University of Calgary
Department of Philosophy

Philosophy 379.01   Logic II

Instructor   **Nicole Wyatt**
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Office Hours: Tuesdays 1-3pm, and by appointment

Text   Boolos, G.S., J.P. Burgess, and R.C. Jeffery. *Computability and Logic*. 5th edition. Cambridge
University Press. (BBJ)

Description

A formal logic consists of a symbolic language together with a semantics, which captures the possible
meanings or truth-conditions of the sentences of the language, and a deductive system, which aims to
capture which inferences are correct. In this course we study the scope and limits of formal logic by
examining the relationship between these three parts of a logic. The major results to be presented
include soundness ("the deductive system captures only truths") completeness ("the deductive system
captures all the truths") undecidability ("there is no mechanical procedure for establishing whether or
not an argument is valid"), and the Löwenheim-Skolem theorems (which concern some of the limits on
the expressive power of first-order logic). Along the way we will study some set theory, recursive
functions, Turing-machines, and the limits of computation. The course is fast paced and students are
expected to supplement lectures with significant independent study.

This is a course in metalogic. It builds upon the material in Logic I (Phil 279), but is very different in
character. In Logic II, we prove theorems about logical systems (and not in logical systems, i.e., there will
be almost no formal proofs). Doing well in 279 is no guarantee that this will come easy to you. 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, 313-3.15, 4.13-4.15.

Provisional schedule of topics and readings

Computability
Week 1-2   Introduction: History, Basic set theory; Enumerability and diagonalization. BBJ 1,2
Week 2-3   Turing machines: Turing-computable functions and non-Turing-computable functions, the
Church-Turing thesis, Unsolvability of the halting problem. BBJ 3, 4

Logic
Week 3-4   Review of first order logic: Formal semantics. Soundness, Completeness, Decidability,
Compactness, Löwenheim-Skolem theorems. BBJ 9, 10, 12
Week 4-8   Proof of Compactness for first order logic with and without identity and terms:
Satisfaction and closure properties, canonical models. BBJ 13

Week 9-10   Proof of Soundness and Completeness for first-order logic with and without identity and terms: The sequent calculus, soundness of the sequent calculus, completeness of the sequent calculus, soundness and completeness for alternate deductive systems. BBJ 14

Computability and Logic
Week 11-13   Undecidability: The halting problem and the undecidability of first order logic. BBJ 11.1

Evaluation

Grades in this class will be based on homework, four assignments, an in class test, and a registrar scheduled final examination.

Due Dates
Homework questions will be announced on Wednesdays in class and on Blackboard and will be due on the following Monday, with the first due Jan 19. Note: due to reading week the homework announced Wed Feb 11 will be due Mon Feb 23.

Assignment 1	Wednesday February 4th
Assignment 2	Wednesday February 25th
In Class Test	Wednesday March 11th
Assignment 3	Wednesday March 25th
Assignment 4	Wednesday April 8th
Final Exam	Scheduled by Registrar.

Grading
1. *Ceteris paribus*, the homework will collectively be worth 10%, the assignments will be collectively worth 40%, the in class test will be worth 25%, and the final exam will be worth 25%.
2. Students must receive a passing grade (D or better) on the final exam in order to pass the course.
3. Each homework submission will be graded on a credit/no-credit basis. Homework will be given credit just in case it constitutes a genuine attempt to answer the question. There will be 12 assigned weeks of homework. Grades for the homework as a whole will be assigned as follows: 12 weeks credit=A, 11=A-, 10=B+, 9=B, 8=B-, 7=C+, 6=C, 5=C-, 4=D+, 3=D, 2 or less = F.
4. Later virtue will be allowed to redeem earlier sin.
5. Tests and assignments will be graded on both accuracy and quality of presentation. As noted below in the grading rubric, an A answer must be correct but also reasonably direct and elegant.

Grading rubric
On each assignment and test question you will receive a letter grade reflecting the level of mastery of the material shown by the work you submit. According to the *Calendar* letter grades are defined as follows:
A   Excellent—superior performance, showing comprehensive understanding of subject matter. (A solution to an assigned problem shows that you understand the problem, is complete and rigorously correct, and is reasonably direct and elegant.)
B   Good—clearly above average performance with knowledge of subject matter generally complete. (You understand the problem and give a complete solution, although there may be minor gaps in the proof, or the solution is correct but circuitous.)
C   Satisfactory—basic understanding of the subject matter. (You understand what the question is asking but your solution contains significant errors or gaps.)

D	Minimal pass—marginal performance. (It is not clear that you understand what the question is asking, or your proposed solution goes completely in the wrong direction.)
F	Fail—Unsatisfactory performance.

In computing your assignment or exam grade, your marks on individual questions will be converted to grade points as defined in the calendar (A = 4, B = 3, C = 2, D = 1, F = 0). "Slash" grades are possible and have grade point values 0.5 below the higher grade (e.g. A/B = 3.5). Each assignment or exam grade will be equal to the average of the grade point value of the questions (e.g. a 3 question assignment with grades A B B would receive a grade point score of 3.33). Your final grade point score will be calculated according to the weights given above. *Ceteris paribus,* the final mark is the letter grade corresponding to this average plus a margin of 0.2. 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 3.8 or higher receives an A, at least 3.5 and less than 3.8 an A–, and so on. There is no D– grade. A+ is reserved for truly exceptional performance.

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 on time will normally result in a mark of zero. Students who cannot submit an assignment or who must miss a test due to medical reasons or other reasonable grounds should contact the instructor as soon as possible.

Collaboration
Collaboration on homework and assignments 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 homework or assignment. ***If you collaborate without following these instructions, it constitutes cheating.***

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 or lecture notes (and only making the necessary changes to apply it to the assigned problem.) The point of logic problems which are similar to the proofs in the text or notes is to make you work through those proofs, understand them, and then prove a similar result on the homework or an assignment. Hence, all homework and assignment solutions must be in your own words; copying or paraphrasing closely from the text will be treated as plagiarism.

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 and log in with your UCIT account name and password, or you can access it through the myUofC portal (my.ucalgary.ca; log in with your eID). If you don't have an eID or UCIT account, see elearn.ucalgary.ca/help.html.

The website will house lecture notes (no warranties express or implied, these are genuinely my lecture notes and are not a replacement for attending lectures or the textbook), links to supplemental reading materials, and model answers for homework and assignment questions. You may submit homework and assignments online using the Assignment link on the left hand menu.

INTELLECTUAL HONESTY

Intellectual honesty is the cornerstone of the development and acquisition of knowledge and requires that the contribution of others be acknowledged. As a result, 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 and possibly also an F in the course, academic probation, or requirement to withdraw. The University Calendar states that plagiarism exists when:

- *the work submitted or presented was done, in whole or in part, by an individual other than the one submitting or presenting the work (this includes having another impersonate the student or otherwise substituting the work of another for one's own in an examination or test;*
- *parts of the work are taken from another source without reference to the original author;*
- *the whole work (e.g., an essay) is copied from another source; and/or*
- *a student submits or presents work in one course which has also been submitted in another course (although it may be completely original with that student) without the knowledge of or prior agreement of the instructor involved.*

While it is recognized that scholarly work often involves reference to the ideas, data and conclusions of other scholars, intellectual honesty requires that such references be explicitly and clearly noted. Plagiarism is an extremely serious offence. Plagiarism occurs not only when direct quotations are taken from a source without specific acknowledgement, but also when original ideas or data from the source are not acknowledged. A bibliography is insufficient to establish which portions of the student's work are taken from external sources; footnotes or other recognized forms of citation must be used for this purpose.

ACADEMIC ACCOMMODATION

It is the student's responsibility to request academic accommodation. If you are a student with a documented disability who may require academic accommodation and have not registered with the Disability Resource Centre, please contact their office at 220-8237. Students who have not registered with the Disability Resource Centre 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.

STUDENTS' UNION REPRESENTATIVE

The Humanities Representative is Daniel Pagan, MSC 251, humanitiesrep@su.ucalgary.ca or 220-3913.