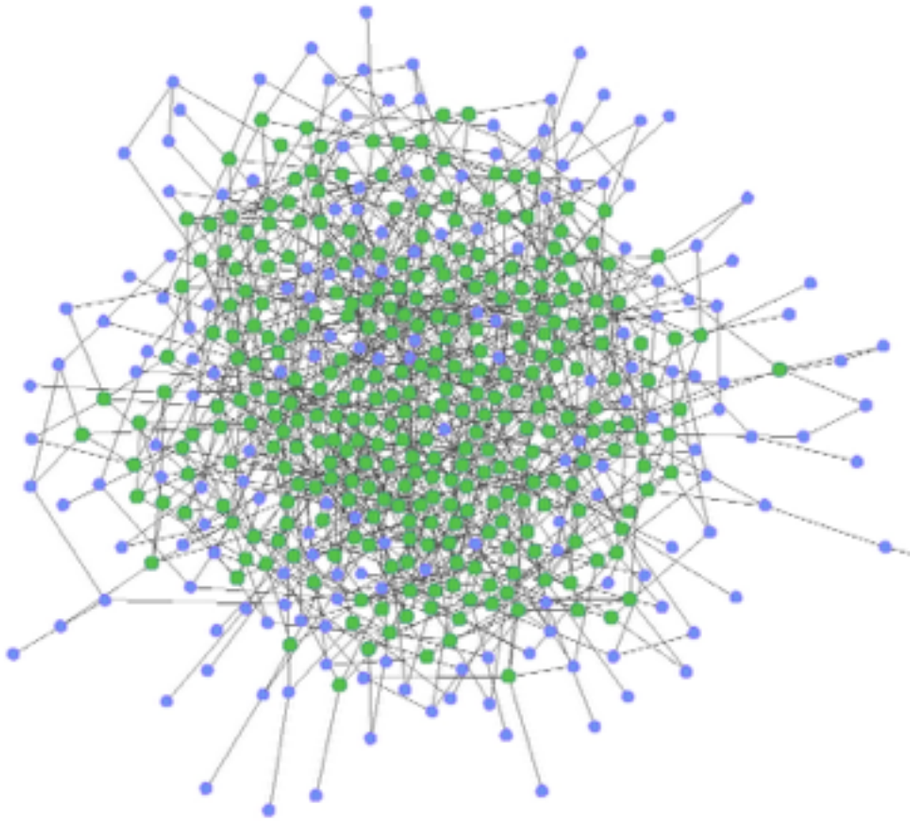
Social and Technological Networks: Review

Rik Sarkar

Networks

- Networks/graphs are fundamental in computer science
- And becoming more important
- As systems, people, computation become more interconnected



Why study networks

- We need network analysis for a lot of big data analysis
  - Since many of them are networks
  - Or about processes operating on networks
- It is possible to apply network analysis even when the data is not about a network
  - Eg. image analysis, text analysis…
  - Clustering is basically community detection…

Today

- Project: follow up discussion
- Lectures and topics: follow up discussion
- What to study for exam
- What to expect in exam

Project

- The purpose:
  - It was about the experience, not memorizing/coding/marks
  - Learn to do large projects
  - Think of some original ideas, try some programming…
  - Use your freedom to do what you like

- What did you think?

- If you thought it was interesting, and you would like to do similar things with more time
- Consider applying for a PhD
  - Only way you get to work on your own ideas
  - You get to develop and learn new, cutting edge ideas that most people do not know

- Apply in december/january
- Make the decision to accept/reject when you get the offer later
- Undergraduates can apply. MS not necessary.

Projects

- Some of the challenges
  - Short time
  - Description vague, expectations not clear
    - You need something “new” not clear what
- These are common in all interesting real-world tasks
- In industrial innovation centers, you have similar jobs:
  - “Do something valuable”

Common mistake: The planning fallacy

- Underestimate the time things would take!

- Spend a lot of time planning/thinking

Suggestions

- When making a plan, also think if you have time for it
- Don’t try for a perfect or best possible plan
- Make a decent plan that seems workable and start working on it
    - Add new ideas as you go
- Change plans as needed
    - When something does not work as expected
- If time feels short, adjust plan. Think: can you do a shorter version?
    - What is the important element that you can do in the short time?
    - What is an alternative that still gets you “some” valuable result, but different from what you were thinking?

Lectures

- The purpose:
  - Show you some interesting ideas
  - How mix of theory and applications are important
  - Give you basics of networks
  - You can now go and read more…

- What did you think?

In the course, We saw…

- Network properties/measures
- Diameter, CC, expansion….
- Random graphs: Erdos renyi model
- Probability of isolated vertices
- Threshold phenomenon at p = (ln n)/n
- Clustering, cycles etc..

We saw…

- Power law networks
  - Generating models
- Small worlds & generating models
- Web graphs
  - Important nodes: HITS & pagerank, analysis
- Spectral graph theory and spectral gap

We saw…

- Tie strengths, bridges, social capital, homophily…
  - triadic closure etc..
- Community detection, modularity, correlation clustering
- Cascades & thresholds
- Viral marketing and maximizing spread
- Submodularity: Coverage, diminishing marginal returns

We saw

- Greedy Approximation of submodular maximization
- Epidemics, diffusion and gossip
- Treeness and curvature of metrics: study of internet
- A hyperbolic generating model
    - Produces power law networks with community structure
- Friendship paradox, finding romantic pairs

For exam

- Everything on slides except when mentioned otherwise
- Everything in “Reading” list for the lecture
- Everything in lecture notes unless mentioned otherwise
- Recommended:
  - Material in additional reading
  - Relevant chapters in Kleinberg & Easley 2010, and Kempe 2011.

What is not in exam

- Hyperbolic geometry
- Network flows
- NP-completeness
- Gossip algorithms

Notes and slides

- Notes and slides being updated
  - Please always use the online & refreshed web page
  - Do not use an old version
- Please let me know any errors/inconsistencies you notice
- I will update you when they are mostly updated or when there is any major change
- **December visiting exam:** Everything updated till end of next week

Exam

- Answer 2 questions out of 3
- Question 1 compulsory
- Answer one out of 2 and 3

Questions

- Define property/measure X.
  - For a given graph in Figure, compute X
  - eg. CC/betweenness of each node, of the graph, diameter of the graph, matrix A or L etc..
- For a description of a graph, show that it must have the following property ….
  - Examples in exercises
- If a graph obtained from source Y has properties a, b, c
  - What would that imply about the source Y?

Questions

- Given a problem such as …
  - How would you solve this? What algorithm will you use? Justify your answer.
- What are the advantages/disadvantages of using X in problem setup Y?
- Kleinberg and Easley 2010 has questions after each chapter.
- Some additional questions etc will be put up after lecture notes etc.