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RECOMMENDING FOR A THREE-SIDED FOOD DELIVERY MARKETPLACE: A MULTI-OBJECTIVE HIERARCHICAL APPROACH

ABSTRACT:

Online food delivery platforms are essentially a three-sided marketplace consisting of consumers, restaurant partners and delivery partners. A recommendation system for these platforms faces two main challenges. First, all sides of the marketplace have different and potentially conflicting utilities. Recommending in these contexts therefore entails jointly optimizing multiple conflicting objectives. Second, most food delivery platforms present their food recommendations hierarchically where a recommendation item can be either a single restaurant or a group of restaurants. Off-the-shelf recommendation algorithms are not applicable in these settings, as they focus on ranking items of the same type as a one-dimensional list. We propose MOHR, a multi-objective hierarchical recommender that tackles these challenges. MOHR combines machine learning with scalable multi-objective optimization for multi-sided recommendation and incorporates a probabilistic model for hierarchical recommendation which accounts for consumers' browsing patterns. The hierarchical approach ensures consistent consumer experience across different levels of aggregations of the recommended items, and provides transparency to the restaurant partners. We further develop an efficient optimization solution for serving MOHR in large-scale online platforms in real time. We implement MOHR at one of the largest industrial food delivery platforms in the world serving millions of consumers, and experiment with objectives including consumer happiness, marketplace fairness and partner earnings. Online experiments show a significant increase in consumer conversion, retention and gross bookings, which combined translate to $1.5 million weekly gain in revenue. Our work has been deployed globally by the industrial food delivery platform as the recommendation algorithm for its homepage.