Designing Fair & Efficient Online Allocations for Networked Markets

Problem definition

The recent emergence of online platforms such as Amazon, eBay, and Alibaba has caused significant research interest in this area of online allocations. Platforms, contrary to the approach of traditional retailers - either in brick-and-mortar stores or in their online stores - do not typically produce or store physical goods but instead match producers or retailers to customers and set prices algorithmically (Pang et al., 2022). These platforms are predicted to grow in both the numbers of users and volume of retail sales, which is why these algorithms steering the platform need to be evaluated critically and designed such that they meet multiple relevant criteria in order to sustain business on the online platforms.

In general allocation settings, multiple design desiderata exist, from efficiency, over fairness, and strategyproofness to individual rationality. While all of these desiderata are relevant when designing a suitable online allocation setup, e.g., for an online marketplace or matching procedure therein, literature frequently focuses on the former two criteria, fairness and efficiency, and their inherent trade-off. However, the understanding of what concludes a fair allocation may differ between different works of research (Benadé et al., 2023), which complicates intuitive distinctions and comparisons. The goal of this thesis is to generate a detailed overview of current streams in research focusing on the trade-offs between fairness and efficiency depending on the different definitions of these goals and the different online allocation settings.

Aims and scope of the thesis

It is the subject of this thesis to investigate how to design fair and efficient online allocations for networked markets. This research goal comprises the following research tasks:

- Structured literature research on general allocation procedures as well as specialized allocation procedures in networked markets
- Particular focus on the investigation of the trade-off between fairness and efficiency in these allocations
- Comparison of the different definitions of fairness and efficiency
- Detection and discussion of potential areas for further research

Related Research

- Aziz, H., Freeman, R., Shah, N., & Vaish, R. (2023). Best of both worlds: Ex ante and ex post fairness in resource allocation. *Operations Research*.
- Benadè, G., Kazachkov, A. M., Procaccia, A. D., Psomas, A., & Zeng, D. (2023). Fair and Efficient Online Allocations. *Operations Research*.
- Kumar, A., & Kleinberg, J. (2006). Fairness measures for resource allocation. *SIAM Journal on Computing, 36*(3), 657-680.
- Pang, J., Lin, W., Fu, H., Kleeman, J., Bitar, E., & Wierman, A. (2022). Transparency and control in platforms for networked markets. *Operations Research, 70*(3), 1665-1690.

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