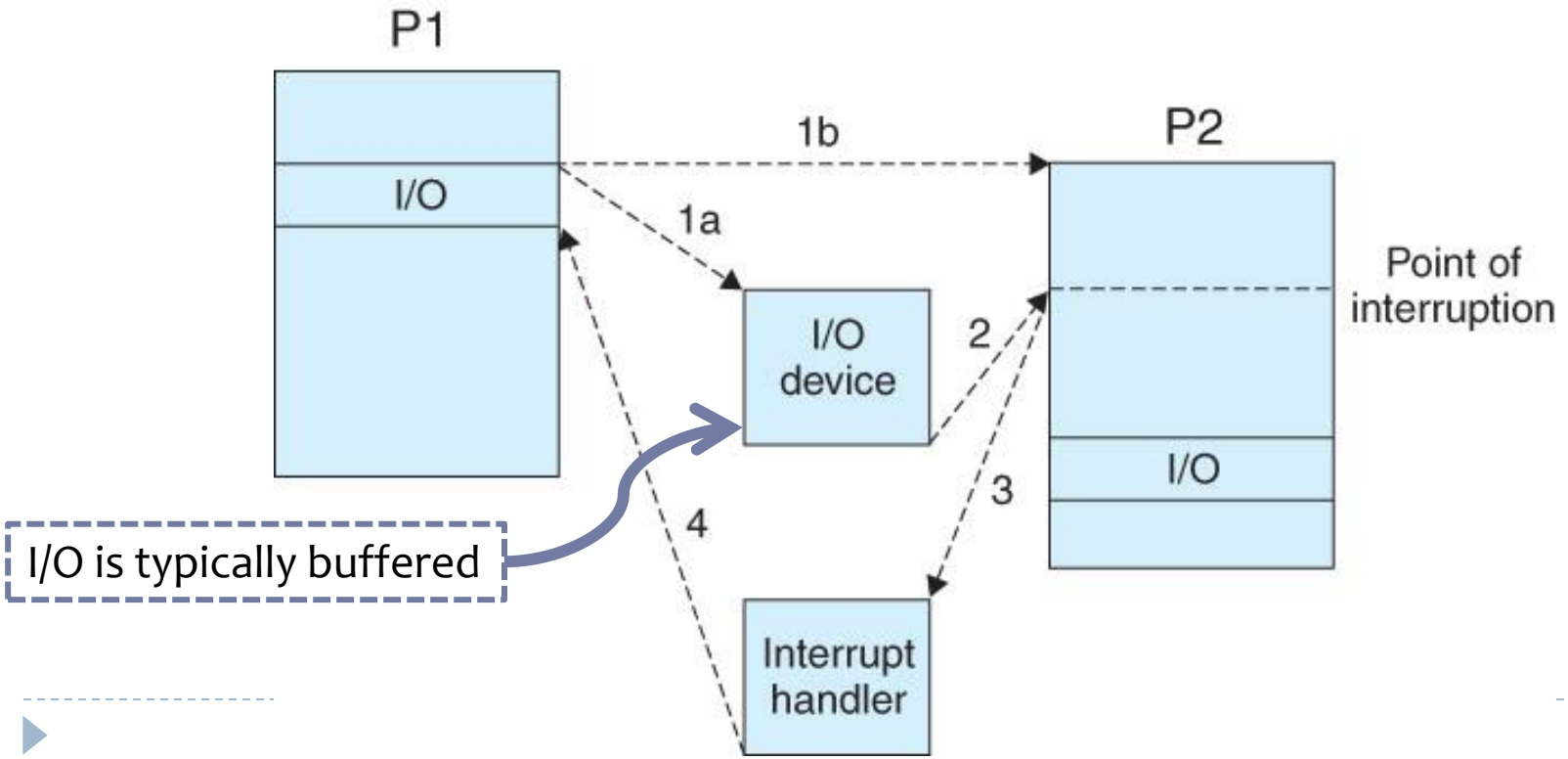
We interrupt this program…

- Software instructions are executed by a Central Processing Unit (CPU)
  - An external hardware event triggers an interrupt by signaling the CPU
    - e.g. mouse movement, keyboard event
  - Software triggers an interrupt by executing a system call
    - e.g. disk read, graphics output, printer output

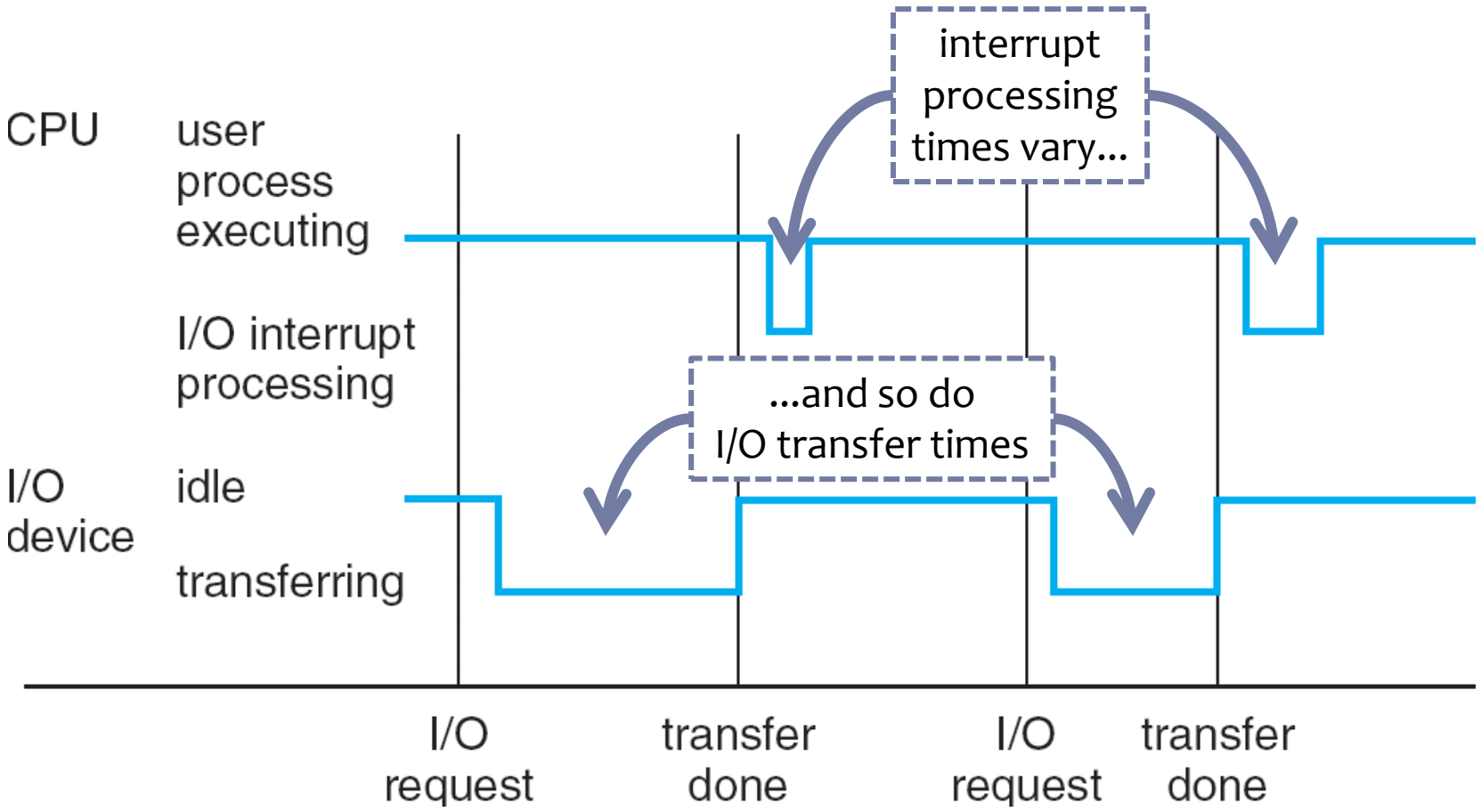


Interrupt mechanism

- Interrupts are handled much like calling a function in a programming language

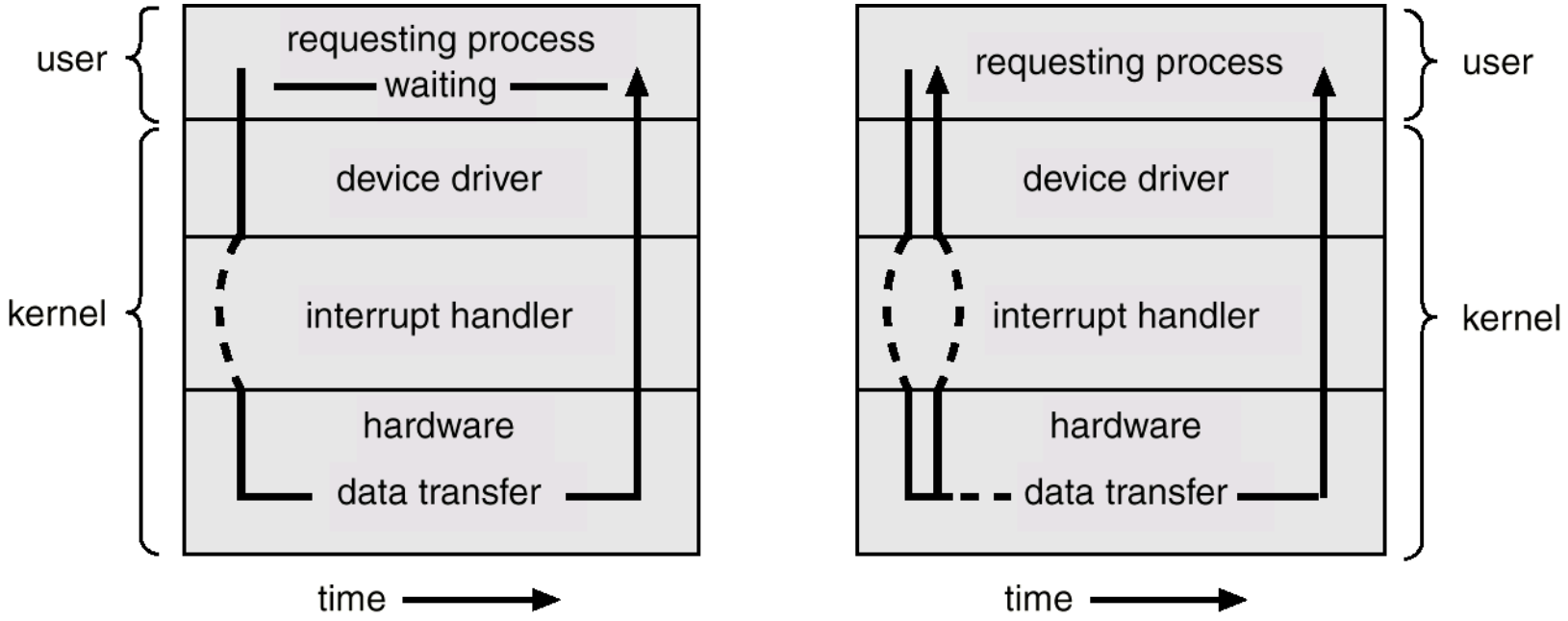


Typical interrupt timeline

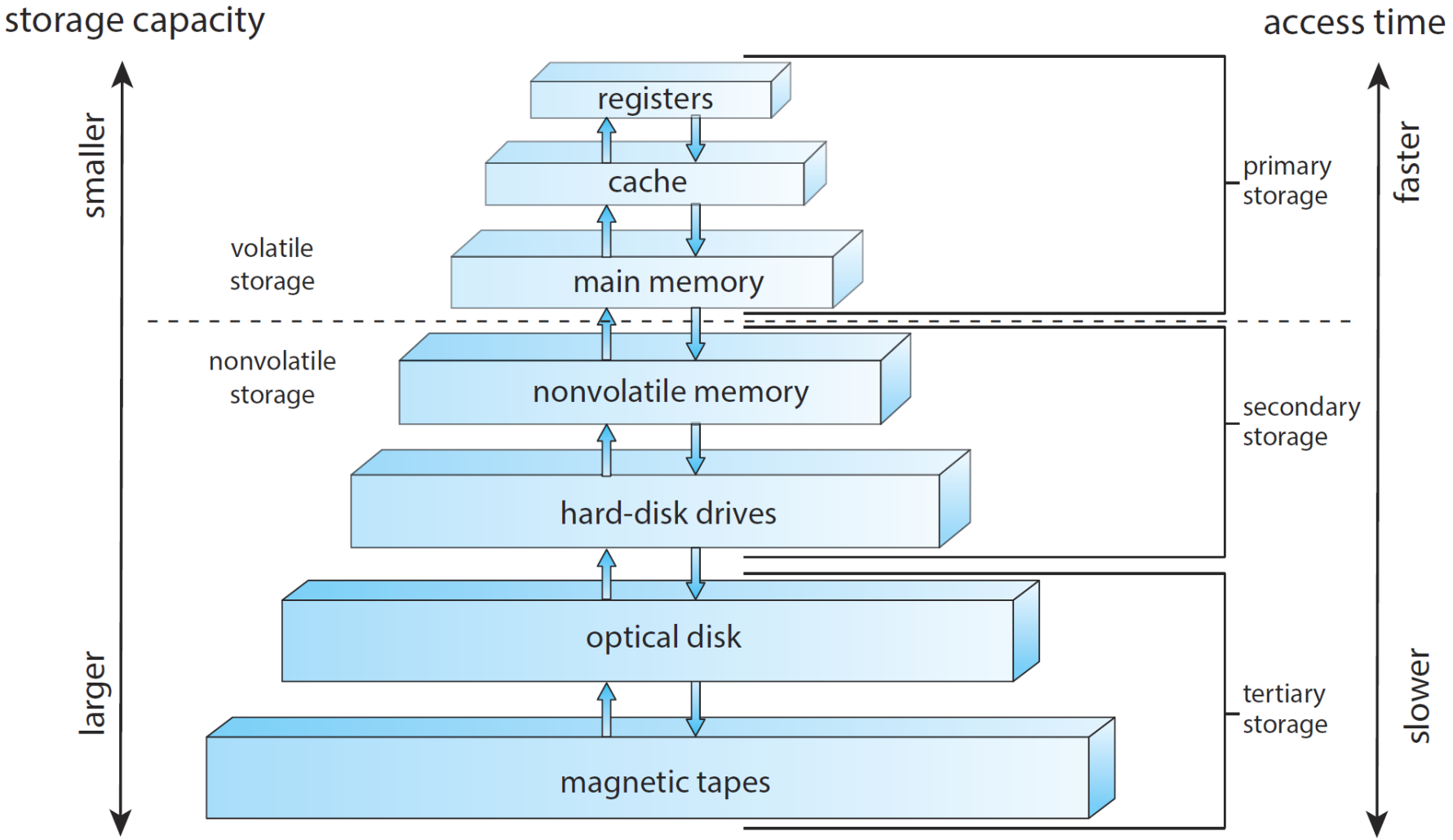


Synchronous and Asynchronous I/O

Synchronous Asynchronous

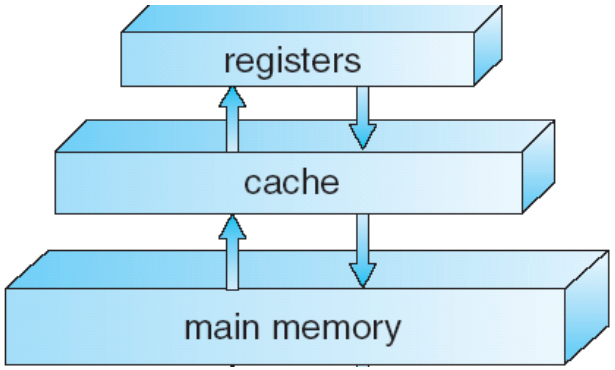


Hierarchical storage architecture



Caching (i)

- Caching is a technique in which data is temporarily stored in a smaller and faster memory component
  - Why implement caching in an operating



Caching (ii)

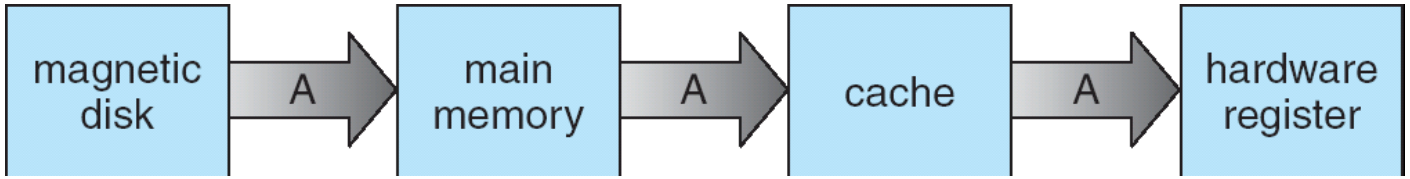
- A key goal in operating system design is achieving *fast and efficient performance*

Level	1	2	3	4
Name	registers	cache	main memory	disk storage
Typical size	< 1 KB	> 16 MB	> 16 GB	> 100 GB
Implementation technology	custom memory with multiple ports, CMOS	on-chip or off-chip CMOS SRAM	CMOS DRAM	magnetic disk
Access time (ns)	0.25 – 0.5	0.5 – 25	80 – 250	5,000.000
Bandwidth (MB/sec)	20,000 – 100,000	5000 – 10,000	1000 – 5000	20 – 150
Managed by	compiler	hardware	operating system	operating system
Backed by	cache	main memory	disk	CD or tape

Caching (iii)

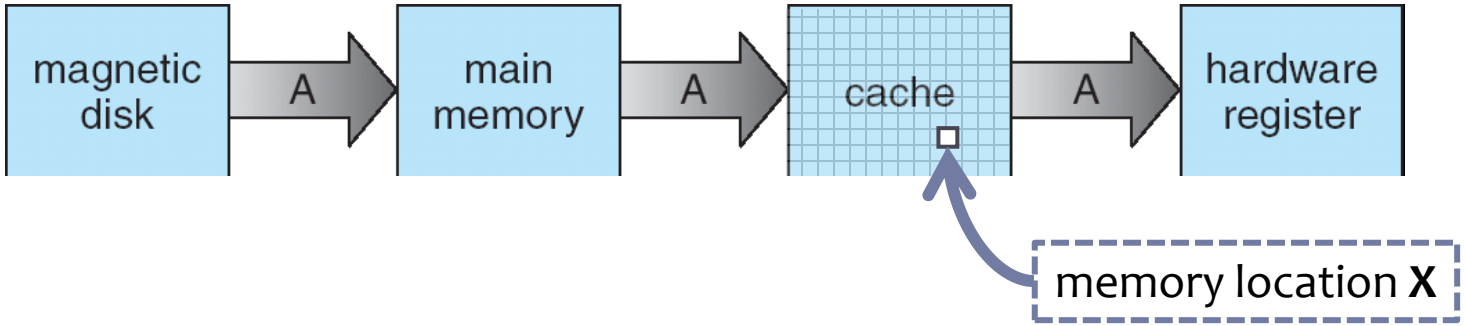
- What's the caching algorithm?
  - When the operating system attempts to read from memory, check to see if the requested data is already in the cache
  - If it is, data is read from the cache (*fast*!)
  - If not, data is copied from memory to the cache

(*maybe next time*...)



Principle of locality

- When a running program reads from memory location **X**, the *principle of locality* predicts that the next memory location requested will be near **X**



- Store *pages* of data in a cache, where each page is typically the same size (e.g. 64KB)