FACULTY OF ARTS
Department of Philosophy

Phil 379
"Logic II"
Fall Term 2017

Instructor
Dr. Nicole Wyatt
Email nicole.wyatt@ucalgary.ca
Office Social Sciences 1256a
Phone 403-220-3166
Office Hours Wednesdays 10-11:30 am, and by appointment.

Teaching Assistant
Samara Burns
Email seburns@ucalgary.ca
Office Social Sciences 1237
Phone 403-220-6465
Office Hours TBA

PASS Leader: **Dante Bencivenga** drbenciv@ucalgary.ca

Lectures: Tuesday/Thursday 12:30pm-1:45pm in Taylor Institute, Learning Studio D&E

Email is preferred over phone. However please keep the following in mind:

1) Students should ensure that "Philosophy 379" or some other clearly identifying term occurs in the subject line. Otherwise there is a strong possibility that your message will be deleted unread as spam.
2) **If you email to make an appointment please indicate the times when you are available**.
3) Please make sure your first and last names are clearly included in the body of any email message.

Prerequisites and Preparation

Logic I (PHIL 279) or Elementary Formal Logic (PHIL 377) is a prerequisite for this course.

Required Text

The Open Logic Project, ***Sets, Logic, Computation***.

The electronic version will also be provided on the course website (D2L). Printed copies will be available via Amazon.ca.

Peer Assisted Study Sessions

This course is supported by the PASS (Peer Assisted Study Sessions) program. PASS provides students with free, organized study groups facilitated by a student who has been successful in the course before. Attending PASS can help you build your understanding of course content as well as learn valuable study skills which will help you to succeed in the course. You will meet your PASS leader and receive more information in the first weeks of classes.

Course Description

Formal logic has many applications both within philosophy and outside (especially in mathematics, computer science, and linguistics). This second course will introduce you to the concepts, results, and methods of formal logic necessary to understand and appreciate these applications as well as the limitations of formal logic. It will be mathematical in that you will be required to master abstract formal concepts and to prove theorems *about* logic (not just *in* logic the way you did in Phil 279); but it does not presuppose any (advanced) knowledge of mathematics.

We will begin by studying some basic formal concepts: sets, relations, and functions. The latter will allow us to study the sizes of infinite sets. In particular, we will prove Cantor's celebrated results that there are different levels of infinity. We will assume (almost) no back- ground. Here, we will first apply proof methods from elementary logic to a new, abstract domain, and become familiar with a central proof method of metalogic: induction.

In the second part of the course, we will begin to investigate first-order logic more closely. We will see how the formulas of first-order logic are precisely defined, what structures for first-order languages are and how truth in structures and entailment is related. We will discuss how properties of structures can be expressed, and how theories are related to their models.

We will study how first-order logic can formalize facts and reasoning about some domains of interest to philosophers, computer scientists, and logicians. We will introduce a proof system for first-order logic, Gentzen's natural deduction. We will then turn to the metatheory of first-order logic, where we will concentrate on a few central results: the soundness and completeness theorems, which relate the proof theory and semantics of first-order logic, and the compactness theorem and Löwenheim-Skolem theorems, which concern the existence and size of first-order structures.

In the third part of the course, we will attempt to make precise the idea of a computable function. To this end, we will discuss a particular "model of computation": Turing machines. We will show that there are problems which are *undecidable* in the sense that there is no Turing machine which, in a finite amount of time, provides a definite yes-or-no answer. The first example of an undecidable problem is the *halting problem*, i.e., the problem of deciding, given the description of a Turing machine, whether it halts on a given input. We will also show that the *decision problem*—i.e., the problem of deciding, given a sentence of first-order logic, whether it is valid—is undecidable.

If there is time, we will cover some advanced topics at the end of the semester, such as second-order logic or solvable cases of the decision problem.

Some of the material we will be covering is discussed in your 279/377 text—if you used *The Logic Book*, review chapters 8 and 11; in Chellas' *Elementary Formal Logic*, review chapters 7 and 9 and the appendices; in *Language, Proof and Logic*, review chapters 15, 16, 18.1–18.3; in *Formal Logic: Its Scope and Limits*, sections 2.7–2.10, 3.13–3.15, 4.13–4.15; in *forall x (Calgary Remix)* chapters V and VI.

Course Outcomes

By the end of the course, you should be able to…

- Understand, construct, and formulate simple mathematical proofs in which you apply definitions, identify hypotheses, and correctly and appropriately use informal patterns of mathematical reasoning.
- Understand and apply the methods of definition by induction and proof by induction, both for the natural numbers and for inductively defined sets such as the set of formulas of first-order logic.
- Understand and use the vernacular of set theory (sets, relations, functions) to describe and explain the metalogical properties of the model and proof theory of first-order logic as well as of Turing machines and computable functions, and to prove intermediate facts about infinite sets and their sizes using, e.g., the diagonal method of Cantor's theorem
- Understand the formal syntax, model theory, and proof theory of first-order logic, to explain the definitions, the properties, and the relationships between logical notions (free and bound

variables, sentences, satisfaction, consequence and satisfiability, inference rule, derivation, provability and consistency), and to prove intermediate facts about them (such as the soundness of the proof system)
- Understand the completeness theorem of first-order logic, to explain the overall structure as well as the individual steps of the proof, to explain and prove from it corollaries such as the compactness and Löwenheim-Skolem theorems, and to apply these to properties of theories and the size of models thereof.
- Understand the concept of Turing machines, how they can be used to define computable functions, to construct simple Turing machines, to formulate and prove the undecidability of the halting problem, and to formulate and explain the decision problem.

Grading

Assignments

On D2L you will find a table showing all assignments and due dates for the class.

Pre-class quizzes

Open book pre-class quizzes covering the background readings and screencasts (where applicable) for each week to be taken on D2L. There will be 10 quizzes in total. Quizzes will be available on D2L for seven days. There will be no quizzes due in the weeks of September 11th, November 13th, or December 4th. Pre-class quizzes are graded either complete or not-complete.

Weekly tests

Open book tests covering the basic concepts introduced each week, to be taken on D2L. There will be 10 tests in total. Weekly tests will be available on D2L for seven days. There will be no tests due in the weeks of September 11th, September 18th, or November 13th. Weekly tests are graded pass/no pass.

Basic problems

Starting in the week of September 25th one short answer problem a week will be due on Fridays, to be submitted to the drop-box on the 12th floor of the Social Sciences building by 4pm. There will be no basic problem due on November 10th. Basic problems are graded according to the EMRN rubric on the next page of the syllabus.

Challenge problems

Additional short answer challenge problems will be due on Friday October 6th, Friday October 20th, Friday November 3rd, Friday November 24th, and Friday December 8th. Challenge problems are graded according to the EMRN rubric on the next page of the syllabus.

In-class group work

Much of the class time will be devoted to working on sample problems rather than passively listening to lectures. Students are expected to do the readings and watch screencasts before coming to class. At least once each week students will be asked to submit written answers to problems they have worked on as a group. Each member of the group will receive a complete for each set of problems their name appears on.

How your work is evaluated

The document *Specifications for Student Work* (found on D2L) contains all the details for how your work on the above items will be graded and the expectations for each of them. Your work is evaluated on one of three scales, depending on what it is:

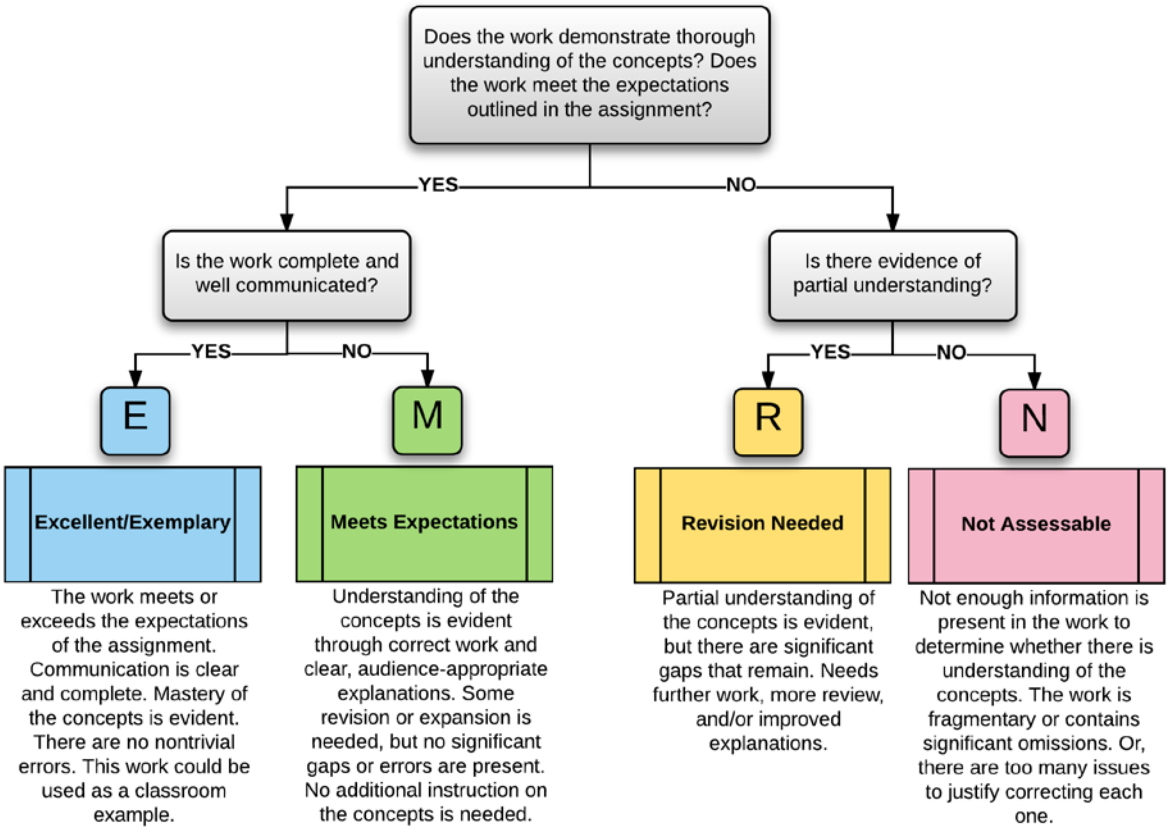
- Pre-class quizzes and in-class group work is graded either **complete** or **incomplete**.
- Weekly tests are graded either **Pass** or **No Pass**.

- Basic and Challenge Problems are graded using a four-level rubric called the **EMRN** rubric, illustrated below. An enlarged version of the rubric is available on the Blackboard site in the *Syllabus and Specifications area*. The grades E, M, R, and N are explained on the rubric below. Marks of **E** (exemplary) and **M** (meets expectations) are "passing". Marks of **R** (needs revision) and **N** (not assessable) are not passing. The exact criteria for what constitutes passing work on each kind of assignment are spelled out in detail in the *Specifications for Student Wor*k document.

Please note that with the exception of the weekly tests, none of the work in the class is assessed using points. **Your progress toward a grade in the course is determined simply by the quantity of passing marks you earn on various assignments and how many E marks you receive on basic and challenge problems**. This is a "competency based" approach to grading that gives you full control over how you earn your grade and provides transparency as to what you have mastered and what you still need to work on.

EMRN Rubric

Courtesy Robert Talbert.



EMRN rubric based on the EMRF rubric, due to Rodney Stutzman and Kimberly Race: http://eric.ed.gov/?id=EJ717675

The table below shows what you have to complete in order to earn a particular letter grade in the course:

	D	C	B	A
Pre-class quizzes	**5/10 complete**	**7/10 complete**	**8/10 complete**	**8/10 complete**
Weekly tests	**Pass 5/10**	**Pass 7/10**	**Pass 8/10**	**Pass 8/10**
Basic problems	**None**	**Passing marks (E or M) on at least 5.**	**Passing marks (E or M) on at least 7, with at least one E grade.**	**Passing marks (E or M) on at least 8, with at least three E grades.**
Challenge problems	**None**	**None**	**Passing marks (E or M) on at least 2.**	**Passing marks (E or M) on at least 4.**
In-class group work	**None**	**Submit at least 5**	**Submit at least 7**	**Submit at least 9**

Minus grades will be awarded to students who meet all the requirements for the letter grade *except* the in-class group work component. There is no D-.
Grades of D+, C+, and B+ will be awarded to students who fulfil all the requirements for the base grade and in addition complete *either* the basic problem requirement *or* the challenge problem requirement for the next grade up. ***The A+ grade*** will be awarded to students who complete all the requirements for the base grade and in addition *either* (a) receive an E grade on at least 7 weekly problems; *or* (b) receive an E grade on at least 2 challenge problems.

Revision
You have the opportunity to revise almost any item of work in the class if you want to raise your grade on it. Specifically:

- You can retry weekly tests up to 5 times, until the deadline.
- You can resubmit any basic or challenge problem on which you received a grade of at least R up to seven days after the graded problem was returned.
- You can use a token (see below) to revise any basic or challenge problem on which you received a grade of N.

Tokens
Tokens are a kind of currency for this class. Each student has three (3) tokens to spend to bend the rules of the class in various ways. In addition to revising problems on which you received an N grade, you can use a token to do the following.

- Purchase a no-questions-asked extension of 24 hours on any basic or challenge problem.
- Purchase a single attempt on a weekly test after the deadline has passed.

Late policy
Assignments will not normally be accepted after the deadlines unless special permission has been given by the instructor. Failure to submit an assignment or test on time will normally result in a mark of zero. Students who cannot submit an assignment or a test due to medical reasons or other reasonable grounds should contact the instructor as soon as possible.

Plagiarism
You might think that it's only plagiarism if you copy a term paper off the Internet. However, you can also plagiarize in a logic course, e.g., by copying a proof verbatim from the textbook (and only making the necessary changes to apply it to the assigned problem.) The point of logic problems which are similar to those in the text is to make you work through those proofs, understand them, and then prove a similar result on your own. Hence, all basic and challenge problem submissions must be in your own words; copying or paraphrasing closely from the text or from other students will be treated as plagiarism.

IMPORTANT DEPARTMENTAL, FACULTY AND UNIVERSITY INFORMATION

Academic Honesty
Cheating or plagiarism on any assignment or examination is regarded as an extremely serious academic offense, 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
The student accommodation policy can be found at: ucalgary.ca/access/accommodations/policy.

Students needing an Accommodation because of a disability or medical condition should communicate this need to Student Accessibility Services in accordance with the Procedure for Accommodations for Students with Disabilities ucalgary.ca/policies/files/policies/student-accommodation-policy.

Students needing an Accommodation based on a Protected Ground other than Disability, should communicate this need, preferably in writing, to their instructor.

D2L Help
Desire2Learn is UCalgary's online learning management system. Important information and communications about this course may be posted on D2L. Go to https://ucalgary.service-now.com/it for help.

General Academic Concerns and Program Planning
Have a question but not sure where to start? The Arts Students Centre is your information resource for everything in the Faculty of Arts. Drop in at SS102, call 403-220-3580, or email ascarts@ucalgary.ca . Advisors in the ASC can also provide assistance and advice in planning your program through to graduation. Visit the Faculty of Arts website at https://arts.ucalgary.ca/undergraduate for detailed information on common academic concerns

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 Undergraduate Advisors. Jeremy Fantl (jfantl@ucalgary.ca), Allen Habib (anhabib@ucalgary.ca), Megan Delehanty (mdelehan@ucalgary.ca).

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 Department Manager, Tram Nguyen (tram.nguyen1@ucalgary.ca). Include the specific course information and your UCID number in your request.

Writing
This course will include written assignments. Faculty policy directs that all written assignments (including, although to a lesser extent, written exam responses) will be assessed at least partly on writing skills. Writing skills include not only surface correctness (grammar, punctuation, sentence structure, etc.) but also general clarity and organization. Research papers must be properly documented. Students are also encouraged to use Writing Support Services and other Student Success Centre Services, located on the 3rd floor of the Taylor Family Digital Library. Writing Support Services assist with a variety of assignments, from essays to lab reports. Students can book 30-minute one-on-one appointments online, sign up for 15- minute drop-in appointments, and register for a variety of

writing workshops. For more information on this and other Student Success Centre services, please visit www.ucalgary.ca/ssc .

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 or teaching assistant.

Internet and Electronic Communication Devices
The instructor reserves the right to establish course policies regarding the use of devices such as laptops, tablets, and smartbooks. If allowed, these devices must be used exclusively for instructional purposes and must not cause disruption to the instructor or to fellow students. Cell phones and paging devices should be set to silent mode during lectures. Audio or video recording of lectures is not permitted without the written permission of the instructor. Students violating this policy are subject to discipline under the University of Calgary's Non-Academic Misconduct policy

Emergency Evacuation:
In case of an emergency evacuation during class, students must gather at the designated assembly point nearest to the classroom. The list of assembly points is found at http://www.ucalgary.ca/emergencyplan/assemblypoints . Please check this website and note the nearest assembly point for this course.

Other Helpful Contacts
- Safewalk and Campus Security: 403-220-5333.
- Faculty of Arts Student Representatives: 403-220-6552, arts1@su.ucalgary.ca , arts2@su.ucalgary.ca, arts3@su.ucalgary.ca, arts4@su.ucalgary.ca .
- Student Ombudsman: http://www.ucalgary.ca/provost/students/ombuds