

PhD thesis proposal

Translating preference statements expressed in natural language to formal preference languages; applications to collective decision making

Description

Standard collective decision-making mechanisms exhibit a certain rigidity, both in the format used to express voters' preferences and in the way constraints on the outcome can be stated. This is not an issue for simple problems involving the election of a single candidate, but it becomes one as soon as multiple candidates or projects are elected, or objects are allocated to individuals.

Consider, for example, the election of a representative council (such as a laboratory council): a voter may wish to express complex preferences such as *I would like a council that is more or less balanced in terms of gender and seniority, but above all, I want my research group to be represented at least in proportion to its importance within the laboratory. All other things being equal, I would like Ann, Bob, and possibly Carol to be members of the committee, and I would like Daniel and Elena not to be members.*

Another example: if I am conducting a poll to organize one or more meeting(s), rather than simply counting the number of attendees, I may want to specify soft constraints on the participants (e.g., *I prefer at least one member of each group to attend, and roughly three times as many senior members as PhD students*), and still others if several meeting dates have to be found.

Yet other examples can be found in fair division of indivisible goods.

Such preferences or constraints (by voters in the first example, by the organiser in the second one) are complex, because they involve preferential dependencies (e.g., my preference for the presence of a participant cannot be specified independently because it depends in which other participants are present).

On the one hand, preferences with such dependencies (technically, *nonseparable preferences*) have been considered in quite a lot of papers in individual and collective decision making (preference languages and logics, social choice on combinatorial domains). On the other hand, studies have mostly remained at the level of theoretical developments, for a pragmatic reason: they rely on complex formal languages for expressing preferences or constraints over combinatorial domains, which individuals or non-specialist decision-makers are likely to find difficult to use.

However, if they are allowed to express preferences or constraints in natural language, with an LLM-type tool downstream to perform the translation (along with verification tools that would need to be designed) in an interpretable formalism,

new possibilities emerge. Hence the key question: how can existing social choice mechanisms be generalized to accommodate complex preferences and constraints, with the help of current AI tools?

The first part of the PhD thesis will consist in using LLMs to translate preference statements into various formalisms such as preference logics, soft constraints, or other formal preference languages such as CP-nets. The second part will apply the findings of the first part to social choice mechanisms especially, multiwinner voting, participatory budgeting, and fair division.

Requirements and context

The candidate should have background and/or taste for some (preferably, at least two) of the following topics:

- machine learning, NLP, LLMs [important]
- computational social choice
- preference modelling
- logic
- constraint satisfaction

and a strong record (e.g., scores, recommendation letters, publications).

Context The PhD will be performed in Université Paris-Dauphine, within the PRAIRIE-PSAI institute

Supervision jointly by Jérôme Lang and Benjamin Nègrevergne, LAMSADE

Salary standard doctoral contract salary, three years, paid by CNRS (2300 € gross per month, including all social benefits; plus supplement if the student is willing to be involved in teaching or other side activities).

How to apply Contact Jérôme Lang (lang@lamsade.dauphine.fr) and Benjamin Nègrevergne (benjamin.negrevergne@dauphine.psl.eu), together with a detailed CV, a motivation letter, and at least one recommendation letter. Deadline April 30, but the sooner the better. If you need any information, please write us.