

Introduction

Fan Wu

Department of Computer Science and Engineering
Shanghai Jiao Tong University
Spring 2020

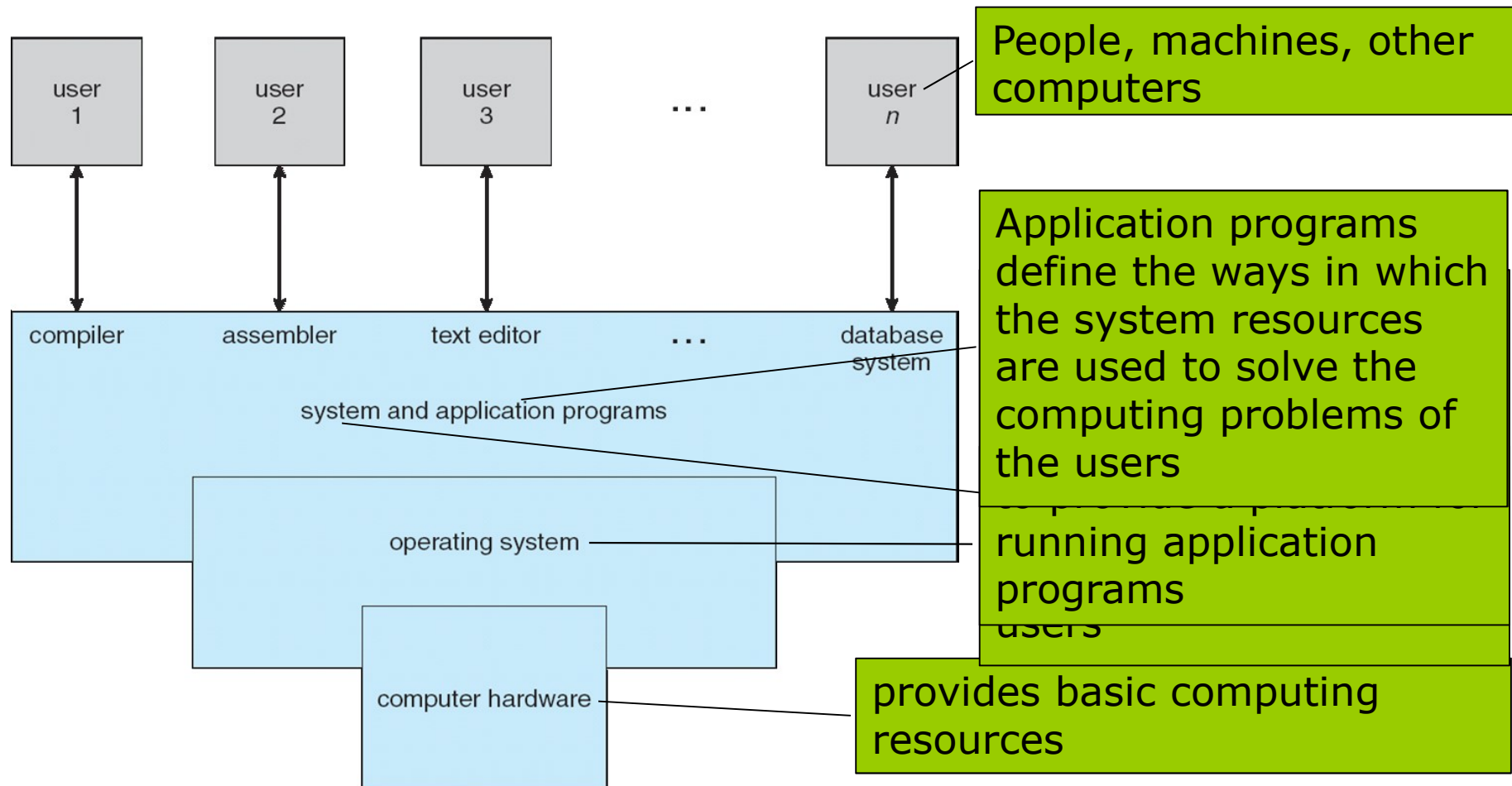
Operating Systems



Operating Systems

- UNIX-family: BSD(Berkeley Software Distribution), System-V, GNU/Linux, MINIX, Nachos, OS X, iOS
- BSD-family: FreeBSD, NetBSD, OpenBSD
- System-V-family: AIX, HP-UX, IRIX, Solaris
- Linux-family: Red Hat, Debian, Ubuntu, Fedora, openSUSE, Linux Mint, Google's Android, WebOS, Meego
- MS-DOS, Microsoft Windows, Windows Mobile, Win-CE, WP8
- AmigaOS
- Symbian, MeeGo
- Google Chrome OS
- OS/2
- XrossMediaBar(XMB) for PS3, Orbis OS for PS4
- Input Output System for Wii
- Tiny-OS, LynxOS, QNX, VxWorks

Four Components of a Computer System



Computer System Structure

- **Hardware** – provides basic computing resources
 - CPU, memory, I/O devices
- **Operating system** – Controls and coordinates use of hardware among various applications and users
- **System programs** – are computer software designed to operate the computer hardware and to provide a platform for running application programs
 - BIOS and device drivers
- **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

What is an Operating System?

- An operating system is a **program** that manages the computer hardware
- A program that acts as an **intermediary** between the computer user 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

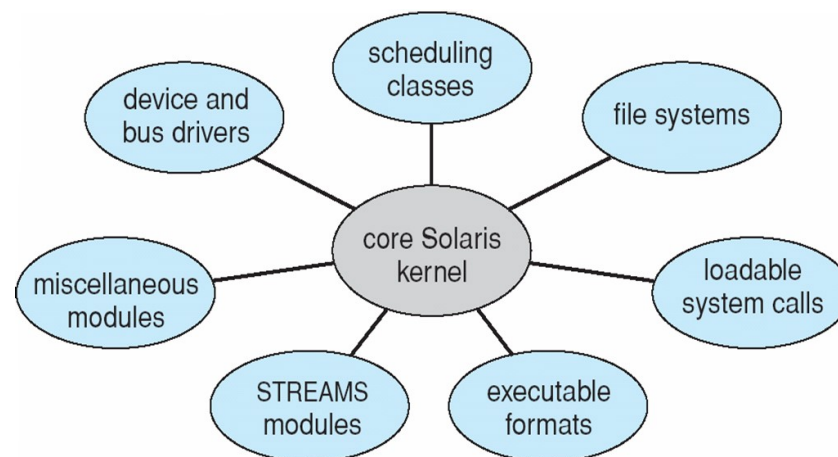
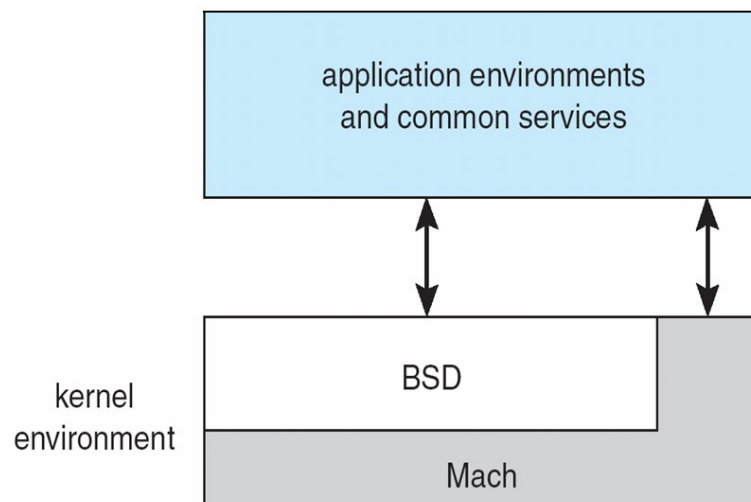
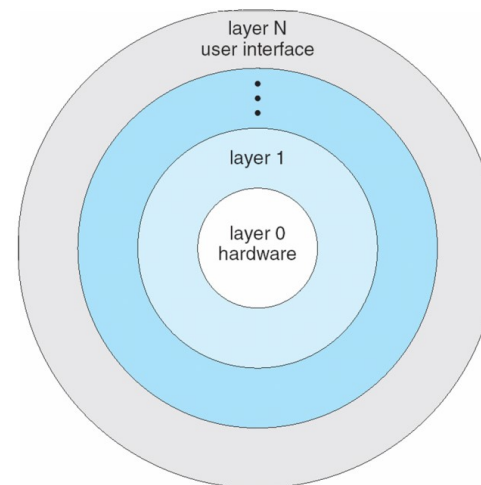
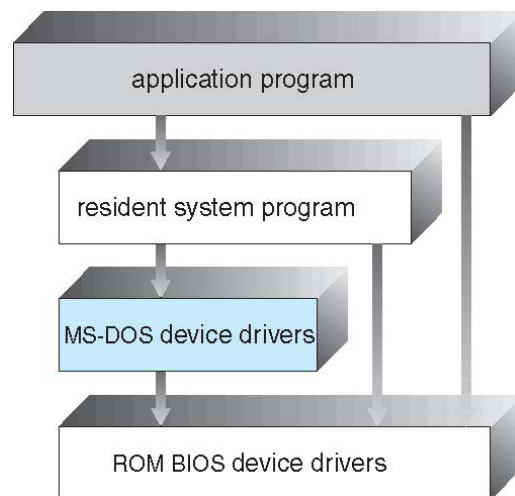
Operating System Definition

- OS is a **resource allocator**
 - Manages all resources
 - Decides between conflicting requests for efficient and fair resource use
- OS is a **control program**
 - Controls execution of programs to prevent errors and improper use of the computer

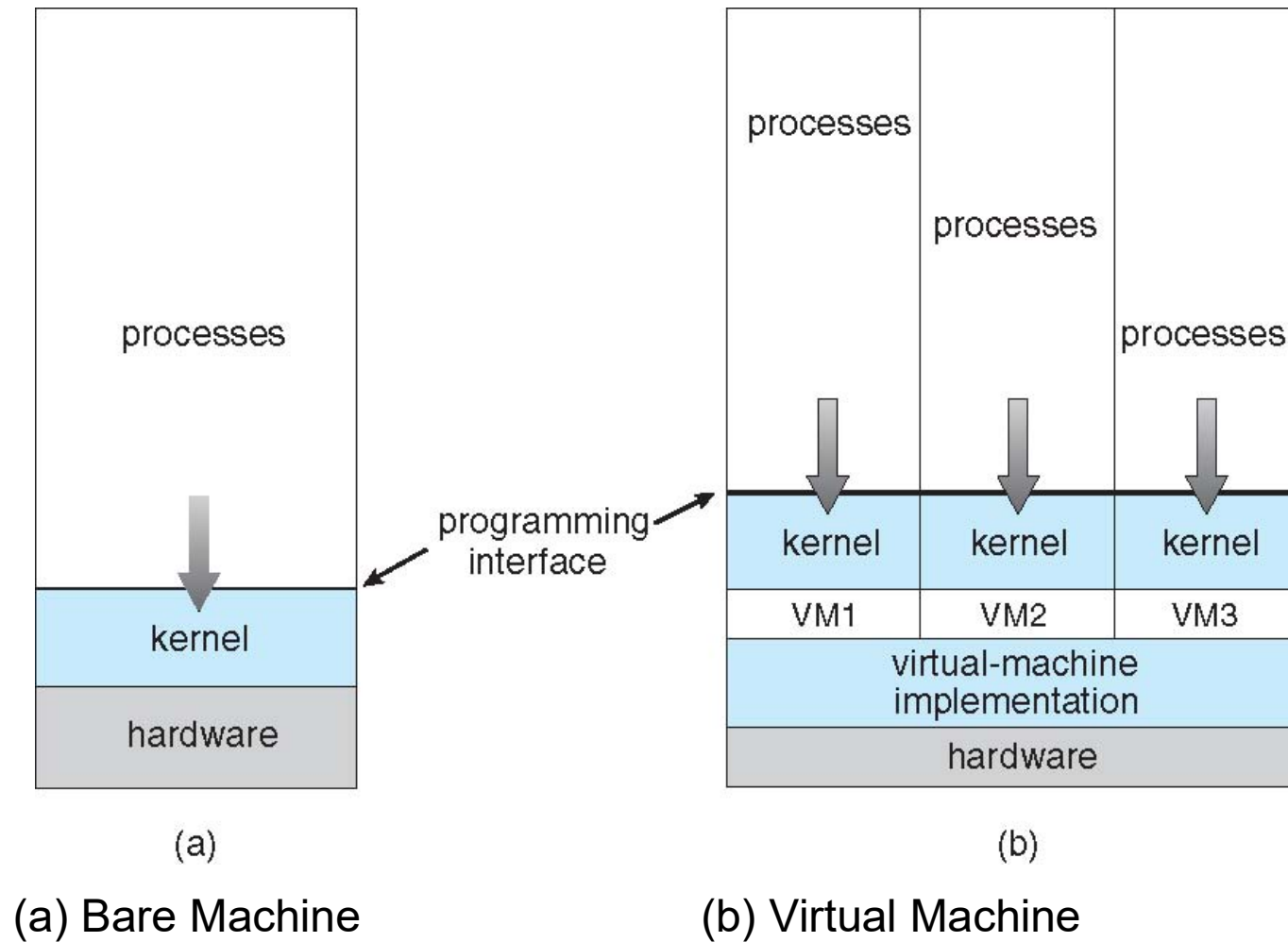
Operating System Definition (Cont.)

- 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.
- “An **operating system (OS)** is **software**, consisting of programs and data, that **runs on computers, manages computer hardware resources, and provides common services for execution of various application software.**” --- From Wikipedia

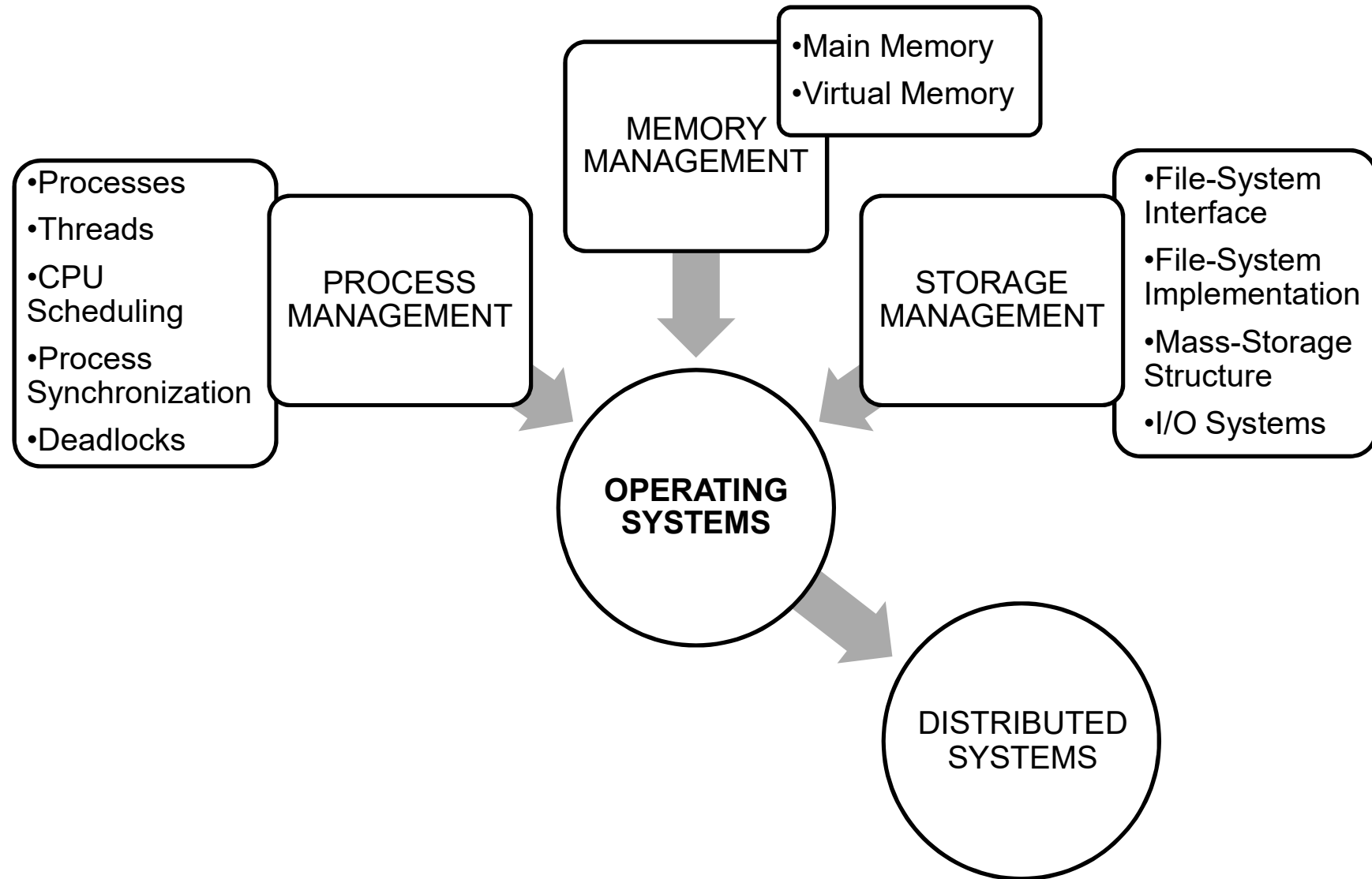
Operating System Structures



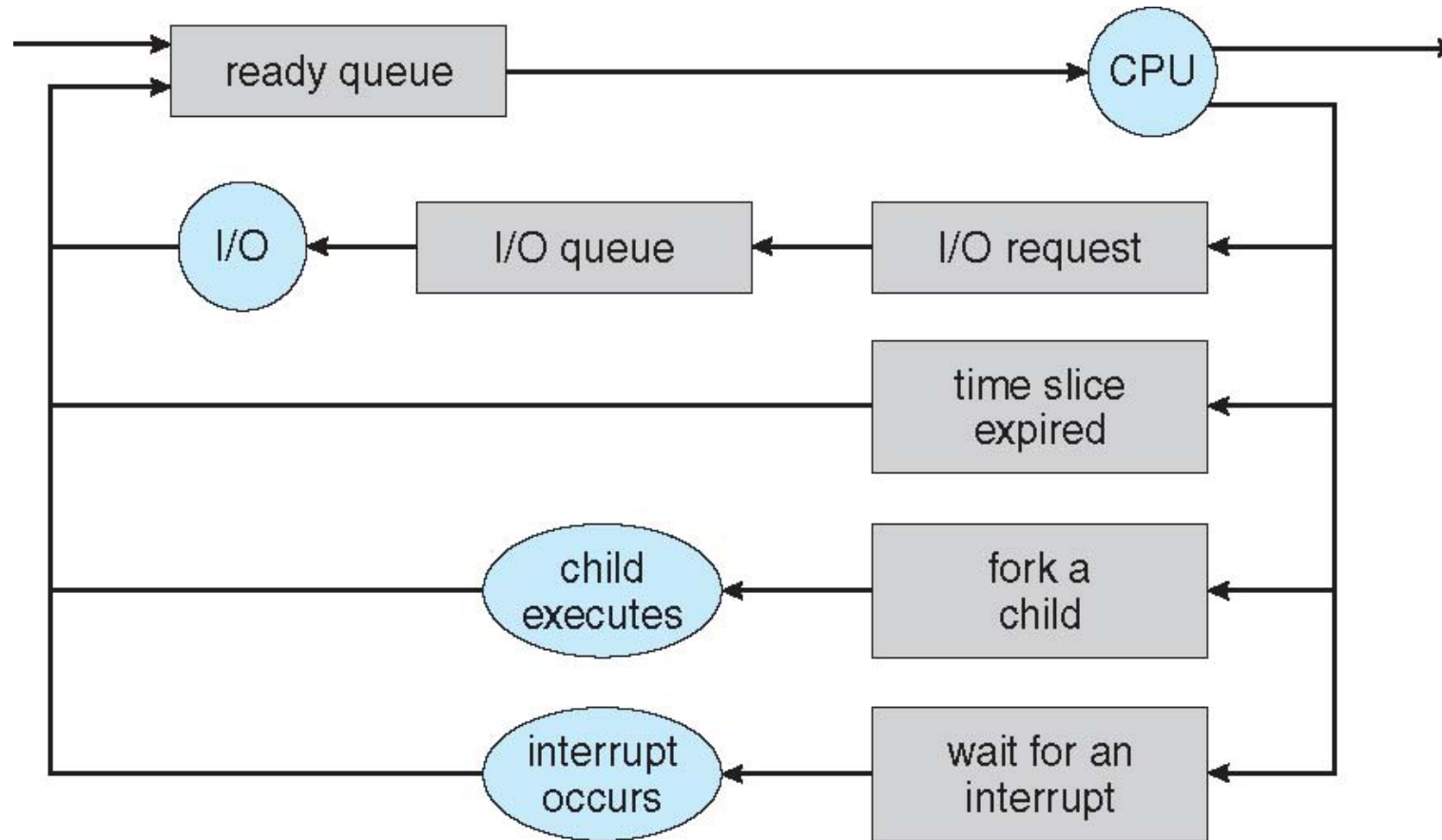
Virtual Machines



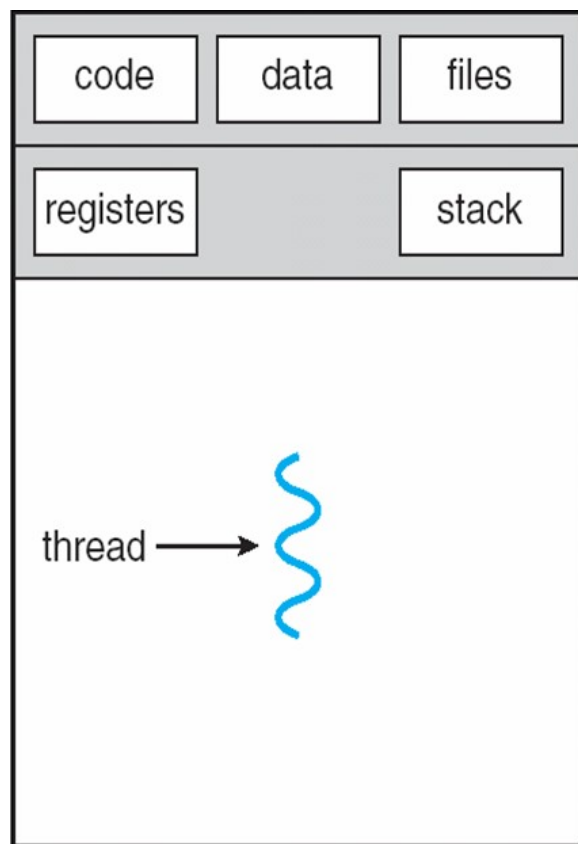
Course Outline



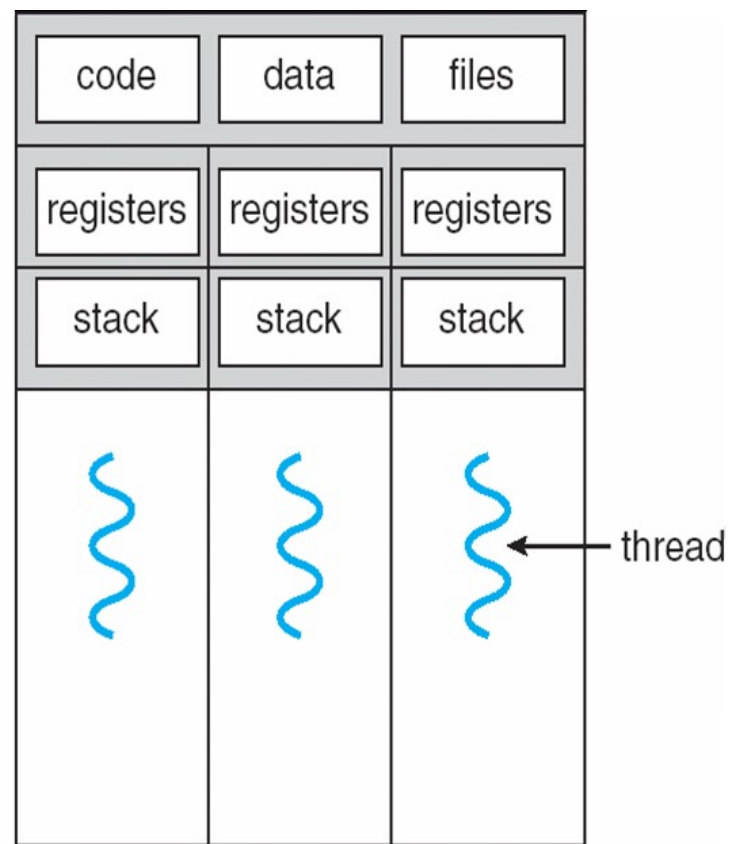
Process Scheduling



Single and Multithreaded Processes



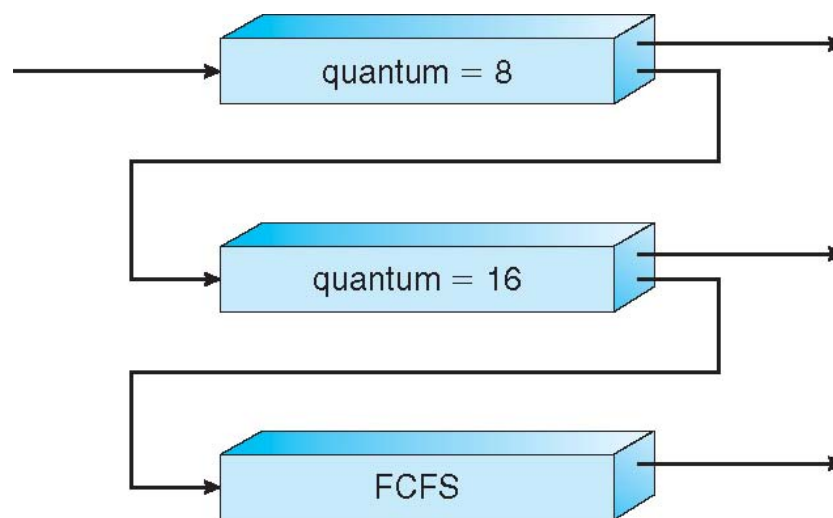
single-threaded process



multithreaded process

CPU Scheduling

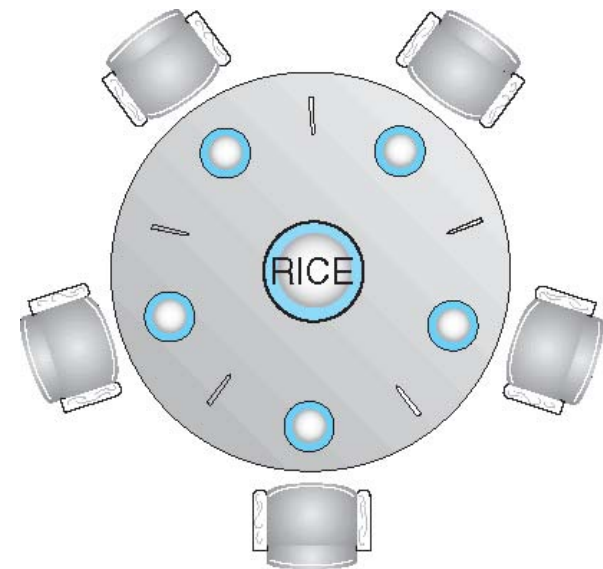
- First-Come, First-Served (FCFS) Scheduling
- Shortest-Job-First (SJF) Scheduling
- Priority Scheduling
- Round-Robin Scheduling
- Multilevel Queue Scheduling
- Multilevel Feedback Queue Scheduling



Process Synchronization

Dining-Philosophers Problem

- Philosophers spend their lives thinking and eating
- Don't interact with their neighbors, occasionally try to pick up 2 chopsticks (one at a time) to eat from bowl
 - Need both to eat, then release both when done
- In the case of 5 philosophers
 - Shared data
 - ▶ Bowl of rice (data set)
 - ▶ Semaphore **chopstick** [5] initialized to 1



Deadlock Avoidance

Example of Banker's Algorithm

- 5 processes P_0 through P_4 ;

3 resource types:

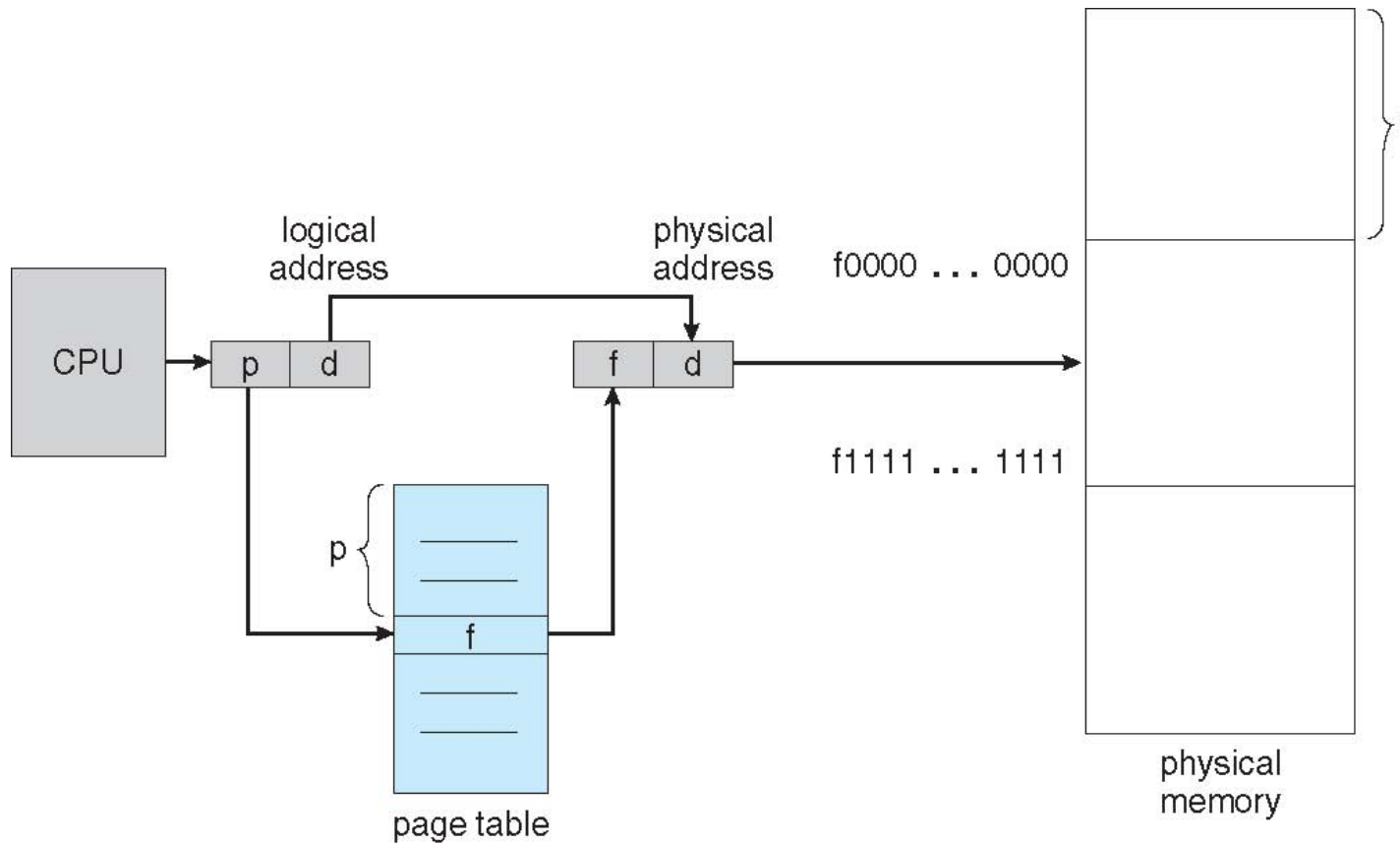
A (10 instances), B (5 instances), and C (7 instances)

Snapshot at time T_0 :

	Max	Allocation	Need	Available
	$A B C$	$A B C$	$A B C$	$A B C$
P_0	7 5 3	0 1 0	7 4 3	3 3 2
P_1	3 2 2	2 0 0	1 2 2	
P_2	9 0 2	3 0 2	6 0 0	
P_3	2 2 2	2 1 1	0 1 1	
P_4	4 3 3	0 0 2	4 3 1	

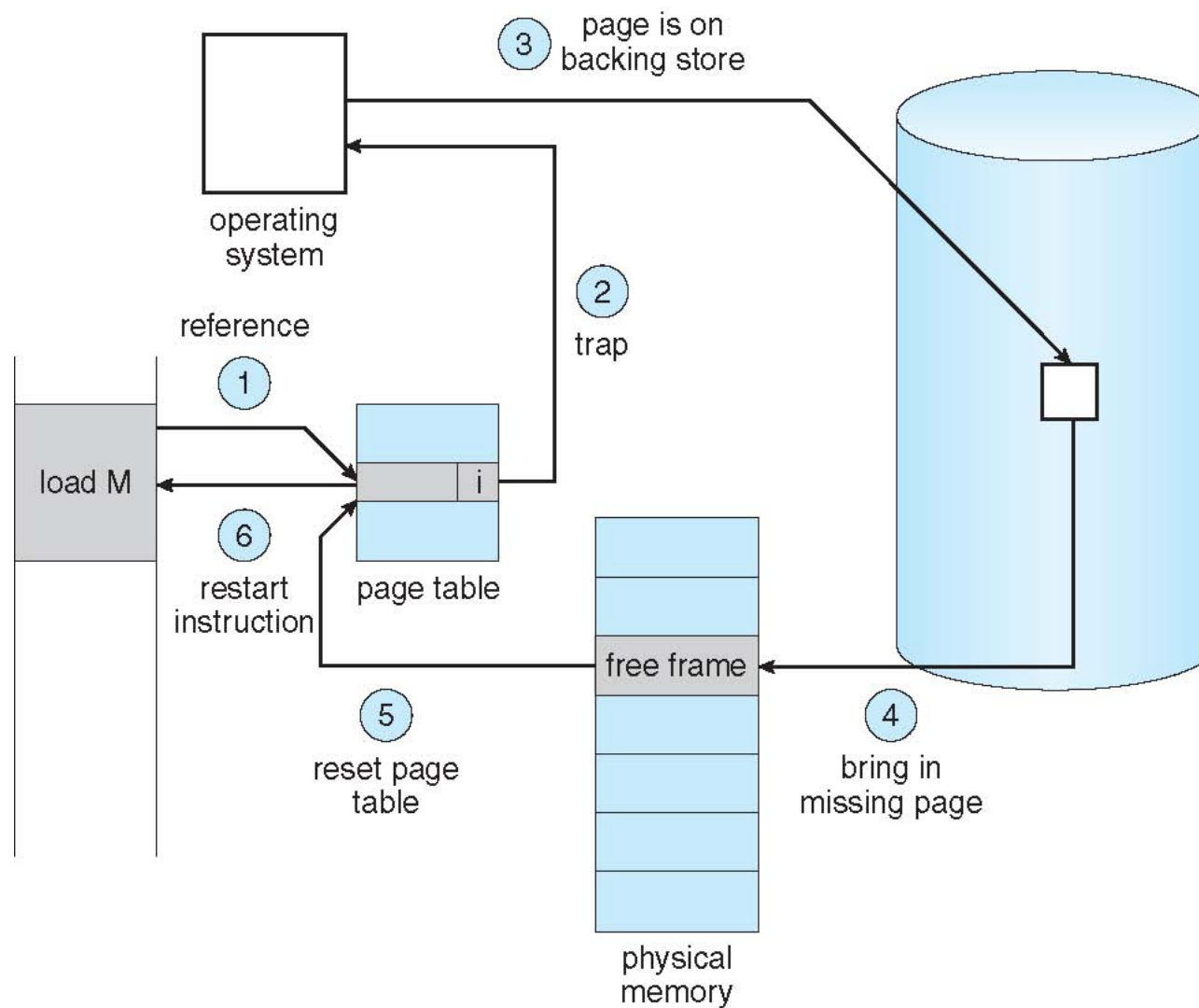
- The system is in a safe state since the sequence $\langle P_1, P_3, P_0, P_2, P_4 \rangle$ satisfies safety criteria

Memory Management

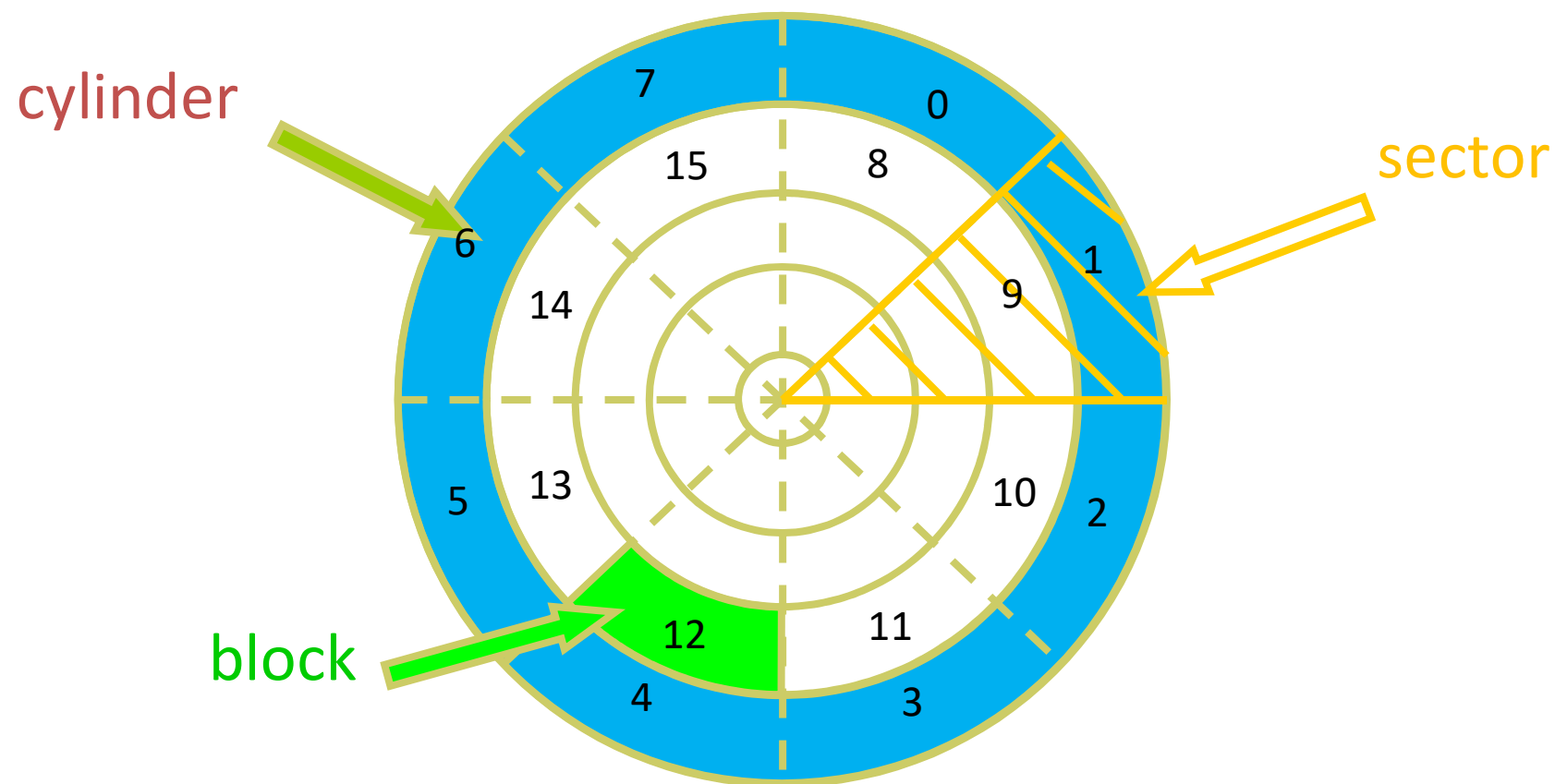


Paging Hardware

Virtual Memory Management

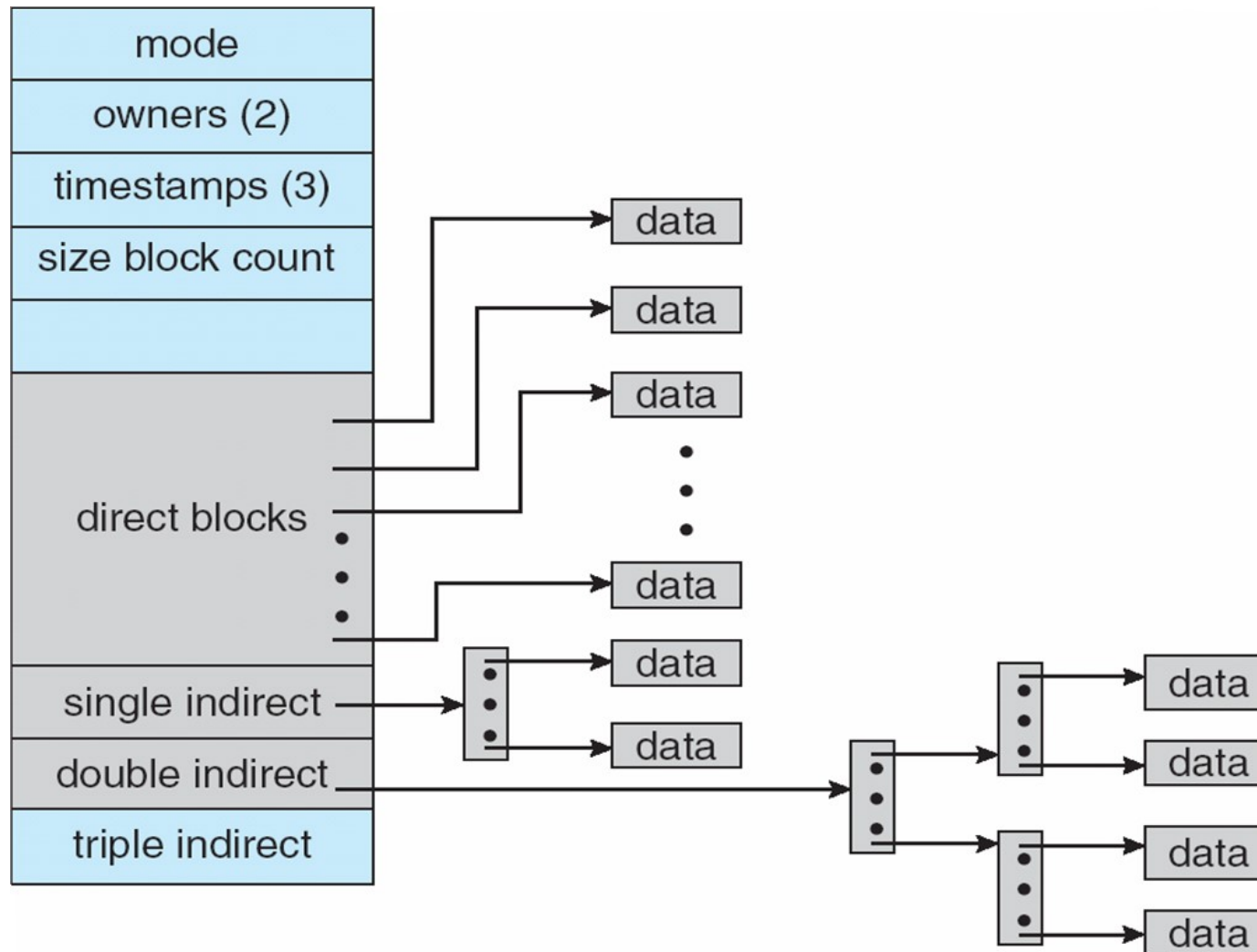


Mass-Storage Systems



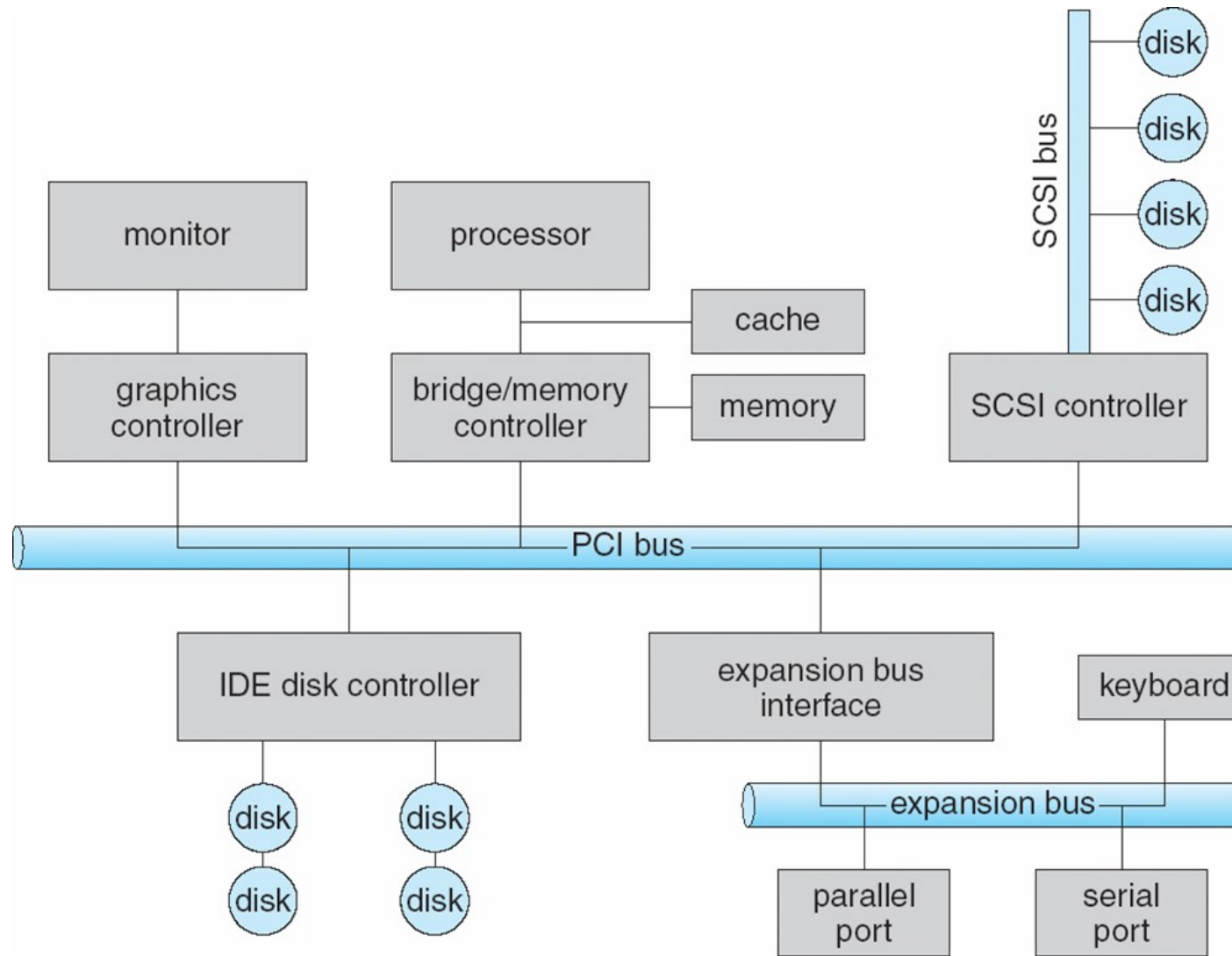
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
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File-System

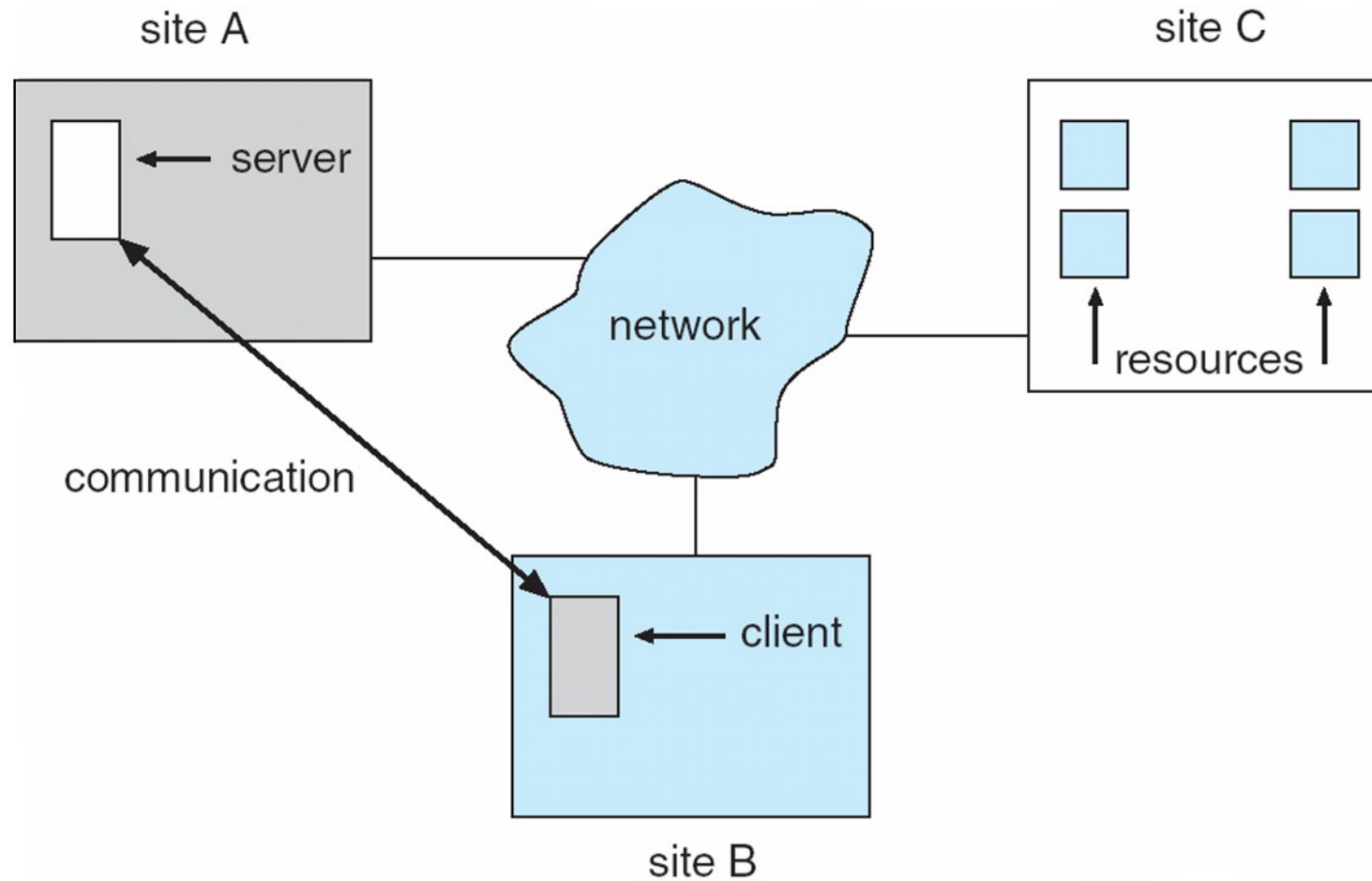


Combined Scheme with **UNIX I-node**

I/O Systems



Distributed System Structure



Homework

- Reading
 - Chapter 1: Introduction