# Abstract

Social networks are an inseparable part of human lives, and play a major role in a wide range of activities in our day-to-day as well as long-term lives. The rapid growth of online social networks has enabled people to reach each other, while bridging the gaps of geographical locations, age groups, socioeconomic classes, etc. It is natural for government agencies, political parties, product companies, etc. to harness social networks for planning the well-being of society, launching effective campaigns, making profits for themselves, etc. Social networks can be effectively used to spread a certain information so as to increase the sales of a product using word-of-mouth marketing, to create awareness about something, to influence people about a viewpoint, etc. Social networks can also be used to know the viewpoints of a large population by knowing the viewpoints of only a few selected people; this could help in predicting outcomes of elections, obtaining suggestions for improving a product, etc. The study on social network formation helps us know how one forms social and political contacts, how terrorist networks are formed, and how one's position in a social network makes one an influential person or enables one to achieve a particular level of socioeconomic status.

This doctoral work focuses on three main problems related to social networks:

- *Orchestrating Network Formation*: We consider the problem of orchestrating formation of a social network having a certain given topology that may be desirable for the intended usecases. Assuming the social network nodes to be strategic in forming relationships, we derive conditions under which a given topology can be uniquely obtained. We also study the efficiency and robustness of the derived conditions.

- *Multi-phase Influence Maximization*: We propose that information diffusion be carried out in multiple phases rather than in a single instalment. With the objective of achieving better diffusion, we discover optimal ways of splitting the available budget among the phases, determining the time delay between consecutive phases, and also finding the individuals to be targeted for initiating the diffusion process.

- *Scalable Preference Aggregation*: It is extremely useful to determine a small number of

representatives of a social network such that the individual preferences of these nodes, when aggregated, reflect the aggregate preference of the entire network. Using real-world data collected from Facebook with human subjects, we discover a model that faithfully captures the spread of preferences in a social network. We hence propose fast and reliable ways of computing a truly representative aggregate preference of the entire network.

In particular, we develop models and methods for solving the above problems, which primarily deal with formation and analysis of social networks.