CS 261
Fall 2025

Sharon Simmons, Professor

AN x64 PROCESSOR IS SCREAMING ALONG AT BILLIONS OF CYCLES PER SECOND TO RUN THE XNU KERNEL, WHICH IS FRANTICALLY WORKING THROUGH ALL THE POSIX-SPECIFIED ABSTRACTION TO CREATE THE DARWIN SYSTEM UNDERLYING OS X, WHICH IN TURN IS STRAINING ITSELF TO RUN FIREFOX AND ITS GECKO RENDERER, WHICH CREATES A FLASH OBJECT WHICH RENDERS DOZENS OF VIDEO FRAMES EVERY SECOND
BECAUSE I WANTED TO SEE A CAT JUMP INTO A BOX AND FALL OVER.
I AM A GOD.

https://xkcd.com/676/

Computer Systems I: Introduction

CS 261
Fall 2025

Sharon Simmons, Professor

Computer Systems I

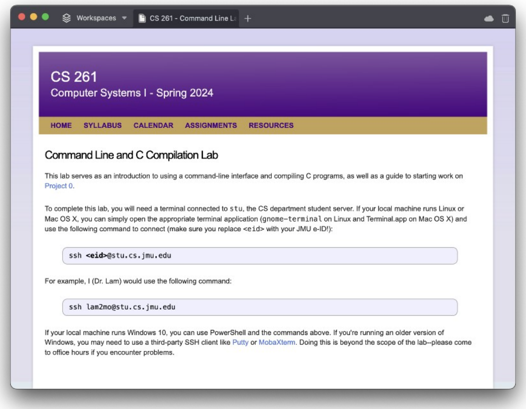
Welcome! Please sit at an available table.

Grab an index card, fold it in half, write your name (and nickname / pronouns if you wish), and stand it up facing the other seats.

Introduce yourselves at your table and help each other perform the following two setup actions (on your laptop if you have one, otherwise on one from the cart):

1) Open today's lab in a browser window.

2) Log into "stu" (the student server) in a terminal window.



CS 261
Computer Systems I - Spring 2024

Command Line and C Compilation Lab

This lab serves as an introduction to using a command-line interface and compiling C programs, as well as a guide to starting work on Project 0.

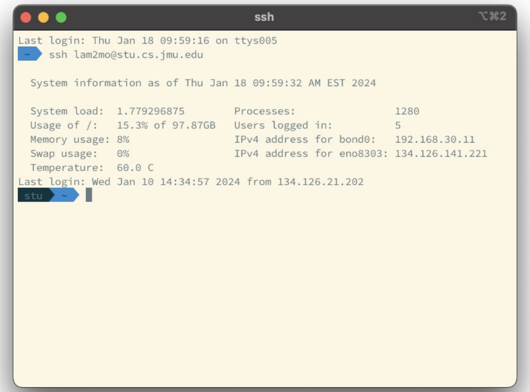
To complete this lab, you will need a terminal connected to `stu`, the CS department student server. If your local machine runs Linux or Mac OS X, you can simply open the appropriate terminal application (`gnome-terminal` on Linux and Terminal.app on Mac OS X) and use the following command to connect (make sure you replace `<eid>` with your JMU e-ID!):

```
ssh <eid>@stu.cs.jmu.edu
```

For example, I (Dr. Lam) would use the following command:

```
ssh lam2mo@stu.cs.jmu.edu
```

If your local machine runs Windows 10, you can use PowerShell and the commands above. If you're running an older version of Windows, you may need to use a third-party SSH client like Putty or MobaXterm. Doing this is beyond the scope of the lab--please come to office hours if you encounter problems.



```
Last login: Thu Jan 18 09:59:16 on ttys005
 ~  ssh lam2mo@stu.cs.jmu.edu

  System information as of Thu Jan 18 09:59:32 AM EST 2024

  System load:  1.779296875       Processes:                1280
  Usage of /:   15.3% of 97.87GB   Users logged in:          5
  Memory usage: 8%                IPv4 address for bond0:   192.168.30.11
  Swap usage:   0%                IPv4 address for eno8303: 134.126.141.221
  Temperature:  60.0 C
Last login: Wed Jan 10 14:34:57 2024 from 134.126.21.202
 stu  ~ 
```

Question

- What will be the output of this C program?

```
#include <stdio.h>
int main() {
    double a = 1e20;  //1 * 10^2
    double b = -a;
    double c = 3.14;
    if (((a+b) + c) == (a + (b+c))) {
        printf("Equal!\n");
    } else {
        printf("Not equal!\n");
    }
    return 0;
}
```

- A) “Equal!”
- B) “Not equal!”
- C) Neither of the above

Question

- Which of the following versions of a “matrix copy” routine will run the fastest?
  - A)
    ```
    for (int i = 0; i < 2048; i++) {
        for (int j = 0; j < 2048; j++) {
            dst[i][j] = src[i][j];
        }
    }
    ```
  - B)
    ```
    for (int j = 0; j < 2048; j++) {
        for (int i = 0; i < 2048; i++) {
            dst[i][j] = src[i][j];
        }
    }
    ```
  - C) Neither; they will always run at approximately the same speed.

What's happening?

- Something about our **mental model** of these programs does not match the **system** on which we're running them.

Systems

- What is a “system?”

Systems

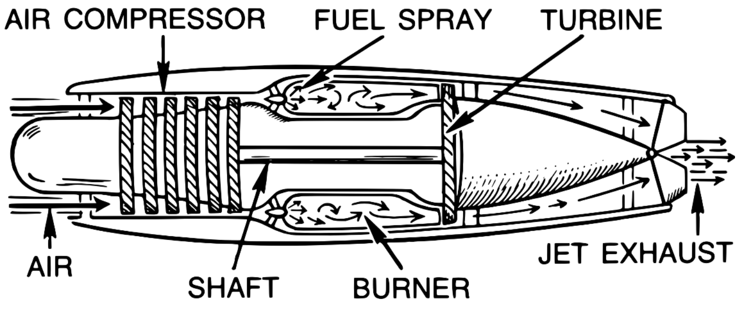
- What is a "system?"
  - Set of interacting components
  - More than the sum of its parts

Jet engine

Computer

Systems

- What is a “system?”
  - Set of interacting components
  - More than the sum of its parts

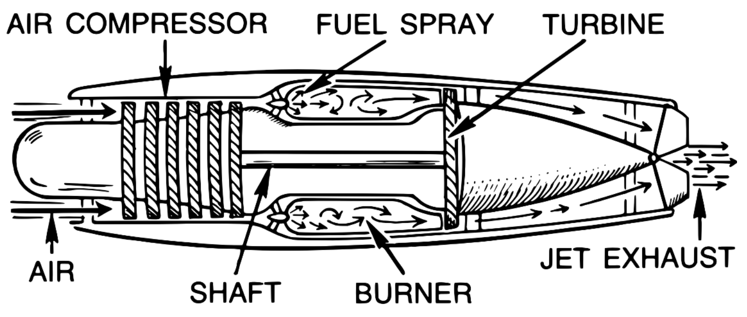


Jet engine

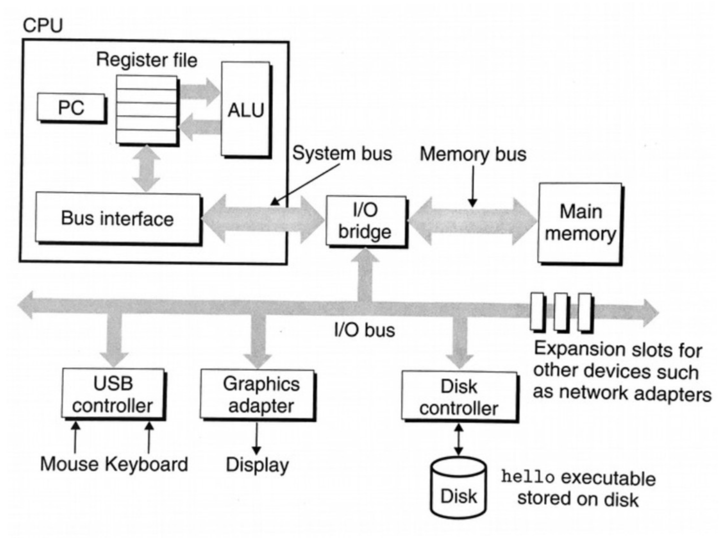
Computer

Systems

- What is a “system?”
  - Set of interacting components
  - More than the sum of its parts



Jet engine



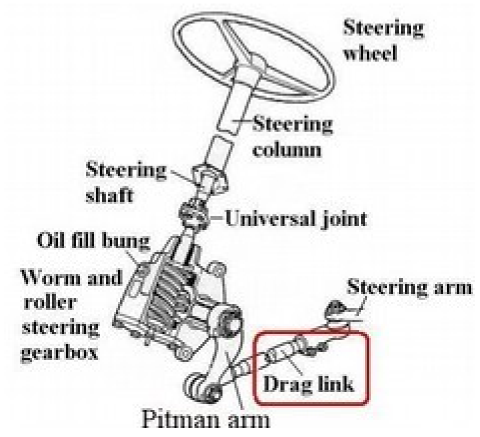
Computer

Systems

- A **computer system** consists of multiple hardware and software components that work together to run user applications.
  - We use complex computer systems every day
  - Our goal: peel back (some of) the complexity
    - See (some of) what’s “under the hood”

Systems

- What is a *process*? What is a *file*?
  - These are examples of abstraction; "fake" views of reality that reduce complexity for users
  - Key ideas: **ignore details** and **focus on interfaces**
  - Especially important in large, complicated systems
  - Understanding abstractions can improve your ability to use them effectively



abstractio
n

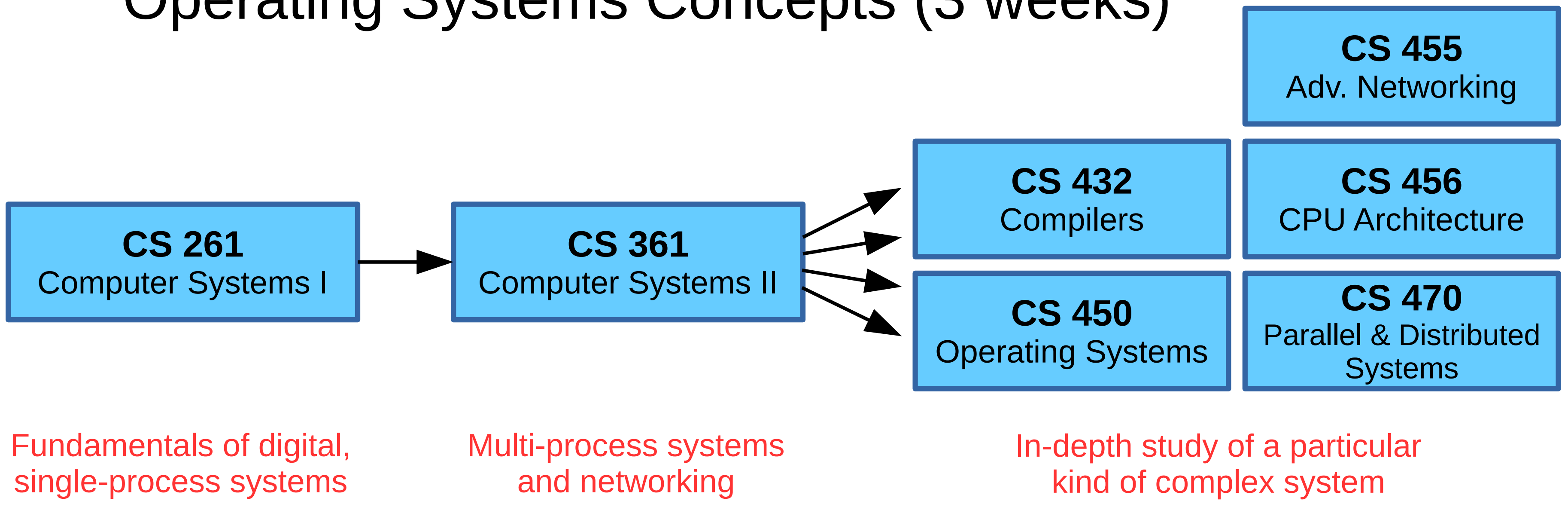
Course Objectives

- Explain machine-level representation of data and code
- Summarize the architecture of a computer
- Explain how complex systems are built from simple components
- Translate high-level code into assembly and machine language
- Write code to emulate the functionality of a computer

- Cultivate a sense of control over computer systems
- Gain an appreciation for software development tools
- Develop a sense of play when writing code
- Appreciate the complexity of systems-level software

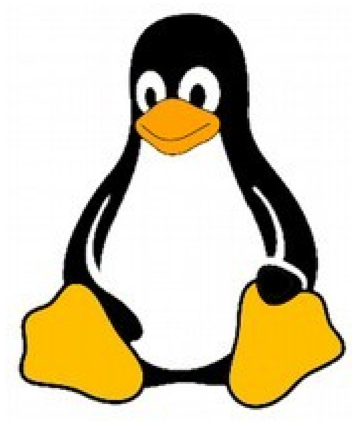
Systems courses

- CS 261 units:
  - C and Linux (3 weeks)
  - Binary Representations (2-3 weeks)
  - Assembly and Machine Code (2-3 weeks)
  - Computer Architecture (3 weeks)
  - Operating Systems Concepts (3 weeks)


CS 261
Computer Systems I
CS 361
Computer Systems II
CS 432
Compilers
CS 450
Operating Systems
CS 455
Adv. Networking
CS 456
CPU Architecture
CS 470
Parallel & Distributed Systems
Fundamentals of digital, single-process systems
Multi-process systems and networking
In-depth study of a particular kind of complex system

CS 261

- What this course is NOT:
  - Programming 101 – I will assume you can program
    - However, we will spend a few weeks learning C
  - Electronics 101 – we won't be going THAT deep
    - If you're interested, see PHYS 140/150 or 240/250 then 371/372
  - Linux 101 – but you have the Unix Users Group
    - Weekly meetings: Wed, 6:30pm, in King Hall 236
    - `https://www.jmunixusers.org`



CS 261

- This is not an “**easy**” course
  - *But you **can** succeed!*
  - I will set you up for success
- Commit to prioritize this course
  - Be prepared to **read** and **work** a lot
  - Don't be afraid to experiment
  - Practice a *growth mindset*: “I can’t do it **YET**”
  - Take advantage of office hours and Piazza
  - Start projects **early** and <u>ask questions</u>

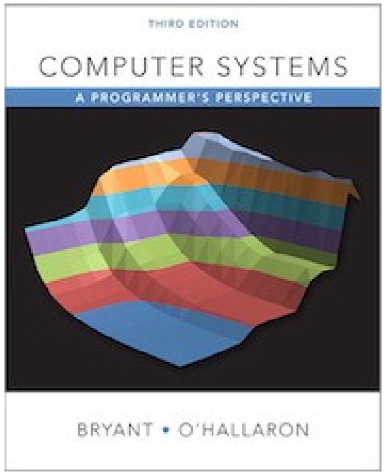
Semester-specific info

- The remaining slides are specific to Fall 2025
  - All slides are posted on the website (calendar page)

- Health and safety concerns
  - If you test positive for COVID or the flu, or are coughing and/or sneezing frequently, **please stay home**
    - Contact me ASAP regarding missed class
  - If you feel ill but well enough to attend class (and are NOT coughing/sneezing frequently), please consider wearing a surgical or N95/KN95 mask to protect others
  - These policies may change
    - Changes will be announced via Canvas message

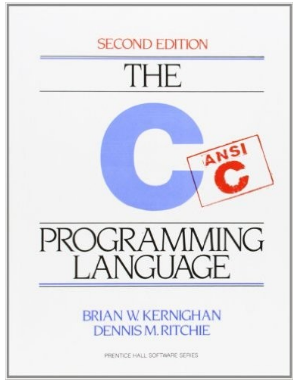
Textbooks

- Required textbook: “Computer Systems”
  - “CS:APP” textbook from Carnegie-Mellon
  - A practical, example-filled introduction
  - Electronic rental available via RedShelf
  - Reserve copy at the Rose library



Important: Readings are listed on their associated quiz

- Recommended book: "The C Programming Language"
  - Brian Kernighan and Dennis Ritchie (creator of C)
  - This is “the book” about C (we’ll refer to it as “CPL”)
  - Scanned excerpts on Canvas (do not redistribute!)
  - Reserve copy at the Rose library



Course Grades

Quizzes and Labs	25%
Programming Projects	25%
Module Tests	15%
Exams	35%

- Quizzes and labs are **formative**
  - Designed to help you learn
- Tests/exams are **summative**
  - Designed to assess what you have learned
- Caution: don’t trust your overall grade in Canvas until after the midterm!
- Projects are **both**
  - Designed to help you learn C and reinforce other course concepts
  - Also designed to assess whether you are ready for CS 361

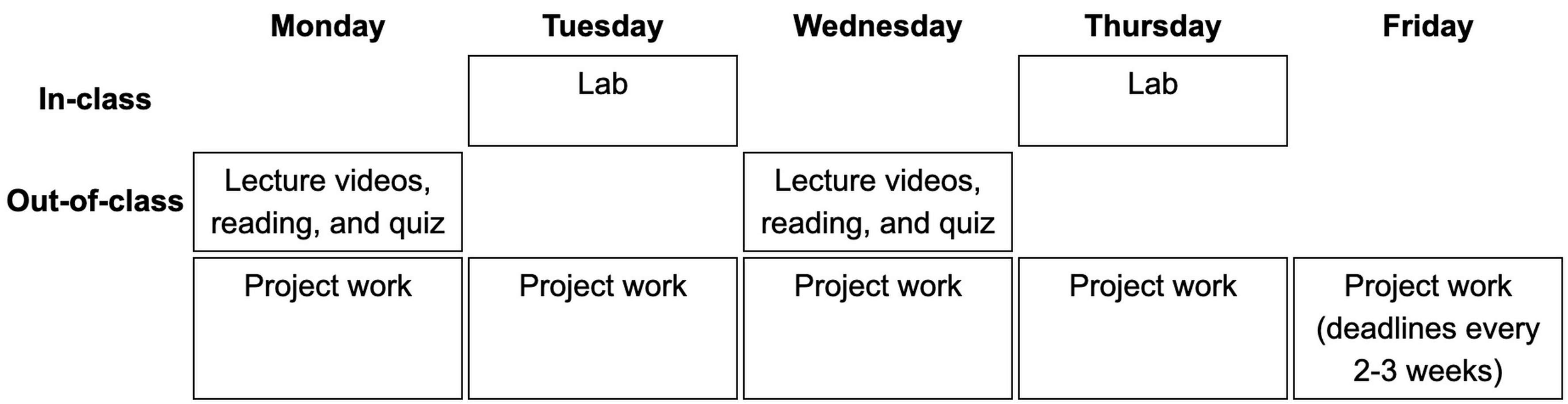
Course Components

- **Public website** (`w3.cs.jmu.edu/simmonsj/cs261`)
  - Syllabus, **calendar**, project descriptions, and resources
  - Links to lecture videos (YouTube, already posted)
    - Most recorded for Fall 2020; all still relevant this year
  - Links to slides
- **Canvas course**
  - Quizzes, lab submissions, and module tests
  - Grades and private files (e.g., lab solutions)
  - Access to Piazza Q&A
- **Student server** (`stu.cs.jmu.edu`)
  - Project development and submission
- **Piazza**
  - Q&A (especially re: projects)

Make sure you can access ALL of these!

Course Design

- This is a **flipped class**
  - Research shows active learning is more effective than passive learning
  - Ahead of time: watch lecture, do reading, take quiz
  - During class: review last lab and work on new lab in small groups
  - Outside class: work on projects, take module tests, and study for exams



	Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**
In-class		Lab		Lab	
Out-of-class	Lecture videos, reading, and quiz		Lecture videos, reading, and quiz		
	Project work	Project work	Project work	Project work	Project work (deadlines every 2-3 weeks)

Video playlists, quizzes, and labs all have a common tag (the first day is “01”)

Class Policies

- Class attendance is necessary and expected
  - We will be completing labs most class periods
  - Find a group (2-4 people) to work with consistently
  - Use a name card for the first half of the of semester

- Every person should fill out a separate copy of the lab
  - Work together and check each other
  - Ask for help when you are stuck or want to confirm something (your goal is to get to the right answers by the end of class)
  - Getting “stuck” or confused is intended; it’s how you learn!
  - Resist the urge to “speedrun” the labs or to work solo

Class Policies

- Submit as PDF on Canvas/Gradescope when done
  - **Scan as a black-and-white PDF**
  - Instructions: https://wiki.cs.jmu.edu/student/canvas/start
  - DO NOT submit raw photos
  - Double-check to make sure it “went through” and that it is legible
  - Submit before leaving class even if you’re not done yet
    - Guarantees at least partial credit if you don’t finish or forget to submit later

- Labs are “lightly graded” (w/o individual mistakes marked)
  - Solutions will be posted on Canvas (under Files→Lab Solutions)
  - Bring your solution to the next class for review
  - Come to office hours if you have further questions

Course Policies

- The projects in this course are VERY important!
  - One purpose of this course is to ensure you are ready to tackle harder projects in CS 361 and the system electives

- Projects are **individual** and **mandatory**
  - A “good faith” submission shows evidence of significant work and investment in writing a solution
  - A good faith submission gets you an “F” (25 points) instead of a zero (!!), in terms of a numeric grade
    - Doing *at least* this on every project is **required** to pass the class

Course Policies

- The JMU Honor Code applies on ALL assignments
  - Violations may be sent to the honor council
  - See relevant section in the syllabus
  - All online quizzes and module tests must be completed **on your own** with no assistance aside from what is allowed in the assignment description in Canvas
- All submitted labs must represent YOUR work
  - You will work in groups to discuss the answers
  - By submitting a PDF on Canvas, you are asserting that these answers are YOUR answers and that you understand WHY you have answered the way you have

Course Policies

- All submitted project code must be YOUR work entirely
  - You may talk with others to discuss general approaches (in fact, I encourage this; use *pseudocode* if necessary)
  - However, one goal of the projects in this course is to develop individual competency in C programming, so **you may NOT share code** with anyone who is not a TA or CS 261 instructor
  - This includes letting someone examine or take a screenshot of your code, or “talking it through” with them line-by-line
  - This also includes using an AI-assist tool (e.g., Github Copilot)
  - If you co-work, sit such that you can’t see each other’s screens
  - Do not store your solution in a public online code repository
  - If you have questions about this, please ask!

Course Policies

- There are a total of four sections of CS 261
  - Two Simmons sections and two Weikle sections
  - Some course materials are shared
  - You are welcome to study with students from other sections, but you must attend and submit assignments to the section you are registered for
  - DO NOT assume assignments are identical or that due dates align

Office hours

- My drop-in office hours are posted on Canvas
  - In person: King Hall 105 (1st floor King)
- CS TAs: in-person and virtual office hours: bit.ly /CS-TAs
  - 261-specific TAs TBD

TODOs in the next few days

- If you haven't already:
  - **Take welcome survey on Canvas**
  - **Take syllabus quiz on Canvas** (due Friday)
  - **Read CS:APP Ch. 1 and take Quiz 01** (due Friday)

- Before class on Tuesday:
  - Review these slides and the syllabus and come with questions
  - **Watch "Command line and C compilation" lecture videos**
  - **Read 02-CPL excerpts** (on Canvas under Files→Readings)
  - **Take Quiz 02** (due Monday)
  - **Make sure you can log into `stu`**
    - Instructions at the top of Tuesday's lab: w3.cs.jmu.edu/simmonsj/cs261/02-cmd_line.html
  - Make sure you can access Piazza
  - Skim the project guide and Project 0 description (on website)

Intro lab (Tuesday)

- Material from Chapter 1
  - Front page: **Computer Organization**
  - Back page: **C Compilation**

- Submit as PDF on Canvas when done
  - **Scan as a black-and-white PDF**
  - Instructions: https://wiki.cs.jmu.edu/student/canvas/start
  - DO NOT submit raw photos, and double-check for legibility!
  - Let the instructor know after you submit for verification
  - Once you have verified a satisfactory submission, please feel free to leave – I'll see you on Thursday!

Closing exhortations

- Take care of yourself
  - And if you can, someone else
  - Build (or reconnect with) a support network
  - Protect your boundaries
  - Carve out time to disconnect and rest
  - Talk to someone if things start getting overwhelming
- Have a great semester!