Logical Frameworks for Multiagent Aggregation

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Timetable: 10 hrs. Lectures in May or June or July or in Autumn.

Course requirements: No strict requirement for attending this course. A good mastery of mathematical proofs and formal modelling will be expected. Familiarity with basic notions in computational complexity (polynomial reductions, NP-completeness) and propositional logic (basic definitions, conjunctive normal form) will be useful.

Examination and grading: Final paper.

SSD: INF/01

Abstract: In this course I will provide an introduction to the various frameworks developed for the study of aggregation of individual expressions, with a focus on judgment aggregation, and explore in depth the main research questions arising in this field. Logic will be our travel companion: we will see that it is a natural tool to model individual views and rationality assumptions, and proves very useful in characterising domains in which aggregation can be performed in a safe way.

Course content: After introducing various aggregation frameworks in the first lecture, and exploring translations from one setting to the other, we will touch upon the most common problem in aggregation theory: paradoxes. We will show that most paradoxical situations, such as the Condorcet paradox in preference aggregation and the discursive dilemma in judgment aggregation, share a common structure. This will allow us to introduce the problem of collective rationality as a central research question in the study of aggregation. In the second lecture we will already show a characterisation result identifying all paradoxes that can be obtained using the majority rule. The third and fourth lectures will contain the central topics of the course, in which we will learn the two most important techniques used in proving characterisation, possibility and impossibility results in judgment aggregation and Social Choice Theory in general. First, we will focus on non-independent aggregation procedures and prove characterisation results that identify syntactically those domains in which aggregation can be performed safely. We will also show that recognising such domains is a hard computational problem (it sits in the second layer of the polynomial hierarchy). Second, we will show how to study the set of winning coalitions (i.e., sets of individuals that can force certain collective outcomes) in independent rules to obtain impossibility results. The course is ended with an overview of practical aggregation procedures for judgment aggregation recently proposed in the literature.

I will provide lecture notes at the beginning of the course.