Formal Tools in the Study of Language

Master in Cognitive Science
PSL & Université Paris Descartes
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Level: 2
Major(s): Linguistics
Semestre: S1, **ECTS:** 4
Number of hours: 36h CM/TD
Prerequisites: Introduction to linguistics
Course taught in: English
Code: LING 102

1a. Course description (English)

The purpose of this course is to present an introduction to several formal frameworks relevant for linguistics (mostly within discrete mathematics). The first part bears on formal language theory (finite state automata, formal grammar, complexity of formal and natural languages). The next topic is first order logic, viewed mostly as a means to represent natural language semantics. Finally, some elements of lambda-calculus will be presented, so that students can get a first idea of Montague's research program: treat English as a formal language.

1b. Description du cours (Français)

L'objet de ce cours est de proposer une introduction à plusieurs cadres formels pertinents pour la linguistique (mathématiques discrètes). On commence par la théorie des langages formels (automates, grammaires formelles, complexité des langages formels et des langues naturelles). On présente ensuite la logique des prédicats, surtout vue comme un moyen de représenter la sémantique des langues naturelles. Enfin, des notions de lambda-calcul sont présentées, afin de permettre aux étudiants d'accéder aux bases du programme de recherche de Montague, qui consiste à traiter l'anglais (ou le français) comme un langage formel.

Prerequisites:
Students should have been exposed to an introductory class in linguistics.

2. Learning outcomes

On successful completion of this course, students should be able to:

- read and understand most formula used in current literature in formal syntax, semantics and pragmatics;
- produce a formal version of a simple linguistic analysis in syntax, semantics or pragmatics;
- make a choice among formal tools to describe a given linguistic phenomenon.

3a. Pedagogy, class organization and homework

Mostly lecturing, with sometimes exercises practiced in class.

3b. Assessment

There will be four homework assignments (worth 60% of the final grade) and a final exam (worth 40% of the final grade).

3c. Textbook and readings

Hopcroft, J. E., & Motwani, R. R. and JD Ullman. (2006). Introduction to Automata Theory, Language and Computation. Addison-Wesley Longman Publishing Co., Inc. Boston, MA, USA

Sipser, Michael. (1998). Introduction to the Theory of Computation. Cambridge: MIT Press.

M. Kearns, U. Vazirani. (1994). An Introduction to Computational Learning Theory. MIT Press.

Gamut, L. T. F. (1991). Logic, Language, and Meaning, volume 1: Introduction to Logic. University of Chicago Press.

Gamut, L. T. F. (1991). Logic, Language, and Meaning, volume 2: Intensional Logic and Logical Grammar. University of Chicago Press.

Van Benthem, J. (2010). Modal Logic for Open Minds. Palo Alto: CSLI Publications.

Osborne, M. J. (2004). An introduction to game theory. New York: Oxford university press.
Perea, A. (2012). Epistemic game theory: reasoning and choice. Cambridge University Press.

4. Course content

Formal Language Theory
Formal Learning Theory
Predicate logic (review)
Lambda Calculus
Modal logic

5. Course policies

Some course policies are general to all Cogmaster courses. These common policies are:

- Attendance is mandatory and verified. More than 2 justified absences means that students can no longer validate a course for credit (ECTS).
- Final grades below 6/20 are eliminatory (i.e. the credits cannot count towards the 30 ECTS necessary to validate a semester).
- There is no second session (“rattrapage”).
- The minimal penalty for plagiarism is the removal of the ECTS from the student’s course contract.
- Courses are indivisible; students cannot follow and validate only part of a course for partial credit.

Laptop/phone policy: describe whether laptops and/or mobile phone use will be forbidden/authorised/encouraged in class, under what conditions and why.

Attendance. Regular attendance of, and punctual arrival at, both lectures and TD are crucial to succeed in this course, and they are mandatory for all students registered for credit. This is important both for your individual success in this course, and for every other students’ success. Keep in mind in particular that, by arriving late, you are jeopardizing your own but also your classmates’ education by disrupting the flow of lectures. Practically speaking, if you are registered for credit then your grade will suffer from poor attendance or recurrent late arrivals. If you are not registered for credit, the same policy applies, though with different consequences: poor attendance or recurrent late arrivals may force us to ask you to stop auditing the course.

Participation. You are strongly encouraged to participate in lectures and in TD. This means asking deep and challenging questions, but also asking simple questions, asking for clarification, saying “I’m just not getting this, please explain it in some new way” or “I’m lost, can you remind me why we’re talking about this?” You can ask questions in French at any time.

Contacting the instructor and TA via Schoology is the best way to contact us when you have brief questions.

Homework. All homework assignments are to be handed on time via Schoology. You can write up your answers in French or in English (NB you will not lose points for grammatical mistakes!). If you hand in all of the assignments, your lowest score will be factored out. Importantly if you do not hand in all of the assignments, your lowest score (namely 0) will not be dropped, and your grade will suffer accordingly. Naturally, exceptions will be considered on a case by case basis given adequately documented extraordinary circumstances.

Discussing assignments with classmates You are allowed (and to some extent encouraged) to discuss homework assignments with your classmates. However, two things are required if you engage in substantive discussions of solutions: (i) you must indicate in your write-up the names of classmates with which you discussed solutions in some depth, and (ii) you must write up your answers to the assignment by yourself. Under no circumstances are you to share typed-up answers to the assignments or to discuss the actual write-ups. Use this opportunity for collaboration with your classmates wisely: working with a classmate who is more comfortable than you on a particular topic can help you understand that topic better; working with a classmate who knows less than you about a particular topic can help you consolidate what you know and force you to reassess fundamental elements of your knowledge. But you should collaborate with classmates in very small groups that are relatively well balanced in terms of understanding of the material.

Academic honesty policy Cheating will not be tolerated and may cost you your grade as well as have deeper repercussions in your academic career. The following is a non-exhaustive list of examples of what counts as cheating in this course: (i) signing on the attendance sheet without attending the class (e.g. signing and leaving, or signing for someone else); (ii) copying the homework write-up or the exam answers of another student, with or without that student’s knowledge; (iii) copying elements of your

solutions of exercises from sources in the literature without giving them due credit; (iv) using the same homework to validate two courses.