COMPUTER SCIENCE 126

Spring 2017

PRINCETON UNIVERSITY

http://www.princeton.edu/~cos126

brought to you by

Kevin Wayne
Faculty
Instructor

Dan Leyzberg
Faculty
Co-Lead Preceptor

Alan Kaplan
Faculty
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Ibrahim Albluwi
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Donna Gabai
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Lawrence Lin
Graduate Student
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Kevin Boutarel
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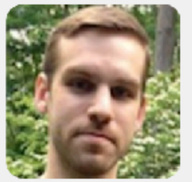
Pranjit Kalita
Graduate Student
Preceptor



Alex Tarr
Graduate Student
Preceptor

Laura Roberts
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Marc Leef
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Ashley Kling
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Preceptor

Natalie Wilkinson
Graduate Student
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Bridger Hahn
Graduate Student
Preceptor

Hansen Zhang
Graduate Student
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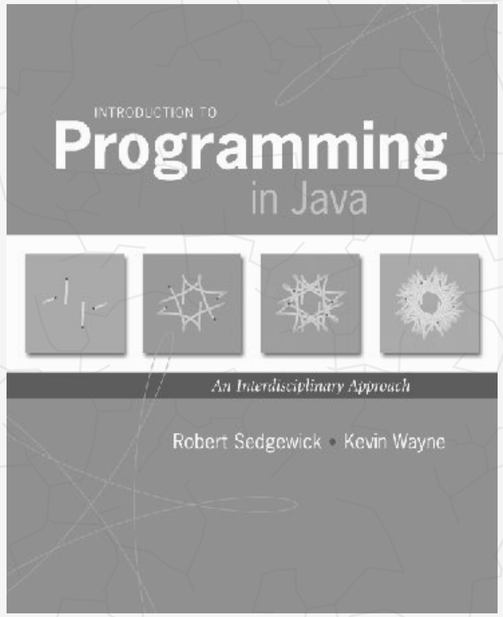
COS 126 course overview

Goals.

- Empower you to exploit available technology.
- Apply concepts to the sciences, engineering, and beyond.
- Build awareness of substantial intellectual underpinnings.
- Demystify computer systems.

topic	examples
elements of programming	variables, loops, conditionals, arrays, I/O
functions	user-defined functions, modularity, recursion
object-oriented programming	user-defined data types, encapsulation, immutability
algorithms	sorting, binary search, stacks, queues, BSTs
theory of computing	regular expressions, universality, computability, intractability
design of computers	machine language, boolean logic, circuits



http://introcs.cs.princeton.edu

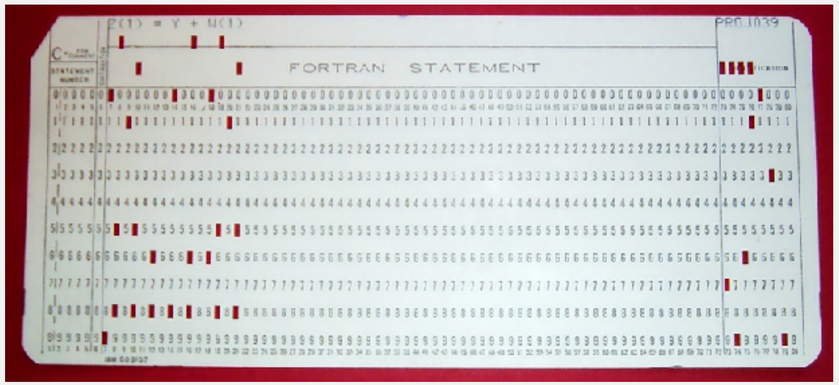
COS 126, SPRING 2017

- *digital revolution*
- *course mechanics*
- *course work*
- *resources*

The digital revolution

Key idea. "Everything" can be encoded as a sequence of bits (0s and 1s).

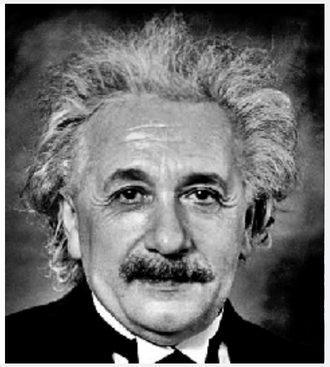
- Numbers and text.
- Pictures, songs, and movies.
- Your DNA.
- 3D objects.
- Computer programs.
- ...



Innovation 1. You can program computers to process bits.

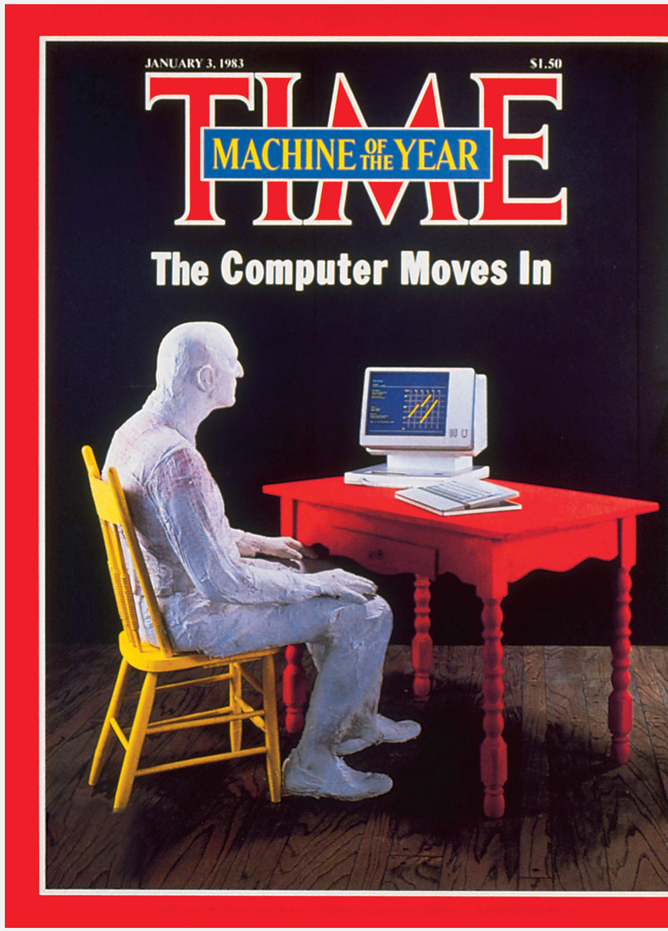
Innovation 2. Devices can use the Internet to send and receive bits.

> *" Computers are incredibly fast, accurate, and stupid; humans are incredibly slow, inaccurate, and brilliant; together they are powerful beyond imagination. "*
>
> — *Albert Einstein*



Computers are transforming society

From the way we work …



Computers are transforming society

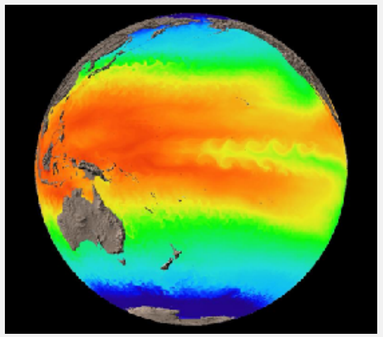
... to the way we live.

Computers are transforming society

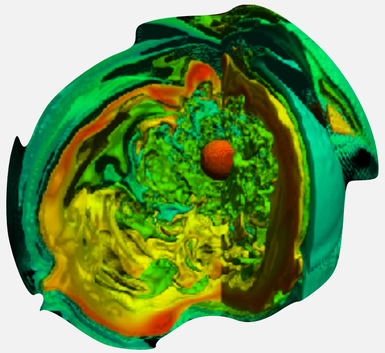
From the “new” economy …

Computers are transforming society

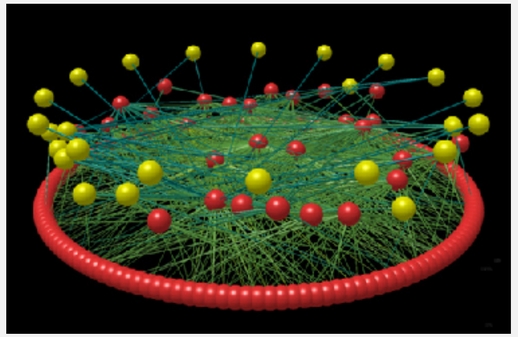
... to the way we do science and engineering.



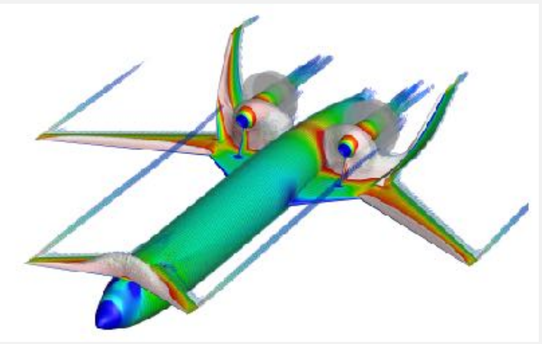
ocean modeling



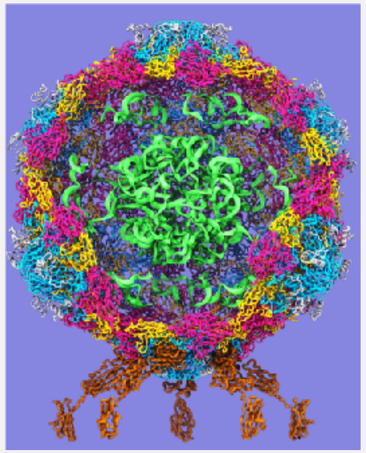
supernova shock wave



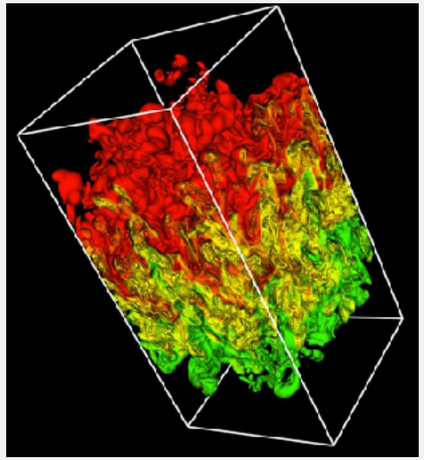
food web in Serengeti



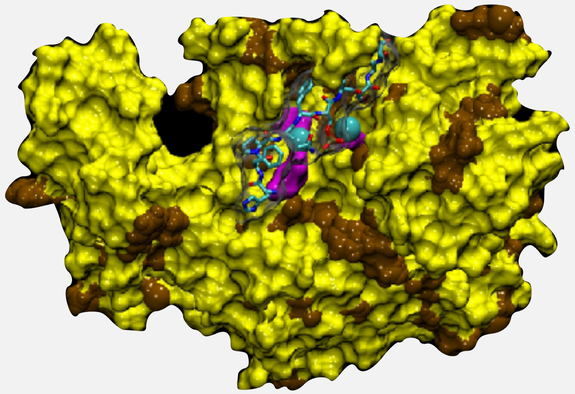
airflow over an aircraft



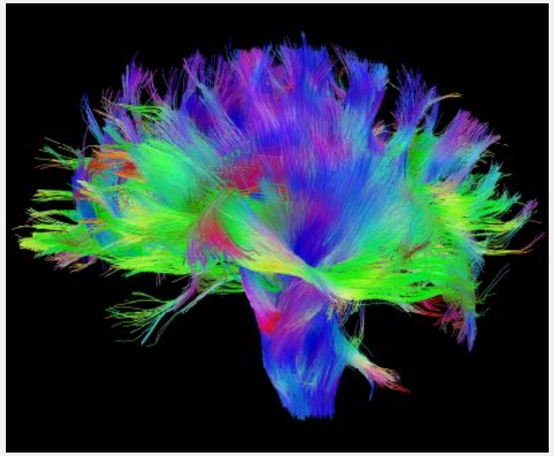
poliovirus



nuclear astrophysics



drug discovery



diffusion MRI of brain

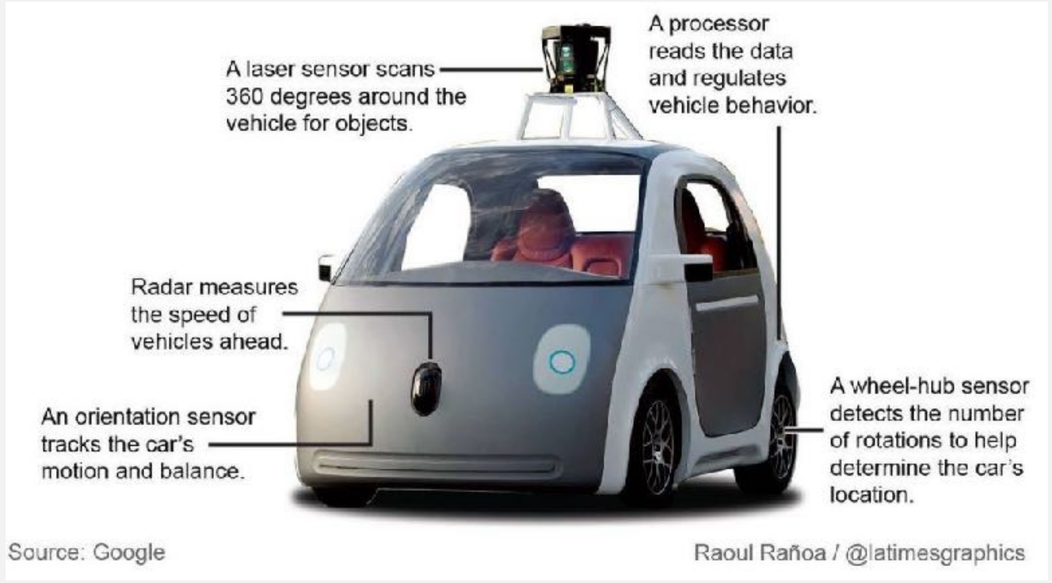
The digital revolution has only just begun

In 2015. Humans created over 4 zettabytes of data (but only 0.5% analyzed).

1 trillion GB

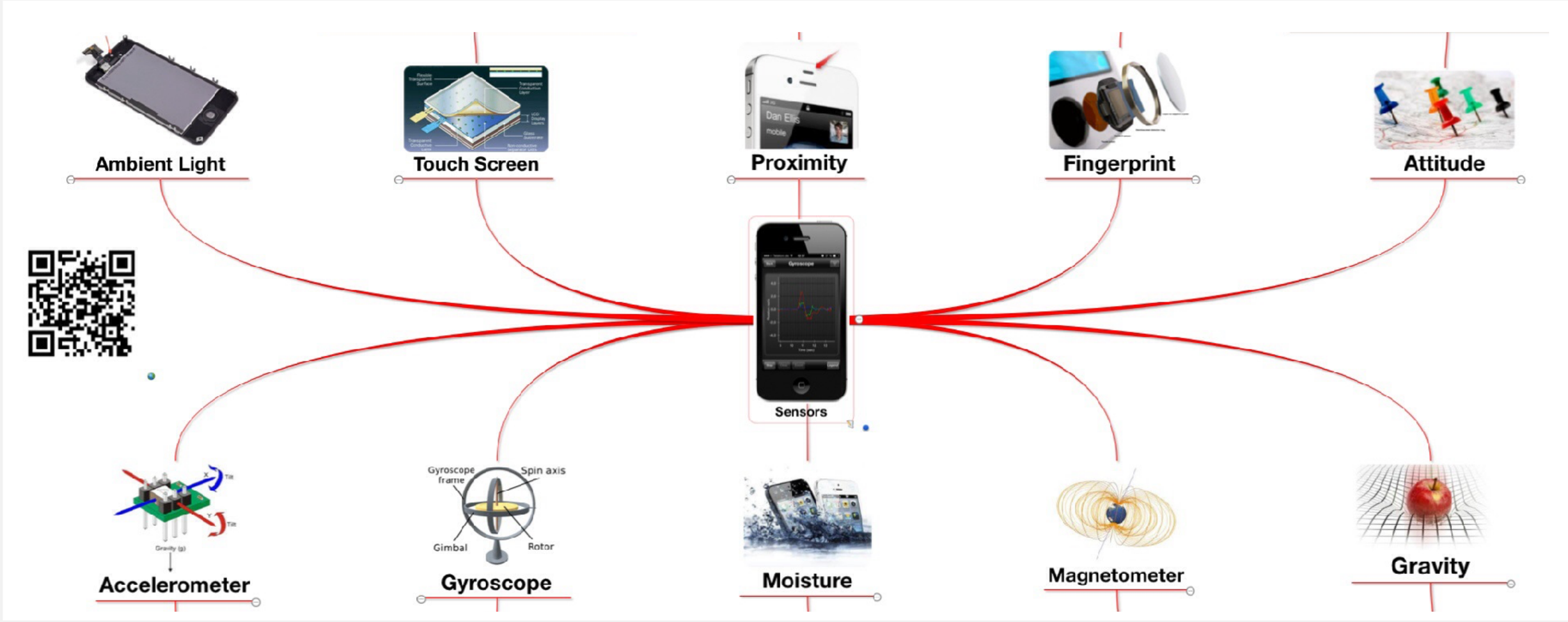
The digital revolution has only just begun

In 2020. 50 billion+ smart connected devices in the world, all developed to collect, analyze, and share data.



The digital revolution has only just begun

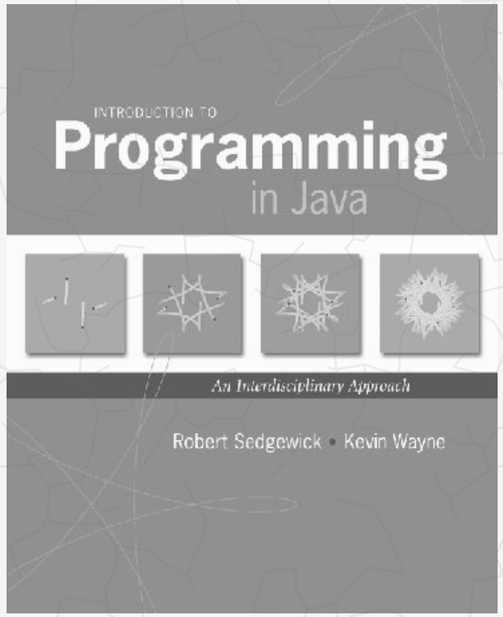
Welcome aboard. You are already a consumer.



The digital revolution has only just begun

Welcome aboard. Now, become a creator!

[99% of politicians agree]



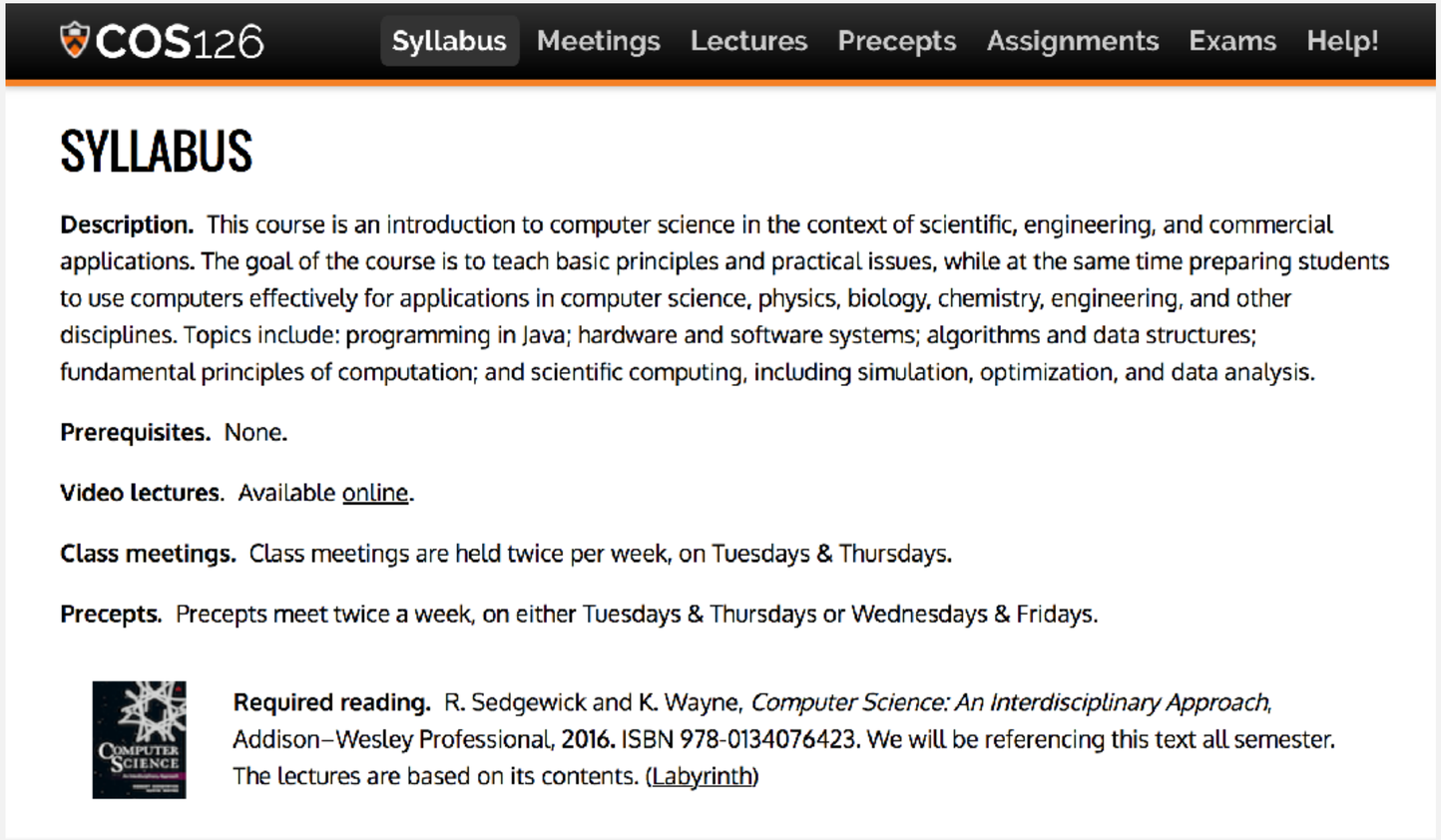
http://introcs.cs.princeton.edu

COS 126, SPRING 2017

- *digital revolution*
- *course mechanics*
- *course work*
- *resources*

Course website: http://www.princeton.edu/~cos126

- Syllabus and course policies.
- Class meetings.
- Lecture videos and slides.
- Precept worksheets.
- Programming assignments.
- Exam archive.
- Help!



Class meetings (not lecture!)

Watch videos lectures online before class meeting/precept.

Do interactive activities in class meetings.

- Assignment tips and tricks, bug hunts, command-line tutorial, ...
- Exams, exam reviews, exam retrospectives, ...

previously done outside of class time

What	When	Where	Who	Office Hours
L01	**TTh 12:30–1:20pm**	**McCosh 50 (here)**	**Kevin Wayne**	see web

Beginning ones primarily for novices.

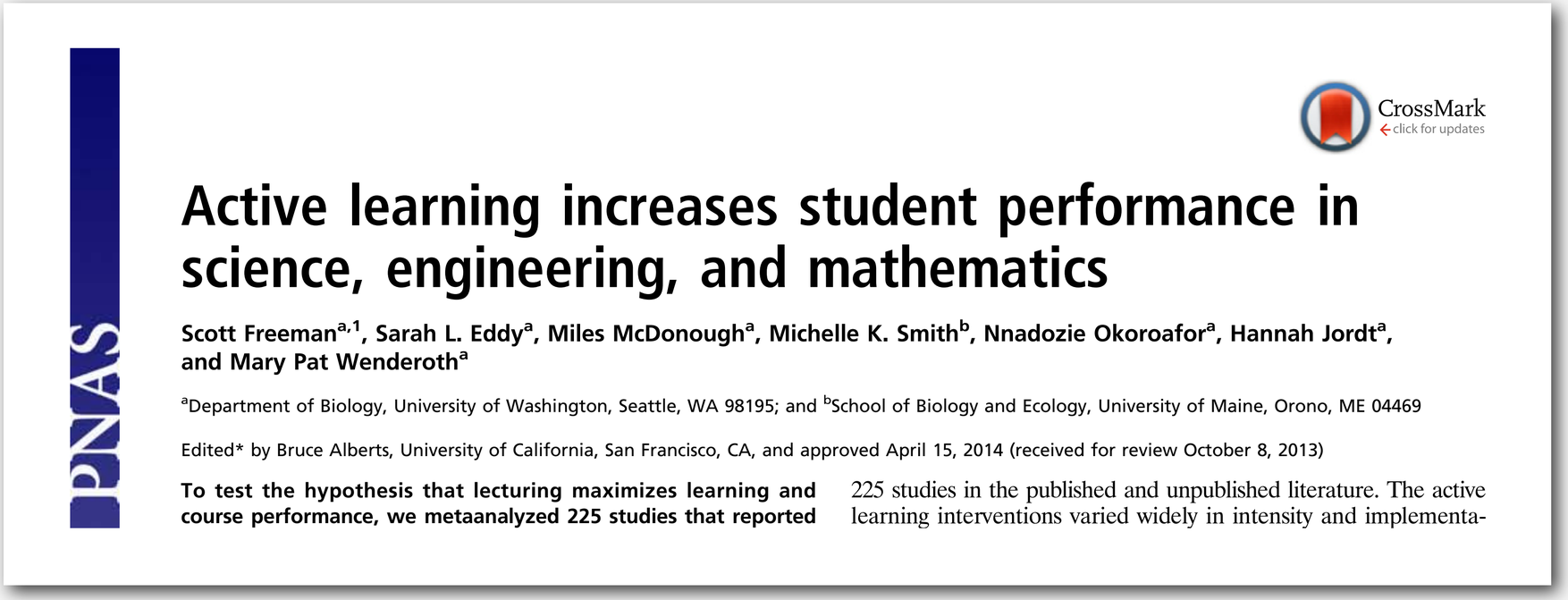
Why flipped lectures?

One-size-fits-all lecture not optimal.

Salman Khan (founder of Khan Academy)

Why flipped lectures?

Active learning increases student performance in STEM.



PNAS

CrossMark click for updates

Active learning increases student performance in science, engineering, and mathematics

Scott Freeman[a,1], Sarah L. Eddy[a], Miles McDonough[a], Michelle K. Smith[b], Nnadozie Okoroafor[a], Hannah Jordt[a], and Mary Pat Wenderoth[a]

[a]Department of Biology, University of Washington, Seattle, WA 98195; and [b]School of Biology and Ecology, University of Maine, Orono, ME 04469

Edited* by Bruce Alberts, University of California, San Francisco, CA, and approved April 15, 2014 (received for review October 8, 2013)

To test the hypothesis that lecturing maximizes learning and course performance, we metaanalyzed 225 studies that reported 225 studies in the published and unpublished literature. The active learning interventions varied widely in intensity and implementa-

Proceedings of the National Academy of Sciences

Precepts

Active learning. Discussion, problem solving, pair programming, ...

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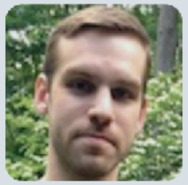

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Bridger Hahn
Graduate Student
Preceptor

Hansen Zhang
Graduate Student
Preceptor

Precepts

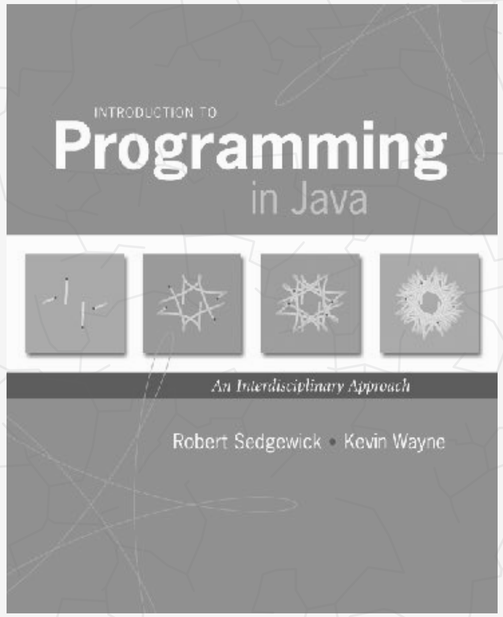
Active learning. Discussion, problem solving, pair programming, ...

P01A	Tuesdays & Thursdays	2:30-3:20pm	with **Lawrence Lin**	in **Friend 111**
P01B	Tuesdays & Thursdays	2:30-3:20pm	with **Hansen Zhang**	in **Friend 009**
P02	Tuesdays & Thursdays	3:30-4:20pm	with **Bridger Hahn**	in **Friend 110**
P02A	Tuesdays & Thursdays	3:30-4:20pm	with **Lawrence Lin**	in **Friend 111**
P03	Tuesdays & Thursdays	4:30-5:20pm	with **Marc Leef**	in **Friend 110**
P03A	Tuesdays & Thursdays	4:30-5:20pm	with **Kevin Boutarel**	in **Friend 111**
P05	Tuesdays & Thursdays	7:30-8:20pm	with **Marc Leef**	in **Friend 108**
P06	Wednesdays & Fridays	10:00-10:50am	with **Laura Roberts**	in **Friend 110**
P07	Wednesdays & Fridays	11:00-11:50am	with **Natalie Wilkinson**	in **Friend 110**
P08	Wednesdays & Fridays	12:30-1:20pm	with **Alex Tarr**	in **Friend 110**
P08A	Wednesdays & Fridays	12:30-1:20pm	with **Pranjit Kalita**	in **Friend 111**
P09	Wednesdays & Fridays	1:30-2:20pm	with **Ashley Kling**	in **Friend 110**

Novice precepts

Same great content; longer precepts with reduced pace. ← students with strong quantitive skills will likely be bored

P11	Tuesdays & Thursdays	3:00-4:20pm	with **Alan Kaplan**	in **Friend 108**
P11A	Tuesdays & Thursdays	3:00-4:20pm	with **Ibrahim Albluwi**	in **Friend 109**
P12	Tuesdays & Thursdays	4:30-5:50pm	with **Alan Kaplan**	in **Friend 108**
P13	Wednesdays & Fridays	11:00-12:20pm	with **Donna Gabai**	in **Friend 108**
P13A	Wednesdays & Fridays	11:00-12:20pm	with **Dan Leyzberg**	in **Friend 109**
P14	Wednesdays & Fridays	1:30-2:50pm	with **Donna Gabai**	in **Friend 108**
P14A	Wednesdays & Fridays	1:30-2:50pm	with **Kevin Boutarel**	in **Friend 109**
P15	Wednesdays & Fridays	3:00-4:20pm	with **Ibrahim Albluwi**	in **Friend 108**



http://introcs.cs.princeton.edu

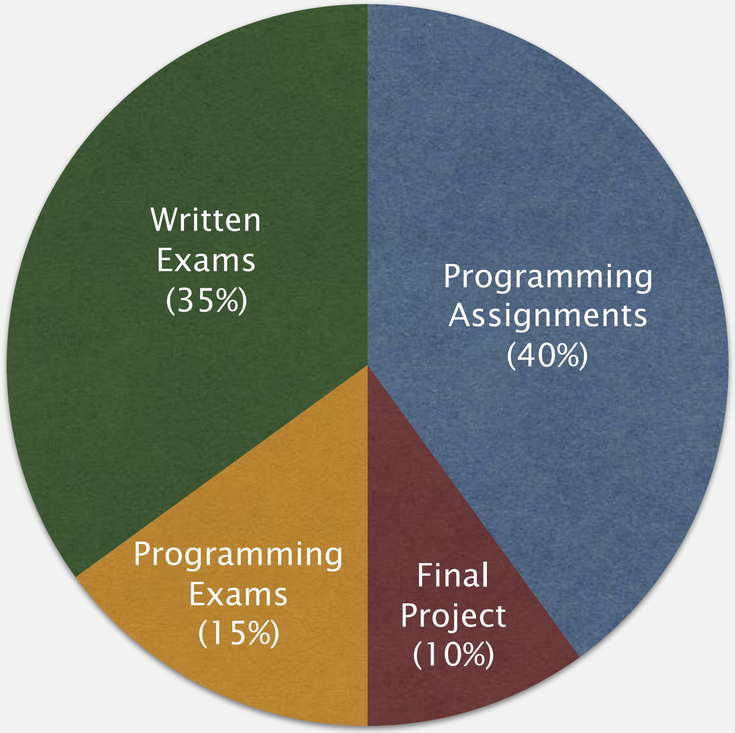
COS 126, SPRING 2017

- *digital revolution*
- *course mechanics*
- *course work*
- *resources*

Coursework and grading

Grades are based on achievement.

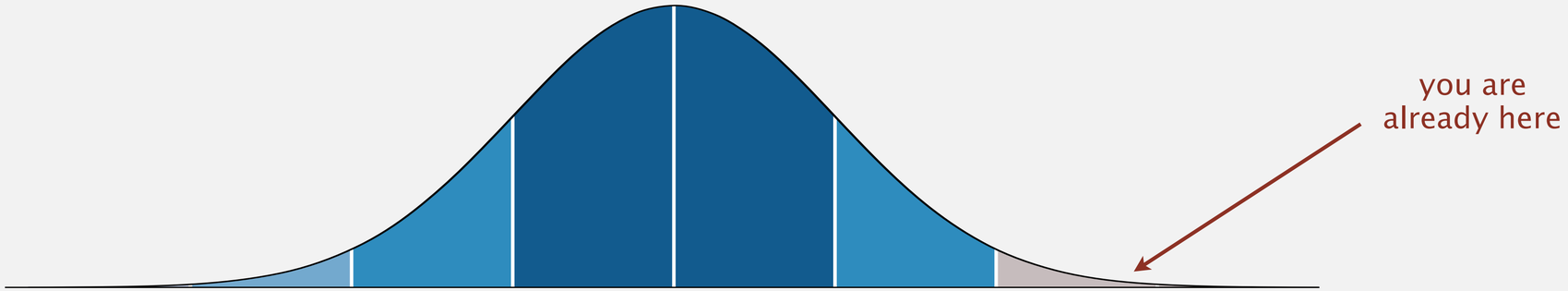
- Programming assignments. ⟵ due Mondays at 11:59pm
- Final programming project. ⟵ due Dean's date
- Programming exams (March 2, April 27). ⎫ in class
- Written exams (March 9, May 4). ⎭



There is no "curve."

- 93.0% ⇒ A.
- 90.0% ⇒ A–.
- 87.0% ⇒ B+.

...

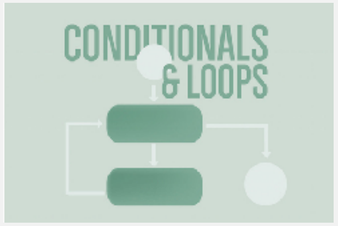


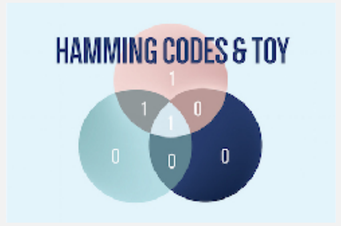
Programming assignments

are an essential part of the experience in learning CS.

Desiderata.

- Illustrate a programming or CS concept.
- Highlight the role of computation in an important application.
- You solve the problem from scratch, on your own computer!

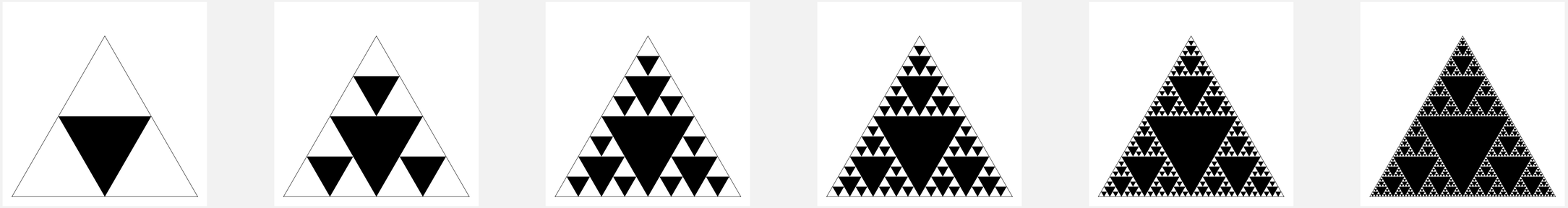




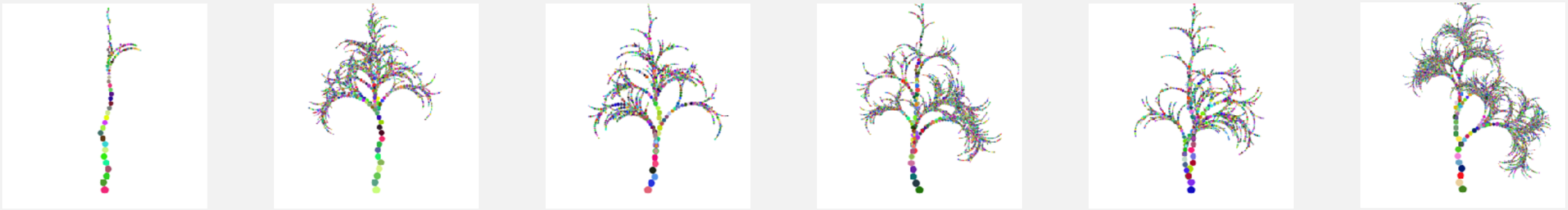
[assignment logos by Kathleen Ma '18]

Recursive graphics

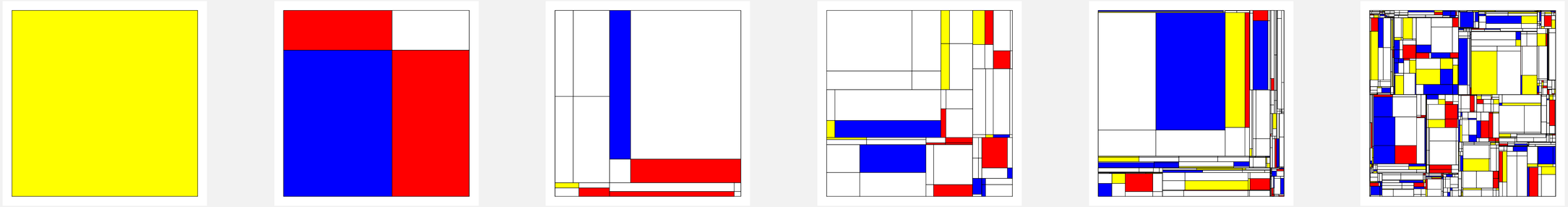
"Sierpinski Triangles"



"Lorax Trees" by Jonathan Zhang (Fall 2014)

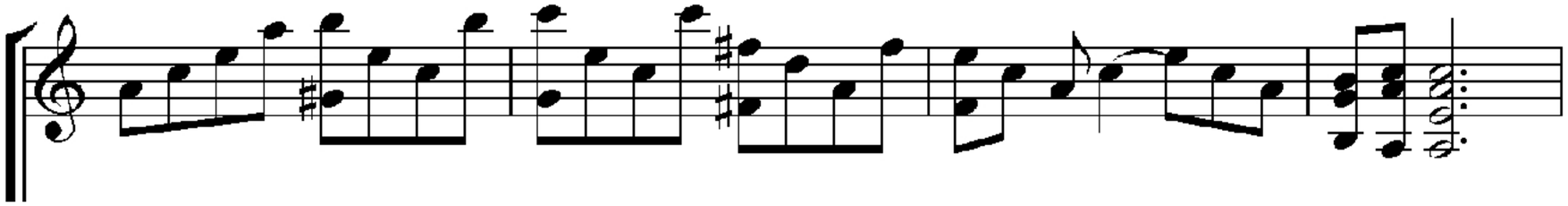


"Piet Mondrian Rectangles" by Laura Herman (Fall 2015)



Guitar hero

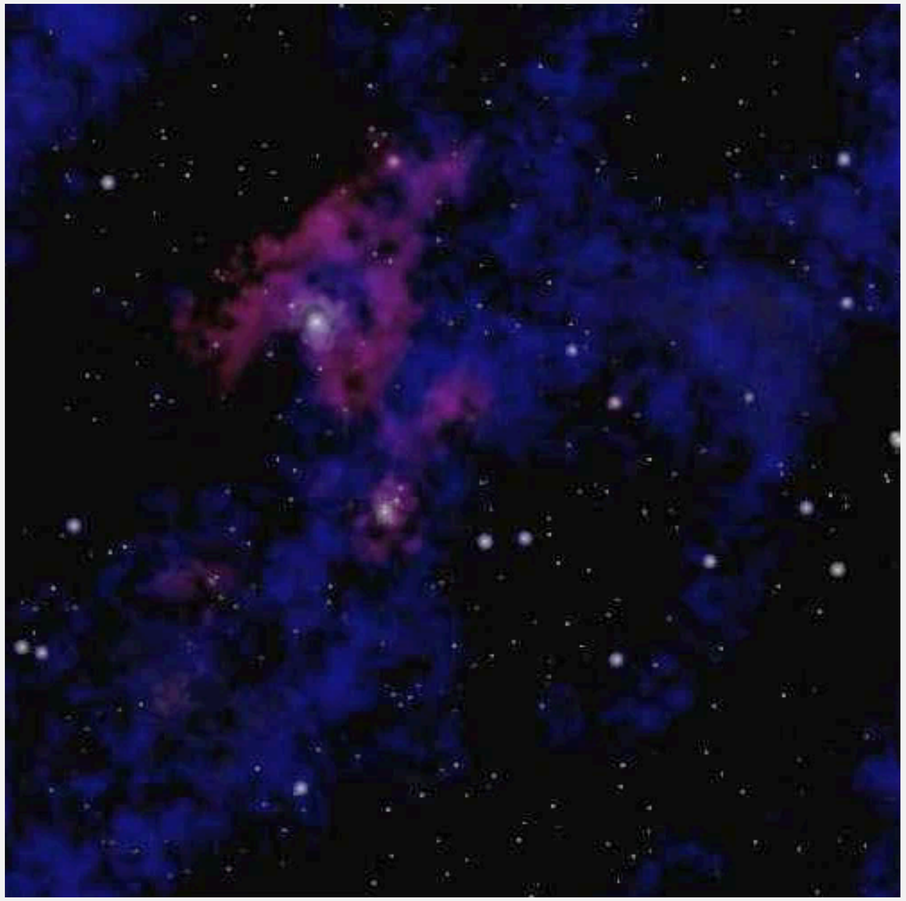
Simulate plucking a guitar string using the Karplus–Strong algorithm.



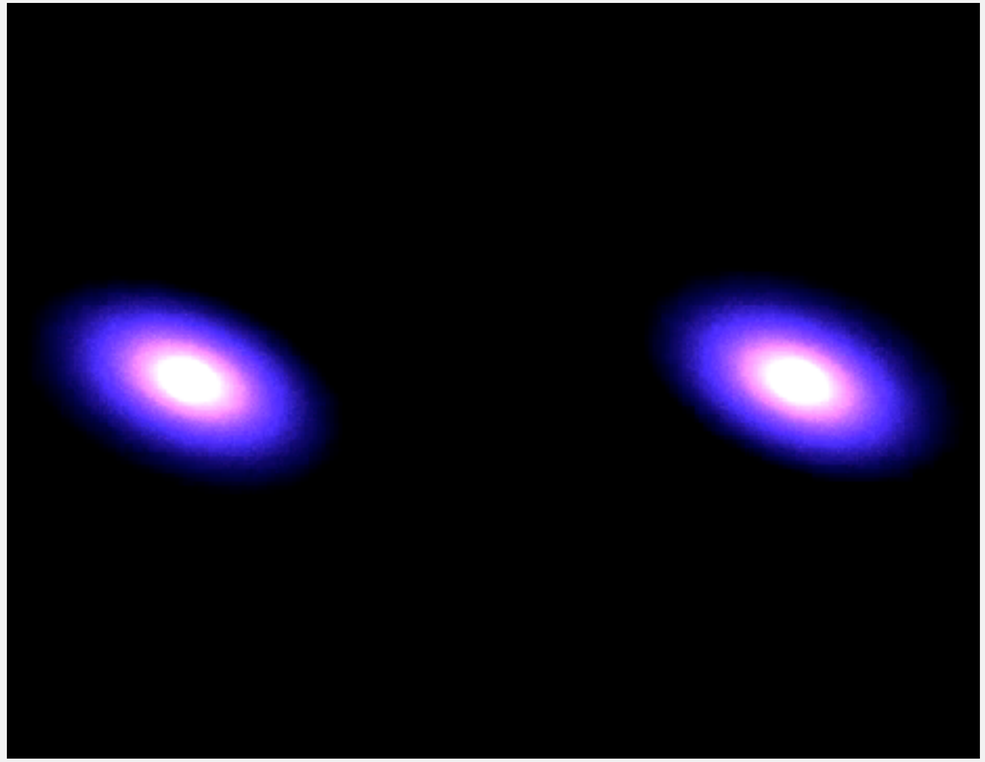
[performed by Kevin Wayne in 2013 on a MacBook Pro]

N-body simulation

Simulate the motion of n particles, subject to Newton's laws of gravity.



our Solar System (5 bodies)



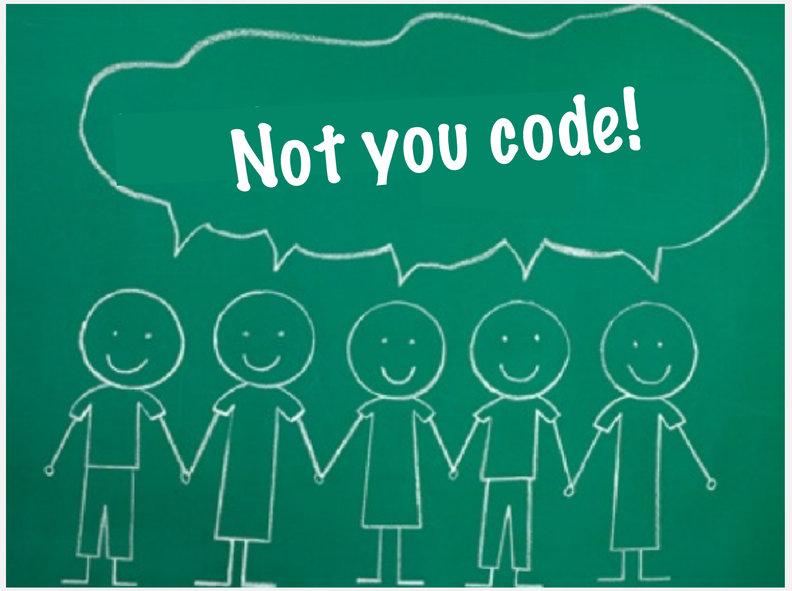
two colliding galaxies (30M bodies)

Collaboration policy

Executive summary.

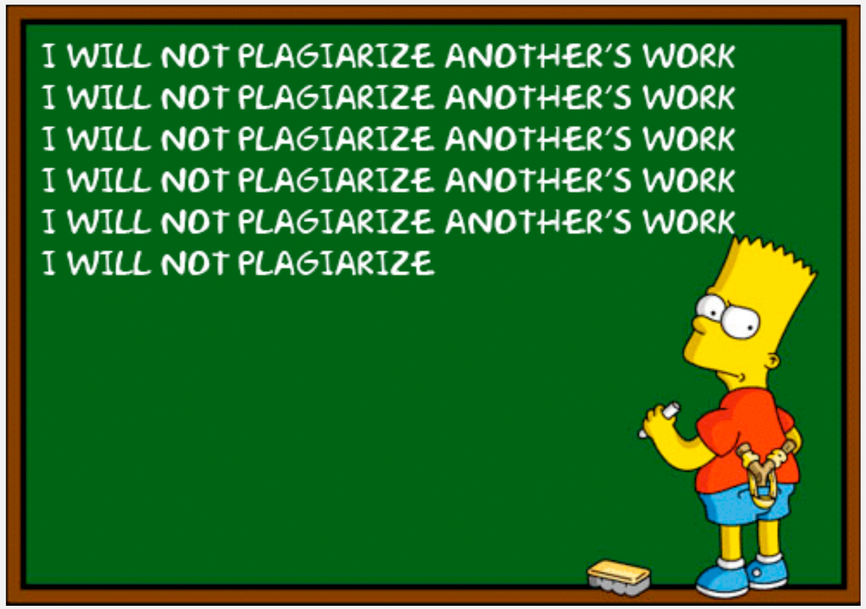
- Do discuss concepts with others.
- Do acknowledge any collaboration with others.
- Do not copy code from others.
- Do not view the code of others.

Full details. See course website.



Plagiarism policy

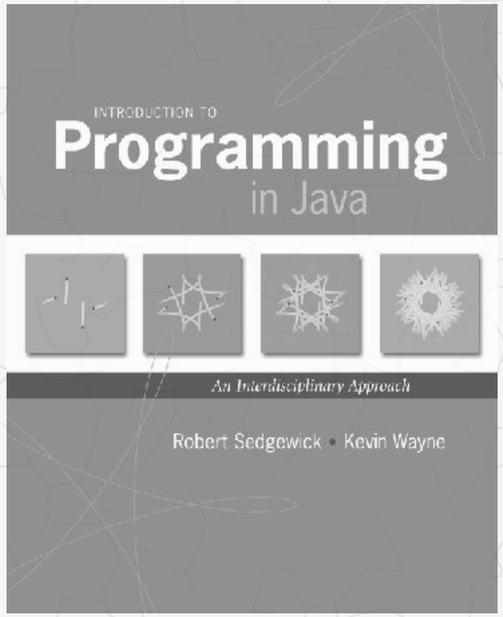
Executive summary.



http://world.edu/academic-plagiarism

Full details. See course website.

CoD warning. Plagiarizing code is treated the same as plagiarizing prose (but is much easier to catch).



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COS 126, SPRING 2017

- *digital revolution*
- *course mechanics*
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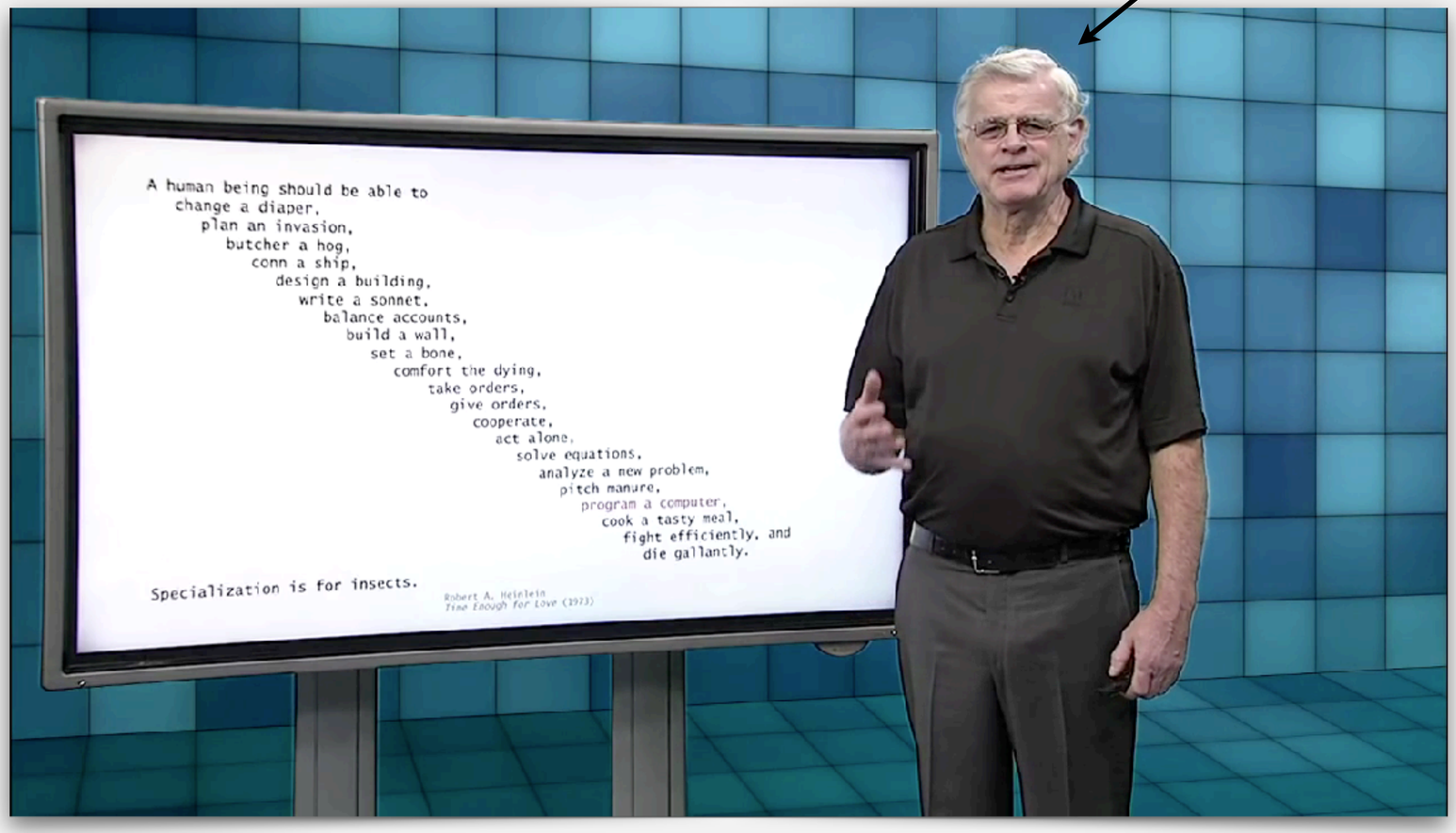
- *resources*

Resources (lecture videos)

Lecture videos (required). ← some exam questions taken from lecture videos

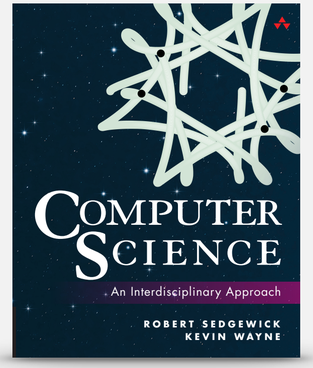
- Watch before corresponding class/precept meeting.
- Watch at your own pace (pause, rewind, 1.5× speed).



Resources (textbook and booksite)

Textbook (required).

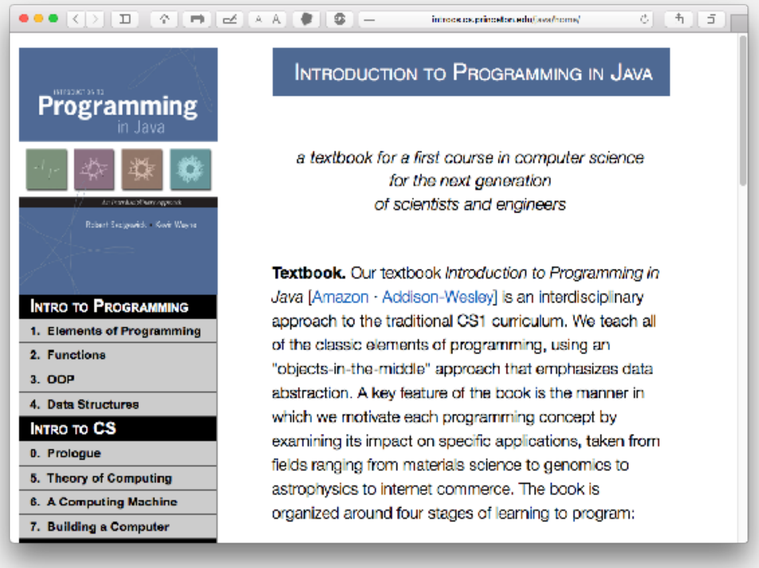
- Developed for this course.
- Full introduction to course material.
- For use while learning and studying.



ISBN 978-0134076423

Booksite.

- Download code from book.
- Brief summary of content.
- For use while online.



http://introcs.cs.princeton.edu

Resources (communication)

Piazza discussion forum.

- Low latency, low bandwidth.
- Mark solution-revealing questions as private.

piazza

http://piazza.com/princeton/spring2017/cos126

Office hours. ⟵ protip: attend

- High bandwidth, high latency.
- See web for schedule.

http://www.princeton.edu/~cos126

Computing laboratory (Lewis 121).

- Undergrad lab TAs.
- For help with debugging.
- See web for schedule.

http://labta.cs.princeton.edu

This week

you are here!

read/watch before Precept 1

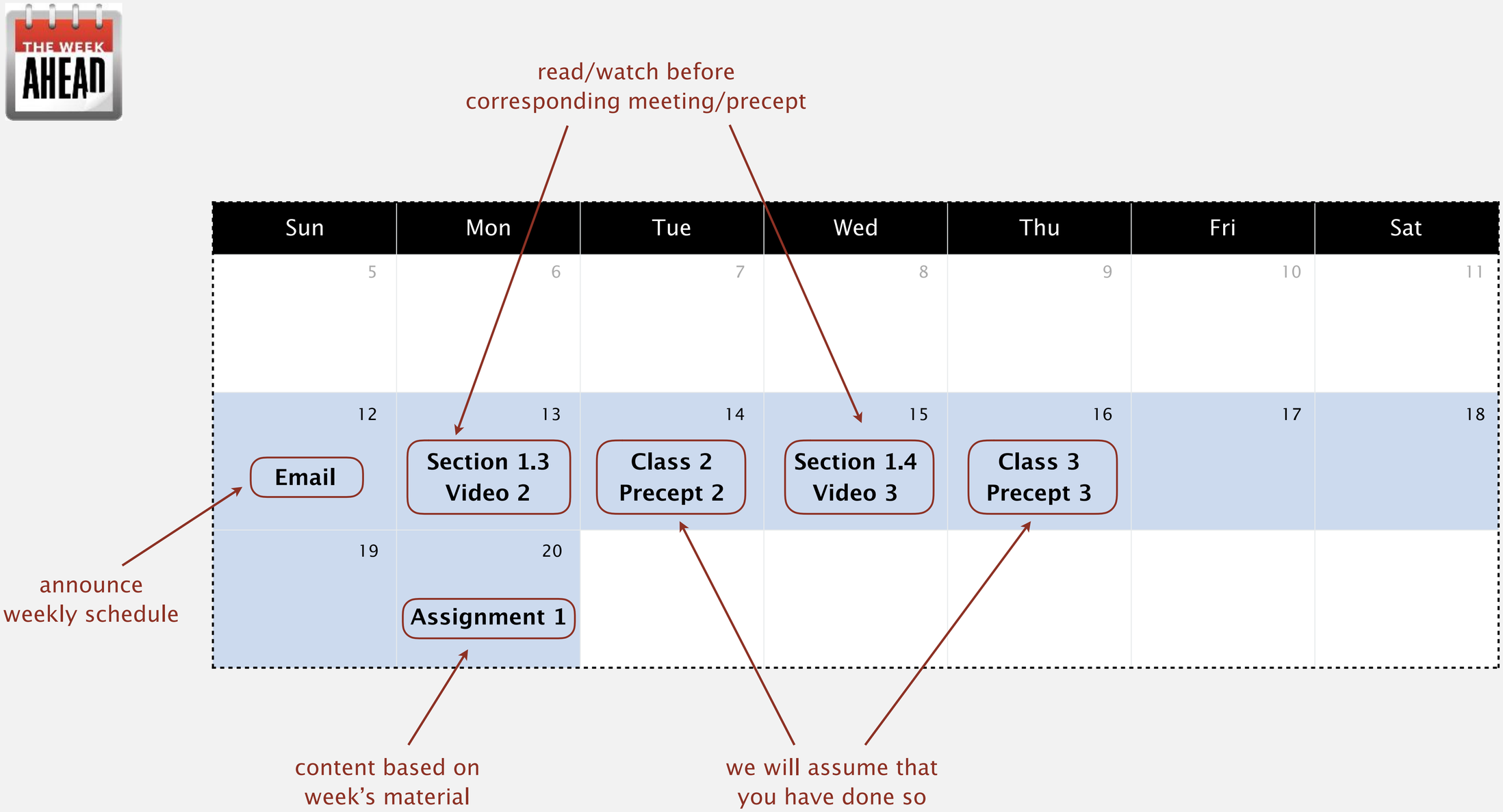
microcosm of course
(not needed for Assignment 0)

Sun	Mon	Tue	Wed	Thu	Fri	Sat
5	6	7 **Class 0** **Precept 0**	8 **Section 1.1–2** **Video 1**	9 **No Class** **Precept 1**	10 **Video 0**	11
12	13 **Assignment 0**					

protip: start early

precept start today
(or tomorrow)!

A typical week



Q&A

Not registered? Register in TigerHub ASAP; attend any precept for now.

Change precept? Use TigerHub.

All feasible precepts are full? Meet with COS undergraduate coordinator (Colleen Kenny–McGinley) in CS 210.

Class number	Section	Time	Days	Room	Enrollment	Status
41353	L01	12:30 pm - 1:20 pm	T Th	McCosh Hall 50	Enrolled:392 Limit:450	
41351	P01	2:30 pm - 3:20 pm	T Th	Friend Center 110	Enrolled:20 Limit:20	Closed
43561	P01A	2:30 pm - 3:20 pm	T Th	Friend Center 111	Enrolled:19 Limit:20	
43562	P01B	2:30 pm - 3:20 pm	T Th	Friend Center 009	Enrolled:16 Limit:20	

Q&A

Not registered? Register in TigerHub ASAP; attend any precept for now.

Change precept? Use TigerHub.

All feasible precepts are full? Meet with COS undergraduate coordinator (Colleen Kenny–McGinley) in CS 210.

How to place out of COS 126? Meet with COS placement officer (Christopher Moretti).

Questions?