

4995: Introduction to Network and Crowds

This course covers the **fundamentals** underlying **information diffusion and incentives on networked applications**. Applications include but are not limited to **social networks, crowdsourcing, online advertising, rankings, information networks** like the world wide web, as well as areas where **opinion formation** and the **aggregate behavior of** groups of people play a critical role. Among *structural concepts* introduced and covered in class feature random graphs, small world, weak ties, structural balance, cluster modularity, preferential attachments, Nash equilibrium, Potential Game and Bipartite Graph Matching. The class examines the following *dynamics*: link prediction, network formation, adoption with network effect, spectral clustering and ranking, spread of epidemic, seeding, social learning, routing game, all-pay contest and truthful bidding.

The objective of this class is to provide undergraduate and graduate students with the necessary toolkit to address that, increasingly, computing systems must be engineered to leverage humans' networked behaviors and participants' incentive. The format (topics covered in textbooks, class interaction and practice through homework) is chosen to welcome students from all background and focus on mature contributions that stood the test of time. The materials will contain rigorous definitions and theorems, but assume no prerequisite beyond basic probability and basic linear algebra. An appetite for precise theoretical results involving graphs is recommended. It is open to all undergraduate and graduate students.

Students will be briefly exposed to the following advanced topics (covered in other graduate classes) without evaluation, to encourage to explore them in the future:

- machine learning on graphical data,
- mining of networks emerging from natural languages.
- mechanism design, auction theory and prediction market
- trading network, resource allocation and optimization

Logistics: (lectures) TR 11:40-12:55, (Q&A) piazza, (textbook) *Network, Crowds and Markets*, D. Easley and J. Kleinberg, Cambridge University Press. (grading) Homework/Midterm/Final-60/15/25%. (contact) augustin@cs.columbia.edu