

Automated design of social choice mechanisms

Francesca Rossi
University of Padova, Italy

Social choice



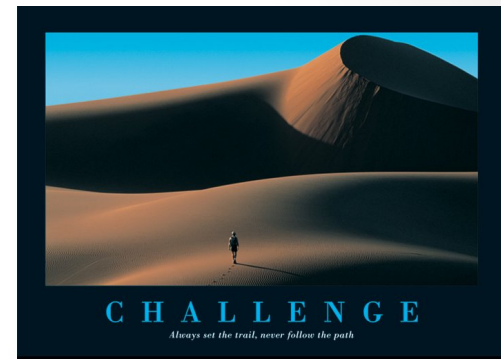
- Several agents who need to take a decision together
- They may have preferences over the set of options
- Possibly complex domains involving multiple issues and a combinatorial structure
- Example:
 - Some friends need to decide what to cook for dinner
 - They will have an entrée, a main course, and a drink
 - They can choose among 3 entrees, 2 main courses, and 4 drinks → 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



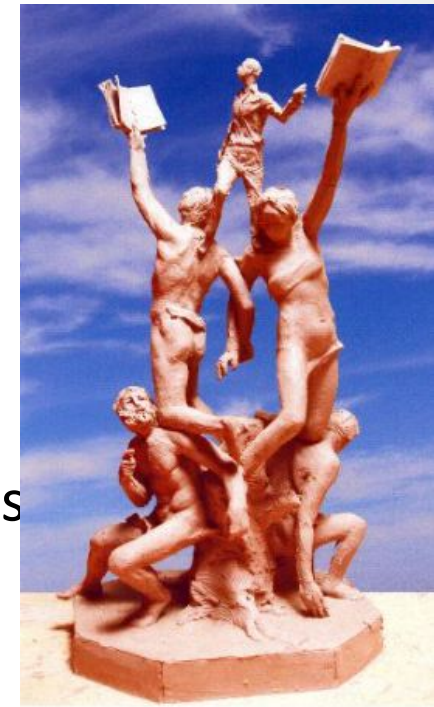
- To collect enough information to take an informative decision
 - Many tools (such as those in social networks) to access and share large amounts of information
- To harness this information adequately to make reasonable collective decisions
- To exploit the combinatorial structure of the set of possible 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

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