Automated design of social choice mechanisms

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Social choice

- Several agents who need to take a decision together
- They may have preferences over the set of options
- Possibly complex domains involving multiple issues and a combinatorial structure
- Example:
  - Some friends need to decide what to cook for dinner
  - They will have an entrée, a main course, and a drink
  - They can choose among 3 entrees, 2 main courses, and 4 drinks \( \Rightarrow \) 24 possible dinners to choose among
- A social choice mechanism will choose among all the options
- Two examples:
  - Plurality (each votes for one option, and we choose the one with most votes)
  - Borda (each ranks all the options and this gives points to each option, and we choose the one with the highest number of points)
The vision

• A more participative, engaging, and active society
  • Of human and/or artificial agents
• Agents will have access to mechanisms for collective choice built on solid formal foundations
• Properties of the mechanisms will be transparent to the agents
• Technology for
  • negotiating, arguing, and discussing about properties of choice mechanisms
  • synthesizing and customising specific collective choice mechanisms with some desirable properties
• Efficient ways to take collective decisions
Challenges

• To collect enough information to take an informative decision
  • Many tools (such as those in social networks) to access and share large amounts of information
• To harness this information adequately to make reasonable collective decisions
• To exploit the combinatorial structure of the set of possible decisions in order to avoid an explosion of the computational complexity of the task
• **To allow agents to specify, discuss, and agree about desired properties of a choice mechanism**
  • There are so many choice mechanisms, but usually we want to use one with certain specific properties
• **To synthesize choice mechanism with some specified desired properties**
  • Such as: fairness, priorities, etc.
• Formal tools to do all this, otherwise
  • No accountability
  • No explanations
  • No transparency
  • Manipulation
  • Decisions that do not reflect the agents’ preferences

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Example

• Agent 1: I like Plurality, except that I would like also that
  • Agent 2 has priority over agents 3 and 4
  • Manipulability from agents 5 and 6 should not be allowed
• Agent 2: I prefer scoring rules
• Agent 3: I don’t care which choice mechanism we use, but I would like agents of type A and of type B to be treated equally

➔ tools for specifying, negotiating, arguing over the properties of the mechanisms
• When agents agree on the properties:
  • Example: we want to use Borda, with a priority to agent 2, and with A and B agents treated equally

➔ we need tools to synthesize a choice mechanism that has the agreed desired properties
We don’t have to start from scratch!

- Social choice
  - Voting rules, properties, impossibility results
- Computational complexity
  - Tractable and intractable problems
- Knowledge representation
  - Compact preference modelling over combinatorial domains
- Logic and formal languages
  - Description of desired properties for the choice mechanisms
But we still need to solve many issues ...

• New formal symbolic languages to specify both properties and choice mechanisms
  • Compact, readable, useful for negotiation and argumentation among agents

• Deliberation protocols, to allow agents
  • to argue over the properties and the choice mechanisms and
  • to choose a suitable mechanism for a given context

• Reasoning services on top of such languages
  • To ask if a certain choice mechanism has certain properties
  • To automatically synthesize a new choice mechanism that satisfies a given set of desirable properties
  • Also check for consistency of the properties, and check for the existence of such a mechanism