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.