CS110
Principles of Computer Systems

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http://cs110.stanford.edu

Today's Goals

- Describe the course
  - Course staff introduction
  - Course administrative details
  - Grading
  - **Course content**
- Computer systems introduction
  - What we mean by systems.
  - Why are computer systems interesting?

Course Personnel

Instructor: Mendel Rosenblum

TAs:

- Tirthankar (Ty) Chatterjee
- Rafael Moreno Ferrer
- Chris Lengerich
- Jim Liu
- Rory MacQueen
- Shizhi Wang

Class electronic communication

- Students & Staff ⟶ Students & Staff
  - Piazza Discussion Forum via website
- Students ⟶ Staff
  - Mail cs110-win1213-staff@lists.stanford.edu
- Staff ⟶ Students
  - Mail sent to all **registered** students

- My Email: **mendel@cs.stanford.edu**

Prerequisites

- Formal:
  - CS107 and (CS103 or CS103B)
- Practical:
  - Basic computer architecture
  - Low level C programming
    - Pointers, strings, etc.

Course Material

- Textbook available at Stanford Bookstore

  Principles of Computer System Design: An Introduction

  Jerome H. Saltzer and M. Frans Kaashoek.

  First 6 chapters in textbook (also available online)

  Rest of book available via class website and as a reader

- Lecture notes distributed in class
  - Also available as PDF files on website
  - Leftover paper copies available Gates Hall 3rd floor between A and B wings

Discussion Sections

- Meet once a week for 50 minutes
  - Discuss material related to assignments
  - **You are responsible for this material**
- Enroll in a section via the course website
  - Sections have enrollment limits

Assignments

Four assignments spread out over the quarter

- 1st out on Friday, 4th due last day of class
- Done individually
- Two parts: Programming, Discussion/design

Subjects:

1. Naming/layering – File system archeology
2. Concurrency
3. Performance
4. Distributed systems

Disclaimer

- Relationship between programming assignments and lectures different from intro CS classes
  - CS110 is about concepts
    - Example: Layering
- Analogy with writing courses and writing assignments in other courses

Policies: Semi-tough Love

- Late policy: Don't get behind
  - 10% penalty per 24-hour day
  - Nothing after five (5) 24-hour days
- Exceptions for special circumstances
  - 3 free 24-hour "late days"
  - Can be used together
- Assignments are done individually
  - Stanford Honor Code
  - Checking software may be deployed

Exams

- Midterm Exam:
  - In class on Monday, February 11th
- Final Exam:
  - Friday, March 22nd 8:30-11:30AM
    - Note: Last day of finals
    - Let me know now if you have a conflict
- Exams are closed book and closed notes

Grading

- Give me sign you understand and can apply the course material
- Grading formula:
  - 50% - Assignments
  - 15% - Midterm Exam
  - 35% - Final Exam

  Some extra credit will be available

Traditional Systems Teaching

- Traditional courses:
  - Computer Architecture
  - Operating Systems
  - Networks
  - Database Systems
  - Programming languages
  - Software Engineering
  - Security
- Too many course so:
  - Take 3 of the above
  - Take (OS or Compilers) and 2 of the above

Course Goals

- Learn **principles** and **abstractions** for engineering computer systems of all kinds
  - Principles – not laws, more like rules of thumb
  - What works and what doesn't work
- Learn how systems work
  - Computer Scientist vs. Computer User
  - Break through the magic
- Install a Systems Perspective in you

Course Organization

- Lectures and textbook readings
  - Cover many concepts
  - Example usages
  - Evaluation: Exam questions
- Assignments and discussion sections
  - Learn by doing
  - Cover few concepts in depth
  - Evaluation: Assignment grade

Examples of Computer Systems

What's interesting?

Example: www.facebook.com

- Fault tolerance
  - Failure of computers, rack computers, possible even data center.
- Coordination of concurrent activities
  - Inside machine with many users
- Geographically separated but linked data
  - For fast access on East Coast – Have friends there.
- Vast quantities of stored information
  - Uploads 24 million photos a day, > 1 petabytes
- Protection from mistakes and intentional attacks
  - Someone who is not your friend should not see your data.
- Interactions with many people
  - The whole point of the website

CS110 Course – Part 1

- Introduction to Computer Systems
  - Complexity, abstractions
- Modularization, Naming and Layering
  - Memory, interpreters, communication links
- Client-Server Architecture
  - RPC, indirection, peer to peer
- Client-Server within a Machine (Virtualization)
  - Bounded buffers, threads, concurrency, virtual memory

CS110 Course – Part 2

- Performance
  - Design approaches, multi-level memories, scheduling
- Networking
  - Layers, sockets
- Protection and Security
  - Authentication, access control, cryptography
- Review of systems concepts
  - Case studies

What is a Computer System?

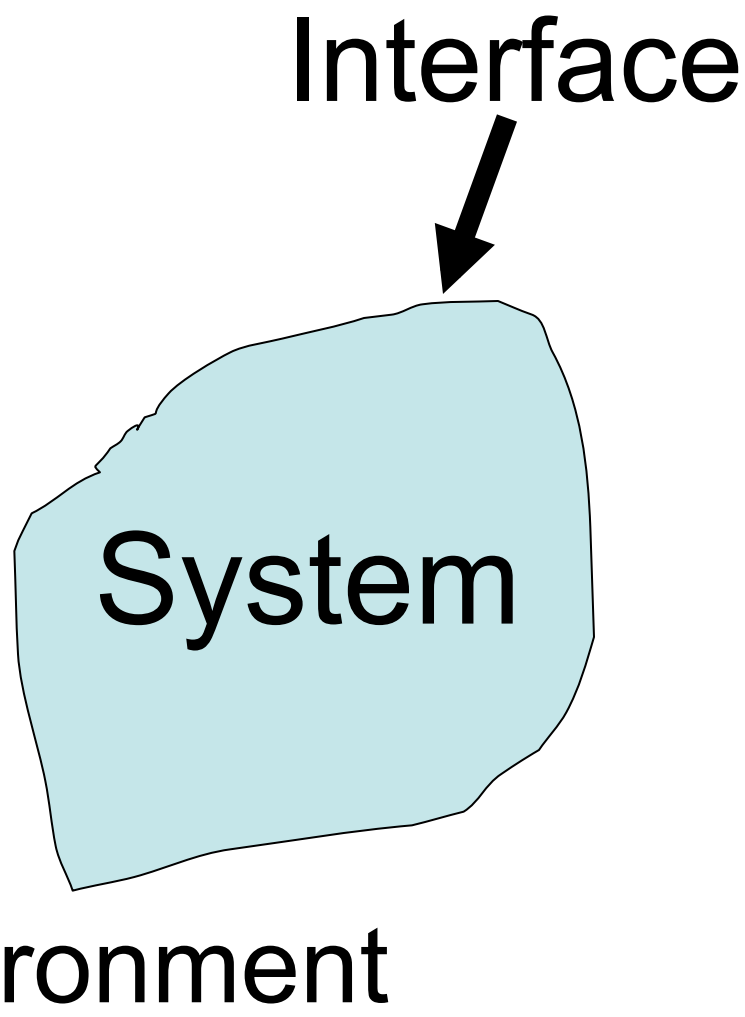
Definition: A **system** is a set of **interconnected components** that has an **expected behavior** observed at the **interface** with its **environment**.

Definition: A **computer system** is a system intended to store, process, or communicate information under automatic control.

A **system** is a set … observed at the **interface** with its **environment**.

Divides World Up

- Everything is either:
  - Part of system
    - or
  - Part of the environment
- www.facebook.com
  - System: data center full of hardware and software, network connections, etc.
  - Environment: other sites, electricity, network backbone, weather, etc



A **system** … has an **expected behavior** observed ….

Behavior depends on point of view

- Different points of view on same system
- Example: Facebook.com
  - Website: Render pages in a browser
    - Eye balls viewing page – Ad revenue
  - Distributed system:
    - Compute, storage, communication
  - Communication mechanism:
    - Compare with eVite or email for setting up a party
  - Menlo Park traffic city planner:
    - Impact of new campus

… **system** is a set of **interconnected components** that …

Observed at different granularity

- Systems built out of **Subsystems**
  - Like *Powers of Ten* film
- Example: Facebook.com

  Website: My page and friends walls

  Data base server: x86 box, Linux, MySQL

  Caching disk controller

  Microcontroller on disk controller

Computer Systems are Special

Like other systems, except:

- Not limited by physical laws or theories.
  - Pile software together
  - Limited by human understanding
- Underlying technology changes fast
  - Example: Moore's law for semiconductors
  - Designs get obsolete fast
- Use computers systems to design new systems

CS110 is about dealing with this.

Action items for next class

1. Enroll in class and a discussion section
2. Get textbook
3. Read Chapter 1 (Pages 1 to 39) for Wednesday's lecture.