Outline

Intro + Personal Networks [2 lectures]

Lecture - overview of course; basic graph theory

Lab 00 - getting started in Jupyter notebooks [old lab0]

Goals:

- quick overview of how Jupyter notebooks work
- test submitting an assignment

Notes:

from Data 8 - basically, to test submission pipeline

Lecture - Personal networks; social connectedness and isolation in America

TODO - some kind of support / reading for students would be helpful

Hwk 01 - collecting personal network survey data [old hwk01]

Goals: - understand how personal network data are collected (reflect on strengths + limitations) - understand quantitative features of UC Berkeley student personal networks - collect ARD info on UC Berkeley students (later used in a lecture demo) ? collect interpersonal contact info on UC Berkeley students? - ask students: what is a name generator q you think would be effective at eliciting information about social isolation at UC Berkeley?

Lab 01 - analyzing personal network survey data [old lab02]

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-> TODO - this should incorporate new material reviewing sampling + the bootstrap
-> goals: work with personal network survey data (reshape, etc)
-> goals: some kind of hypothesis test for significance
-> analyze personal network data from GSS (old hwk 01)
```

Hwk 02 - analyzing personal network data from the GSS

Goals: use skills from lab 01 to analyze personal network data we collected on the our survey (so, take analysis of last year's hwk 02 but update it to be about this year's student survey data)

Lab 02 - working w/ complete network data [old lab01 + lecture demo]

Goals: - understand how a network is represented in a computer - understand how to load a network from a file - understand how to calculate some simple features of a network - avg degree, degree distribution - avg shortest path length / diameter / periphery / core / radius - clustering coefficient - understand how to plot networks (and some limitations of doing so) - a couple of important formulas: - max number of edges on n nodes - avg degree in terms of number of edges, number of nodes Data: Add Health survey data

from lecture demo

- loading a complete network
- avg degree
- plotting
- most possible edges in a net with n nodes

from prev lab (quite long):

- Add health study
- representing a network in a computer
- plotting networks
- degree distribution
- average degree + formula
- avg shortest path lenth / diameter / periphery / core / radius
- repeat calculations on all add health networks

Hwk 03 - complete network data

Goals: assess skills from Lab 02 - open up a complete network dataset - calculate some features of the network - plot the degree distribution - [old hwk02 on the clustering coefficient has material]

Reading - TODO

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-> candidates: SOWT original, Onnela et al paper
```

Network structure [6 lectures]

Lecture - Triadic closure; strength of weak ties

```
- idea of triadic closure
- quantifying closure - clustering coefficient
-> Lecture Demo: triadic closure in an email network
- sowt
  - bridge + local bridge + span of a local bridge
  - tie strength
  - strong triadic closure property, weak triadic closure property
  - Onnela et al / tie strength in mobile phone datasets
```

! Lecture - Social capital and structural holes [this seems thin]

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-> Lecture Demo: strength of weak ties
- TODO - add some more about social capital
  - Jackson - typology of social capital
  - ? Portes review article
```

Lecture - Networks in context - homophily; positive + negative networks

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-> NB: two different sets of slides
-> Lecture Demo: structural balance
```

Lab 03 - Enriching network data and testing a hypothesis about homophily [old lab03]

Goals: - add attributes to nodes and edges, and calculate things involving attributes - discuss ways to quantify homophily - test a hypothesis related to homophily - TODO - something about positive/negative edges? -> TODO: add some overview/review of hypothesis testing if this was not done in an earlier lab

Hwk 04 - Problem set I

Goals: assess problem-solving with concepts covered so far, including: - look at old [hwk04], which has lots of qs - graph theory concepts (paths, cycles, connected components) - balance theory - friendship paradox - strength of weak ties - homophily / assortativity coefficients - TODO others?

Lecture - Intro to mathematical models; the ER random network model

? Lecture - configuration model + stochastic block model

```
- revisit homophily w/ this context...
-> should this go after midterm?
```

Lab 04 - Exploring mathematical models of network structure

Goals: - experience simulating networks from mathematical models - using ER, then configuration model as null hypothesis in a hypothesis test

Lecture - Centrality; The friendship paradox

```
- indices of centrality
    - could add 1/(avg distance) as a measure of centrality in SIR/centrality notebook (this
- jackson et al models?
- maybe Ansell/Padgett - medici example, others?
```

Reading - TODO

Small worlds and beyond [6 lectures]

Lecture - Small worlds

Lecture - Search in small worlds

Lecture - Affiliation networks; foci; one-mode projections of bipartite networks

Lab 05 - Two-mode networks; Friendship paradox [old lab04]

-> Maybe borrow material from later NB on friendship paradox? [old hwk7]

Hwk 05 - advanced complete network data

Goals: - assess skills from lab 03, enriching network data + lab 04, exploring - open a network that has node attributes with minimal hand-holding - calculate - avg degree - clustering coef - avg path length - test for homophily (maybe using more advanced null model) - maybe one-mode projection of a two-mode network - NB: MIGHT GIVE EXTRA TIME FOR THIS ONE -> MAYBE borrow material from later notebook stuff on betwenness centrality? -> Maybe borrow material from later NB on friendship paradox? [old hwk7]

Hwk 06 - Problem set II

Goal: assess problem-solving with - ER model - advanced network models - scale-free networks - two-mode networks - TODO others?

Lecture - Scale-free networks

Lecture - Community detection [NB: could make this a little longer]

Lecture - empirical studies of network structure

```
-> include friendship paradox stuff here...
```

Reading - TODO

Dynamics: simple contagion [4 lectures]

Lecture - diseases and simple contagion; SIR model [maybe add SI model, SIS model]

Lecture - SIR model on networks [NB: could make this a little longer]

```
* the Menczer et al book (First Course in Network Science) has a good chapter on dynamics (cl
    - SIS and rumor spreading model
    - more on cascades
    - opinion dynamics
    - co-evolution of networks and dynamics
```

Lab 06 - Simple contagion [old lab05]

- NB: some of the centrality material may get moved to earlier in the semester
- old lab05 has centrality and SIR model stuff...

Hwk 07 - centrality/epidemic model in US legislators [old hwk06]

- maybe incorporate community detection?

Lecture - Sexual networks, concurrency and HIV

Lecture - empirical studies of simple contagion [TODO - see notes on stuff to add]

Reading - TODO

Dynamics: complex contagion and social influence [5 lectures]

Lecture - Social influence, herding, and cascades

##Lecture - Threshold models and complex contagion [NB: look at notes on complex contagion lectures]

? Add material on imitation and social learning? (Bass model? DeGroot learning?)

Lab 07: Mini-project prep

Goals: - have students start from just a dataset and some questions, then write a notebook to perform the analysis + submit the results

Mini-project

Goals: - from lab 07: have students start from just a dataset and some questions, then write a notebook to perform the analysis + submit the results - analysis should cover - open up a new network dataset - calculate avg degree, degree distn, clustering coefficient - extract largest component - identify most central nodes? - and/or test for homophily with respect to some characteristic?

Note: on this assignment, we might let them choose to work with a partner?

Lecture - Complex contagion on networks I

Lecture - Complex contagion on networks II

Lecture - Is obesity contagious? Experimental + observational studies of complex contagion

Hwk 08 - Problem set III

Goals: assess problem-solving with concepts covered in last part of class, including - community detection - simple contagion / SIR model - influence / Bass model / DeGroot model - complex contagion

Reading

Wrap-up [1 lecture]

Leceture - Wrap up