Graphs

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CSE 160

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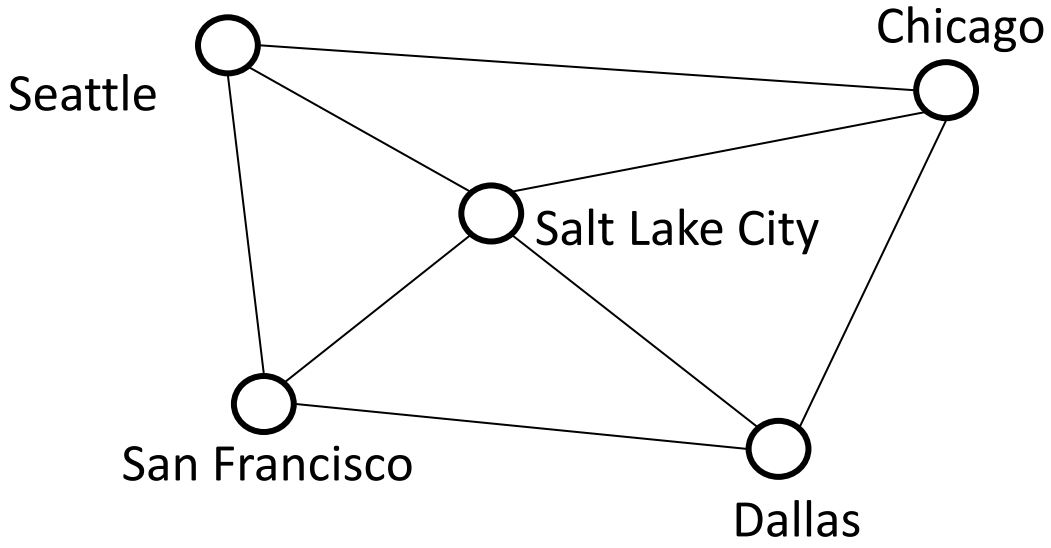
A graph contains nodes and edges




Lynden
Ferndale
Bellingham
Friday Harbor
Anacortes
Concrete
Mount Vernon
Oak Harbor
Coupeville
Arlington
Darrington
Port Angeles
Sequim
Port Townsend
Marysville
Everett
Forks
Mukilteo
Edmonds
Shoreline
Mountlake Terrace
Redmond
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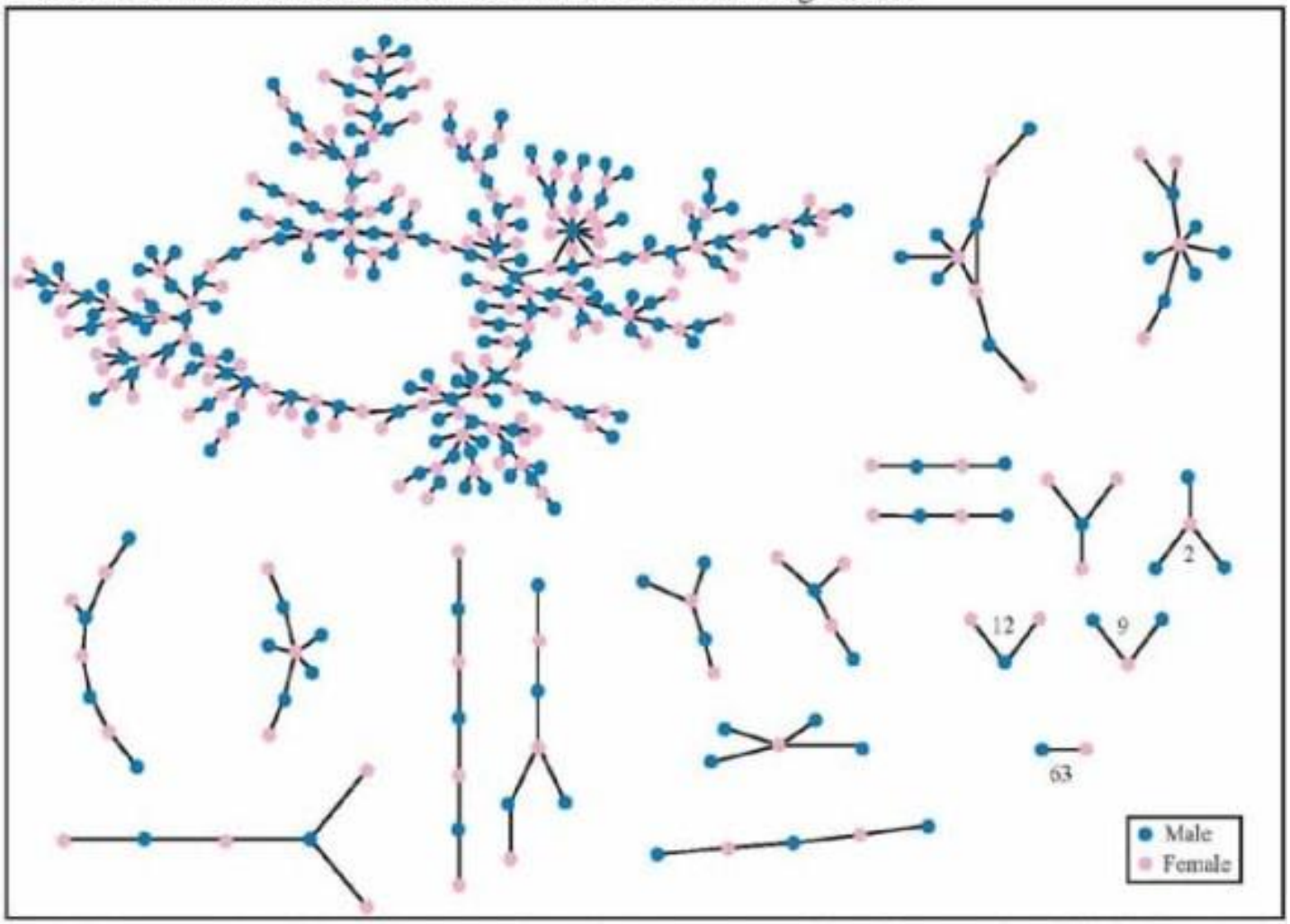
Skykomish
Leavenworth
Seattle
Bellevue
Bremerton
Issaquah
Burien
Renton
Des Moines
Kent
Federal Way
Auburn
University Place
Tacoma
Lakewood
Carbonado
Olympia
Lacey
Roy
Yelm
Tenino
Eatonville
Aberdeen
Montesano
Westport
Oakville
Centralia
Chehalis
South Bend
Pe Ell
Winlock
Morton
Messyrock
Toledo
Long Beach
Castle Rock
Cathlamet
Longview
Kelso
Kalama
Woodland
Yacolt
Battle Ground
Vancouver
Camas
Washougal
Stevenson
Goldendale
Oroville
Tonasket
Conconully
Winthrop
Twisp
Omak
Okanogan
Riverside
Republic
Northport
Metaline
Ione
Kettle Falls
Colville
Chewelah
Cusick
Nespelem
Newport
Springdale
Deer Park
Pateros
Brewster
Bridgeport
Grand Coulee
Chelan
Mansfield
Almira
Creston
Davenport
Spokane
Airway Heights
Coulee City
Entiat
Waterville
Cashmere
Wenatchee
East Wenatchee
Harrington
Cheney
Spangle
Wilson Creek
Odessa
Ephrata
Quincy
Sprague
Malden
Latah
Moses Lake
Ritzville
Oakesdale
Saint John
George
Ellensburg
Kittitas
Warden
Lind
Endicott
Colfax
Garfield
Royal City
Othello
La Crosse
Washtucna
Hatton
Pullman
Mattawa
Connell
Kahlotus
Tieton
Selah
Yakima
Mesa
Starbuck
Colton
Pomeroy
Clarkston
Asotin
Wapato
Toppenish
Sunnyside
Mabton
Richland
Kennewick
Pasco
Waitsburg
Dayton
College Place
Walla Walla
US Highways
Interstate Highways
0
50 KM
50 Miles
© geology.com

The Structure of Romantic and Sexual Relations at "Jefferson High School"



Each circle represents a student and lines connecting students represent romantic relations occuring within the 6 months preceding the interview. Numbers under the figure count the number of times that pattern was observed (i.e. we found 63 pairs unconnected to anyone else).

+ 350 students in no romantic and/or sexual relationship

From: "Chains of Affection: The Structure of Adolescent Romantic and Sexual Networks", *American Journal of Sociology*, by Peter Bearman of (Columbia), James Moody (Ohio State), and Katherine Stovel (U. of Washngton);

Graphs

- A graph can be thought of as either of:
  - a collection of edges
    - Each edge represents some relationship
  - for each node, a collection of neighbors
    - The neighbors are those connected by an edge

Operations on a graph

Creation:

- Create an empty graph

Querying:

- Look up a node: Does it exist? What are its neighbors?
- Look up an edge (= a pair of nodes): does it exist? (You know the nodes it connects.)
- Iterate through the nodes or edges

Modification:

- Add/remove a node
- Add/remove an edge

networkx Graph Library

- Used in Homework 4
- http://networkx.github.io/documentation/latest/tutorial/tutorial.html

```
import networkx as nx
g = nx.Graph()
g.add_node(1)
g.add_node(2)
g.add_edge(1, 2)
print g.nodes()
print g.edges()
```

Installing networkx Graph Library

- Used in Homework 4
- http://networkx.github.io/documentation/latest/tutorial/tutorial.html

- To install networkx:
  - Open up "canopy" (can search for it)
  - Then select tools-> package manager
  - Click on "available Packages" and search for "networkx".
  - The button next to networkx will say something like "free“, click on that button.
  - It will ask if you want to install, say yes.
  - To check if you have it installed, type “import network x” in IDLE (nothing should happen, but if it is NOT installed you will get an error message).

```
import networkx as nx
import matplotlib.pyplot as plt

g = nx.Graph()      # Creates a graph

g.add_node(1)       # Adds node 1
g.add_node(3)
g.add_node(2)
print g.nodes()

g.add_edge(1, 2)    # Adds edge from node 1 to node 2
g.add_edge(1, 3)
print g.edges()

assert len(g.nodes()) == 3
assert len(g.edges()) == 2

nx.draw(g)          # Draw the graph
plt.show()          # Show the graph in a separate window
```