

Formal Logic (80-310/80-610)

Fall 2019

Tuesday/Thursday 12:00–1:20, BH A53

<https://canvas.cmu.edu/courses/11760>

Instructor: Adam Bjorndahl

abjorn@cmu.edu

Office hour: Monday 11:00–12:00, BH 155D

Teaching Assistant: Shuyan Wang

shuyanw@andrew.cmu.edu

Office hour: Wednesday 3:00–4:00, DH 4301

Teaching Assistant: Jacob Neumann

jacobneu@andrew.cmu.edu

Office hour: Monday 5:00–6:00, PH A22

Course Description: Among the most significant developments in modern logic is the formal analysis of the notions of provability and logical consequence for the logic of relations and quantification, known as first-order logic. These notions are related by the soundness and completeness theorems: a logical formula is provable if and only if it is true under every interpretation. This course provides a formal specification of the syntax and semantics of first-order logic and then proves the soundness and completeness theorems. Other topics may include: basic model theory, intuitionistic, modal, and higher-order logics.

Recommended Text: *Logic and Structure* by Dirk van Dalen.

Course Objectives: The primary objective of this course is to develop mathematical competence in propositional and first-order logic, along with the ability to apply this competence in useful ways. This means being able to:

- read and comprehend different logical formalisms;
- understand the difference between proofs and models, and the deep connections between them;
- formalize intuitions and analyze real problems using logical tools and methods;
- probe and critically assess the underlying assumptions of standard logics.

Grade Distribution:

Problem sets	60%
Tests	30%
Quizzes	10%

Course Outline: Weekly topics are subject to change; the below should only be considered a rough guideline. The evaluation schedule will not change.

Date	Topic	Evaluation
8/27 8/29	the language of propositional logic · structural induction	— —
9/3 9/5	semantics for propositional logic	quiz 1 PS1 assigned
9/10 9/12	equivalence relations · the algebraic perspective	quiz 2 —
9/17 9/19	<i>Jeremy Avigad's guest lecture</i> <i>no class</i>	PS1 due; test 1 —
9/24 9/26	deduction in propositional logic	— PS2 assigned
10/1 10/3	soundness and completeness of propositional logic	quiz 3 —
10/8 10/10	quantifiers and relations	PS2 due; test 2 PS3 assigned
10/15 10/17	the language of predicate logic	quiz 4 —
10/22 10/24	semantics for predicate logic	PS3 due; test 3 PS4 assigned
10/29 10/31	validity · substitution · identity	quiz 5 —
11/5 11/7	first-order structures	PS4 due; test 4 PS5 assigned
11/12 11/14	deduction in predicate logic	quiz 6 —
11/19 11/21	soundness and completeness of predicate logic	PS5 due; test 5 PS6 assigned
11/26 11/28	model theory <i>no class (Thanksgiving)</i>	quiz 7 —
12/3 12/5	additional topics (e.g., modal logic, intuitionistic logic, etc.)	PS6 due; test 6 —

Evaluation: Most of the evaluation is based on take-home problem sets, which are paired with in-class, 20-minute tests that take place on the day the problem set is due (which is always a Tuesday). Each test covers the same material as the corresponding problem set, but generally consists in shorter/easier problems. On those weeks where no problem set is due, there will be a 10-minute quiz based on the material covered during the previous two weeks. There is no final exam.

Course Policies: Problem sets are due at the beginning of class. Collaboration is both allowed and encouraged; however, each student must write up their solutions independently, and clearly indicate for each question with whom they shared ideas (see <http://www.cmu.edu/policies/student-and-student-life/academic-integrity.html>).

Campus Resources

Academic Development (AD): Academic Development is the place to go for help with your academic work. They offer everything from Academic Counseling in study skills to Peer Tutoring. They also offer Supplemental Instruction and EXCEL Groups for select courses. Their services are designed to help both students who are having academic difficulties and those who just want to improve their performance. For more information, visit <http://www.cmu.edu/acadev>.

Global Communications Center (GCC): The GCC, on the ground floor of Hunt Library, provides one-on-one tutoring in written, oral, and visual communication for any student, at any level, in any discipline, at any stage of the composing process (<http://www.cmu.edu/gcc>).

Intercultural Communications Center (ICC): The Intercultural Communication Center helps nonnative English speakers (both international students and students who attended high school in the U.S.) develop the English language skills and cultural understanding needed to succeed at Carnegie Mellon. The center offers classes and noncredit workshops and seminars (for example, Presentation Basics, Communicating Data Effectively, and Language and Culture for Teaching (for international TAs)). For more information, visit <http://www.cmu.edu/icc>.

Disability Services: The Office of Disability Resources at Carnegie Mellon University has a continued mission to provide physical and programmatic campus access to all events and information within the Carnegie Mellon community. They work to ensure that qualified individuals receive reasonable accommodations as guaranteed by the Americans With Disabilities Act (ADA) and Section 504 of the Rehabilitation Act of 1973. For more information, visit: <http://www.cmu.edu/disability-resources/>.

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.

Take care of yourself. Do your best to maintain a healthy lifestyle this semester by eating well, exercising, getting enough sleep, and taking some time to relax. You can't achieve your goals if you're sick from stress or burnt out.

All of us benefit from support during times of struggle. You are not alone. There are many helpful resources available on campus; an important part of the college experience is learning how to ask for help. Asking for support sooner rather than later is usually better.

If you or anyone you know needs help, consider reaching out to a friend, faculty member, or family member you trust. Counseling and Psychological Services (CaPS) is also here to help: call 412-268-2922 and visit their website at <http://www.cmu.edu/counseling/>.