Course Overview

COS 316: Principles of Computer System Design

Lecture 2

Amit Levy & Jennifer Rexford

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Course Staff: Intros

Prof. Jen Rexford
Instructor

- Joined Princeton faculty in 2005
- Often teaches COS 217 and COS 561
- Research in computer networking

- Research goals
  - An Internet worthy of society's trust
  - Greater innovation inside the network
  - Emerging 5G/NextG access networks

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Course Staff: Intros

Prof. Amit Levy
Instructor

- Joined Princeton faculty in 2018
- Often teaches COS 316
- Research in operating systems

- Systems building blocks for building an endless number of applications.
- Systems that allow developers to have the most flexibility and creativity
- … while being secure and performant.

Course Staff: Intros

Qingchen Dang
TA

- 2nd-year Masters student
- Interested in computer systems
- … and applying ML to system design
- Has TAed for COS 318 (OS) and 226

Course Staff: Intros

Mary Hogan
TA

- 4th-year PhD student working with Jen
- Interested in computer networks
- … and creating platforms that make it easier to program the network
- Love systems because projects can have tangible, real-world impact
- Has TAed for COS 316 and COS 561

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Course Staff: Intros

Julian Knodt
TA

- MSE student
- Interested in computer graphics
- … and physically-based rendering
- Open-source contributions to a compiler and graphics systems

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Course Staff: Intros

Natalie Popescu
TA

- PhD student working with Amit
- Interested in system design
- .. and lowering the barrier to entry for building secure and privacy applications
- Likes systems because they are foundational aspects of our world
- Learning about a new system can feel like being in someone else's mind
- Has TAed COS 316 in fall 2020

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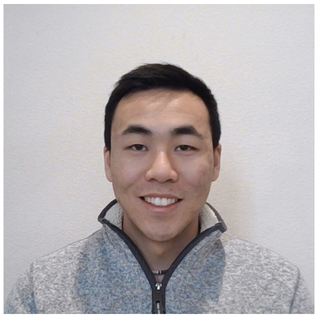
Course Staff: Intros



John Yang
TA

- 1st-year Masters student
- Interested in program synthesis and programming languages
- Enjoy systems because of its practicality
- … and balancing trade-offs to build tailored systems for different problems
- Has TAed for COS 126

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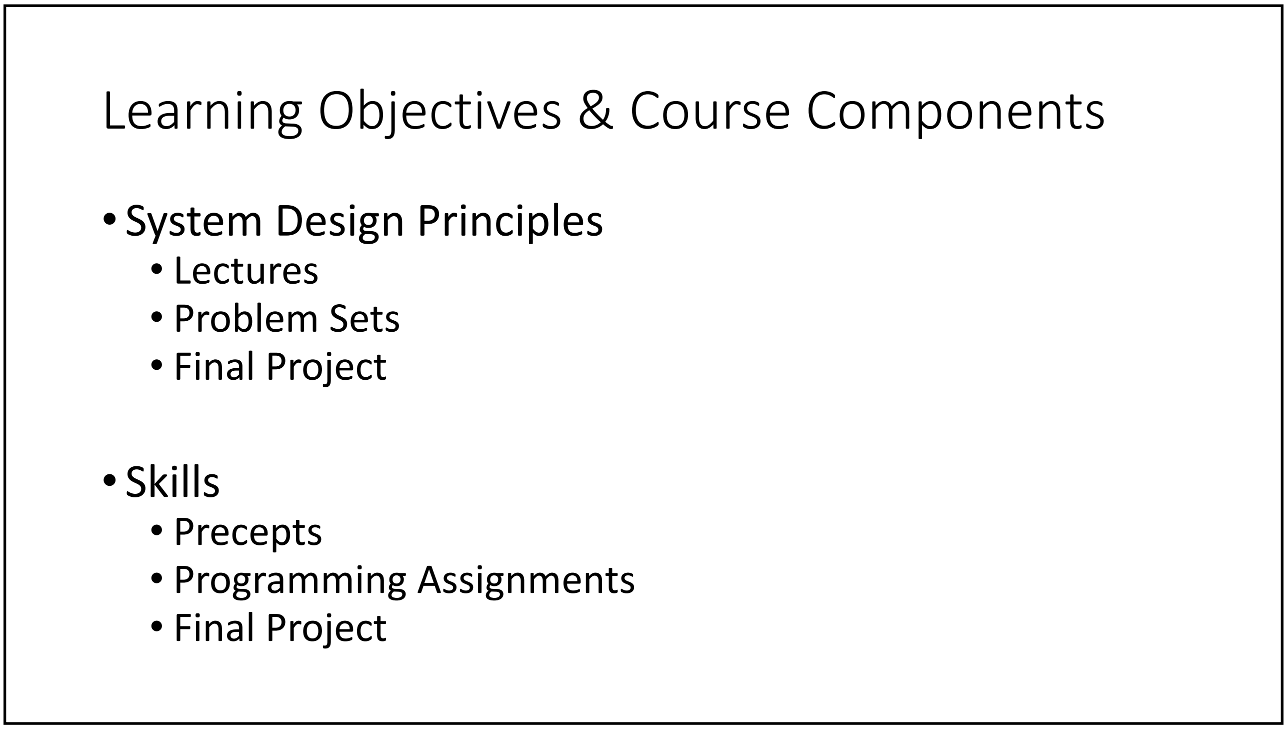

Learning Objectives & Course Components

- System Design Principles
  - Lectures
  - Problem Sets
  - Final Project

- Skills
  - Precepts
  - Programming Assignments
  - Final Project

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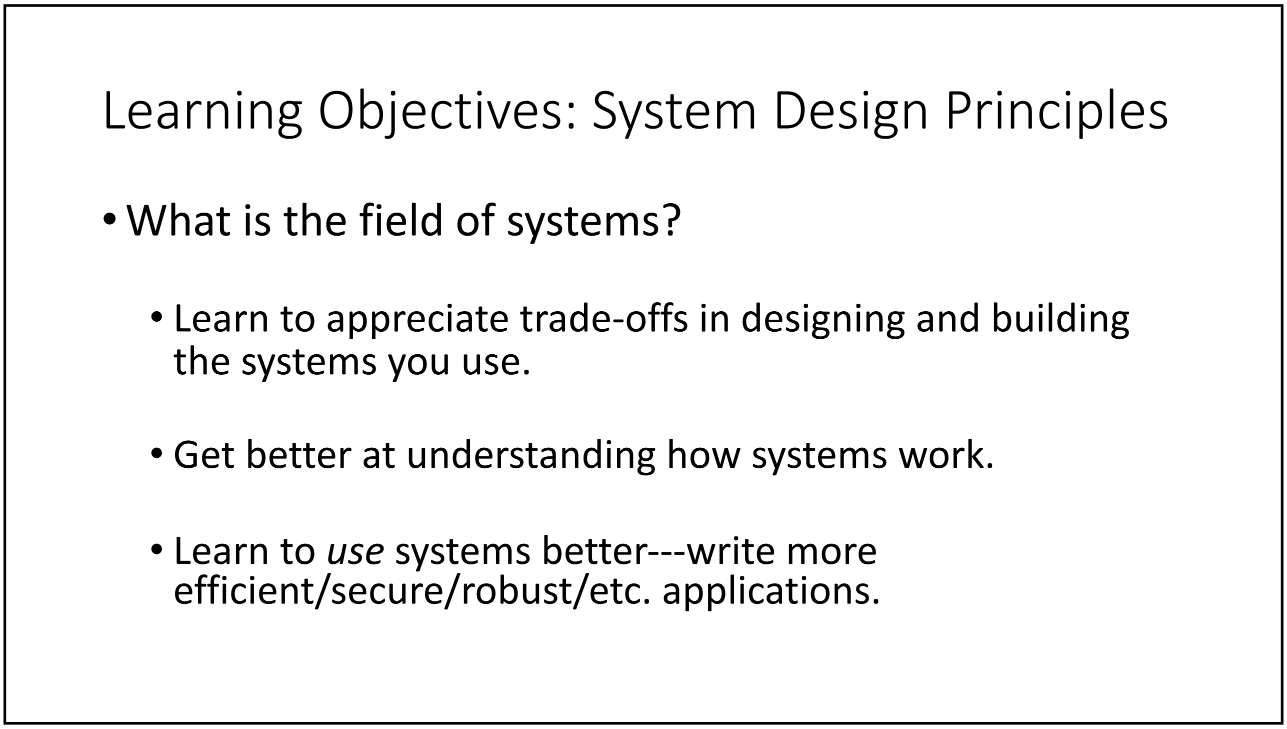

Learning Objectives: System Design Principles

- What is the field of systems?
  - Learn to appreciate trade-offs in designing and building the systems you use.
  - Get better at understanding how systems work.
  - Learn to *use* systems better---write more efficient/secure/robust/etc. applications.

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Lectures

- Attend synchronously (if possible)
  - Active thinking through concepts (you)
  - Active calibration of teaching (us)
- Explore fundamental concepts,
  ways of thinking,
  cutting-edge research

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Lectures

- 6 Major Themes:
  - Naming
  - Caching
  - Layering
  - Concurrency
  - Access Control
  - Scheduling

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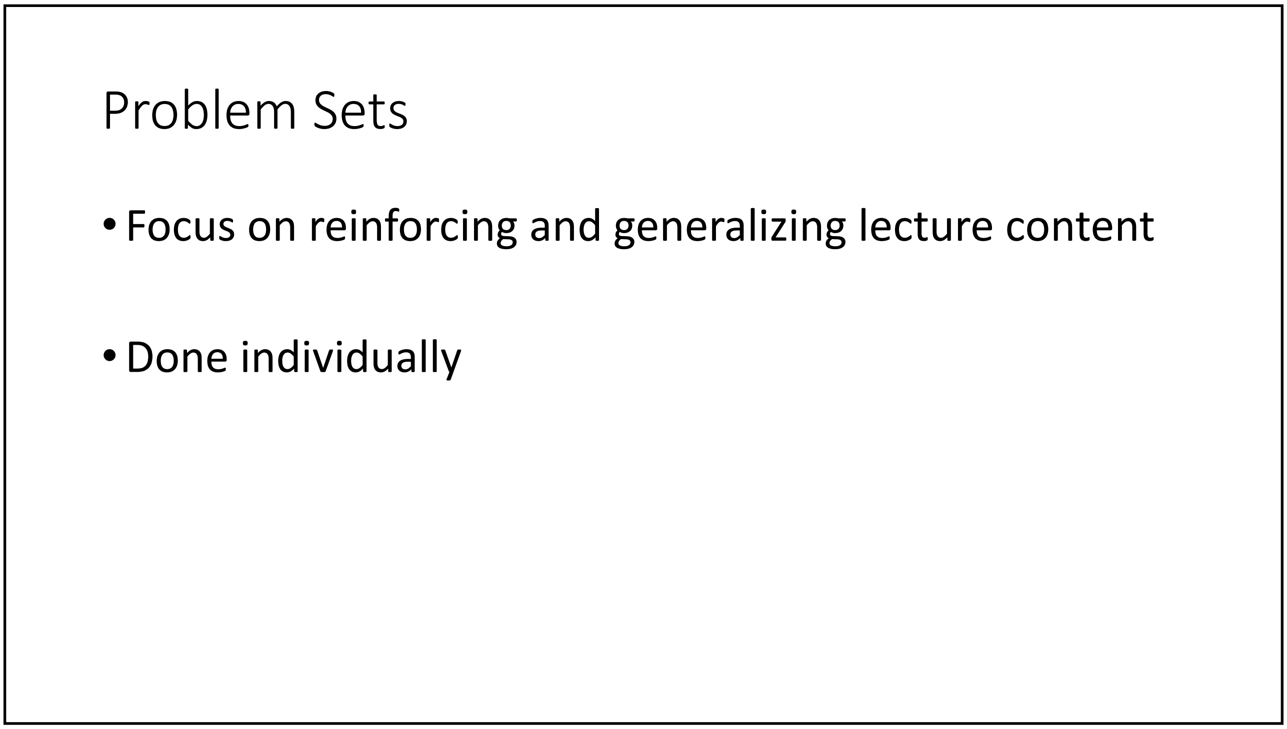

Problem Sets

- Focus on reinforcing and generalizing lecture content
- Done individually

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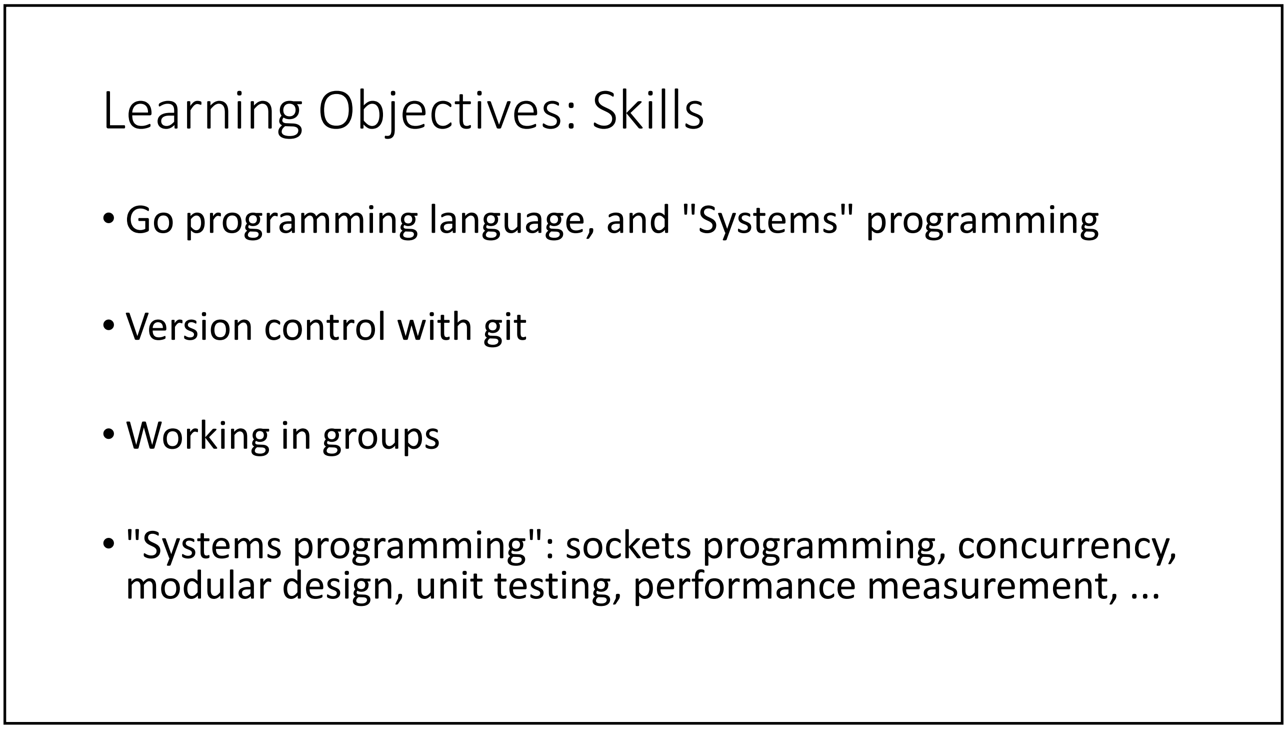

Learning Objectives: Skills

- Go programming language, and "Systems" programming
- Version control with git
- Working in groups
- "Systems programming": sockets programming, concurrency, modular design, unit testing, performance measurement, ...

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Precepts

- Attend synchronously
- Hands on, active learning in small groups
- Coupled primarily with the programming assignments

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Programming Assignments

- You’re Building a Web Framework!
- Set of libraries and tools for building sophisticated web applications
  - Abstracts connection and protocol handling
  - Routes requests to controllers/handlers
  - Caching for common queries and computations
  - Multiplexes concurrent access to databases
  - Translates database objects into programming language constructs
  - User authentication and authorization
- Examples: Rails, Django, Express, Apache Struts, Laravel

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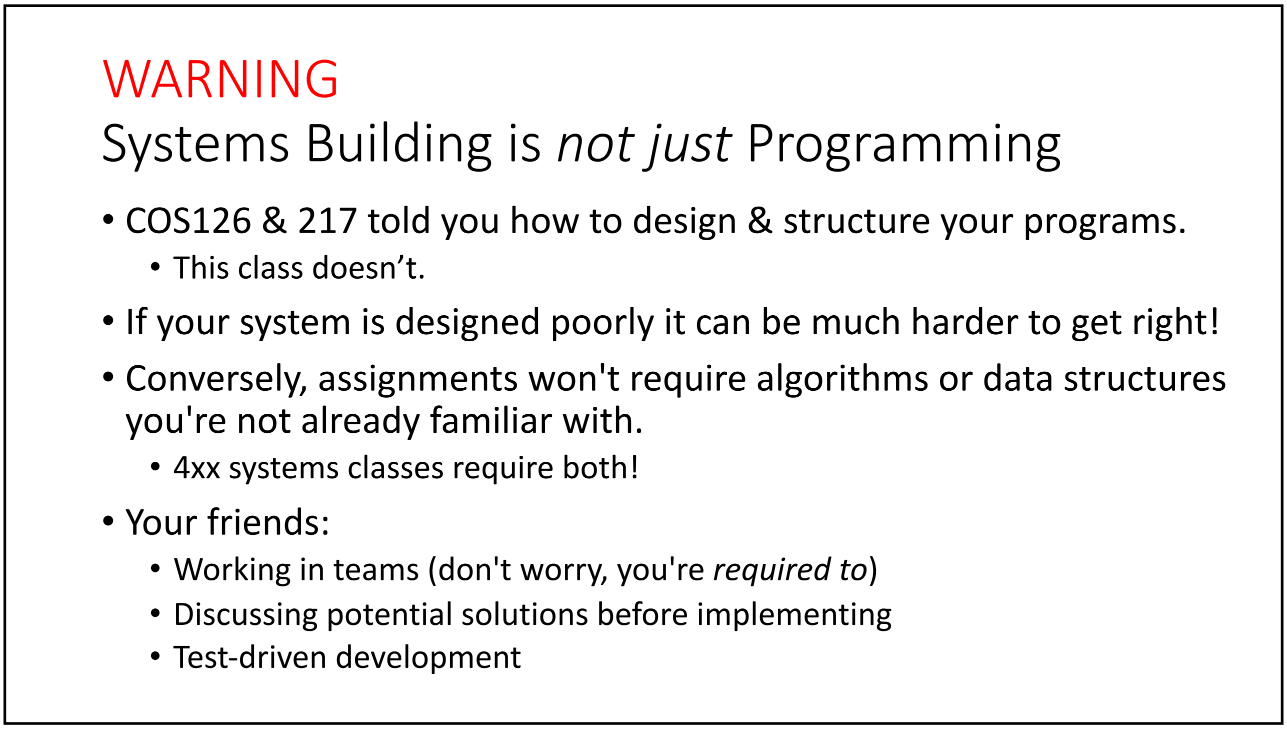

WARNING
Systems Building is *not just* Programming

- COS126 & 217 told you how to design & structure your programs.
  - This class doesn’t.
- If your system is designed poorly it can be much harder to get right!
- Conversely, assignments won't require algorithms or data structures you're not already familiar with.
  - 4xx systems classes require both!
- Your friends:
  - Working in teams (don't worry, you're *required to*)
  - Discussing potential solutions before implementing
  - Test-driven development

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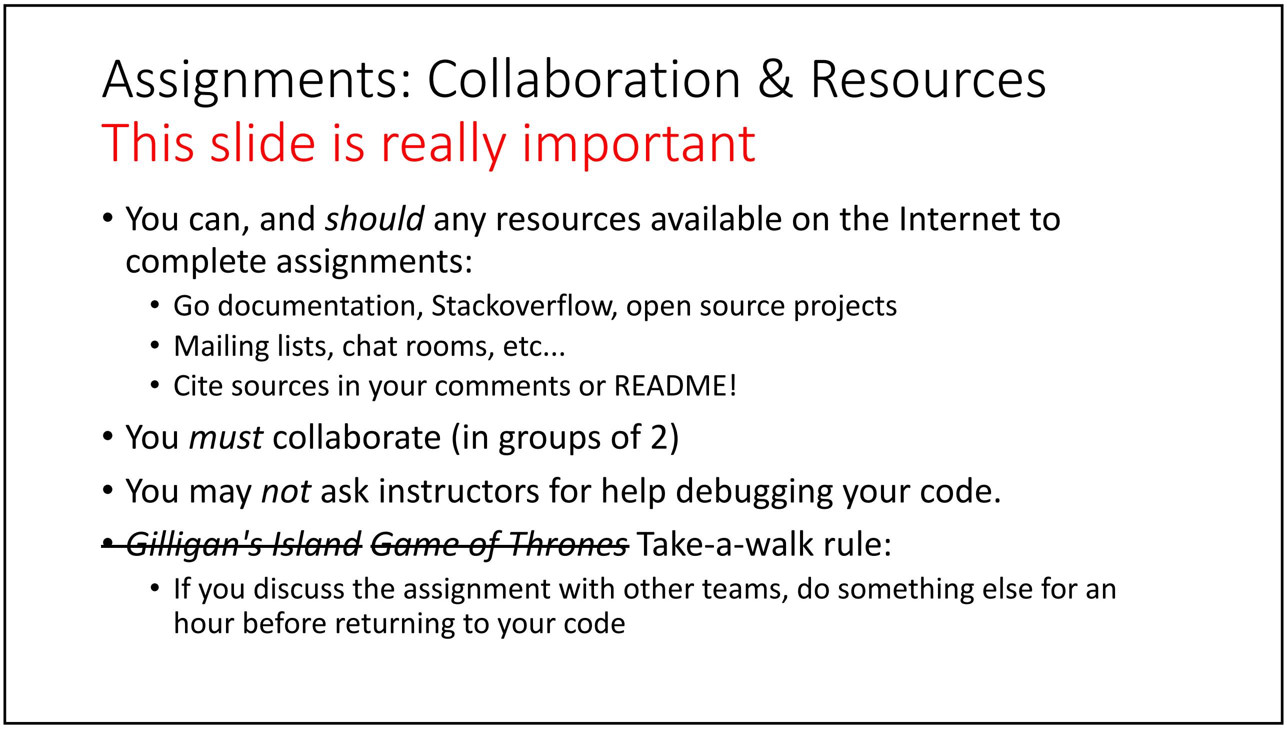

Assignments: Collaboration & Resources
This slide is really important

- You can, and *should* any resources available on the Internet to complete assignments:
  - Go documentation, Stackoverflow, open source projects
  - Mailing lists, chat rooms, etc...
  - Cite sources in your comments or README!
- You *must* collaborate (in groups of 2)
- You may *not* ask instructors for help debugging your code.
- ~~*Gilligan's Island* *Game of Thrones*~~ Take-a-walk rule:
  - If you discuss the assignment with other teams, do something else for an hour before returning to your code

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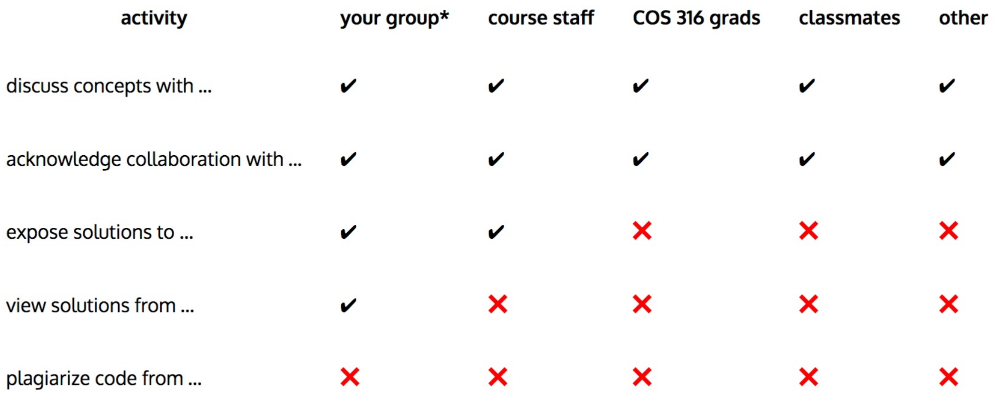
Assignments: Collaboration & Resources

https://cos316.princeton.edu/assignments



activity	your group*	course staff	COS 316 grads	classmates	other
discuss concepts with ...	✔	✔	✔	✔	✔
acknowledge collaboration with ...	✔	✔	✔	✔	✔
expose solutions to ...	✔	✔	✗	✗	✗
view solutions from ...	✔	✗	✗	✗	✗
plagiarize code from ...	✗	✗	✗	✗	✗

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Assignments: Submitting and Grading

- Submitting happens whenever you "push" to your "master" branch on GitHub
  - You can push as many times as you like (we encourage you to do so *often*)
- Grading is automatic and immediate
  - There is no penalty for multiple submissions. We will use your highest graded submission (push)
  - Each automatic grading is posted as a comment to the last commit of each push. It includes a break down of tests cases, including which failed.

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Programming Assignment Late Days

- 7 late days total for the semester
  - Granularity of 1 day
    - 1102pm on Wednesday is 1 day late
    - 1050pm on Thursday is 1 day late
- Assigned retroactively to give you the best possible overall grade
  - We do this for you!

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Late Days Example

1. Parker submits assignment #1 on time, but can't figure out how to pass the last test case. Their grade so far for the assignment is 95%.
2. 7 days after the deadline, Parker figures out how to pass the last test and submits late, getting 100%.
3. Months later... Parker underestimates their workload and isn't able to submit assignment 4 until 7 days after the deadline, but passes all tests to get 100%.
4. We assign the late days to assignment 4, so that Parker's grade is 95% + 100%, as opposed to 100% + 0%.

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Final Project

- Open ended systems building project
- Later precepts will help you refine topic
- You design and build something you’re interested in!
- Small written component (< 2 pages)

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What is Due When?

- Alternating Problem Sets and Assignments each week
  - Each is due on Wednesday at 11pm Princeton Time
- Final project is due on Dean’s Date at 5pm Princeton Time

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Grading

- 60% - Programming Assignments
  - 6 Assignment, each worth 10%
- 20% - Problem Sets
- 20% - Final Project
- No curve anticipated
  - Will **not** curve down (i.e., a 93% is an A no matter what)

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Learning Objectives & Course Components

- System Design Principles
  - Lectures – Attend Synchronously
  - Problem Sets – Due every other week
  - Final Project – You build something new
- Skills
  - Precepts – Attend Synchronously
  - Programming Assignments – Due every other week
  - Final Project – Due on Dean’s Date

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