TDDB68/TDDE47
Concurrent Programming and Operating Systems

Lecture 1:
Introduction, interrupts and system calls

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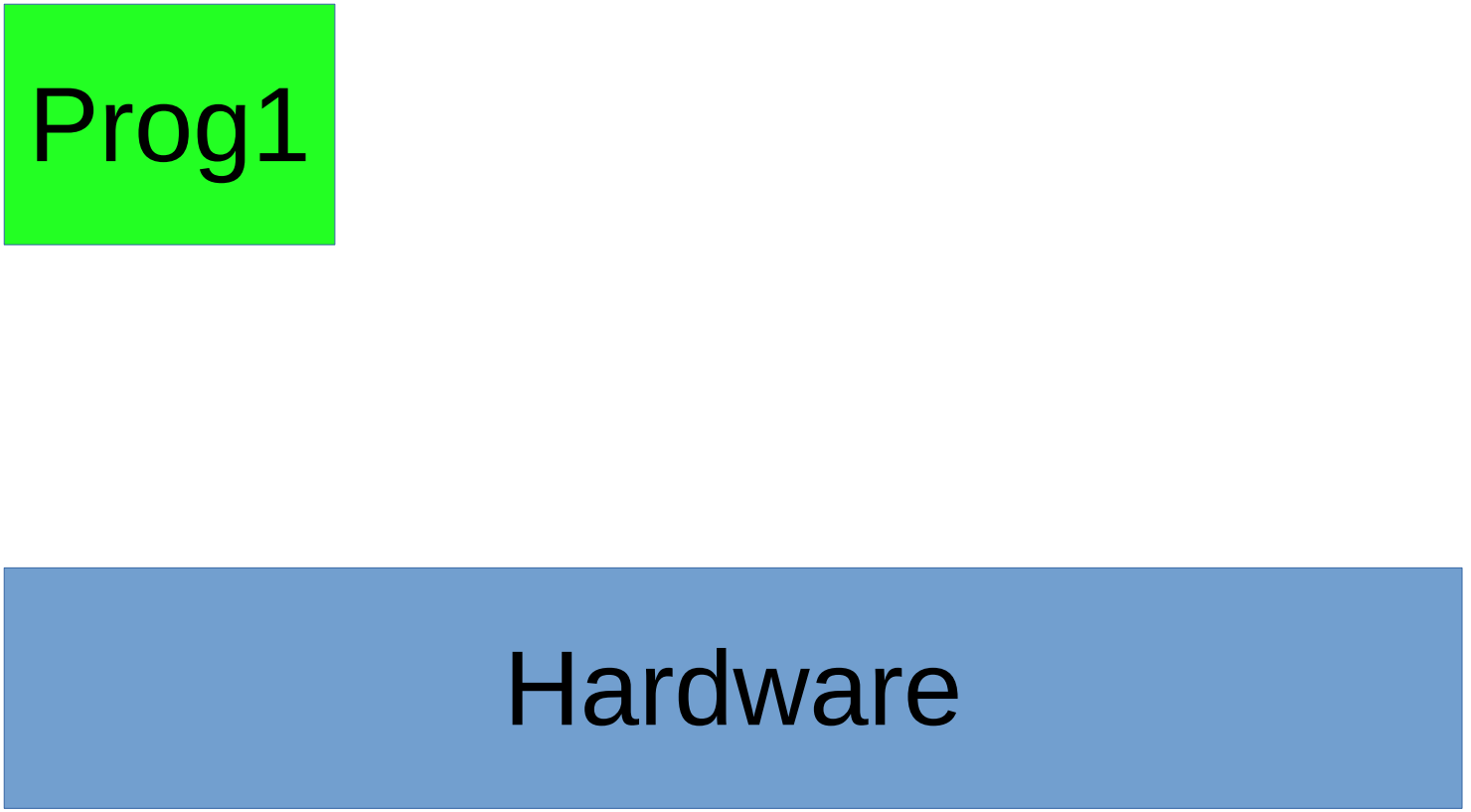
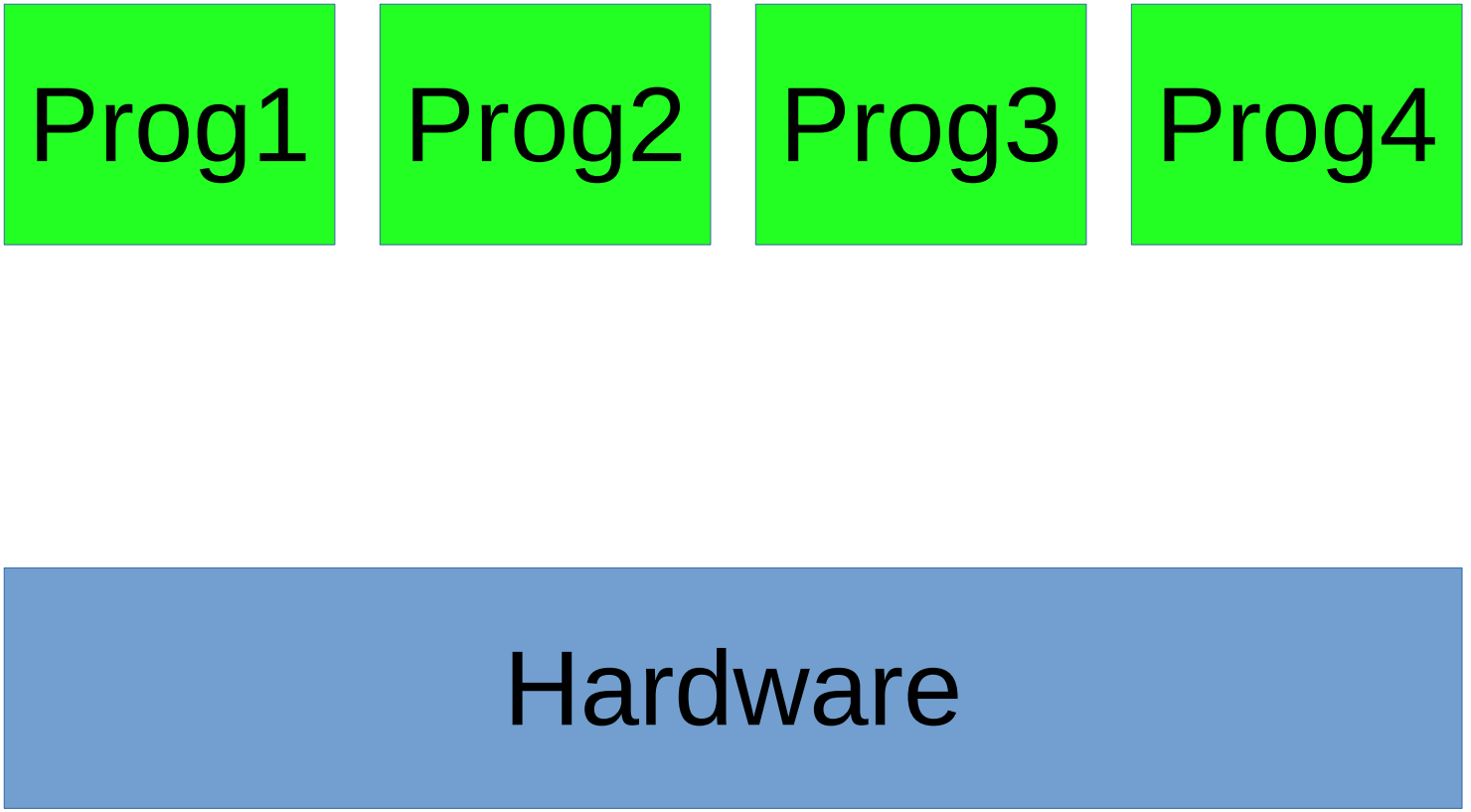
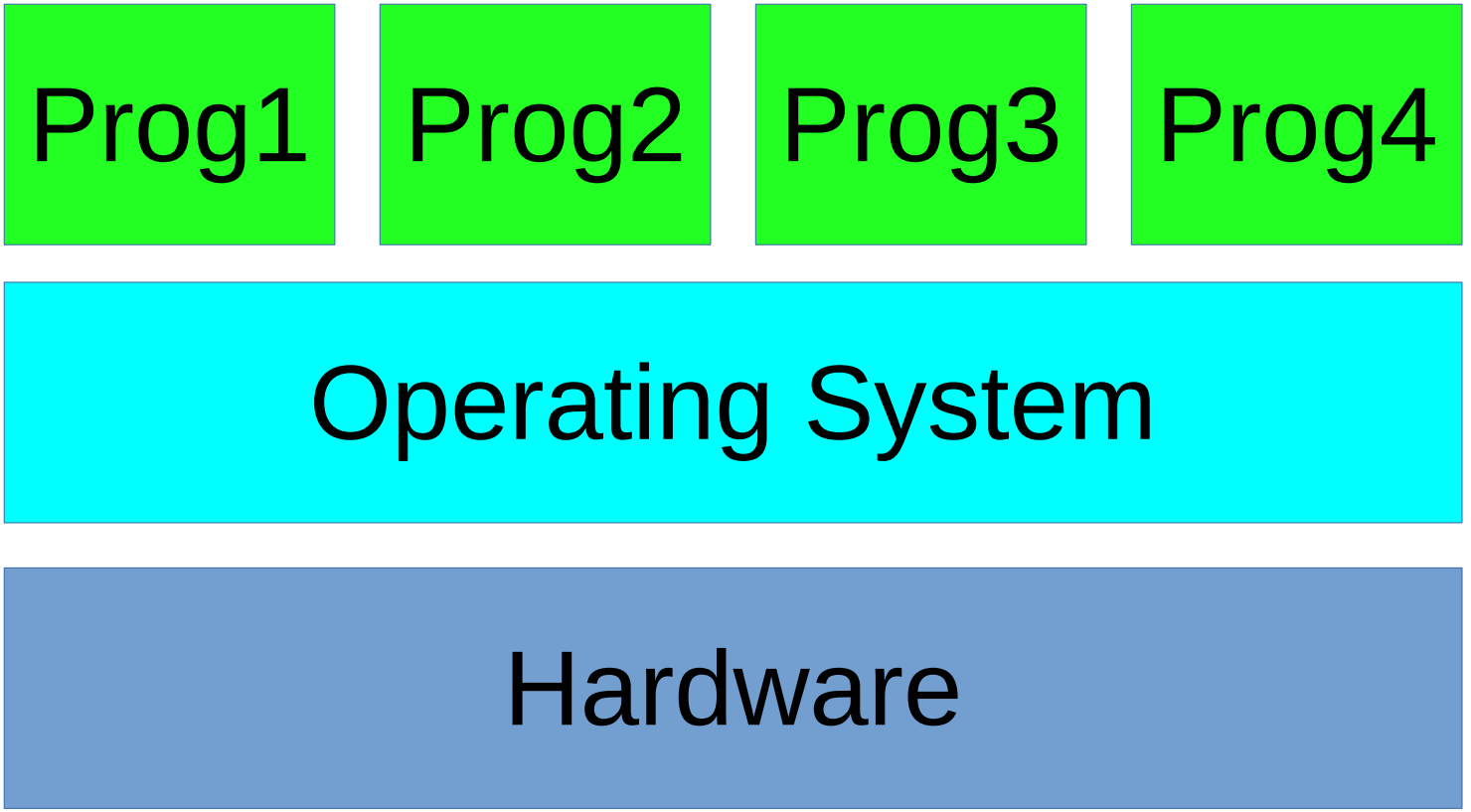
Real-time Systems Laboratory
Department of Computer and Information Science

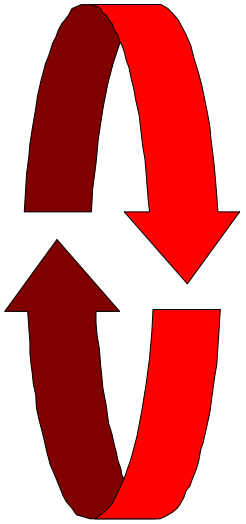
Hardware


Prog1
Hardware


Prog1
Prog2
Prog3
Prog4
Hardware


Prog1
Prog2
Prog3
Prog4
Operating System
Hardware

Concurrency



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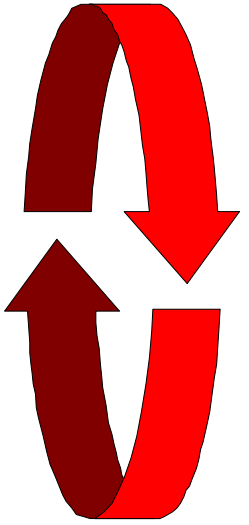

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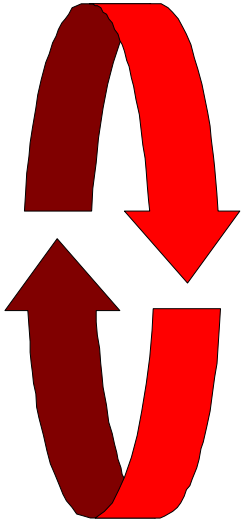

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2. Connect to database
3. Send db-query
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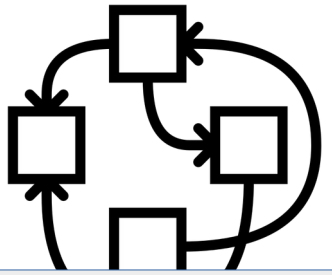
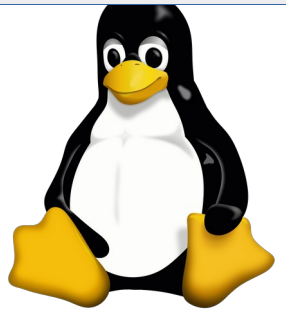
5. Create web page
6. Reply to request



In this course:

Focus on basic principles



Courses

- TDDB68: 6hp course for D + U + I + M.Sc. + Erasmus
  - C/C++ with pointers a prerequisite
- TDDE47: 8hp course for IT
  - More time and some PBL sessions for learning about memory allocation and pointers
- TDDE47 and TDDB68 have the same exam and labs.
- TDDD82: Three lectures on processes and synchronization shared

Course web

- TDDB68:
  - https://www.ida.liu.se/~TDDB68
- TDDE47
  - https://www.ida.liu.se/~TDDD47
- Same content – report if anything is strange

People

- Examiner: Mikael Asplund
- Course assistant: Felipe Boeira
- Lab assistants:
  - TDDB68 Group A: Felipe Boeira
  - TDDB68 Group B: Rodrigo Saar Moraes
  - TDDB68 Group C: Jesper Jonsson
  - TDDB68 Group D: Viktor Hellqvist
  - TDDB68 Group E: Benjamin Hansson
  - TDDB68 Group F: Oscar Bergman
  - TDDE47 group: Erik Norrestam Held

Examination

- Labs 3hp for TDDB68, 5hp for TDDE47
- Written exam 3hp
- Bonus assignment 0hp
  - 4p bonus points on the exam
  - Pass all labs no later than **2020-03-13**
  - Need to be first-time registered in VT1 2020

Labs

- Pintos
  - Stanford educational OS
- Challenging!
- Register in webreg today
  - Only new students!

Deadlines

- **2020-01-23** Sign up in webreg (new students)
- **2020-03-13** Lab deadline to get the bonus points on the exam
- **2020-03-30** Last chance to pass the labs in VT1

Lab feedback

- **Promise:**
  - No later than 2w from the soft deadline
  - Lab6 at least one chance to correct if you hand in on the 10th

- Soft deadlines:
  - Lab0: January 29
  - Lab1: February 5
  - Lab2: February 15
  - Lab3: February 21
  - Lab4: February 27
  - Lab5: March 4
  - Lab6: March 10

Time management

- Lectures 8*2h + 1*4h
- Lessons 3*2h (to prepare for labs)
- Labs 36h (42 for TDDE47)
- Self-study TDDB68: ~100h, TDDE47: ~145h

Time management

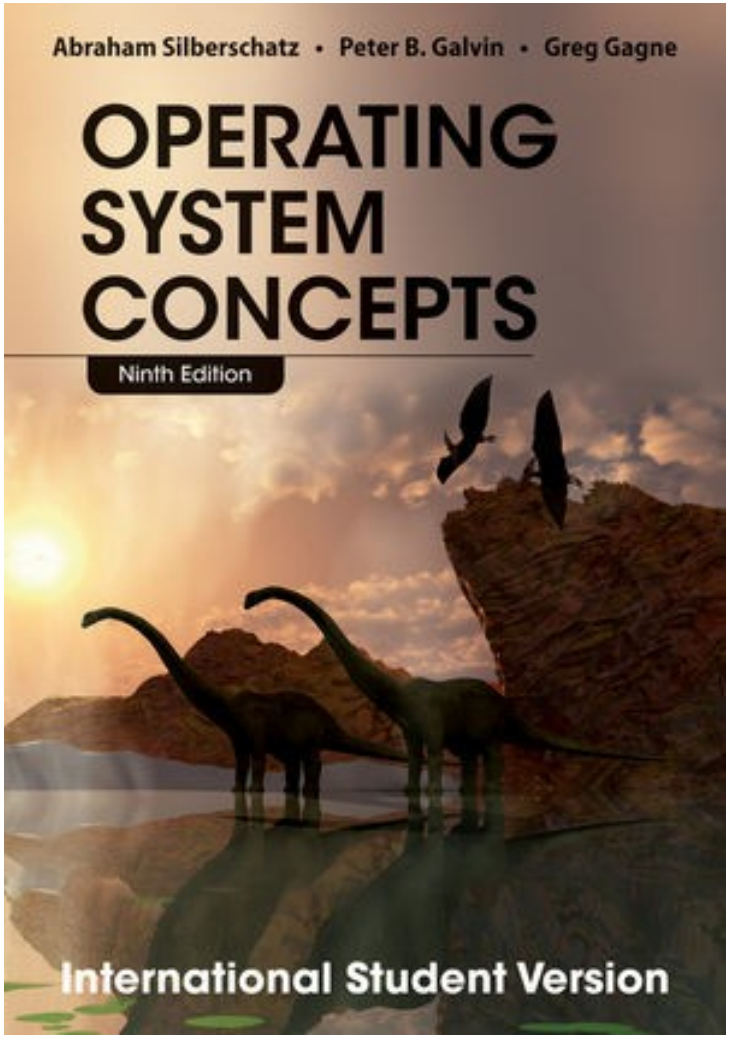
- Le
- Le
- La
- Self-study TDDB68: ~100h, TDDE47: ~145h

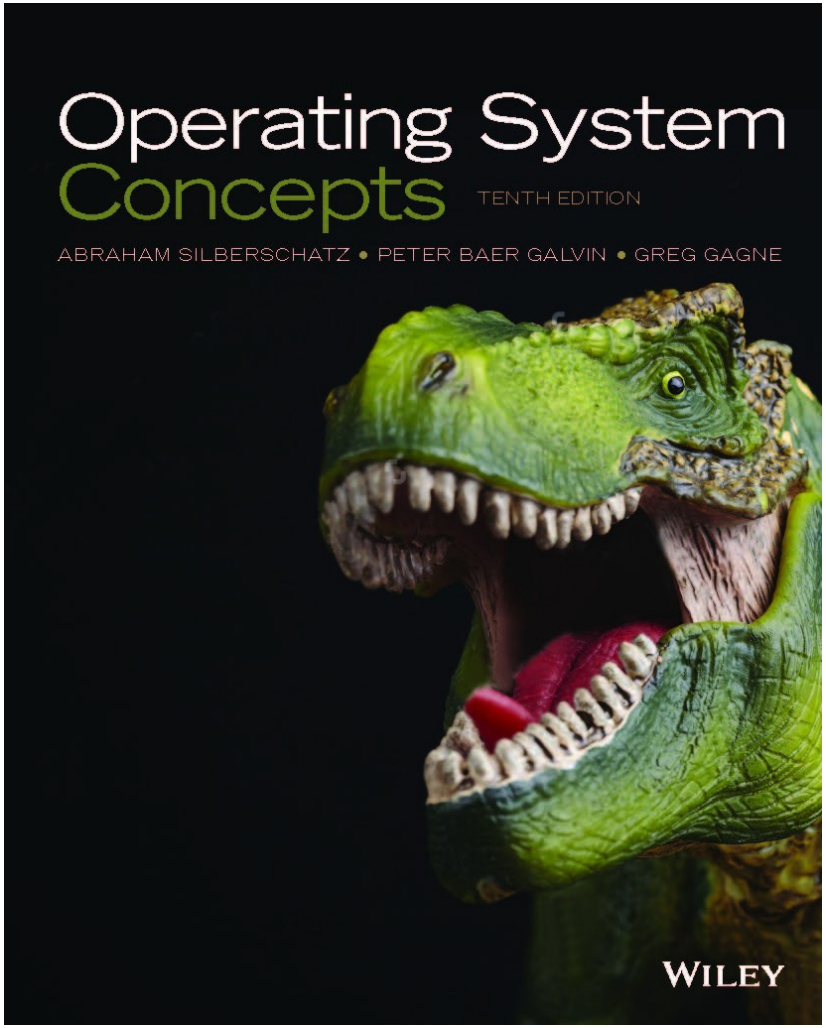
If you’re not spending **10+ hours/week** of free timedoing labs and studying for this course, you will be in trouble.

Do not cheat!

- Labs are hard and you might find solutions online
- It is **not allowed** to copy anyone else's solution
- We are obliged to report suspected plagiarism to the disciplinary board

Course book


Abraham Silberschatz • Peter B. Galvin • Greg Gagne
OPERATING SYSTEM CONCEPTS
Ninth Edition
International Student Version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TENTH EDITION
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WILEY

Exam

- Previous exams available
- Solutions **not available**
- New this year: part A and B
  - Part A: must be passed, will contain multiple choice questions, one question on concurrency, and one multi-part question on basic knowledge
  - Part B: will only be corrected if part A has been passed, only used to determine higher grades (4 or 5)

Lectures vs. Labs

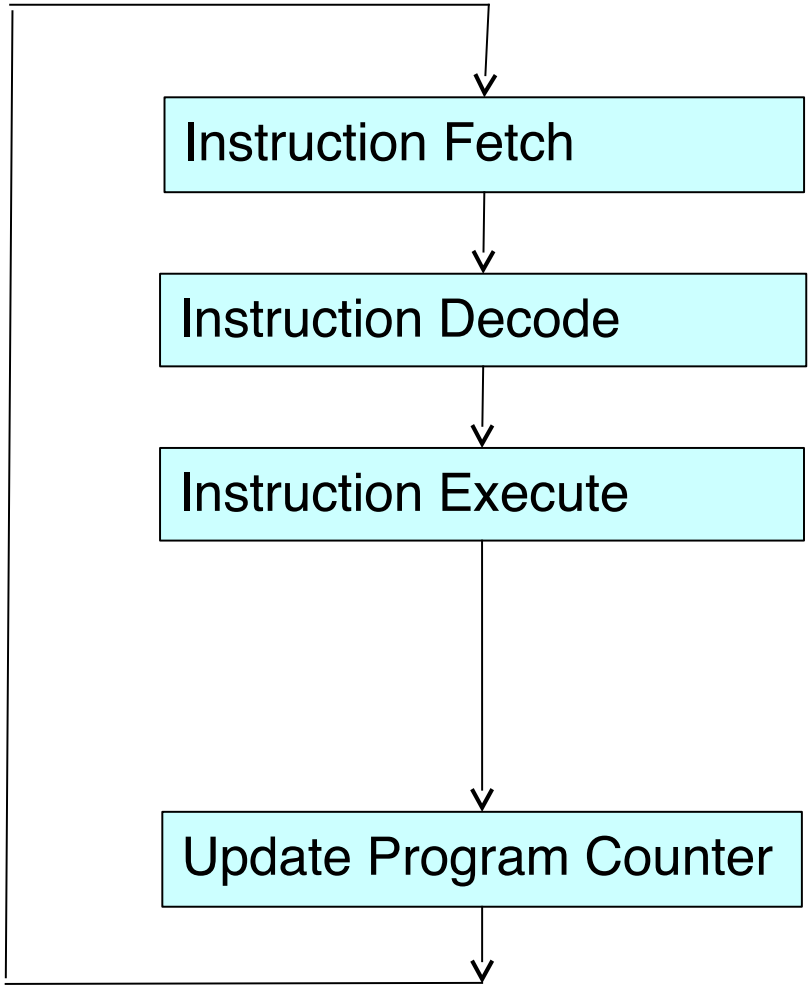
- Intentionally different scope
- Lectures provide an overview of a vast area
- Labs provide hands-on experience with a particular educational OS.

Changes from last year

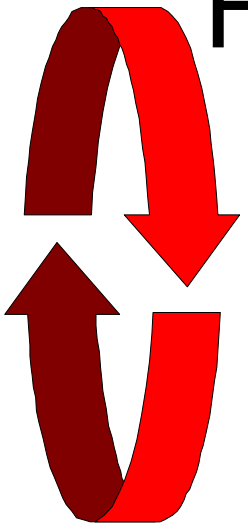
- Lab structure
  - Lessons in time
- More lab assistants

What does an operating system do?

Program execution (von-Neumann cycle) by a processor



How to do concurrency?



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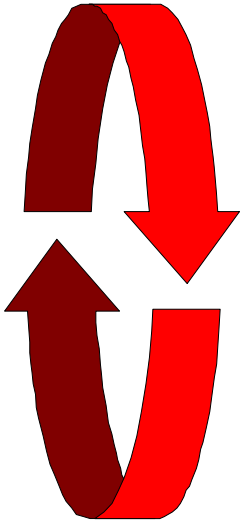

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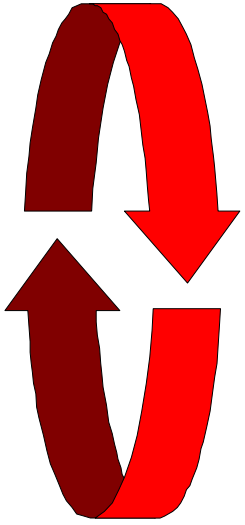

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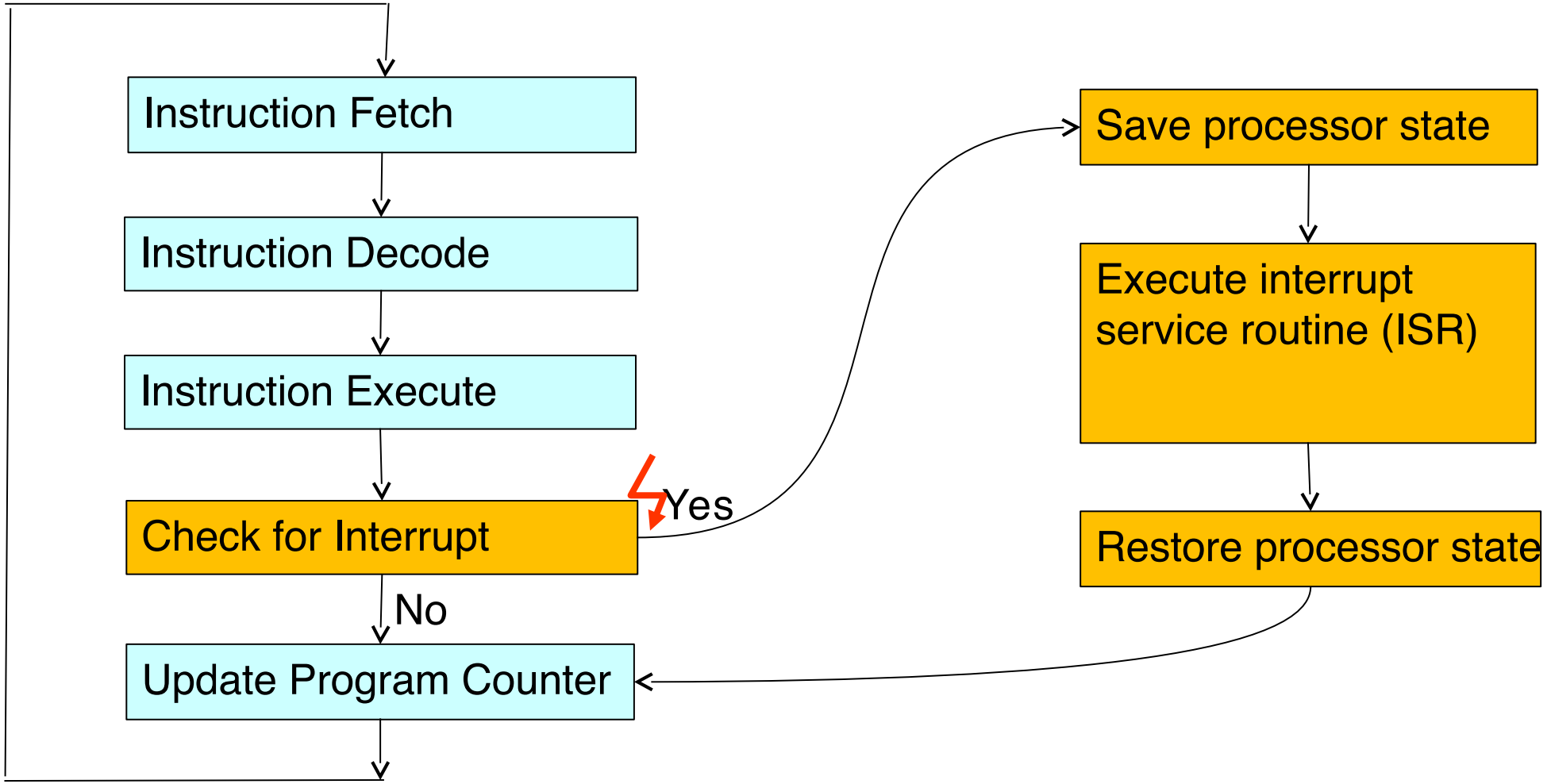
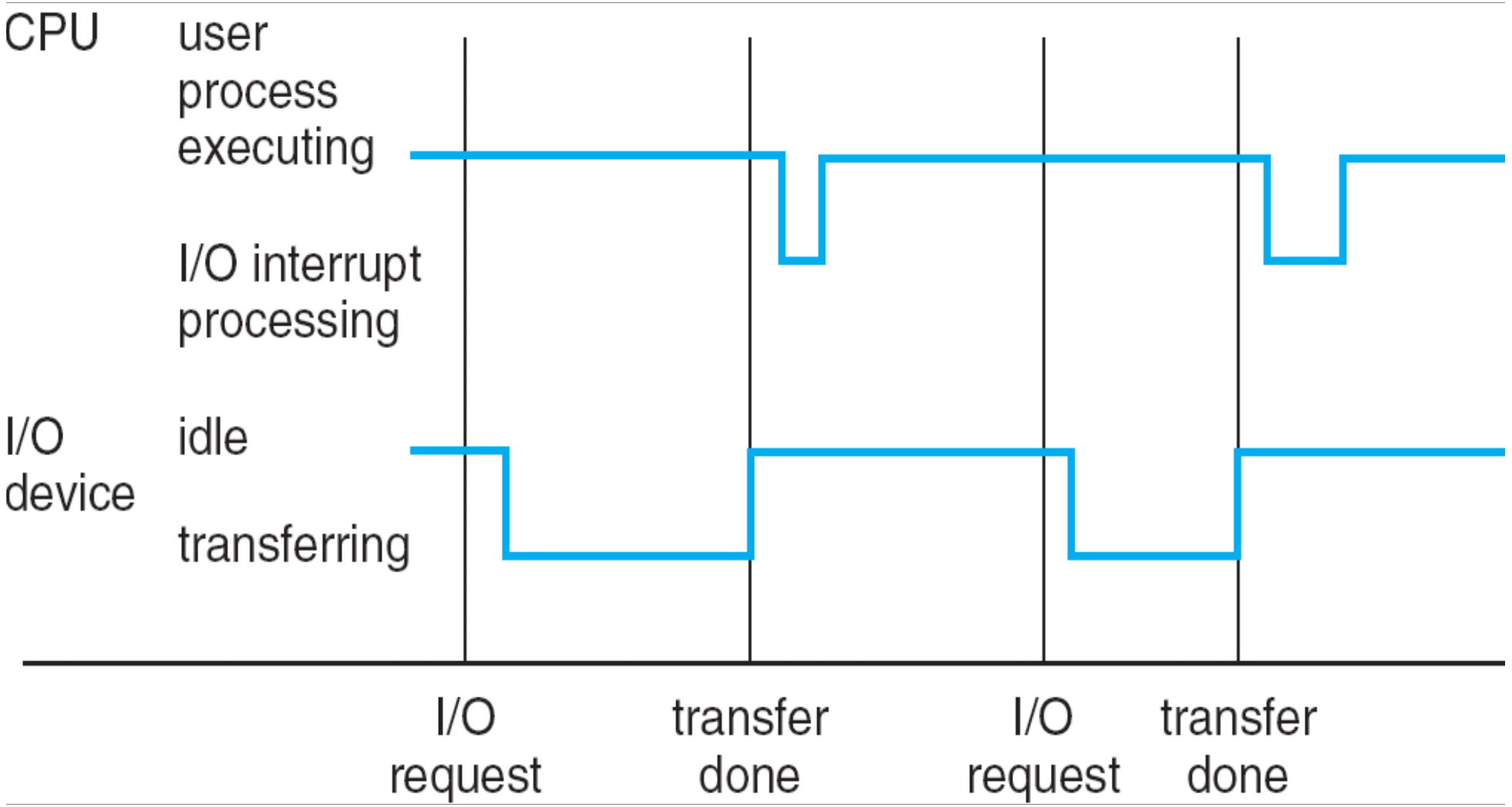
Interrupts


Instruction Fetch
Instruction Decode
Instruction Execute
Check for Interrupt
Yes
No
Update Program Counter
Save processor state
Execute interrupt service routine (ISR)
Restore processor state

Interrupt Timeline



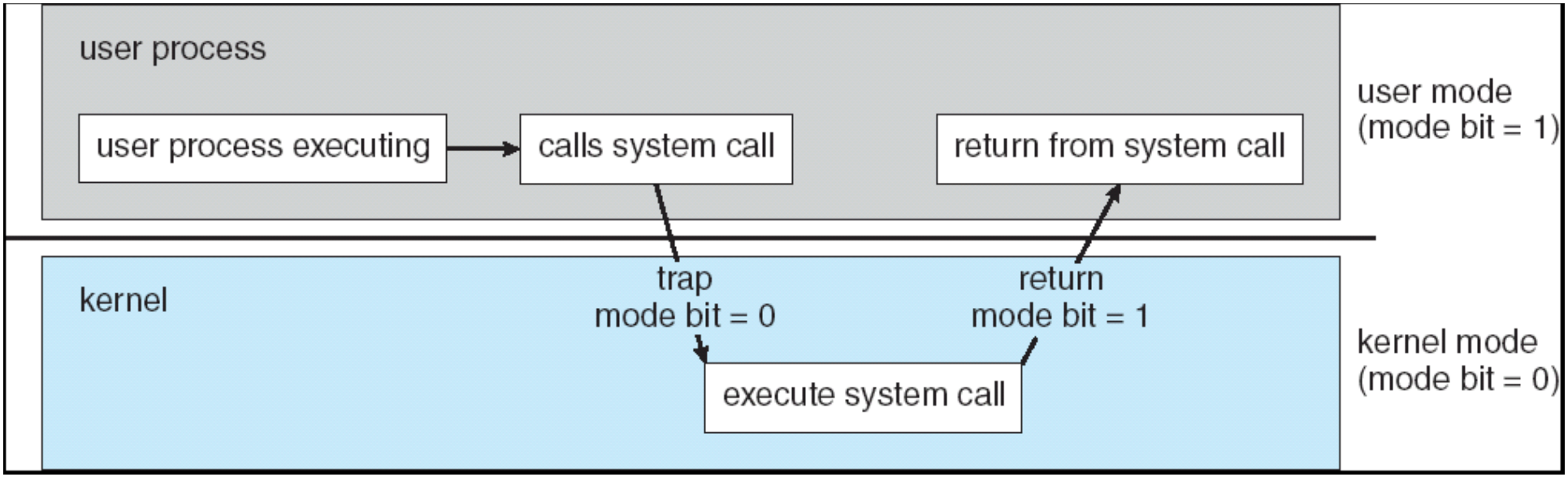
Software Interrupts

- A ***trap*** is a *software*-generated interrupt caused either by an error or a user request.
  - Examples: Division by zero;
    Request for OS service

An operating system is ***interrupt*** **driven**.

Why not just have a function API?

Dual Mode


user process
user process executing
calls system call
return from system call
user mode
(mode bit = 1)
kernel
trap
mode bit = 0
return
mode bit = 1
execute system call
kernel mode
(mode bit = 0)

Types of System Calls

- **Process control**
  load, execute, end, abort, create, terminate, wait ...
  memory allocation and deallocation
- **File management**
  open, close, create, delete, read, write, get/set attributes...
- **Device management**
  request / release device, read, write, ...
- **Information maintenance**
  get / set time, date, system data, process / file attributes
- **Communications**
  create / delete connection, send, receive, ...

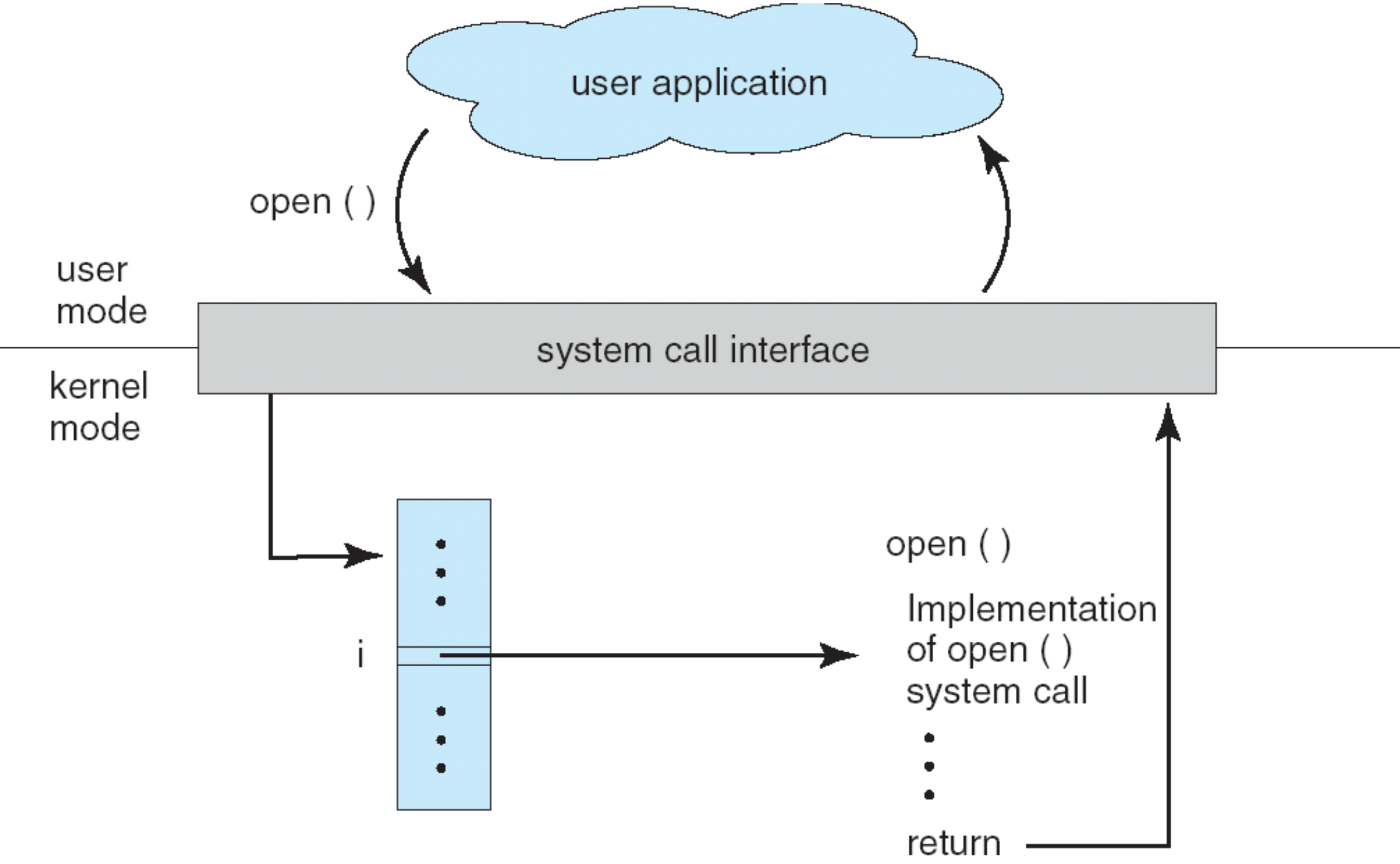
Syscalls In Linux

(man syscalls)

Tracing system calls

Linux – ltrace
Mac OSX - dtrace

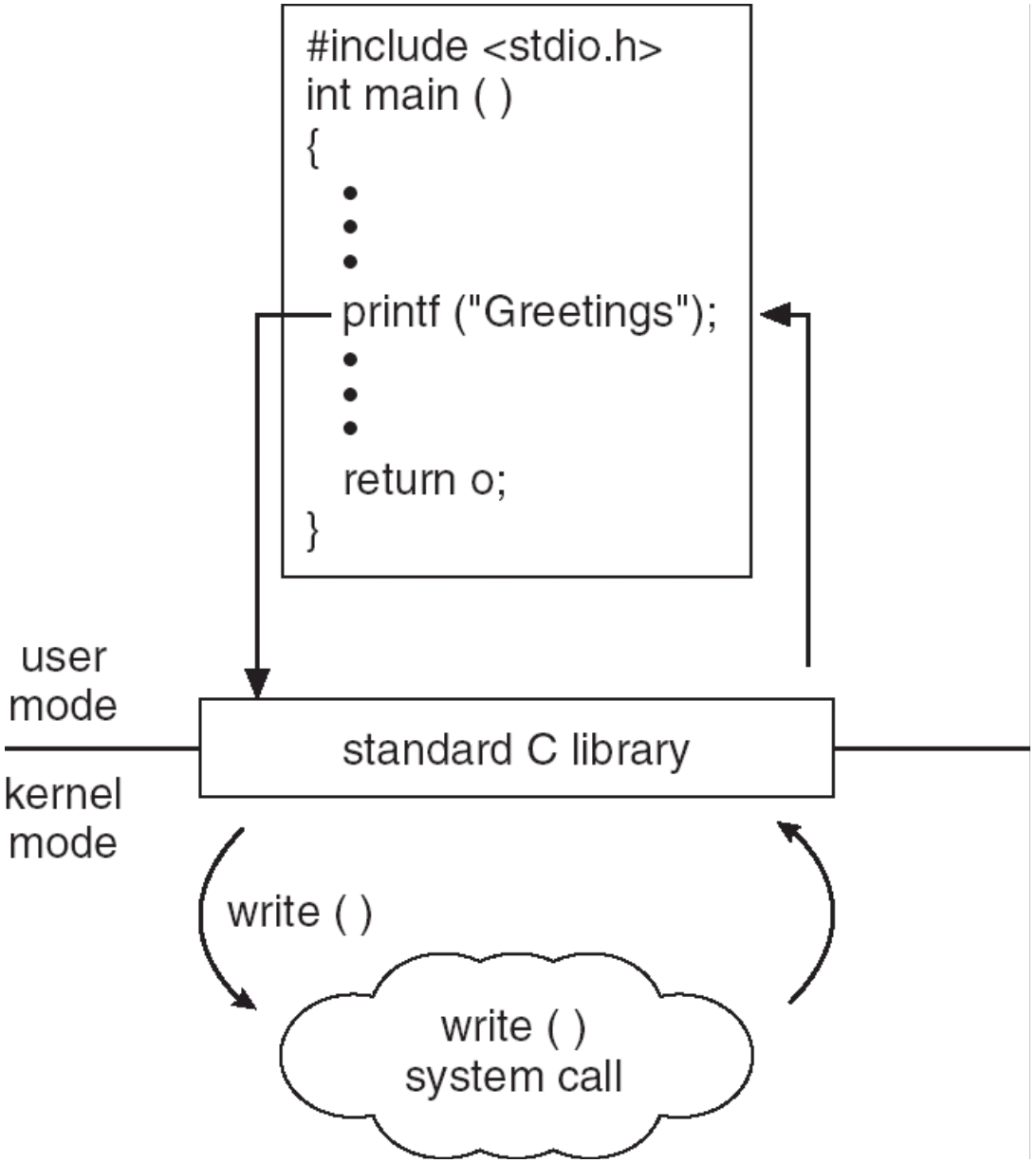
System Call API – OS Relationship



System Call API Implementation

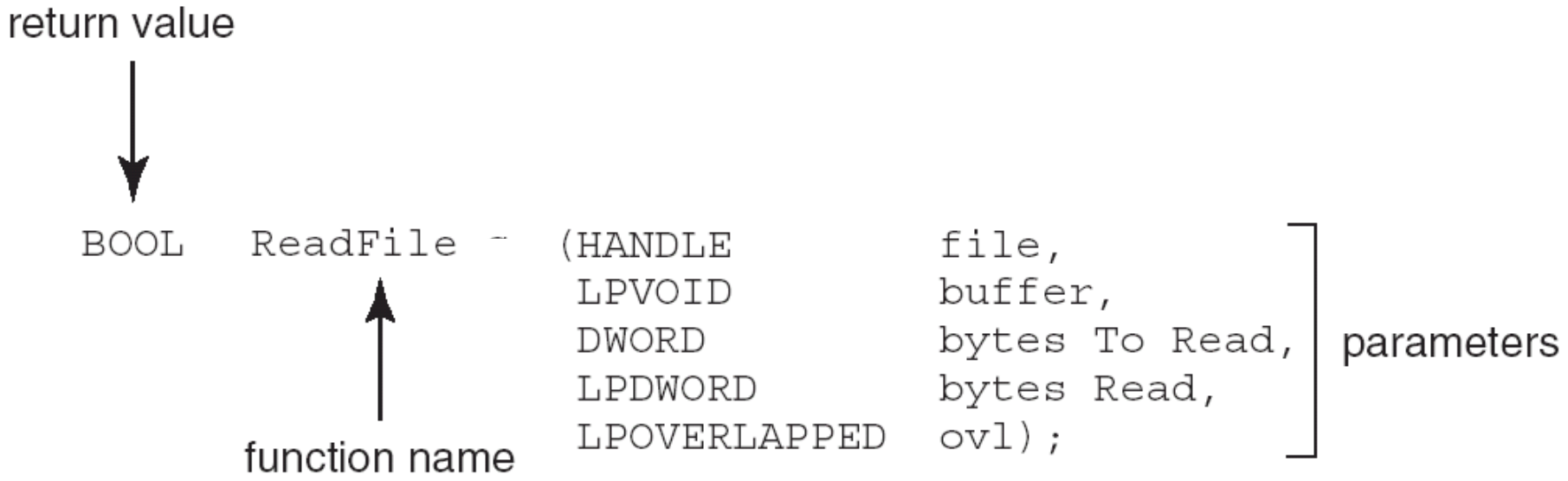
- **System call implementation**
  - hardware-specific
- **System call interface**
  - usually, in C
  - standard across multiple platforms
- **Advantage:**
  - Caller does not need to know anything about how the system call is implemented
  - Most details of OS interface hidden from programmer by API

Printf example



Example of a System Call API

- ReadFile() function in Win32 API (function for reading from a file)



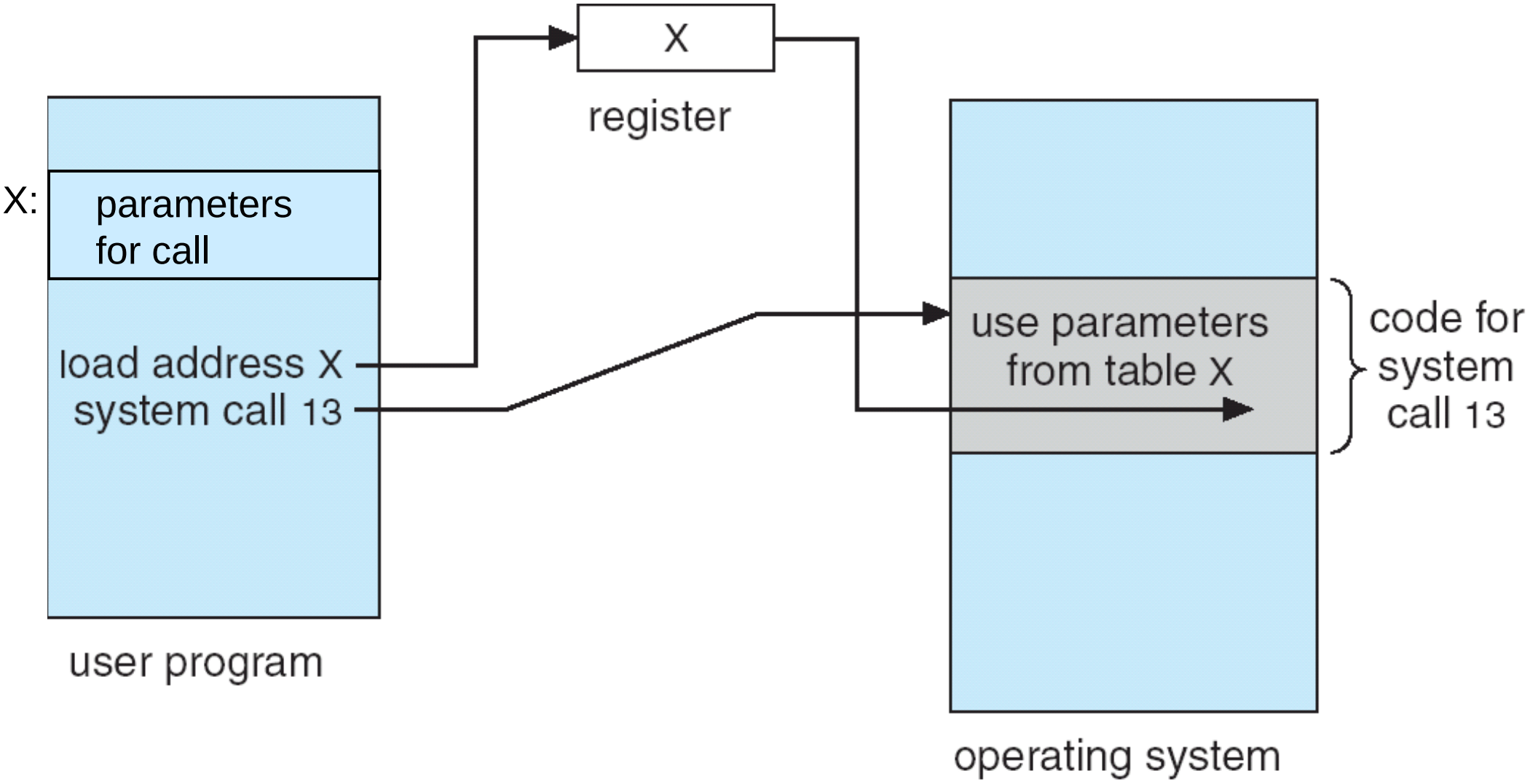
- Parameters passed to ReadFile():
  - file — the file to be read
  - buffer — a buffer where the data will be read into and written from
  - bytesToRead — the number of bytes to be read into the buffer
  - bytesRead — the number of bytes read during the last read
  - ovl — indicates if overlapped I/O is being used

System Call Parameter Passing

- Three general methods used to pass parameters to syscalls:
  - Parameters **in *registers***
  - Parameters **in a *block in memory***, and address to block in a register
    - This approach taken by Linux
  - Parameters ***pushed onto the stack***

- What are the advantages/disadvantages?

System Call Parameter Passing via Block



System Programs

- User's view of an Operating System
- Provide a convenient environment
  - File management
  - Program development
  - Graphical user interface
  - ...

Summary

- **Operating System** = OS Kernel + System Programs
  - Mediates all accesses to system resources
  - **Interrupt**-driven
    - Error handling
    - Controlled access to system resources, e.g.
      - I/O devices, DMA
      - CPU time sharing
    - …
- **Dual-Mode** (user mode, kernel mode)
  - **System Call** API for portability

Reading guidelines

- 9th edition
  - Chapter 1: Sections 1.1-1.7
  - Chapter 2: 2.3-2.5
- 10th edition
  - Chapter1: 1.1-1.5
  - Chapter2: 2.3-2.4

What's next?

- Today
  - Sign up in Webreg!
  - Get the book
- Tomorrow
  - 13-17 Introductory C lecture
  - Try some C programming
- Thursday
  - 8-10 lesson to introduce the labs
- Friday
  - First lab (lab0)