Social and Technological Networks: Review

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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.