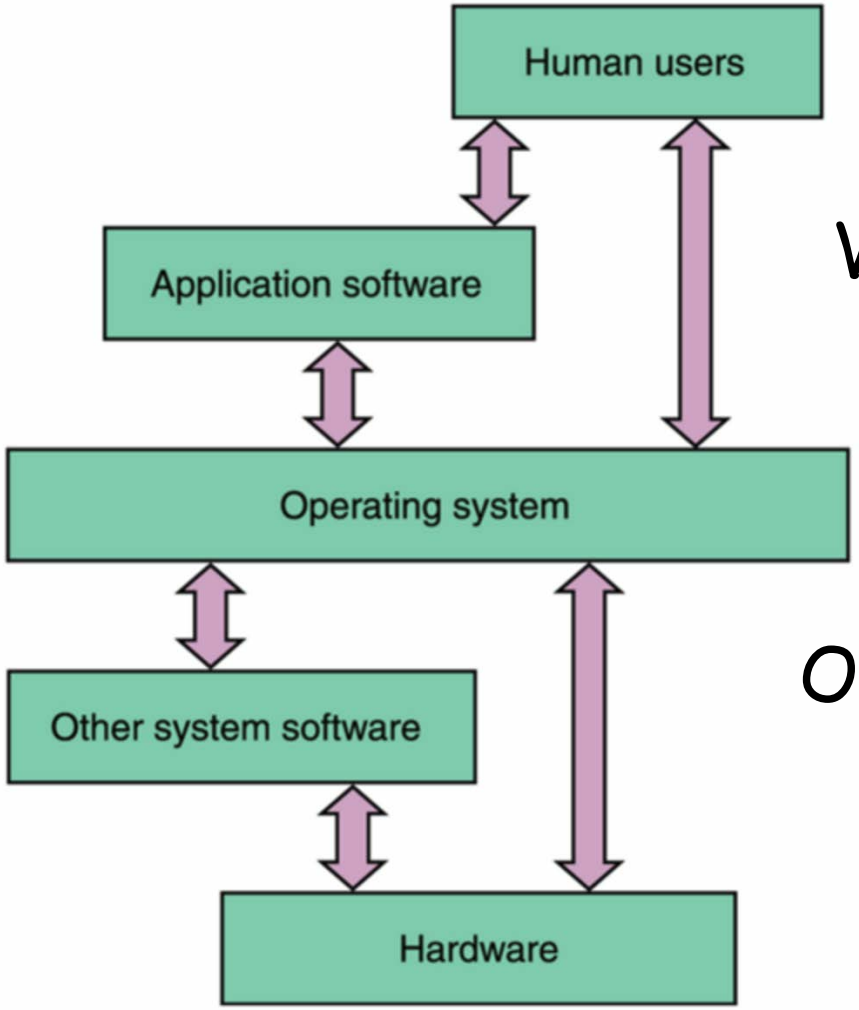
COP-5614 Exam Review Session

Instructor: Dr. Liting Hu

Introduction to Operating Systems

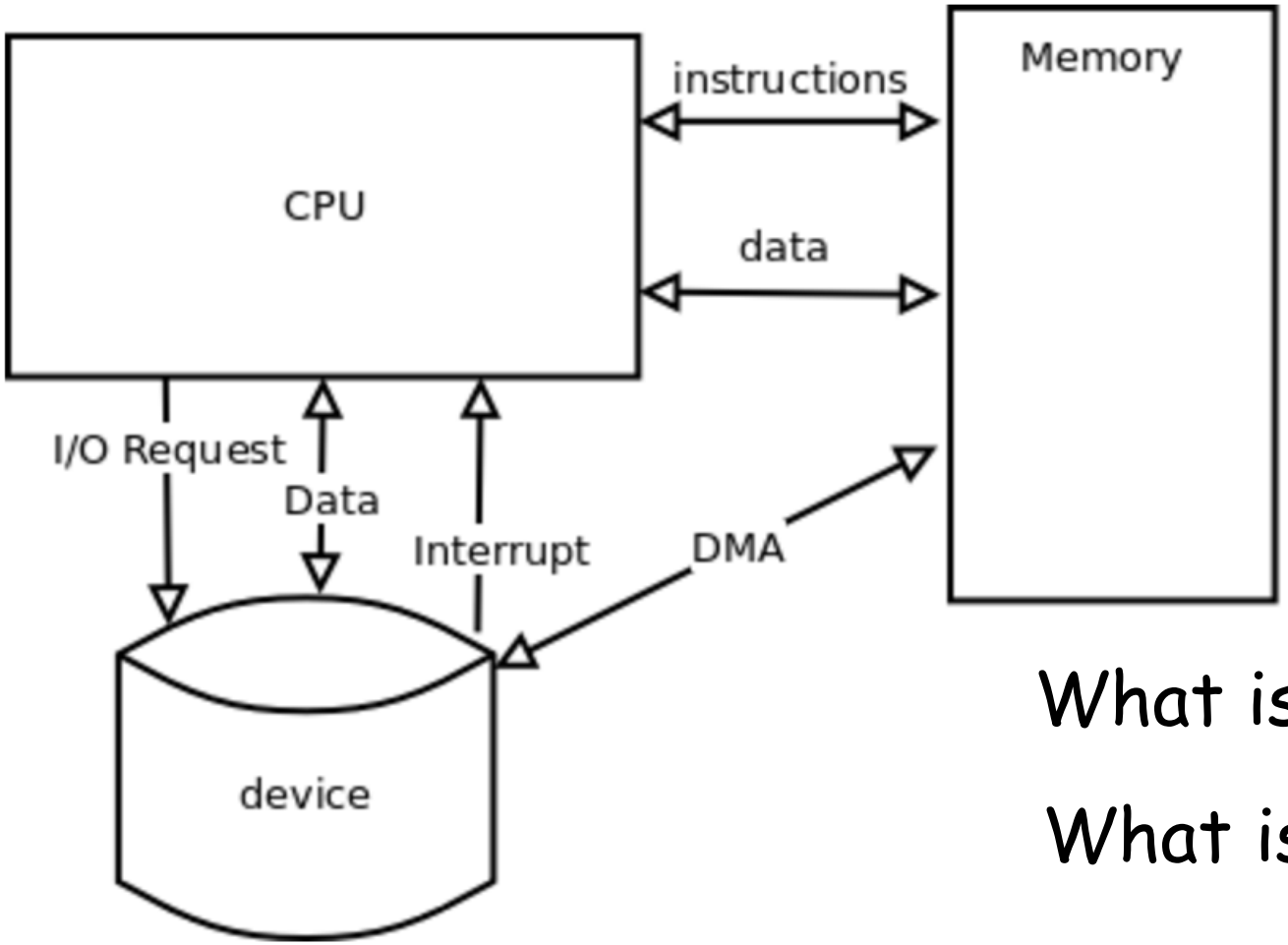
1. Introduction to Operating Systems



What is operating system?

Operating system benefits?

1.1 Computer Architecture

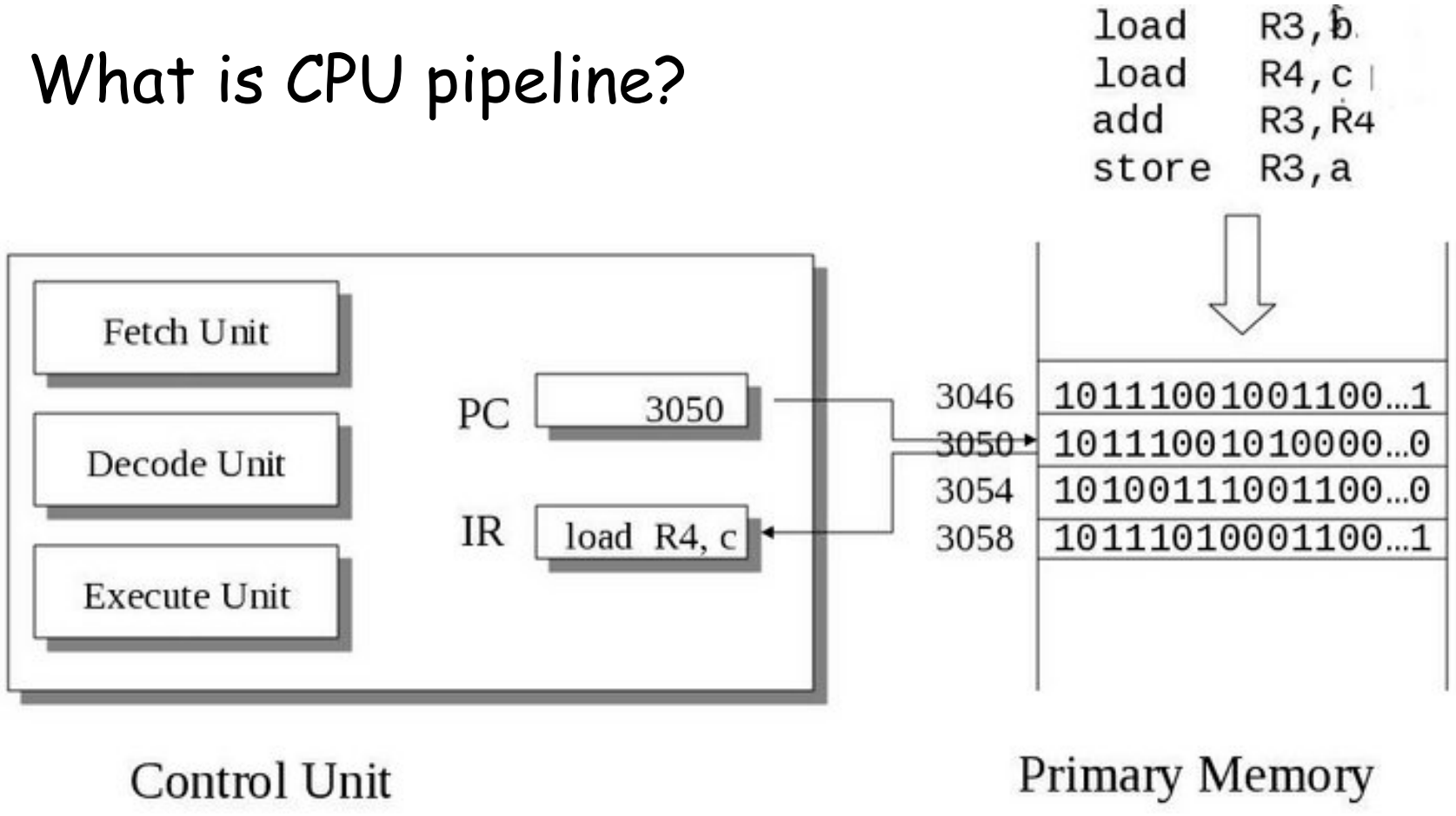


What is interrupt?

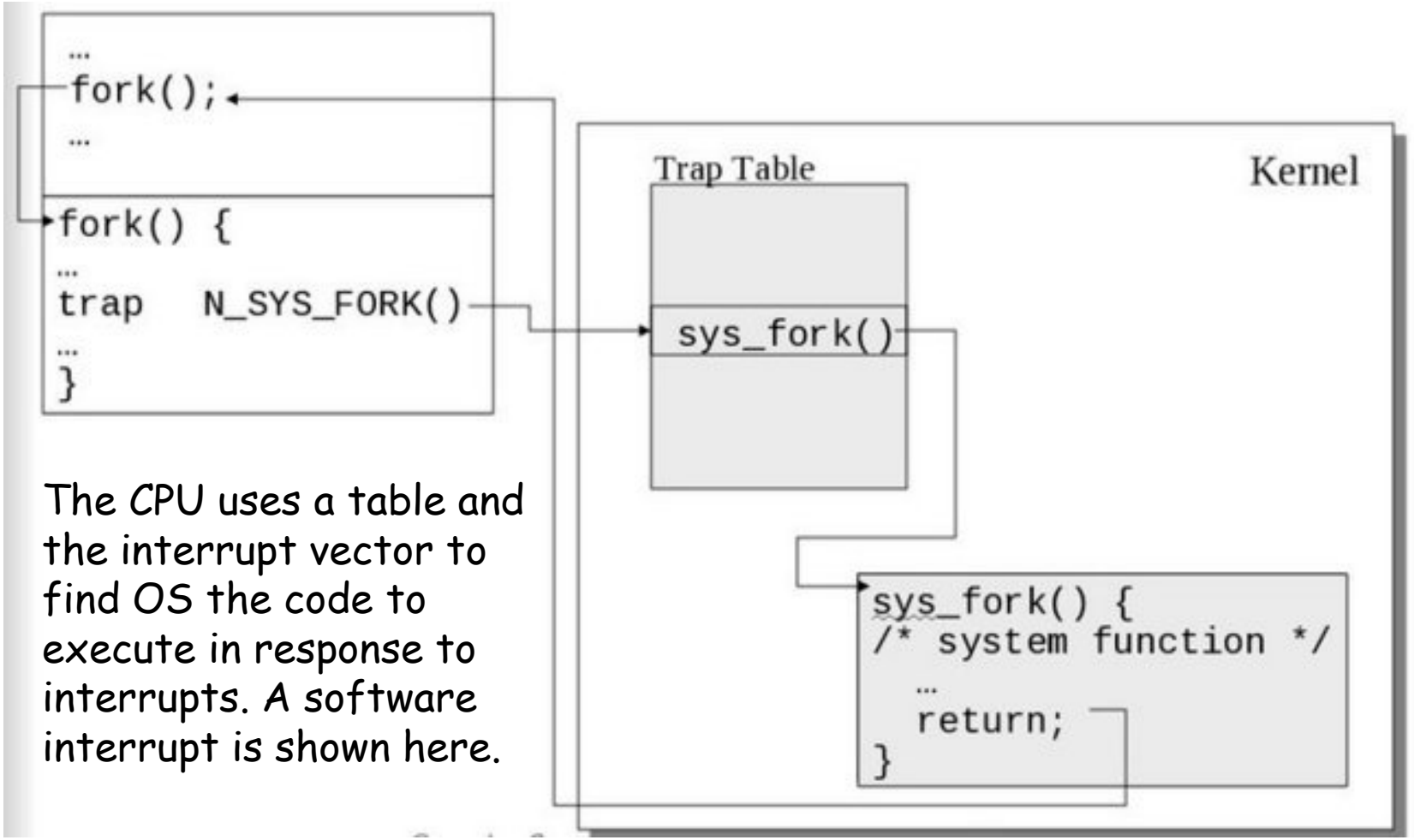
What is DMA?

1.2 The CPU Control Unit

What is CPU pipeline?

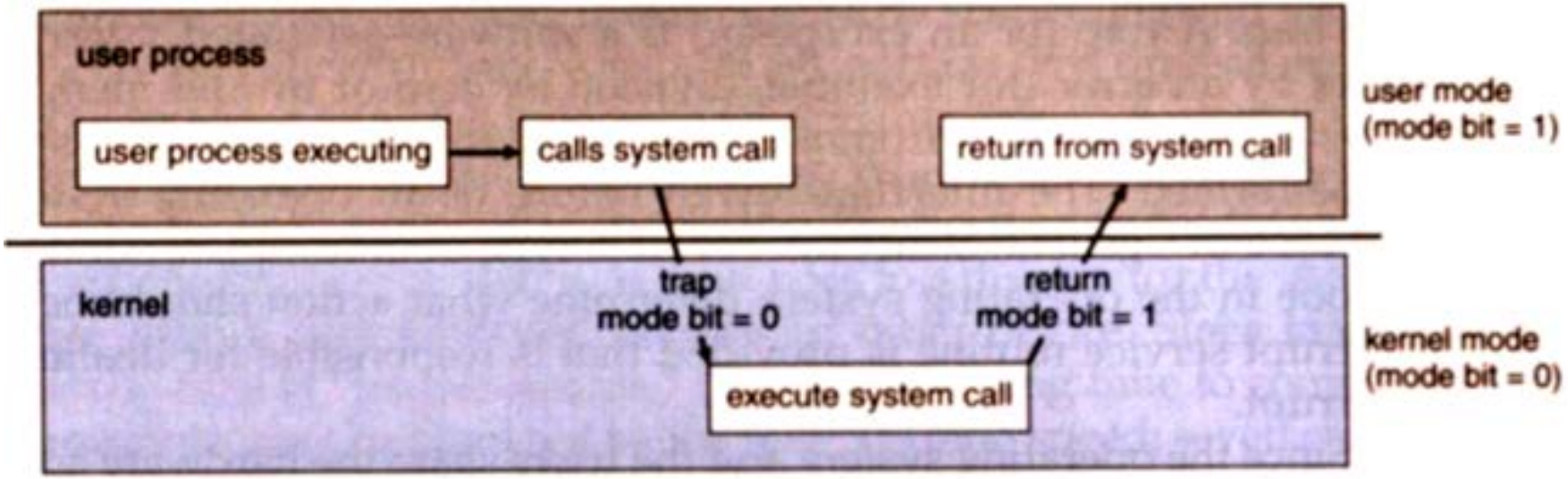


1.3 CPU Response to Interrupts



The CPU uses a table and the interrupt vector to find OS the code to execute in response to interrupts. A software interrupt is shown here.

1.4 System Calls

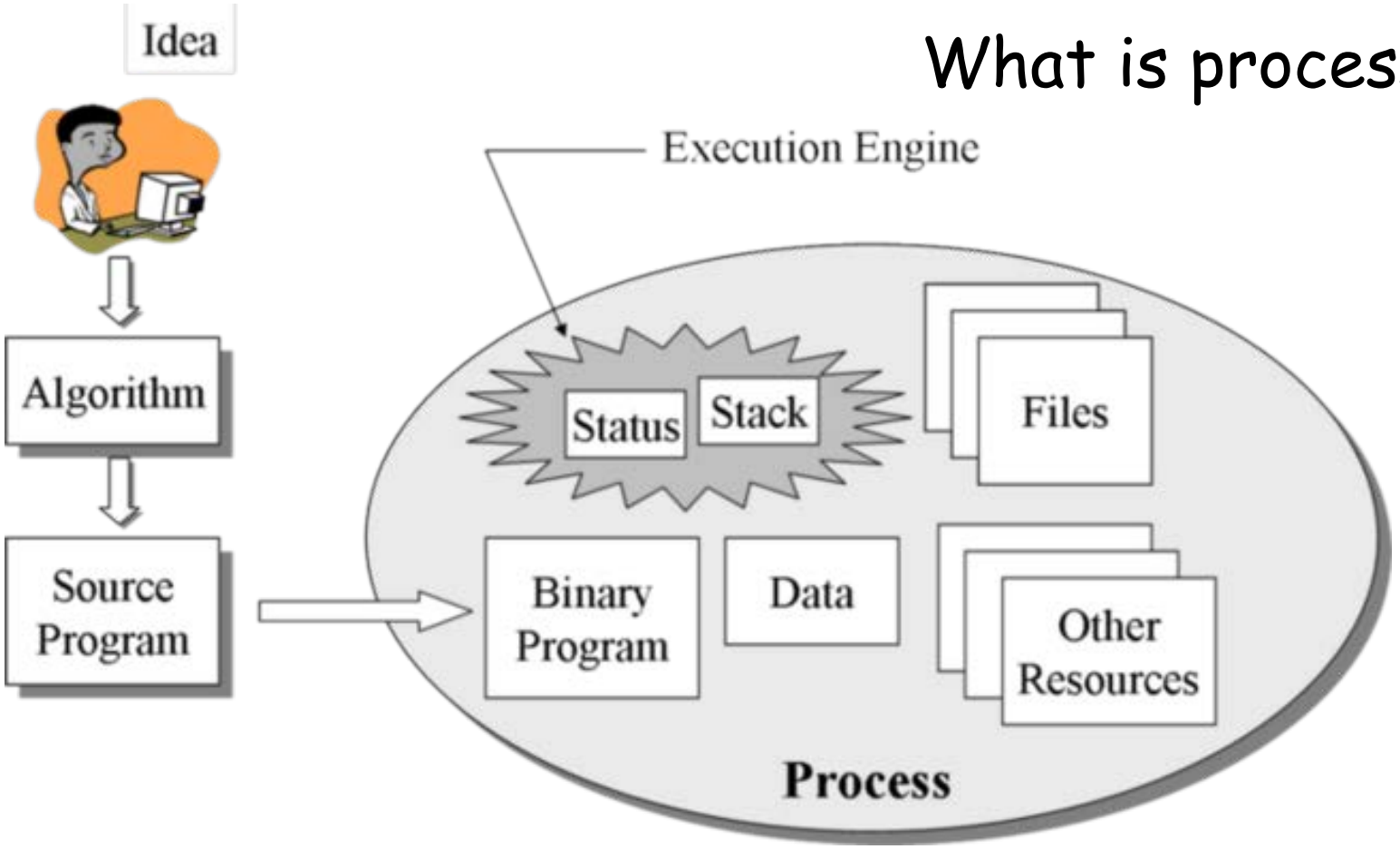


When to switch from user mode to kernel mode?

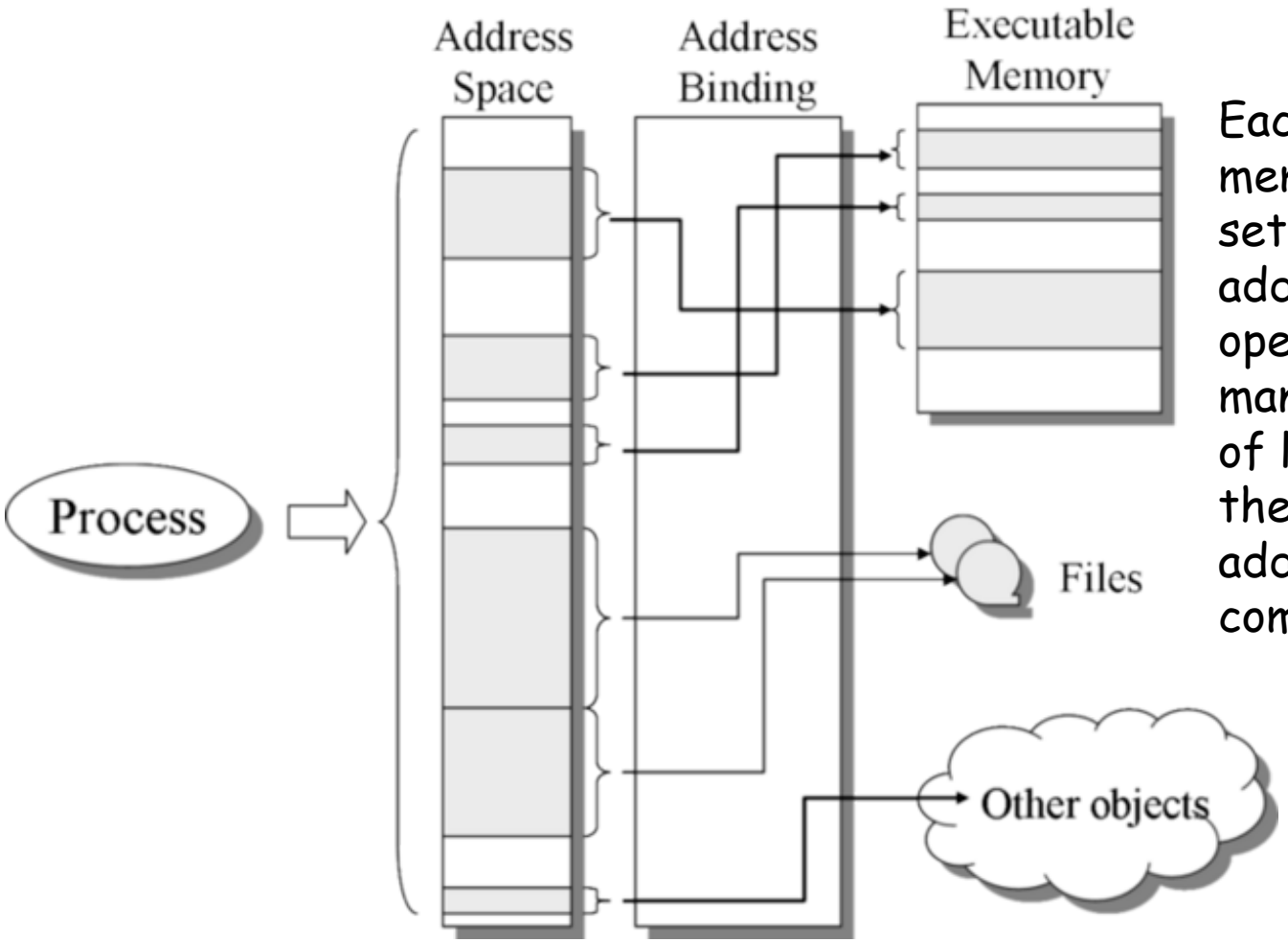
Processes management

2. Processes Management

What is process?



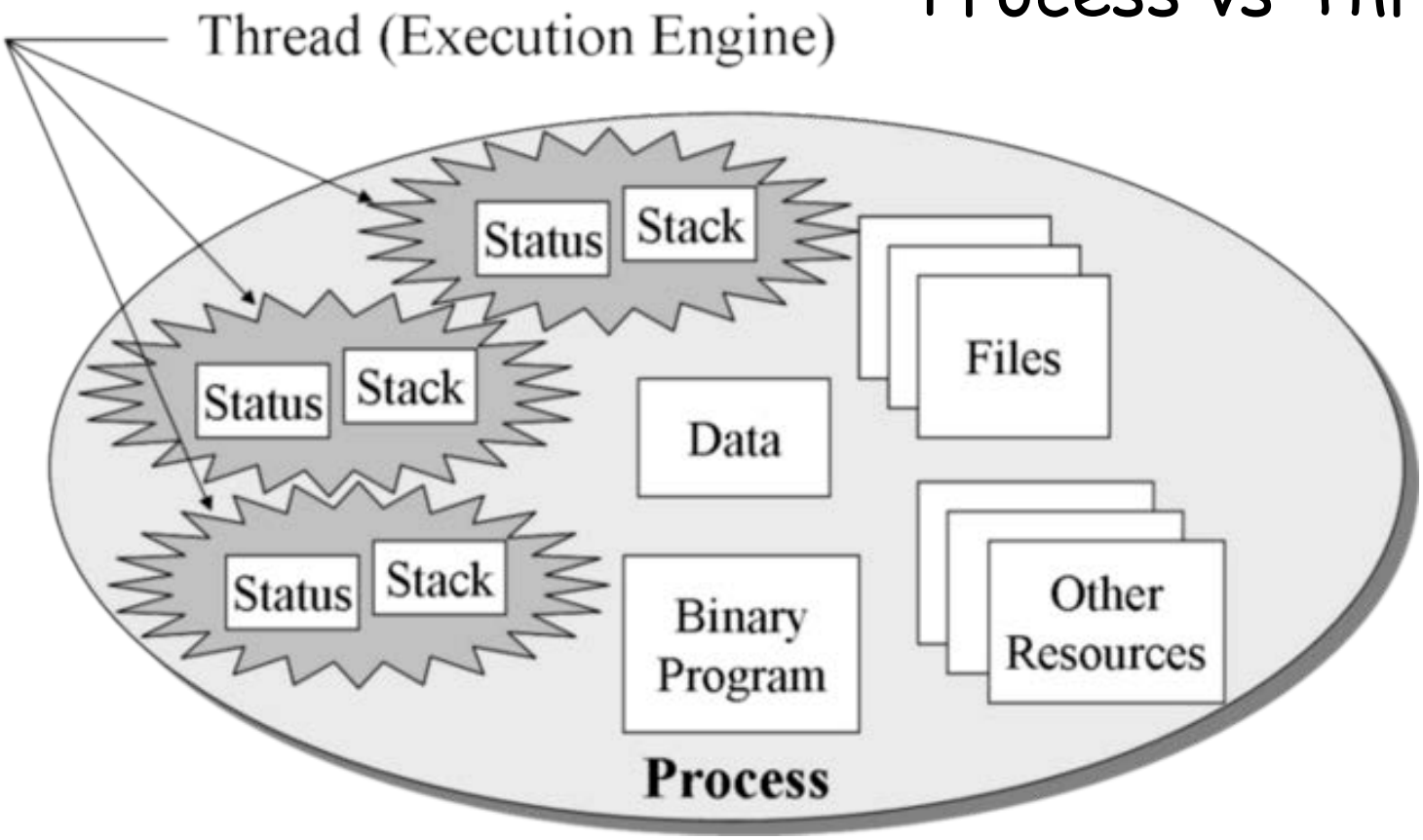
2.1 Address Space



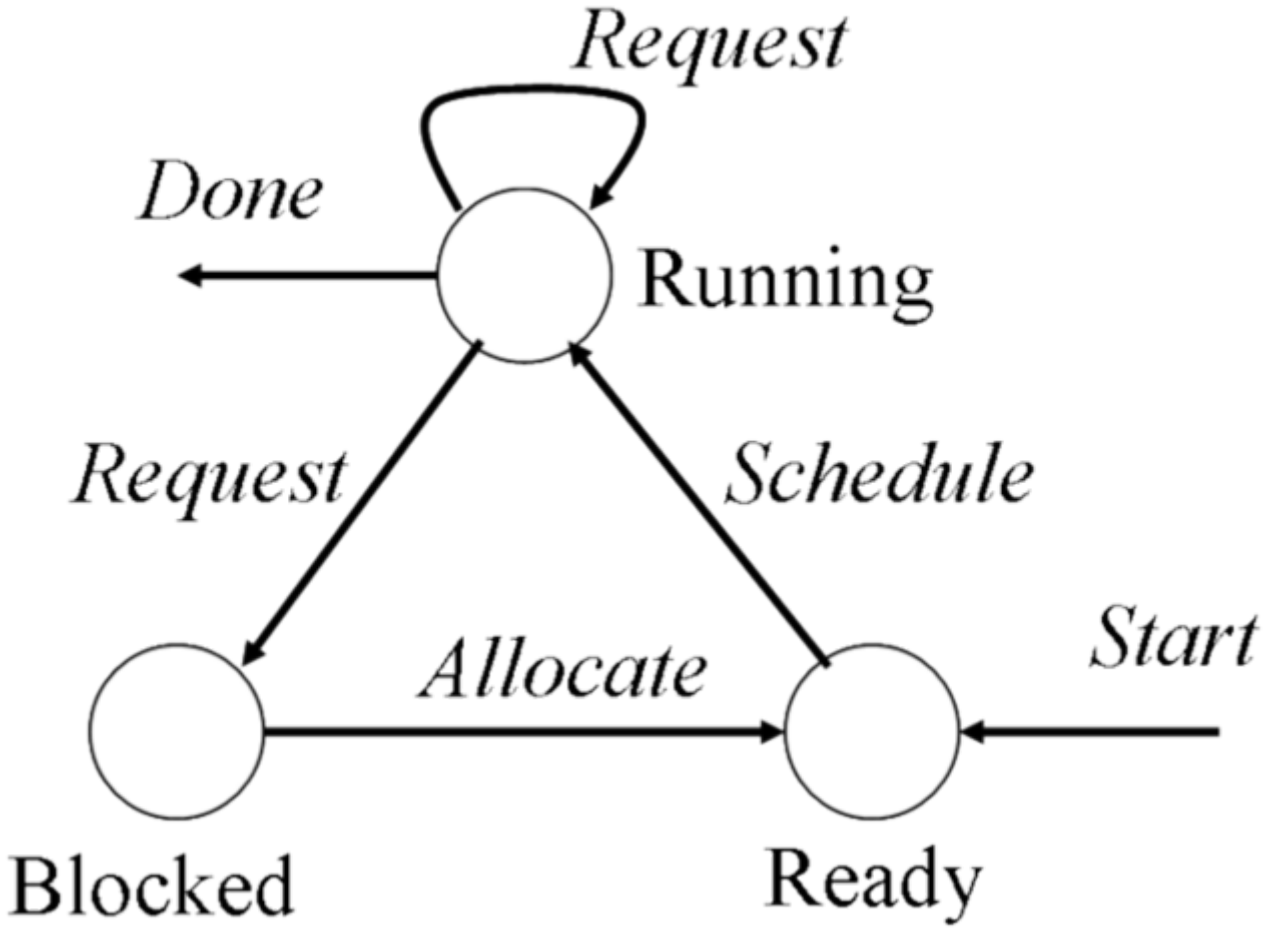
Each process views its memory as a contiguous set of logical memory addresses. The operating system manages the translation of logical addresses to the physical memory addresses of the computer.

2.2 Multi-threaded Process

Process vs Thread?

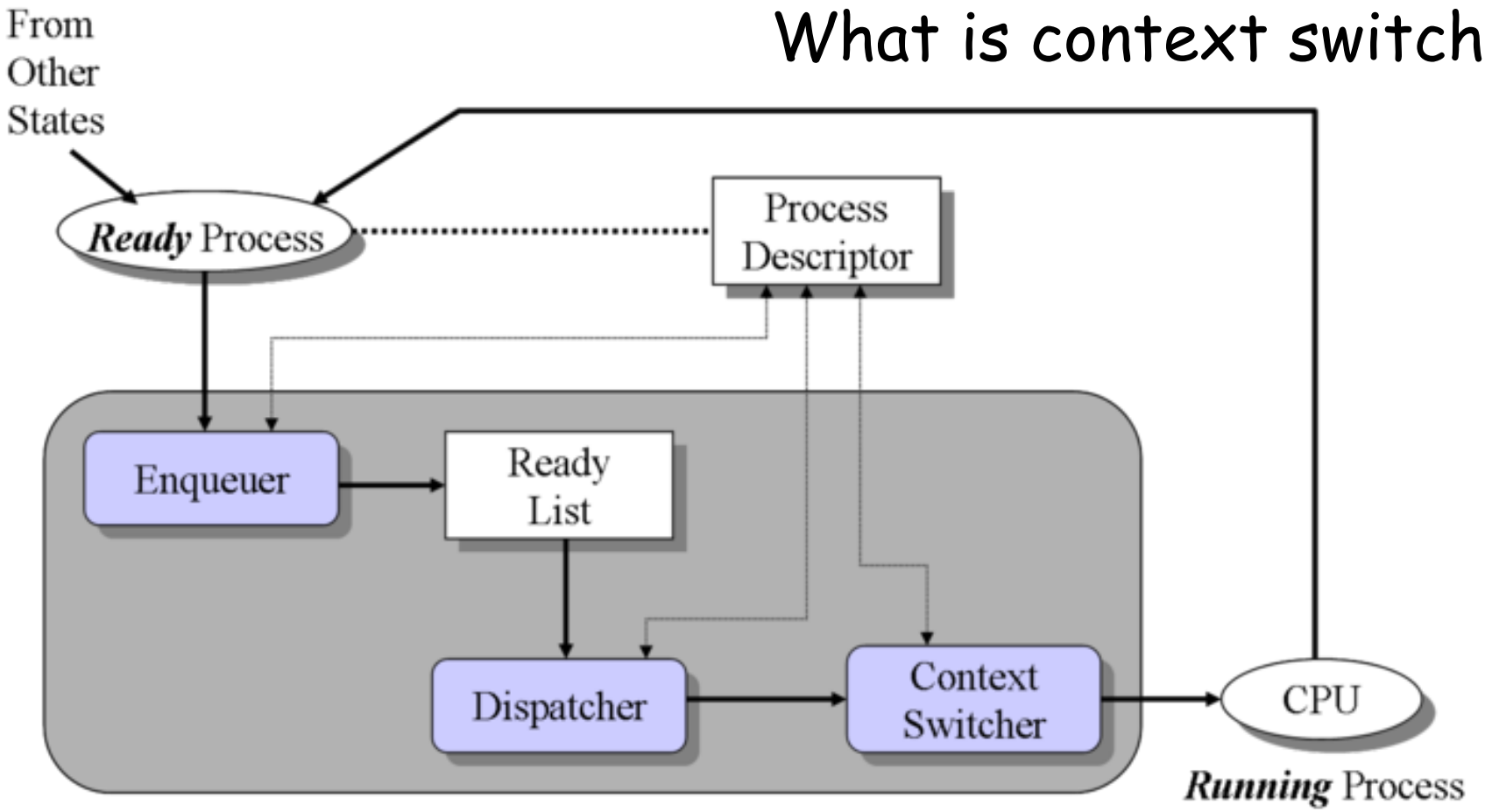


2.3 Process Finite State Diagrams



2.4 Process Scheduler

What is context switch?

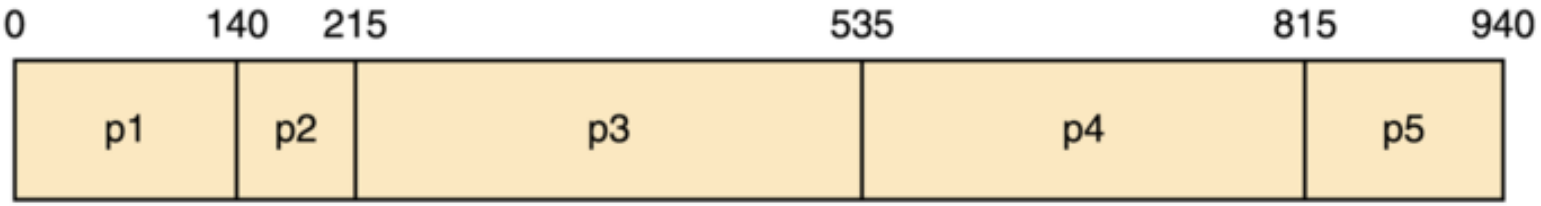


2.5 Scheduler Metrics

- CPU Utilization
- Throughput
- Waiting time
- Service time
- Turnaround time for a process
- Response time

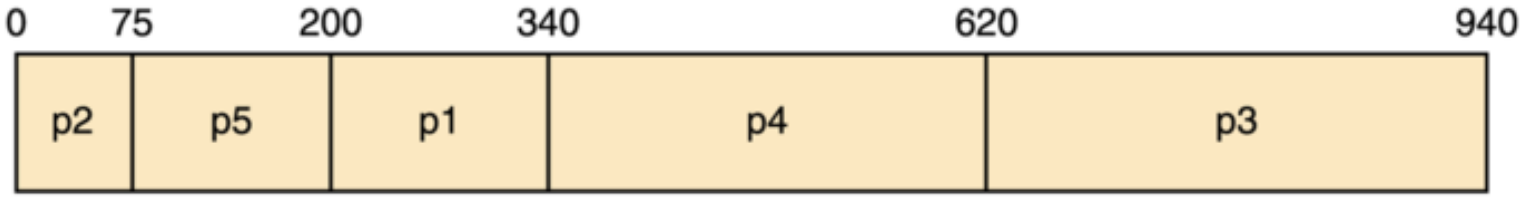
2.5.1 First Come, First Served Scheduler

Process	Service time
p1	140
p2	75
p3	320
p4	280
p5	125



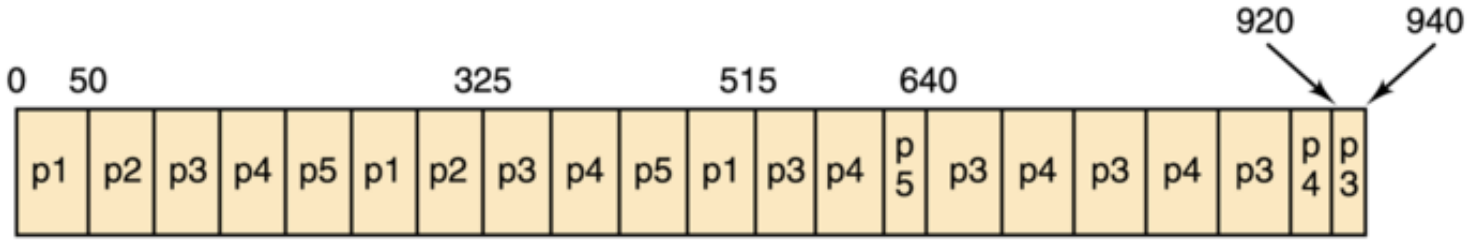
2.5.2 Shortest Job Next Scheduler

Process	Service time
p1	140
p2	75
p3	320
p4	280
p5	125



2.5.3 Round Robin Scheduler

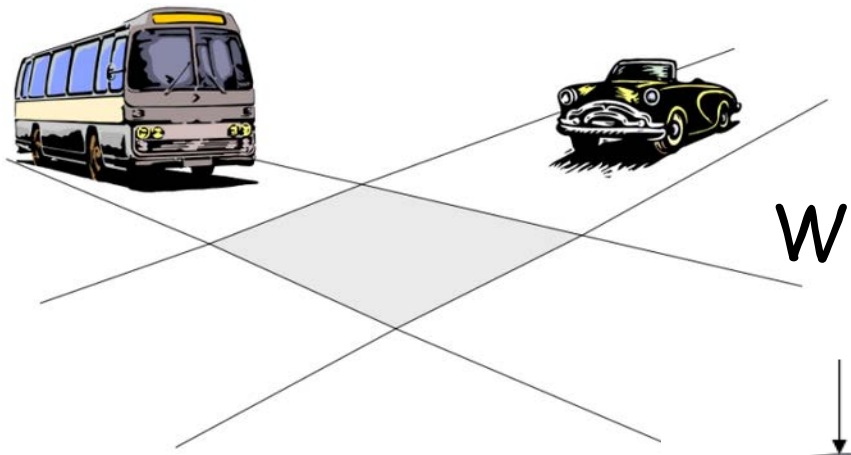
Process	Service time
p1	140
p2	75
p3	320
p4	280
p5	125



Interprocess Communication and Synchronization

3. IPC and Synchronization

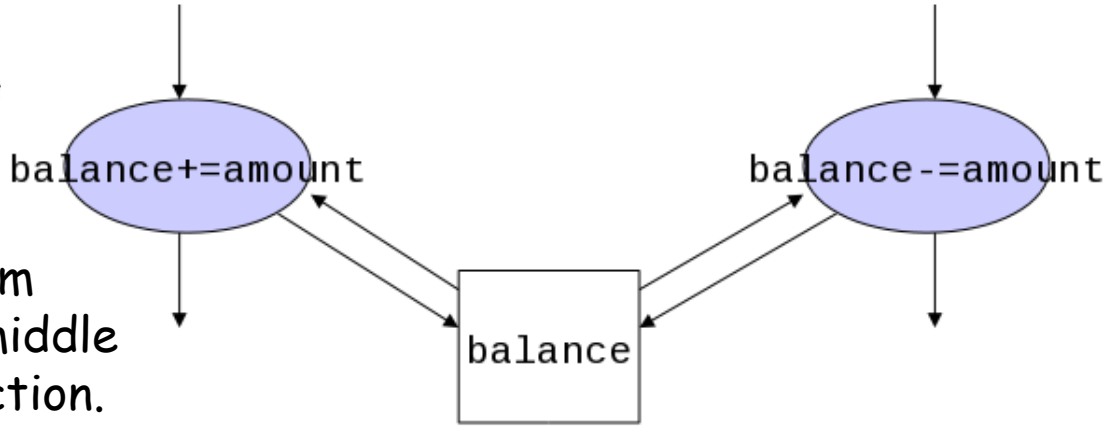
- Potential IPC problems



Race condition?

Critical region?

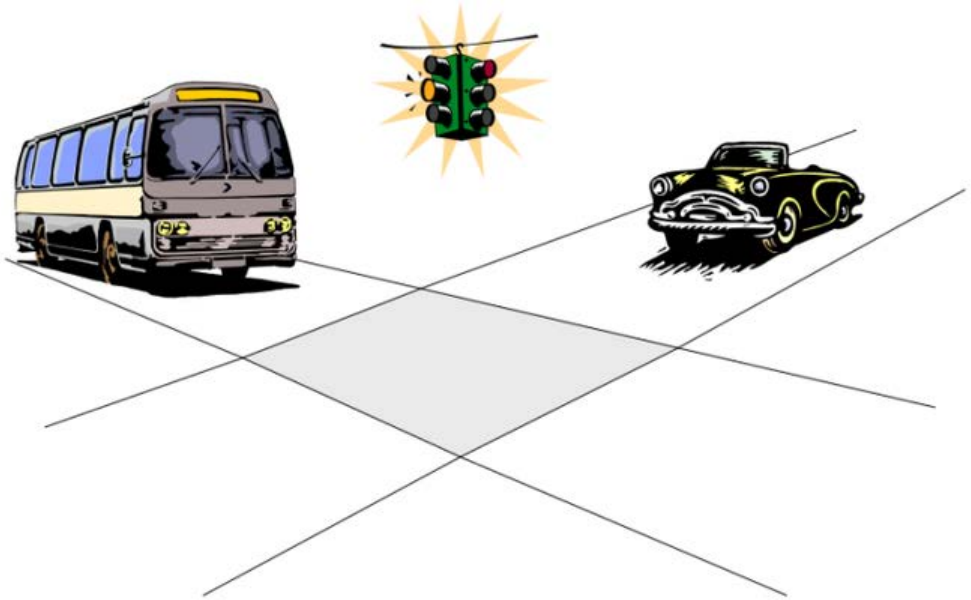
What is data inconsistency?



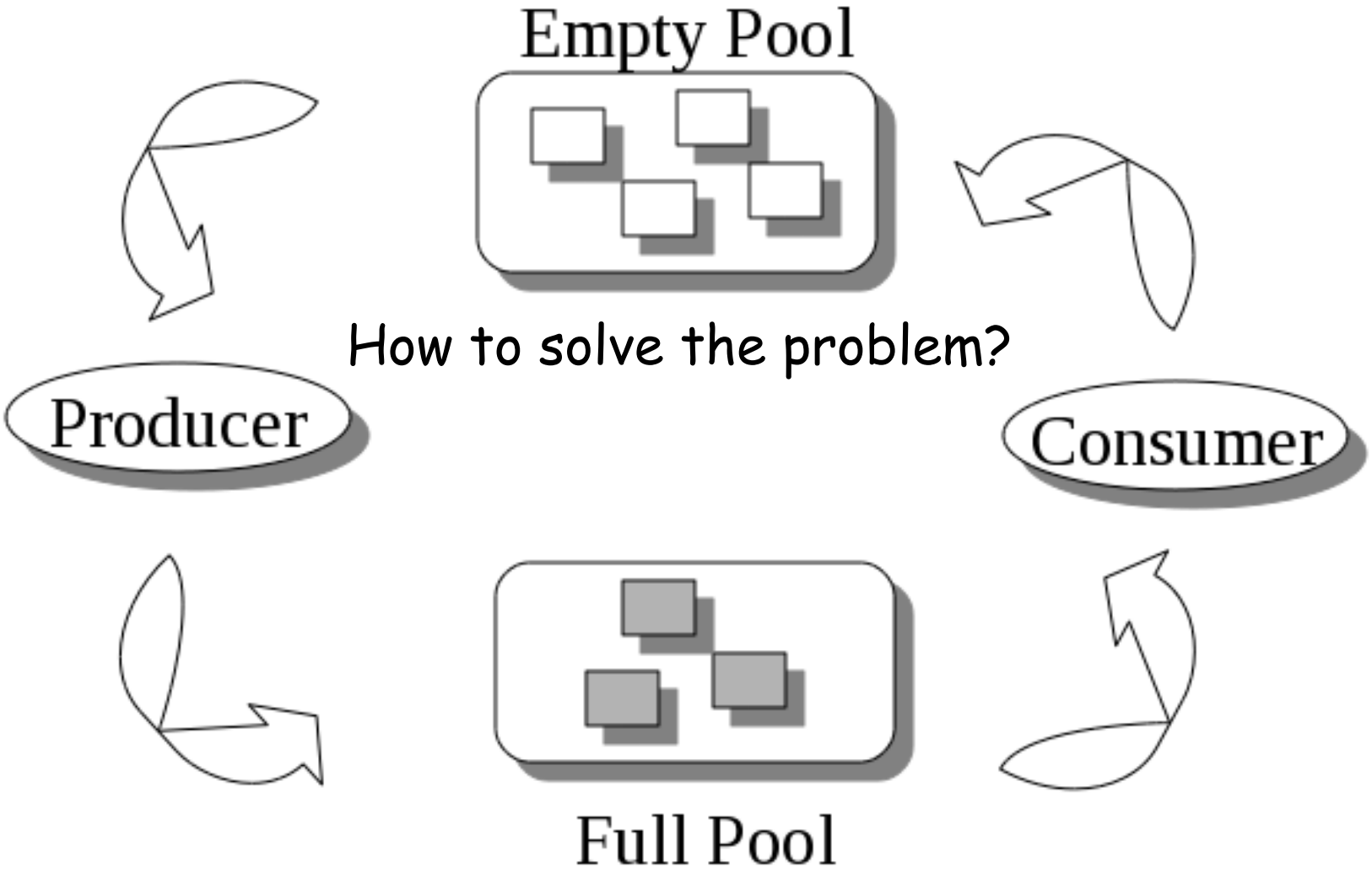
The root of the problem stems from a context switch occurring in the middle of the execution of the critical section.

3.1 Possible solutions

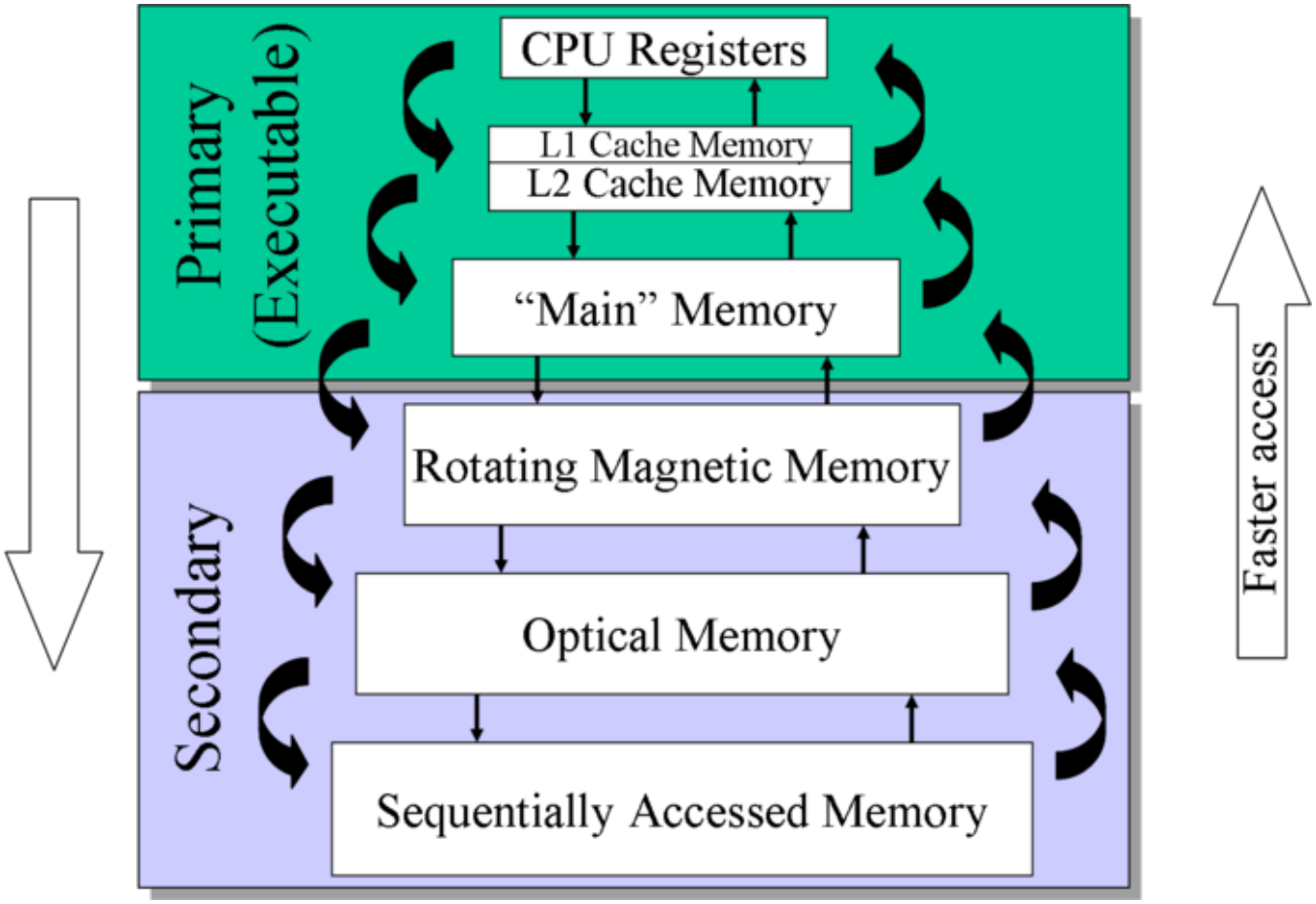
- Software solution
- Disable interrupts
- Mutex and Semaphore



3.2 Bounded Buffer (Producers and Consumers)

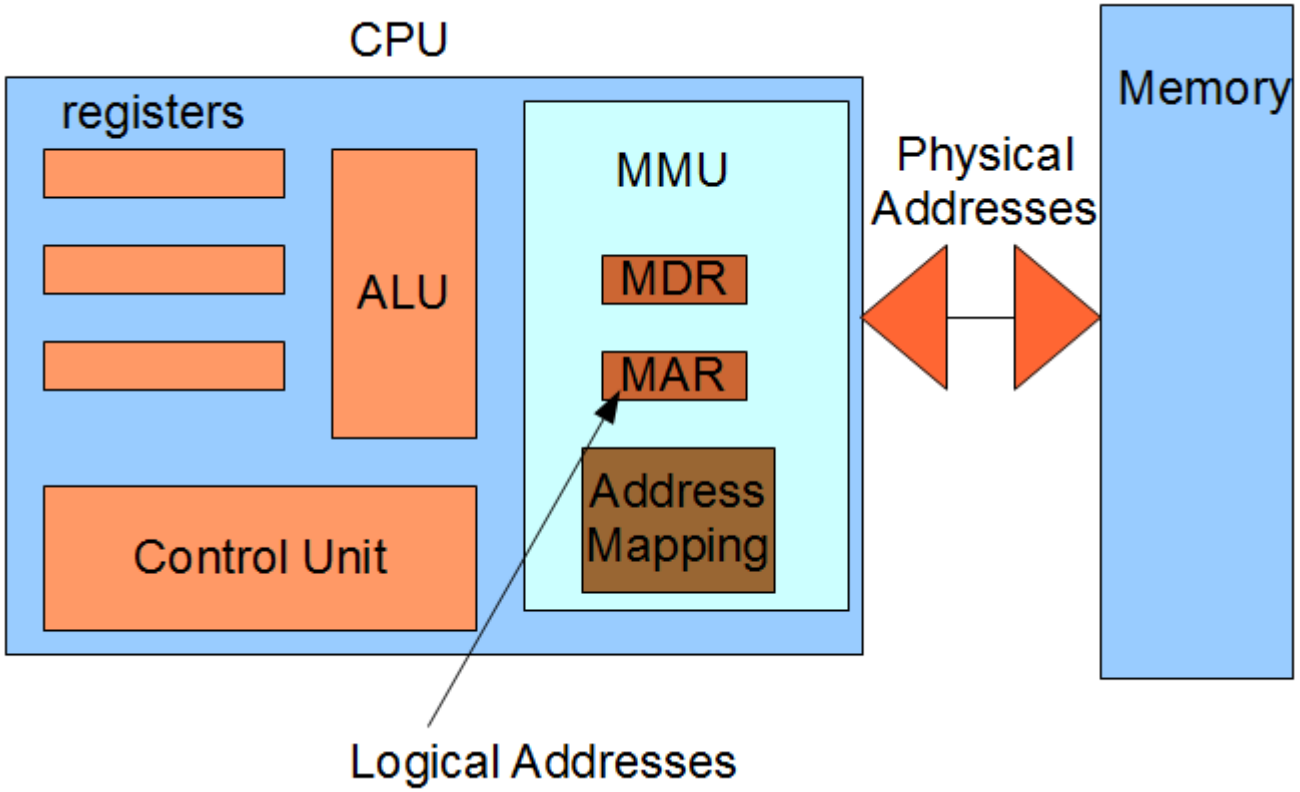


4. Memory Management

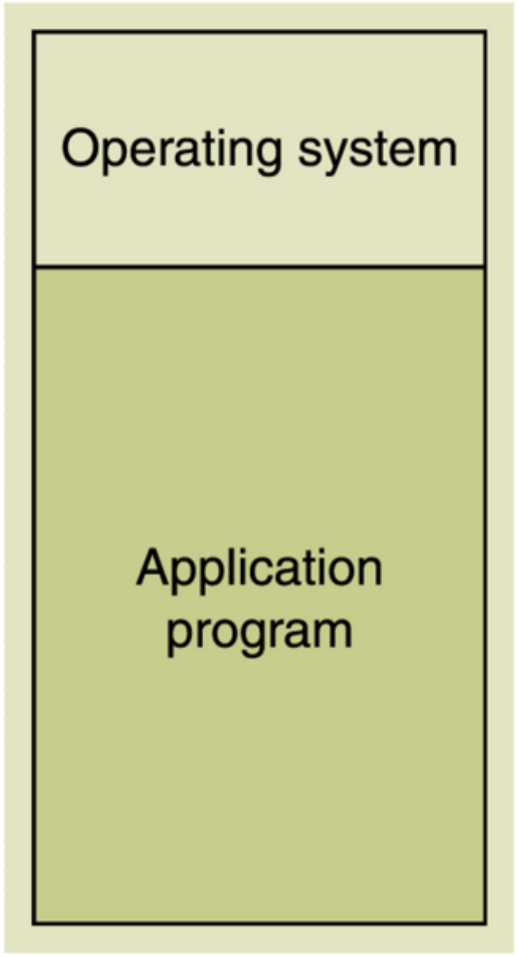


4.1 Memory Management Unit

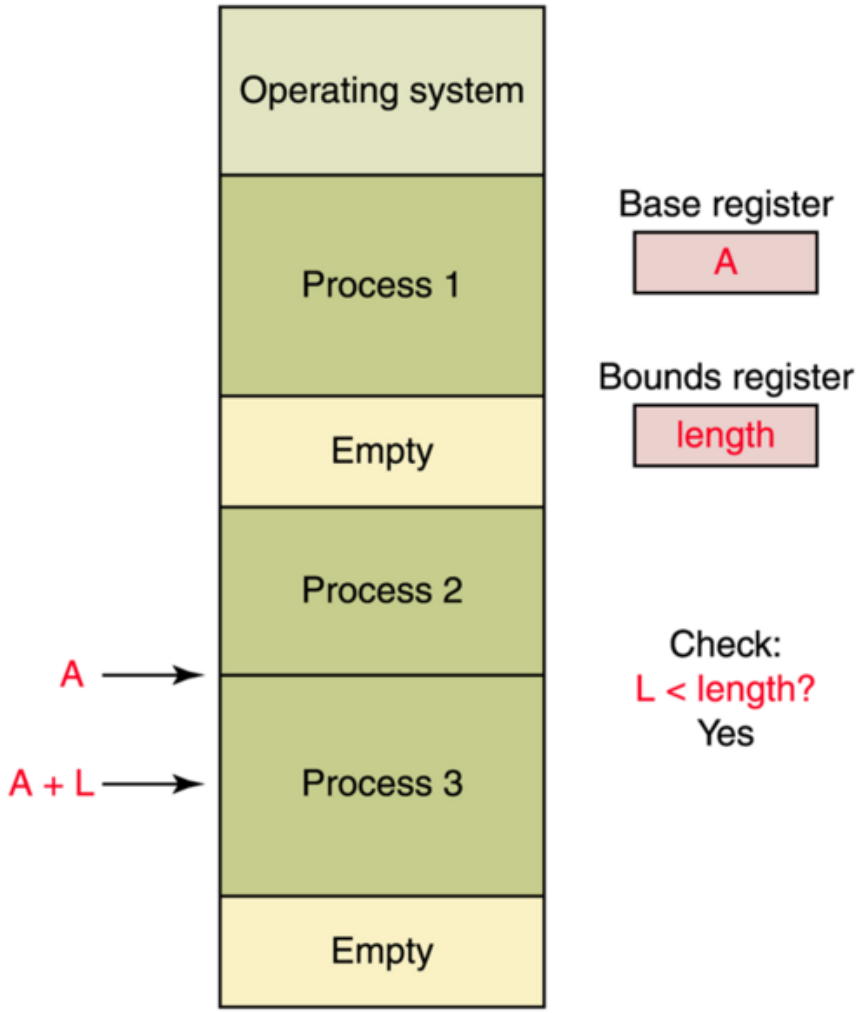
What is the task of MMU?



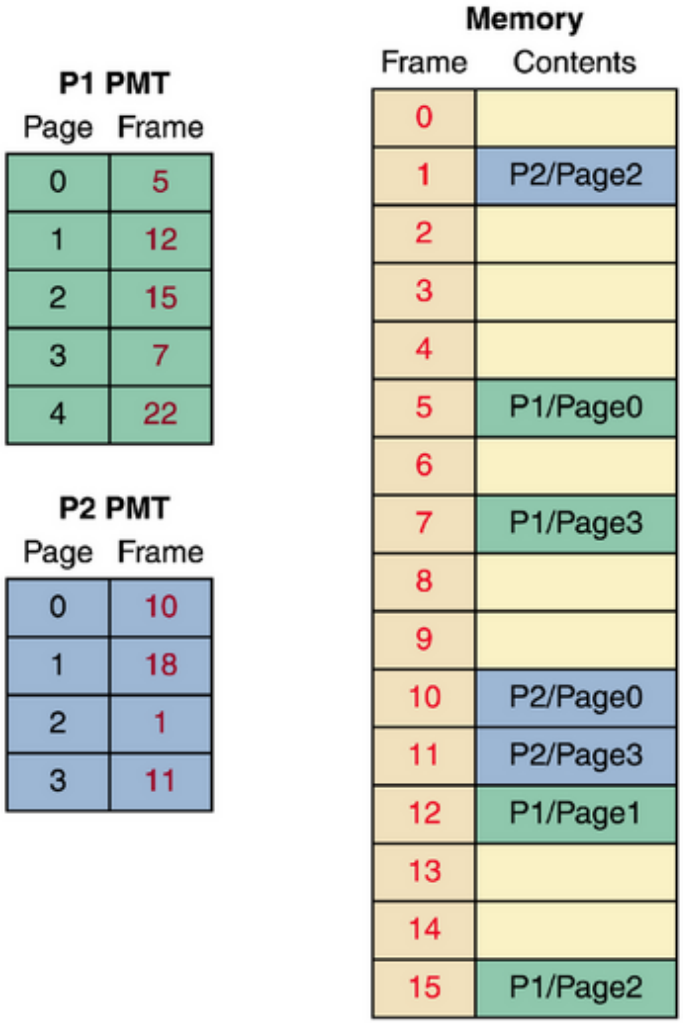
4.2 Single Contiguous Allocation



4.3 Partitioned Allocation



4.4 Paged Memory Management



A page is a unit of logical memory of a program

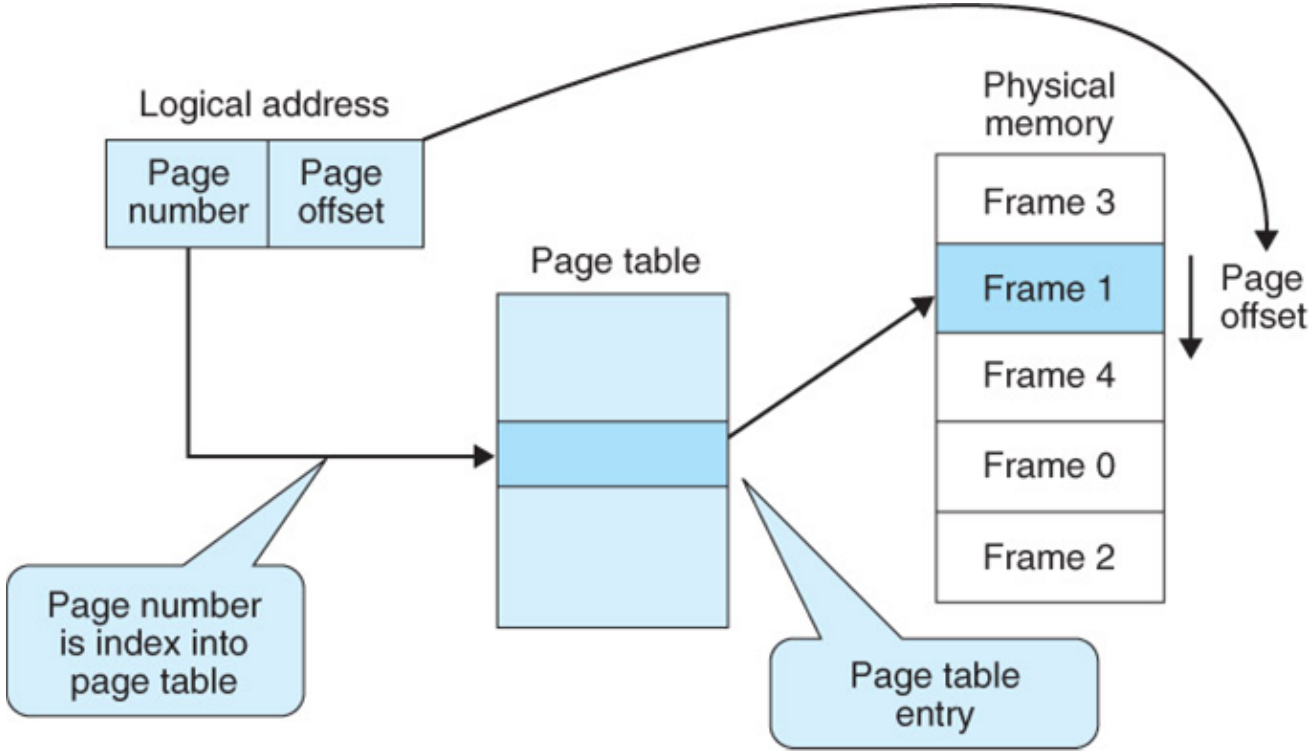
A frame is a unit of physical memory

All pages are of the same size

All frames are of the same size

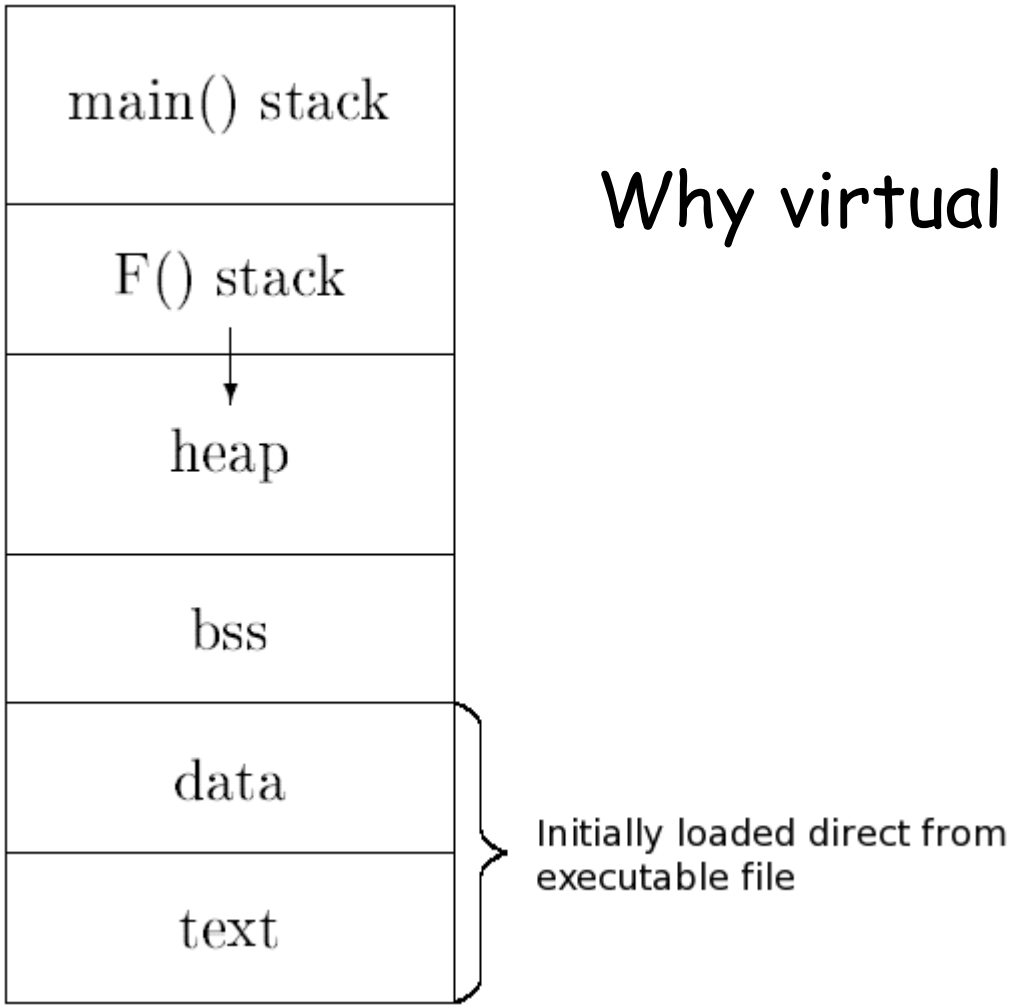
A frame is of the same size as a page

4.4.1 Using the Page Table



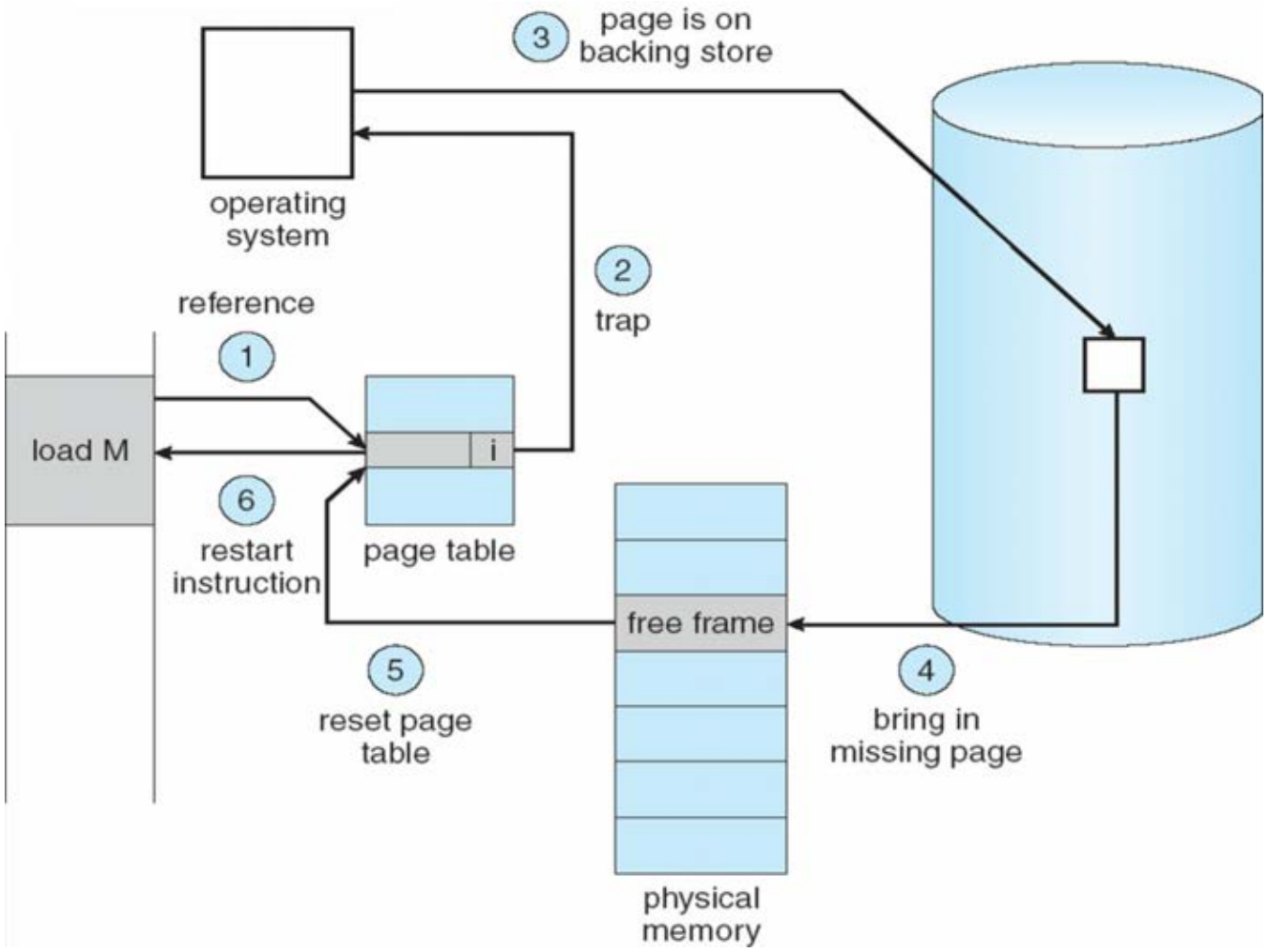
To produce a physical address, you first look up the page in the PMT to find the frame number in which it is stored. Then multiply the frame number by the frame size and add the offset to get the physical address. A page table is kept in main memory. It is part of the process control block (PCB) for each process.

4.4.2 Virtual Memory Management

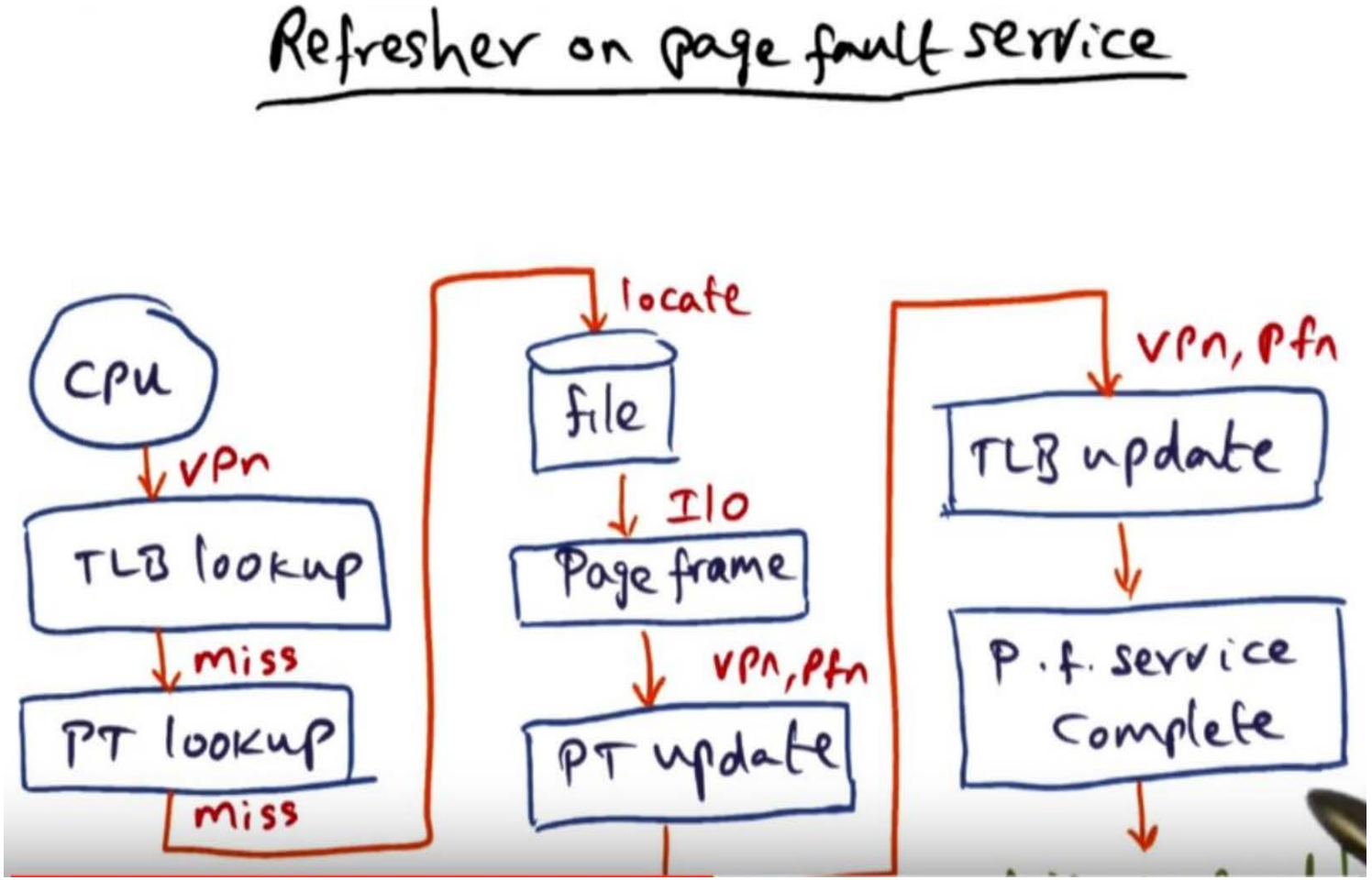


Why virtual memory?

4.4.3 Page Faults



4.4.4 Handling of a Page Fault



4.5 Page Replacement Algorithms

- First-In-First-Out (FIFO) Replacement

Page reference stream:

1	2	3	2	1	5	2	1	6	2	5	6	3	1	3	6	1	2	4	3
1	1	1	1	1	2	2	3	5	1	6	6	2	5	5	3	3	1	6	2
	2	2	2	2	3	3	5	1	6	2	2	5	3	3	1	1	6	2	4
		3	3	3	5	5	1	6	2	5	5	3	1	1	6	6	2	4	3
*	*	*			*		*	*	*	*		*	*		*		*	*	*

FIFO

Total 14 page faults

4.5 Page Replacement Algorithms

- Least Recently Used (LRU) Replacement

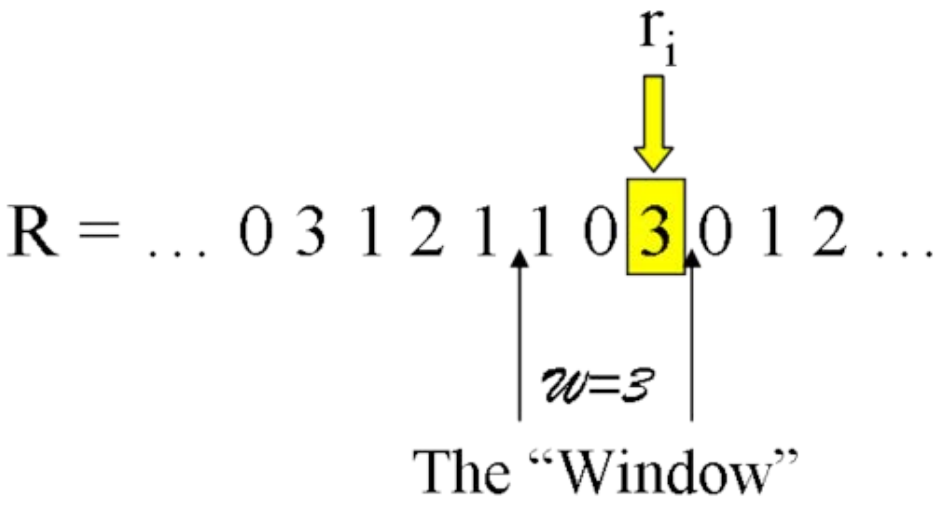
Page reference stream:

1	2	3	2	1	5	2	1	6	2	5	6	3	1	3	6	1	2	4	3
1	1	1	1	3	2	1	5	2	1	6	2	5	6	6	1	3	6	1	2
	2	2	3	2	1	5	2	1	6	2	5	6	3	1	3	6	1	2	4
		3	2	1	5	2	1	6	2	5	6	3	1	3	6	1	2	4	3
*	*	*			*			*		*		*	*				*	*	*

LRU

Total 11 page faults

4.6 The Working Set Model



What is the working set? Dynamical adjust of *w*?

At virtual time i-1: working set = {0, 1}

At virtual time i: working set = {0, 1, 3}

File System Management

5.1 File System Abstractions

- Disk partition

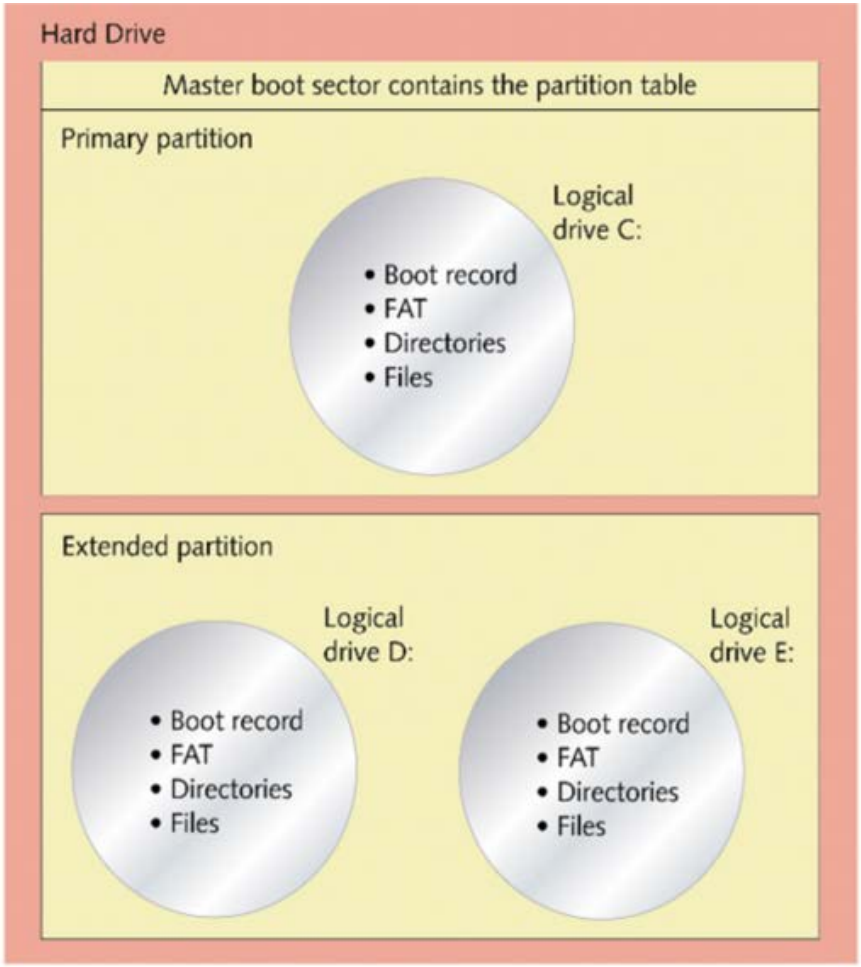
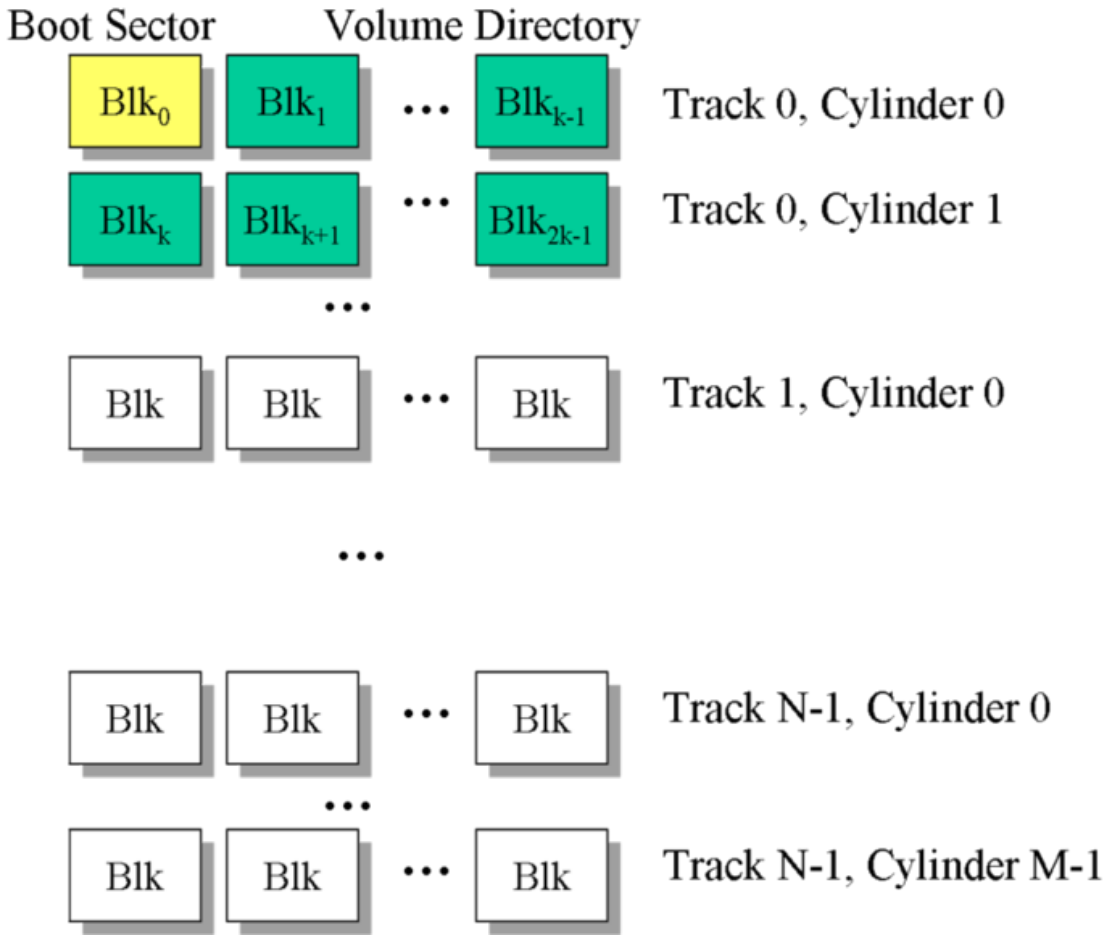


Figure 7-12 A hard drive is divided into one or more partitions that contain logical drives

5.1 File System Abstractions

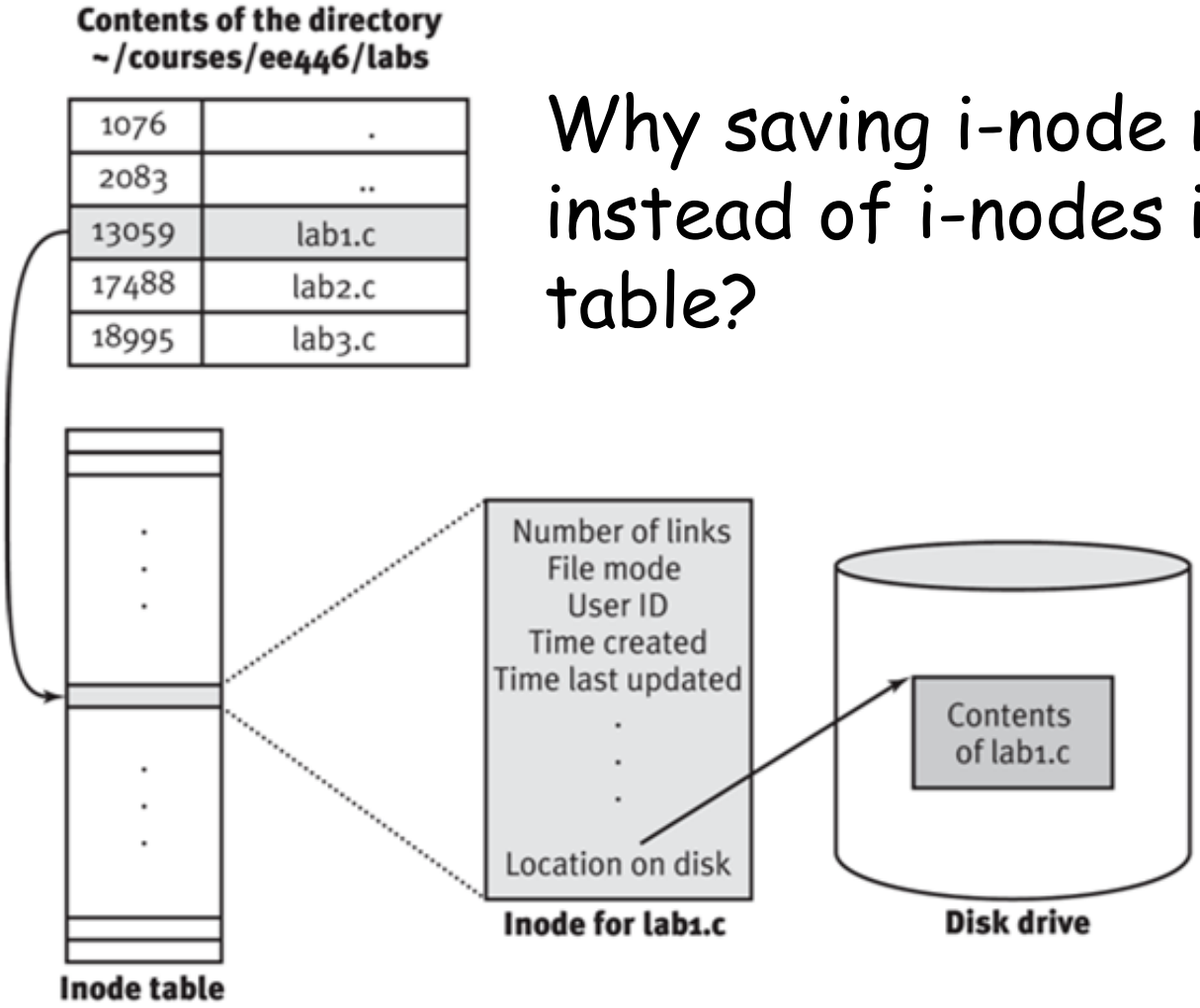
- Disk blocks



5.2 A File

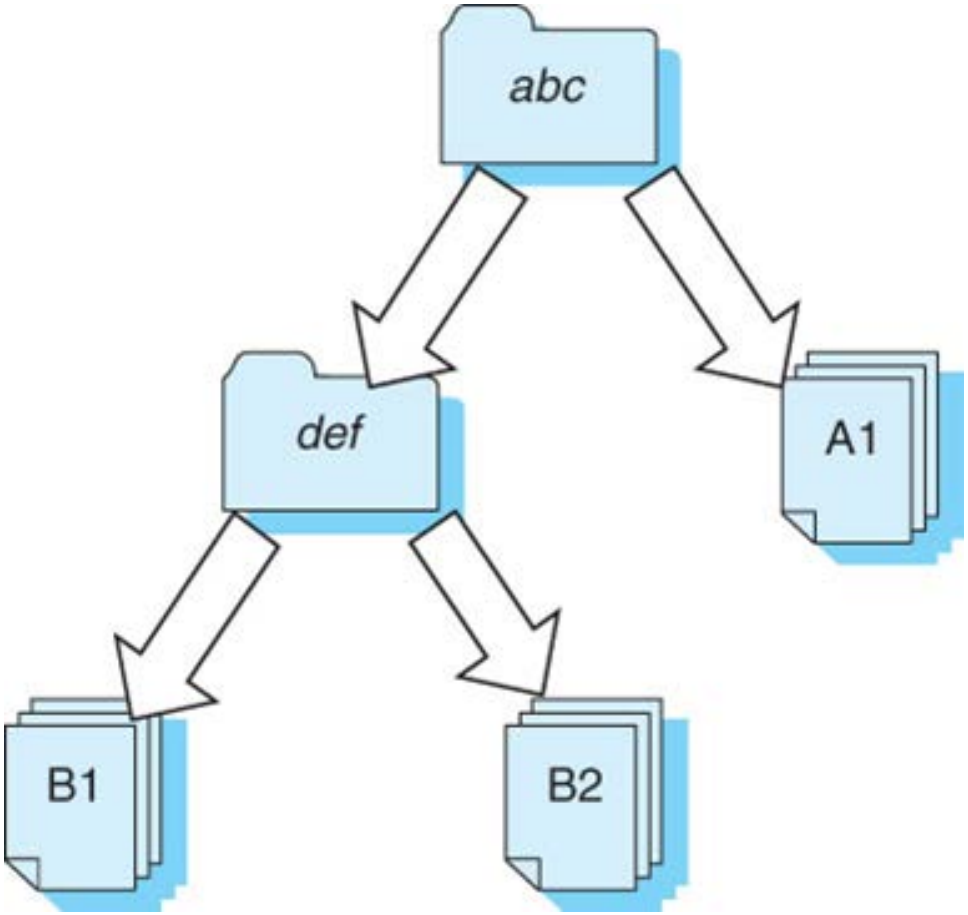
- A file is an ordered collection of data blocks

5.3 Directories and File System Tables

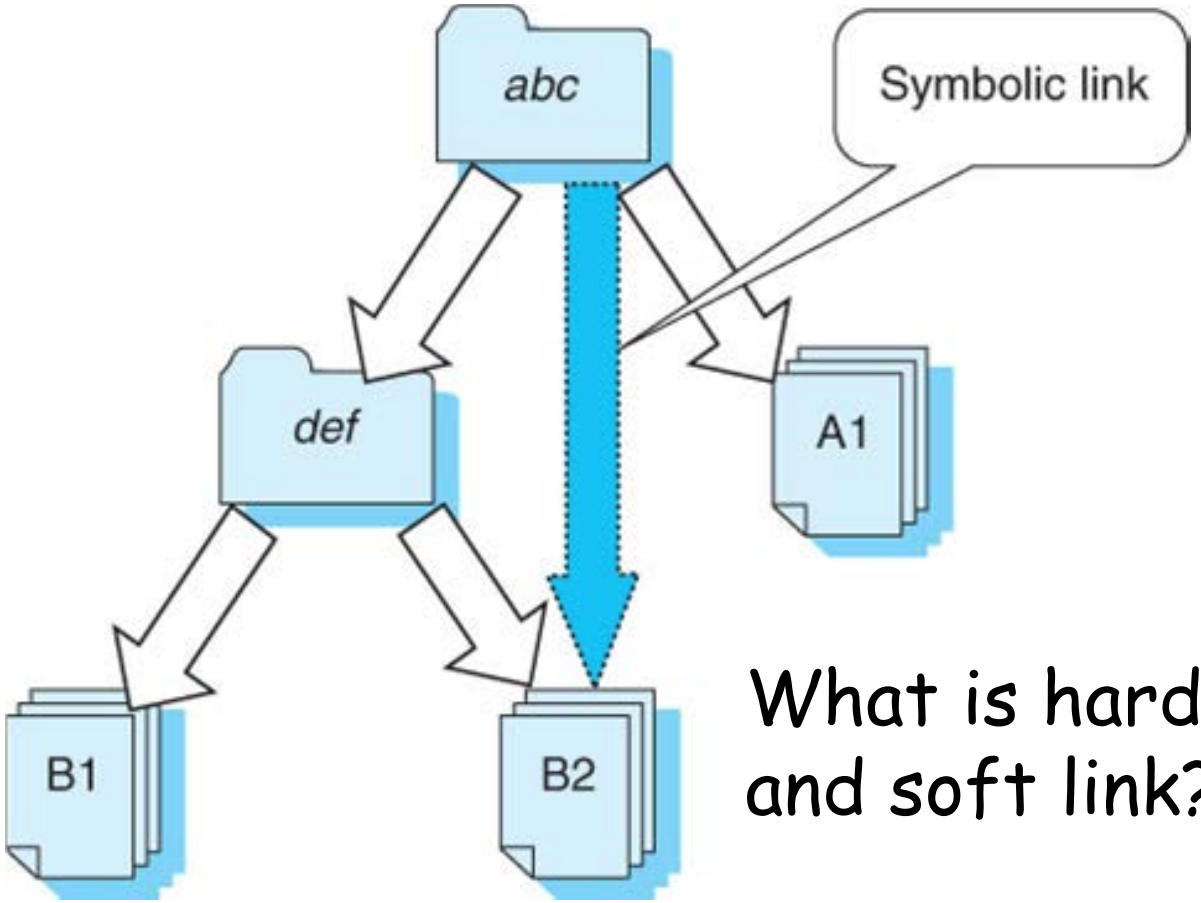


Why saving i-node numbers instead of i-nodes in i-node table?

5.3.1 Directory Trees

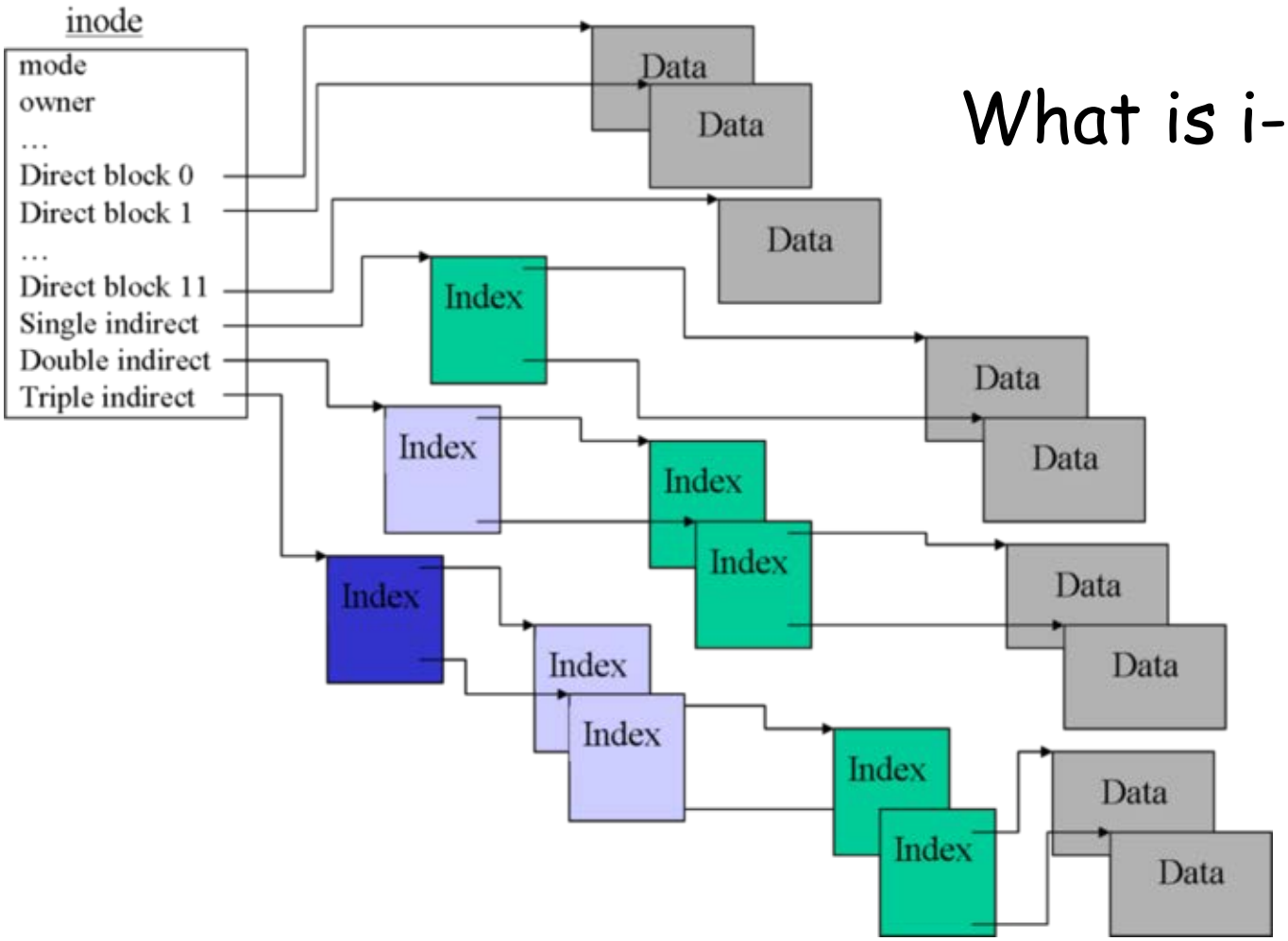


5.3.2 File Object Links



What is hard link and soft link?

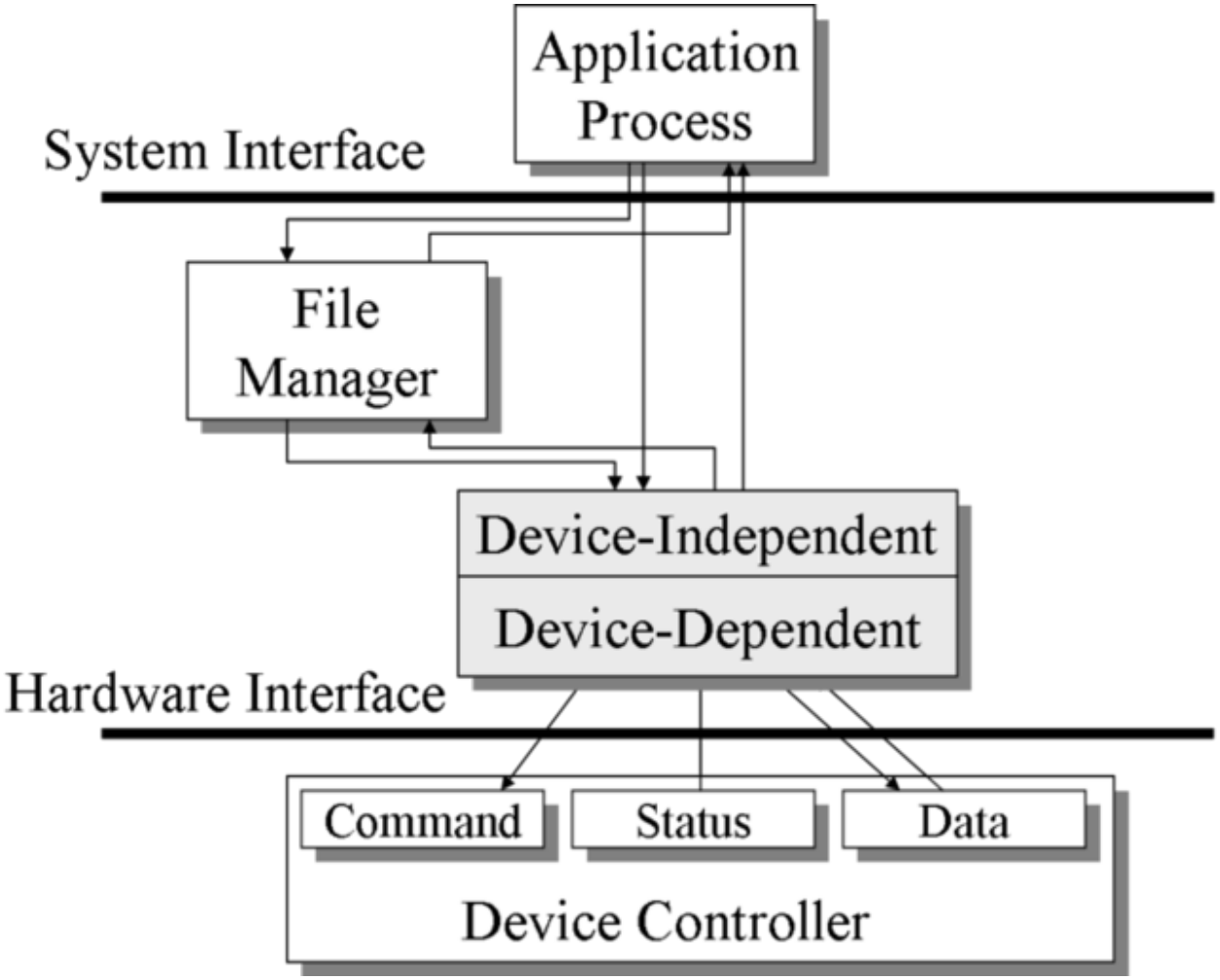
5.4 I-node



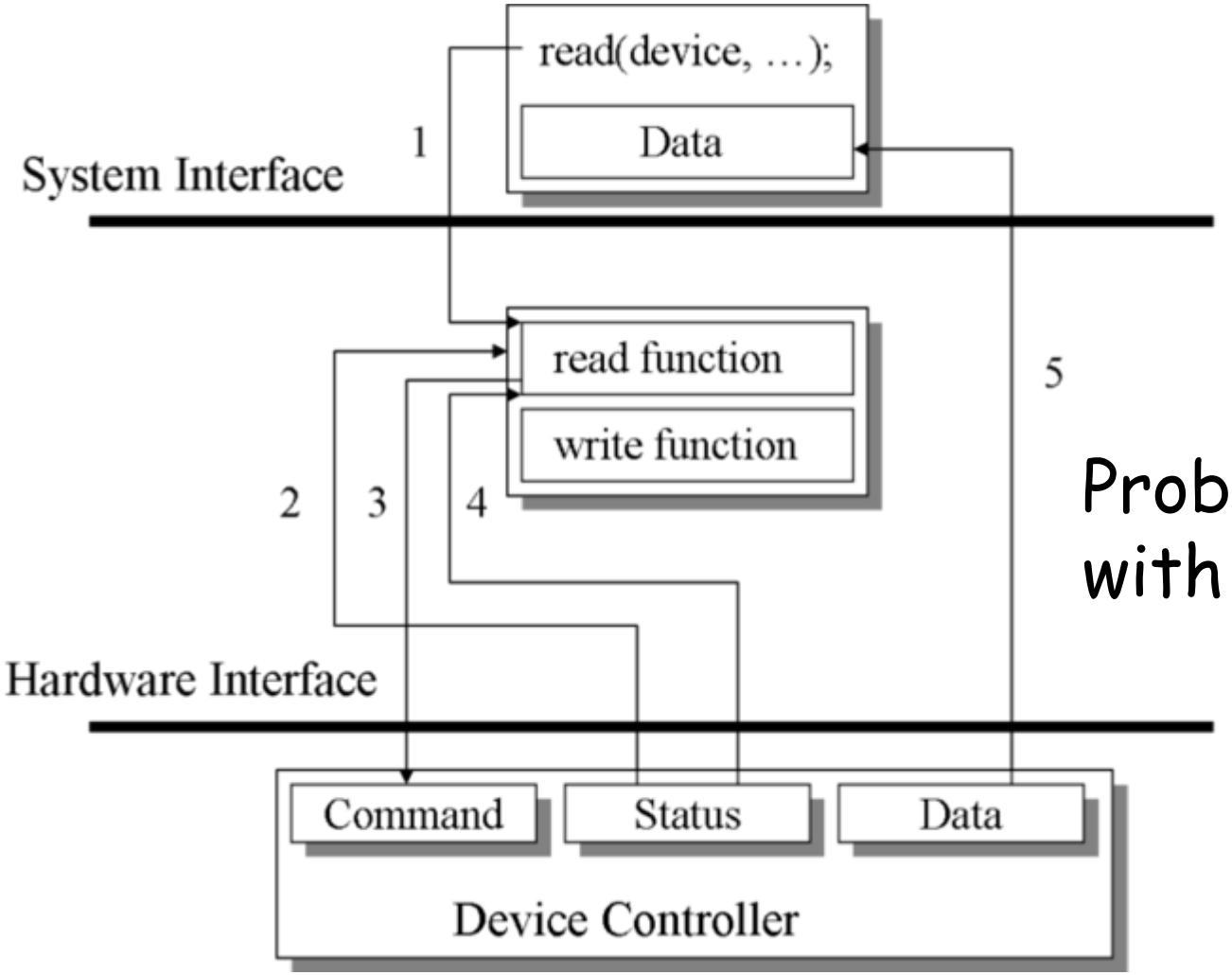
What is i-node?

Input/Output and Deadlocks

6.1 Device Driver Layers

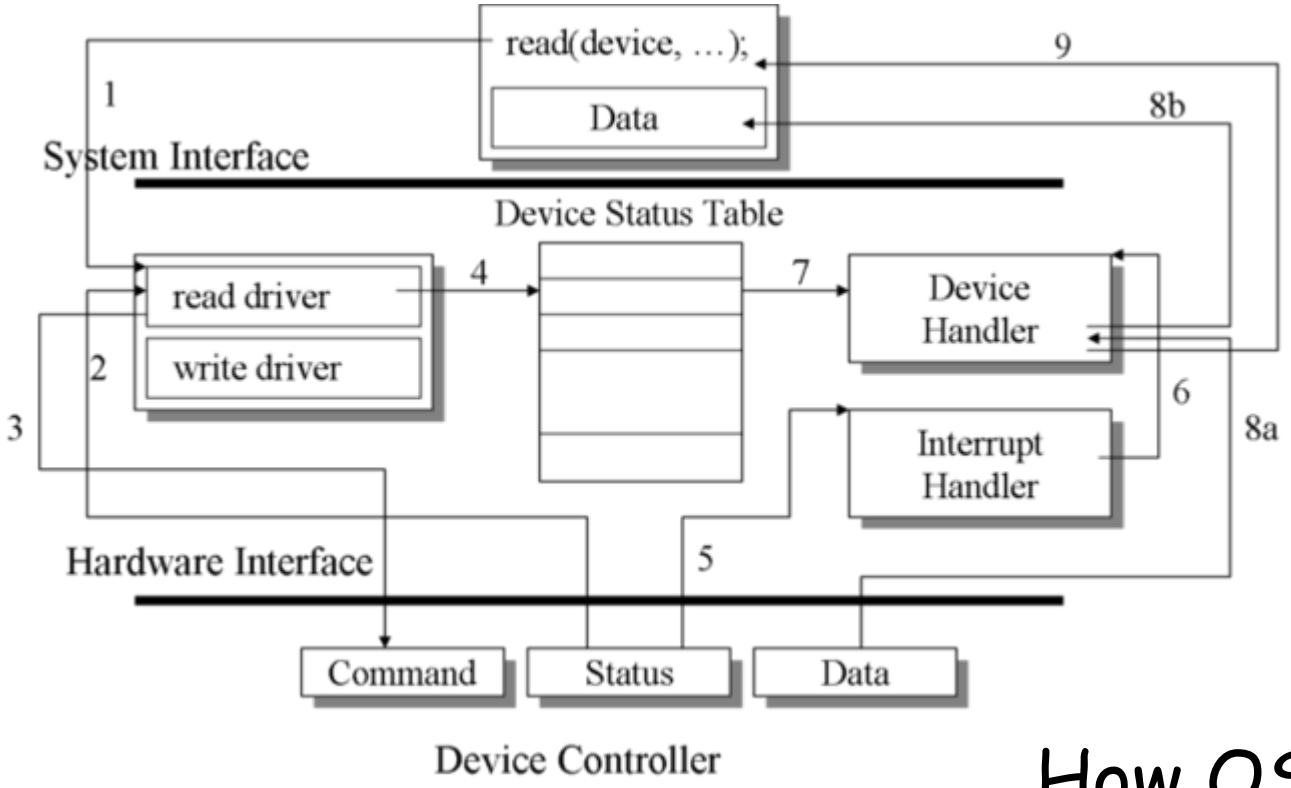


6.2.1 Polling



Problems with polling?

6.2.2. Interrupt Driven



How OS deals with interrupt?

6.3 Deadlocks

A deadlock condition can occur when two processes need multiple shared resources at the same time in order to continue.

How to avoid deadlocks?

Review Tips

- Slides
- Section quiz
- Exam review session
- Text book