

Introduction to Logical Reasoning

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| Units | 1.0 | Instructor | David Emmanuel Gray |
| Time | Monday, Wednesday, Thursday: 8:00–8:50AM | Contact | CMUQ 1039, d-gray@northwestern.edu |
| Location | CMUQ 3069 | Office hours | Sunday, Monday, Tuesday, Wednesday, Thursday: 1:00–3:00PM |
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Course Overview

Description

Most people like to think of themselves as logical. Telling someone “You are not being logical” is normally not a complement. To be illogical is to be foolish, confused, muddled, irrational. But what does it mean to be logical? The word itself, ‘logic’, comes from the Greek word ‘logos’, or reason, and logic can be broadly construed as the study of what counts as a good reason for what, and why.

Understanding logic is important because we reason all the time. We try to figure out what might hold, reasoning on the basis of what we already know. Is it the aspirin or the glass of water it is taken with that stops a headache? What are the odds that Qatar will win the World Cup? What would have happened had George W. Bush never been President of the United States? We reason about events occurring in time or space; we reason about knowledge and belief; we reason about moral responsibility and ethical behavior. We then try to persuade others by giving them reasons.

Rather than examine all these types of reasoning, this course focuses on a concern common to them all: identifying and evaluating arguments. We begin the course by informally examining the structure and various components of an argument. We then make explicit the structure of argumentation and learn how to organize the claims within an argument into a visual composition called an argument diagram. Following that, we explore how modern propositional logic helps identify the logical form of many everyday claims and assess the validity of an argument. Then we consider classical categorical logic, which allows us to identify claims and assess arguments of another sort. Finally, we conclude by looking at how you can reason more logically about everyday issues in non-formal ways.

Readings

The following is the required textbook for the course:

- Lewis Vaughn. *The Power of Critical Thinking*, 3rd edition. Oxford: Oxford University Press. 2010.

Additional readings will be posted on the course webpage. You are expected to read the material according to the class schedule.

Objectives

By the end of this term, I expect that you will be able to:

- Deconstruct the inferential structure of an argument,
- Translate ordinary language statements into formal structures revealing their logical form,
- Assess when the premises of an argument entail its conclusion, and
- Avoid elements of illogical reasoning in your own thinking.

I have designed each course requirement with these objectives in mind.

Announcements and Other Communication

I will post important information on the course webpage, so please routinely check for updates at

<http://www.andrew.cmu.edu/user/degray/logic/>

Otherwise, I am glad to answer your questions, discuss your work, or respond to your concerns. Please see me at my office hours or get in touch via email.

Requirements and Grading

Classes will typically follow an interactive lecture format, with certain days set aside for skill-building workshops. As a result, the quality of the course depends critically on your individual attention and participation. The purpose of us coming together as a class is to both learn and practice the skills of critically thinking together as a group.

I strongly encourage you to practice the course’s skills outside of class with your fellow classmates, friends, and family, as well as with myself. However, all work must be done independently, unless otherwise noted. You are all expected to be familiar with the university policies on cheating and plagiarism. If you have any questions, please ask; do not assume.

Assignments include 13 problem sets, 11 quizzes, and 3 exams. Please refer to page 2 for more information.

The total points will vary from assignment to assignment. However, each is ultimately scaled to a score from 0 to 5. Unless you are notified of otherwise, the grading distribution will be as follows:

| | | | | | | | |
|-----------|----|-----------|----|-----------|----|-----------|---|
| 4.67–5.00 | A+ | 3.67–3.99 | B+ | 2.67–2.99 | C+ | 1.00–1.99 | D |
| 4.33–4.66 | A | 3.33–3.66 | B | 2.33–2.66 | C | 0.00–0.99 | F |
| 4.00–4.32 | A– | 3.00–3.32 | B– | 2.00–2.32 | C– | | |

Your final course grade will be on the same 5-point scale, with each assignment weighted as indicated on page 2. (The wise student will realize that using this scale allows you to do poorly on an assignment or two without seriously damaging your overall class grade.)

If during the semester you wish to know how you are currently doing in more specific terms than what you can infer from this information, do not hesitate to meet with me. Please note, however: due to Family Educational Rights and Privacy Act (FERPA) regulations, *I will not transmit grade information over email*. All discussion of grades must be done face-to-face with me.

Late Policy / Absence Policy

I do not accept late assignment submissions, and you get *no* “free” absences in this class. There are only two exceptions to this:

- You and I agree on a reasonable accommodation *prior* to either the original due date or the date you are missing class, or
- You provide me with a signed letter from the Office of the Dean justifying why it is permissible for you to turn in the assignment late or to be absent from class.

I recognize that these are extremely demanding requirements. *If you do not feel that you can meet them, please enroll in another course.*

Participation and Attendance

Logic is learned through practice, and so we will work in and out of class with a lot of examples. Class attendance and participation is therefore very important in understanding and retaining class material. I expect you to show up to class on time, participate thoughtfully, ask questions when you are confused, take notes, and have a grasp of what was accomplished in each meeting. *Attendance is therefore required without exception, and anyone showing up more than 10 minutes late will be politely asked to leave and come back (on time) to our next class meeting.* To enforce this policy, I will promptly take attendance at 8:00AM. If you arrive after I have called your name, then you will be marked as tardy. Please refer to page 2 for details.

Assignments

Reading

Most days of class will have an assigned reading (see the schedule on pages 3 and 4) that you will be expected to have read and thought about *before* class. This will allow us to devote our time to understanding and practicing the skills it is trying to teach rather than simply reviewing their contents. Hence, you need to do more than merely peruse the readings: you must endeavor to understand what they are trying to convey. Keep in mind that reading the course material is not like reading a novel. There will be times when you have to read slowly and carefully. Sometimes you may have to stop and think about things; and you should be prepared to go back and reread if necessary. In some cases, multiple readings of the text may be necessary. I highly recommend taking notes while you read, so that you can remember the text's main points. Finally, feel free to bring questions about the reading to class.

Participation (10% of Final Grade)

Your base participation grade will be on the 5-point scale from page 1, and it will consist of your overall grade on all graded assignments. For example, if your weighted average on quizzes and exams is an 3.57, then your base participation grade is also an 3.57, or a B. Calculating your base participation grade can be done with a calculator. The formula is as follows:

$$\text{Base Participation Grade} = [(Overall Quiz Grade \times 0.30) + (Exam \#1 Grade \times 0.20) + (Exam \#2 Grade \times 0.20) + (Exam \#3 Grade \times 0.20)] \div 0.90.$$

At the end of the semester, I will calculate your base participation grade this way. After that, I will then take into consideration the items below in order to raise or lower this grade.

Absences, tardy arrivals, and distracting behavior impact your participation grade in the following ways: each class absence will lower your participation grade by 1.0 point (one letter grade), while each time you are tardy will lower it by 0.5 points (one-half letter grade). Being caught sleeping in class, chatting with the person sitting next to you, using your cell phone, leaving the classroom, or similar behavior will be treated as an absence or as tardiness depending on the particulars of the circumstances.

Active and productive class participation, on the other hand, boosts your participation grade by up to 2.0 points (two letter grades). Also, if you have perfect attendance with no tardy arrivals, your participation grade will be automatically boosted an additional 1.0 point (one letter grade).

Note that it is possible that your participation grade can go negative because of penalties. On the other hand, it is also possible that your participation grade could go well above 5.0 points. Strive for the latter!

Extra Credit

There are thirteen opportunities for extra credit, one on each problem set. Each extra credit problem can add up to 0.1 points to your overall quiz grade *after* your lowest three quizzes have been dropped. This may not seem like a lot, but if you do all the extra credit, your overall quiz grade could go up by 1.3 points, well over a letter grade!

Group work is allowed for these extra credit problems. However, each of you must turn in your own individual response, putting the answers in your own words and not just copying what your partner wrote. You must also denote the names of everyone in your group on your submission. If I get the impression that only one student in a group is actually doing the work, I will no longer make extra credit problems available.

Problem Sets

Each week, a problem set will be assigned, but it will be neither collected nor graded. The purpose of these problem sets is to allow you to practice the skills you are learning in class as much or as little as you would like. Solutions to most of these problems will be available, so you can check your answers or see me for help as necessary. I do highly encourage you to work on these problems, either individually or in a group with your classmates. You are personally accountable for mastering this material, however: the overwhelming majority of problems presented on quizzes and exams will be functionally identical to problems given on the problem sets. As a result, if you do not devote some time to the problem sets, you are extremely unlikely to do well on the graded material.

Quizzes (30% of Final Grade)

Throughout the semester, there will be eleven short quizzes, with the lowest three dropped and your highest eight each counting for 3.75% towards your final course grade. Quizzes assess your proficiency with the skills you have learned in class and have practiced on the problem sets and during the weekly in-class workshops.

Quizzes will be given promptly at the start of class at 8:00AM and collected ten minutes later. If you come in late before they are collected, you will not be given extra time. If you come in after they are collected, you will have missed your chance to take the quiz. *So arrive promptly for class.* Quizzes are announced in advance, but cannot be made up. The reason that three of your quizzes are dropped is so you have the freedom to miss or do poorly on a quiz with no questions asked. To summarize: *there will be no make-up quizzes* without either a prior reasonable accommodation from me or a signed letter from the Office of the Dean.

Exams (60% of Final Grade)

There will be three fifty-minute exams, each counting for 20% towards your final course grade. Each exam will test your comprehension of the course material and the skills you have been practicing on problem sets, workshops, and quizzes. Exams are *not* cumulative, focusing only on material and skills covered in class since the previous exam. However, be aware that certain key concepts, seen repeatedly in class and on the problem sets, will be relevant on all the exams and so should not be forgotten.

Schedule

| wk | Date | Topic/Readings | # Pages | Assignments |
|----|-------------|--|---------|--|
| 1 | 9/5 (Mon) | Introduction | | Problem set #1 handed out. |
| | 9/7 (Wed) | What is an Argument? (Unit #1) Irving M. Copi and Carl Cohen, "Propositions" (handout). | 2 | |
| | 9/8 (Thu) | What is an Argument? Workshop on Statement Classification. | | |
| 2 | 9/12 (Mon) | What is an Argument? <i>The Power of Critical Thinking</i> , pp. 9–17. | 9 | Quiz #1, Extra credit #1 due, and Problem set #2 handed out. |
| | 9/14 (Wed) | What is an Argument? <i>The Power of Critical Thinking</i> , pp. 17–20. | 4 | |
| | 9/15 (Thu) | What is an Argument? Workshop on Argument Parsing. | | |
| 3 | 9/19 (Mon) | Understanding an Argument (Unit #2) <i>The Power of Critical Thinking</i> , pp. 96–101. | 5 | Quiz #2, Extra credit #2 due, and Problem set #3 handed out. |
| | 9/21 (Wed) | Understanding an Argument Irving M. Copi and Carl Cohen, "Diagramming Arguments" (handout). | 6 | |
| | 9/22 (Thu) | Understanding an Argument Workshop on Diagramming Arguments. | | |
| 4 | 9/26 (Mon) | Understanding an Argument Irving M. Copi and Carl Cohen, "Emotive Language, Neutral Language, and Disputes" (handout). Irving M. Copi and Carl Cohen, "Disputes and Ambiguity" (handout). | 8 | Quiz #3, Extra credit #3 due, and Problem set #4 handed out. |
| | 9/28 (Wed) | Review of Units #1 and #2. | | |
| | 9/29 (Thu) | | | Exam #1. |
| 5 | 10/3 (Mon) | Assessing Arguments (Unit #3) Irving M. Copi and Carl Cohen, "Deductive and Inductive Arguments" (handout). | 5 | Problem set #5 handed out, and Extra credit #4 due. |
| | 10/5 (Wed) | Assessing Arguments Irving M. Copi and Carl Cohen, "Validity and Truth" (handout). | 6 | |
| | 10/6 (Thu) | Assessing Arguments Workshop on Informally Assessing Arguments. | | |
| 6 | 10/10 (Mon) | Modern Propositional Logic (Unit #4) <i>The Power of Critical Thinking</i> , pp. 219–228. | 10 | Quiz #4, Extra credit #5 due, and Problem set #6 handed out. |
| | 10/12 (Wed) | Modern Propositional Logic Reread <i>The Power of Critical Thinking</i> , pp. 219–228. | 10 | |
| | 10/13 (Thu) | Modern Propositional Logic Workshop on Translating Natural Language and Creating Truth Tables. | | |
| 7 | 10/17 (Mon) | Modern Propositional Logic <i>The Power of Critical Thinking</i> , pp. 231–238. | 8 | Quiz #5, Extra credit #6 due, and Problem set #7 handed out. |
| | 10/19 (Wed) | Modern Propositional Logic <i>The Power of Critical Thinking</i> , pp. 88–93. | 6 | |
| | 10/20 (Thu) | Modern Propositional Logic Workshop on Assessing Arguments with Truth Tables. | | |

| wk | Date | Topic/Readings | # Pages | Assignments |
|----|-------------|---|---------|---|
| 8 | 10/24 (Mon) | Natural Deduction (Unit #5) Irving M. Copi and Carl Cohen, "The Elementary Valid Argument Forms" (handout). | 5 | Quiz #6, Extra credit #7 due, and Problem set #8 handed out. |
| | 10/26 (Wed) | Natural Deduction Irving M. Copi and Carl Cohen, "Formal Proofs of Validity Exhibited" (handout). | 3 | |
| | 10/27 (Thu) | Natural Deduction Workshop on Identifying Valid Argument Forms. | | |
| 9 | 10/31 (Mon) | Natural Deduction Irving M. Copi and Carl Cohen, "Constructing Formal Proofs of Validity" (handout). | 3 | Quiz #7, Extra credit #8 due, and Problem set #9 handed out. |
| | 11/2 (Wed) | Natural Deduction Irving M. Copi and Carl Cohen, "Constructing More Extended Formal Proofs" (handout). | 4 | |
| | 11/3 (Thu) | Natural Deduction Workshop on Natural Deduction. | 5 | |
| 10 | 11/7 |  Eid Al-Adha Break | | |
| | 11/9 (Wed) | Natural Deduction Reread Irving M. Copi and Carl Cohen, "Constructing More Extended Formal Proofs" (handout). | 5 | Quiz #8, Extra credit #9 due, and Problem set #10 handed out. |
| | 11/10 (Thu) | Review of Units #3, #4, and #5. | | |
| 11 | 11/14 (Mon) | | | Exam #2. |
| | 11/16 (Wed) | Classic Categorical Logic (Unit #6) "Elementary Set Theory" (handout). | 5 | Extra credit #10 due, and Problem set #11 handed out. |
| | 11/17 (Thu) | Classic Categorical Logic Workshop on Set Theory. | | |
| 12 | 11/21 (Mon) | Classic Categorical Logic <i>The Power of Critical Thinking</i> , pp. 252–268. | 17 | Quiz #9, Extra credit #11 due, and Problem set #12 handed out. |
| | 11/23 (Wed) | Classic Categorical Logic Irving M. Copi and Carl Cohen, "The Traditional Square of Opposition" (handout). | 6 | |
| | 11/24 (Thu) | Classic Categorical Logic Workshop on Translating and Diagramming Categorical Statements. | | |
| 13 | 11/28 (Mon) | Classic Categorical Logic Irving M. Copi and Carl Cohen, "Further Immediate Inferences" (handout). | 8 | Quiz #10, Extra credit #12 due, and Problem set #13 handed out. |
| | 11/30 (Wed) | Classic Categorical Logic <i>The Power of Critical Thinking</i> , pp. 269–276. | 8 | |
| | 12/1 (Thu) | Classic Categorical Logic Workshop on Reasoning with Categorical Statements and Syllogisms. | | |
| 14 | 12/5 (Mon) | Reasoning Logically in Everyday Life (Unit #7) <i>The Power of Critical Thinking</i> , pp. 130–139. | 10 | Quiz #11, and Extra credit #13 due. |
| | 12/7 (Wed) | Reasoning Logically in Everyday Life <i>The Power of Critical Thinking</i> , pp. 145–151. | 7 | |
| | 12/8 (Thu) | Reasoning Logically in Everyday Life <i>The Power of Critical Thinking</i> , pp. 152–161. | 10 | |
| 15 | 12/12 (Mon) | Review of Units #6 and #7 | | |
| | TBA | | | Exam #3. |

Policies

Reasonable Accommodations

I recognize that you are a human being with occasional human problems associated with human finitude. Illness, family emergencies, job interviews, other professors, etc. . . will inevitably lead to legitimate conflicts over your time. If you expect that you will be missing class or be unable to turn in an assignment on time, please notify me (either in class or via email) *in advance* and we can agree on a reasonable accommodation. Please recognize that most reasonable accommodations will still carry a penalty: your grade on the assignment may be reduced (since you will be given more time than your classmates), or you may have to do additional work not required of your classmates. So when proposing a reasonable accommodation be prepared to state what you take to be a fair penalty for that accommodation. I will then decide whether to accept or reject your proposal. Any arrangements after the fact require a signed letter from the Office of the Dean.

Challenging an Assignment Grade

Please recognize that I am human also: mistakes may occasionally occur when grading your assignments. Therefore, you have *one week* after an assignment is handed back to challenge its grade. To do so, you must return the assignment to me along with a clearly written explanation of your reason for challenging its grade. I will promptly and seriously consider all such requests and meet with you, if necessary, to resolve them. Assignments without a written explanation will not be considered. After one week, no challenges will be accepted. Of course, if you are not satisfied with your grade, but recognize that it was not due to a fault in the grading, I encourage you to talk with me to learn how to improve on future assignments.

Students with Disabilities

In compliance with university policy and equal access laws, I am available to discuss appropriate academic accommodations that you may require as a student with a disability. Request for academic accommodations should be made during the first week of the term, except for unusual circumstances, so arrangements can be made. Students are required to register for disability verification and for determination of reasonable academic accommodations. For more information, visit

<http://www.northwestern.edu/disability/>

Sexual Harassment Policy

It is the policy of the university that no male or female member of the university community (i.e., students, faculty, administrators, or staff) may sexually harass any other member of the community. Sexual advances, requests for sexual favors, and other verbal or physical conduct of a sexual nature constitute harassment when:

- Submission to such conduct is made or threatened to be made, either explicitly or implicitly, a term or condition of an individual's employment or education; or
- Submission to or rejection of such conduct is used or threatened to be used as the basis for academic or employment decisions affecting that individual; or
- Such conduct has the purpose or effect of substantially interfering with an individual's academic or professional performance or creating what a reasonable person would sense as an intimidating, hostile, or offensive employment, educational, or living environment.

For more information, visit

<http://www.northwestern.edu/sexual-harassment/policy/index.html>

A Note on Classroom Courtesy

Class begins promptly at 8:00AM. You are expected to be seated by that time and to remain seated until the class is dismissed. If you must leave before the class ends because of a medical appointment, or similar commitment, notify me before class begins and sit near the door. Students who leave without providing such notice and have not suddenly taken ill will be expected to drop the course and not to return.

Video Taping and Audio Recording

Your classmates and I have a reasonable expectation to not be recorded in this course. Therefore, videotaping and audio recording are prohibited without our expressed, unanimous permission.

Cell Phones, Laptops, and Related Technologies

Student interactions with portable technology devices can harm the dynamics of the classroom. Therefore, I expect you to silence your cell phones prior to class and to not text-message during class. *All laptops should be closed unless you have made prior arrangements with me and have demonstrated that using a laptop is necessary for your learning.*

Academic Integrity

Academic integrity is embodied by commitments to honesty, respect, trust, diligence, and rigor in the pursuit of knowledge. As a student in this class, academic integrity means following all directions on assignments, doing your own work on exams and quizzes, and seeking help whenever you feel that you are struggling.

Most violations of academic integrity in this class involve cheating on an exam or quiz by copying the answers from a neighbor or using an unauthorized "cheat sheet". Exams and quizzes assess your proficiency with the skills this class conveys, so you must do them on your own. In real life, you may have a logic textbook to refer to when assessing an argument, but my goal is to train you better than that. I want you to internalize the skills that you are learning, being able to quickly and efficiently employ the tools of informal and formal logical analysis. So ultimately you should not need a logic textbook to help you. This will make it far more likely that your future reading and writing will retain its logical edge.

While I treat violations of academic integrity on a case-by-case basis, there are some basic patterns I follow. When I suspect a violation, I will immediately contact the Dean of Admissions, whose office will conduct an investigation of the issue. Until that investigation is resolved, university policy prevents me from discussing the matter with the student in question. The intent of this policy is to protect the student. If the investigation concludes that there was a violation, I will typically impose a penalty that exceeds the penalty of not having done the assignment at all. For instance, the penalty for cheating on a quiz is worse than for not having done the quiz at all. Such an action is also a violation of the community standards at Northwestern University. As such, there may be further penalties imposed by the university. For more information, see

<http://www.northwestern.edu/uacc/plagiar.html>

If you ever find yourself tempted to violate these standards of academic integrity, please seek an alternative course of action. Email me for a reasonable accommodation, or turn in partially completed work. I assure you that the impact on you will be far gentler in these ways.