

PHIL 240H (201): Introduction to Logic (Honors)
Fall 2023

Instructor: Byron Simmons
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Class: MWF 9:00 – 10:00 AM in YMCA 115
Office Hours: MW 10:15 – 11:15 AM in YMCA 301J and by appointment

COURSE DESCRIPTION: Logic is the philosophical study of correct reasoning. It aims to give a precise account of the relation of logical consequence or entailment, which distinguishes valid arguments from invalid arguments. An *argument* is a collection of one or more statements, one of which is the *conclusion*, and the rest of which are the *premises*. An argument is *valid* when its conclusion is a logical consequence of its premises (or, to put it roughly, when it is impossible for the argument's conclusion to be true and its premises false).

We will begin by studying the fairly simple system of Sentential Logic (which will focus on various truth-functional connectives such as 'not', 'and', 'or', 'if...then'), and then move on to more complex systems of Predicate Logic (which will introduce various forms of predication and quantification). We will learn how to represent the logical structure of English language arguments in each formal system, and then develop a system of natural deduction to determine whether these formally represented arguments are valid.

Along the way, we will discuss the concepts of probability and inductive logic, which aim to tell us when some premises give us good reason to believe a conclusion, even if they don't entail or guarantee it.

In this **honors version** of the course, we will also discuss truth trees, equivalence rules, restricted quantification, identity, definite descriptions, function symbols, and (time permitting) quantifier semantics. We will focus not just on *how* to derive conclusions in various logical systems, but on *why* those systems are designed as they are. This additional coverage will provide you with deeper insight into the philosophy of logic.

COURSE PREREQUISITES: None.

SPECIAL COURSE DESIGNATION: This course has been given the following special course designation: core curriculum (CORE). It falls in the category of Mathematics and focuses on developing quantitative literacy in logic, patterns, and relationships. It should help to sharpen your critical thinking, communication, and empirical and quantitative skills.

Note that in order to satisfy the communication requirement one or more of the homework assignments will, for example, require you to provide **visual representations** (or models) which are intended to show that certain arguments are invalid as well as **oral explanations** as to how and why these models demonstrate the invalidity of these arguments. You will need, to this end, to upload an audio recording (in .mp3 format) of your oral explanation and a picture (in, for example, .jpeg format) of your model to [Canvas](#).

COURSE LEARNING OUTCOMES: The primary goal of this course is to familiarize you with the basic methods of formal logic. By the end of this course, you will have developed and refined the ability to:

- Identify the logical structure of English arguments by identifying their premises and conclusions,
- Grasp the basic concepts of logic such as validity, soundness, truth-functionality, tautology, contradiction, contingency, logical equivalence, contradictoriness, and logical consistency,
- Employ both truth-table and truth-tree (or tableaux) methods to establish validity (**Honors exclusive**),
- Translate English sentences into the formal languages of Sentential and Predicate Logic,
- Differentiate inference rules from equivalence rules (**Honors exclusive**),
- Derive conclusions from premises in the formal systems of Sentential and Predicate Logic (with both Restricted and Unrestricted Quantification, **Honors exclusive**), and
- Employ the basic tools of Identity, Description, and Functional Logic (**Honors exclusive**).

TEXTBOOK AND COURSE RESOURCE MATERIALS: We will use the following textbook for this course:

Gary Hardegree, *Symbolic Logic: A First Course*

which is available online at: <https://courses.umass.edu/phil110-gmh/MAIN/IHome-5.htm>. I will make selections from Thomas J. McKay, *Modern Formal Logic*, 2nd ed. (Thomson, 2007) and F.M. Dekking, C. Kraaikamp, H.P. Lopuhaä, L.E. Meester, *A Modern Introduction to Probability and Statistics: Understanding Why and How* (Springer, 2005) available electronically, but I will rework this material in my lecture notes so that it conforms to Hardegree's system (which is a modified version of a system due to Kalish and Montague).

GRADING POLICY: There will be **four in-class exams** (on September 15th, October 4th, November 6th, and November 20th), and **two additional exams** (both held during the final exam period on December 8th) each worth 100 points. (There are six exams in total, but your two lowest exam grades will be dropped. So if you are happy with your grades on the four in-class exams, there is no need to take the two additional exams held during the finals period.) There will also be **several homework assignments** worth 100 points total. There are thus a total of 500 points available in this course (400 points from your best four exams and 100 points from your homework). Your grade will be determined on the basis of this numerical grade and will break down as follows:

- A: 500 – 450 points (100% - 90%)
- B: 449 – 400 points (89% - 80%)
- C: 399 – 350 points (79% - 70%)
- D: 349 – 300 points (69% - 60%)
- F: below 300 points (below 60%)

LATE WORK POLICY: Each homework assignment is due at the start of class on the day that it is due. I will accept late work with no penalty, provided that you turn it in at the start of the next class period.

Work submitted by a student as makeup work for an excused absence is not considered late work and is exempted from the late work policy ([Student Rule 7](#)).

PARTICIPATION AND ATTENTANCE POLICY: It is very important for you to attend class regularly and to actively participate in the class discussion. We will often work as a class through particular problems on the board and I strongly encourage you to work through the solutions and to ask questions whenever you are puzzled or confused.

The university views class attendance and participation as an individual student responsibility. Students are expected to attend class and to complete all assignments.

Please refer to [Student Rule 7](#) in its entirety for information about excused absences, including definitions, and related documentation and timelines.

MAKEUP WORK POLICY: Students will be excused from attending class on the day of a graded activity or when attendance contributes to a student's grade, for the reasons stated in [Student Rule 7](#), or other reason deemed appropriate by the instructor.

Please refer to [Student Rule 7](#) in its entirety for information about makeup work, including definitions, and related documentation and timelines.

Absences related to Title IX of the Education Amendments of 1972 may necessitate a period of more than 30 days for make-up work, and the timeframe for make-up work should be agreed upon by the student and instructor" ([Student Rule 7, Section 7.4.1](#)).

"The instructor is under no obligation to provide an opportunity for the student to make up work missed because of an unexcused absence" ([Student Rule 7, Section 7.4.2](#)).

Students who request an excused absence are expected to uphold the Aggie Honor Code and Student Conduct Code. (See [Student Rule 24](#)).

ACADEMIC INTEGRITY STATEMENT AND POLICY: "An Aggie does not lie, cheat or steal, or tolerate those who do."

"Texas A&M University students are responsible for authenticating all work submitted to an instructor. If asked, students must be able to produce proof that the item submitted is indeed the work of that student. Students must keep appropriate records at all times. The inability to authenticate one's work, should the instructor request it, may be sufficient grounds to initiate an academic misconduct case" ([Section 20.1.2.3, Student Rule 20](#)).

You can learn more about the Aggie Honor System Office Rules and Procedures, academic integrity, and your rights and responsibilities at aggiehonor.tamu.edu.

AMERICANS WITH DISABILITIES ACT (ADA) POLICY: Texas A&M University is committed to providing equitable access to learning opportunities for all students. If you experience barriers to your education due to a disability or think you may have a disability, please contact Disability Resources office on your campus (resources listed below). Disabilities may include, but are not limited to attentional, learning, mental health, sensory, physical, or chronic health conditions. All students are encouraged to discuss their disability related needs with Disability Resources and their instructors as soon as possible.

Disability Resources is located in the Student Services Building or at (979) 845-1637 or visit disability.tamu.edu.

TITLE IX AND STATEMENT ON LIMITS TO CONFIDENTIALITY: Texas A&M University is committed to fostering a learning environment that is safe and productive for all. University policies and federal and state laws prohibit gender-based discrimination and sexual harassment, including sexual assault, sexual exploitation, domestic violence, dating violence, and stalking.

With the exception of some medical and mental health providers, all university employees (including full and part-time faculty, staff, paid graduate assistants, student workers, etc.) are Mandatory Reporters and must report to the Title IX Office if the employee experiences, observes, or becomes aware of an incident that meets the following conditions (see [University Rule 08.01.01.M1](#)):

- The incident is reasonably believed to be discrimination or harassment.
- The incident is alleged to have been committed by or against a person who, at the time of the incident, was (1) a student enrolled at the University or (2) an employee of the University.

Mandatory Reporters must file a report regardless of how the information comes to their attention – including but not limited to face-to-face conversations, a written class assignment or paper, class discussion, email, text, or social media post. Although Mandatory Reporters must file a report, in most instances, a person who is subjected to the alleged conduct will be able to control how the report is handled, including whether or not to pursue a formal investigation.

The University's goal is to make sure you are aware of the range of options available to you and to ensure access to the resources you need.

Students wishing to discuss concerns in a confidential setting are encouraged to make an appointment with [Counseling and Psychological Services](#) (CAPS).

Students can learn more about filing a report, accessing supportive resources, and navigating the Title IX investigation and resolution process on the University's [Title IX webpage](#).

STATEMENT ON MENTAL HEALTH AND WELLNESS: Texas A&M University recognizes that mental health and wellness are critical factors that influence a student's academic success and overall wellbeing.

Students are encouraged to engage in healthy self-care by utilizing available resources and services on your campus.

Students who need someone to talk to can contact Counseling & Psychological Services (CAPS) or call the TAMU Helpline (979-845-2700) from 4:00 p.m. to 8:00 a.m. weekdays and 24 hours on weekends. 24-hour emergency help is also available through the 988 Suicide & Crisis Lifeline (988) or at 988lifeline.org.

IMPORTANT NOTE: Some students find the first part of the course very easy and are misled into thinking that the rest of the course will also be easy. This mistake always has serious negative consequences when it leads to neglect of homework or uneven attendance in class.

Some of you may be somewhat familiar with the material in the first part of the course (and it can be pretty easy for some students who are learning it for the first time). But no one will have much prior knowledge of what is going on in the second half of the course, and mastery of this material will require considerable attention from everyone.

(TENTATIVE) COURSE SCHEDULE: You should try to do the readings and work through the exercises from the textbook before we discuss them in class on the indicated dates.

Please note the distinction between **practice exercises** (which are worked out in the textbook) and **homework assignments** (which you are required to submit at the start of class on the indicated dates). The practice exercises are optional, the homework assignments are not.

I cannot, however, overestimate the importance of working through the practice exercises (and then comparing your answers to the ones provided in the textbook). As with most mathematics classes, you will learn far more by working through the exercises than by reading the explanations in the textbook over and over again. You should thus strive to learn by doing, not by observing.

I would thus highly recommend that you work through the practice exercises *before* you attempt the homework.

Unit I: Basic Concepts & Translations in Sentential Logic

Mon, 8/21	Course Introduction
Wed, 8/23	Basic Concepts of Logic Hardegree, <i>Symbolic Logic</i> , 1.1-1.9 (i.e., chapter 1 section 1 through section 9) Exercises: 1A-1C (chapter 1 exercise set A through exercise set C)
Fri, 8/25	Truth-Functional Connectives (\sim , $\&$, and \vee) Hardegree, <i>Symbolic Logic</i> , 2.1-2.7, 2.12-2.13 Exercises: 2C, 1-9
Mon, 8/28	More Truth-Functional Connectives (\rightarrow and \leftrightarrow) Hardegree, <i>Symbolic Logic</i> , 2.8-2.11 Exercises: 2C, 10-25 Homework 1 due (10 points)
Wed, 8/30	Implication and Equivalence Hardegree, <i>Symbolic Logic</i> , 3.1-3.2 Exercises: 3A
Fri, 9/1	Validity and Invalidity & Consistency and Inconsistency Hardegree, <i>Symbolic Logic</i> , 3.3-3.5 Exercises: 3B-3D
Mon, 9/4	[No Class – Labor Day]
Wed, 9/6	Truth Trees McKay, <i>Modern Formal Logic</i> , ch. 4, pp. 67-79, and ch. 5, pp. 101-110

Exercises: 4a-4b, 5d-e
Homework 2 due (10 points)

Fri, 9/8 Truth Trees (continued)
McKay, *Modern Formal Logic*, ch. 4, pp. 79-85, and ch. 5, pp. 110-111
Exercises: 4c-4d, 5f-5g

Mon, 9/11 Translations in Sentential Logic
Hardegree, *Symbolic Logic*, 4.1-4.11
Exercises: 4A

Wed, 9/13 Translations in Sentential Logic (continued)/Review for Exam 1
Hardegree, *Symbolic Logic*, 4.12-4.23
Exercises: 4B
Homework 3 due (10 points)

Fri, 9/15 **Exam 1 (100 points)**

Unit II: Derivations in Sentential Logic

Mon, 9/18 Simple Derivations & Inference Rules
Hardegree, *Symbolic Logic*, 5.1-5.5
Exercises: 5A

Wed, 9/20 Direct Derivations (DD)
Hardegree, *Symbolic Logic*, 5.6-5.10
Exercises: 5B & 5C

Fri, 9/22 Equivalence Rules
McKay, *Modern Formal Logic*, ch. 7, "Equivalence Rules"
Exercises: 7b (1-8, 10-15), 7c (1-2, 5-11, 15)

Mon, 9/25 Conditional Derivations (CD)
Hardegree, *Symbolic Logic*, 5.11
Exercises: 5D
Homework 4 due (10 points)

Wed, 9/27 Indirect Derivations (ID)
Hardegree, *Symbolic Logic*, 5.12
Exercises: 5E

Fri, 9/29 Indirect Derivations (ID) & Derived Inference Rules
Hardegree, *Symbolic Logic*, 5.13-5.14
Exercises: 5F

Mon, 10/2 Advanced Derivation Strategies/Review for Exam 2
Hardegree, *Symbolic Logic*, 5.15-5.21
Exercises: 5G-5H
Homework 5 due (10 points)

Wed, 10/4 **Exam 2 (100 points)**

Interlude: Probability Theory

- Fri, 10/6 Introduction to Probability Theory
Dekking, *et. al.*, *A Modern Introduction to Probability and Statistics*, 2.1-2.3
- Mon, 10/9 [No Class – Fall Break]
- Wed, 10/11 Conditional Probability
Dekking, *et. al.*, *A Modern Introduction to Probability and Statistics*, 3.1-3.2, 3.4
- Fri, 10/13 Bayes' Theorem
Dekking, *et. al.*, *A Modern Introduction to Probability and Statistics*, 3.3
- Mon, 10/16 Bayes' Theorem (continued)

Unit III: Predicate Logic (with Restricted Quantification)

- Wed, 10/18 Predicates, Relations, and Singular Terms
McKay, *Modern Formal Logic*, ch. 10, "The Language", pp. 219-226
Exercises: 10a-10b
Homework 6 due (10 points)
- Fri, 10/20 Restricted Quantifiers
McKay, *Modern Formal Logic*, ch. 10, "The Language", pp. 226-238
Exercises: 10c-10g
- Mon, 10/23 Universal-Out ($\forall O$) and Existential-In ($\exists I$)
McKay, *Modern Formal Logic*, ch. 11, "Derivations", pp. 249-265
Exercises: 11b
- Wed, 10/25 Universal-Out ($\forall O$) and Existential-In ($\exists I$) (continued)
Homework 7 due (10 points)
- Fri, 10/27 Universal Derivation (UD)
McKay, *Modern Formal Logic*, ch. 11, "Derivations", pp. 265-270
Exercises: 11c
- Mon, 10/30 Existential Out ($\exists O$)
McKay, *Modern Formal Logic*, ch. 11, "Derivations", pp. 270-281
Exercises: 11d
- Wed, 11/1 Negation Quantifier Elimination ($\sim\forall O$ and $\sim\exists O$)
McKay, *Modern Formal Logic*, ch. 11, "Derivations", pp. 282-287
Exercises: 11e
- Fri, 11/3 Predicate Logic Truth-Trees/Review for Exam 3
McKay, *Modern Formal Logic*, ch. 12, "Predicate Logic Truth-Trees and Models", pp. 300-322
Exercises: 12a-12e
Homework 8 due (10 points)
- Mon, 11/6 **Exam 3 (100 points)**

Unit IV: Predicate Logic (with Unrestricted Quantification)

- Wed, 11/8 Unrestricted Quantification
McKay, *Modern Formal Logic*, ch. 13, "Unrestricted Quantification", pp. 323-337
Hardegree, *Symbolic Logic*, 6.1-6.10, 7.1-7.4
Exercises: 6A-6D, 7A-7B
- Fri, 11/10 Universal-Out ($\forall O$), Existential-In ($\exists I$), and Universal Derivation (UD) Revisited
Hardegree, *Symbolic Logic*, 8.1-8.13
Exercises: 8A-8C
- Mon, 11/13 Existential-Out ($\exists O$) and Negation Quantifier Elimination ($\sim\forall O$ and $\sim\exists O$) Revisited
Exercises: 8D-8E
- Wed, 11/15 Relational Quantification
Hardegree, *Symbolic Logic*, 8.13
Exercises: 8F-8G
- Fri, 11/17 More Relational Quantification
Exercises: 8H
Homework 9 due (10 points)
- Mon, 11/20 **Exam 4 (100 points)**
- Wed, 11/22 [No Class – Reading Day]
- Fri, 11/24 [No Class – Thanksgiving Break]

Coda: Identity, Description, and Function Logic

- Mon, 11/27 Identity
McKay, *Modern Formal Logic*, ch. 15, "Identity, Definite Descriptions, and Function Symbols", pp. 349-354, 363-365
Exercises: 15a, 15d
- Wed, 11/29 Definite Descriptions
McKay, *Modern Formal Logic*, ch. 15, "Identity, Definite Descriptions, and Function Symbols", pp. 354-359, 367-369
Exercises: 15b, 15f
- Fri, 12/1 Function Symbols
McKay, *Modern Formal Logic*, ch. 15, "Identity, Definite Descriptions, and Function Symbols", pp. 354-359, 366-367
Exercises: 15c, 15e
- Mon, 12/4 Quantifier Semantics/Last Day of Class
McKay, *Modern Formal Logic*, ch. 16, "Quantifier Semantics"
Homework 10 due (10 points)
- Fri, 12/8 **Exam 5 & Exam 6 at 8:00 – 10:00 AM (100 points each)**