

Constructive Logic (15-317/657)

Karl Crary

Fall 2024

This undergraduate course provides an introduction to constructive logics, such as intuitionistic and linear logic, with an emphasis on their application in computer science. This includes basic means for defining logics (for example, natural deduction and sequent calculus), establishing properties of logics (for example, cut elimination), and for investigating their computational interpretations (for example, via proof reduction or proof search).

Prerequisites: We use Standard ML in this class. A minimum grade of C in 15-150 is a prerequisite to take 15-317. For the cross-listed graduate version, 15-657, some experience with functional programming is strongly recommended.

Students are responsible for everything contained in this document, including the homework policy and the academic integrity policy.

Instructors

Karl Crary	<code>crary@andrew.cmu.edu</code>
Jonathan Ho	<code>jeh2@andrew.cmu.edu</code>
Aresh Pourkavoos	<code>apourkav@andrew.cmu.edu</code>
Emily Song	<code>emsong@andrew.cmu.edu</code>

Sessions

Lecture	MW	11:00 AM–12:20 PM	DH 2122
Section A	T	9:00 AM–9:50 AM	POS 147
Section B	T	10:00 AM–10:50 AM	DH 2122
Section C	T	11:00 AM–11:50 AM	GHC 4211
Section D	T	12:00 PM–12:50 PM	Wean 4707

Online resources

The course web page is located at:

`cs.cmu.edu/~crary/317-f24`

It gives a tentative schedule of topics, often with lecture notes. We will also distribute assignments through the web page. In addition, we will use a Piazza forum for announcements, questions, and discussion.

Please transact course business (*e.g.*, requests for extensions) by email or in-person, not by Piazza. You will get attention more promptly that way. Also, before contacting us, please review the course FAQ:

`cs.cmu.edu/~crary/317-f24/faq.txt`

It is best to view the lecture notes as the textbook for the course. Do not view them as a substitute for lecture! The notes are generally very good, but they do not cover all the topics of the course, and those that it does cover, it does not always cover the same way. This is particularly true in the second half of the course; don't be lulled into a false sense of security by the first half.

Homework

Homework will be assigned weekly and collected using Gradescope. You will have three late days to use as you see fit, with at most one late day on any single assignment. (If, for any reason, you are granted extra late days, that does not affect the maximum of one late day on any particular assignment.)

These late days are intended to address all normal circumstances that obstruct getting work done, include mild illnesses and interviews. Their purpose is to spare the student and instructor the trouble of requesting extensions in normal circumstances.

Late days are not intended as a time management tool. Although we do not police their use (as that would defeat the purpose), students who exhaust their late days in this manner might not be granted additional days if later it turns out that they need them. Homeworks turned in late with no late days remaining will be assessed a 50% penalty.

No homework will be accepted more than one day late without prior arrangement.

Students are responsible for handing in their homework correctly. That includes ensuring that the correct files are handed in. It also includes taking care to read Gradescope's output in its entirety, which might report an error. Extensions will not be granted for failure to exercise this basic diligence.

All students who were registered for the course on August 21 should be in the Gradescope system already. Other students should contact an instructor.

Advice: Start programming assignments early. They are probably trickier than you anticipate.

Exams and attendance

Students are permitted two pages of notes (*i.e.*, one sheet, front and back) during exams. Exams are closed internet.

Attendance in lectures is required. Attendance will be taken using a daily quiz. The quiz will consist of one question that will be easy if you have been paying attention. Getting the question wrong will result in half credit for attendance that day.

A small number of absences (approximately three, but the number may be adjusted) will be forgiven, so you not need to notify the course staff regarding absences.

The weighting in assigning grades will be 48% homework, 19% midterms, 29% final, 4% attendance.

Software

For much of the course, we will be using an automated proof checker called Dcheck. Dcheck runs on Gradescope, but it has some auxiliary tools that are available to you on Andrew. The documentation is at:

`cs.cmu.edu/~crary/dcheck/dcheck.pdf`

The paths where the auxiliary tools are located are given on page 5 of the documentation.

We assume that you are familiar with some Standard ML compiler, such as Standard ML of New Jersey.

In the middle part of the course, we will be writing programs in Prolog. Two good, free Prolog interpreters are GNU-Prolog and SWI-Prolog.

Academic integrity

All assignments in the course are individual assignments. All work you hand in on assignments must be your own work. You should not examine or copy any other person's solution. You should not discuss any homework solution with anyone else until after the due date (including late days). You must not make your solution available to any other student, in whole or in part. It is your responsibility to ensure that others cannot read your files.

The homework assignments and their associated support files are copyrighted material, and must not be uploaded to any web site (other than Gradescope for turn-in). If you happen to discover any Constructive Logic homework solutions, for this semester or any preceding instance, you must report your discovery to the instructor.

It is permissible, and indeed you are encouraged, to discuss the course content with other students, including the concepts that underlie a homework problem. But you must stop short of discussing the homework problem itself.

Be aware that the above is a change in policy from some earlier semesters.

Exam work must be exclusively your own. You are not to discuss any exam problem with anyone other than course staff until you turn in your exam. Thereafter, you may discuss exam problems with others, provided you take care, proactively, to ensure you are not overheard by any student who, for whatever reason, might not yet have finished his or her exam. This includes when you are in a location other than where the exam took place.

Note taking

Research has shown that taking notes, by hand, using a pen or pencil is a vital part of learning for most students. Taking notes on a laptop is a poor substitute. In fact, research has shown that you are better off taking notes by hand and then throwing those notes away, than taking notes on a laptop. It seems that the act of processing material into handwritten notes involves the parts of the brain responsible for learning, while the act of transcribing class material on a laptop largely bypasses those parts.

You can learn about this research, which some people find counterintuitive, here:

www.scientificamerican.com/article/a-learning-secret-don-t-take-notes-with-a-laptop/

It does seem reasonable that taking notes on a laptop or tablet using a stylus probably is similar to taking notes with pencil, although I am not aware of any research that actually confirms this intuition. Conversely, simply taking screenshots of the lecture is likely even worse than taking notes on a laptop.

Accommodations for students with disabilities

If you have a disability and have an accommodations letter from the Disability Resources office, I encourage you to discuss your accommodations and needs with me as early in the semester as possible. I will work with you to ensure that accommodations are provided as appropriate. If you suspect that you may have a disability and would benefit from accommodations but are not yet registered with the Office of Disability Resources, I encourage you to contact them at access@andrew.cmu.edu. Note that we cannot provide any special accommodations without a Disability Resources letter.

Support for students' health and well-being

There are many helpful resources available on campus and an important part of the college experience is learning how to ask for help. Asking for support sooner rather than later is almost always helpful. If you or anyone you know experiences any academic stress, difficult life events, or feelings like anxiety or depression, we strongly encourage you to seek support. Counseling and Psychological Services (CaPS) is here to help: call 412-268-2922 and visit their website at <http://www.cmu.edu/counseling/>. Consider reaching out to a friend, faculty or family member you trust for help getting connected to the support that can help.

Diversity

We must treat every individual with respect. We are diverse in many ways, and this diversity is fundamental to building and maintaining an equitable and inclusive campus community. Diversity can refer to multiple ways that we identify ourselves, including but not limited to race, color, national origin, language, sex, disability, age, sexual orientation, gender identity, religion, creed, ancestry, belief, veteran status, or genetic information. Each of these diverse identities, along with many others not mentioned here, shape the perspectives our students, faculty, and staff bring to our campus. We, at CMU, will work to promote diversity, equity and inclusion not only because diversity fuels excellence and innovation, but because we want to pursue justice. We acknowledge our imperfections while we also fully commit to the work, inside and outside of our classrooms, of building and sustaining a campus community that increasingly embraces these core values.

Each of us is responsible for creating a safer, more inclusive environment.

Unfortunately, incidents of bias or discrimination do occur, whether intentional or unintentional. They contribute to creating an unwelcoming environment for individuals and groups at the university. Therefore, the university encourages anyone who experiences or observes unfair or hostile treatment on the basis of identity to speak out for justice and support, within the moment of the incident or after the incident has passed. Anyone can share these experiences using the following resources:

- Center for Student Diversity and Inclusion: csdi@andrew.cmu.edu, (412) 268-2150
- Report-It online anonymous reporting platform: reportit.net username: **tartans** password: **plaid**

All reports will be documented and deliberated to determine if there should be any following actions. Regardless of incident type, the university will use all shared experiences to transform our campus climate to be more equitable and just.