

PHI3002 - Introduction to Logic

JAKE CHANDLER



1 Overview

Logic aims to uncover the most general patterns of good reasoning, so as to improve the way we draw inferences and even allow us to automate parts of that process. It is fundamental to the study of philosophy, mathematics, and computer science, and it has strong connections with many disciplines including law, psychology, and linguistics. Reasoning also occurs everywhere, from the privacy of one's own mind to political and scientific debates in the public domain, and all good reasoning is implicitly governed by logical principles. Developing an explicit grasp of those principles then is an important transferrable skill, as that understanding can help one to spot when arguments have gone awry and how to get them back on track.

This subject will provide a gentle introduction to some of the basic elements of deductive logic, including the formalisation of arguments, propositional and predicate logic, and an accessible proof method known as “semantic tableaux”. It will also touch on some more discipline-specific topics.

To give you a sense of what we cover, I have provided links to the lecture slides for each week below, along with an outline of what that week covers. Lecture recordings are available on request, and tutorial exercises are provided to enrolled students. The La Trobe Handbook entry for the subject can be found [here](#).

The 2024 instalment of this subject led to a *Recognition of Teaching Excellence* letter from the School of Humanities and Social Sciences, for its student satisfaction result.

2 Student Testimonials

“This subject helped me improve my ability to think clearly and systematically. I appreciated the way the course taught me to break down arguments and spot logical fallacies, which made a noticeable difference in how I approach both academic work and everyday conversations. The logical techniques we learned felt practical, and I found myself applying them in different areas.”

“The lectures were communicated and explained so clearly and intuitively, even though for me, logic was an entirely new subject area. I really appreciate that all the tasks and coursework were uploaded onto the LMS, along with the answers, so that we could work through it in our own pace.”

“Knowing that this subject is applicable to many disciplines, weekly tutorial allows us to engage with other students and lecturer from other disciplines and give us ideas of how it relates to other disciplines that other students may be studying in.”

“Jake, the teacher, was really good at giving examples to help break things down, and was available for questions whenever I had them. The subject was difficult but the lecturer made it manageable.”

“The subject is engaging as the exercises are a necessary part of learning and test your knowledge. Supportive lecturer who takes the time to work with you on parts you need help with. Zoom tutorials are a good way to clarify and ask questions regarding what’s in the textbook and lecture videos.”

“Jake made the lectures engaging and interesting. His explanations also helped solidify any answers to the questions we didn’t understand. The tutorials were easily the best aspect of the subject, as this was our only available FTF time to discuss questions with our lecturer & apply our learning.”

“Logic was a new subject area for me, so it took a little bit for all the new symbols and writing conventions to click. I had never thought about arguments and reasoning before in such a structured and mathematical way, so it was very eye opening and thought provoking!”

3 Assessment and teaching activities

Assessment:

- Take home exam (55%)
- Weekly quizzes (35%)
- Early assessment quiz (10%)

Teaching Activities:

- Weekly pre-recorded video lectures (0.75 hours)
- Weekly tutorials, face-to-face or online (1.5 hours)

4 Weekly breakdown

Week 1: Arguments

Logic is concerned with the evaluation and construction of particular kinds of arguments. In this first session we take a look at some key concepts in argumentation. We will be learning how to neatly present an argument in standard form and which issues to look out for when trying to reconstruct a real-world argument, such as one that one might find in a newspaper op ed or academic paper.

- Slides: [Week 1 Slides](#)
- *Lecture recordings are available on request.*
- *Tutorial exercises are provided to enrolled students.*

Week 2: Validity + Sentential Form

This week we turn to the core concern of logic: the evaluation of arguments. We discuss the concept of deductive validity, a crucial feature of many good arguments. We introduce the idea that arguments can be valid just because of the “form” or again “structure” of the sentences involved and single out two important levels of description of argument structure: sentential and sub-sentential form. We then turn to the first of these, namely sentential form, and look at the way in which complex sentences are built up from atomic ones using “connectives”.

- Slides: [Week 2 Slides](#)
- *Lecture recordings are available on request.*
- *Tutorial exercises are provided to enrolled students.*

Week 3: The Language of Sentential Logic

This week, we learn how to use special notation (the 'language of sentential logic') to express the sentential form of a sentence or argument and use it to present a number of well-known valid sentential argument forms. We then introduce the question of the existence of a procedure to establish the validity of a sentential form, explaining, along the way, the concepts of decidability and complexity.

- Slides: [Week 3 Slides](#)
- *Lecture recordings are available on request.*
- *Tutorial exercises are provided to enrolled students.*

Week 4: Truth Tables For Sentential Logic

This week, we learn an easy method, the method of truth tables, to help us determine whether any given sentential argument form is valid or not. We also use this method to prove the invalidity of three common 'deductive fallacies', before looking at a possible explanation of why these problematic patterns of reasoning might be attractive to some people.

- Slides: [Week 4 Slides](#)
- *Lecture recordings are available on request.*
- *Tutorial exercises are provided to enrolled students.*

Week 5: Tableaux for Sentential Logic

While reliable, the method of truth tables, can be quite inefficient at times. This week, we take a look at an alternative method known as the tableaux method (aka tree method). Rather than searching through every possible interpretation to find a countermodel, this procedure attempts to construct one. We prove that this method has the desirable properties of being "sound" and "complete".

- Slides: [Week 5 Slides](#)
- *Lecture recordings are available on request.*
- *Tutorial exercises are provided to enrolled students.*

Week 6: The Language of Predicate Logic

As we have seen previously, some arguments are formally valid, but for reasons that can't be captured at the level of sentential form: we need to dig deeper into the inner structure of the atomic sentences. This week, I introduce you to a logical language that allows us to express this "sub-sentential" form: the language of predicate logic. We cover its syntactical rules, the issue of translation from English and the concept of a model for predicate logic, which is somewhat more complex than the corresponding concept of valuation in sentential logic.

- Slides: [Week 6 Slides](#)
- *Lecture recordings are available on request.*
- *Tutorial exercises are provided to enrolled students.*

Week 7: Tableaux for Predicate Logic

Having introduced a way to describe the sub-sentential structure of an argument, we now consider how to go about testing its validity. We learn how to extend the tableau method to this new context. We shall see that, unlike what was the case in relation to sentential form, here, the tableaux method does not guarantee that our question of interest can be decided in a finite amount of time! the satisfiability problem for predicate logic is in fact undecidable. Finally, we see how our language of predicate logic can be extended to express relations of identity between objects, allowing us to expand our range of quantifiers to cover explicitly numerical expressions such as “there are at least three...” and so on.

- Slides: [Week 7 Slides](#)
- *Lecture recordings are available on request.*
- *Tutorial exercises are provided to enrolled students.*

Week 8: Review of Sentential & Predicate Logic

This week, I will pause the addition of new content in order to recap and consolidate what we have learned up until now. The idea is to make sure that as many of you as possible are 100% comfortable and up to speed with what constitutes the basic core of our subject: sentential and predicate logic.

- Slides: No slides this week
- *Tutorial exercises are provided to enrolled students.*

Week 9: Beyond Truth and Falsity, Part 1

We have so far assumed that every sentence must be either true or false. But philosophers and linguists have long suggested that this need not always be the case: according to them, some sentences can be neither true nor false (“aka “gappy”). This week we take a look at some of the kinds of sentences that are thought to sometimes give rise to truth value gaps. These include sentences involving definite descriptions, conditionals, universal generalisations, sentences containing factive or aspectual verbs, sentences about future contingents and sentences about borderline (aka “vague”) cases. We also discuss a first alternative system of truth tables that has been proposed in connection with these phenomena: the logic B₃.

- Slides: [Week 9 Slides](#)
- *Lecture recordings are available on request.*
- *Tutorial exercises are provided to enrolled students.*

Week 10: Beyond Truth and Falsity, Part 2

After presenting, last week, a number of situations in which it is plausible to claim that some sentences can be neither true nor false, we continue our discussion of how to extend classical bivalent sentential logic to handle these situations. This week, we cover the logics K_3 and SV and briefly discuss the properties of trivalent tables for conditionals in the style of De Finetti. We also take a look at how to extend the tableau method to trivalent logics, using the case of the logic K_3 as an illustration.

- Slides: [Week 10 Slides](#)
- *Lecture recordings are available on request.*
- *Tutorial exercises are provided to enrolled students.*

Week 11: Logic and the Dynamics of Belief Pt.1

This week we ask ourselves the important question of the role of Logic in regulating rational belief. We find that, although Logic plays an important role in explaining the static constraints that govern what we can and can't believe, it has little to say about the dynamic rules that guide the way in which our beliefs change over time. This second question is the focus of a field that has become known as "Belief Revision Theory". We take a first look at some of its basic concepts and results.

- Slides: [Week 11 Slides](#)
- *Lecture recordings are available on request.*
- Tutorial exercises: No exercises this week

Week 12: Logic and the Dynamics of Belief Pt. 2

This week, we close our discussion of the dynamics of beliefs with two important topics in the field. The first is whether, and if so how, the AGM postulates that we studied last week are in need of supplementation in order to handle sequences of belief change, a question that has become known as the "problem of iterated change". The second question is whether the AGM postulates and some popular supplementary principles might not be too strong, imposing excessive requirements on rational change in belief.

- Slides: [Week 12 Slides](#)
- *Lecture recordings are available on request.*
- Tutorial exercises: No exercises this week