

Logic 2: Modal Logics

Course Guide (2020/2021)

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Course description

This course is a follow-on course to Logic 1 focusing on modal extensions of classical propositional and predicate logic. Modal logic is used to reason about possibility and necessity, knowledge and belief, permission and obligation, past and future, and a variety of other topics. The first part of the course will introduce standard models and proofs for propositional modal logic, with a brief look at the meta-logical properties of soundness and completeness. We will then go through a range of philosophical applications, studying the logic of knowledge, the logic of obligation, the logic of time, and logical properties of ‘if-then’ constructions. Finally, we will turn to quantified modal logic. We will look at the choices between constant and variable domains, rigid and non-rigid names, and discuss whether standard predicate logic should be weakened to a “free” logic.

Weekly classes will probably consist of online lectures and tasks, as well as a two-hour live tutorial, of which the first hour is compulsory.

Due to uncertainty about the extent to which the university will be open for in-person classes, information about class timing and format is subject to change. Please consult the LEARN page for the course.

The lecture notes with exercises are available at <https://www.wolfgangschwarz.net/logic2/logic2.pdf>. This is the only required reading.

If you want to get a wider perspective, you may find one or more of the following books useful (listed in increasing difficulty):

- Rod Girle, *Modal Logics and Philosophy*, 2nd edition, 2009
- Graham Priest, *An Introduction to Non-Classical Logic*, 2nd edition, 2008
- G.E. Hughes and Max Cresswell, *A New Introduction to Modal Logic*, 1996

Assessment

The course is assessed by three take home tests, accounting for 20%, 30%, and 50% of the mark.

Provisional syllabus

Week 1: Modal Operators

Reasoning with necessity and possibility. Translating from English. Different meanings of 'possible'. Some logical principles.

Week 2: Possible Worlds

Basic possible-worlds semantics for modal propositional logic. Tree rules to establish validity and to find counterexamples.

Week 3: Accessibility

Adding an accessibility relation to possible-worlds models. Properties of the accessibility relation and corresponding logical systems.

Week 4: Proofs

Soundness and completeness for trees and axiomatic proofs. A brief look at the logic of provability.

Week 5: Epistemic Logic

The logics of knowledge and belief. Gaining information as excluding possibilities. Modal logics with multiple modalities. Interaction principles.

Week 6: Deontic Logic

The logic of obligation and permission. Ideal-worlds models. Some puzzles and paradoxes. Neighbourhood models. The concept of conditional obligation.

Week 7: Temporal Logic

The logic of past, present, and future. Worlds and times. Branching time. 'Now'. Two-dimensional modal logics.

Week 8: Conditionals

The "paradoxes of material implication". Strict implication. Lewis-Stalnaker conditionals. If-clauses as restrictors.

Week 9: Towards Modal Predicate Logic

Modality de dicto and de re. Predicate logic recap. Predicate logic as a modal logic. Challenges for a modal predicate logic.

Week 10: Semantics for Modal Predicate Logic

Quantification and existence. Constant domain models and variable domain models. Free logics. Rigid and non-rigid designators.