Processes I

CSE 351 Autumn 2023

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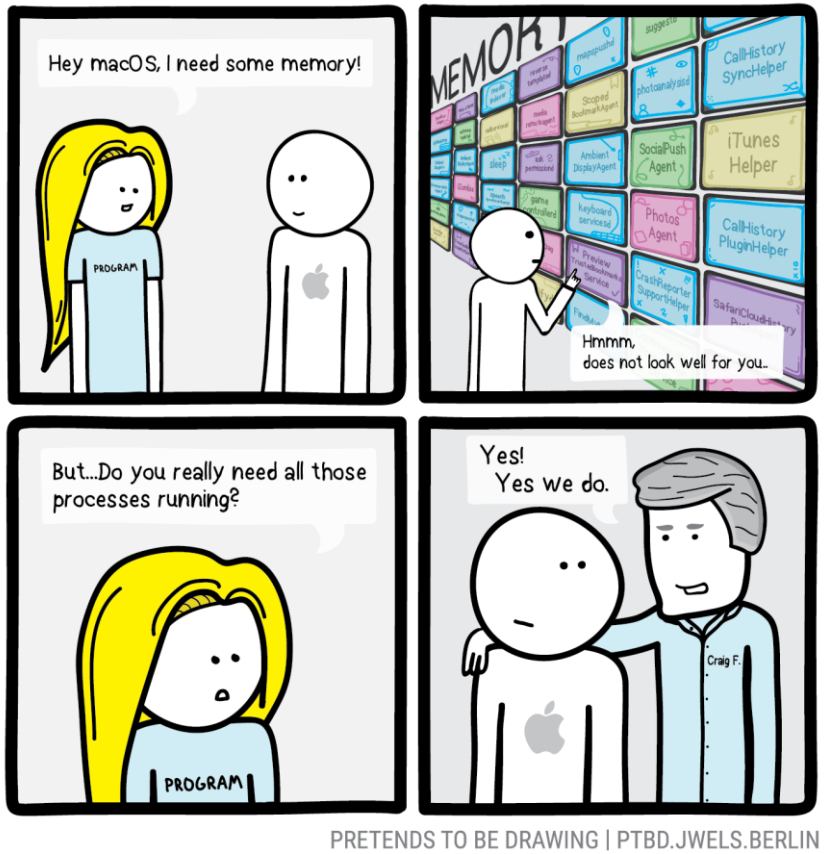


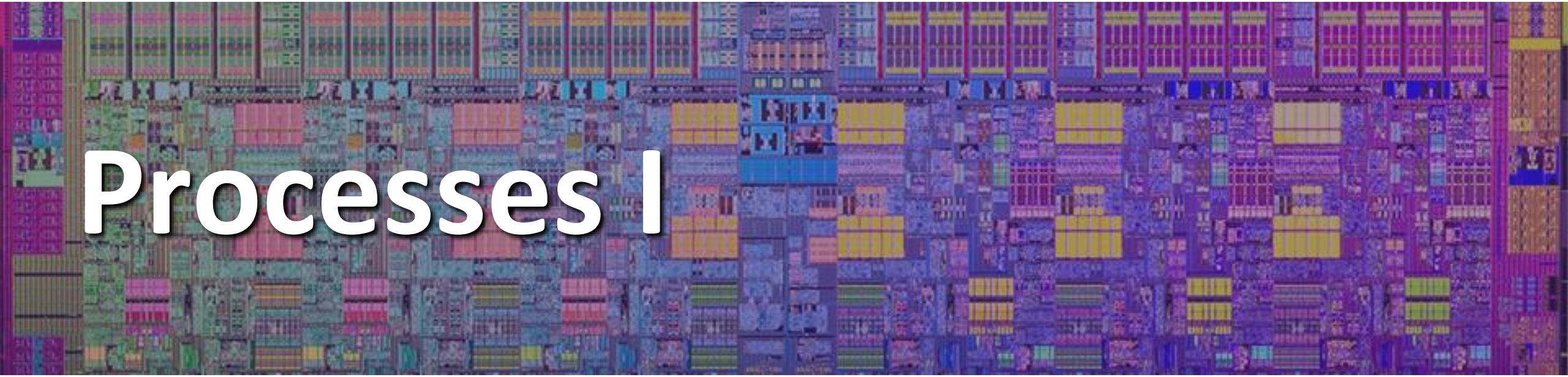
https://ptbd.jwels.berlin/comic/21/

Relevant Course Information

- HW21 due Friday (11/24)
- No HW24; HW25 will cover processes
- Lab 4 due Monday (11/27)
- Lab 5 due 12/7

- "Virtual Section" on Memory Allocation/Lab 5
  - Worksheet and solutions released on Wednesday or Thursday
  - Videos will be released of material review and problem solutions

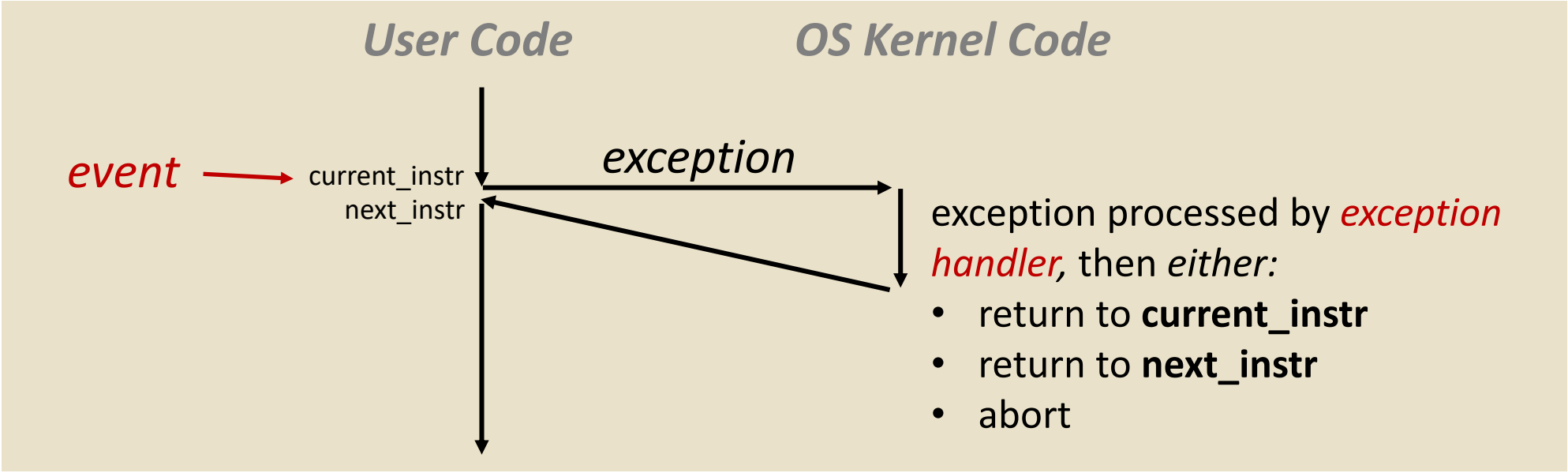
- Final Dec. 11-13, regrade requests Dec. 17



Processes I

Lesson Summary (1/3)

- ***Exceptional control flow*** enables a computer to respond/react to system *events* that can be external to the running process
  - The event generates an ***exception*** that transfers control to ***exception handler*** in operating system kernel, which will have 1 of 3 possible outcomes:



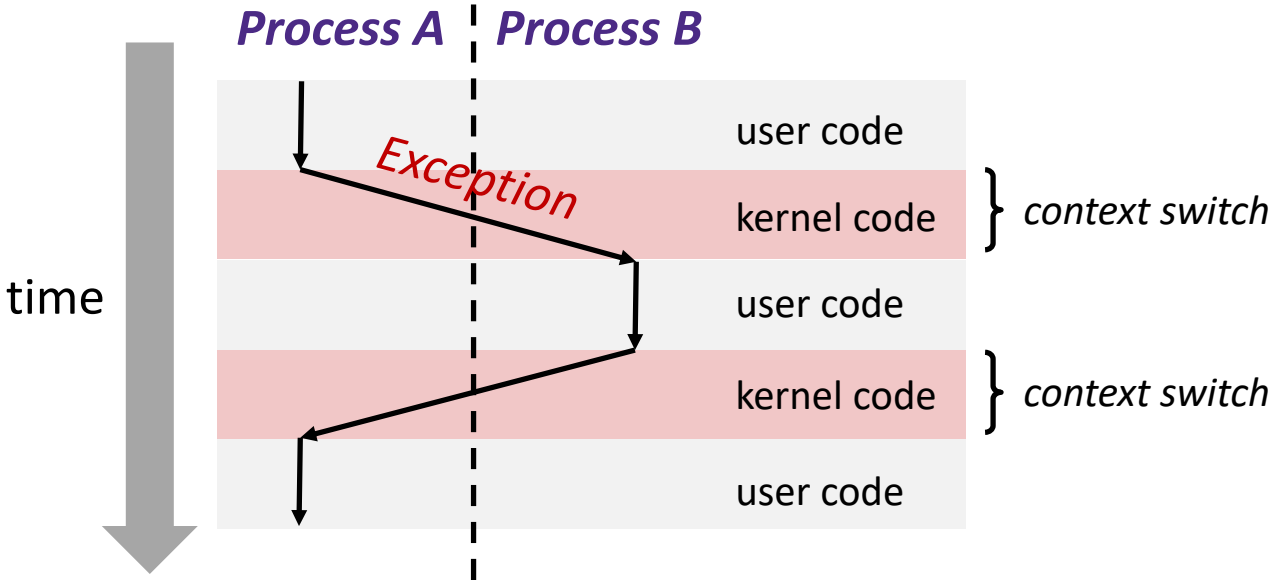
Lesson Summary (2/3)

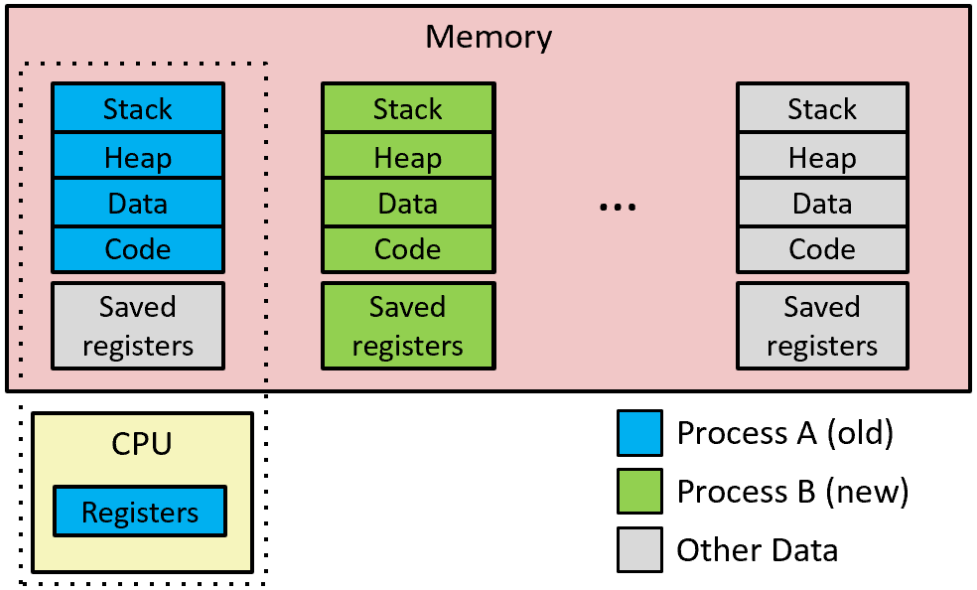
- *Asynchronous exceptions* (external to running process)
  - ***Interrupts*** don't affect the currently running process
- *Synchronous exceptions* (internal to running process)
  - ***Traps*** are intentional – asking the operating system to do something for you
  - ***Faults*** are unintentional but possibly recoverable
  - ***Aborts*** are unintentional and unrecoverable

Lesson Summary (3/3)

- A ***process*** is an instance of an running program and provides two key abstractions: logical control flow and private address space

- Multiple running processes can be run *concurrently* via ***context switching***
  - Parallelism only possible with multiple CPUs/cores



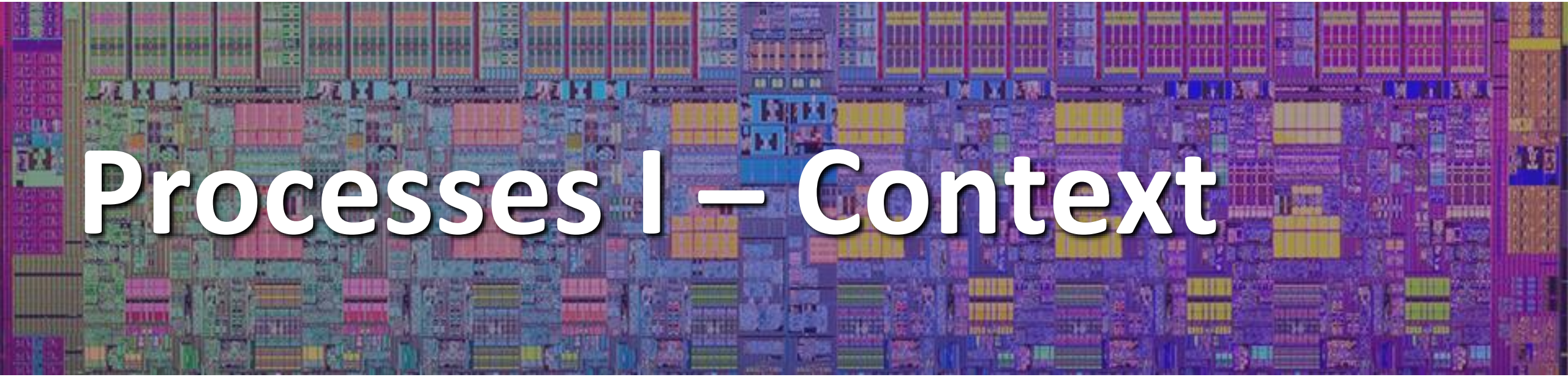


Lesson Q&A

- Terminology:
  - Exceptional control flow, event handlers, operating system kernel
  - Exceptions: interrupts, traps, faults, aborts
  - Processes: concurrency, context switching

- Learning Objectives:
  - Define exceptional control flow and explain its importance in enabling concurrency and error handling.

- What lingering questions do you have from the lesson?

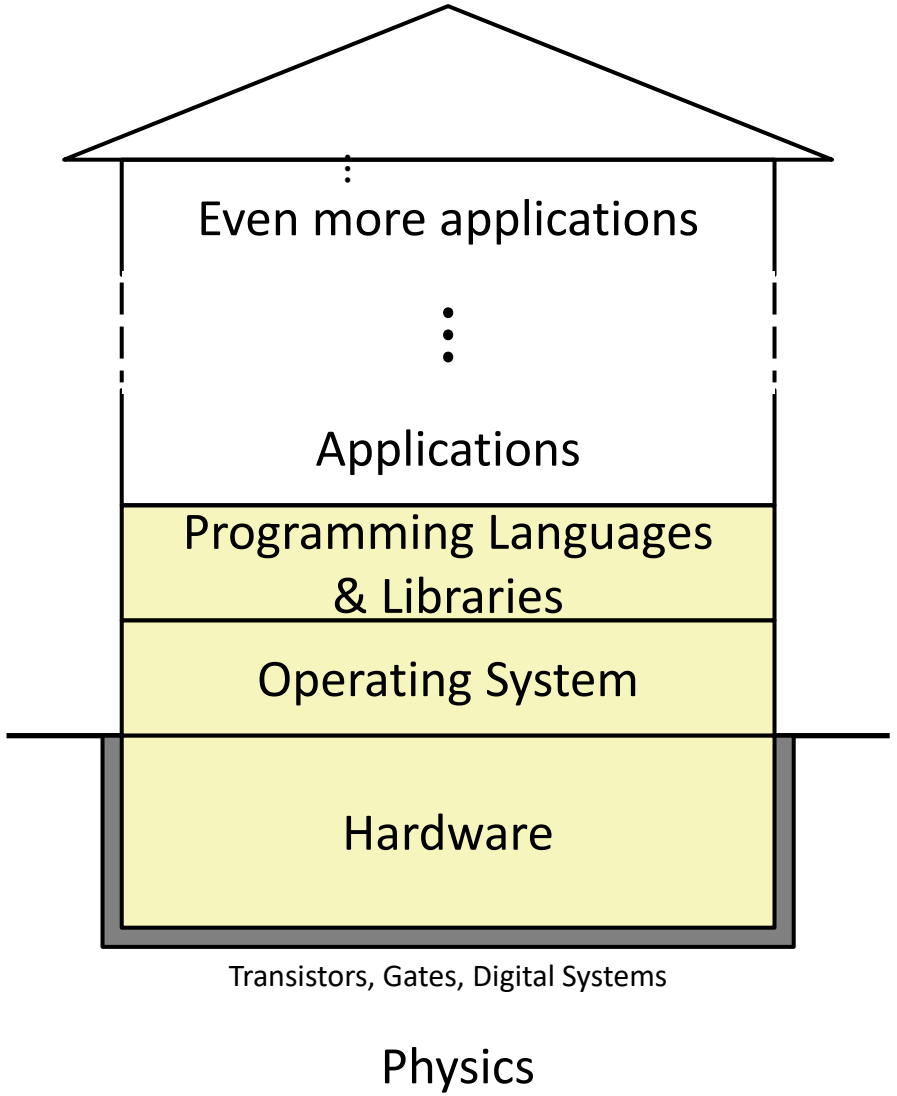


Processes I – Context

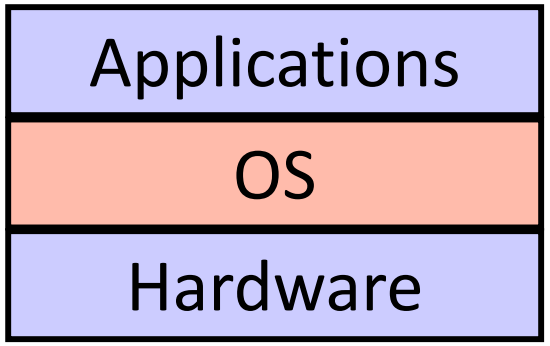
The Hardware/Software Interface

- Topic Group 3: **Scale & Coherence**
  - Caches, Memory Allocation, **Processes**, Virtual Memory

- How do we maintain logical consistency in the face of more data and more processes?
  - How do we support control flow both within many processes and things external to the computer?
  - How do we support data access, including dynamic requests, across multiple processes?



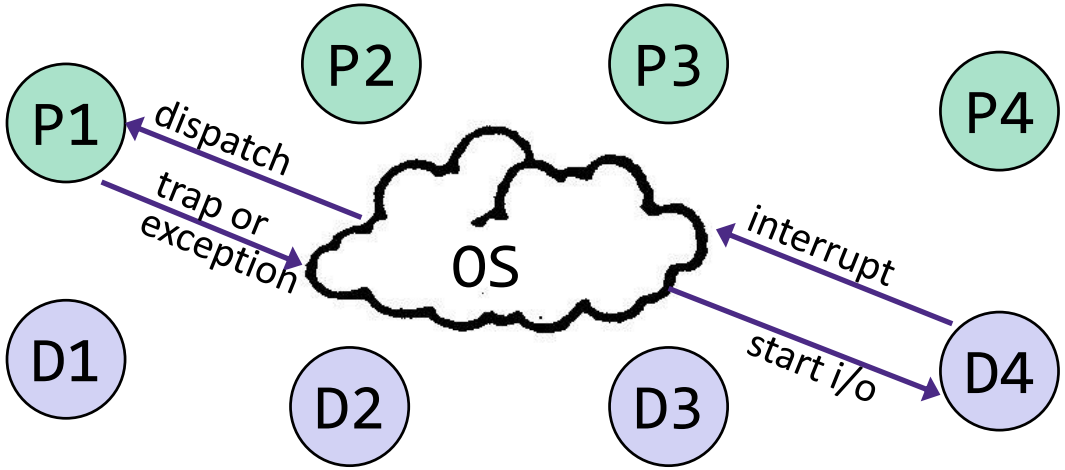
The Operating System



- "The OS is everything you don't need to write in order to run your application"
- This depiction invites you to think of the OS as a library
  - In some ways, it is:
    - All operations on I/O devices require OS calls (`syscalls` – traps)
  - In other ways, it isn't:
    - You use the CPU/memory without OS calls
    - It intervenes without having been explicitly called

Operating System Structure

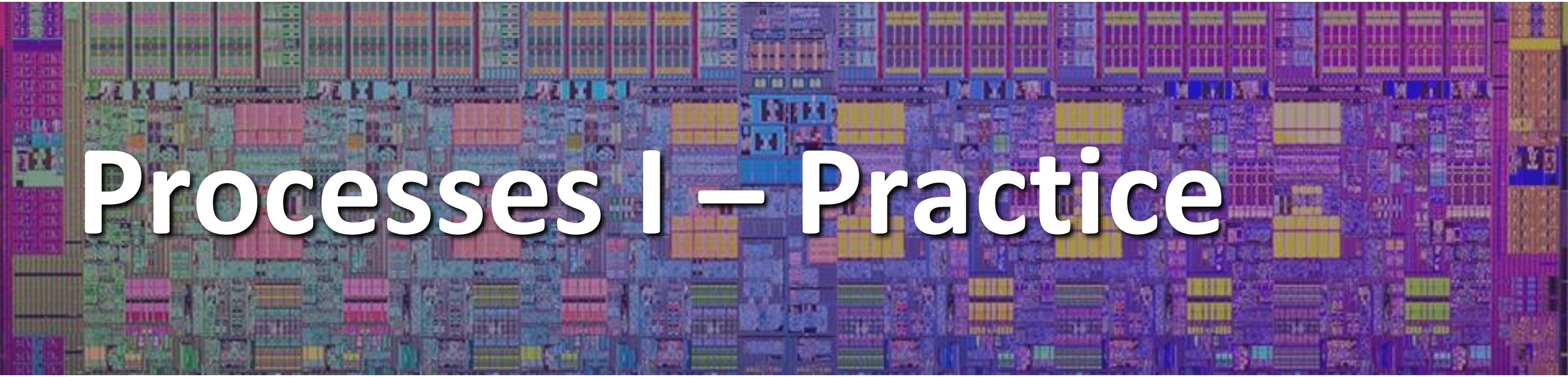
- The OS sits between application programs (P for processes) and the hardware (D for devices)
  - It mediates access (sharing and protection)
    - Programs request services via *traps* or *exceptions*; devices request attention via *interrupts*
  - It abstracts away hardware into *logical resources* and well-defined *interfaces* to those resources (ease of use)
    - *e.g.*, **processes** (CPU, memory), files (disk), programs (sequences of instructions), sockets (network)



OS Relevance in 351

- From programmer's perspective, the application benefits include:
  - Programming simplicity
    - Can deal with high-level abstractions instead of low-level hardware details
    - Abstractions are *reusable* across many programs
  - Portability (across machine configurations or architectures)
    - Device independence: 3com card or Intel card?

- Want to learn more?
  - CSE 333 will cover the application interface with the OS via system calls
  - CSE 451 will have you implementing the complex details of an operating system



Processes I – Practice

Group Work Time

- During this time, you are encouraged to work on the following:
  1) If desired, continue your discussion
  2) Work on the homework problems
  3) Work on the current lab

- Resources:
  - You can revisit the lesson material
  - Work together in groups and help each other out
  - Course staff will circle around to provide support