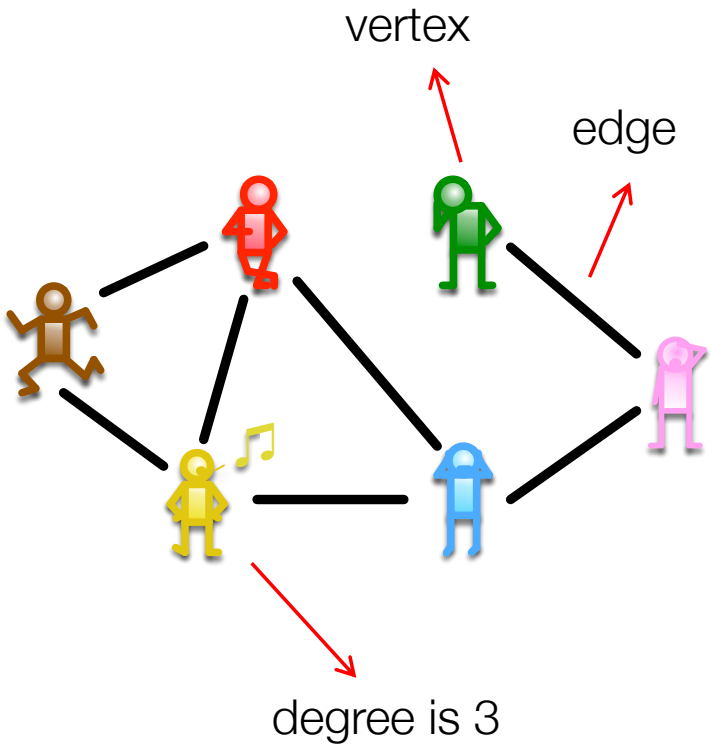
CSE 610:
Special Topics in Network Science

A. Erdem Sariyuce

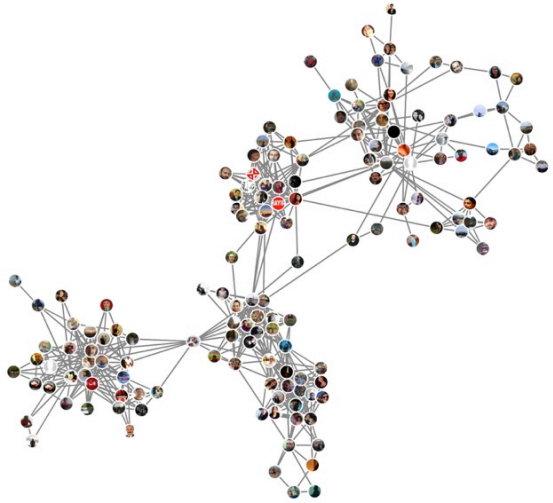
What is “Network Science”?

- Study of complex networks (complex means non-trivial)
  - Social networks
  - Information networks
  - Web networks
  - Telecommunication networks
  - Computer networks
  - Biological networks
  - Cognitive and semantic networks
- Distinct entities: Nodes (or vertices)
- Connections: Links (or edges)

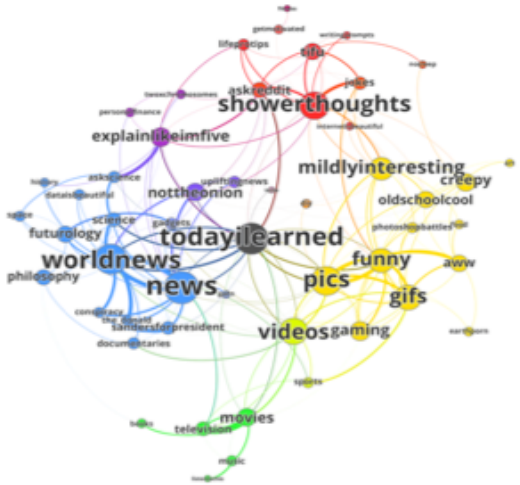


Graphs (networks) are everywhere

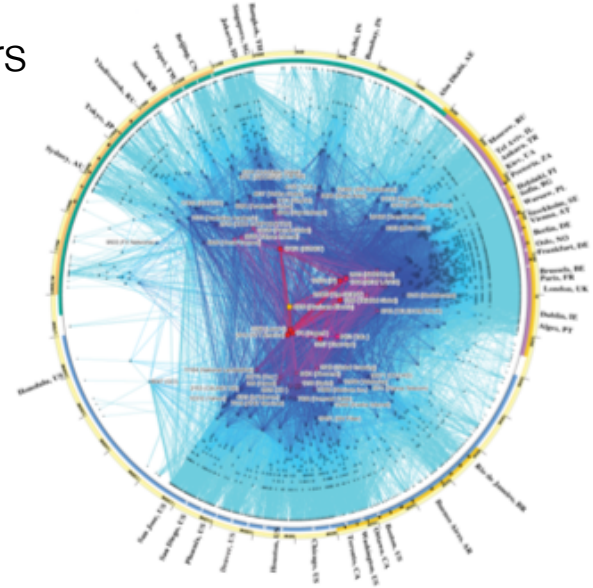
Social



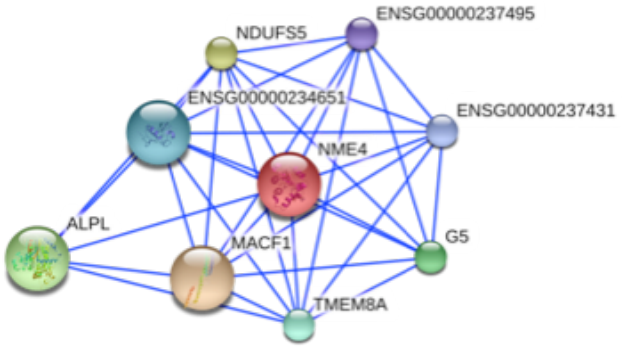
Information



Routers



Protein-interaction



Transformers of disciplines

- Graph theory
  - Mathematics
- Statistical mechanics
  - Physics
- Data mining
  - Computer science
- Inferential modeling
  - Statistics
- Social structure
  - Sociology

Questions we ask

- Real-world networks
  - What characteristics do we observe?

- Nodes and edges
  - Which ones are more important than others?
  - What does important mean in this context?

Questions we ask

- Given a person in a social network;
  - How do we determine her social circles?
  - How do we suggest new friends?
  - Can we infer her spouse? (there is a paper on that)

- Or given a webpage about booking flights,
  - How likely it will be accessed next week?
  - How can we make it appear on top in search results?

Questions we ask

- Graph algorithms
  - What is used in the state-of-the-art search engines?
  - What about recommendation systems?

- How does a network evolve over time?
  - Which nodes will get more edges?
  - Which edges will be removed or added?

Logistics

- Class hours: MW 3:00-4:20 @ 113A

- Office: 323 Davis Hall
- Office hours: MW 1:30-2:30 (before classes)

- erdem@buffalo.edu
- Website: http://sariyuce.com/specialTopicsNS.html
- Piazza page

This class is not hard

- No prerequisite needed
  - Background in graph theory, discrete math
- No textbook required. Will benefit from
  - Networks: An Introduction
    - By M. Newman
  - Networks, Crowds and Markets
    - By D. Easley and J. Kleinberg

Lectures and papers

- Papers will be pointed for advanced topics
  - Community Detection
  - Partitioning

- Great papers from the top venues!
  - Science, Nature
  - SIGKDD, WWW, WSDM, ICDM, SDM
  - VLDB, SIGMOD, ICDE

Grading

- Homeworks
  - 4 x 10%
- Random Attendance
  - Toss a coin every class
  - 3%
- Project
  - 57%

Homeworks

- Combination of exam-style questions
  - Require light coding
- Analysis and discussions by charts, tables
- Due in one week
- Individually

Project

- Proposal by 3rd week
  - Report: 10%
  - Short presentation: 5%
- Progress by 10th week
  - 10% + 5%
- Final by last week
  - 10% + 5%

- Ideas will be provided
  - Don't worry, I'll guide
- Weekly meetings
  - 12 weeks: 12%
  - 15 mins at most
  - Mon or Wed
  - 12:00-1:15 or office hours
- **We aim to publish papers!**

Academic integrity

- Don’t cheat in homeworks, please, really easy to detect
- University policy
  - http://grad.buffalo.edu/study/progress/policylibrary.html
- Department policy
  - https://engineering.buffalo.edu/computer-science-engineering/undergraduate/resources-for-current-students/academic-integrity-students.html
- Grads: Sanctions can even reach to RA/TA cancellation

Any questions?

Project Ideas

- Repeatability experiments for some popular papers
  - And extensions
- Surveys on certain hot topics
  - With a codebase for comparison
- Any idea you may want to go for!
  - Consultation with instructor

Project Ideas

- Graph coloring
  - With smart orderings of vertices
- Graph summarization by tree hierarchy
  - VLDB tutorial
- Clique enumeration up to 10
  - Extending existing triangle-based frameworks

Project Ideas

- Relations between core numbers of vertices and truss numbers of edges
  - Any patterns that do not appear? Any anomaly?
- Conductance measurement
  - State-of-the-art dense subgraph discovery algoritmhs
- Probing vertices for k-core
  - With recent local algorithms
  - Further generalizations?