Syllabus: PHI 112 Language, Logic and Mathematics

Term: Spring 2023
Sec 001: TuTh 8:00AM - 9:15AM, Stevenson 228
Sec 002: TuTh 12:35PM - 1:50PM, Stevenson 233A
Instructor: David Sanson
Office: Stevenson 341
Office Hours: Tu 4-5pm; Th 2-3pm
Contact: GroupMe DM or desanso@ilstu.edu (I **strongly prefer** that you contact me via GroupMe DM rather than email.)

I teach two sections of this course. Please attend the appropriate section.

Short course description

This is a class in formal logic. We cover sentential logic and predicate logic, with a focus on translation and natural deduction.

What you are actually getting yourself into

In *logic* we study reasoning, and what makes good reasoning good and bad reasoning bad. In *formal* logic, we do this by studying *logical form*, and identifying those forms of reasoning that are good, and those that are bad. For example, this form of reasoning is good:

> If P is true, then Q is true. P is true. Therefore, Q is true.

But this form of reasoning is bad:

> If P is true, then Q is true. Q is true. Therefore, P is true.

When we reason, we are processing *information*. Maybe you have been told by your boss that if you are late, then your pay will be docked, and you know that you will be late. You can reason from those two pieces of information, to the conclusion that your pay will be docked. Or maybe you know that, if the moon explodes, the earth's atmosphere will be destroyed, and you know that the moon will explode, so you reason to the conclusion that the atmosphere will be destroyed. The *logical form* of the information and the reasoning is the same in both cases, but the *content* is different.

In the short course description, I said that we will study both sentential logic and predicate logic. In sentential logic, we concentrate on forms generated by combining sentences using words like 'if…then…', 'both…and…', and 'either…or…'. In predicate logic, we add additional forms, generated by combining predicates with proper names and variables, and binding those variables with quantifiers.

We will use an artificial language to describe and display logical forms. Sentences in this langauge look like formulas from algebra. Here are some examples:

- P → (Q □ R), which means *If P, then both Q and R*

- □x□y(F(x) ↔ G(y)), which means *For every x, some y is such that x is F if and only if y is G*

In the short course description, I said that will focus on translation and natural deduction. By "translation", I meant translating sentences in English into sentences in our artificial language, a process that involves both understanding our artificial language, and thinking about the logical forms of English sentences.

Natural deduction is a way of representing and reconstructing complex chains of reasoning, of the sort you might encounter in a mathematical proof or a work of philosophy. There are several systems that have been designed for doing this. The short course description mentions the system we will be using. But that is probably only meaningful to other logic professors.

This class has one foot in mathematics, and one foot in language. If you think of yourself as good at math but bad at language, or bad at language but good at math, you will probably find parts of this class easy, and parts hard. Most students report that the class makes their brain hurt in one way or another. Please understand: this is a *good* thing. It means your brain is being rewired, and you are gaining new powers.

One of the secrets to those new powers: the sharp distinction between math and language is not as real as you think. For that matter, neither is the sharp distinction between the sciences and the humanities. The study of logic cuts across the first, just as the study of philosophy cuts across the second. This class is meant to rewire your brain, and make you *think* in a new way, that does not respect such distinctions. This new way of thinking applies to anything and everything you ever might think about.

Aside: About this document

This unit the course syllabus, but is is also a tutorial, introducing you to the nuts and bolts of course assignments.

All units, including this one, include questions that you need to answer or exercises that you need to complete, as you read. For example, you need to answer this multiple choice question now. Just for fun, try giving the *wrong* answer, and see what happens.

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1 This unit is
|*a tutorial, but also the syllabus, and also counts for course credit.
|an optional introduction with sample questions that don't actually count for course credit.
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If you selected the wrong answer, you were told so, and asked to try again. Questions and exercises in the reading are always like this. The software will not allow you to submit an incorrect answer. If you try to do so, you will be asked to try again, until you get it right.

I can make things more difficult on you by giving you a multiple choice question with multiple correct answers, and asking you to select all the correct answers:

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2 The kinds of questions that are asked in this unit include (select all correct answers):
| *multiple choice questions with one correct answer
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| *multiple choice questions with several correct answers, like this one
| CAPTCHAs designed to verify that you are human
| *open-ended short response questions
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I can also include open-ended short response questions, like this:

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3 Why are you taking this class? What do you hope to get out of it?
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Sometimes, when you submit an answer to a question, a reaction box like this will open, giving you a bit of feedback or advice.

For short response questions like (3), you get full credit for submitting *something*. I will typically use such questions to encourage you to stop and think: the value lies in your making the attempt, not in whether or not you get it right.

Course design and expectations

This class is *flipped*. I will not lecture. I expect you to read and work outside of class, and make an effort to figure things out for yourself. In class, I will help you figure out whatever you couldn't figure out on your own.

This will likely make you *uncomfortable*. Trying to figure out how to do logic by reading about it on your own is hard. It *feels better* if someone first walks you through each step, before you try to figure it out for yourself. But experience shows that what *feels* better *works* worse. Until you've tried it for yourself, you aren't really in a position to learn from somebody else's explanations.

More generally, the best way to learn is to *try*, *fail*, *get help*, and *try again*. That's uncomfortable, because we don't like failing, and many of us don't really like asking for help. It is more comfortable to *wait*, and only *try* once you think you can *avoid failing*. But, again, that is more comfortable, but in practice it doesn't work very well.

This class is designed to maximize your chances to try, maximize your chances to fail, maximize your chances to get help, and maximize your chances to try again.

But—and I can't emphasize this enough—**you need to take advantage of these chances for yourself**. You need to try early and often. You need to give yourself permission to fail and try again. You need to ask for help when there is something you aren't getting. And you need to take advantage of the opportunities to try again, and again, and again, as needed, until you really learn the material.

Trying early and often means reading and trying *before* class, not during class. Ideally, you come to class knowing that you are confused and knowing what you are confused about.

Giving yourself permission to fail means not just being willing to make mistakes, but being willing to learn from those mistakes. Each unit is followed by a *mastery check*. This is a mini test, but if you fail it, that's okay: you can retake it several times. What is important is that you figure out how to *learn* from that failure. What went wrong, and why? What was it that you didn't understand? What can you do to understand that better, and avoid similar mistakes on future retakes? Some students try to bulldoze their

way to success, taking retake after retake, in hopes that they will pass by brute force or luck. This usually doesn't work.

Asking for help means reaching out to me or to your classmates. Don't suffer in silence. Nobody expects you to learn logic on your own. We are in this together, and, most importantly, I am here to help. That might involve spending some one-on-one time in class or office hours, working through some problems. It might involve an impromptu mini-lecture, going over some key concept or process that you are stuck on. All kinds of help is available. But only you can tell me where you're stuck, so we can work on figuring out how to get you unstuck.

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4 For this course, you are expected
| *to do the reading before class, and come to class confused
| to wait and only attempt problems and exercises after the material has been covered in cla
| *to pay attention when things go wrong or you make mistakes, and figure out what you didn'
| to brute-force your way through exercises and retakes, grinding your way to course credits
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Grades

When it comes to your grade, what matters is how much and how well you learn in the end. That is, your grade will be determined by *how many* units you *complete or master* by the end of the term, in accordance with the following chart:

Course Grade	Units Complete
A	at least 16 units complete, at least 10 of which are complete and mastered
B	at least 14 units completed, at least 8 of which are complete and mastered
C	at least 12 units complete
D	at least 8 units complete

A unit can either be incomplete, complete, or complete and mastered:

Complete and Mastered Reading = 100% and Mastery check ≥ 80%
Complete Reading = 100% and Mastery check ≥ 60%
Incomplete Reading < 100% or Mastery check < 60%

As you can see from the chart, you don't get any credit for incomplete units.

In addition, certain key units are **required** for certain grades, according to the following chart:

Course Grade	Required units
A	Must complete units 04,05,09,10
B	Must complete units 04,05,09
C	Must complete units 04,05,09
D	Must complete unit 04

Predictably, these are the units are the ones that experience shows students are most tempted to avoid.

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5 Select all true claims from the list below:
| *To complete a unit, I need to get 100% on the reading questions and get 60% or above on t
| *If a unit is mastered and complete, it is also complete
| *It is possible to get a C without mastering any units
| It is possible to get a D without completing any units, as long as I earn a lot of points
| If I complete enough other units, I can pass this class without completing unit 04
| *I can earn a B in this class without mastering unit 04
| I can earn a B in this class without completing unit 04
| *If I complete enough other units, I can pass this class without completing this unit, uni
| This course has a final exam
```

Mastery checks

A mastery check is a short low-stakes assessment, consisting of 3 to 6 problems. Most mastery checks are online. Some may be in-class only, completed on paper and graded by hand.

You are **not allowed to collaborate** on mastery checks. A mastery check is something you do on your own, to prove, both to me and to yourself, that you have learned the material from that unit. Collaboration on mastery checks is cheating, and grounds for disciplinary action.

When you are ready to attempt a mastery check, send me a DM on GroupMe, and I will send you a link with a password. **This link is for your use alone. Do not share this link or password with other students.** For in-class mastery checks, ask me in class, and I will hand you a mastery check to take. You cannot request more than one in-class mastery check in the same period, and you cannot request an in-class mastery check if there is less than 15 minutes left in the class period.

If you wish to retake a mastery check, talk to me. First, we will make sure that you understand what went wrong, and so aren't likely to repeat your mistakes. Then, I'll give you a new version of the mastery check to take. Typically, the individual problems on each mastery check are aligned: you only need to complete the problems you got wrong on your previous attempts.

There are three limits on retakes:

1. There is a mandatory waiting period between attempts: you cannot take or retake the same mastery check twice in one day.
2. You are only allowed two *retakes* total each week: not two per unit, but two across all units.
3. Some mastery checks expire, which puts further limits on retakes (see below for details).

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6 Select all and only the true claims from this list:
| It is okay to collaborate on mastery checks, as long as the final answer is your own.
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| If you fail a mastery check, you can retake it again that same day
| You are allowed more than two retakes each week, as long as they are spread across differe
| If a friend needs a link to retake and hasn't gotten a response from the professor, you ca
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Pace, Due Dates, and Expiration Dates

By design, this class *must* be self-paced. Many students struggle mightily with this, quickly fall behind, and fail.

To help keep you on track some of the early reading assignments have set due dates: the reading for this unit is due by 11:55 pm on Friday of the first week of classes; the reading for unit 01, by Friday of week two; for unit 02, by Friday of week three; for unit 03, by Friday of week four.

These due dates as goads meant to keep you from falling completely off the rails. **This is not my recommended pace**. I recommend is that you complete units 00, 01, and 02 as quickly as possible. Things only get harder. Get ahead early, and bank time to work through the more difficult later units.

Readings for later units are due by 5pm on Friday, May 5th. This is Friday of the last week of classes. Again, this has nothing to do with recommended pace. It just reflects the fact that, once we get deeper into the course, your job is to complete as many units as you can. There is no fixed pace that works well for all students.

Some but not all mastery checks have *expiration* dates. For example, the expiration date for the mastery check for this unit is the end of Friday of the second week of classes. Expiration dates are not due dates: you can still take and complete a mastery check after it has expired. Instead, expiration dates change the rules for retakes: after a mastery check has expired, you can only take it once, whether that is for the first time, or one last retake.

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7 Select all and only the true claims from this list:
| *After a mastery check has expired, you can still take it one more time
| To succeed in this course, you just need to pay attention to the due dates
| Once a mastery check has expired, you are not allowed to take it
| *Many students struggle to stay on track with this course, because it is self-paced
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Finals Week

There is no final for this class. All reading assignments are due at or before Friday, May 5th, at 5pm.

After that time, the class shifts into “Finals Week mode”. You are no longer able to complete readings, but you are allowed one last chance at the mastery checks, including mastery checks that have expired. There are two limits on this:

- 1 attempt per unit: you are only one finals week attempt per unit, whether that is your first attempt or a retake.
- 5 attempts total: you are allows a maximum of 5 attempts total across all units.

Online mastery checks can be requested any time before 5pm on Wednesday, May 10th, and completed any time before 5pm on Friday, May 12th. In-class mastery checks can only be requested and attemped during the scheduled Final Exam period.

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8 Select all and only the true claims:
| It is okay to share online mastery check links to help out a friend
| If you haven't completed the reading for a unit by May 5th, you can still complete that un
| *During Finals Week, you can retake an expired mastery check, even if you have already att
| Nothing for this class is due until the last day of classes, May 5th at 5pm
```

Collaboration Units

Genuine engagement, participation, and collaboration are hard to measure. Schemes that "bean count" participation tend to motivate folks just to do the bare minimum, which is counterproductive.

Attendance is a necessary but not sufficient condition for engagement, participation, and collaboration. I hope that, if I can get you to attend, I can get you engage and collaborate. It may sound cheesy, but I want us to come to together into a friendly and supportive community of folks working together to learn logic. Trust me, learning logic is easier when you are part of such a community.

For each class you attend, you earn 10 "collaboration points". Your first 100 collaboration points earn you one complete collaboration unit. Your second 100 collaboration points earn you a second collaboration unit. These are real units: they count toward your total complete units, for the purpose of calculating your grade. (No, there is no way to "master and complete" these units.)

I recognize that there are legitimate reasons to miss class. Note that you can miss several classes and still earn both collaboration units.

Drop-In Office Hours

My drop-in office hours are times that I set aside, so that students can drop in and ask for help. You do not need to make an appointment. You can just drop-in. If you cannot make my drop-in office hours, ask for an appointment.

You can also use drop-in office hours to take or retake an in-class only mastery check.

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9 Drop-in office hours are
| by appointment only
| a time for me to be alone in my office without being bothered by students
| *times when you can drop by and ask for help
| *times when you can drop by without an appointment
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10 The best way to contact me about this course is
| via shortwave radio
| *via GroupMe
| via email
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The answer to question 10 can be found near the beginning of the syllabus, if you missed it the first time through.

Common Challenges and Barriers to Success

Many students arrive in this class who have an unhappy history with math. If that is you, you seen and you are not alone.

There is no getting around the fact that this class is in part a math class, and can trigger old anxieties and open old wounds. I assure you, formal logic is objectively *much simpler* than high school algebra. Also, formal logic is freestanding and its own thing: it does not presuppose or build upon high school algebra in any way. Many people who are "bad at math" turn out to be great at logic.

This class involves thinking about language in a math-y way, and thinking about math in a language-y way. It combines ways of thinking that you have been taught to keep separate (for no good reason, as far as I can see). This tends to make everyone uncomfortable! Students who identify as "good with language" but "bad at math" struggle with the "math-y" bits. Students who identify as "good at math" but "bad with language" struggle with the "language-y" bits. Students who think of themselves as good at both often still struggle when asked to put both together.

Finally, this is not a course in abstract theory, and it is not a class that asks you to memorize and regurgitate facts. It is a course that asks you to learn *how* to solve different kinds of problems. Learning *how* to do something takes *practice*, and practice takes *time*. The course is designed to maximize your opportunities to practice, both inside and outside of class, and maximize your opportunities to get help as you practice. But I cannot maximize your *time*: that is a limited resource that you will need to manage.

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11 This class might be challenging for you because
| *it combines both mathematics and language
| it will be taught entirely in French
| it is a course in abstract theory
| *learning how to solve the problems takes practice, and practice takes time
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C'est la seule partie de ce cours qui est en français.

Carnap.io

The readings and assignments for this course are all on Carnap.io. Carnap is a tool for automatic machine grading of complicated logic problems. It is free, but you will need a Google account to sign in. If you are reading this, presumably you have already succeeded at doing this!

For the record: to enroll in Carnap, follow this link:

- https://carnap.io/enroll/ISU_112_SPRING_2023
- If you don't already have a Google account, you can create one for free.

- When you create your account on Carnap, you will be asked for your name and your University ID.
  - Use your preferred name. If that's different from the name that will show up on my official roster, I'll figure it out.
  - For your University ID, use your **ULID**, not your **UID**. Your ULID is the first part of your ISU email address. Your UID is your nine digit student ID number.

If you already have an account on Carnap from a previous course, you will be asked if you want to change your enrollment, and join this new course, ISU_112_SPRING_2022. That is what you want to do. So click on the "Change Enrollment" button.

Reggienet

You can track your progress on individual assignments on Carnap by looking at the progress bar at the top of each assignment. You should see this bar now, at the top of this page. If you click on that bar, you can see more useful information about this assignment.

You can also go to your User Page on Carnap, where you can find a list of assignments, and, if you scroll down, a list of each problem that you have submitted for each assignment.

For an overview of your progress through the course, you should instead go to Reggienet's gradebook. There you can find a breakdown of how many units you have completed and how many you have completed and mastered, as well as a tally of your collaboration points. If you scroll down, you can also see a "score" for each unit: 0 means incomplete, 1 means complete, 2 means complete and mastered. Next to that score, you should see, in the comments, a break down of your reading percentage and mastery check percentage for each unit.

Unfortunately, the Reggienet gradebook cannot be updated automatically from Carnap. This is something I need to do manually, so it will tend to lag behind your actual progress in the course. I try to manually update the gradebook at least once a week, and more frequently than that as we near the end of the term.

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12 The Reggienet gradebook
| will automatically stay in sync with Carnap, so if my scores don't show up on the Reggiene
| *needs to be updated manually, so newly completed work will not show up immediately on Reg
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Accommodations

Any student needing to arrange a reasonable accommodation for a documented disability should contact Student Access and Accommodation Services at 350 Fell Hall, 309-438-5853, http://studentaccess.illinoisstate.edu.

I'm happy to work with you.

Also, if you come across accessibility issues with Carnap or other course materials, please let me know.

Other Sources of Support

Life at college can get complicated. If you're feeling stressed, overwhelmed, lost, anxious, depressed or are struggling with personal issues, do not hesitate to call or visit Student Counseling Services (SCS). These services are free and completely confidential. SCS is located at 320 Student Services Building, (309) 438-3655.

If you are worried about a friend and don't know how to help, you can call SCS and ask to speak to a counselor. The Kognito simulation, available through SCS's webpage, can also help you learn how to assist your friend in connecting to services.

Also, it's hard to learn if you're hungry or couch-surfing. If you are having difficulty affording groceries, accessing sufficient food to eat every day, or securing a safe and stable place to live, help may be available. I urge you to contact the Dean of Students Office to learn more. One great resource available to all students is the School Street Food Pantry.

Academic Misconduct

Academic integrity is expected and required. Students are expected to be honest in all academic work. A student's placement of their name on any academic exercise shall be regarded as assurance that the work is the result of the student's own thought, effort, and study.

If you have questions, refer to the Code of Student Conduct, B1 (Academic Integrity), which outlines unacceptable behaviors in academic matters, or talk to me. In certain circumstances (such as cheating or plagiarism) I may be required to refer a student to Community Rights & Responsibilities for a violation of Illinois State University's Code of Student Conduct.

ISU General Education Objectives

Courses in the Quantitative Reasoning category of General Education address the following program objectives:

I. knowledge of diverse human cultures and the physical and natural world, allowing students to

a. use theories and principal concepts, both contemporary and enduring, to understand technologies, diverse cultures, and the physical and natural world
b. *explain how the combination of the humanities, fine arts, natural and social sciences, and technology contribute to the quality of life for individuals and communities*

II. intellectual and practical skills, allowing students to

a. make informed judgments
b. analyze data to examine research questions and test hypotheses
c. *report information effectively and responsibly*

III. personal and social responsibility, allowing students to

a. demonstrate ethical decision making
b. demonstrate the ability to think reflectively

IV. integrative and applied learning, allowing students to

a. identify and solve problems
b. transfer learning to novel situations
c. *work effectively in teams*

Primary outcomes are indicated in plain text and secondary outcomes are indicated in italics.

Phew! That's a lot of boiler plate. Did you hear the story about the professor who hid $50, and told students where to find it on his syllabus? I am afraid I have not done the same. Do I look like I'm made of money?!!

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13 According to the ISU General Education Objectives, a course in Quantitative Reasoning is
| *teach you personal and social responsibility, allowing (enabling?) you to demonstrate eth
| teach you how to cook, allowing (enabling?) you to cook quick and easy healthy meals on a
| *teach you about cultures and the physical and natural world (but not math?), allowing (en
| teach some aspect of quantitative reasoning
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Apologies for the snark.

What Now?

The mastery check for this unit, unit 00, is online, and expires at the end of the day on Friday, January 27th. When you are ready to attempt it, send me a GroupMe DM. In your DM, please specify that you want a mastery check for unit 00, and include your ULID.