Title

Modeling Self-Reinforcement and Inter-Competition in Multivariate Temporal Point Processes and Graph-based Semi-Supervised Learning

Abstract

In multivariate temporal point processes, individual events of a process may reinforce the process according to their own event magnitudes, while different processes may compete with each other for dominance in intensity. While the former can be described as self-reinforcement of a process, the latter may be described as inter-competition between processes. In graph-based semi-supervised learning, nodes with revealed labels belong to several communities. While determining the community label of an unknown node, neighbouring labelled nodes from a given community reinforce each other to amplify the chance of the unknown node being assigned the label of that community. On the other hand, neighbouring labelled nodes from different communities compete with each other, each community aiming to ``claim'' the unlabelled node for itself. While the former may be described as self-reinforcement of a community, the latter may be described as inter-competition between communities. This thesis aims to bring out the necessity to explicitly model these two general effects of self-reinforcement and inter-competition in these apparently disparate realms (multivariate temporal point processes and graph-based semi-supervised learning) through domain-specific modelling techniques. This thesis proposes novel modelling frameworks for both multivariate temporal point processes and graph-based semi-supervised learning where the effects of self-reinforcement and inter-competition are organically integrated into the model. In the particular case of multivariate temporal point processes, this thesis presents a marked departure from the traditional view that such processes mutually excite each other by studying several application domains where a competitive effect exists instead of mutual excitation. Also, while previous approaches have typically used simple linear models for such multivariate processes, we show that it is possible to graft these effects into non-linear neural models. Aside from the empirical advantages conferred by our approach, modelling these effects is also shown to yield distinct theoretical advantages in case of graph-based semi-supervised learning.

Keywords: Temporal point processes, graph-based semi-supervised learning, self-reinforcement, inter-competition