Social Network Analysis

Data and Process

Robin Burke

DePaul University

Chicago, IL

Outline

- Questions
  - Homework I
- Social network analysis process
- Social network data
- Ethical issues
- Data preparation
- Sampling

Homework 1

- Questions

Teams Milestone

- Due next week
- Submit to D2L
  - Names of team members
  - 2 or 3 person teams
  - Everybody should do this (undirected network!)
- You can also submit
  - “Don’t have a team”
  - And I will form teams
- Use #project channel if you want to put together a team

Applying social network analysis

- Relational data
  - it has to make sense to treat the data as a network
  - does it matter that there is a path from one individual to another?
- Relational questions
  - questions must go beyond what you can get from a table
    - counts, relative proportions, etc.

Relational questions

- Who are the important individuals in the network?
  - (What does it mean to be important?)
- What are the sub-groups in the network?
  - (How are sub-groups defined?)
- What roles do individuals play in the network?
  - (What roles matter? How to detect?)
- What influences led to the formation of this network?
  - (What kinds of influences are we talking about?)

Stages of social network analysis

- Network definition / collection
- Manipulation
- Calculation
- Visualization

Network definition / collection

- The “true” social network is the whole planet
  - “no man is an island”
- Always have to set boundaries
- Cannot apply sampling in the same way
  - as traditional social science research
- Collecting social networks can also be difficult
  - the Internet and the social web has made it a lot easier

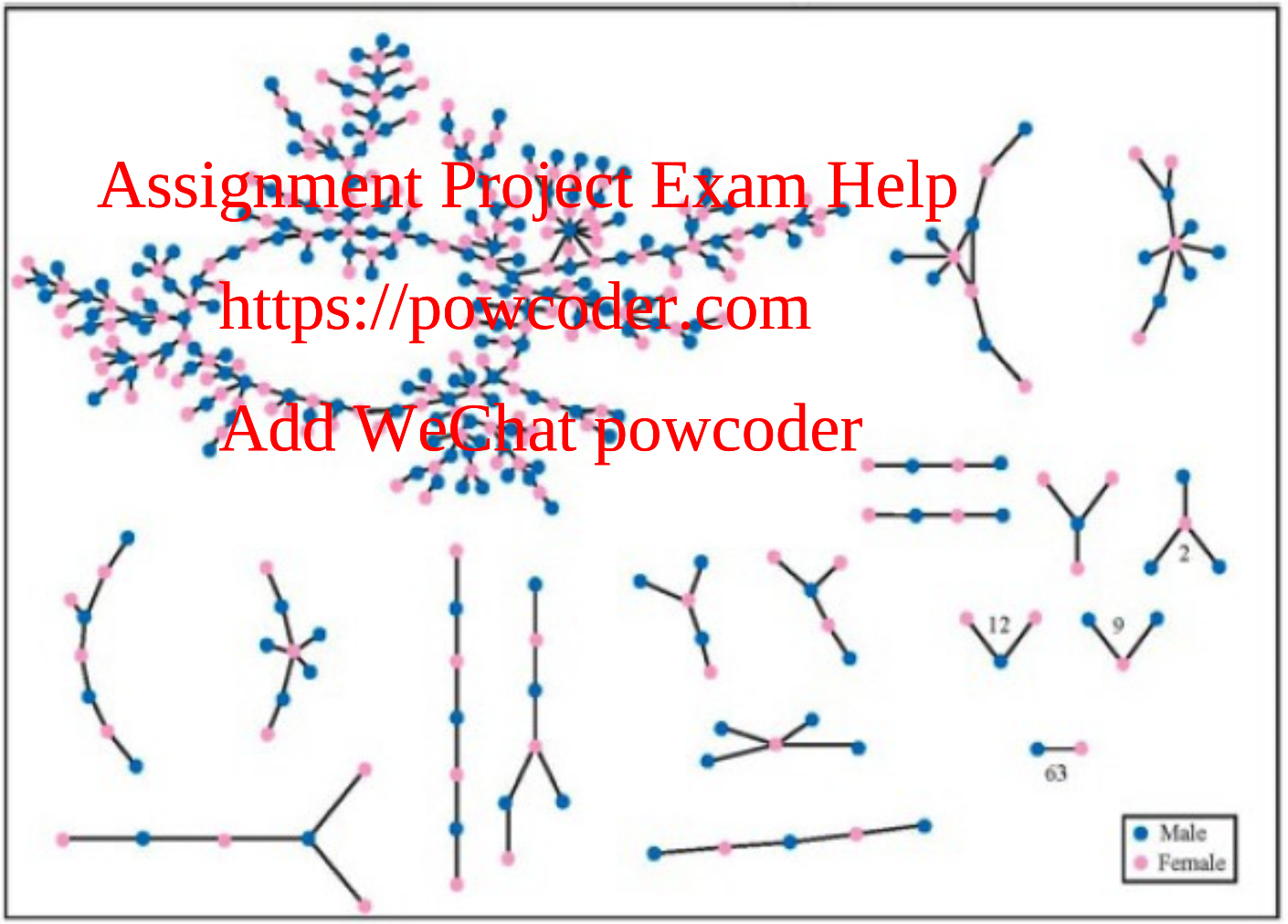
Manipulation

- Recovering the network may require computation
  - individual emails with “from” and “to” fields
- Data cleaning is important
  - Data has to be filtered, merged, normalized, etc.

Calculation

- We'll spend a lot of time on this
- What can we measure about a network?
- What does it make sense to measure about a network?

Visualization



Visualization

- Network data is inherently complex
  - visualization is often the best way to make sense of it
- But you can also make bad visualizations
  - we'll talk about how to avoid that

Stages of social network analysis

- Network definition / collection
- Manipulation
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- Visualization

Network Definition

- Basic questions
  - what are nodes?
    - usually people, but not always
  - what are edges?
    - usually relationships, but how defined?

Boundaries

- Very important question
  - what is the set of individuals under consideration?
    - where do we stop?
- Part of any data description

Network relations

- Not every relation is an edge
- For example
  - I could create an age-based bipartite network
    - link people by their ages
- Why not?
  - age doesn't have "path semantics"

Problems with the age network

- People only have one age
  - Connected only to people of the same age
  - This is the same information you could get by creating a table of people vs age
- More generally
  - there is no utility to paths in this network
  - true of some multiplex relations as well
    - citizenship

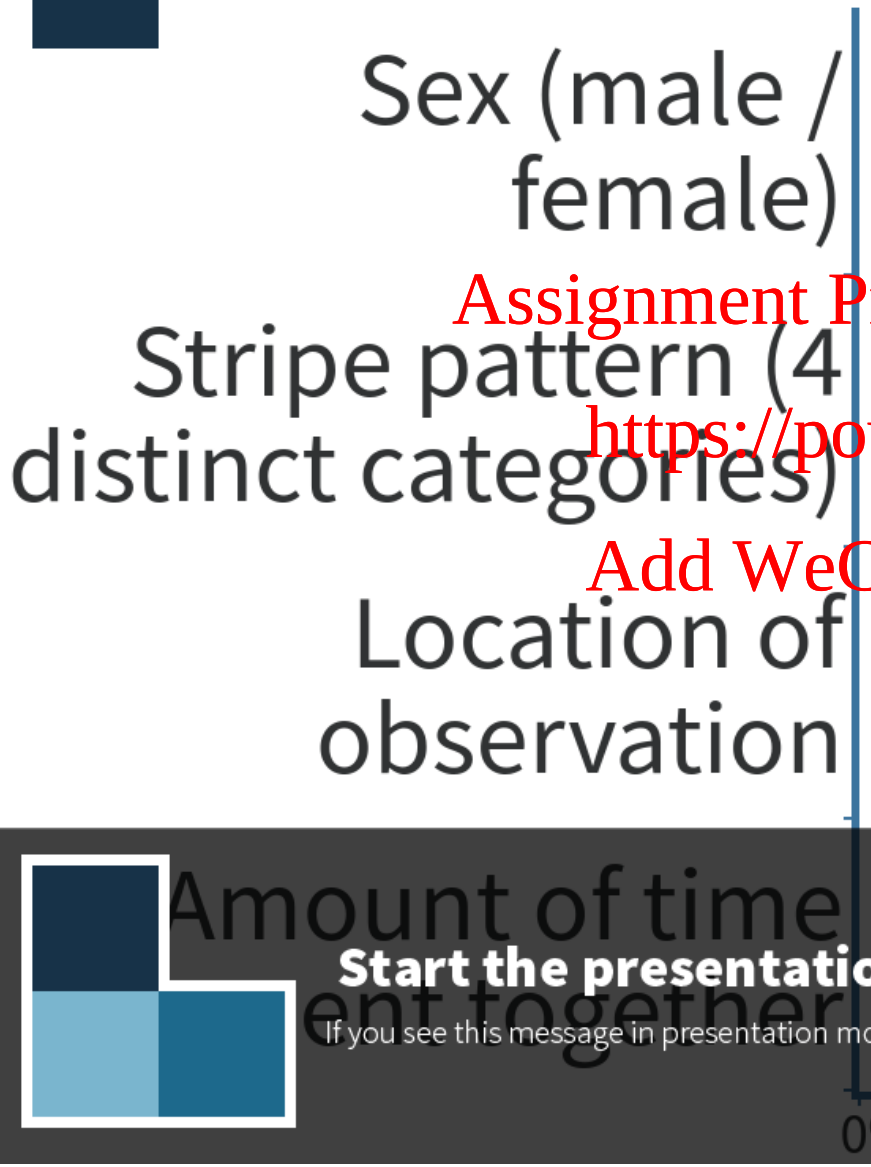
Network relations / edges

- Will be multiple
  - more than one connection for each node
- Will have path semantics
  - paths of arbitrary length have meaning

Measuring relations

- Binary
  - tie exists or not
- Heterogeneous
  - what kind of tie?
- Ranked ordinal
  - "close" vs "distant"
  - even "liked" vs "disliked"
- Interval measures
  - harder to get from people
  - easier to get from machines
    - e.g. # of interactions

observing zebras in the wild. What would be
relation for building edges?



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Gathering data

- Go out and get the data you've defined
- Often the network must be redefined
  - issues arise while gathering it
- If you have a network someone else has gathered
  - very important to know how they defined the network when collecting it

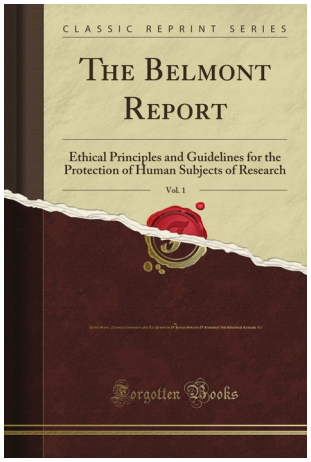
Ethics

- Social network data is often easy to collect
  - public sites / APIs
- What are the ethical considerations?

Key principle

- Social network data is data about people

Belmont Principles



- Belmont Report, 1978
- Autonomy/Respect for persons
  - respect for individual autonomy, and particularly protection of persons with diminished autonomy
- Beneficence and Nonmaleficence
  - maximize benefits and minimize harms
- Justice
  - benefits and burdens should be justly divided

Association of Internet Researchers

- The more vulnerable the community/participants, the greater the obligation of the researcher
- Harm is contextually defined, hence ethical principles are inductively understood, in a context-dependent manner
- Data comes from people. You work with data generated by people, thus you work with people. Personal information involves a person in the end, even if the relationship is not always obvious.
- Balance the rights of subjects with benefits of research
- Ethical issues arise at every step, from planning through research through dissemination
- Ethical decision making is a deliberative process, it is best to consult widely
- https://aoir.org/

Four Research Types

I. User awareness and manipulation

Lab-based user study

II. Awareness without manipulation

User diaries / focus groups

Many corporate settings

III. No awareness with manipulation

A/B testing of new feature

IV. No awareness, no manipulation

most observational studies

This class

What is the harm?

- Data can be used to infer attributes of individuals
  - Including attributes they might want to keep private
  - Sexual orientation, health status, etc.
- Social networks are intensely personal
  - Who you interact with, how much?
  - How long have you know a given person?
  - Comments may reveal political preferences, income level, etc.

Primary obligation

- Remove personally identifying information (PII)
  - If the data is in any way non-public
  - Example:
    - You build a network from your own Facebook network
  - If you're drawing conclusions of a sensitive nature, even if the data is public
  - Example:
    - Detecting sexual orientation from Twitter posts
- Treat any link between identifiers and data as confidential

PII

- Is not just names, addresses and identifiers
  - Depends on the size and homogeneity of the group
- Example
  - In a smaller group, name of high school and year of graduation may uniquely identify individuals

Ethics = balance

- Balancing the concerns of individuals and those of society
- Specific scenarios are important
- Issues
  - benefit (who gains?)
  - cost (who loses?)
  - expectation

For our purposes

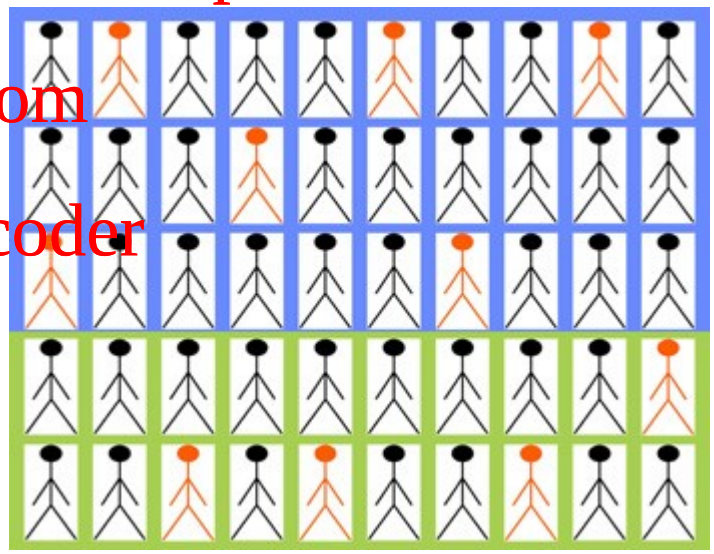
- If you're collecting data
  - think about
    - what kind of action resulted in that data
      - public or private?
    - what is the reasonable "expectation of privacy"?
  - consider possible harm
    - what if someone reading your final report knew an individual involved?

Example

- Dining social network
- Potential benefit?
- Potential harm?
- Mitigation strategy?

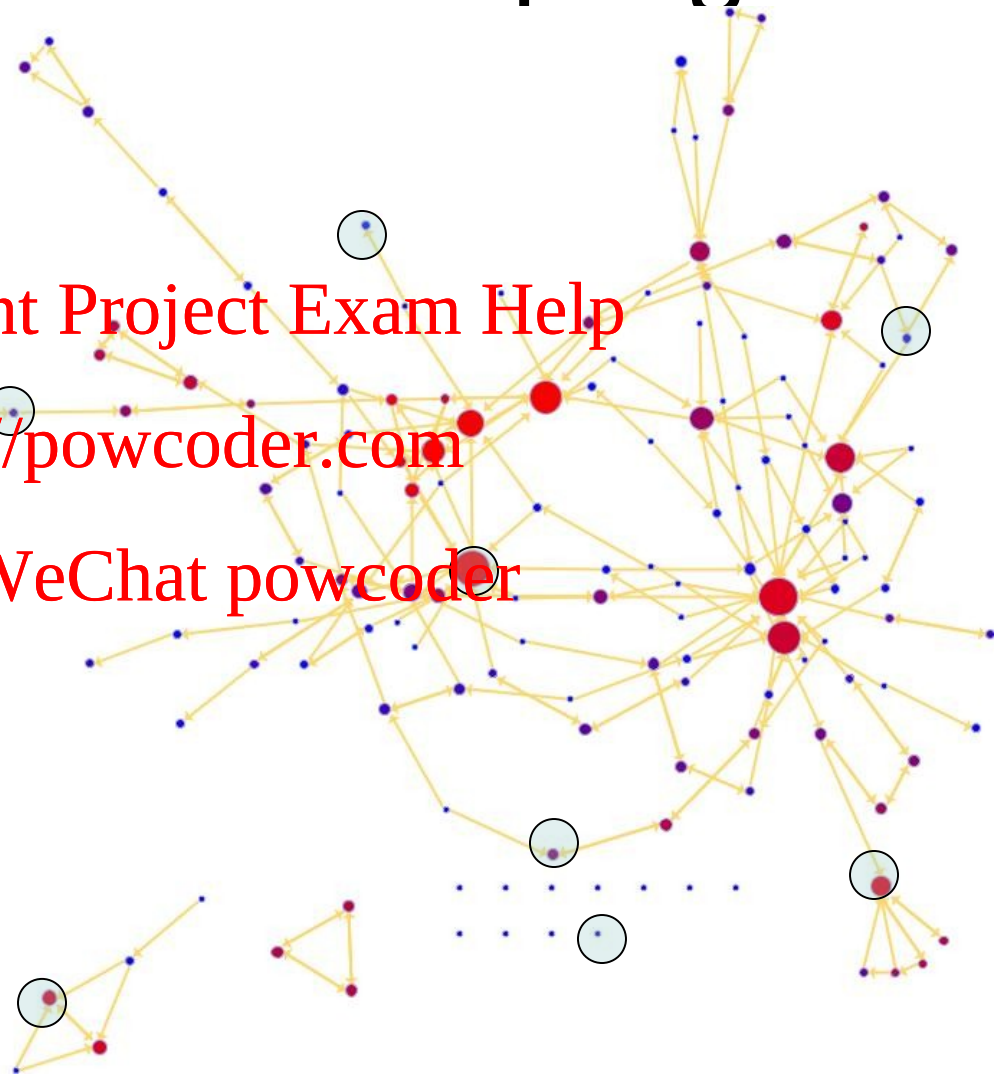
Sampling

- Social science research often depends on sampling a population
  - think election polls
- Identify individuals at random from a population
  - test their properties
  - extrapolate to the population as whole



Social network sampling

- Random doesn't work so well
- Have to make sure that the local properties of the network are captured
- Becomes a complex question



Full network

- You are interested in a known set of individuals
  - collect all the connections between these individuals
  - (not sampling)
- Example
  - all students in this class
  - all passengers on the Titanic
- Not always possible to do this

Reset Boundaries

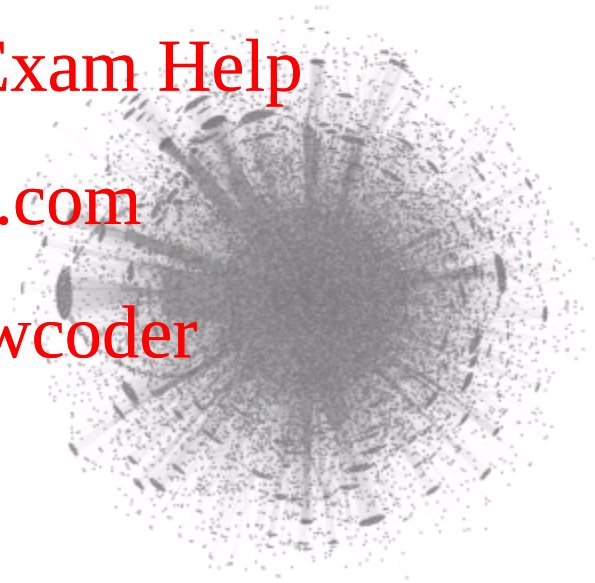
- If the data is
  - too big, or
  - can't be accessed in raw form
- You might need to establish new boundaries
  - collect within those
- Example
  - all users who tweeted using a particular hashtag in a given week
  - all students in a certain degree program

Sampling

- With online data (social networks)
  - you often don't have access to raw data
  - limited access via API
- Must be aware of the effect of not having all the data

Enron email network

- All people who exchanged at least 10 messages
- Pretty hard to make sense of this

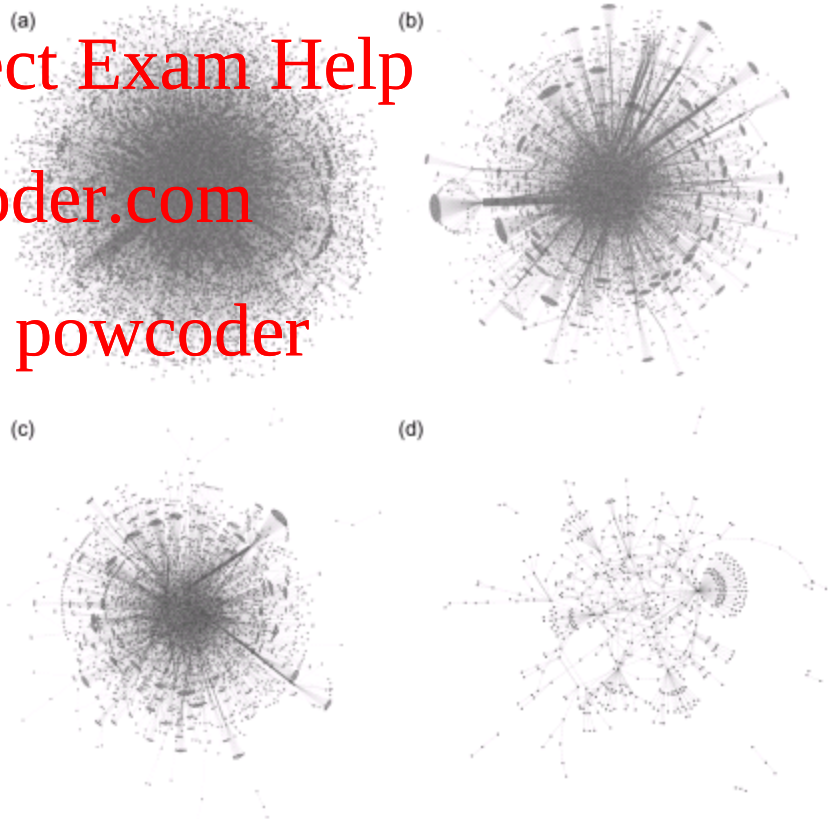


Random Sampling

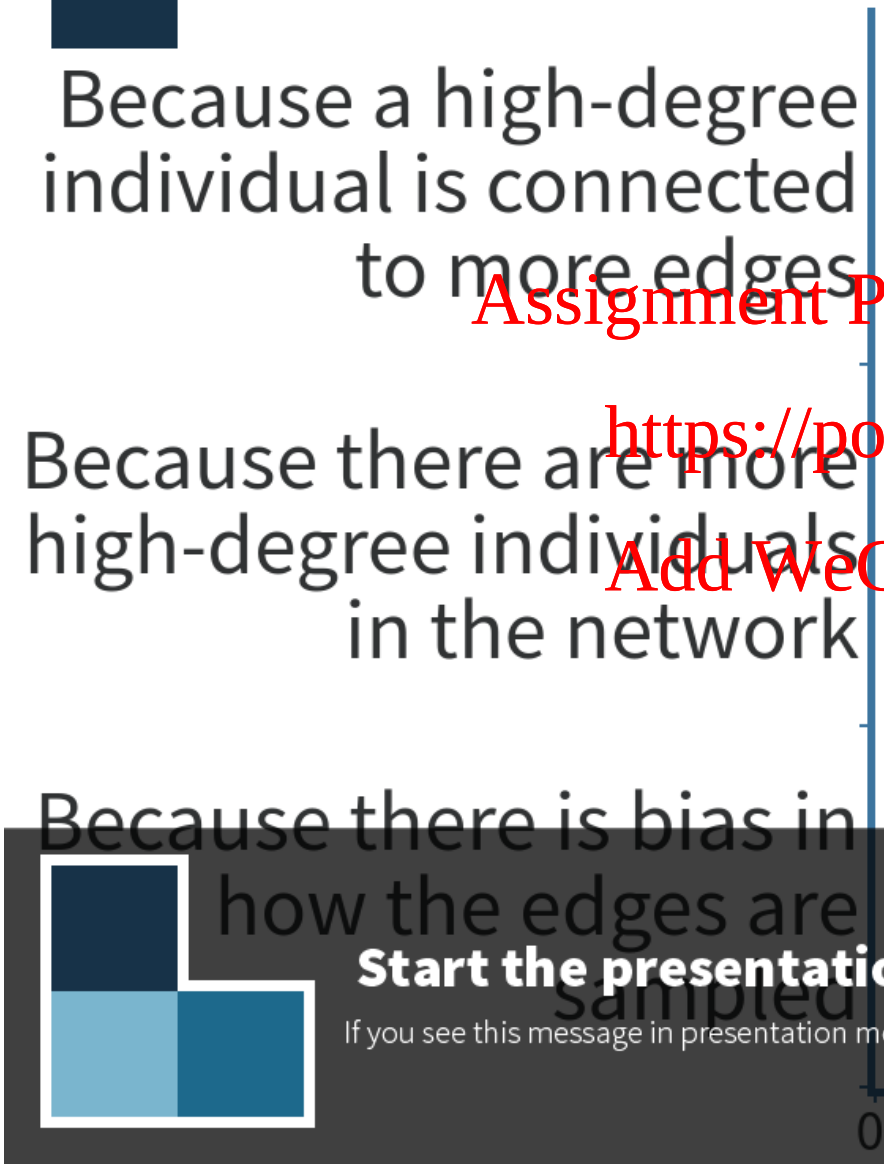
- Randomly select a certain percentage of **nodes** and keep all edges between them
  OR
  Randomly select a certain percentage of **edges** and keep all nodes that are mentioned.
- Problems
  - Edge sampling biased toward high degree nodes
  - Node sampling loses structural characteristics
- Benefits
  - Easy
  - Node sampling keeps some network statistical features

Enron network (random edges)

- Edge sampling
  - 50%, 25%, 10%, 1%
- Some structural properties preserved
- Biased towards high-degree individuals



a network formed by edge sampling more li
high-degree individuals than low-degree indi



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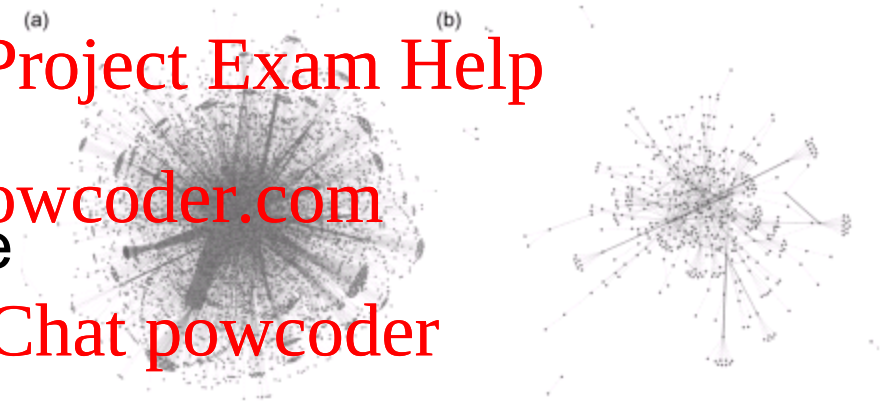
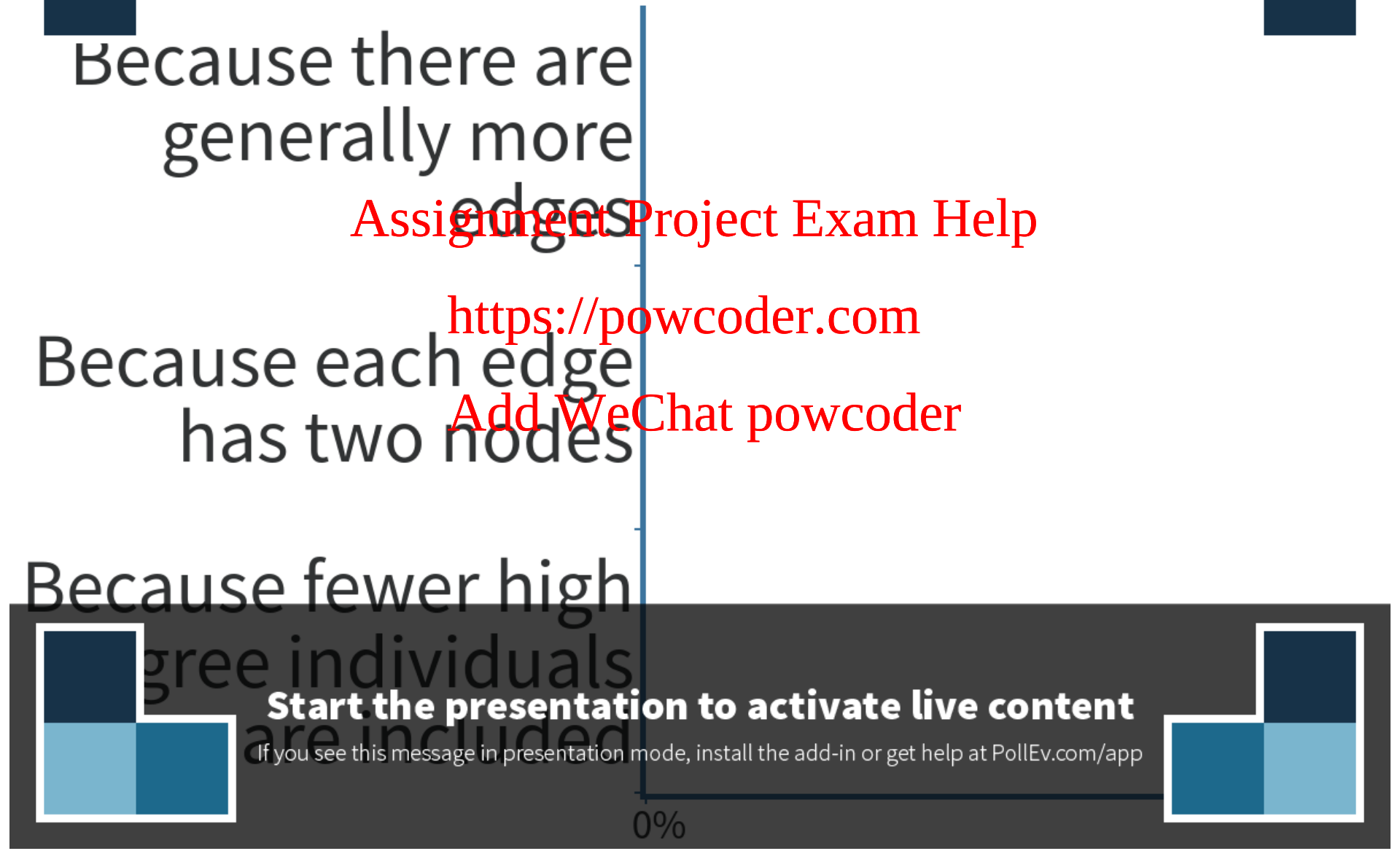
Enron network (random nodes)

- Node sampling
  - 50%; 10%
- Much less dense than edge sampling
- Less bias
- Node metrics can still be computed



s a given degree of node sampling (say 10%)
er network than edge sampling at the same



Survey methods

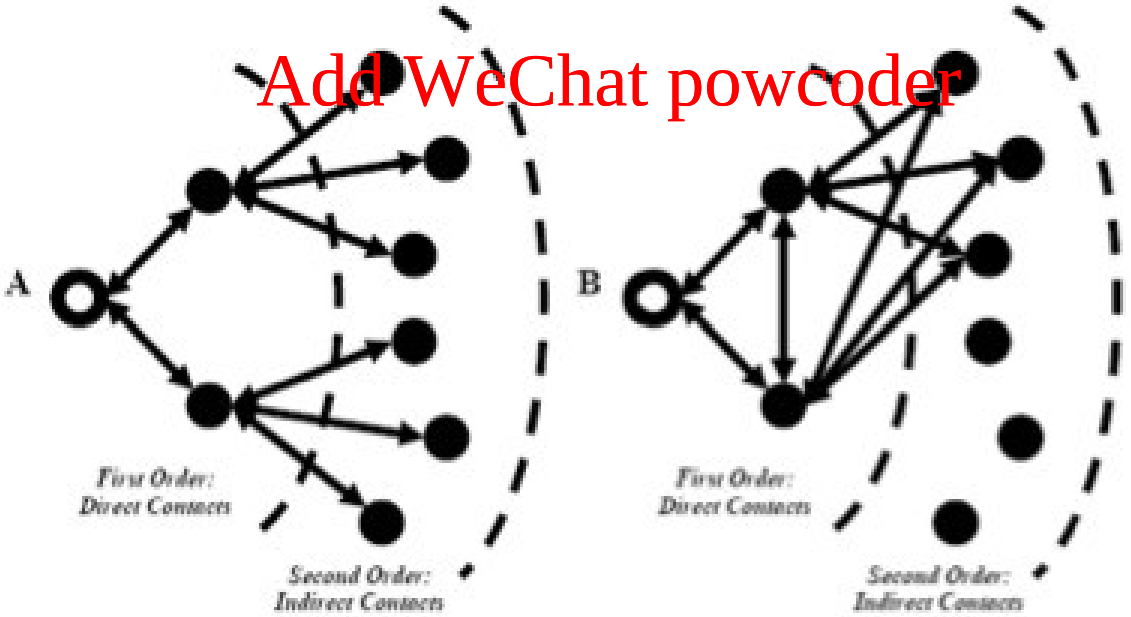
- In the social sciences
  - standard methodology is to survey individuals
    - ask them to name all of their ties
    - "who do you ask for advice?"
  - or collect observations of who interacts with whom
    - hard to ensure completeness
    - for some domains, this is all there is: animal social networks
- In online social networks
  - more likely to look at observed on-line behavior
  - but there may be unobserved off-line activity

Snowball Sampling

- When working with a large network, choose a starting node
- Get that node, its connections, their connections, and so on until the network is the right size for analysis
- Problems
  - Biased toward the part of the network sampled
  - May miss large-scale features
  - Cannot find isolates
- Benefits: Easy to do, common
- Might have no other options

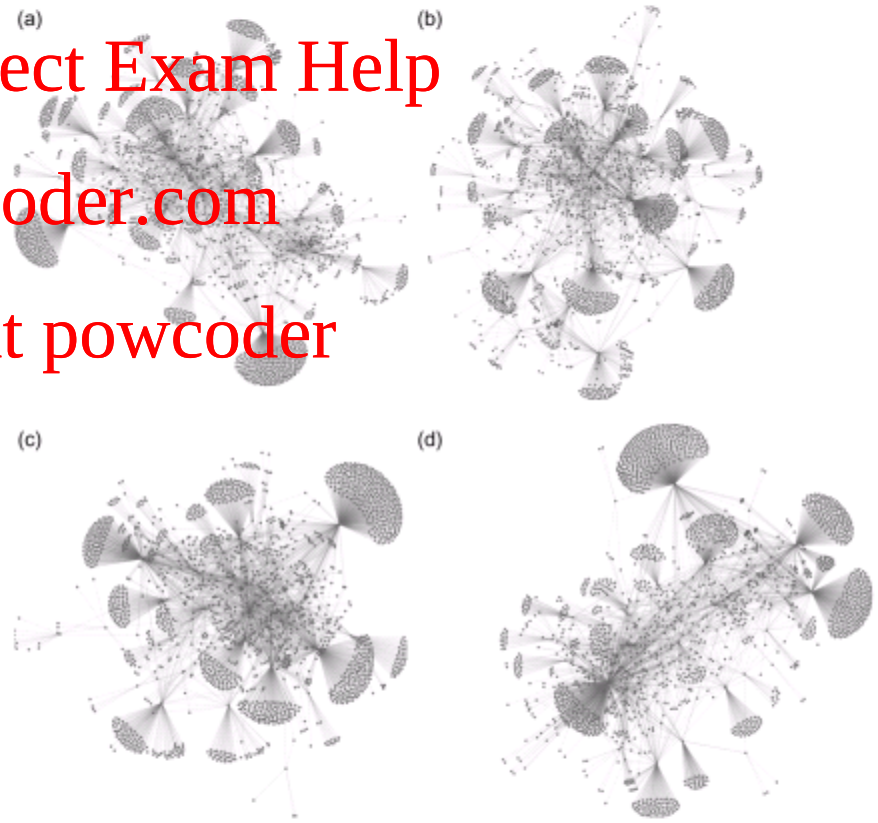
Sampling contacts

- Most prominent contacts are most likely to be shared
  - so a short contact list may not show the full network
- May need a longer list of contacts
  - sample from those



Enron network (snowball)

- Snowball samples of size 4
- Different starting points
- Note the “fans” at the edges
- Cannot measure network metrics reliably

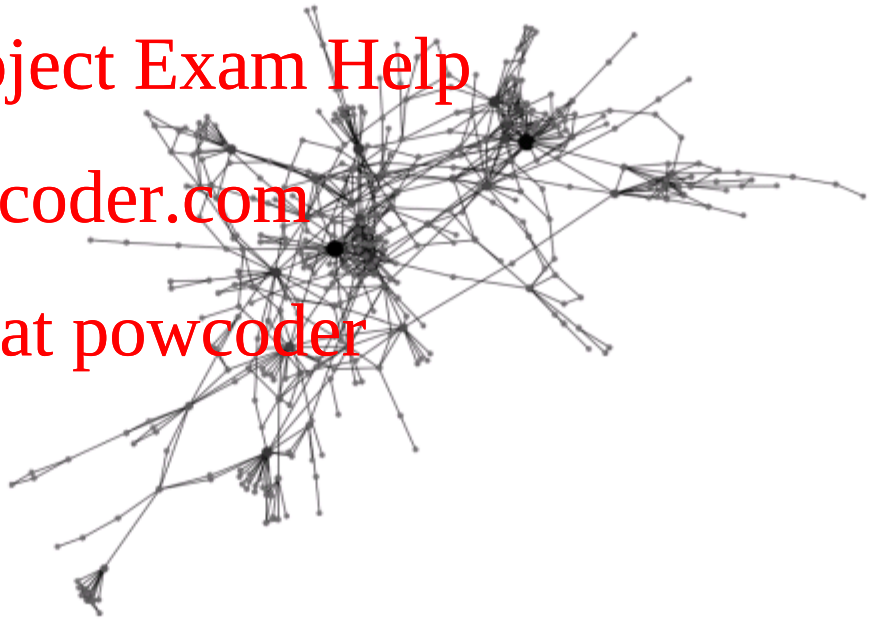


Filtering

- You can filter the network
  - keeping particular nodes or edges of interest
- Usually
  - interested in the most active users
  - the strongest ties
  - 80 / 20 rule

Enron network (filtered)

- Keep edges with 100 emails
- Keep edges if they account for at least 10% of total email output for a user
- Discard nodes of degree 1
- Keep only the giant component



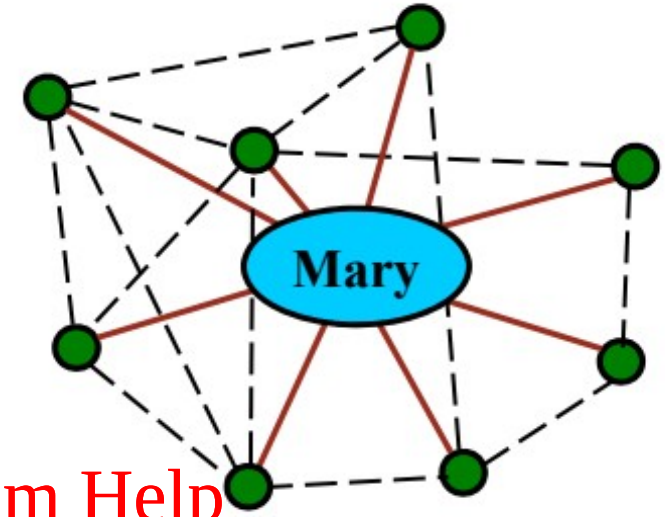
Sampling

- It is often necessary to sample social networks
  - practical reasons
  - computational reasons
- Key point
  - understand what sampling is doing to your data

Egocentric Network Analysis

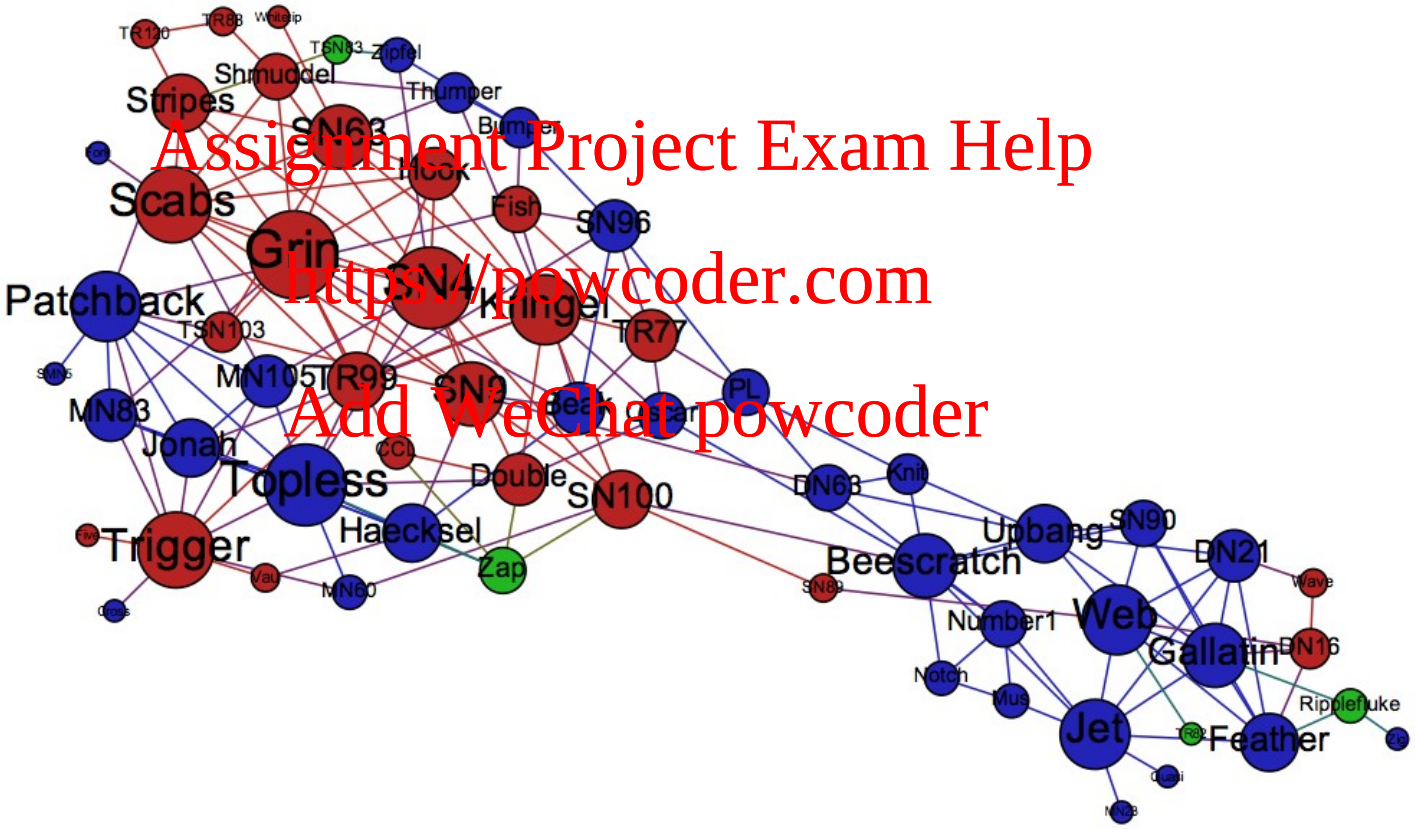
- Instead of looking at the whole network,
  - look at the local networks of some nodes
- A different type of analysis than overall network analysis, but it shows the role of an individual in context.

Ego networks



- Also, First-person network
  - also, 1 neighborhood
  - first-order zone
  - 1.5 neighborhood
- Pieces
  - ego
  - alters
  - ties between alters
- If we don't have ties between alters
  - it isn't a network, just a list of contacts

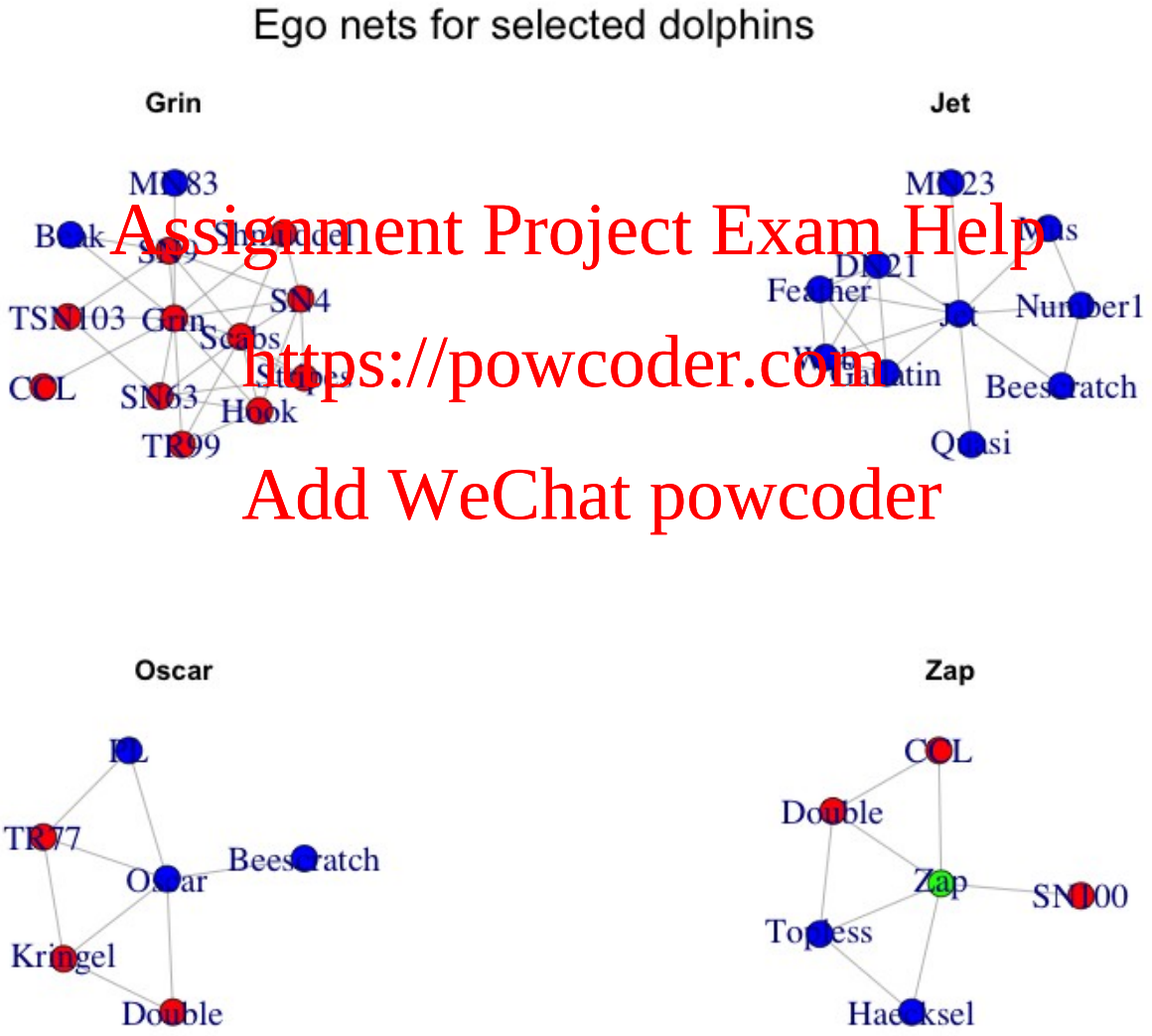
Dolphin network



make_ego_graph

- can specify any distance away from the ego node
- order = 1
  - is usually what is meant

Ego networks



An alternative / complement

- Instead of studying the whole network
  - look at particular individuals
- Useful
  - if network is too large
  - if network is hard to discover
  - if we want to focus on particular individuals

Break