Advanced Topics in Logic
Hanoch Ben-Yami

2019–20 Winter Term
No. of Credits: 2. No. of ECTS credits: 4
Time-Period of the Course: one semester
Course Level: PhD

Description
The course is divided into two parts: (i) the truth-valuational approach to logic; (ii) the quantified argument calculus.

(i) The standard semantics for the Predicate Calculus and other formal systems is model-theoretic, using domains and interpretation functions to explain when a sentence is true, and with this theory of truth define validity and prove various properties of the calculus, primarily soundness and completeness (“adequacy”). We shall criticise this semantics, claiming that its concepts of object and of reference are empty. We shall then replace it with a truth-valuational substitutional approach, which does away with models. Like the truth-table approach in the Propositional Calculus, the truth-valuational approach is a theory of truth-value relations between sentences and not a theory of truth. We shall prove the adequacy of the first order predicate calculus on the truth-valuational approach. We shall next apply this approach to modal logic and prove the adequacy of the Modal Propositional Calculus without recourse to possible worlds. Our conclusions will be, among other things, that models (in the sense of Model Theory) and possible worlds can be eliminated from logic.

(ii) Frege’s logic allots the role of argument only to singular terms, and in this way departs from Natural Language, in which quantified arguments also occupy that role. By contrast to Natural Language, Frege introduced quantification into his calculus as a sentential operator. We shall follow Natural Language in having the quantifier attach to a one-place predicate to form a quantified argument. This departure has far-reaching consequences, which we shall pursue. We develop a formal system which is closer in many respects to Aristotle’s logic than to Frege’s, the Quantified Argument Calculus (Quarc). It will incorporate elements analogous to Natural Language’s negative predication, converse relation terms, anaphora, and more. We also develop a deductive system which we prove to be adequate. We then apply the system to modal logic, show how it incorporates a de dicto – de re distinction, how it invalidates the Barcan formulas, and more. We also consider extensions of the system to three-valued logic, incorporation of the ‘there is’ structure and of definite descriptions, and more; part of this is work-in-progress. A conclusion shall be that this system should replace the Predicate Calculus as a tool for representing and studying the logic of Natural Language.

Breakdown into units
Weeks 1-5: Part (i)

Weeks 6-12: Part (ii)

Course requirements
Attendance, readings and participation in discussion. A few written assignments – logic exercises – will be given during the course, with a Pass/Fail grade.
Assessment
Home exam 80%. Assignments 20%. Participation in class can contribute up to plus one grade (from B to B+ etc) to the final grade.

Course Goals
Thorough familiarity with the truth-valuational substitutional approach, which is an important alternative, logically and philosophically, to model-theoretic semantics. Familiarity with Quarc, an alternative to Predicate Logic which is closer to the logic of Natural Language and contributes to the clarification of several logic concepts.

Learning outcomes
Apart from the course goals, the students will acquire improved competence in formal logic, knowledge of the history of logic, and a deeper understanding of some of the logic issues that have occupied contemporary philosophy.

Readings
For Part (i):

For Part (ii):