Aalto University

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Data science for social good

Title of the dissertation	Data science for social good: theory and applications in epidemics, polarization, and fair clustering
Contents of the dissertation	Technical innovations have transformed our lives fundamentally, in both positive and negative ways. In this thesis, we look at the negative side, identify three problems to tackle, namely *epidemics*, *online polarization*, and *bias in automatic decision-making*, and approach them using data-driven approaches.
	The rapid spread of disease is happening globally, as evidenced by the pandemic of COVID-19. To effectively contain an epidemic, early identification of infected individuals is crucial. Nonetheless, this task is challenging. We study the problem of automatic detection of hidden infections in the context of social networks.
	Online polarization is formed partly due to the widespread use of online social media. As a result, people are unlikely to adopt new ideas that differ from their beliefs, which finally leads to a polarized society. To tackle online polarization, we argue that it is important to discover who is involved in the polarization. To this end, we consider a problem of finding polarized subgraphs in social networks.
	Machine learning algorithms allow the automation of many decision-making processes. However, unfair results that favor one demographic group (e.g., male) over another (e.g., female) are witnessed. We focus on fairness issues for data clustering -- an important machine learning task, which has applications in infrastructure design and online social media. We propose a new clustering formulation that captures a novel fairness notion.
	For all proposed problems, we study their complexity and design algorithms whose theoretical performance is analyzed. We evaluate all proposed algorithms' efficacy in both synthetic and real-world settings.
Field of the dissertation	Computer Science, Data mining
Doctoral candidate	Han Xiao, M.Sc.
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Opponent	Assistant Professor Danai Koutra, University of Michigan, United States.
Custos	Professor Aristides Gionis, KTH Royal Institute of Technology, Sweden. Professor Aristides Gionis is also an Adjunct Professor at Aalto University, Finland.
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