CSE 421/521 - Operating Systems
Fall 2018

LECTURE - I

INTRODUCTION

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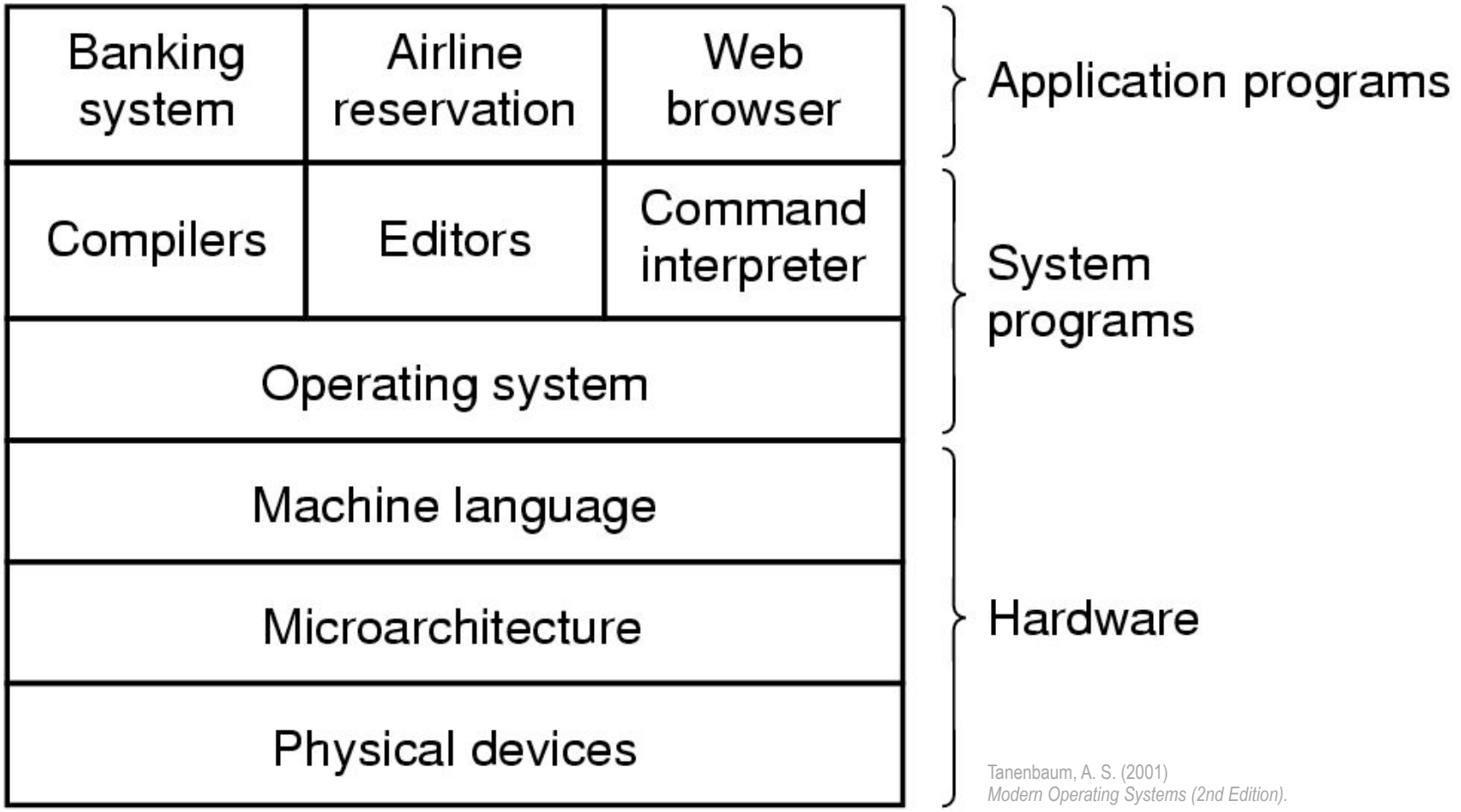
What is an Operating System?

- It is a program
- It is a big hairy program
  - The Linux source code has more than 1.7 M lines of C code
- A program that manages the computer hardware
- An intermediary between the computer user and the computer hardware
- Manages hardware and software resources of a computer

Role of an Operating System

- **The Tanenbaum "layered" view**

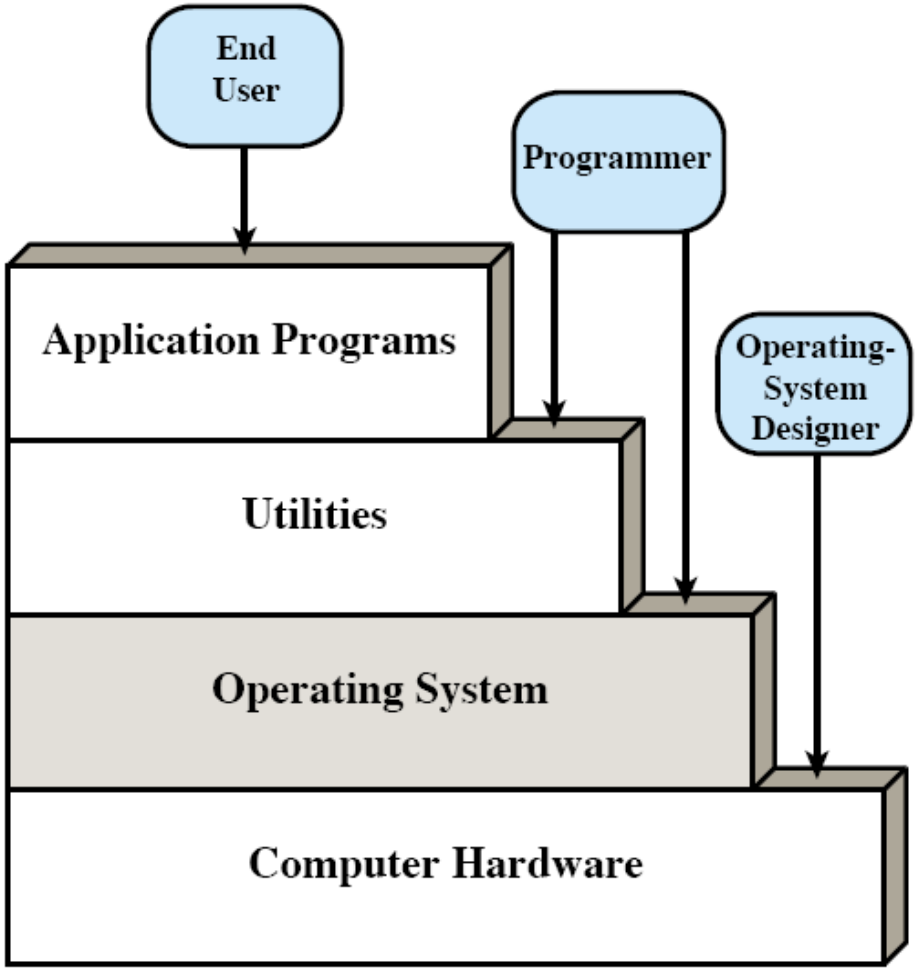


Tanenbaum, A. S. (2001)
Modern Operating Systems (2nd Edition).

A computer system consists of hardware, system programs and application programs

Role of an Operating System

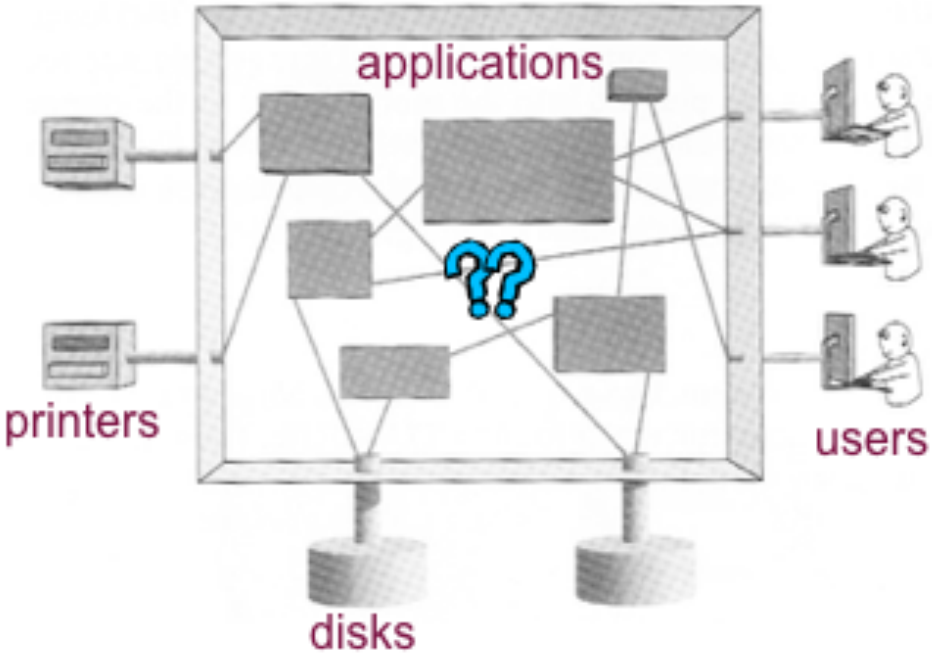
- **The Stallings "layered & stairs" view**



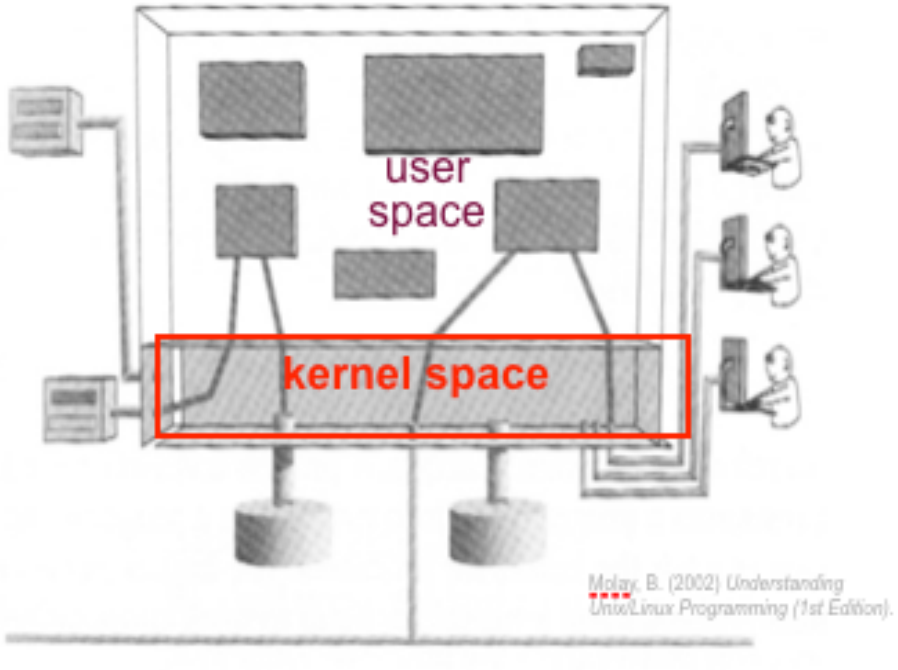
"Layers and stairs" view of a computer system

Role of an Operating System

- **The Molay "aquarium" view**
  - the only not-layered view
  - everything must transit through the O/S or "kernel"



How are they all connected?



The kernel manages all connections

Key Point

- An operating system is a program that acts as an intermediary between users/applications and the computer hardware.

Operating System Goals

- From the user perspective:
  - Executes user programs and make solving user problems easier
  - Makes the computer system convenient to use
    - hides the messy details which must be performed
    - presents user with a virtual machine easier to use

- From the System/HW Perspective:
  - Manages the resources
  - Uses the computer hardware in an efficient manner
    - time sharing: each program gets some time to use a resource
    - resource sharing: each program gets a portion of a resource

What Expect to Learn?

- Key Concepts of Operating Systems
  - Design, Implementation, and Optimization

- Topics will include:
  - Processes, Threads and Concurrency
  - CPU and I/O Scheduling
  - Memory and Storage Management
  - File System Structures
  - Synchronization and Deadlocks
  - Protection and Security
  - Distributed Computing & Related Issues

- Kahoot.it

Contact Information

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Recitations

- The undergrads need to attend one of the following recitations:
  - Fri 8 - 8:50am
  - Fri 12 - 12:50pm

  * Recitations will start this week

- Recitations will include:
  - Clarification of some important course material
  - Solutions of quiz, HW, and other exercise questions
  - Project guidance
  - Programming tips

- PS: undergrads only, no grads allowed in recitations!

Course Web Page

- Course web page:
  - http://www.cse.buffalo.edu/faculty/tkosar/cse421-521_fall2018

Date	Lect.	Title	Notes
Aug 28	1	Introduction	
Aug 30	2	Operating System Structures	
Sep 4	3	Processes	
Sep 6	4	Threads	*Project-1 out*
Sep 11	5	Project-1 Discussion	
Sep 13	6	CPU Scheduling – I	
Sep 18	7	CPU Scheduling – II	
Sep 20	8	Process Synchronization – I	
Sep 25	9	Process Synchronization – II	
Sep 27	10	Deadlocks – I	
Oct 2	11	Deadlocks – II	
Oct 4	12	Midterm-I Review	
Oct 9		MIDTERM-I EXAM *(Room: NSC 201)*	
Oct 11	13	Midterm-I Discussion	
Oct 16	14	Main Memory - I	
Oct 18	15	Main Memory – II	*Project-1 due*
Oct 23	16	Project-2 Discussion	*Project-2 out*
Oct 25	17	Virtual Memory – I	
Oct 30	18	Virtual Memory – II	
Nov 1	19	File Systems – I	

Piazza Discussion Forum

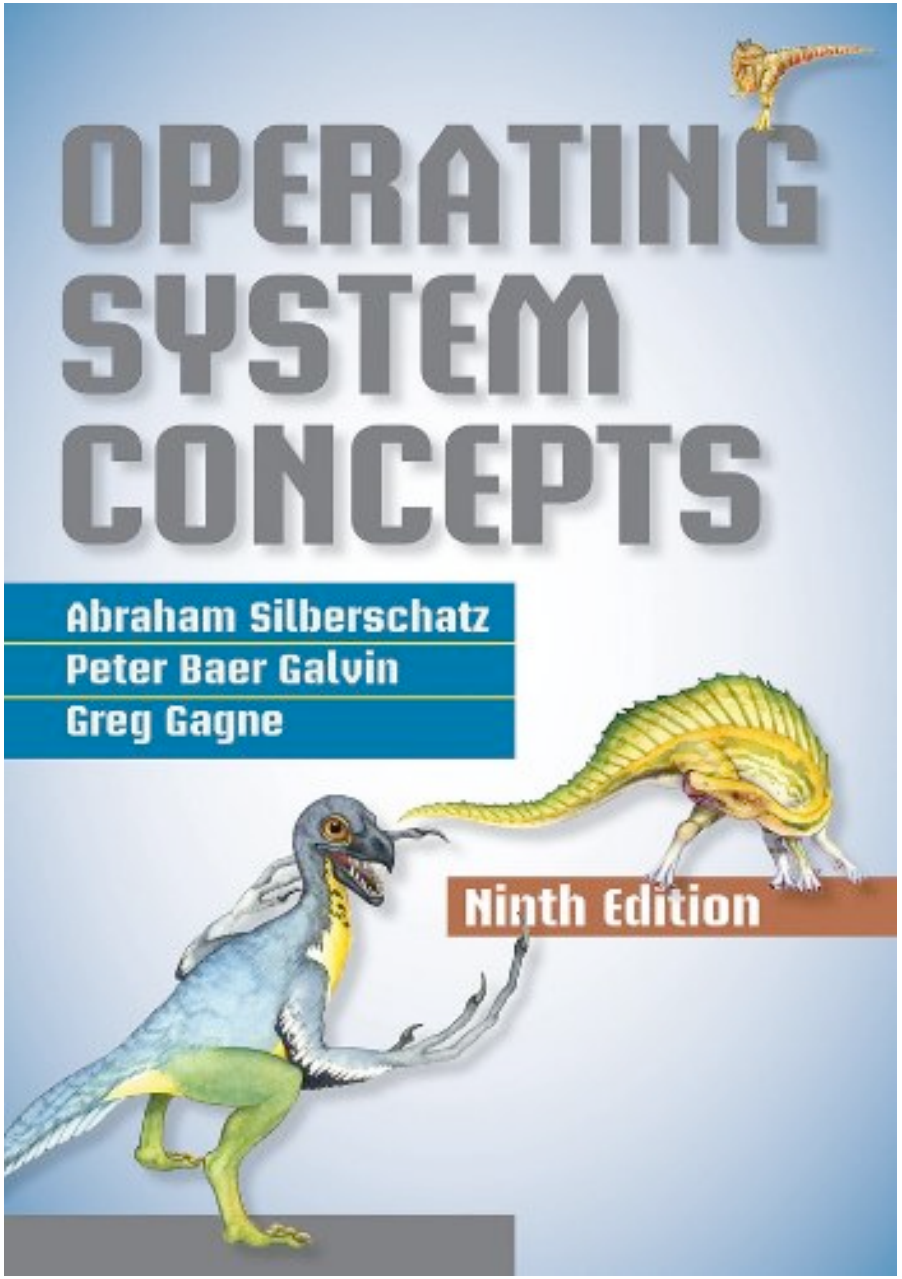
- We will be using Piazza for class discussion. The system is highly catered to getting you help fast and efficiently from classmates, the TA, and myself.
- Rather than emailing questions to the teaching staff, I encourage you to post your questions on Piazza.
- All lecture notes, important links and other documents will be posted to Piazza
- Find our class page at: https://piazza.com/buffalo/fall2018/cse421521

Course Syllabus

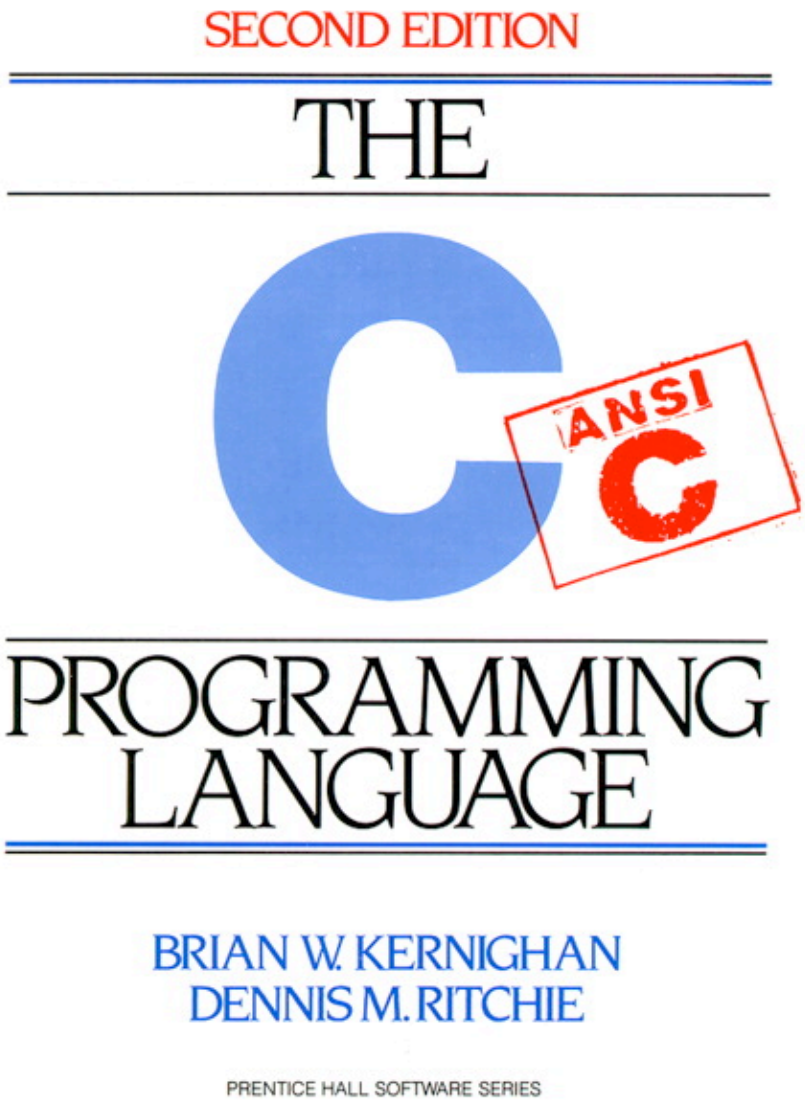
- Available online at:

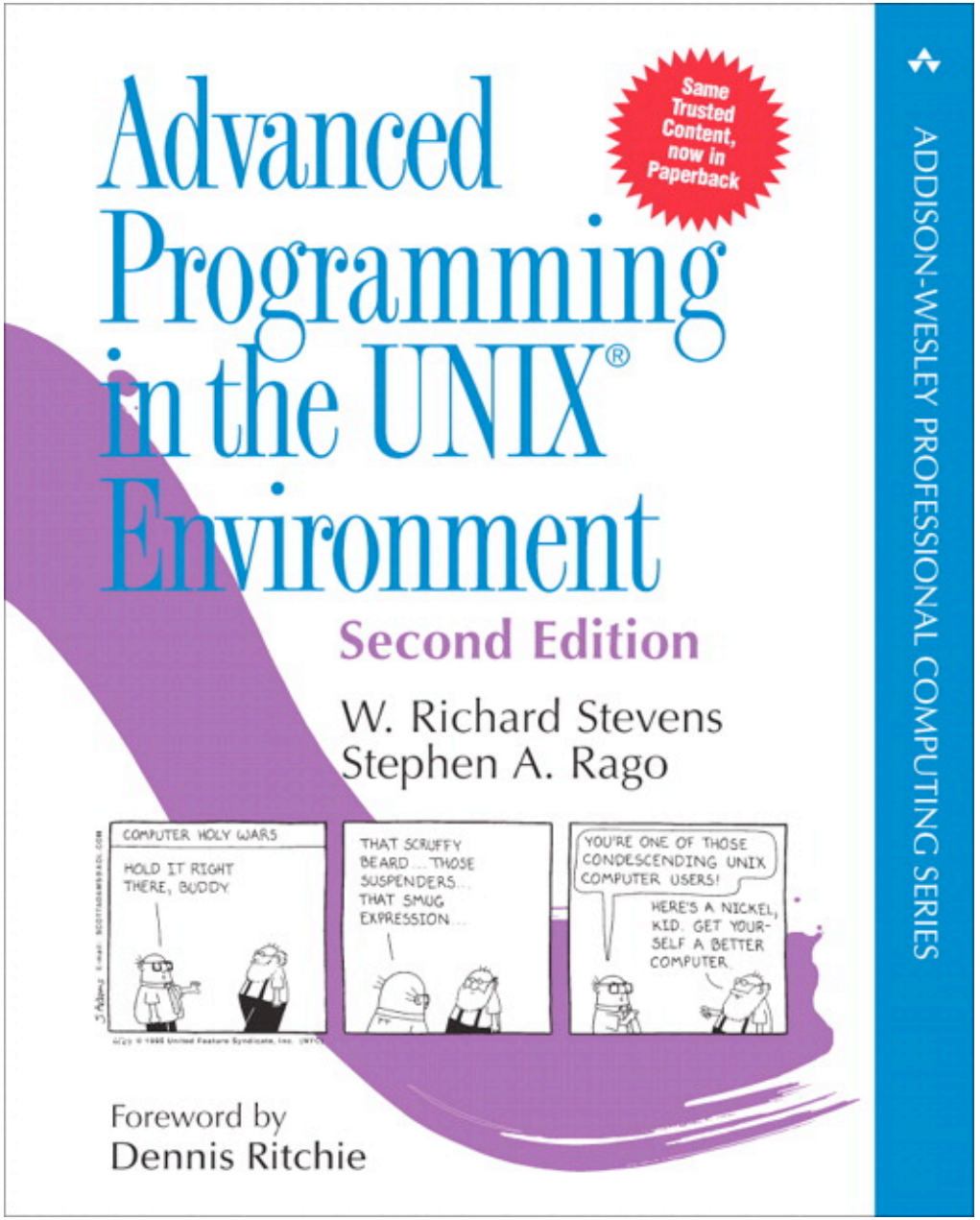
- https://piazza.com/buffalo/fall2018/cse421521/resources

Textbook: ~~Required~~ Highly Recommended



Recommended Supplementary Text





Grade Components

- The end-of-semester grades will be composed of:

- Pop Quizzes	: 5%	(5; 4 counted)
- Homework	: 5%	(4)
- Project-1	: 20%	
- Project-2	: 20%	
- Midterm-1	: 25%	
- Midterm-2	: 25%	

* You are expected to attend the classes and actively contribute via asking and/or answering questions

** There will be NO final exam!

Pop Quizzes


OK GUYS! FOR TODAY'S IMMUNITY CHALLENGE YOU HAVE TO REALLY MULTITASK...
NOKIA
MICROSOFT
HP
PALM
OUTWIT
OUTPLAY
SURVIVOR
MOBILE OS
OUT LAST
©SLASHGEAR.COM / RUE LIU

Pop Quizzes

- There may be pop quizzes at the beginning of some classes.
- The questions in the quizzes will come mostly from the material discussed in the previous lecture(s) or homework assignment(s).
- The quizzes will be very short (5-10 min) with one or two questions aiming to test whether you have understood the most recently discussed material in the curse.
- There will be 5 pop quizzes throughout the semester. One with the lowest grade will be discarded, and the rest four will count toward your final degree.

Homework

- There will be four homework assignments throughout the semester.

- The format of the homework questions will be similar to the exercises at the end of each chapter in the Silberschatz book.

- The homework assignments aim to ensure that you read the textbook and study regularly for the material covered in the class.

* HW assignments will be graded, but not corrected. You will get the solution key after the submission deadline.

Projects

- There will be two hands-on programming projects throughout the course.
- These projects will aim to implement some core Operating System components at the kernel-level for better understanding of the concepts.
- These will be “team” projects and they will require strong programming background (in C) and UNIX programming experience.
- Teams will consist of three students.

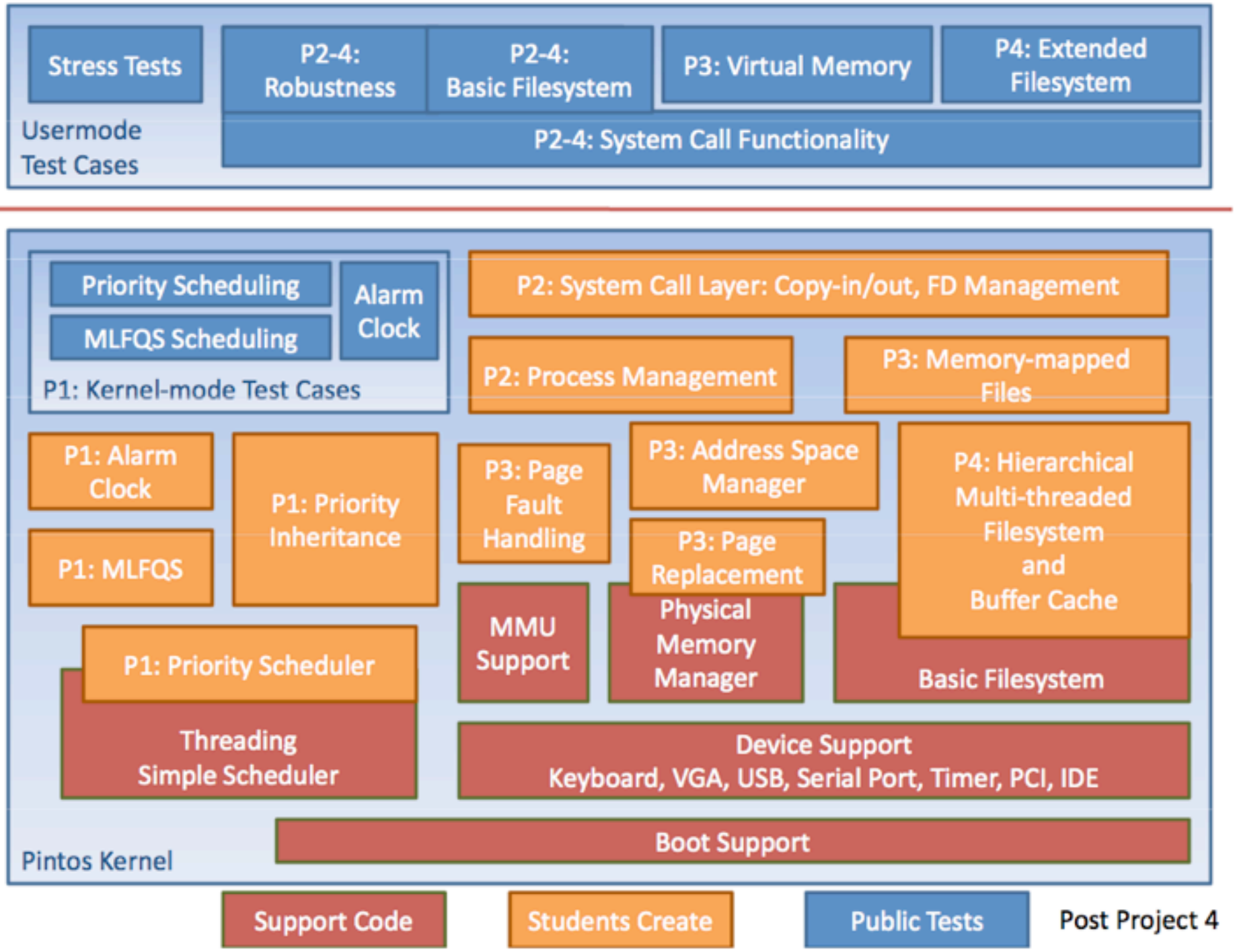
Projects *(cont.)*

- Both projects will be based on Pintos operating system.
- Pintos is a simple operating system framework for the 80x86 architecture developed at Stanford University.
- http://www.cse.buffalo.edu/faculty/tkosar/cse421-521/projects/pintos.pdf

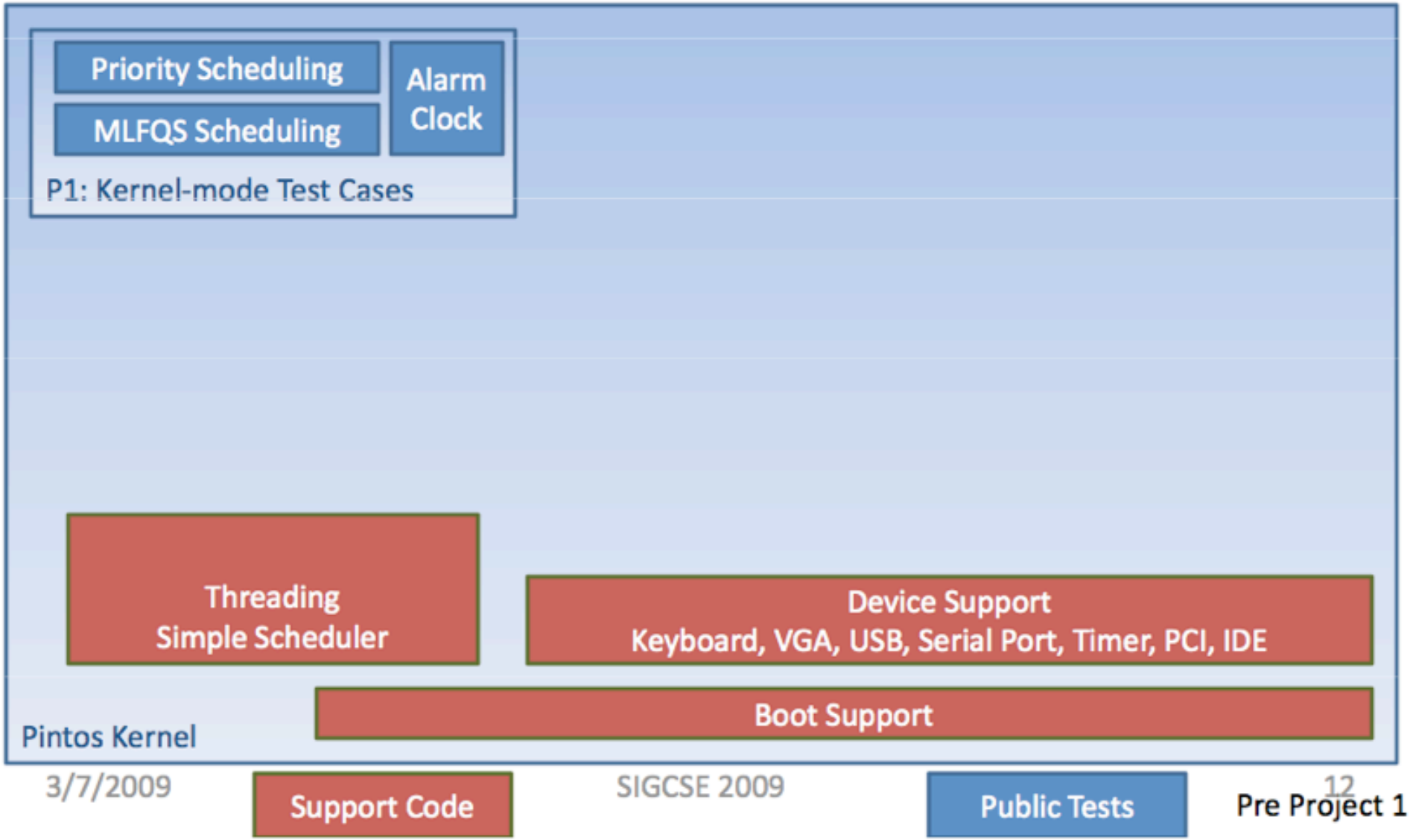
Pintos Projects

1. Threads <-- CSE 421/521 Project 1
2. User Programs
3. Virtual Memory
4. File Systems

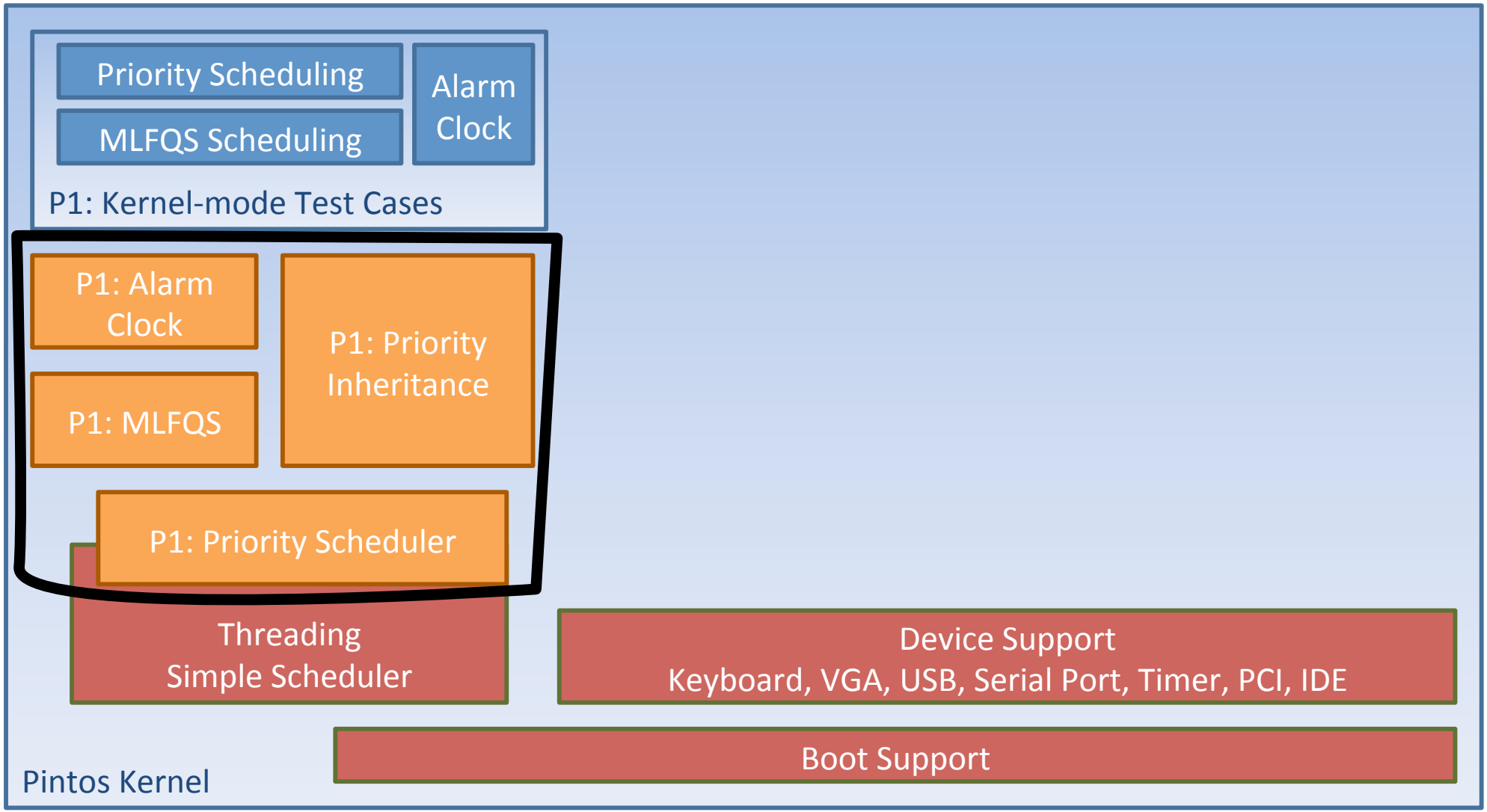
Pintos after full implementation (post prj-4)



Yo will be provided with this (pre prj-1)



You will implement this (post prj-1)



Step 1: Preparation

READ:

Chapters 3-5 from Silberschatz

Lecture slides on Processes, Threads and CPU Scheduling

From Pintos Documentation:

- Section 1 - Introduction
- Section 2 - Threads
- Appendix A1- Pintos Loading
- Appendix A2 - Threads
- Appendix A3 - Synchronization
- Appendix B - 4.4BSD Scheduler

Step 2: Setting Up Pintos

- Use the Pintos **VM** we have prepared for you:

  http://ftp.cse.buffalo.edu/CSE421/UB-pintos.ova

- It requires **Virtualbox** software

  ==> will work on most Linux, Windows, Mac systems

  https://www.virtualbox.org/wiki/Downloads

- Detailed setup instructions are available on Piazza.

Rules

- No use of laptops/phones during the lectures except for the course purposes!
- No late project submissions accepted!
- Exams will be closed book.
- You are only responsible from material covered in the class, homework, and projects.
- Academic dishonesty will be treated “very” seriously!

Academic Dishonesty

- There is a very fine line separating conversation pertaining to concepts and academic dishonesty. You are allowed to converse about general concepts, but in no way are you allowed to share code or have one person do the work for others. If you are caught violating the academic integrity policy, you will minimally receive an "F" in the course.

- We are using professional software which can easily detect any cheating attempts in programming projects. The results generated by this software is considered as official evidence for cheating from another student, or from internet or any other resource.

Academic Dishonesty *(cont.)*

- It is required as part of this course that you read and understand the departmental academic integrity policy located at the following URL:

- http://www.cse.buffalo.edu/undergrad/current_students/policy_academic.php

Summary

- What is an OS?
- Role of an OS
- Operating System Goals
  - User View vs System View
- Course Logistics

- Reading Assignment: Chapters 1 & 2 from Silberschatz.

Acknowledgements

- “Operating Systems Concepts” book and supplementary material by A. Silberschatz, P. Galvin and G. Gagne
- “Operating Systems: Internals and Design Principles” book and supplementary material by W. Stallings
- “Modern Operating Systems” book and supplementary material by A. Tanenbaum
- R. Doursat and M. Yuksel from UNR, Ed Lazowska from UWashington