Inferring Impact Direction Graphs from Large Scale Online User Engagement Data

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Abstract: Nowadays many companies of online services or mobile apps are using user engagement based metrics as the pointers toward the North Star (i.e. the success) of the business. However, many commonly used North Star metrics, such as Daily Active Users (DAU), Monthly Active Users (MAU), long-term revenue per user, are often not useful for day-to-day decision making because either they are insensitive to small and incremental product improvements, or their short-term movements mis-align with the real user experience in the long-term [1]. Thus it has been critical for online service or mobile app developers to find user engagement metrics that are actionable enough in the short term, and at the same time, are constantly the impact drivers for the growth of the North Star metrics in the long term. In this work, we propose a fast and scalable method based on Concave penalized Coordinate Descent with reparametrization (CCDr) [2] to learn the skeleton of the impact relationships among various user engagement metrics of an online service or mobile app. By applying the method on more than 1,500 A/B tests data of Snapchat, we construct impact direction graphs that deliver clear and useful insights on the impact relationship among the user engagement metrics, and effectively identify the metrics that eventually drive users' long-term retention in spite of the complex user activities in using Snapchat.

[1] Deng, A. and Shi X. Data-Driven Metric Development for Online Controlled Experiments: Seven Lessons Learned. SIGKDD 2016.
[2] Aragam, B. and Zhou, Q. Concave penalized estimation of sparse Gaussian Bayesian networks. Journal of Machine Learning Research, 16:2273–2328, 2015