Introduction to Logic [296.617]

Syllabus

Instructor: Matteo de Ceglie

Summer Semester 2020

General Information

- We will meet on Thursday, from 11:00 to 13:00 [meetings suspended until further notice];
- *Office hours*: Tuesday from 11:00 to 13:00 (or by appointment) [meetings suspended until further notice];
- For any queries, you can write me at `decegliematteo[at]gmail[dot]com`;
- All the course materials can be found on `www.matteodeceglie.com/Teaching` and Blackboard.
- Language: English.

Course description

Logic, it is often said, is the art of correct reasoning. Since reasoning correctly is crucial for virtually any cognitive enterprise, logic is a very important art indeed. Reasoning in natural language is messy business: arguments which may seem valid may turn out to be actually invalid, and, conversely, arguments that may seem invalid may turn out to be valid instead. Formal logic offers tools to abstract from the distracting, and potentially misleading, features of natural languages, and establish the validity and invalidity of arguments beyond any reasonable doubt.

The main topic of this is course is a brief (but thorough) introduction to logic. Logic as a research field is as old as "systematic philosophy" itself, and from Aristotle onwards it was central to any philosophical system. The 19th century saw the birth of modern logic, with Boole, De Morgan and especially Frege, and with it the birth of analytic philosophy. In the 20th century logic became the founding stone of analytic philosophy: it is now central to any type of philosophical reasoning, from philosophy of language to epistemology. It is even possible to argue that logic is enormously important for rhetoric and arguments in natural language (e.g. in English). And I am not even mentioning the influence of logic in the philosophy of mathematics and mathematical practice! However, before engaging in any higher discussion on the role of logic in other fields, or researching in the field themselves, a knowledge of the basics is needed. In this course we will explore these basics, with particular attention on the skills needed to solve logical problems, so that in the future these techniques could be used in other contexts.

Every class will be divided in two sections of equal length: a first section in which we will look at the exercises given the previous week (you will also be called to the chalkboard to try out some exercises yourself); and a second section in which we will introduce new concepts and techniques.

We will introduce both propositional and predicate logic, in a friendly and accessible way, always stressing the connection between formal languages and tools and ordinary language and reasoning.

Course goals

The generic aim of the course is to enable all students to apply some foundamentals logical techniques. More specifically, by the end of this module you are expected to be able to, both for propositional and first order logic:

- recognise when an argument is good/valid;
- know the difference between formal and natural languages, and be able to "translate" between them;
- apply the method of truth tables to decide whether a sentence is true/always true (a tautology)/false/always false (a contradiction);
- learn how to use natural deduction to check if a sentence follows from a set of premises.

Why take this course?

Since logic is central to any philosophical argument, knowing the basics of it is important for future philosophers. Moreover, the skill of logical reasoning is actually important in any other field of human culture and occupation, even if not directly related to philosophy or research. Obviously, if you end up studying logic itself or philosophy of mathematics, then this course is the first step to do that.

This module will improve your understanding of arguments. It is crucial for students of virtually any subject. During your time here in this master program you will be reading, and writing, a large amount of *academic articles*. The module will help you *read* academic articles, since academic articles contain arguments, and you need to be able to assess their cogency. And it will help you *write* academic articles: your essays, in virtually any subject, need to be structured as arguments—and they need to be cogent! Last, but not least, you will need to use and assess arguments throughout your lives.

This course is specially designed for MA students who either lack a logic background or would like a refresher. There are no prerequisite to take this course, so everyone is free to attend it regardless of his/her background. In particular, **no mathematical background or skills are needed nor expected!**

Homework

This is not like any other philosophy module:

- It is not essay-based.
- You will be learning general techniques rather than particular theories.

Accordingly, what we'll learn throughout the semester is *how to practice general techniques*. So there'll be plenty of exercises.

Every week, I'll give you some exercises (you can find them in the course website). You will need to do the exercises, or at least to give it your very best shot. If you get stuck, or have difficulties, or are not confident about that week's material, please come and see me during my office hour (see above), and/or raise your concerns at the beginning of the class.

Every week, I will be calling some of you at the board, and you'll show me, and the class, how you did some of that week's exercises. If you weren't able to finish the exercises,

1. **that's perfectly OK** and normal: we're here to learn;
2. please come and see me, before the class, during my office hour, so we can try to go through the problem and solve it together.

The aim of the class is to teach you the techniques you'll be tested on in April and June—and to show how they are relevant for evaluating arguments in natural language. It is therefore *in your interest* to bring up any difficulties you might have, and do the weekly exercises. If you try to hide, or skip exercises classes because you haven't been able to do the weekly exercises, you will likely not be able to pass the in-class test.

It is now required that you send me your exercises by email every Thursday. I will correct them and send them back with some comments.

How to pass this course successfully

Typically, logic students do either really well, or really badly. Learning logical techniques is a bit like cycling: either you've learned how to cycle (know how to apply a certain technique), or you fall! There's no middle ways. So how to learn these techniques? The main advice I can give you is to **not fall behind**. To do that, avoid missing classes, always do your homework and, this is *crucial*, always speak up if something in class is not clear! This could be for every possible reason, and is perfectly normal. But it is really difficult to learn at home something that in class wasn't clear, so try to avoid this situation. Another thing you could do is to take a look at the exercise and the class notes before the class, so you know what we are working towards solving. This is quite helpful to get you engaged in the lecture part.

So, to reiterate:

- Don't fall behind!
- To do well you need to do some homework each week to keep up.
- Don't just try to cram in the material the week before the tests: it will be too late.
- If after the class you still aren't confident about that week's lecture material then turn up to my office hour.

I will also upload step-by-step worked out examples on how to solve particular exercises.

Readings (optional, what we say in class is enough to pass the course)

For this course I will not use any book in particular, but most of the material are taken from the following:

1. *The Open Logic Text*, Open logic Project, `https://openlogicproject.org/download/`

This contains *much more* than what is needed for the course (it contains nearly *all* of logic), but you can find all the relevant parts, and also all the course material (weekly notes, worked out examples and exercises, the books that I may quote) on my website: `www.matteodeceglie.com/Teaching`.

If you are generally interested in logic, and want to learn more about it, you should check this very comprehensive guide:

2. *Teach Yourself Logic 2020*, Peter Smith, `https://www.logicmatters.net/tyl/`.

In particular, you should consider the principal advise of this guide: always skim through more than one particular book, since something can be explained in a clearer manner in some other place!

Lastly, if you are curious about some of the history of logic, you should read the following graphic novel:

3. *Logicomix: An Epic search for truth*, Doxiadis A., Papadimitrou C., Papadatos A., 2008

Assignments and grading

- 1st Mid-term take home test, 25% on Week 6 (April 23), **due for Week 7 (April 30)**. No late submission accepted.
- 2nd Mid-term take home test, 25% on Week 11 (June 04), **due for Week 12 (June 18)**. No late submission accepted.
- Final in-class test, 30%, on **June 25**. There will be other sessions if needed (one in July and one in September).
- In-class participation, 20%.
- Attendance [from now on: sending the exercises] is required! If you miss class for more than three times (without proper justification) during the semester, you will get a 0 irrespective of how the tests go.

Student support

- If you have any problems with the course, please get in touch with the course convenor (MdC).
- If you need to talk about any problems affecting your work, please contact the Head of Department, Alexander Hieke (`alexander.hieke@sbg.ac.at`).

Weekly breakdown (indicative, provisional, and subject to change!)

Week [Date]	Lecture	Exercise focus
1 [05/03]	Introduction (logistic of the course, arguments)	Valid/invalid arguments
2 [12/03]	Propositional logic: Syntax (connectives, translations)	Translations
3 [19/03]	Propositional logic: More on syntax and connectives (language, formulas, truth tables)	Well-formed formulas
4 [26/03]	Propositional logic: Semantics (tautologies, contradictions, contingency)	Truth tables
5 [02/04]	Propositional logic: Natural deduction I - Rules and derivations	Derivations
6 [23/04]	Propositional logic: Natural deduction II - Proof-theoretic notions (derivability, consistency) **1st Midterm Take - home test**	Derivations
7 [30/04]	First order logic: Syntax (languages, quantifiers. terms and formulas, variables substitution) **1st Midterm Take - home test due**	Variables substitutions
8 [07/05]	First order logic: Semantics I - Structures and satisfaction (domain, interpretations, variable assignment, values, satisfaction)	Models and counterexamples
9 [14/05]	First order logic: Semantics II - Semantic notions (validity, entailment, satisfiability)	Models and counterexamples
10 [28/05]	First order logic: Natural deduction I - Rules	Derivations
11 [04/06]	First order logic: Natural deduction II - Rules (derivability, consistency) **2nd Midterm Take - home test**	Derivations
12 [18/06]	Recap **2nd Midterm Take - home test due**	Recap
13 [25/06]	**Final exam**	-