COS 226, Fall 2018

Algorithms and Data Structures

Kevin Wayne · Maia Ginsburg · Ibrahim Albluwi
Intro to COS 226

- motivation
- course structure
- assessments
- resources
COS 226 course overview

What is COS 226?

- Intermediate-level survey course.
- Programming and problem solving, with applications.
- Algorithm: sequence of instructions for solving a problem.
- Data structure: method to organize data in a computer.

<table>
<thead>
<tr>
<th>topic</th>
<th>data structures and algorithms</th>
</tr>
</thead>
<tbody>
<tr>
<td>data types</td>
<td>stack, queue, union–find, priority queue</td>
</tr>
<tr>
<td>sorting</td>
<td>quicksort, mergesort, heapsort, radix sorts</td>
</tr>
<tr>
<td>searching</td>
<td>BST, red–black BST, hash table</td>
</tr>
<tr>
<td>graphs</td>
<td>BFS, DFS, Prim, Kruskal, Dijkstra</td>
</tr>
<tr>
<td>strings</td>
<td>KMP, regular expressions, tries, data compression</td>
</tr>
<tr>
<td>advanced</td>
<td>k-d tree, suffix array, maxflow</td>
</tr>
</tbody>
</table>
Why study algorithms and data structures?

Their impact is broad and far-reaching.
Why study algorithms and data structures?

To solve problems that could not otherwise be addressed.

http://www.youtube.com/watch?v=ua7Y1N4eL_w
Why study algorithms and data structures?

They may unlock the secrets of life and of the universe.

“Computer models mirroring real life have become crucial for most advances made in chemistry today…. Today the computer is just as important a tool for chemists as the test tube.”

— Royal Swedish Academy of Sciences
(Nobel Prize in Chemistry 2013)

Martin Karplus, Michael Levitt, and Arieh Warshel
Why study algorithms and data structures?

Old roots, new opportunities.

- Study of algorithms dates at least to Euclid.
- Named after Muḥammad ibn Mūsā al-Khwārizmī.
- Formalized by Church and Turing in 1930s.
- Some important algorithms were discovered by undergrads in a course like this!
Why study algorithms and data structures?

To become a proficient programmer.

“I will, in fact, claim that the difference between a bad programmer and a good one is whether he considers his code or his data structures more important. Bad programmers worry about the code. Good programmers worry about data structures and their relationships.”

— Linus Torvalds (architect of Linux and git)
Why study algorithms and data structures?

For intellectual stimulation.

“For me, great algorithms are the poetry of computation. Just like verse, they can be terse, allusive, dense, and even mysterious. But once unlocked, they cast a brilliant new light on some aspect of computing.” — Francis Sullivan
Why study algorithms and data structures?

For fun and profit.
Why study algorithms and data structures?

- Their impact is broad and far-reaching.
- To solve problems that could not otherwise be addressed.
- They may unlock the secrets of life and of the universe.
- Old roots, new opportunities.
- To become a proficient programmer.
- For intellectual stimulation.
- For fun and profit.

Why study anything else?
Intro to COS 226

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Lectures

**Live lectures.** Introduce new material.

<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 11-12:20</td>
<td>Thomas Lab 003</td>
<td>Kevin Wayne</td>
<td>M 1:30-3:30pm</td>
</tr>
</tbody>
</table>

**Electronic devices.** Permitted *only* to support lecture (e.g., viewing slides and taking notes).
Student response system (required).

- Any hardware version of iClicker.
  (use iClicker Reef at your own risk, WiFi issues?)
- Register your iClicker in Blackboard.
- Available at Labyrinth Books ($30).

Which model of iClicker are you using?

A. iClicker.
B. iClicker+.
C. iClicker 2.
D. iClicker Reef.

save serial number to maintain resale value
Precepts

Discussion, problem-solving, assignment prep, ...

Maia Ginsburg
Faculty
Lead Preceptor

Ibrahim Albluwi
Faculty
Lead Preceptor

Allison Chang
Graduate Student
Preceptor

Lisa Jian
Graduate Student
Preceptor

Ross Teixeira
Graduate Student
Preceptor

Qasim Nadeem
Graduate Student
Preceptor
## Precepts

Discussion, problem-solving, assignment prep, ...

<table>
<thead>
<tr>
<th>What</th>
<th>When</th>
<th>Where</th>
<th>Who</th>
</tr>
</thead>
<tbody>
<tr>
<td>P01</td>
<td>F 10–10:50am</td>
<td>Friend 009</td>
<td>Ibrahim Albluwi</td>
</tr>
<tr>
<td>P01A</td>
<td>F 10–10:50am</td>
<td>Friend 108</td>
<td>Lisa Jian</td>
</tr>
<tr>
<td>P02</td>
<td>F 11–11:50am</td>
<td>Friend 009</td>
<td>Ibrahim Albluwi</td>
</tr>
<tr>
<td>P02A</td>
<td>F 11–11:50am</td>
<td>Friend 108</td>
<td>Allison Chang</td>
</tr>
<tr>
<td>P03</td>
<td>F 12:30–1:20pm</td>
<td>Friend 009</td>
<td>Maia Ginsburg</td>
</tr>
<tr>
<td>P03A</td>
<td>F 12:30–1:20pm</td>
<td>Friend 108</td>
<td>Qasim Nadeem</td>
</tr>
<tr>
<td>P04</td>
<td>F 1:30–2:20pm</td>
<td>Friend 009</td>
<td>Ross Teixeira</td>
</tr>
<tr>
<td>P05</td>
<td>Th 3:30–4:20pm</td>
<td>Friend 009</td>
<td>Maia Ginsburg</td>
</tr>
</tbody>
</table>
Review sessions

- Recap of material discussed during the week.
- Q&A session.
- Active learning activities.

Q. Required?
A. No. Intended for students seeking extra help to keep up with the course.

<table>
<thead>
<tr>
<th>When</th>
<th>Where</th>
<th>Who</th>
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</thead>
<tbody>
<tr>
<td>F 3–4pm</td>
<td>TBA</td>
<td>Ross Teixeira</td>
</tr>
</tbody>
</table>
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- resources
- union–find
Programming assignments

Implement an efficient algorithm or data structure.

Solve an interesting application using a “textbook” algorithm.
Programming assignments

New IntelliJ-based programming environment (highly recommended).

- Continuous inspection; integrated Checkstyle and Findbugs.
- Autoformat, autoimport, and autocomplete.
- Embedded bash terminal.
- ...

![Programming assignment example]
Quizzes

- 2–3 short questions per lecture.
- 3 attempts per question.
- Use pencil and paper.
Written exams.

- Questions drawn from quizzes and lectures.
- Emphasizes non-programming material.

This exam has 10 questions (including question 0) worth a total of 55 points. You have 80 minutes. This exam is preprocessed by a computer, so please write darkly and write your answers inside the designated spaces.

Policies. The exam is closed book, except that you are allowed to use a one page cheatsheet (8.5-by-11 paper, one side, in your own handwriting). No electronic devices are permitted.
Grading

Programming assignments. 45%
- Due at 11pm on Mondays via TigerFile.
- Collaboration/lateness policies: see web.

Quizzes. 10%
- Due at 11pm on Fridays via Quizzera.
- Collaboration/lateness policies: see web.

Exams. 15% + 25%
- Midterm (in class on Tuesday, October 23).
- Final (to be scheduled by Registrar).

Participation. 5%
- Attend and participate in precept/lecture.
- Answer questions on Piazza.
INTRO TO COS 226

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**Resources (textbook)**


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Available in various formats.
- Online: Amazon ($85 hardcover, $60 Kindle, $40 rent), ...
- Brick-and-mortar: Labyrinth Books ($60 hardcover).
- On reserve: Engineering library.
Resources (videos)

Lecture videos (optional).

- Missed lecture.
- Review for exams.
Resources (videos)

Lecture videos (optional).

- Missed lecture.
- Review for exams.

http://salon.cs.princeton.edu
Resources (web)

Course content.
- Course info.
- Lecture slides.
- Programming assignments.
- Quizzes.
- Exam archive.

Booksite.
- Brief summary of content.
- Download code from book.
- APIs and Javadoc.

http://www.princeton.edu/~cos226

http://algs4.cs.princeton.edu
Resources (people)

Piazza discussion forum.
  • Low latency, low bandwidth.
  • See Piazza for guidelines.

Office hours.
  • High bandwidth, high latency.
  • See web for schedule.

Computing laboratory.
  • Undergrad lab TAs.
  • For help with debugging.
  • See web for schedule.
This week

预览这周的课程安排和作业信息。注意，预览中提到的”你在这里！“和”预览开始明天（或今天）阅读作业1前的预览“等提示。
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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</thead>
<tbody>
<tr>
<td>9</td>
<td>10</td>
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<td>15</td>
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<td>20</td>
<td>21</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lecture 2 (Analysis)</td>
<td></td>
<td>Lecture 3 (Stacks)</td>
<td>Precept 2</td>
<td>Quiz 2 and 3</td>
</tr>
<tr>
<td>23</td>
<td>24</td>
<td>25</td>
<td>26</td>
<td>27</td>
<td>28</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td>Assignment 2 (Deques+RQs)</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

- Content based on week's material
- Support lecture material; assignment prep
- Content based on corresponding lectures
Q+A

Not registered? We are currently exceeding the room capacity.
Change precept? Use TigerHub.

Haven’t taken COS 126? See COS placement officer.
Placed out of COS 126? Review Sections 1.1–1.2 of Algorithms 4/e.