Philosophy Faculty Reading List and Course Outline 2018-2019

PART IA PAPER 05: FORMAL METHODS

SYLLABUS

- Basic notions: object-/meta-language; use/mention; validity & consistency
- Truth-functional logic: syntax; semantics; proofs
- First-order logic: syntax; semantics; proofs
- Classes and relations
- Elementary probability theory

Course Outline

This compulsory course introduces students to elementary formal methods.

This is important, since a basic working knowledge of formal methods is presupposed in almost every other area of English-speaking philosophy. However, these formal methods also generate deep philosophical questions of their own (to be explored in other papers).

A key notion is the idea of a deductively valid argument (e.g. All men are mortal; Socrates is a man; so, Socrates is mortal). We can ask about the validity of arguments in natural languages (such as English); but this is likely to be imprecise and intuitive. However, we can also construct artificial (but precise) formal languages, and ask precise questions about the validity of arguments in those formal languages.

Students will be introduced to two simple formal languages: truth-functional logic and first-order logic. They will practise moving between English and these formal languages. They will also learn how to approach both languages semantically (via valuations and interpretations) and proof-theoretically (via natural deductions).

Students will then apply these techniques to elementary reasoning about classes and relations. They will also study the elements of probability theory.

For exam purposes, this paper carries only half of the weight of Papers 1-4.

Objectives

Students will be expected to:

1. Acquire a broad understanding of the scope and purpose of formal logic
2. Learn how to symbolise natural language arguments using formal languages

3. Become familiar with semantic and proof-theoretic concepts
4. Acquire an elementary understanding of classes, relations, and probability

Prerequisites

None; this is a self-contained introduction to formal methods for philosophers.

Preliminary Reading

There is no need to do any preliminary reading. However, the main textbook is MAGNUS & BUTTON (see below), and some students may find it helpful to dip into this before the course begins. Equally, some students may want to look at STEINHART (see below).

BASIC NOTIONS

(A) Basic Reading

The textbook for the first three topics on the syllabus is:

MAGNUS, P.D., and Tim BUTTON, 'Forallx: Cambridge' [Online]. Available at: http://people.ds.cam.ac.uk/tecb2/forallxcam.pdf (Accessed: 8 September 2018).

Important Warning. Every logic textbook is idiosyncratic in various ways. Quite apart from differences in emphasis, different books may use:

- different nomenclature (e.g. “predicate logic” rather than “first-order logic”);
- different deductive systems (e.g. taking different rules as primitive);
- different notational conventions (e.g. “~” or “–” instead of “¬” for negation; Appendix A of *forallx*: Cambridge version summarises the various alternatives).

To repeat: the official textbook for this part of the course is ***forallx: Cambridge***. This is what you will be taught from, and it is what you will be examined on. If in doubt, ask the lecturer, your supervisor, or your logic class tutor. With this **Important Warning** in mind, students may wish to read beyond the textbook.

(B) Further Reading

These will give you more practice on moving between formal and natural languages:

BERGMANN, Merrie,James MOOR, and Jack NELSON, *The Logic Book* (Boston, MA: McGraw-Hill Education, 2013), sects. 2.2-2.4 & 7.3-7.4.

FORBES, Graeme, *Modern Logic: A Text in Elementary Symbolic Logic* (Oxford: Oxford University Press, 1994), chs. 2, 5 & 7.

GOLDFARB, Warren, *Deductive Logic* (Cambridge, MA: Hackett, 2003), sects. 1-8, 18-22 & 28-29. Also available online at: http://www.gutenberg.org/ebooks/6560

GUTTENPLAN, Samuel, *The Languages of Logic: An Introduction to Formal Logic*. 2nd ed. (Oxford: Blackwell, 1997), chs. 7 & 13.
KLENK, Virginia, Understanding Symbolic Logic (Pearson, 5th edition 2007), chs. 4 & 13, *Understanding Symbolic Logic*. 5th ed. (Upper Saddle River, NJ: Pearson Prentice Hall, 2007), chs. 4 & 13.
SMITH, Peter, *An Introduction to Formal Logic* (Cambridge: Cambridge University Press, 2009), chs. 23-24 & 33-34.
TELLER, Paul, *A Modern Formal Logic Primer* (Englewood Cliffs, NJ: Prentice Hall, 1989), vol. 1; ch. 2 & vol. 2; ch. 4. Also available online at: http://tellerprimer.ucdavis.edu

This article discusses the idea of logical consequence, going into more detail than *forallx*:

BEALL, J.C., and Greg RESTALL, 'Logical Consequence', in E.N. Zalta, ed., *Stanford Encyclopedia of Philosophy (Winter 2016 Edition)* [Online]. Available at: https://plato.stanford.edu/archives/win2016/entries/logical-consequence/ (Accessed: 6 August 2018).

CLASSES AND RELATIONS

(A) Basic Reading

STEINHART, Eric, *More Precisely: The Math You Need to Do Philosophy* (Peterborough, ON: Broadview Press, 2009), chs. 1 & 2.

The book's website is at: www.ericsteinhart.com/TOOLS/tools-resources.html. Some further support materials and exercises can be found there. You might also read:

PAPINEAU, David, *Philosophical Devices: Proofs, Probabilities, Possibilities, and Sets* (Oxford: Oxford University Press, 2012), ch. 1 'Naive Sets and Russell's Paradox'. Also available online at: www.dawsonera.com

(B) Further Reading

As an alternative to Steinhart, you could consider:

POLLOCK, John L., *Technical Methods in Philosophy* (Boulder, CO: Westview Press, 1990), ch. 1, sects. 1-3.

Here is a different treatment of relations:

HODGES, Wilfrid, *Logic* (London: Penguin, 1977), sects. 30-33. Also available on Moodle

Some students prefer brisker, less 'conversational', introductions to the core concepts and notation of set theory. Those students might try:

DEVLIN, Keith, *The Joy of Sets*. 2nd ed. (New York, NY: Springer, 1993), ch. 1 'Naive set theory'. Also available on Moodle
HALMOS, P., *Naïve Set Theory* (New York, NY: Springer, 1974).

ELEMENTS OF PROBABILITY THEORY

(A) Basic Reading

STEINHART, Eric, *More Precisely: The Math You Need to Do Philosophy* (Peterborough, ON: Broadview Press, 2009), ch. 5 'Probability'.

(B) Further Reading

Here are two alternative introductions to probability theory:

HACKING, Ian, *An Introduction to Probability and Inductive Logic* (Cambridge: Cambridge University Press, 2001). [Especially the part 'How to Calculate Probabilities']
KYBURG, Henry E., *Probability and Inductive Logic* (London: Macmillan, 1970), ch. 2 'The Probability Calculus'. Also available on Moodle

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We welcome your suggestions for further readings that will improve and diversify our reading lists, to reflect the best recent research, and important work by members of under-represented groups. Please email your suggestions to phillib@hermes.cam.ac.uk including the relevant part and paper number. For information on how we handle your personal data when you submit a suggestion please see https://www.information-compliance.admin.cam.ac.uk/data-protection/general-data.