



FACULTY OF ARTS  
DEPARTMENT OF PHILOSOPHY

**PHIL 579.03 — “Advanced Topics in Logic:  
Applications of Logic in Philosophy”  
(Proof Theory)**

**Winter Term 2014**

**Course Outline**

**Lectures:** M 17:30–20:15, 1253 Social Sciences

**Instructor:** Richard Zach  
**Office:** 1254 Social Sciences  
**Phone:** (403) 220–3170      **Email:** rzach@ucalgary.ca  
**Office Hours:** M 12:30–2:30 (subject to change)  
or by appointment

**Course Description**

Formal proofs in logic and mathematical systems play an important role in several areas of analytic philosophy, including the philosophy of logic and the philosophy of mathematics. The study of formal proofs is the subject of proof theory. It investigates the structure, length, and complexity of formal proofs, operations on formal proofs, relationships between formal proofs in various different proof systems such as sequent calculus and natural deduction, and special forms formal proofs can have. Formal proofs of theorems in mathematical systems have been used to account for the meaning and truth of these theorems. Proof theoretic results such as consistency proofs have been used for philosophical aims such as to account for the security of mathematical knowledge or to argue for or against various positions in the philosophy of mathematics such as instrumentalism or the so-called indispensability arguments.

In this course we will study some of the basic methods and results in proof theory. This will include a study of the sequent calculus and the cut-elimination theorem, of natural deduction systems and normal form theorems, and formalizations of mathematics and consistency proofs. The approach will be in part historical: we will study the pioneering work of Gerhard Gentzen in the 1930s and its context in the development of logic and metamathematics.

Proof theory also has important applications outside of philosophy: in mathematics, computer science, and linguistics. We will touch on some of these applications, depending on

student interest.

### **Prerequisites**

Phil 279 (Logic I) is a prerequisite for this course.

### **Readings**

Readings will be made available electronically on the course's BlackBoard site.

### **Requirements and Evaluation**

*Course Requirements.* Three homework assignments (60%, 20% each) and a final paper (30%) are required to pass the course. There will be no exams. You will give a short presentation on the topic of your final project in the last week of the semester, i.e., on April 14, 2104. This presentation will make up 5% of your grade. The remaining 5% will be based on participation in discussion in-class and on the course website. You will get full marks for participation for 4 substantive posts on the BlackBoard discussion forum.

*Final Project.* The final project will be due on Monday, April 14, 2014, and you should submit an extended abstract (2–3 pages including bibliography) by Monday, March 31. A project will consist in either a worked out presentation of an advanced topic (e.g., a proof of a proof-theoretic result, a survey article on some application of proof theory in mathematics, computer science, or linguistics), or a philosophical paper on a topic related to proof theory. A technical project should run about 7–10 pages; a more philosophical paper 10–15 pages. Technical projects may be completed in groups of up to 3 students.

The evaluation of your final paper will take into account the difficulty of the chosen topic, the amount and quality of research evident in it, and the quality, clarity, and precision of your exposition. Your writing and the grading thereof is a factor in the evaluation of your work for this course.

*Evaluation and Grades.* On each assignment you will receive a letter grade reflecting the level of comprehension of the readings and your ability to assess philosophical arguments shown by the work you submit. There will be no +/– grades, but “slash” grades (e.g., A/B) are possible. The meanings of letter grades are defined in the *Calendar* as follows:

- A** Excellent—superior performance, showing comprehensive understanding of subject matter.
- B** Good—clearly above average performance with knowledge of subject matter generally complete.
- C** Satisfactory—basic understanding of the subject matter.
- D** Minimal pass—marginal performance.
- F** Fail—Unsatisfactory performance.

In computing your final grade, your marks will be converted to grade points and averaged according to the weights given above. The correspondence of letter grades with

grade points is defined in the *Calendar* (A = 4, B = 3, C = 2, D = 1, F = 0). “Slash” grades receive 0.5 below the value of the higher grade (e.g., A/B = 3.5).

The final grade will be the letter grade corresponding to the weighted average of your assignments, paper, presentation, and participation plus a margin of 0.1. For the final grade, +’s and –’s are possible, too; as defined in the *Calendar*, +/- adds/subtracts 0.3 grade points. In other words, a course average of 3.9 or higher receives an A; at least 3.6 and less than 3.9, an A–; at least 3.2 and less than 3.6, a B+; at least 2.9 and less than 3.2, a B; and so on. There is no D– grade; to earn a D you require a course average of at least 0.9. The A+ grade is reserved for “truly outstanding” performance.

### **Assignments and Policies**

*Late work and extensions.* Assignments handed in late will be penalized by the equivalent of one grade point per calendar day, unless you can document a medical or other valid reason for why your assignment is late.

*Collaboration.* Collaboration on exercises is encouraged. However, you must write up your own solutions, and obviously you must not simply copy someone else’s solutions. You are also required to list the names of the students with whom you’ve collaborated on the assignment.

*Plagiarism.* You will find the University policy on plagiarism at the end of this outline. Plagiarism is a very serious academic offense. It is *not limited* to copying papers wholesale from the Internet; close paraphrase of the texts, of the lectures, or of anyone (other than you) without attribution constitutes plagiarism. Your assignments should only contain your own formulations. When in doubt, consult with the instructor. **Plagiarism will result in a failing grade on the assignment or in the course and a report to the Dean’s office.**

*Checking your grades and reappraisals of work.* University policies for reappraisal of term work and final grades apply (see the *Calendar* section “Reappraisal of Grades and Academic Appeals”). In particular, term work will only be reappraised within 15 days of the date you are advised of your marks. Please keep track of your assignments (make sure to pick them up in lecture or in office hours) and your marks (check them on the website) and compare them with the graded work returned to you.

### **Course Website**

A course website on U of C’s BlackBoard server has been set up. You will be automatically registered if you’re registered in the class. To access the BlackBoard site, you can either go directly to [blackboard.ucalgary.ca](http://blackboard.ucalgary.ca) and log in with your UCIT account name and password, or you can access it through the myUofC portal at [my.ucalgary.ca](http://my.ucalgary.ca).

**Tentative Schedule and Due Dates** (topics subject to change)

**Week 1** (Jan 13). Introduction. The Sequent Calculus.

**Week 2** (Jan 20). Cut Elimination

**Week 3** (Jan 27). Consequences of Cut Elimination

**Week 4** (Feb 3). Natural Deduction Systems. Relation to Sequent Calculus

**Week 5** (Feb 10). The Normal Form Theorem

Assignment 1 due February 10

**Week 6** (Feb 24). Intuitionistic Logic

**Week 7** (Mar 3). Formal Systems of Arithmetic

**Week 8** (Mar 10). Ordinal Notation Systems

Assignment 2 due March 10

**Week 9** (Mar 17). Consistency Proofs

**Week 10** (Mar 24). Philosophical Implications of Consistency Proofs

**Week 11** (Mar 31). Proof-theoretic Harmony

Extended abstract of paper due March 31

**Week 12** (Apr 7). Catch-up/Further Topics

Assignment 3 due April 7

**Week 13** (Apr 14). Student presentations.

Final project due April 14

## **Academic Honesty**

Cheating or plagiarism on any assignment or examination is regarded as an extremely serious academic offence, the penalty for which may be an F on the assignment, an F in the course, academic probation, or requirement to withdraw from the University. See the relevant sections on 'Academic Misconduct' in the current University Calendar. Intellectual honesty requires that your work include adequate referencing to sources. Plagiarism occurs when you do not acknowledge or correctly reference your sources. If you have questions about correct referencing, consult your instructor.

## **Academic Accommodation**

It is the student's responsibility to request academic accommodation. If you are a student with a permanent disability or temporary impairment who may require academic accommodation, you must first register with Student Accessibility Services, located in MacEwan Student Centre 452; phone 403-220-8237; email [access@ucalgary.ca](mailto:access@ucalgary.ca). Students who have not registered with Student Accessibility Services are not eligible for formal academic accommodation. You are also required to discuss your needs with your instructor no later than fourteen (14) days after the start of this course. Go to <http://www.ucalgary.ca/access/> for further information.

## **Blackboard Help**

Go to <http://www.ucalgary.ca/computersupport/onlineservices/blackboard> for Student Help and FAQs about Blackboard. Troubleshooting tips and a tutorial are available at <http://elearn.ucalgary.ca/blackboard/students>.

## **Student Advising and Information Resources**

- **General Academic Concerns**—Have a question but not sure where to start? The Faculty of Arts' Program Information Centre (PIC) is your information resource for everything in Arts. Drop in at SS110, call 403-220-3580, or email [artsads@ucalgary.ca](mailto:artsads@ucalgary.ca). You can also visit the Faculty of Arts website at <http://arts.ucalgary.ca/undergraduate> for detailed information on common academic concerns.
- **Program Planning**—For assistance and advice in planning your program through to graduation, contact the Student Success Centre at 403-220-5881 or visit it on the 3rd Floor of the Taylor Family Digital Library.
- **Advice on Philosophy Courses**—You may find answers to your more specific questions about a philosophy degree on the Department of Philosophy's website <http://phil.ucalgary.ca> or contact one of Philosophy's current Undergraduate Advisors (see below).
- **Registration Overload/Prereq Waivers**—If you are seeking to register in a Philosophy course that is full or to get permission to waive the prereqs for a course, email the instructor of the course.

## **Protection of Privacy**

The University of Calgary is under the jurisdiction of the provincial Freedom of Information and Protection of Privacy (FOIP) Act. The Department of Philosophy ensures the student's right to privacy by requiring all graded assignments be returned to the student directly from the instructor.

## **Student Ombudsperson and Students' Union Representatives**

The Student Ombuds Office provides independent, impartial, and confidential support for students who require assistance or advice in addressing issues and concerns related to their academic careers. For more information, see <http://www.ucalgary.ca/provost/students/ombuds>. For the Students' Union Faculty of Arts rep: [arts1@ucalgary.ca](mailto:arts1@ucalgary.ca).

## **Safewalk**

Call 403-220-5333 (24/7/365) for a Safewalk volunteer to accompany you safely to your destination on campus including parking lots, housing, and the LRT station or use a Campus Help Phone.

## **Philosophy Department**

The Department of Philosophy is located on the 12th floor of the Social Sciences Building and on the web at [www.phil.ucalgary.ca](http://www.phil.ucalgary.ca).

Philosophy Undergraduate Program Advisors for Fall 2013:

Chris Framarin [chris.framarin@ucalgary.ca](mailto:chris.framarin@ucalgary.ca)

Reid Buchanan [buchanar@ucalgary.ca](mailto:buchanar@ucalgary.ca)

Mark Migotti (Honours Program Advisor) [migotti@ucalgary.ca](mailto:migotti@ucalgary.ca)

For assistance with registration issues in Philosophy courses, contact Merlette Schnell ([schnell@ucalgary.ca](mailto:schnell@ucalgary.ca))