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.

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

Computers are transforming society

IBM  Microsoft®  Apple  Sun

ORACLE

PeopleSoft.

Office  Adobe  SAS  MATLAB

Yahoo!  Google  LinkedIn
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.
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
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.
Welcome aboard. You are already a consumer (and producer and product).
Welcome aboard. Now, become a creator!

The digital revolution has only just begun

[ 99% of politicians agree ]
COS 126, FALL 2017

- digital revolution
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- 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!)

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>
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<tbody>
<tr>
<td>L01</td>
<td>TTh 10:00–10:50</td>
<td>McCosh Hall 10 (here)</td>
<td>David August</td>
<td>see web</td>
</tr>
</tbody>
</table>

Previously done outside of class time

Watch videos lectures online before class meeting/precept.
Lecture Videos

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

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

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

Lecture Video

Bob Sedgewick (2× speed)
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*,1, Sarah L. Eddy*, Miles McDonough*, Michelle K. Smithb, Nnadozie Okoroafora, Hannah Jordta, and Mary Pat Wenderotha

*Department of Biology, University of Washington, Seattle, WA 98195; and bSchool 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-
Active learning. Discussion, problem solving, pair programming, ...
### Precepts

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

<table>
<thead>
<tr>
<th>Course</th>
<th>Section</th>
<th>Time</th>
<th>Days</th>
<th>Location</th>
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<tr>
<td>20485</td>
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<tr>
<td>20487</td>
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<td>2:30 pm - 3:20 pm</td>
<td>W F</td>
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</tr>
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</table>
Extended-time precepts

Same great content; longer precepts with reduced pace and more time for questions. Students with strong quantitative skills will likely be bored.

<table>
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<tr>
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</tr>
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</table>
COS 126, Fall 2017

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http://introcs.cs.princeton.edu
Coursework and grading

Grades are based on achievement.

- Programming assignments. ➡️ due Mondays at 11:59pm
- Final programming project. ➡️ due Dean’s date
- Programming exams (October 12, December 7).
- Written exams (October 19, December 14).

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!
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.

Full details. See course website.

CoD warning. Plagiarizing code is treated the same as plagiarizing prose (but is much easier to catch).
COS 126, FALL 2017

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http://introcs.cs.princeton.edu
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
Course website
Course website
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/fall2017/cos126

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

http://labta.cs.princeton.edu
The first week

**Protip:** start early (or tomorrow)!

You are here!

Microcosm of course (not needed for Assignment 0)

Assignment 0

Video 1

Class 0

Precept 0

Video 0

Do before Precept 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>Assignment 1</td>
<td>24</td>
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<td></td>
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</table>

- **Email**
- **Section 1.2 Video 1**
- **Class 1 Precept 1**
- **Section 1.3 Video 2**
- **Class 2 Precept 2**

- Announce weekly schedule
- Watch/read before corresponding class/precept
- Content based on week’s material
- 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>Enrollments</th>
<th>Status</th>
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<tbody>
<tr>
<td>20489</td>
<td>L01</td>
<td>10:00 am - 10:50 am</td>
<td>T Th</td>
<td>McCosh Hall 10</td>
<td>Enrolled:365 Limit:445</td>
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<tr>
<td>20485</td>
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<td>12:30 pm - 1:20 pm</td>
<td>T Th</td>
<td>Friend Center 108</td>
<td>Enrolled:22 Limit:25</td>
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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?