

# LOGIC, COMPUTATION AND GAMES

Tsinghua University, autumn 2023

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Website: Tsinghua web learning

The first part of this course is taught on-line, the following parts in person, including guest lectures by Zheng Gang Fellows at the Tsinghua Logic Center <https://tsinghualogic.net/JRC/zgfellows/>

*Aim* Introduction to the themes of information and agency in contemporary logic, and in the process, showing you how logic connects between several different academic fields.

*Level* This is a technical mid-level course. Students should have had a logic course or similar background [such as <http://www.logicinaction.org/>]. Each week adds new skills plus outlooks to math, computer science, philosophy, etc., including current research problems.

*Reading materials* (course notes, parts of books, papers) will be posted on the course website, plus slides of on-line presentations. You should skim the material lightly before each class and read it again afterwards. Many readings are from the books “Modal Logic for Open Minds” (MLOM) and “Logical Dynamics of Information and Interaction” (LDII), but we will also post special materials for later topics that are not covered in these books.

*Note:* The content of this course is only what is presented on slides/whiteboards in class.

## Current plan

### *Taught on-line by Johan van Benthem*

<i>Part I</i>	<i>Dynamic Logics of Information, Knowledge and Belief</i>	
<i>Week 1</i>	Epistemic logic	LDII, Ch. 2
	Public announcement logic	LDII, Ch. 3
<i>Week 2</i>	Logic of conditional belief	MLOM, Ch. 13
	Belief revision	LDII, Ch. 7

### *Taught in person by Professor Thomas Bolander (Copenhagen)*

<https://orbit.dtu.dk/en/persons/thomas-bolander>

<i>Week 3</i>	General dynamic-epistemic update and epistemic planning	LDII, Ch.4
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*Taught in person by Professor Ram Ramanujam (Chennai)*

[https://www.imsc.res.in/r\\_ramanujam](https://www.imsc.res.in/r_ramanujam)

<i>Week 4.1</i>	Modal logics and computational complexity	MLOM, Ch. 6
<i>Week 4.2</i>	The modal mu-calculus	MLOM, Ch. 22

*Taught in person by Johan van Benthem*

<i>Part II</i>	<i>Further Mathematical Perspectives</i>	
<i>Week 5</i>	Topological models for information	MLOM, Ch. 19
	Combining logic and probability	
<i>Week 6.1</i>	Combining logic and counting	
<i>Part III</i>	<i>Games and Interaction over Time</i>	
<i>Week 6.2</i>	Logics for analyzing extensive games	
<i>Week 7</i>	Logics for strategic and evolutionary games	
	Graph games and logic design	
<i>Week 8</i>	Games for analyzing logic	
	<i>Student presentations</i>	

*Explanation.* In Part I, we look at semantic information, knowledge, and the laws governing their update, and after that, spaces with plausibility orderings that support beliefs, belief revision and learning. We also define much more general updates that mix private and public information with applications in epistemic planning. We end this part with two computational themes: computational complexity of the modal logics used in this course and related ones, and on background in the modal mu-calculus as a basic theory of computation. Part II adds three mathematical perspectives on information: topology, and probability, and we discuss how quantitative models combine naturally with qualitative logical ones. Finally, Part III is about games, a model for strategic interactive agency taking place over time, using interfaces with the logics presented earlier. In addition to logical core theory, the course has outlooks to CS, AI, linguistics, cognitive science, game theory and formal philosophy.

*Class time structure* Presentation Part I (40 minutes), questions (5), break (5), presentation Part II (40), questions (5). The teaching assistants will moderate the in-class procedure during the first two on-line weeks of the course.

*Requirements* Weekly homework, at the end: minipaper + short presentation.

Homeworks contain standard questions and occasional bonus questions, graded by point totals. HWs will be posted each Tuesday, are due the Sunday after, and are returned graded by the next Thursday, when short model answers will be posted.

Minipaper: some 4 pages, presentations: 5 ppt slides. The presentation is your try-out for the paper. Further details later on the website.

*Contacts* There are 10 (5 + 5) minutes for asking questions during class. During the week, you can email your further questions or comments to the assistant or the teacher. Also, the TA will hold office hours, and you can make appointments with the teacher.

If time and energy permit, we may add a few 'recap and further directions' sessions, one after each completed part, for which students can send in broader questions beforehand.