

# Computational Social Choice Summer School San Sebastian, 18-22 July 2016



Computational social choice is an interdisciplinary field of study at the interface of social choice theory and computer science, promoting an exchange of ideas in both directions. On the one hand, it is concerned with the application of techniques developed in computer science, such as complexity analysis or algorithm design, to the study of social choice mechanisms, such as voting procedures or fair division algorithms. On the other hand, computational social choice is concerned with importing concepts from social choice theory into computing.

The objective of the summer school is to provide an in-depth introduction to the research area of computational social choice, covering the topic from the perspectives of economics, mathematics, and computer science. The summer school consists in tutorials, and presentations by trainees. The scientific Committee is composed of the Management committee of the COST Action IC 1205 (<http://www.illc.uva.nl/COST-IC1205/>)

### **Organizers**

- Ulle Endriss (University of Amsterdam)
- Elena Iñarra (University of the Basque Country)
- Jérôme Lang (University Paris Dauphine)
- Annick Laruelle (University of the Basque Country).

### **Tutorials:**

- Axiomatic Foundations of Voting Theory (William Zwicker)
- Domain Restrictions in Voting (Edith Elkind)
- Strategic Behaviour in Voting (Reshef Meir)
- Proportional Representation (Friedrich Pukelsheim)
- Matching Theory (Katarina Cechlarova)
- Fair Allocation of Indivisible Goods (Nicolas Maudet)
- Judgment Aggregation (Umberto Grandi)

### **Local Committee**

- Elena Iñarra, Dep. de Fundamentos del Análisis Económico I
- Annick Laruelle, Dep. de Fundamentos del Análisis Económico I
- Federico Valenciano, Dep. de Economía Aplicada IV

### **Sponsors**

- COST Action IC1205 "Computational Social Choice"
- Fundación Urrutia Elejalde
- University of the Basque Country (UPV/EHU)

## Tutorials

### 1. Axiomatic Foundations of Voting Theory (William Zwicker)

Voting takes place when ballots are used as the basis for a collective decision reached via a voting rule. Our focus will be on *social choice functions* (aka SCFs) – voting rules that use *ranked* ballots. We will explore a variety of SCFs, the axioms that express desirable properties of these rules, and the famous impossibility theorems of Arrow and of Gibbard and of Satterthwaite that tell us, in the immortal words of the Rolling Stones (1968):

You can't always get what you want  
But if you try sometimes you find  
You get what you need

### 2. Domain Restrictions in Voting (Edith Elkind)

Arrow's famous impossibility theorem (1951) states that there is no perfect voting rule: for three or more candidates, no voting rule can satisfy a small set of very appealing axioms. However, this is no longer the case if we assume that voters' preferences satisfy certain restrictions, such as being single-peaked or single-crossing. In this tutorial, we discuss single-peaked and single-crossing elections, as well as some other closely related restricted preference domains, and associated algorithmic questions.

### 3. Strategic Behaviour in Voting (Reshef Meir)

Standard analysis of voting rules (e.g. outcome quality) assumes that voters submit their true preferences. However, what if voters are strategic agents? We will first cover some strong negative results regarding the existence of truthful voting rules. Then, we will consider several ways to regain truthfulness via economic and computational techniques, and conclude with game-theoretic approaches to (non-truthful) equilibrium analysis.

### 4. Proportional Representation (Friedrich Pukelsheim)

Proportional representation methods are studied that are used in electoral systems for the translation of vote counts into seat numbers. The methodology is illustrated by concrete examples, with some emphasis on the 2014 elections to the European Parliament.

## **5. Matching Theory (Katarína Cechlárová)**

Suppose there are two sides of a market, say students and universities. Each student likes some universities more and some less, and each university is able to tell which students it wishes to have more and which less. We present a formal model of situations of a similar flavour, explain the notion of stability as introduced in the seminal paper College admissions and the stability of marriage by Gale and Shapley in 1962 and describe the famous deferred acceptance algorithm. Then we deal with several modifications of the basic model and the computational complexity of the associated problems. Finally, we report on a real application of the matching theory to the problem of assigning pre-service teachers to practical placements that we encountered in Slovakia.

## **6. Fair Allocation of Indivisible Goods (Nicolas Maudet)**

Allocating goods to agents is one of the most pervasive collective decision problem. Beyond efficiency, it is often desirable to obtain a fair allocation. Criteria of fairness include for instance maximizing the minimal level of satisfaction within the society, or minimizing envy among agents. In this tutorial I will overview different algorithms and protocols designed to allocate indivisible goods fairly, ranging from centralized to fully distributed approaches.

## **7. Judgment Aggregation (Umberto Grandi)**

What happens when a group of individuals needs to take a collective decision on multiple correlated issues? Or when they need to elect a committee respecting various constraints about the distribution of power? In these and similar cases the standard models of voting need to be enriched with more complex models of individual opinions. Judgment aggregation is a general setting in which individuals vote for sets of propositional formulas. In this lecture we will explore its generality as an aggregation framework, and study the main computational challenges that arise in this setting.

## About the organizers



**Ulle Endriss** is Associate Professor of Logic and Artificial Intelligence at the Institute for Logic, Language and Computation at the University of Amsterdam. His research concerns the use of formal methods in Artificial Intelligence, specifically in multiagent systems and knowledge representation. In recent years, he has mostly focused on problems at the interface of Artificial Intelligence with economics and political science, and much of this work falls under the heading of computational social choice.



**Elena Iñarra** is a Professor at the department of Foundation of Economic Analysis I at the University of the Basque Country (UPV/EHU). Her main research is game theory and applications to social sciences. In recent years she is working on coalition formation problems and matching theory.



**Jérôme Lang** is a senior researcher at Centre National de la Recherche Scientifique (CNRS) and works at LAMSADE, Université Paris-Dauphine. He holds a PhD from the University of Toulouse in 1991. His research interests are computational social choice and artificial intelligence. He is an associate editor of several journals and has been or will be program chair of several major conferences. He is the author of 34 publications in international journal, 12 book chapters, 1 edited book, and more than 120 publications in the proceedings of international conferences.



**Annick Laruelle** is an Ikerbasque Research Professor at the department of Foundation of Economic Analysis I at the University of the Basque Country (UPV/EHU). Previously she was a professor at the University of Caen Basse-Normandie and was a research fellow at the University of Alicante. She got her PhD from the University of Louvain in 1998. She has published in the areas of voting and game theory.

## About the speakers



**Katarína Cechlárová** graduated in mathematics at the Faculty of Science, P. J. Safárik University, Kosice, Slovakia. Her whole professional life is connected with this faculty. Currently she is a professor at the Institute of mathematics. Her research interests include combinatorial optimization and various topics in mathematical economics and computational social choice, above all algorithmics of various types of matching models.



**Edith Elkind** is an Associate Professor on the Department of Computer Science of University of Oxford, where her research is supported by an ERC Starting Grant. She obtained her PhD from Princeton in 2005. Edith has worked on a variety of topics in algorithmic game theory and computational social choice, and published over 80 papers in selective international conferences and journals. She serves on editorial boards of leading AI journals, and was the program chair of the AAMAS conference in 2015.



**Umberto Grandi** is an assistant professor at Université Toulouse 1 Capitole (France). He is affiliated to the Institut de Recherche Informatique de Toulouse (IRIT), where he is part of the research group in Logic, Interaction, Language and Computation. In 2012 he got his PhD thesis at the University of Amsterdam. He does research in computational social choice, a research field on the interface between artificial intelligence and economic theory, with special focus on judgment aggregation, game theoretic models of voting, and social choice on social networks.





**Nicolas Maudet** is a Professor in Computer Science at Pierre et Marie Curie University (aka Paris-6). He previously held a position as an Assistant Professor at Paris-Dauphine and spent a year as a postdoctoral Research Fellow at Imperial College and City University. He holds a PhD from Univ. Paul Sabatier (Toulouse) and an habilitation from Paris-Dauphine. His research focuses on artificial intelligence, more specifically multiagent systems and various settings of collective decision-making.



**Reshef Meir** is a senior lecturer in the Department of Industrial Engineering and Management at the Technion-Israel Institute of Technology. His research interests focus on artificial intelligence, social choice, mechanism design, and behavioral game theory. Meir received a PhD in computer science from the Hebrew University, followed by a post-doctorate at Harvard Center for Research on Computation and Society.



**Friedrich Pukelsheim** is Professor emeritus, University Augsburg, Germany, where he held the Chair for Stochastics and Its Applications in the Institute for Mathematics 1983-2014. Since 2000 he has published numerous papers on the mathematical analysis of proportional representation methods, and has advised constitutional courts and parliamentary bodies in Germany, Switzerland, and the European Union.



**William Zwicker** is the William D. Williams Professor of Mathematics at Union College, in New York. With a 1976 Ph.D. in mathematical logic from MIT, he has published in the areas of set theory, voting, fair division, and cooperative game theory. He serves on the editorial board of *Mathematical Social Sciences*, is the author, with Alan D. Taylor, of *Simple Games* (Princeton U Press, 1999), and wrote the chapter on voting in the forthcoming *Handbook of Computational Social Choice* (Cambridge U Press, 2016).

Two sessions of two hours each will be devoted to posters presented by the trainees. Some space has also been booked for lectures, which may be delivered by some of the organizers or by trainees.

## Venue



Palacio Miramar  
San Sebastián – Donostia

