

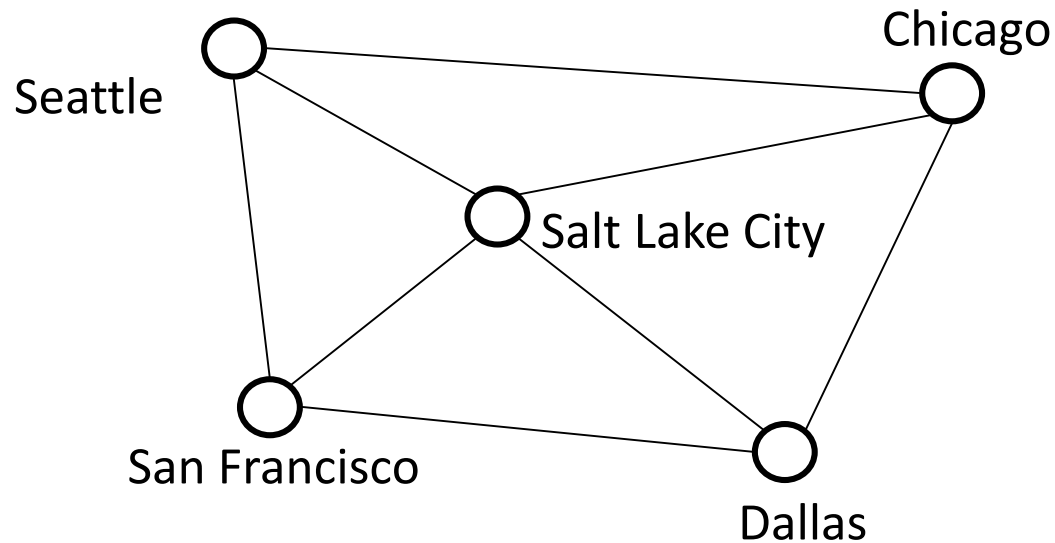
Graphs

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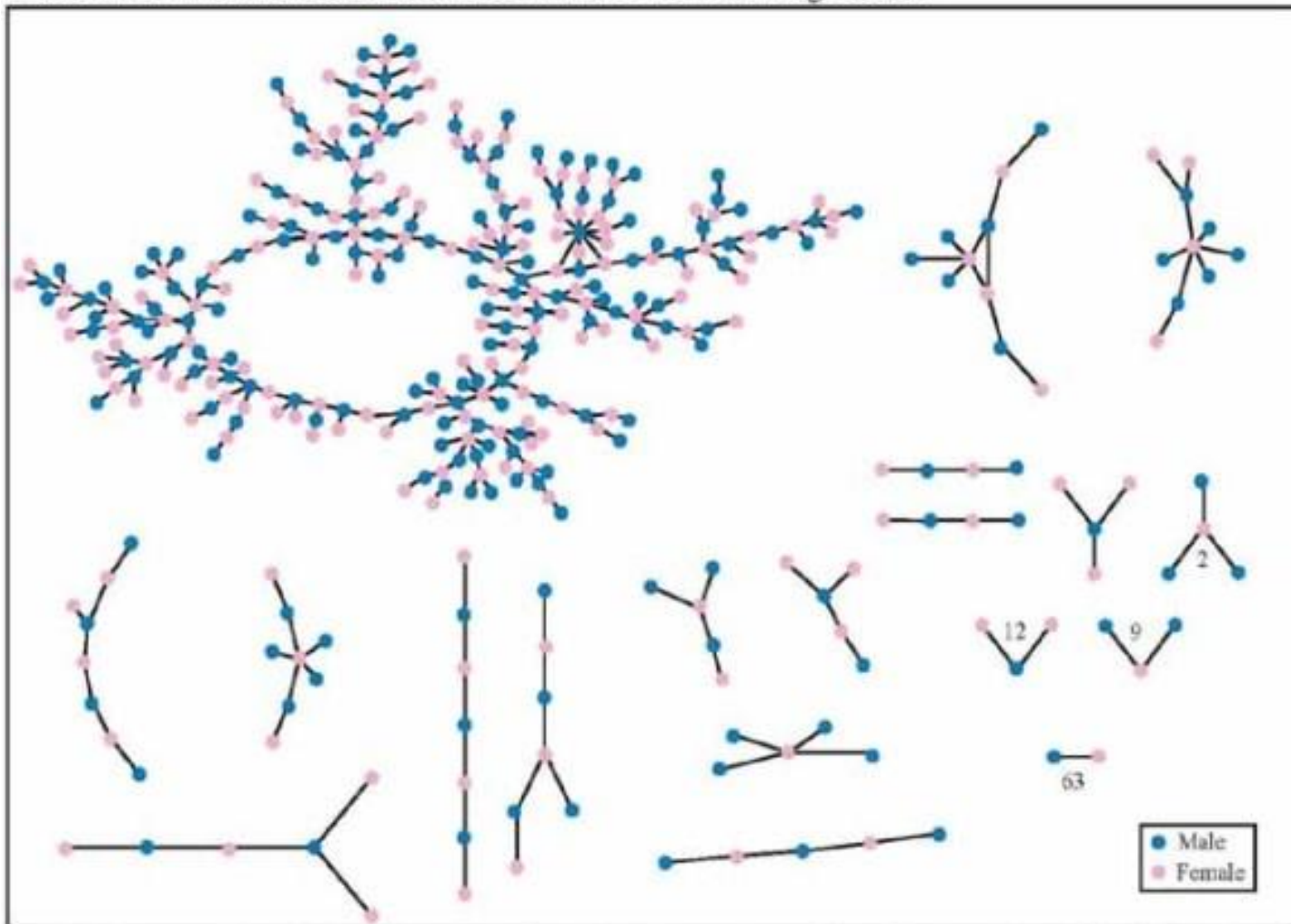
A graph contains nodes and edges





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



Each circle represents a student and lines connecting students represent romantic relations occurring 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 Washington);

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
- <https://networkx.github.io/documentation/networkx-1.11/tutorial/index.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()
```

Note: It is also o.k. to just add an edge before you add the individual nodes; the nodes will be added for you in that case.

Installing networkx Graph Library

Through the GUI:

- In Canopy select Tools-> Package Manager
- In the left hand panel, click on “Available ” and then type "networkx“ in the search box in the upper right
- Once found, click the Install button.

To check if you have networkx installed, type:

```
import networkx
```

in the python interpreter in Canopy. If it is installed properly 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_edge(1, 2)       # Adds edge from node 1 to node 2
g.add_edge(1, 3)
g.add_node(4)          # Adds node 4
print g.edges()
print g.nodes()
print g.neighbors(1)

assert len(g.nodes()) == 4
assert len(g.edges()) == 2

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