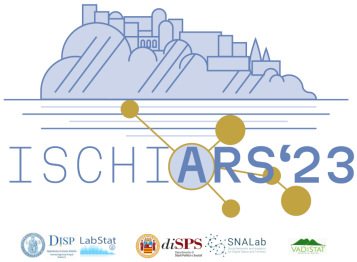

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DREAM: deep relational event additive model for patent citations

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The patent citation network is a complex dynamic system that reflects the diffusion of knowledge and innovation across all fields of technology. Relational event models (REMs) have been used to describe citation networks. The two main issues in analyzing this network are that the number of citation events is huge and its dynamic structure changes over time. In this work, we aim to overcome these challenges by proposing a computational REM extension, called the Deep Relational Event Additive Model (DREAM).

DREAM employs machine learning concepts to capture the relationships between cited and citing patents as events that occur over time. Each predictor in the generative citation model is assumed to have a non-linear behavior, which has been modeled via a B-spline approach. In order to fit such model to a network of approximately 8 million patents and over 100 million citation events, we estimate the model through a stochastic gradient descent approach. This allows real-time, efficient estimation of the DREAM parameters and the identification of the key factors that drive the citation network dynamics. The spline approach can be extended to include complex relationships between predictors through multivariate interaction splines, leading to a more accurate and comprehensive interpretation of the underlying mechanisms. Our analysis has revealed several interesting insights, such as the identification of time windows in which citations are more likely to happen and the relevancy of the increasing number of citations received per patent.

Overall, our results demonstrate the potential of the DREAM in capturing complex dynamics that arise in a large sparse relational event network, maintaining the features and the interpretability for which REMs are most famous.

Keywords

Citation networks, Machine Learning, Non-linear effects, Computation

Topics

- Complex networks

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