Trustworthiness and Expertise: Social Choice and Logic-based Perspectives

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Thesis Overview

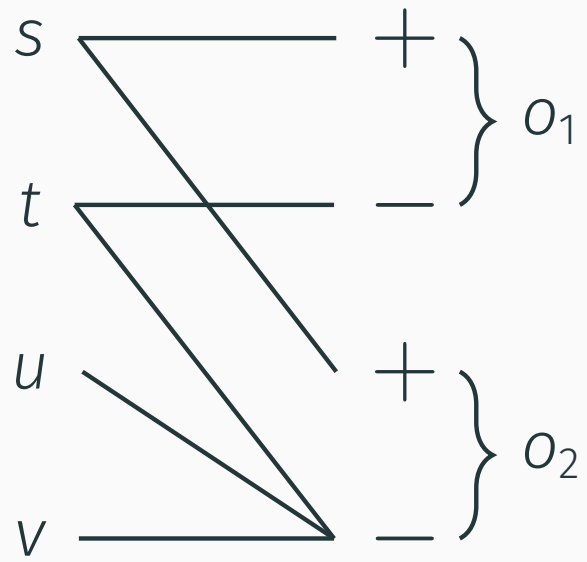
- The thesis studies problems relating to unreliable information and expertise
- Emphasis on applying formal methods
  - social choice theory
  - modal logic
  - belief revision
  - formal learning theory

Social Choice Perspectives

- The first half of the thesis uses the methodology of computational social choice theory
- We develop an axiomatic framework for truth discovery and bipartite tournament ranking
- Axioms formalise “desirable” properties for a method
- Axiomatic analysis complements empirical work for comparing and developing new methods

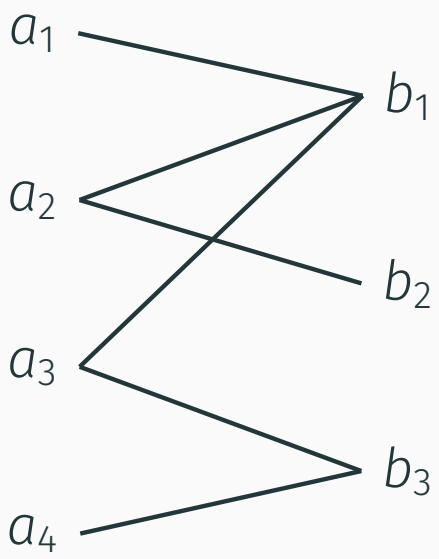
Truth Discovery

- Truth Discovery has recently arisen as a branch of the literature on crowdsourcing
- Central question: given conflicting information, who should we trust and what should we believe?
- We set out new axioms for truth discovery, and analyse an existing method from the literature



Bipartite Tournament Ranking

- "Ground truth" data can help with truth discovery:
  - We already know something about the trustworthiness of sources
  - But this is not straightforward if objects vary in *difficulty*
- We generalise aspects of this problem: how should players in a bipartite tournament be ranked?



Logic-based Perspectives

- The second half of the thesis uses logic-based methods:
  - Modal logic framework to reason about expertise
  - Multi-source belief change problem with non-experts
  - Investigation into truth-tracking with non-experts

Logic of Expertise

- We develop a modal logic framework to reason about expertise
- Key notion: information is *sound* if it is true "up to lack of expertise"
- We explore connections between expertise and *knowledge* via epistemic logic
- This serves as the logical foundation for the following two chapters...

$$\mathsf{E}\varphi \to \mathsf{A}(\mathsf{S}\varphi \to \varphi)$$

Multi-Source Belief Change

- How can the methods of belief revision be used to handle information from non-expert sources?
- How do we revise *trust* in sources?
- We set out a belief change problem using the expertise framework of the previous chapter
- Axiomatic approach once again; inspired by AGM-style rationality postulates

$$\varphi \in K(\sigma) \implies \neg \mathrm{E}\varphi \in K(\sigma \cdot \langle i, \neg\varphi \rangle)$$

Truth-Tracking with Non-Expert Sources

- AGM revision focusses on rationality, not on finding the truth
- We augment the belief change problem with notions of truth-tracking from formal learning theory
- This shows what can be learned in principle with non-experts
- Even with strong assumptions, there are fundamental limits on what one can learn