PHIL736: Logic 1
Advanced Modal Logic

Semester 1: 2013

This course gives you the fundamental mathematical and logical tools to undertake research in applied modal logic. We will emphasize model theoretic techniques and investigate how to choose logical languages for modeling purposes. The upshot of the course is that modal logic, seen as a fragment of First-order Logic, provides an ideal balance between expressivity and complexity for practical investigations. The course is based on weekly assignments taken from the textbook. You will need a great level of autonomy throughout the semester, but I will give as much support as I can.

- Lecturer: Patrick Girard
  Email: `p.girard@auckland.ac.nz`
  Phone: 373 7599 ext 82752.
  Office Hours: By appointment, or drop by and see if I'm there. I'm always happy to talk about modal logic.
  My office is in the dungeon, Arts II, level 2, room 209.

- Lectures: Thusday, 12:00-14:00
  Room: 240-G03.

- Textbook: *Modal Logic*, Patrick Blackburn, Maarten de Rijke and Yde Venema, Cambridge University Press, 2002.

  This book has been quite standard in the modal logic community since its publication. It is a very good reference to have if you intend to pursue research in logic.

- Recommended readings:

You should read the introduction of the *Handbook of Modal Logic* by Johan van Benthem and Patrick Blackburn, entitled "Modal Logic: A Semantic Perspective". It is available as an e-book via the university library with your UPI.

There are plenty of good books on modal logic, of which I recommend the following:

1. Herbert B. Enderton. *A mathematical introduction to Logic*. New York, Academic Press, 1972. Admittedly not a book in modal logic! But if you need to brush up on first-order logic during the course, this is a very good reference. In particular, look at the so-called "Hilbert style" axiomatization of first-order logic, which is the style used in our textbook - and quite different from what you have learned in PHIL222, although equivalent.

2. *Handbook of Modal Logic*, edited by Patrick Blackburn, Johan van Benthem and Frank Wolter, Elsevier, 2007. This book is available as an e-book with your UPI and you will find there anything you ever wanted to know about logic as well as references.

3. van Benthem, Johan. *Modal Logic for Open MInds*, CSLI publications, 2010. This is a more informal version of pretty much the same material as in our textbook, but with further more up to date applications. We might refer to it in the course.

4. G. Hughes and M.J.Cresswell. *A New Introduction to Modal Logic*, Routledge, 1996. This book is the reference for modal logic as practiced until the 1980's. It presents Modal Logic in the traditional way with emphasis on axiomatics. The textbook we use is in the more recent *Dutch* tradition and is now dominant in research, especially in Europe.

5. R. Goldblatt (Victoria University), *Mathematics of Modality*, volume 43 of *Lecture Notes*. CSLI Publications, 1987. You can download the book from Goldblatt's webpage:

   http://homepages.ecs.vuw.ac.nz/∼rob/

   This book is maybe less user-friendly than the textbook we are using, but is mathematically very precise and one of the best references you will find.

6. Alexander Chagrov and Michael Zakharyaschev. *Modal Logic.* Oxford, Clarendon Press, New York, Oxford University Press, 1997. This is another standard reference in the more mathematical modal logic community. The Dutch approach we are studying in this course is more popular with computer science and is more oriented towards applications, or at least this is how I will lead this course.

7. B. G. Chellas. *Modal Logic, an Introduction.* Cambridge University Press, 1980. I do not think this book really qualifies as an introductory book. I am including this book here because it focuses on a semantics for modal logic known as "neighborhood semantics", which is more general than the now standard Kripke semantics in terms of possible worlds. If you are under the impression that modal logic is committed to some weird metaphysical assumptions on possible worlds, Chellas's book should convince you that this is in fact very misguided. On the other hand, it might also convince you that Kripke semantics is much more amicable - and thus more popular.

- Assessment: 100% Coursework.
  Each week, you will be asked to submit your solutions to 2 exercises taken form the textbook (to keep balance, we sometimes combine two exercises into 1, indicated with +). You have the choice of not submitting solutions on two occasions. You will thus have to submit a total of 20 questions during the semester, and each will count for 5% or your final mark. If you don't submit your exercises the following week, that's it, I won't look at it. But if you do, I'll give you as many chances as you want to re-submit, until we are both happy that you understand the solution.

  Alternatively, you may choose to submit a total of 10 questions and write a final paper on a topic to be decided in consultation with me.

- Schedule:

NB: There are 13 weeks on the calendar this semester, but we will only meet 12 times. This course will end at the end of week 12.

Week 1, March 4 - March 10		
Readings	Preface:	p. xi-xix
	§ 1.1:	p. 1-7
	§ 1.2:	p. 9-13
Exercises	§ 1.1:	1.1.1-1.1.5
	§ 1.2:	1.2.1-1.2.3, 1.2.5
To submit on 05/03/12	1.1.1 & 1.2.1 + 1.2.3	

Week 2, March 11-17		
Readings	§ 1.3:	p. 16-23, 24-26
	§ 1.5:	p. 31-32
	§ 1.6:	p. 33-37
	§ 1.7:	p. 37-49
Exercises	§ 1.3:	1.3.1-1.3.5
	§ 1.5:	1.5.1-1.5.3
	§ 1.6:	1.6.1-1.6.7
To submit on 12/03/12	1.3.3 & 1.6.1	

Week 3, March 18-24		
Readings	§ 2.1	p. 50-63
	§ 2.2:	p. 64-71
Exercises	§ 2.1:	2.1.1-2.1.7
	§ 2.2:	2.2.1-2.2.6, 2.2.8
To submit on 19/03/12	2.1.1 + 2.2.4 & 2.2.2	

Week 4, March 25-31		
Readings	§ 2.3	p. 73-82
	§ 2.4	p. 83-90
Exercises	§ 2.3:	2.3.1 - 2.3.9
	§ 2.4:	2.4.1 - 2.4.5
To submit on 26/03/12	2.3.3 & 2.3.5	

Week 5, April 1-April 7		
Readings	§ 2.5:	p. 91-98
	§ 2.6	p. 100-109
	§ 2.8:	p. 117-122
Exercises	§ 2.5:	2.5.1-2.5.8, 2.5.10-2.5.11
	§ 2.6:	2.6.1-2.6.4
To submit on 02/04/12	2.5.4 (a)-(c) & 2.6.1	

Week 6, April 8-14		
Readings	§ 3.1	p. 123-130
	§ 3.2:	p. 130-136
	§ 3.3:	p. 138-142
Exercises	§ 3.1:	3.1.1-3.1.2
	§ 3.2:	3.2.1-3.2.4
	§ 3.3:	3.3.1-3.3.4
To submit on 09/04/12	3.2.2 & 3.3.3	

Week 7, April 15- April 21		
Readings	§ 3.5	p. 148-156
	§ 3.6:	p. 156-166
	§ 3.9:	p. 183-187
Exercises	§ 3.5:	3.5.1-3.5.3
	§ 3.6:	3.6.1-3.6.3
To submit on 30/04/12	3.5.3 & 3.6.1 (a)-(c), (e)-(f)	

Week 8, April 29- May 5		
Readings	§ 4.1	p. 188-195
	§ 4.2:	p. 196-201
Exercises	§ 4.1:	4.1.2-4.1.4
	§ 4.2:	4.2.1-4.2.4
To submit on 07/05/12	4.1.4 & 4.2.2	

Week 9, May 6-12		
Readings	§ 4.3	p. 201-210
	§ 4.4:	p. 211-216
	§ 4.5:	p. 217-223
Exercises	§ 4.3:	4.3.1-4.3.7
	§ 4.4:	4.4.2-4.4.5
	§ 4.5:	4.5.1-4.5.6
To submit on 14/05/12	4.3.3 (no syntactic proofs) & 4.5.5	

Week 10, May 13-19		
Readings	§ 4.6	p. 223-229
	§ 4.8	p. 239-246
	§ 4.10:	p. 256-260
Exercises	§ 4.6:	4.6.1-4.6.2
	§ 4.8:	4.8.1-4.8.8
To submit on 21/05/12	4.6.1 & 4.8.7	

Week 11, May 26-26		
Readings	§ 4.8	p. 239-246
	§ 4.10:	p. 256-260
Exercises	§ 4.8:	4.8.1-4.8.8
To submit on 21/05/12	4.8.3 & 4.8.7	

Week 12, May 27- June 2		
Readings	§ 7.1	p. 414-422
Readings	§ 7.3	p. 434-444
Exercises	§ 7.1	7.1.1-7.4.4, 7.1.6, 7.1.7-7.1.9
	§ 7.3:	7.3.1-7.3.9
To submit on 28/06/12	7.1.3 & 7.3.3	