Week 2:
Constructors, Plotting, and Centrality

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Math 581.05:
Computational Tools for Complex Networks
Fall 2020

Outline

Excelephants #3

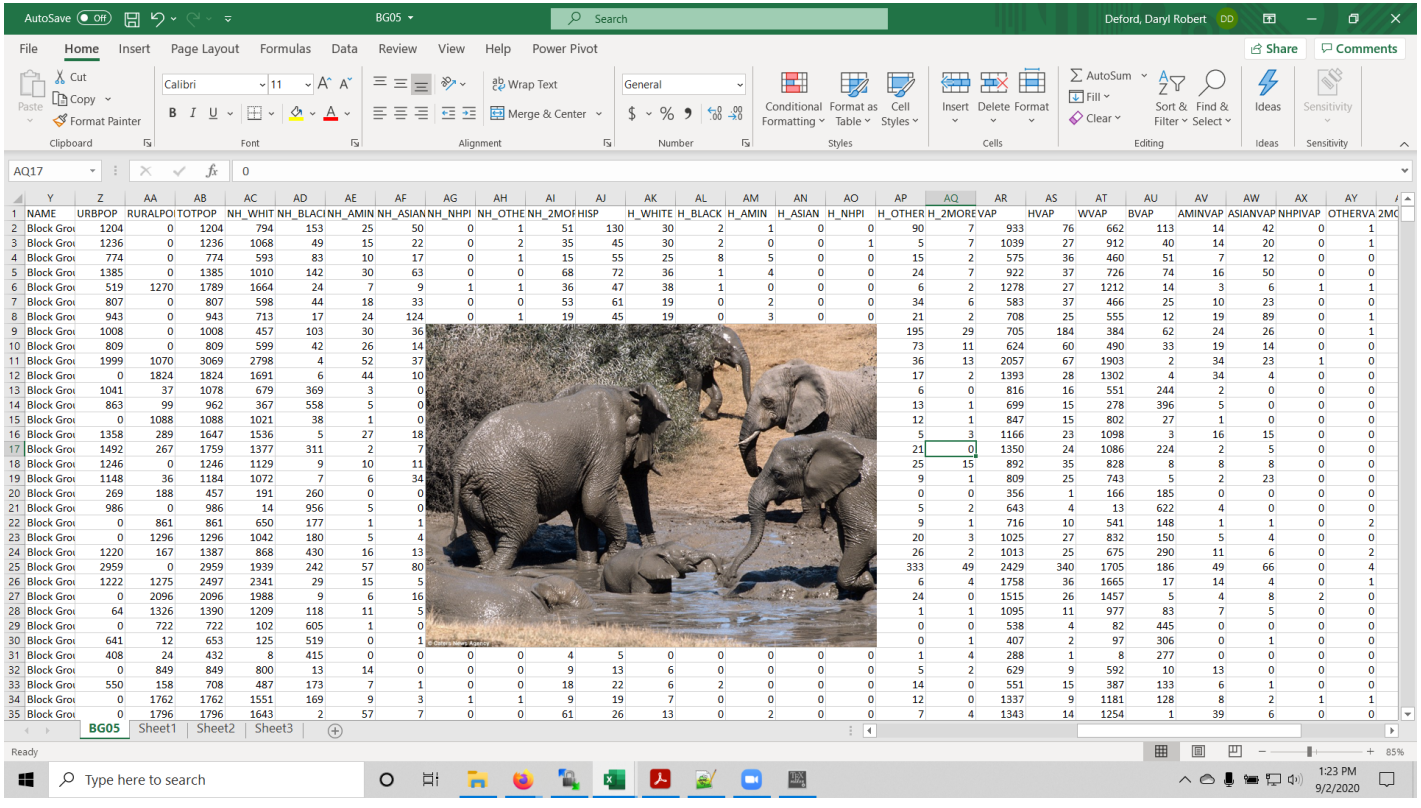

Figure: We may need a hose for this cleaning project.

Ways to play along...

- These slides are on GitHub: link
- CoCalc: cocalc.com
- CoLab: colab.research.google.com
- Sage Cell:
  - math.wsu.edu/faculty/ddeford/sage_cell.html
  - people.csail.mit.edu/ddeford/sage_cell.hmtl
- On your own machine

Building Graphs

- Individual nodes/edges
- Generators: link
- Data structures link
  - Adjacency matrices
  - Edge lists
  - Adjacency list
  - Pajek, json, etc.

- G1 = nx.grid_graph([4,5])
- G2 = nx.wheel_graph(10)
- G3 = nx.karate_club_graph()

Drawing Networks

- Options: link
  - Node size
  - Node color
  - Node shapes
  - Labels
  - Edge properties
- Layouts: link
  - Circular
  - Spring
  - Kamada-Kawai
  - Shell

- nx.draw_kamada_kawai(G1, node_color='hotpink', node_size=400 , node_shape='*')

Centrality

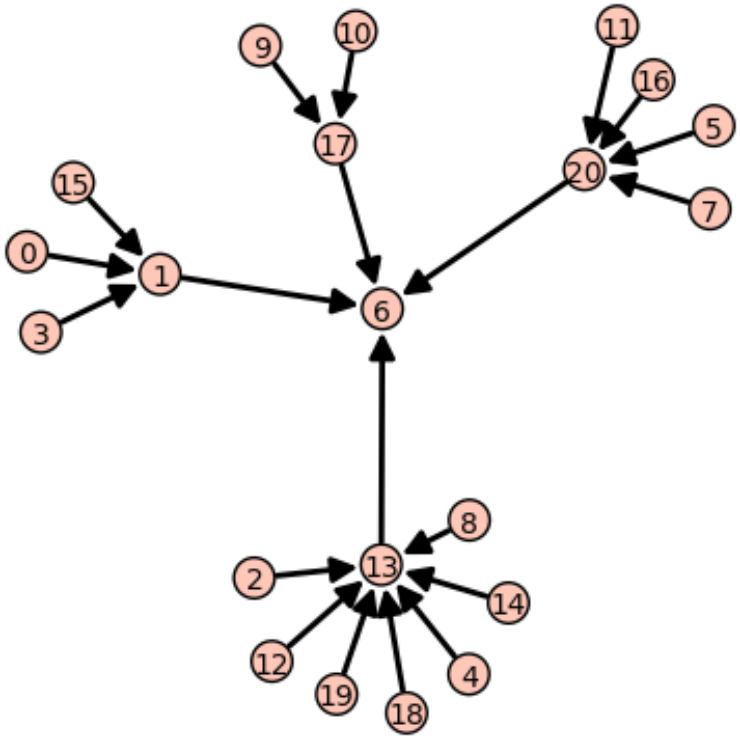

Figure: Link to networkx docs

Structural Measures

- Degree Centrality
  - You are popular if you have lots of friends

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  - You are popular if your friends are popular (recursion)
- Page Rank
  - You are popular if you have a relatively high occupation probability in the steady state of a properly designed Markov chain[1]

[1] less pithy - more useful!

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- Big underlying assumptions:
  - Shortest paths are relevant
  - Full network structure is known
  - No competition of messages
  - Messages are sent regularly
  - Etc.

References

- Centrality and network flow (Borgatti), Social Networks, 27(1), 2005.
- Axioms for Centrality (Boldi and Vigna) arxiv:1308.2140, 2013.
- The anatomy of a large-scale hypertextual Web search engine, (Brin and Page), Computer Networks and ISDN systems, 30, 1998.