15-317 Constructive Logic

Course Syllabus
André Platzer

1 Overview

This multidisciplinary junior/senior-level course is designed to provide a thorough introduction to modern constructive logic, its roots in philosophy, its numerous applications in computer science, and its mathematical properties. The core topics of this class are intuitionistic logic, natural deduction, Heyting arithmetic, proofs as programs, connections between classical and constructive logic, inductive definitions, sequent calculus, and decidable classes. Advanced topics may vary from year to year and include type theory, logic programming, proof search, logical frameworks, temporal logic and model checking, modal logic.

Additional information, including a lecture schedule, homework policy, lectures notes, etc. can be found on the course home page at
http://lfcps.org/course/constlog.html.

2 Course Information

Lectures see course web page

Recitations see course web page

Credit 9 units

Prerequisites 15-150 Functional Programming
For the cross-listed graduate version, 15-657, some experience with functional programming is recommended.

Textbook There is no textbook, but lecture notes will be on the course web page if available

Grading 40% Homework, 15% Midterm I, 15% Midterm II, 30% Final

Grade Cutoffs A: $\geq$90%, B: $\geq$80%; C: $\geq$70%; D: $\geq$60%
Grade ranges may be lowered slightly based on difficulty of homeworks and exams

Homework Weekly, usually Tuesday to Tuesday. 3 late days total.

Midterm I in class, closed book, date on course web page.

Midterm II in class, closed book, date on course web page.

Final TBD, closed book, date on course web page.

Home http://lfcps.org/course/constlog.html

Piazza discussion board linked from course web page

3 Learning Objectives

1. Understand the working principles of logic
2. Understand how the meaning of a proposition comes from its verifications
3. Distinguish propositions from judgments
4. Use proof rules to conduct formal proofs
5. Formalize informal problems into precise logical language
6. Justify how proof rules fit to one another in sound and complete ways
7. Assess the validity of a formal proof
8. Relate constructive logic to computation and constructive proofs to functional programs
9. Understand propositions as types and proofs as programs
10. Relate induction to recursion and use induction to prove properties in and about logical systems
11. Relate deductive proof search to computation in logic programming
12. Understand formulas as programs
13. Understand the principles and applications of logic programming

14. Identify logical core working principles of an algorithm or a data structure
15. Relate logical reasoning to operational reasoning
16. Distinguish classical reasoning from constructive reasoning
17. Ability to conduct proofs of appropriate scope in simple proof assistants

4 Take care of yourself

All of us benefit from support during times of struggle. You are not alone. 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 often 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.

5 Individuals with Disabilities

Carnegie Mellon University makes every effort to provide accessible facilities and programs for individuals with disabilities. If you have a disability and require accommodations, contact the Office of Disability Resources at access@andrew.cmu.edu. Please let the instructors know early in the semester so that your needs may be appropriately met.