Computer Science 241: Data Structures

Fritz Ruehr • Willamette University • Fall 2020

See this page for the latest Covid pandemic policies and procedures:

`https://willamette.edu/offices/wellness/coronavirus/index.html`

Introduction

The study of data structures and algorithms serves as a basic foundation to a Computer Science education. As a second course in programming, it enriches a student's understanding of the basic processes involved in computing … but it also begins to focus attention on deeper and more abiding issues. In this course, we shift our attention from simple coding techniques to the analysis of algorithms, in terms of resource use (time and space), generic solutions to recurring problems, and larger-scale program design. A good portion of our time will be spent becoming familiar with the discipline's standard repertoire of data structures and algorithms. In order to support larger-scale design, we will stress principles of abstraction and modularity. We will try to divide our programs into cleanly-separated components, with narrow interfaces, and consider the specification of their behavior separate from its possible implementations. Through all of this, our programming vehicle will be the modern, high-level programming language Python. Students should come out of this course with a solid capability for programming and design and a good foundation for future study of Computer Science in general.

Instructor

Name: Fritz Ruehr — *Office:* Ford Hall 208

Phone: 370-6165 — *E-mail:* `fruehr@willamette.edu`

Course homepage: `http://www.willamette.edu/~fruehr/241`

Office hours: Tue 2:15-3:15 ; Th 1:00-2:00 (after CS Tea).

NB: Office hours this semester will be via Zoom, either via email appointment or perhaps via Wise (or similar) later in the term; see class announcements for details.

Computer Science Tea is an informal gathering **Thursdays from 11:30-12:45 via Zoom.**

You are invited!

Logistics and attendance

Classroom time will be spent mainly in lecture; however, you are strongly encouraged to attend lab to work on your assignments when possible, or to meet with the instructor at some other time if you are having trouble and cannot make it to lab.

Lectures	MWF 11:45-12:45	Ford 201
Lab times	MWF 1:00-2:00	Ford 202

You are responsible for all content, changes in assignments or policies, etc., announced during the course of scheduled lectures; if you are unavoidably absent, inquire at the next class meeting, in office hours or by email.

Grading of programming projects will be based on an interactive, hands-on "demo:" when you are confident that your program is complete and correct, you will seek me out (preferably during lab) and ask to show me your work. I will look over your running application and your written program, try different inputs and features, verify that your program is correct and well-designed, and giving you feedback as appropriate. If I find errors or problems that could be easily fixed, I will try to give you an opportunity to make changes before the due date.

We feel that this is a flexible and humane approach to the grading process which maximizes interaction between students and faculty.

Textbook

We will use **Problem Solving with Algorithms and Data Structures using Python** (2nd edition), by Brad Miller and David Ranum, which should be available in the bookstore. ISBN: 978-1590282571.

Language and tools

We will use the Python programming language (see `www.python.org/downloads`); it should be installed on all lab machines and is a free download.

Grading policy

Grades will be based on programming projects, exams and class participation—in-class quizzes and written homework may also be included, as needed to determine student progress. Individual grades will be given in numeric form and then combined to determine an overall grade at the end of the semester, according to the weights listed below. I grade on a modified curve basis—that is, I grade students relative to each other's performance, but not necessarily to fit a normal curve. I try to correlate letter-grade breaks with the **gaps** between student scores.

Much of the time you devote to class will be spent writing programs. I also plan to give one shorter mid-term and a longer, comprehensive final (during the regularly scheduled exam period—see below). The weights used for the overall grade will be:

- 45% divided evenly among the programming projects;
- 20% for the mid-term exam;
- 25% for the final exam; and
- 10% total for in-class quizzes, other class participation, and any written homework .

(And see above regarding the "demo" style of program grading.)

Programming projects will generally be due about one week (at the beginning of the course) or two weeks (toward the end) after they are assigned. On occasion, class-wide extensions may be announced. If you think you will be unlikely to be able to complete an assignment, contact me ***before*** the due date regarding the problem.

Grading of programming projects will be done in the lab (and/or via Zoom), based on an interactive "demo" by the student for the instructor. This approach allows you to make some adjustments to your program in response to problems I find. We feel that this is a flexible and humane approach to the grading process which maximizes interaction between students and faculty.

Note: the **final exam** is scheduled (by the College) for **Thursday, December 3rd, from 2-5pm ;**
please make your holiday travel plans accordingly!

Collaboration and related issues

All programming projects, exams and other work you hand in should be your own. You are allowed (and encouraged) to seek help from other students for general study purposes, but you should never allow other people to do your work *for* you. You may use standard libraries supplied with Python, but you should leave all copyrights and attributions intact and clearly identify your own contributions. Violations of these rules will result in penalties according to College policies, but could include a zero grade for the assignment or a failing grade for the course. In essence, it is OK to discuss ideas with other students, but to copy a piece of writing or program from another source (unattributed), or to have someone else dictate it verbatim, write it down, or type it in for you is NOT allowed.

Topical coverage

We will follow the Weiss textbook fairly closely, although we will not likely make it through the whole book (a later course, *CS 343 Analysis of Algorithms,* covers the remaining topics (and more).

Topics we cover this semester should include the following (at a pace of roughly 3-4 days per topic):

- course introduction and basic concepts
- Python language review
- asymptotic analysis and O-notation
- linked lists and other linear structures (stacks, queues, and deques)
- recursion and induction
- searching and sorting algorithms
- trees, including algebraic expression trees
- binary search trees, AVL trees, splay trees (and possibly B-trees)
- hash tables and hashing
- priority queues and heaps
- possibly graphs and basic graph algorithms (if time permits)

College-wide policies

Accreditation information

In accordance with college accreditation initiatives, the following are the **student learning objectives** *associated with this class (SLO numbers are relative to CS Department norms):*

CS/SLO #1: "Students will achieve proficiency in discrete math."

CS/SLO #2: "Students will achieve proficiency in Computer Science skills (fundamentals of programming, computer organization, architecture, algorithms, theory, designing and implementing software)."

CS/SLO #5: "Students will demonstrate the ability to work independently to analyze and solve problems."

Important dates

For the official college academic calendar for this year, see:

`https://willamette.edu/offices/registrar/calendar/index.html`

Diversity and Disability Statement

Willamette University values diversity and inclusion; we are committed to a climate of mutual respect and full participation. My goal is to create a learning environment that is usable, equitable, inclusive and welcoming. If there are aspects of the instruction or design of this course that result in barriers to your inclusion or accurate assessment or achievement, please notify me as soon as possible. Students with disabilities are also encouraged to contact the Accessible Education Services office in Matthews 103 at 503-370-6737 or Accessible-info@willamette.edu to discuss a range of options to removing barriers in the course, including accommodations.

Religious Practice

Willamette University recognizes the value of religious practice and strives to accommodate students' commitment to their religious traditions whenever possible. Please let me know within the first two weeks of the semester if a conflict between holy days or other religious practice and full participation in the course is anticipated. I will do my best to work with you to determine a reasonable accommodation.

Time Commitment

Willamette's Credit Hour Policy holds that for every hour of class time there is an expectation of 2-3 hours work outside of class. Thus, for a class meeting three days a week you should anticipate spending 6-9 hours outside of class engaged in course-related activities. Examples include study time, reading and homework assignments, research projects, and group work.

Academic Integrity

Students of Willamette University are members of a community that values excellence and integrity in every aspect of life. As such, we expect all community members to live up to the highest standards of personal, ethical, and moral conduct. Students are expected not to engage in any type of academic or intellectually dishonest practice and encouraged to display honesty, trust, fairness, respect, and responsibility in all they do. Plagiarism and cheating are especially offensive to the integrity of courses in which they occur and against the College community as a whole. These acts involve intellectual dishonesty, deception, and fraud, which inhibit the honest exchange of ideas. Plagiarism and cheating may be grounds for failure in the course and/or dismissal from the College.

See also: `https://willamette.edu/arts-sciences/catalog/policies/plagiarism-cheating.php`

Trans Inclusive Classroom Space

If I accidentally use an incorrect gender pronoun when addressing you, please feel free to let me know, in whatever manner makes you comfortable, what pronouns you use so that I can make every effort to correct that error.

Mental Health

As a student, you may experience a range of challenges that can interfere with learning, such as strained relationships, increased anxiety, substance use, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may diminish your academic performance and/or reduce your ability to participate in daily activities. Willamette services are available and treatment does work. If you think you need help, please contact Bishop Health as soon as possible at http://willamette.edu/offices/counseling/. Crisis counseling is available 24/7 at WUTalk: 503-375-5353 *and Campus Safety is available at* 503-370-6911. *Emergency resources are also available from the Psychiatric Crisis Center at* 503-585-4949 *and the National Suicide Prevention Lifeline at* 1-800-273-8255.

Commitment to Positive Sexual Ethics

Willamette is a community committed to fostering safe, productive learning environments, and we value ethical sexual behaviors and standards. Title IX and our school policy prohibit discrimination on the basis of sex, which regards sexual misconduct — including discrimination, harassment, domestic and dating violence, sexual assault, and stalking. We understand that sexual violence can undermine students' academic success, and we encourage affected students to talk to someone about their experiences and get the support they need. Please be aware that as a mandatory reporter I am required to report any instances you disclose to Willamette's Title IX Coordinator.

If you would rather share information with a confidential employee who does not have this responsibility, please contact our confidential advocate at confidential-advocate@willamette.edu. Confidential support also can be found with SARAs and at the GRAC (503-851-4245); and at WUTalk - a 24-hour telephone crisis counseling support line (503-375-5353). If you are in immediate danger, please call campus safety at 503-370-6911.

DACA/Undocumented Student Advocate

Willamette is committed to supporting our DACA/Undocumented students in a variety of ways. This year, Professor Michael Niño is the contact person for all DACA/undocumented students can provide those students with a number of external and internal resources that are available. His contact information is email: mdnino@willamette.edu, Office: Smullin 213, Phone: 503-370-6643.

SOAR Center Offerings: Food, Clothing, and School Materials

The Students Organizing for Access to Resources (SOAR) Center strives to create equitable access to food, professional clothing, commencement regalia, and scholarly resources for WU and Willamette Academy students. The SOAR Center is located in the Putnam University Center's third floor (in the former Women's Resource Center and across from the Harrison Conference Room). The space houses the Bearcat Pantry, Clothing Share, and First-Generation Book Drive and is maintained by committed students and staff and faculty advisers. Hours of operation are M-F, 9am-5pm and weekends from 12-2pm. The Center opens for fall semester 2019 on Labor Day, Monday, Sept. 2 at 12pm.

Land Acknowledgement

We are gathered on the land of the Kalapuya, who today are represented by the Confederated Tribes of the Grand Ronde and the Confederated Tribes of the Siletz Indians, whose relationship with this land continues to this day. We offer gratitude for the land itself, for those who have stewarded it for generations, and for the opportunity to study, learn, work, and be in community on this land. We acknowledge that our University's history, like many others, is fundamentally tied to the first colonial developments in the Willamette Valley. Finally, we respectfully acknowledge and honor past, present, and future Indigenous students of Willamette.