Modeling Information Diffusion in Online Social Networks with Partial Differential Equations

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Abstract

Online social networks such as Facebook and Twitter have played a significant role in information spreading. The availability of unprecedented amounts of digital data has accelerated research on information diffusion. However, the mechanism of information spreading in online social networks remains elusive due to the complexity of social interactions and rapid change of online social networks. Most of dynamical models arising from online social networks only involve ordinary differential equations which describe static or collective social processes over time. In a number of recent works, we propose to use partial differential equation models to study the temporal and spatial characteristics of information diffusion in online social networks. The extension of applications of partial differential equations into online social networks presents new opportunities and challenges for mathematicians as well as computer scientists and researchers in social media. In this talk, I will examine several partial differential equation models for online social networks including a diffusive logistic model and linear model with heterogeneity. Free boundary value problems and bifurcation problems arising from online social networks will be discussed. I will also demonstrate that these models with geocoded data in Twitter can be used to real-timely monitor spread of flu related information in social media, and, as a result, help control spread of influenza. We also discuss its application in analysis of Egyptian Revolution of 2011.