<table>
<thead>
<tr>
<th>Name</th>
<th>Title</th>
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</thead>
<tbody>
<tr>
<td>Kevin Wayne</td>
<td>Faculty Instructor</td>
</tr>
<tr>
<td>Dan Leyzberg</td>
<td>Faculty Co-Lead Preceptor</td>
</tr>
<tr>
<td>Alan Kaplan</td>
<td>Faculty Co-Lead Preceptor</td>
</tr>
<tr>
<td>Ibrahim Alblawi</td>
<td>Faculty Co-Lead Preceptor</td>
</tr>
<tr>
<td>Donna Gabai</td>
<td>Faculty Preceptor</td>
</tr>
<tr>
<td>Lawrence Lin</td>
<td>Graduate Student Preceptor</td>
</tr>
<tr>
<td>Kevin Boutarel</td>
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</tr>
<tr>
<td>Pranjit Kalita</td>
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<td>Alex Tarr</td>
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<td>Laura Roberts</td>
<td>Graduate Student Preceptor</td>
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<tr>
<td>Marc Leef</td>
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<tr>
<td>Ashley Kling</td>
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</tr>
<tr>
<td>Natalie Wilkinson</td>
<td>Graduate Student Preceptor</td>
</tr>
<tr>
<td>Bridger Hahn</td>
<td>Graduate Student Preceptor</td>
</tr>
<tr>
<td>Hansen Zhang</td>
<td>Graduate Student Preceptor</td>
</tr>
</tbody>
</table>

Spring 2017

brought to you by

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

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

<table>
<thead>
<tr>
<th>topic</th>
<th>examples</th>
</tr>
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<tbody>
<tr>
<td>elements of programming</td>
<td>variables, loops, conditionals, arrays, I/O</td>
</tr>
<tr>
<td>functions</td>
<td>user-defined functions, modularity, recursion</td>
</tr>
<tr>
<td>object-oriented programming</td>
<td>user-defined data types, encapsulation, immutability</td>
</tr>
<tr>
<td>algorithms</td>
<td>sorting, binary search, stacks, queues, BSTs</td>
</tr>
<tr>
<td>theory of computing</td>
<td>regular expressions, universality, computability, intractability</td>
</tr>
<tr>
<td>design of computers</td>
<td>machine language, boolean logic, circuits</td>
</tr>
</tbody>
</table>
COS 126, SPRING 2017

- digital revolution
- course mechanics
- course work
- resources

http://introcs.cs.princeton.edu
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 ...

IBM  Microsoft  Apple  Sun
ORACLE

TIME
MACHINE OF THE YEAR
The Computer Moves In

Image 37. Time Magazine named the computer the “machine of the year” for 1982 [image courtesy of Time Magazine; used by permission]
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).
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!
COS 126, Spring 2017

- digital revolution
- course mechanics
- course work
- resources

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

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

SYLLABUS

Description. This course is an introduction to computer science in the context of scientific, engineering, and commercial applications. The goal of the course is to teach basic principles and practical issues, while at the same time preparing students to use computers effectively for applications in computer science, physics, biology, chemistry, engineering, and other disciplines. Topics include: programming in Java; hardware and software systems; algorithms and data structures; fundamental principles of computation; and scientific computing, including simulation, optimization, and data analysis.

Prerequisites. None.

Video lectures. Available online.

Class meetings. Class meetings are held twice per week, on Tuesdays & Thursdays.

Precepts. Precepts meet twice a week, on either Tuesdays & Thursdays or Wednesdays & Fridays.

Required reading. R. Sedgewick and K. Wayne, Computer Science: An Interdisciplinary Approach. Addison–Wesley Professional, 2016. ISBN 978-0134076423. We will be referencing this text all semester. The lectures are based on its contents. (Labyrinth)
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, ...

---

<table>
<thead>
<tr>
<th>What</th>
<th>When</th>
<th>Where</th>
<th>Who</th>
<th>Office Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>L01</td>
<td>TTh</td>
<td>McCosh 50</td>
<td>Kevin Wayne</td>
<td>see web</td>
</tr>
<tr>
<td></td>
<td>12:30-1:20pm</td>
<td>(here)</td>
<td></td>
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</tr>
</tbody>
</table>

**Previously done outside of class time**

Beginning ones primarily for novices.
Why flipped lectures?

One-size-fits-all lecture not optimal.

Salman Khan (founder of Khan Academy)
Active learning increases student performance in STEM.

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

Scott Freeman<sup>a,b</sup>, Sarah L. Eddy<sup>a</sup>, Miles McDonough<sup>a</sup>, Michelle K. Smith<sup>b</sup>, Nnadozie Okoroafor<sup>a</sup>, Hannah Jordt<sup>c</sup>, and Mary Pat Wenderoth<sup>a</sup>

<sup>a</sup>Department of Biology, University of Washington, Seattle, WA 98195; and <sup>b</sup>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
Active learning. Discussion, problem solving, pair programming, …
Active learning. Discussion, problem solving, pair programming, ...

<table>
<thead>
<tr>
<th>Precept</th>
<th>Days</th>
<th>Time</th>
<th>Instructor</th>
<th>Room</th>
</tr>
</thead>
<tbody>
<tr>
<td>P01A</td>
<td>Tuesdays &amp; Thursdays</td>
<td>2:30-3:20pm</td>
<td>with Lawrence Lin</td>
<td>in Friend 111</td>
</tr>
<tr>
<td>P01B</td>
<td>Tuesdays &amp; Thursdays</td>
<td>2:30-3:20pm</td>
<td>with Hansen Zhang</td>
<td>in Friend 009</td>
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<tr>
<td>P02</td>
<td>Tuesdays &amp; Thursdays</td>
<td>3:30-4:20pm</td>
<td>with Bridger Hahn</td>
<td>in Friend 110</td>
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<td>P02A</td>
<td>Tuesdays &amp; Thursdays</td>
<td>3:30-4:20pm</td>
<td>with Lawrence Lin</td>
<td>in Friend 111</td>
</tr>
<tr>
<td>P03</td>
<td>Tuesdays &amp; Thursdays</td>
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<td>with Marc Leef</td>
<td>in Friend 110</td>
</tr>
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<td>P03A</td>
<td>Tuesdays &amp; Thursdays</td>
<td>4:30-5:20pm</td>
<td>with Kevin Boutilier</td>
<td>in Friend 111</td>
</tr>
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<td>P05</td>
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<td>7:30-8:20pm</td>
<td>with Marc Leef</td>
<td>in Friend 108</td>
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<tr>
<td>P06</td>
<td>Wednesdays &amp; Fridays</td>
<td>10:00-10:50am</td>
<td>with Laura Roberts</td>
<td>in Friend 110</td>
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<td>P07</td>
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<td>with Natalie Wilkinson</td>
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<td>with Alex Tarr</td>
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<td>12:30-1:20pm</td>
<td>with Pranit Kalita</td>
<td>in Friend 111</td>
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<tr>
<td>P09</td>
<td>Wednesdays &amp; Fridays</td>
<td>1:30-2:20pm</td>
<td>with Ashley Küng</td>
<td>in Friend 110</td>
</tr>
</tbody>
</table>
Novice precepts

Same great content; longer precepts with reduced pace.

<p>| | | | | |</p>
<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
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<td>with Ibrahim Albluwi</td>
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<tr>
<td>P12</td>
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<td>in Friend 108</td>
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<td>in Friend 108</td>
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<td>1:30-2:50pm</td>
<td>with Kevin Boutarel</td>
<td>in Friend 109</td>
</tr>
<tr>
<td>P15</td>
<td>Wednesdays &amp; Fridays</td>
<td>3:00-4:20pm</td>
<td>with Ibrahim Albluwi</td>
<td>in Friend 108</td>
</tr>
</tbody>
</table>
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).
- 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)
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).
Resources (lecture videos)

Lecture videos (required).

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

Bob Sedgewick
Resources (textbook and booksite)

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

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.

Office hours.  protip: attend
- High bandwidth, high latency.
- See web for schedule.

Computing laboratory (Lewis 121).
- Undergrad lab TAs.
- For help with debugging.
- See web for schedule.

http://piazza.com/princeton/spring2017/cos126
http://www.princeton.edu/~cos126
http://labta.cs.princeton.edu
<table>
<thead>
<tr>
<th>Sun</th>
<th>Mon</th>
<th>Tue</th>
<th>Wed</th>
<th>Thu</th>
<th>Fri</th>
<th>Sat</th>
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<tr>
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<td>Class 0</td>
<td>Section 1.1–2</td>
<td>No Class</td>
<td>Video 0</td>
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<td>Video 1</td>
<td>Precept 1</td>
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<td>13</td>
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</table>

- protip: start early
- precept start today (or tomorrow!)
- you are here!
- read/watch before Precept 1
- microcosm of course (not needed for Assignment 0)
A typical week

<table>
<thead>
<tr>
<th>Sun</th>
<th>Mon</th>
<th>Tue</th>
<th>Wed</th>
<th>Thu</th>
<th>Fri</th>
<th>Sat</th>
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<td><strong>Email</strong></td>
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<td>20</td>
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</tbody>
</table>

- Announce weekly schedule
- Content based on week's material
- Read/watch before corresponding meeting/precept
- We will assume that you have done so
**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.

<table>
<thead>
<tr>
<th>Class number</th>
<th>Section</th>
<th>Time</th>
<th>Days</th>
<th>Room</th>
<th>Enrollment</th>
<th>Status</th>
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<tr>
<td>41353</td>
<td>L01</td>
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<td>T Th</td>
<td>McCosh Hall</td>
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<tr>
<td>41351</td>
<td>P01</td>
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<td>T Th</td>
<td>Friend Center</td>
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<td>Closed</td>
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<tr>
<td>43561</td>
<td>P01A</td>
<td>2:30 pm - 3:20 pm</td>
<td>T Th</td>
<td>Friend Center</td>
<td>Enrolled:19</td>
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</tbody>
</table>
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?