Modal Logic

Carnegie Mellon University
Fall 2012

Instructor:	Dr. Gregory Wheeler
E-Mail:	wheeler@cmu.edu
Website:	http://gregorywheeler.org
Office:	Baker Hall 155C
Office Hours:	Wednesday 11:00 - 12:00 & by appointment
Classroom:	Hamburg Hall, 1002
Meeting Times:	Monday & Wednesday, 12:00 - 1:20

Course Description

Modal languages are simple languages for talking about relational structures, with several applications appearing in philosophy, computer science, and linguistics. This course is an introduction to modal logic and to some of its applications. The first part of the course will provide a thorough grounding in normal propositional modal logic. We will introduce the standard model theory (invariance results, the relationship between modal and first-order logic, the finite model property, and notions of modal model equivalence), common normal systems, proof systems, soundness, completeness, decidability, and basic complexity results. We will also consider two important extensions to the standard theory. The first extends the language to accommodate first-order quantification. The second extends the semantics to talk about more fine-grained relational structures. The second part of the course will cover various applications of modal logic, including epistemic logics, conditional logics, deontic logics, action-event logics, logics of information, an temporal logics. The third part of the course introduces some limitations of modal logics, including incompleteness results and complexity problems that arise from combining modalities.

Requirements

Required Texts:	Johan van Benthem (2010), *Modal Logic for Open Minds*. (*MLOM*) Brian Chellas (1980), *Modal Logic*, Cambridge University Press. (*ML*)
Recommended:	Melvin Fitting and Richard Mendelsohn (1998), *First-Order Modal Logic* (*FOML*), *Synthese Library*, Springer.
Problem Sets:	5 Exercise sets
Midterm Exam:	Take home exam, due October 17, 2012
Final Exam:	Held during the scheduled final exam period. (*no exceptions*)

Course Schedule

Week	date	Topic	Readings	Assignments
1	8/27	Introduction	*MLOM*, ch 1	
	8/29	Basic Language & Kripke Semantics	*MLOM*, ch 2	
2	9/3	*Labor Day Holiday*		
	9/5	Expressive Power & Invariance	*MLOM*, ch 3	Set 1
3	9/10	Validity & Decidability	*MLOM*, ch 4	
	9/12	Axioms, Proofs, & Completeness	*MLOM*, ch 5	Set 1 due.
4	9/17	Computation & Complexity	*MLOM*, ch 6	
	9/19	Varieties of Expressive Power	*MLOM*, ch 7	Set 2
5	9/24	Increasing Deductive Power:	*MLOM*, ch 8	
		The Landscape of Modal Logics	*ML*, ch 4	
	9/26	TBD		
6	10/1	Frame Correspondence	*MLOM*, ch 9	Set 2 due.
	10/3	Abstract Model Theory	*MLOM*, ch 25	Set 3
7	10/8	Extended Modal Languages	*MLOM*, ch 10	
	10/10	Neighborhood Semantics	*ML*, ch 7	Set 3 due.
8	10/15	Classical Systems	*ML*, chs 8 & 9	
	10/17	MIDTERM EXAM		
9	10/22	Modal Predicate Logic	*MLOM*, ch 11	
	10/24	Barcan Formulas	*FOML*, ch 4	
10	10/29	Systems of Modal Predicate Logic	*FOML*, ch 6	Set 4
	10/31	Modal Foundations for Classical Logic	*MLOM*, ch 27 & Appendix A	
11	11/5	Epistemic Logic I	*MLOM*, ch 12	Set 4 due.
	11/7	Epistemic Logic II		
12	11/12	Conditional Logic	*MLOM*, ch 13	
	11/14	Dynamic Logic: Action & Events	*MLOM*, ch 14	Set 5
13	11/19	Logic and Information Dynamics		
	11/21	*Thanksgiving Holiday*		
14	11/26	Deontic Logic	*MLOM*, ch 16	
	11/28	Temporal Logic	*MLOM*, ch 18	Set 5 due.
15	12/3	Combining Modalities	*MLOM*, ch 24	
	12/5	Incompleteness	*MLOM*, ch 26	
16	tba	FINAL EXAM		

Grading

You are allowed to discuss the problem sets with your classmates in attempting to solve the exercises, but each student must write up independent answers. If you collaborate with another student in solving a particular exercise, you must identify who that student is and note which problems you collaborated on. Failure to note collaboration or copying answers verbatim constitutes academic dishonesty.

The problem sets and midterm exam are to be completed outside of class. The final exam will be administered during the scheduled examination period. In order to pass the course, you must pass the final exam. Therefore, you should view the problem sets and the midterm exam as preparation for your end-of-term exam.

30% Problem Sets (5 problem sets will be assigned)
30% Midterm Exam, October 17, 2012
40 % Final Exam‡

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‡ **You must pass the final exam to pass the course:** If you pass the final exam, then your final exam grade will count for 40% of your course grade. If you fail the final exam, then your final exam grade will be your grade for the course.