[537] Processes

Tyler Harter
9/8/14

0

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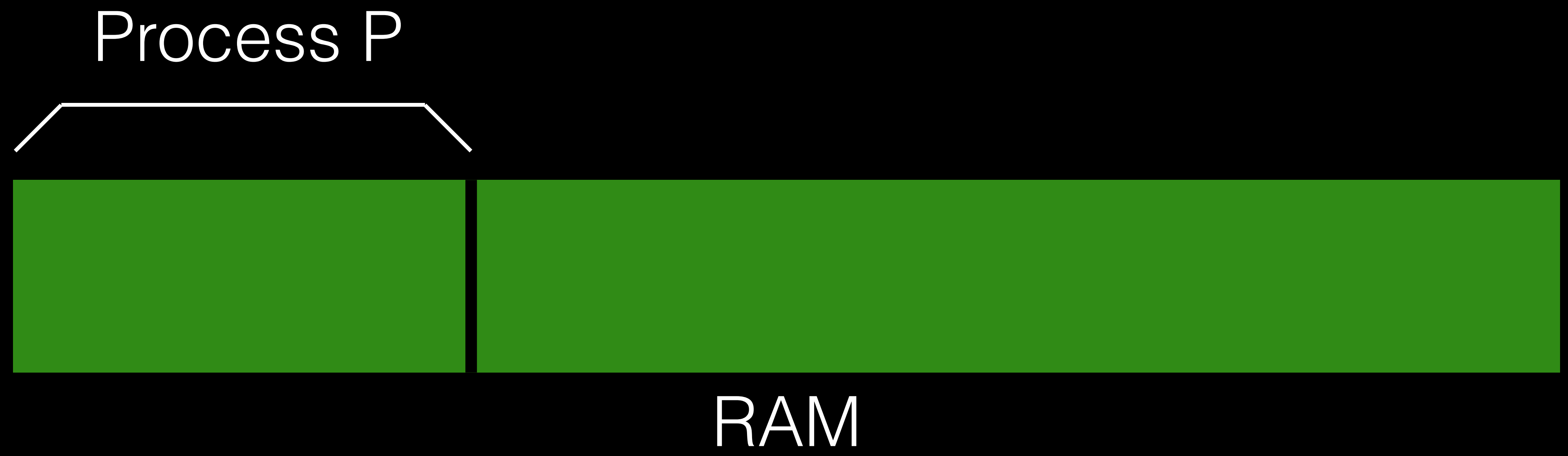
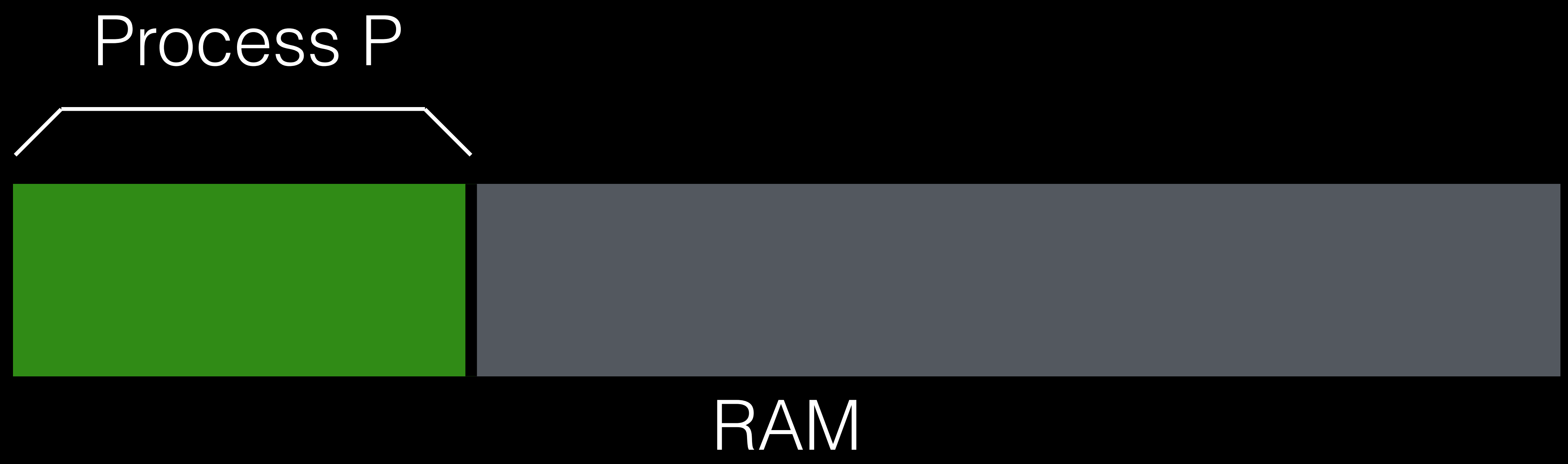
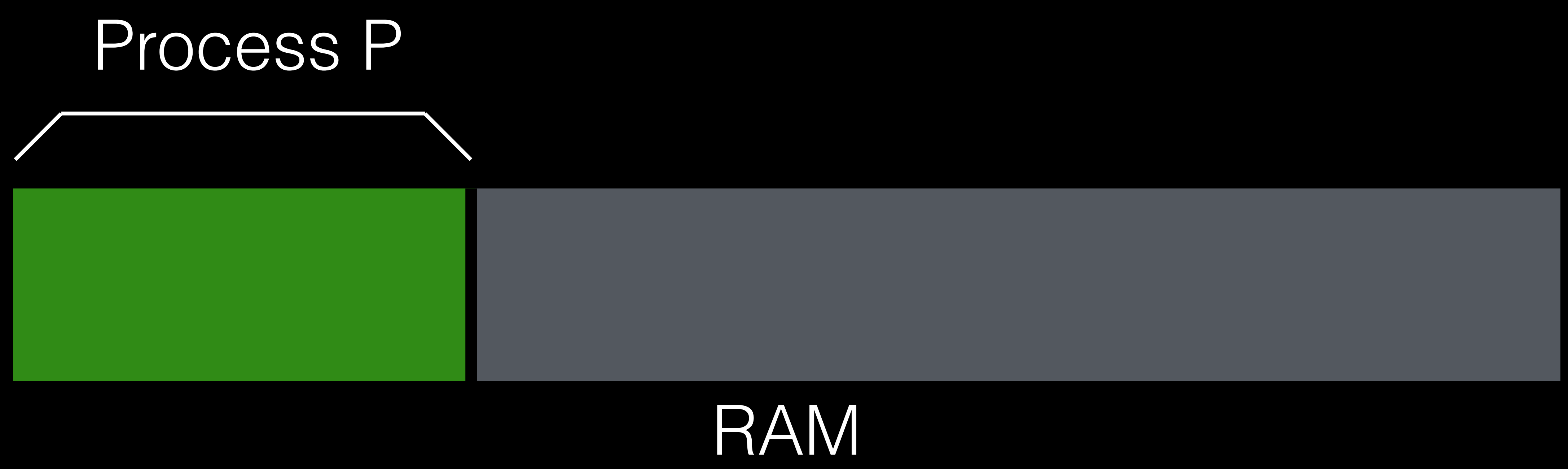
A B C D E F G H I J K L

Review: System Calls

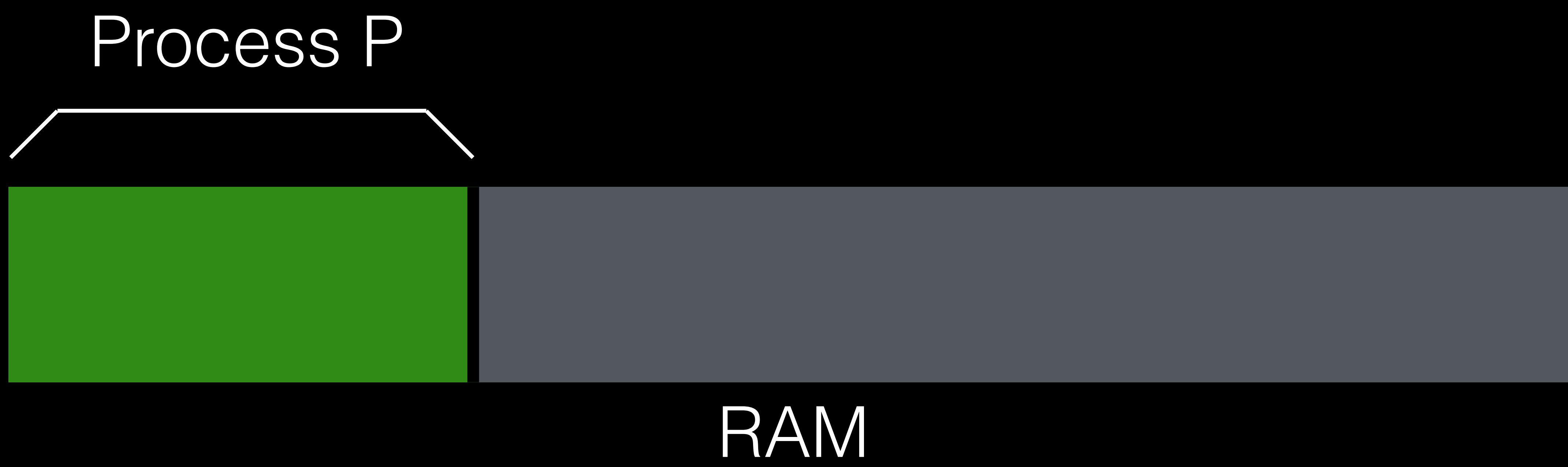

Process P
RAM



P can only see its own memory because of **user mode**
(other areas, including kernel, are hidden)

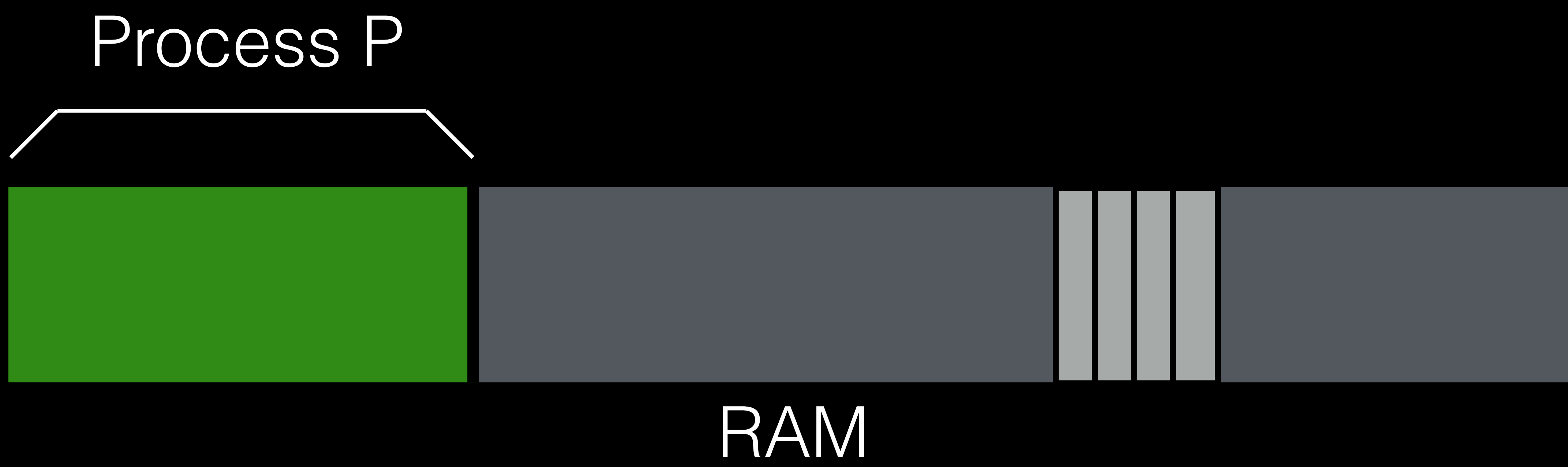


P wants to call read()




```
movl $6, %eax;   int $64
```

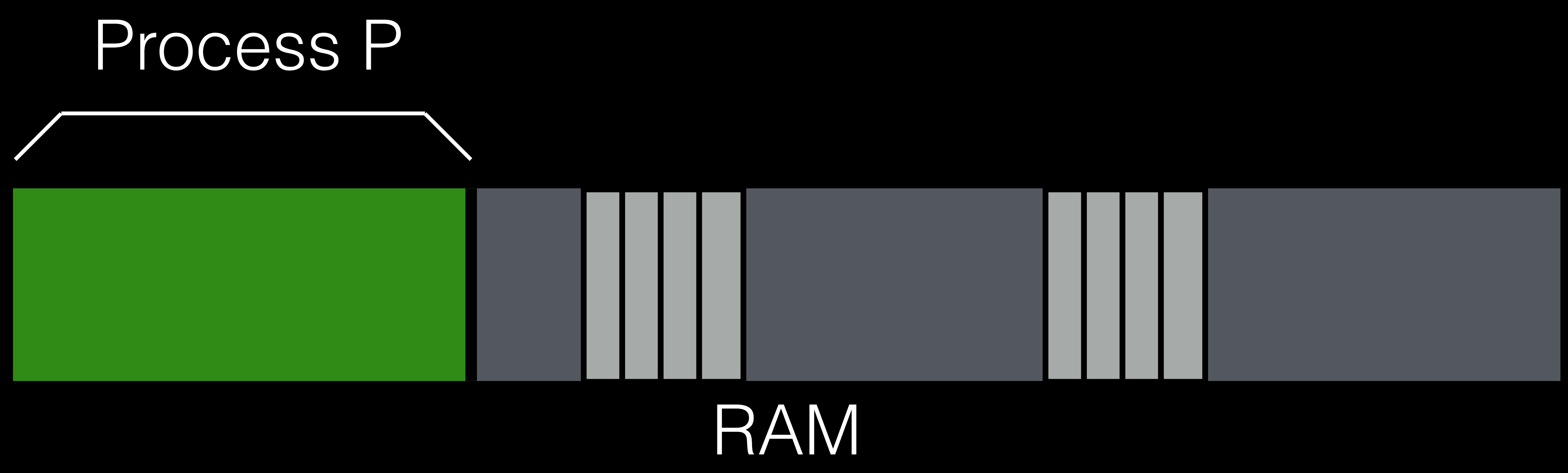
```
static int (*syscalls[])(void)    (syscall.c)
```




```
movl $6, %eax;   int $64
```

syscall-table index

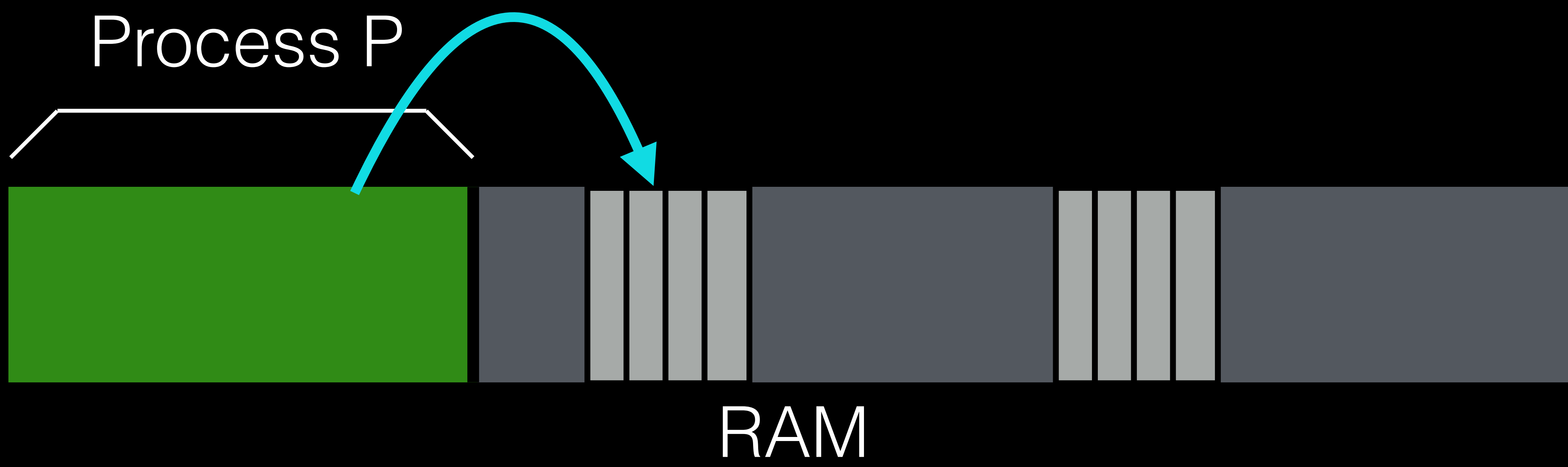
`struct gatedesc idt[256]`   (trap.c)



`movl $6, %eax;    int $64`

syscall-table index

trap-table index

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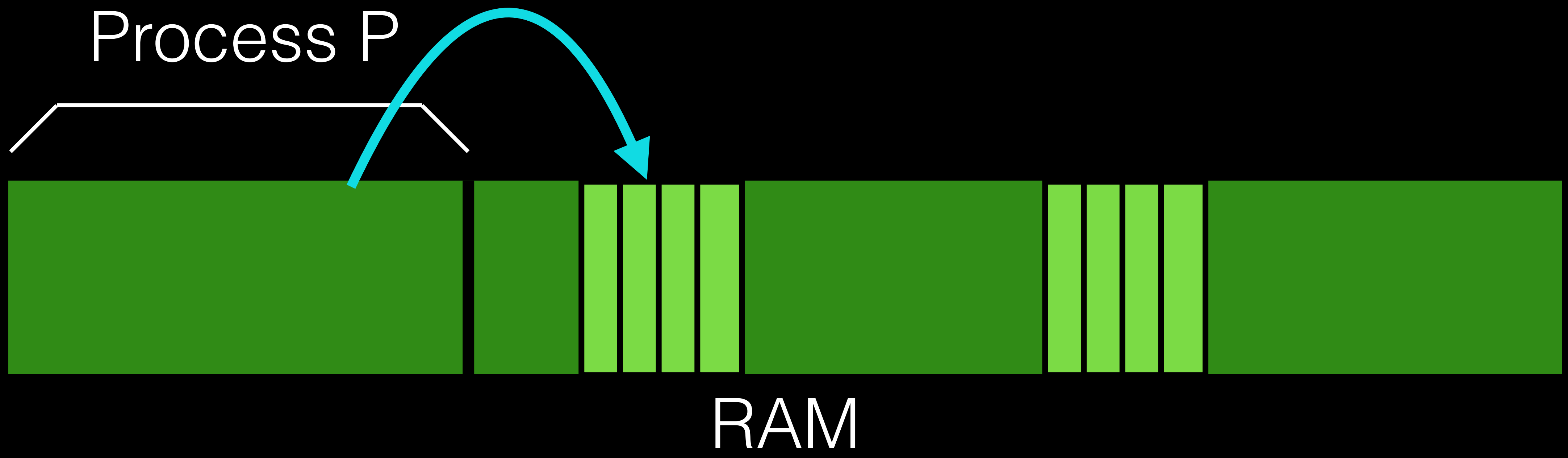
syscall-table index

trap-table index

Kernel mode: we can do anything!

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syscall-table index

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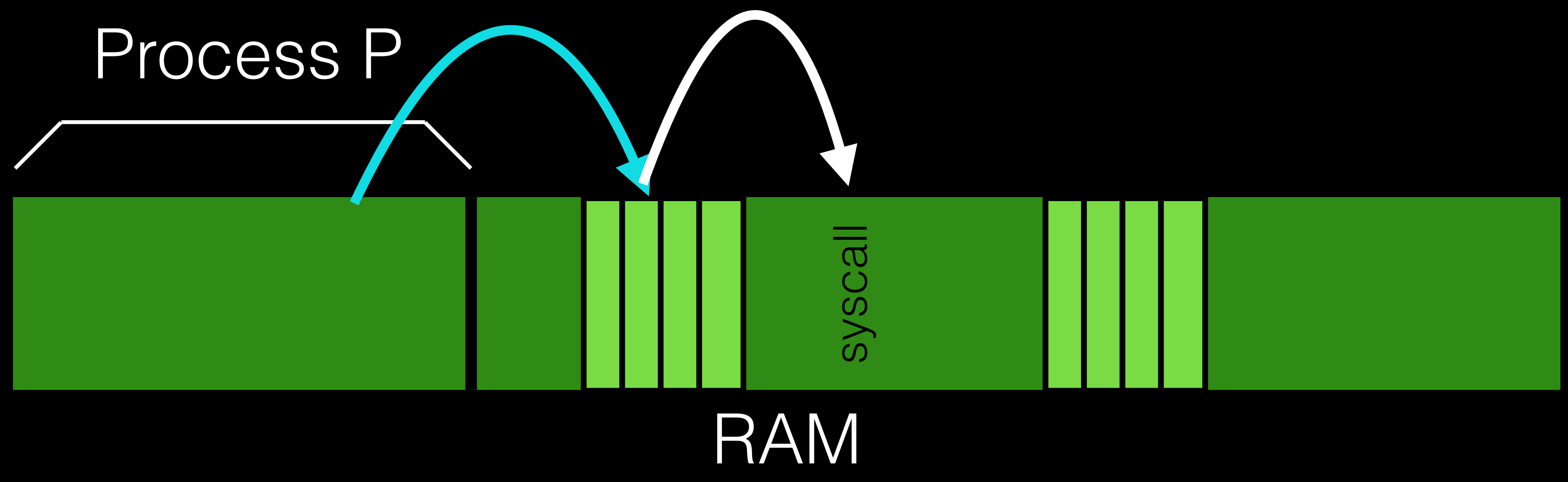


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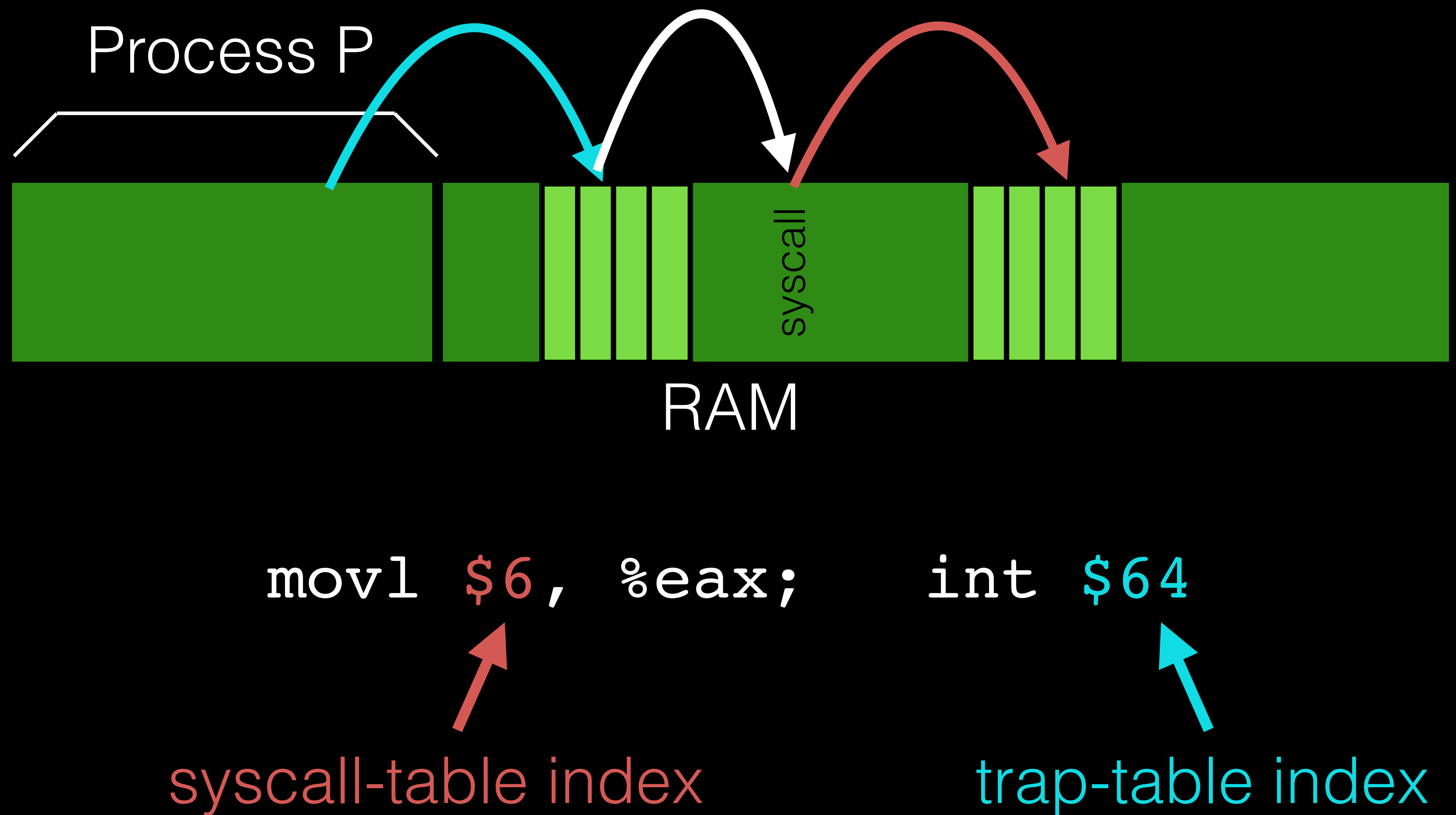
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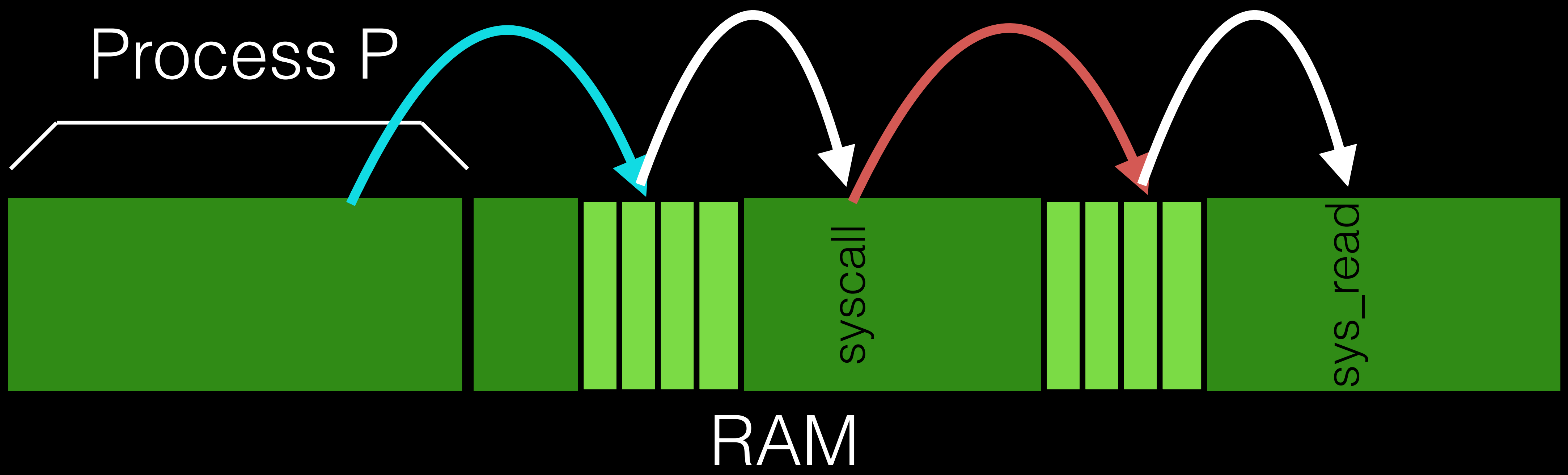


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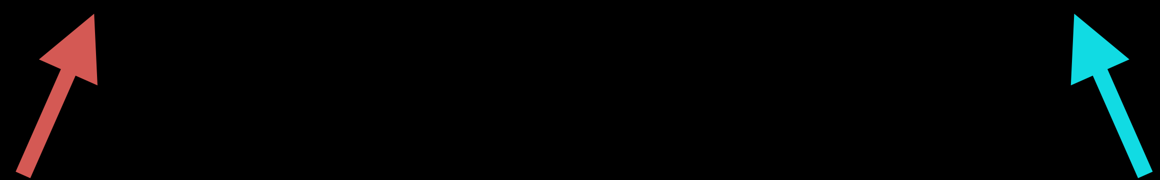
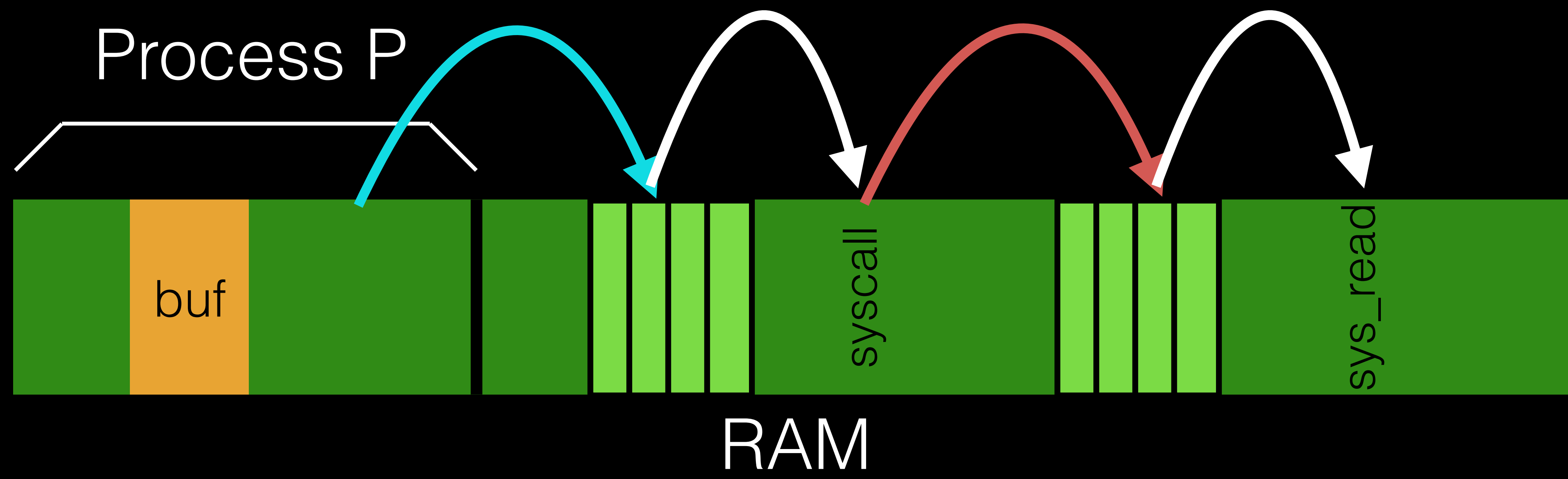


syscall-table index

trap-table index

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trap-table index

Processes

What’s a Process?

Java analogy:

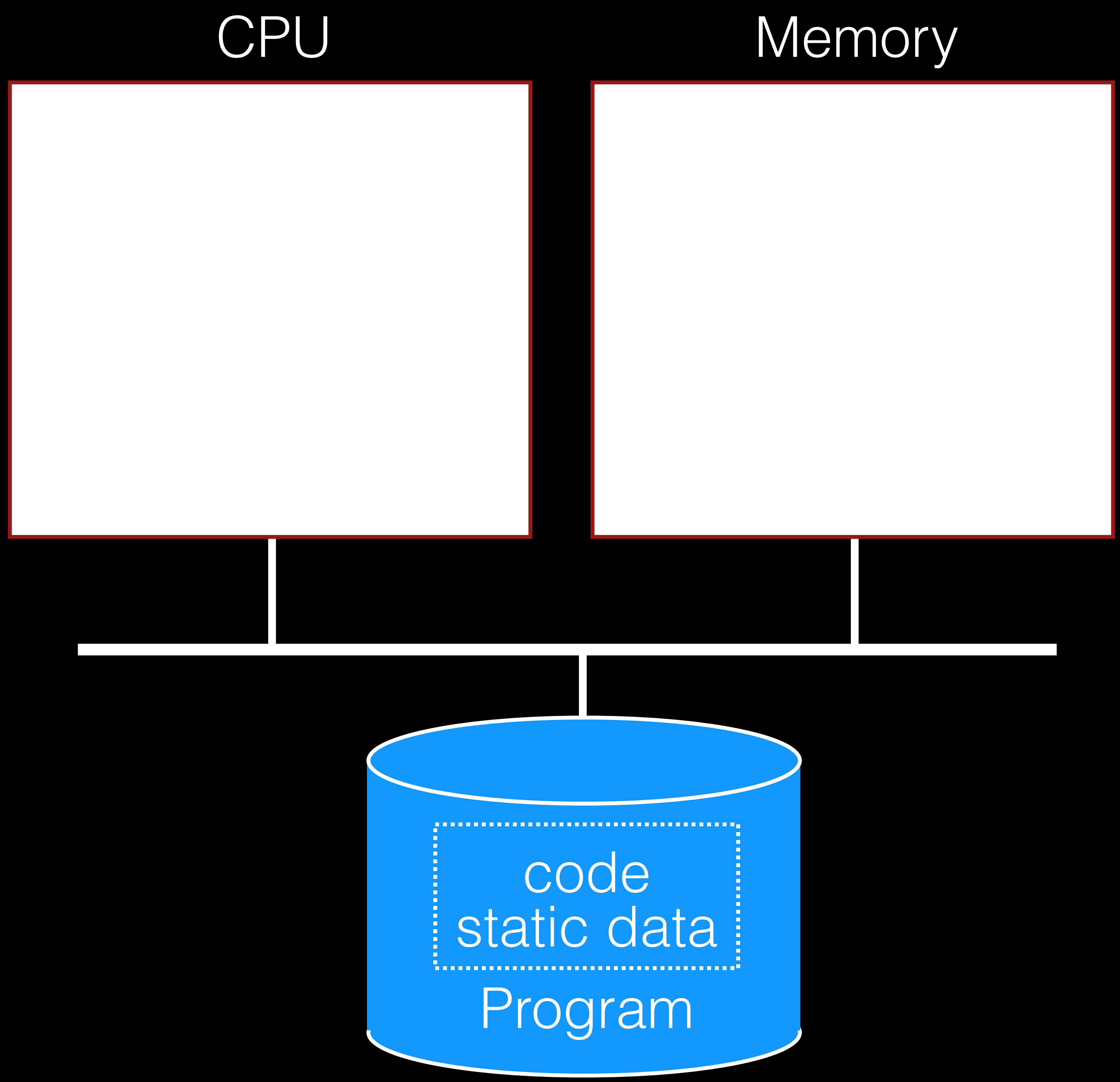
  class => “program”

  object => “process”

Programs are just code.
Processes are running programs.

A process is an instance of a program.
There may be 0 or more processes per program.

Process Creation



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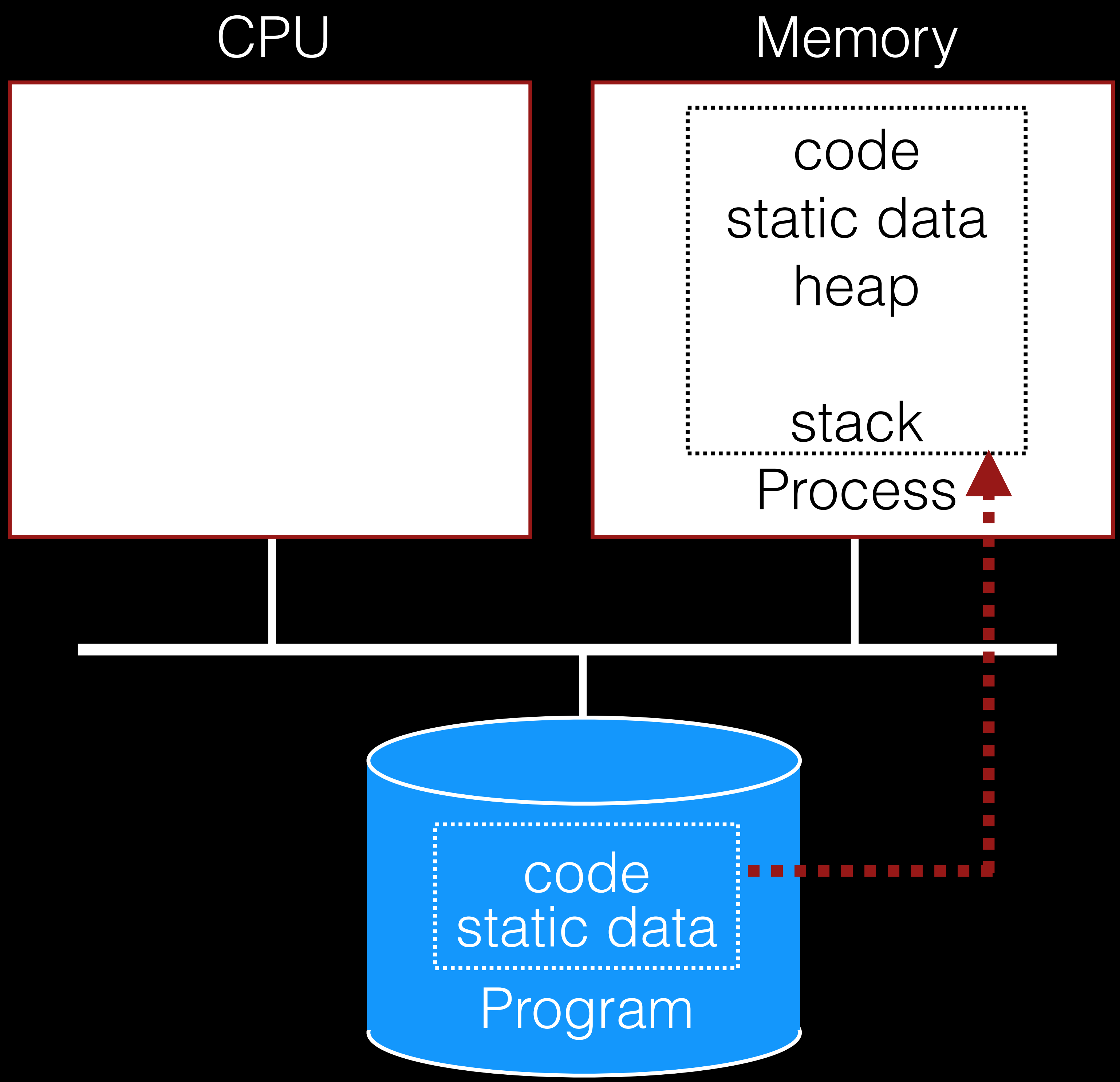

What’s in a Process?

Processes share code, but each has its own “context”

CPU

Instruction Pointer (aka Program Counter)

Stack Pointer

Memory

set of memory addresses (“address space”)

`cat /proc/<PID>/maps`

Disk

set of file despritors

`cat /proc/9506/fdinfo/*`

Do we enough CPUs?

Linux commands:

```
ps ax | wc

top

cat /proc/cpuinfo | grep 'model name'
```

How do we share?

CPU?

Memory?

Disk?

How do we share?

CPU? (a: time sharing)

Memory? (a: space sharing)

Disk? (a: space sharing)

How do we share?

CPU? (a: time sharing)

TODAY

Memory? (a: space sharing)

Disk? (a: space sharing)

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CPU? (a: time sharing)

TODAY

Memory? (a: space sharing)

Disk? (a: space sharing)

Goal: processes should NOT even know they are sharing (each process will get its own virtual CPU)

What to Do with Processes That Are Not Running?

A: store context in OS struct

Look in kernel/proc.h

- `context` (CPU registers)
- `ofile` (file descriptors)
- `state` (sleeping, running, etc)

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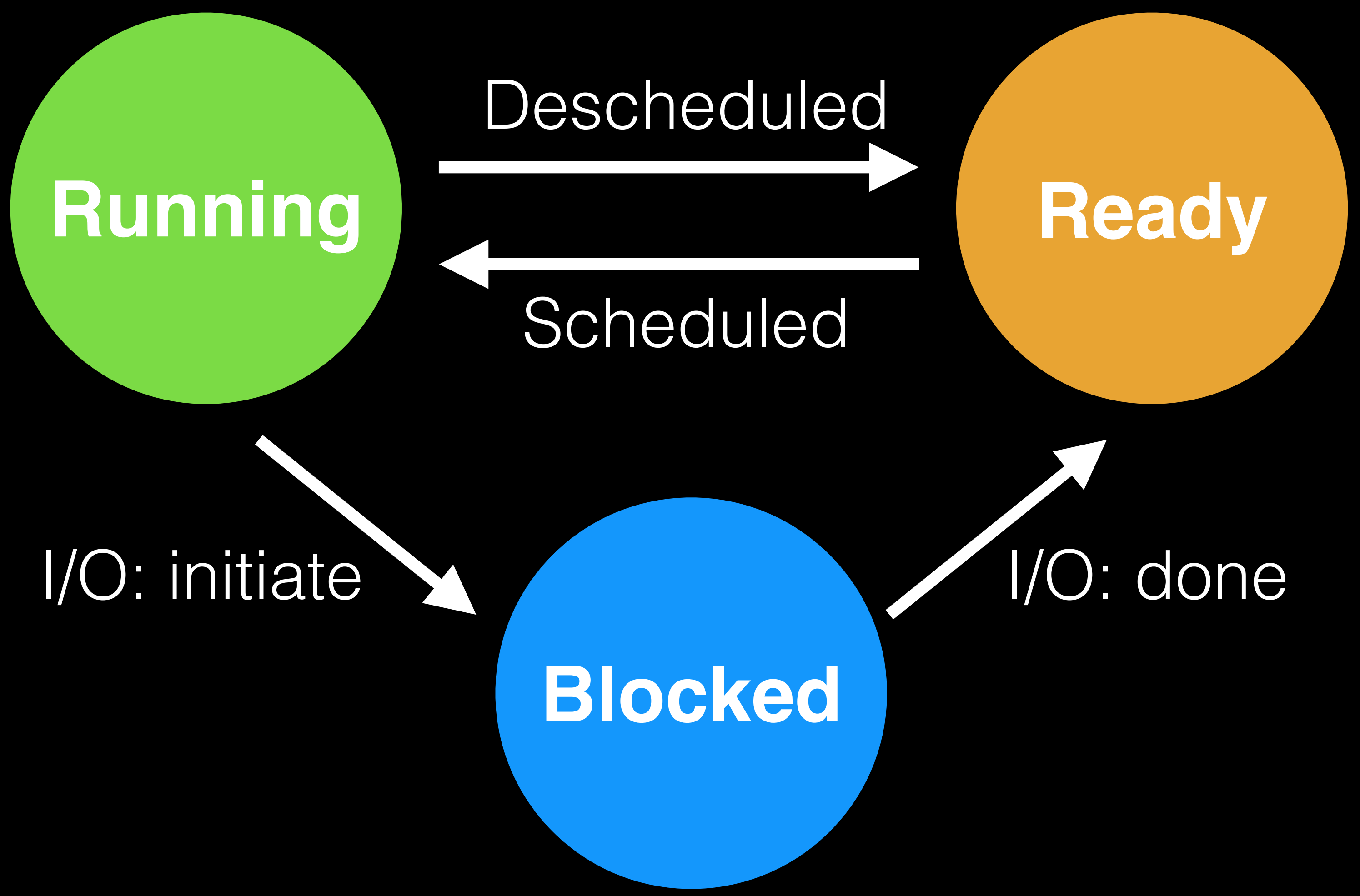

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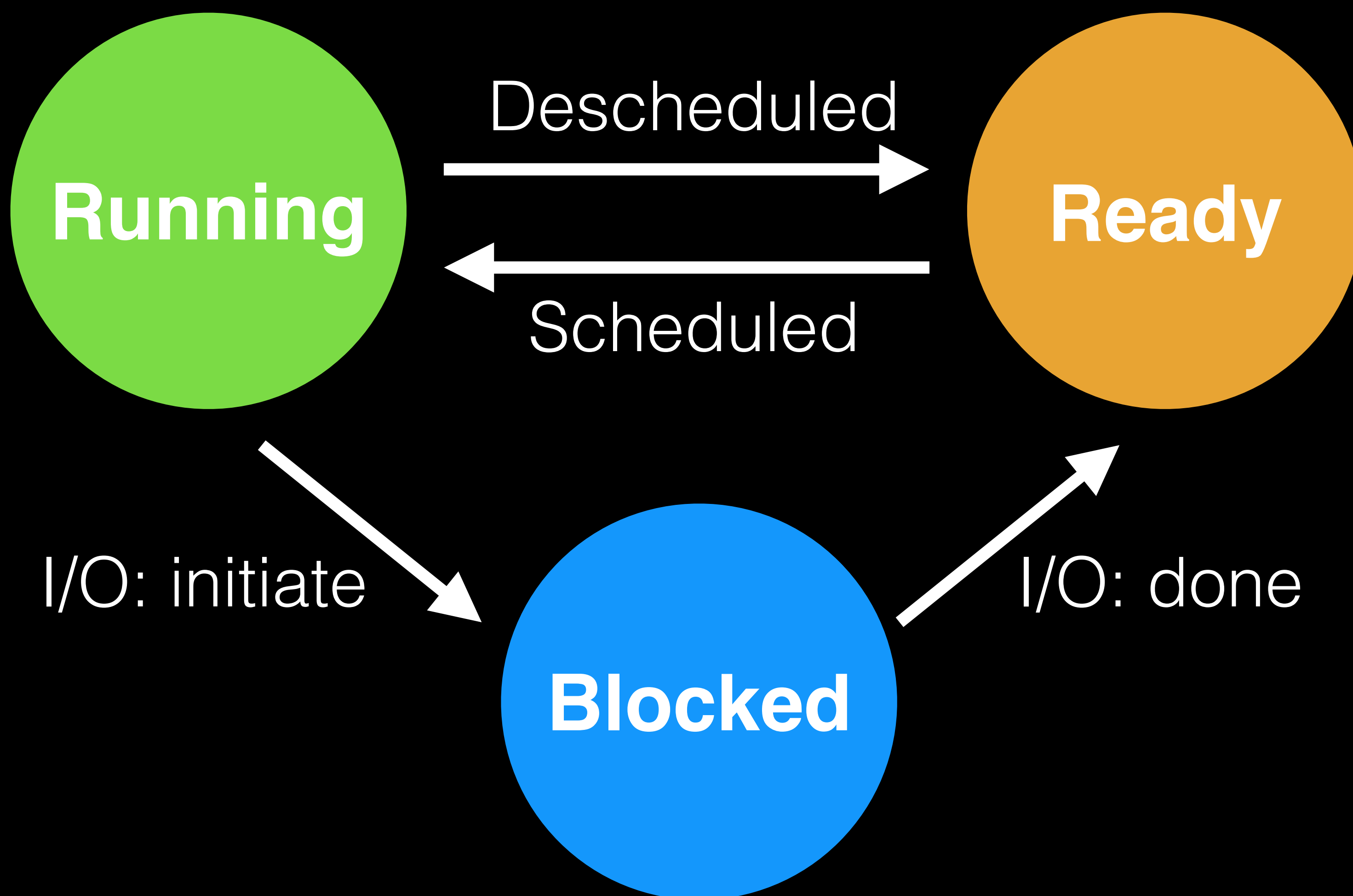
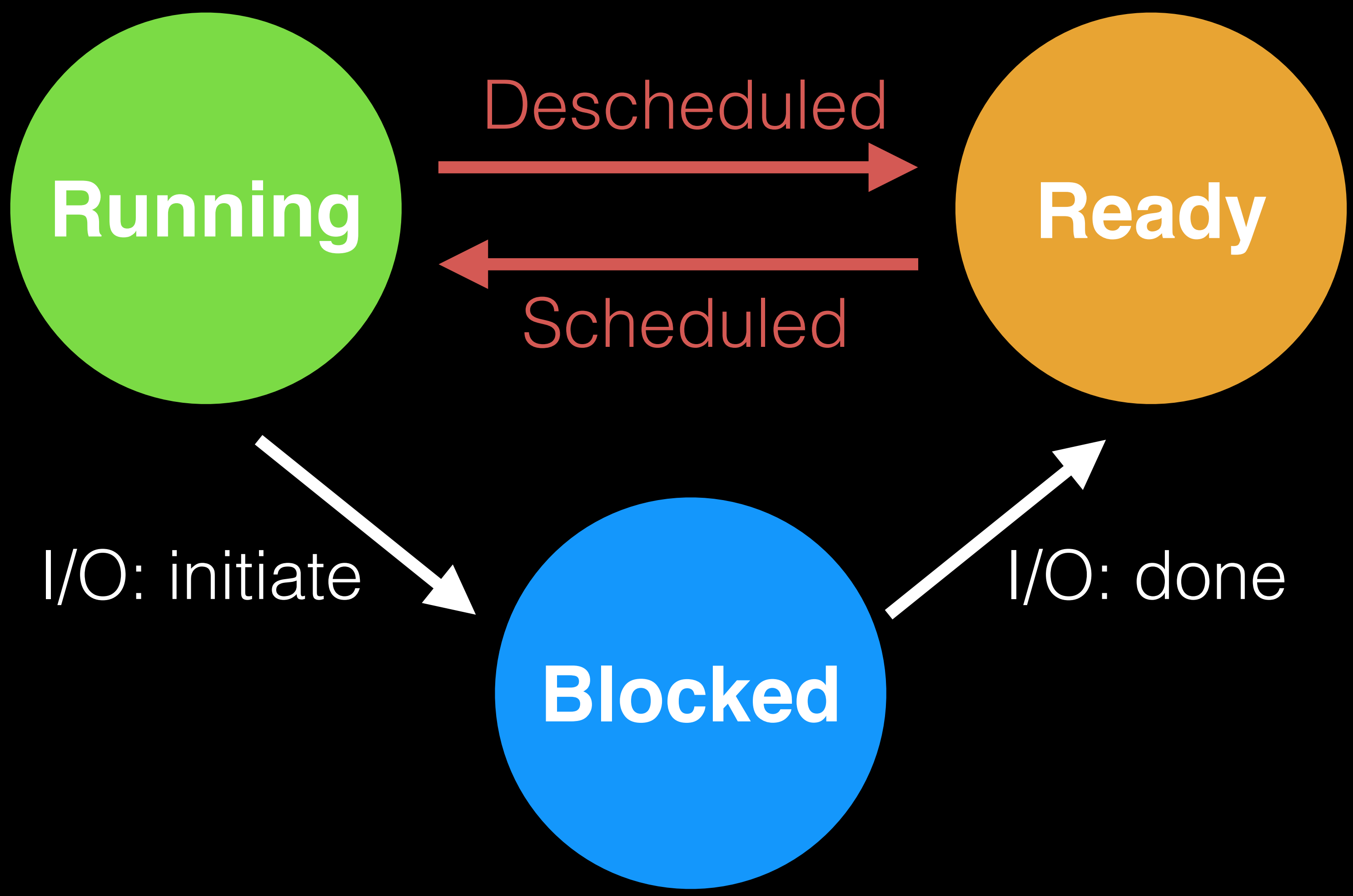


View process state with “ps xa”

How to transition? ("mechanism")
When to transition? ("policy")



Administrative Stuff

- P1 due on 9/16 (eight days left!)
- Office hours: today after class (in lab), Wed 2-3pm
- Exam prep: understand book and exams
- Reading: chapters 1-2 (last time) and 3-6 (today)
- Learning names
- Wait list: good news!

CPU Time Sharing

Goal 1: efficiency

OS should have minimal overheard

Goal 2: control

Processes shouldn't do anything bad

OS should decide when processes run

Solution: limited direct execution

Limited Direct Execution

What to limit?

General memory access

Disk I/O

Special x86 instructions like `lidt`

How? Get HW help, put processes in “user mode”

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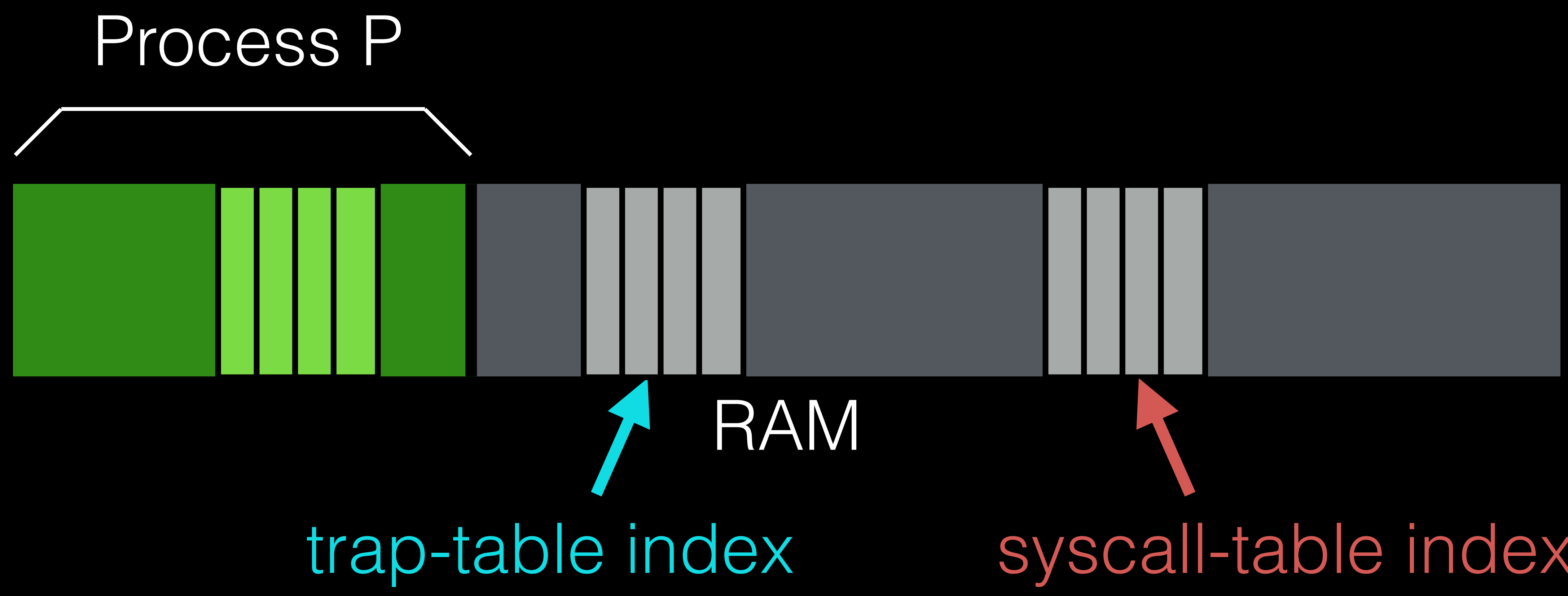
`lidt` example



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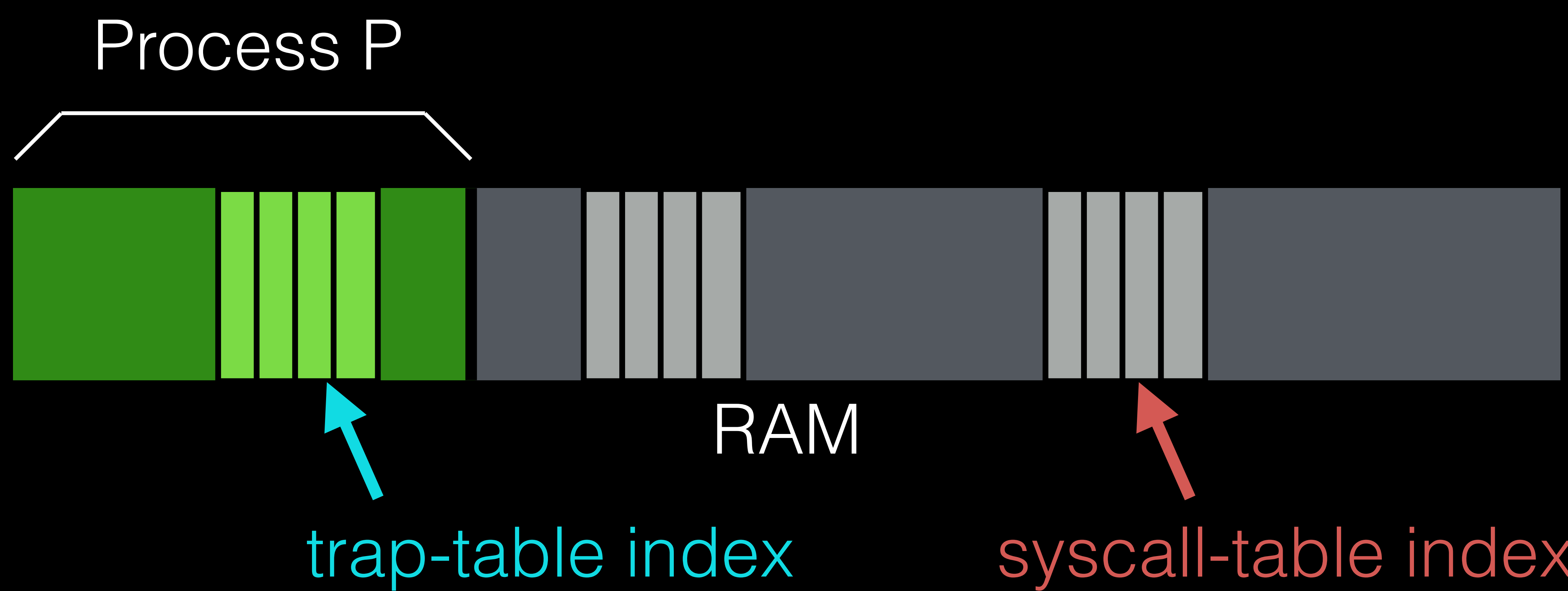

P tries to call `lidt`!

`lidt` example

CPU warns OS, OS kills P

Context Switch

Problem: when to switch process contexts?

Direct execution => OS can't run while process runs

How can the OS do anything while it's not running?

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Solution: **switch on interrupts**. But which interrupt?

Cooperative Approach

Switch contexts for syscall interrupt.

Provide special `yield()` system call.

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P1

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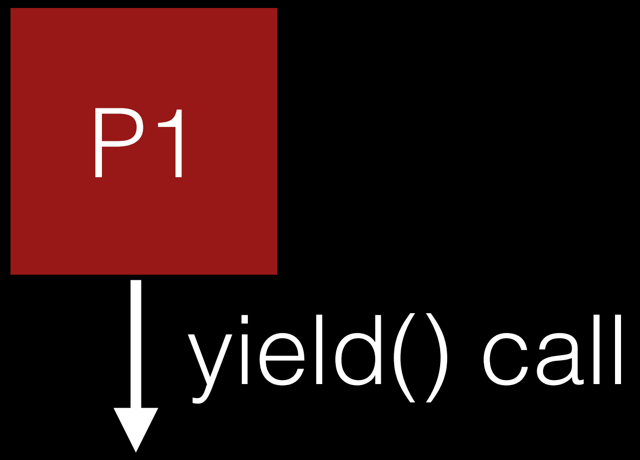

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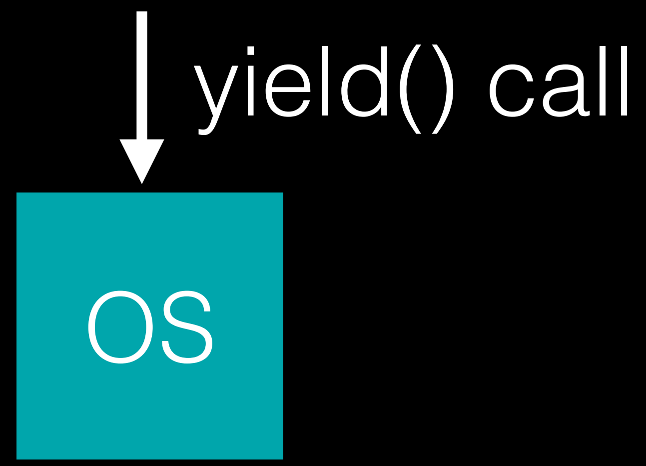

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OS

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Cooperative Approach

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Cooperative Approach

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P2

Cooperative Approach

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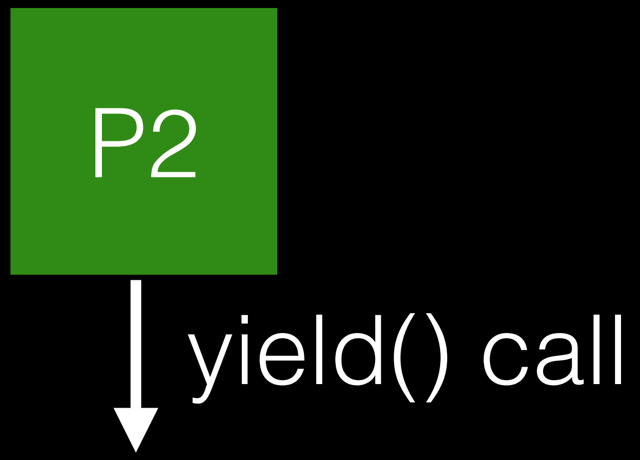

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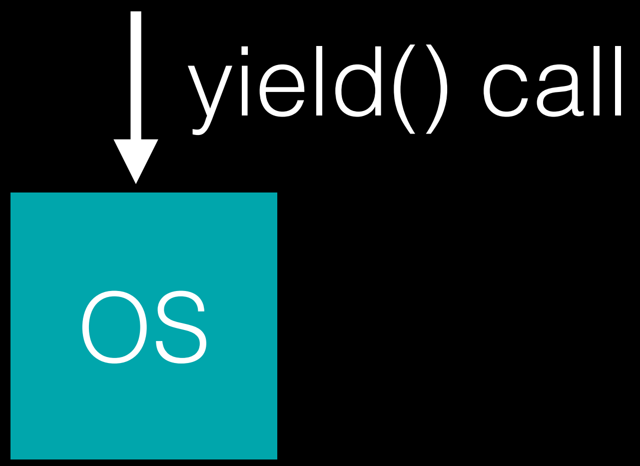

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Non-Cooperative Approach

Switch contexts on timer interrupt.

Set up before running any processes.

HW does not let processes prevent this.

Is it better to be cooperative or non-cooperative?

Operating System	Hardware	Program
		Process A …

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		Process B …

Summary

- Smooth context switching makes each process think it has its own CPU (virtualization!)
- Direct execution makes processes fast
- Hardware provides a lot of OS support
  - limited direct execution
  - timer interrupts
  - automatic register saving

Things to Look Forward to

- CPU-sharing policy (Wed lecture)
- Process APIs (Thu discussion)
  Also: syscall timing and more C review
- Memory virtualization (next Mon lecture)