

A Fast Optimizer for Large-scale Fulfillment Planning based on Genetic Algorithm

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Abstract : Market Kurly is the first South Korean online grocery retailer that guarantees same-day, overnight shipping. More than 1.6 million customers place an average of 4.7 million orders and add 3 to 14 products into a cart per month. The company has sold almost 30,000 kinds of various products in the past 6 months, including food items, cosmetics, kitchenware, toys for kids/pets, and even flowers. The company is operating and expanding multiple dry, cold, and frozen fulfillment centers in order to store and ship these products. Due to the scale and complexity of the fulfillment, pick-pack-ship processes are planned and operated in batches, and thus, the planning that decides the batch of the customers' orders is a critical factor in overall productivity. This paper introduces a metaheuristic optimization method that reduces the complexity of batch processing in a fulfillment center. The method is an iterative genetic algorithm with heuristic creation and evolution strategies; it aims to group similar orders into pick-pack-ship batches to minimize the total number of distinct products. With a well-designed approach to create initial genes, the method produces streamlined plans, up to 13.5% less complex than the actual plans carried out in the company's fulfillment centers in the previous months. Furthermore, our digital-twin simulations show that the optimized plans can reduce 3% of operation time for packing, which is the most complex and time-consuming task in the process. The optimization method implements a multithreading design on the Spring framework to support the company's warehouse management systems in near real-time, finding a solution for 4,000 orders within 5 to 7 seconds on an AWS c5.2xlarge instance.

Keywords : fulfillment planning, genetic algorithm, online grocery retail, optimization

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