

# Logic 2: Modal Logics

## Course Guide (2019/2020)

### Course organiser:

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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 consist of a two one-hour lectures plus a two-hour tutorial (of which only the first hour is compulsory).

Lecture notes with exercises will be made available each week, and are the only required reading.

You are encouraged (but not required) to work through the following textbook alongside the classes:

- Rod Girle, *Modal Logics and Philosophy*, 2nd edition, 2009

If you want to know even more, get one (or both) of these:

- Graham Priest, *An Introduction to Non-Classical Logic*, 2nd edition, 2008
- G.E. Hughes and Max Cresswell, *A New Introduction to Modal Logic*, 1968

## Assessment

In addition to the final exam, which accounts for 50% of the grade, there will be two take-home tests, the first counting 20%, the second 30%.

## 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: 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: Existence

The connection between quantification and existence. Constant domain models and  
variable domain models. Free logics.

### Week 11: Trans-World Identity

Rigid and non-rigid designators. Contingent identity. Counterpart models.