

CONFIRMED INVITED TALKS (in alphabetical order)

Craig Boutilier, *University of Toronto, Canada*

PREFERENCE ELICITATION FOR SOCIAL CHOICE: A STUDY IN STABLE MATCHING AND VOTING (joint work with Joanna Drummond and Tyler Lu)

While the methods of social choice provide firm foundations for many decision problems involving groups of individuals, their practical realization requires some means of eliciting, assessing, or learning the underlying preferences of participants. This can impose a tremendous cognitive burden on participants, who may be required to provide precise rankings or utilities for dozens, hundreds, or thousands of alternatives, only to discover that much of this information has no impact on the ultimate decision.

In this talk, I will describe methods for robust optimization in social choice problems given only partial user preference information, using the concept of minimax regret. I will also describe techniques for effectively eliciting user preferences, driven by the robust solutions of the partial preference problems, that allow the computation of optimal decisions with relatively little preference information. I will focus on the application of these techniques to stable matching problems, but also briefly describe the application to voting problems as time permits. And while I emphasize their use in distribution-free models, I will briefly describe how to probabilistic preference models to further reduce the elicitation burden.

David Rios Insua, *King Juan Carlos University, Madrid, Spain*

DESIGNING SOCIETIES OF ROBOTS (joint work with Pablo G. Esteban)

We are interested in designing groups of robots that interact among themselves and with users with certain goals and objectives. Robots may compete or cooperate depending on the tasks and issues involved. For the competitive case, we describe a model based on adversarial risk analysis. For the cooperative case, we describe a solution concept which maximizes a distance to the disagreement point, with some constraints. We then combine both cases with a parametric model and explore its implications. We shall refer to robots in educational contexts.

Miroslav Kárný, *Institute of Information Theory and Automation, Prague*

A UNIFIED VIEW ON ROOTS OF IMPERFECTION (joint work with Tatiana V. Guy)

Decision making (DM), broadly interpreted as an active choice among alternatives, is ubiquitous. A range of normative theories has arisen aiming at support and analysis of DM. Classical Savage's axiomatisation led to Bayesian DM, which suits DM with a non-negligible uncertainty. Observed discrepancies between recommendations of the normative theory and DM practice represent the major challenge of the related research. The talk discusses these discrepancies, and: **a)** respects the presence of imperfect decision maker; **b)** considers neglecting of importance of closed-loop behaviour as their major cause; **c)** provides tasks where **a)** and **b)** do matter and where a unified view on imperfection roots can help.

These tasks include: **i)** preference elicitation, which can be converted into the Bayesian learning; **ii)** "non-rationality" caused by a difference arising from the difference of DM preferences declared and preferences respected by a real decision maker; **iii)** influence of human emotions on DM; **iv)** differences between a theoretically optimal game strategy (for example in ultimatum game) and strategies used by human players; **v)** respecting limitations on deliberation effort within DM by using the framework of sequential DM; **vi)** other cases.

The above list indicates that our talk will offer more hypothesis and open questions, than answers, so an active discussion is appreciated.

Stephen Roberts, *University of Oxford, United Kingdom*

SCALABLE INFORMATION AGGREGATION FROM WEAK INFORMATION SOURCES

In many applications large numbers of weak information sources need to be combined. For realistic deployment methods for such combination should conform to optimality wherever possible, yet scale well with large numbers of weak information sources and amounts of data. This talk will focus on a dynamic Bayesian information aggregation model. We discuss how use of approximate inference, based on variational learning, allows excellent scaling properties in our model whilst retaining high performance. We show case the breadth of applicability of the approach with examples from large citizen science domains, detection of attacks in cyber-security settings, financial data aggregation and real-time coordination of crowd-sourcing.

Naftali Tishby, *The Hebrew University, Israel*

PREDICTIVE INFORMATION AND THE BRAIN'S INTERNAL TIME

One of the most intriguing questions in cognitive neuroscience is how our sensation and perception of time is related to the physical (Newtonian) time axis. In this talk, I will argue that our sensation of time is scaled non-linearly with the information we have about the relevant past and future. In other words, we scale our internal clock with the number of "bits" of perceptual and actionable information, as determined by our sensory and planning tasks. To this end, I will introduce a Renormalisation Group procedure of the Bellman equation for Partially Observed Markov Decision Processes (POMDP), and argue that such renormalisation (non-linear rescaling of time) can explain the subjective discounting of rewards, and the emergence of hierarchies and reverse hierarchies in perception and planing. Finally, I will argue that the structure of our natural language reflects the "fixed point" of this renormalisation group - namely, the divergence of our planning and perception horizons.

Alessandro E.P. Villa, *University of Lausanne, Switzerland*

STIMULUS EVALUATION AND RESPONSE SYSTEMS STUDIED BY REACTION TIMES IN DECISION MAKING TASKS

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