Identifying Nashville's Popular Pythonistas with NetworkX

PYNASH -- NOVEMBER 16, 2017

STEPHEN BAILEY


Who should I get to know?
What groups should I attend?
Where should I advertise?
BAKER DONELSON

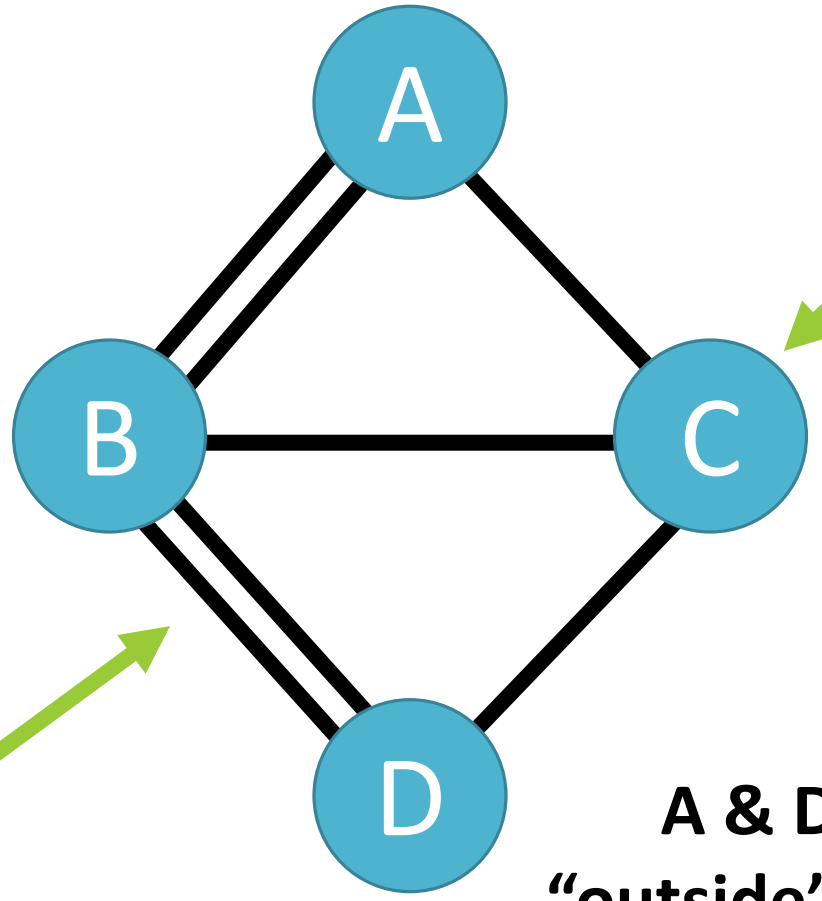
Popular Pythonistas

1. What is a network?
2. Building graphs
3. Who's who in PyNash?

Can you traverse every bridge just once?


A
B
C
D
1
2
3
4
5
6
7

Graph



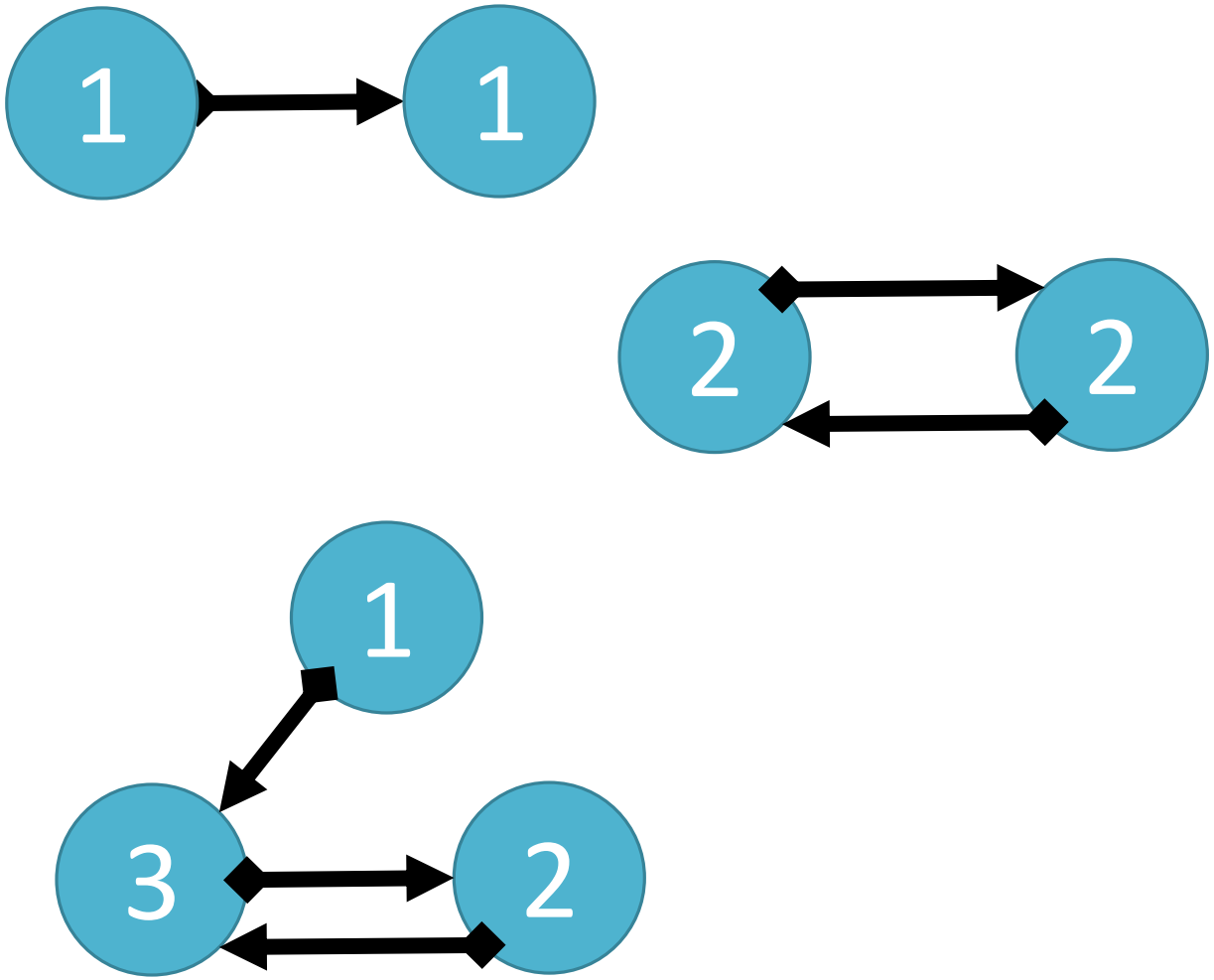
Node

B has the most connections

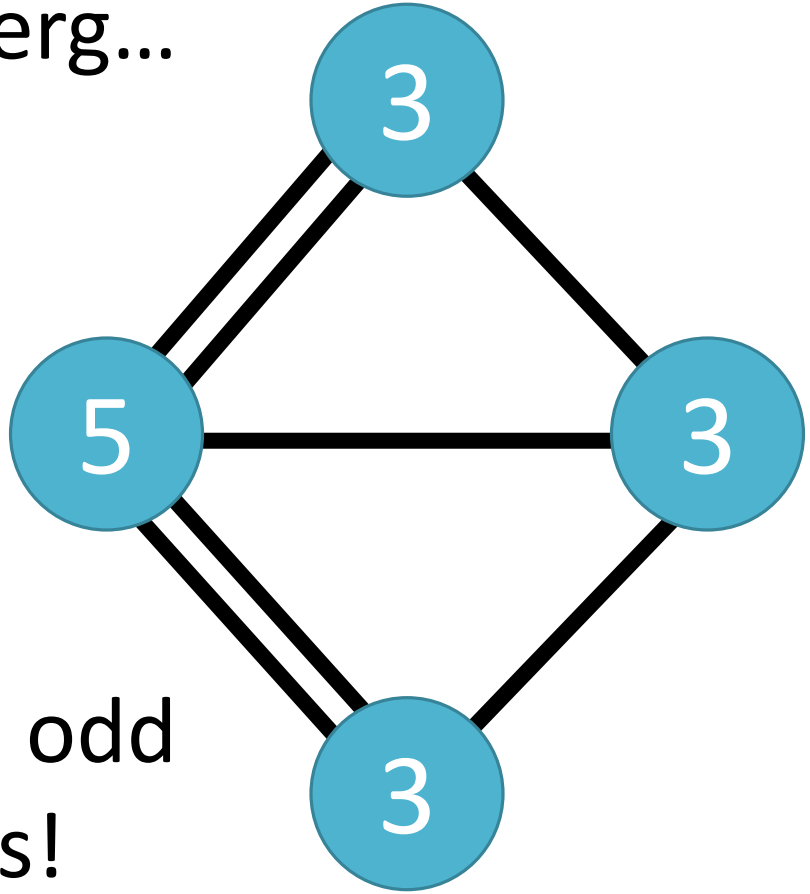
Edge

A & D are on the “outside” – they are not connected to each other

1. To travel into AND out of a node, requires 2 steps (or 4 or 6…).
2. Therefore… either:
   - All nodes are even.
   - Exactly two nodes are odd.

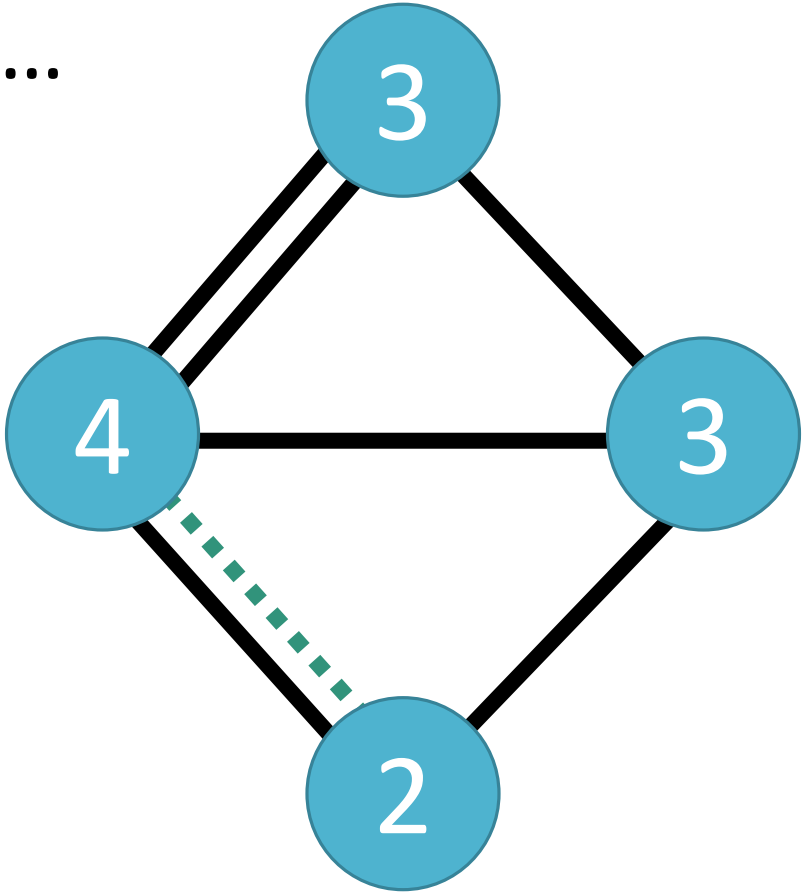


Back to Konigsberg…



Four nodes with odd number of edges!

That’s the ticket…

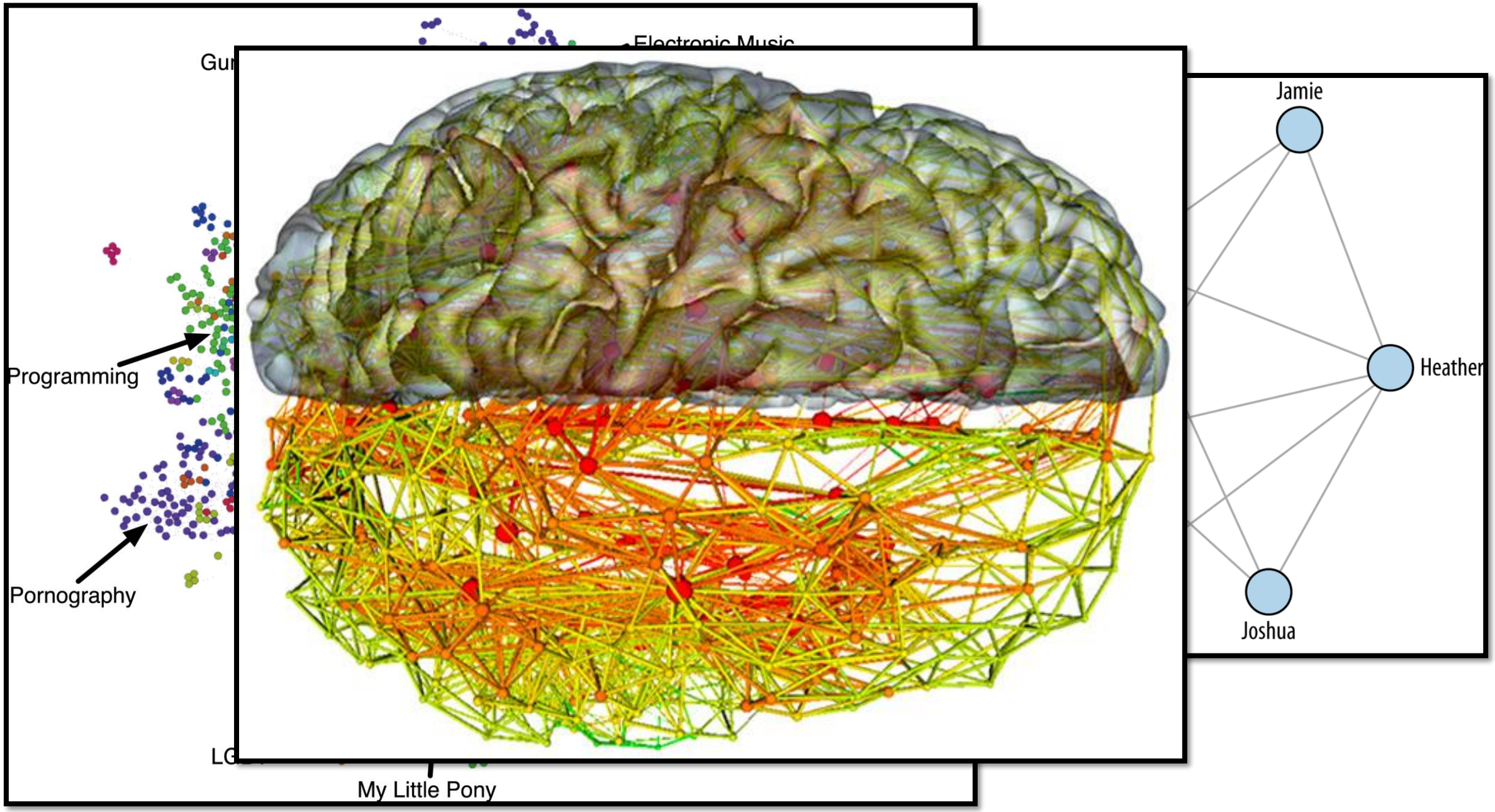


Graphs

Useful for understanding **relationships**.

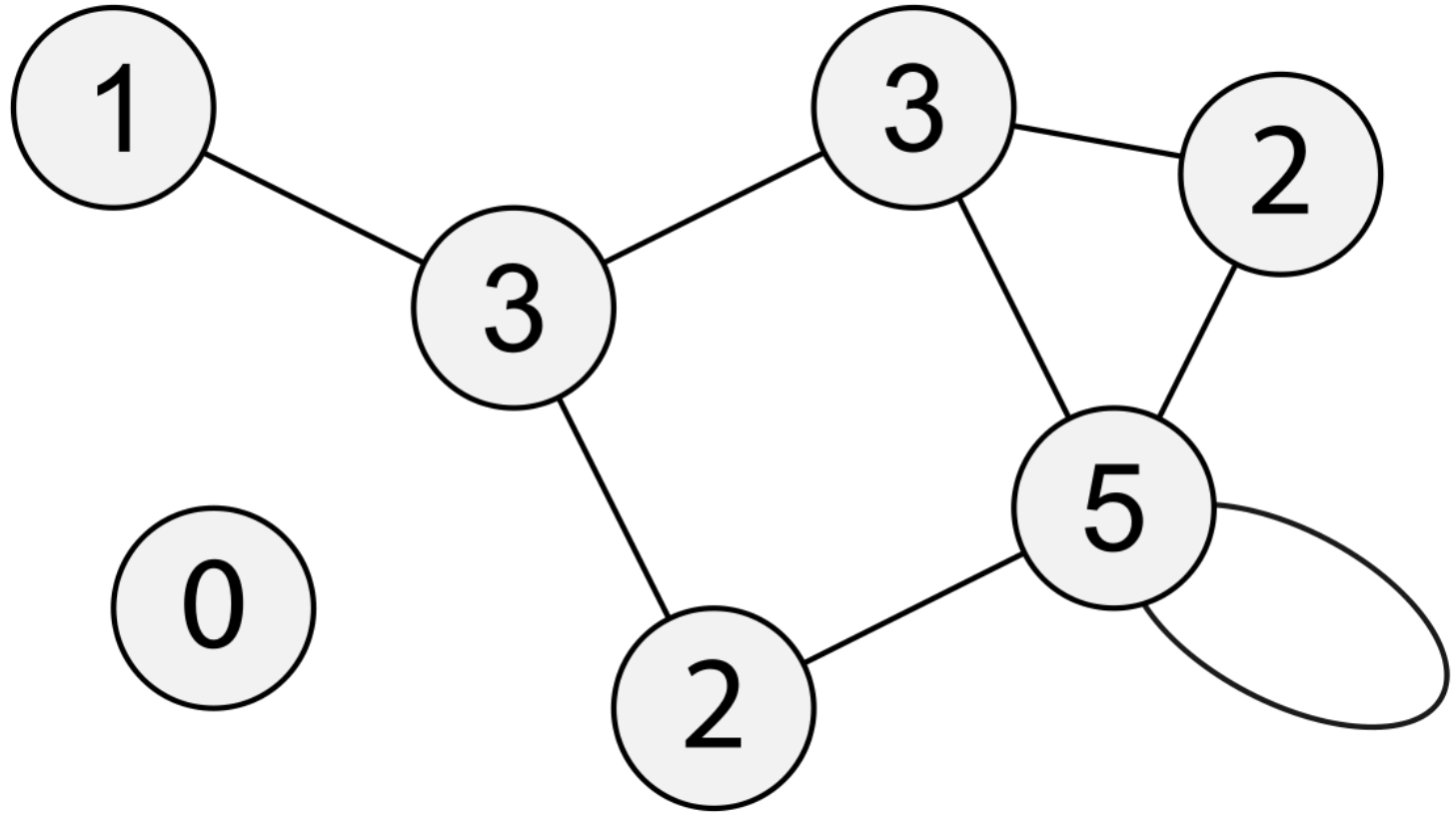
Describe **topology** (arrangement) of networks.

Many possible measurements to derive.


Electronic Music
Programming
Pornography
My Little Pony
Jamie
Heather
Joshua

Common Measures

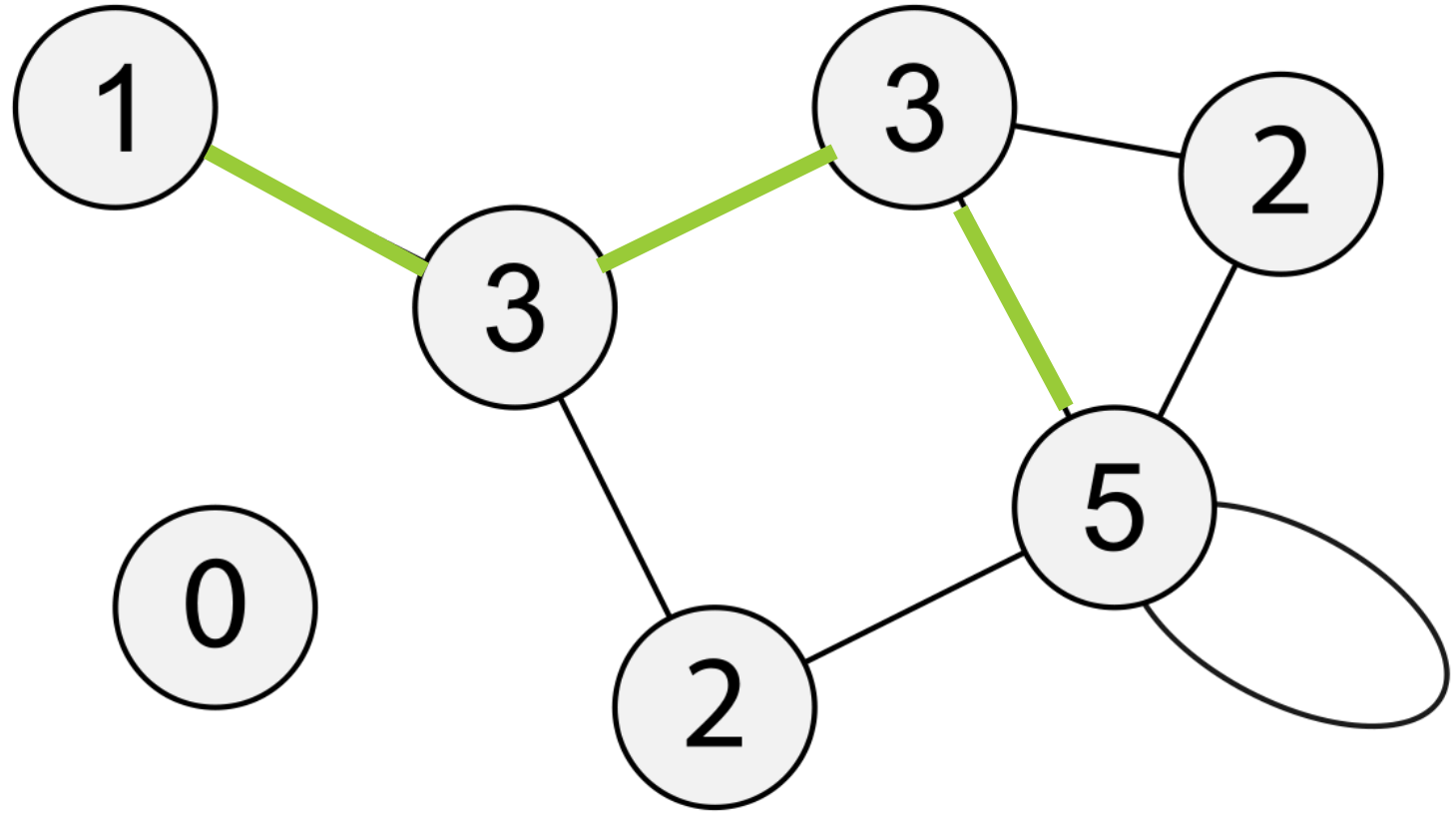
Degree

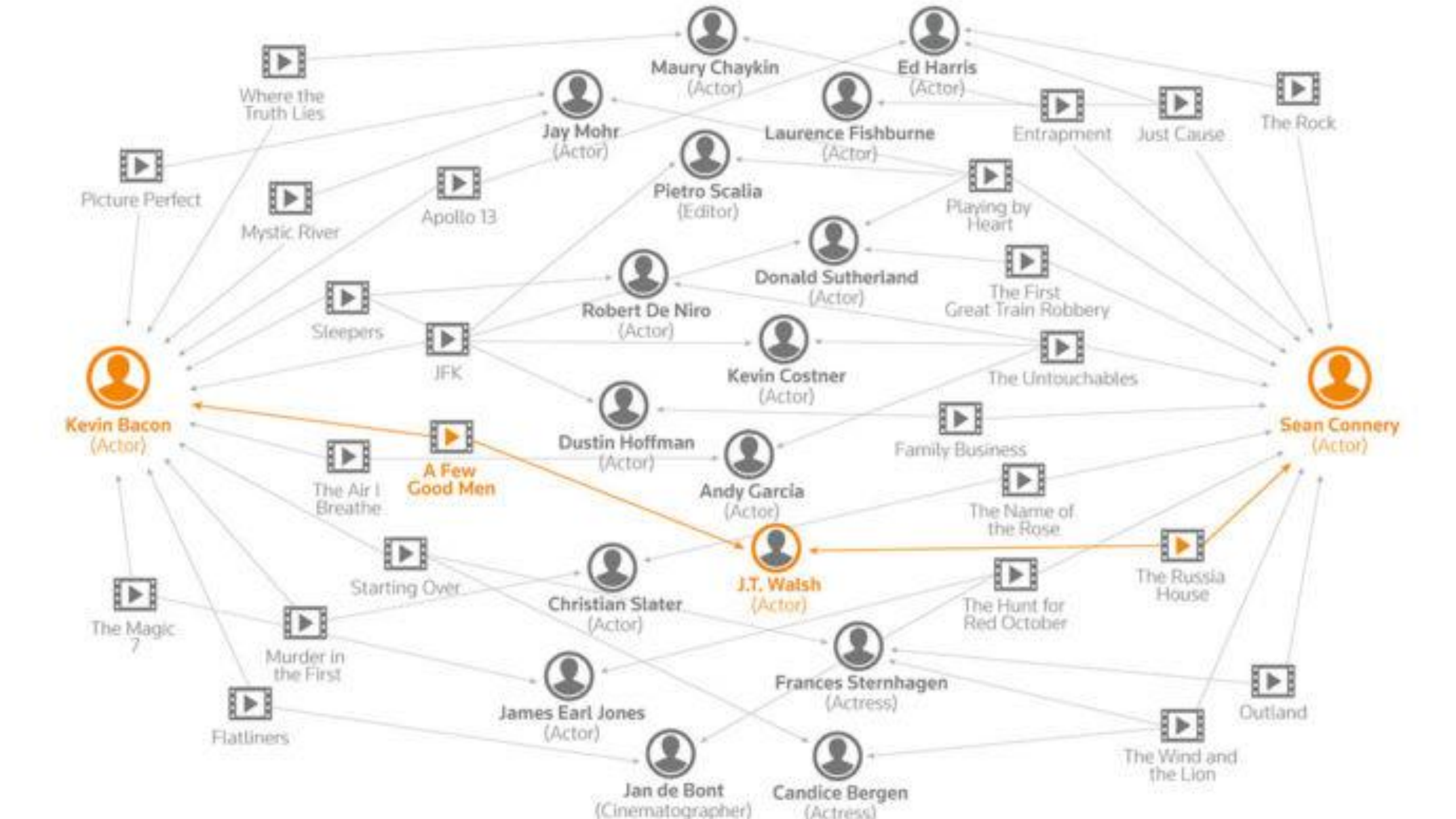


Common Measures

Degree

Path Length



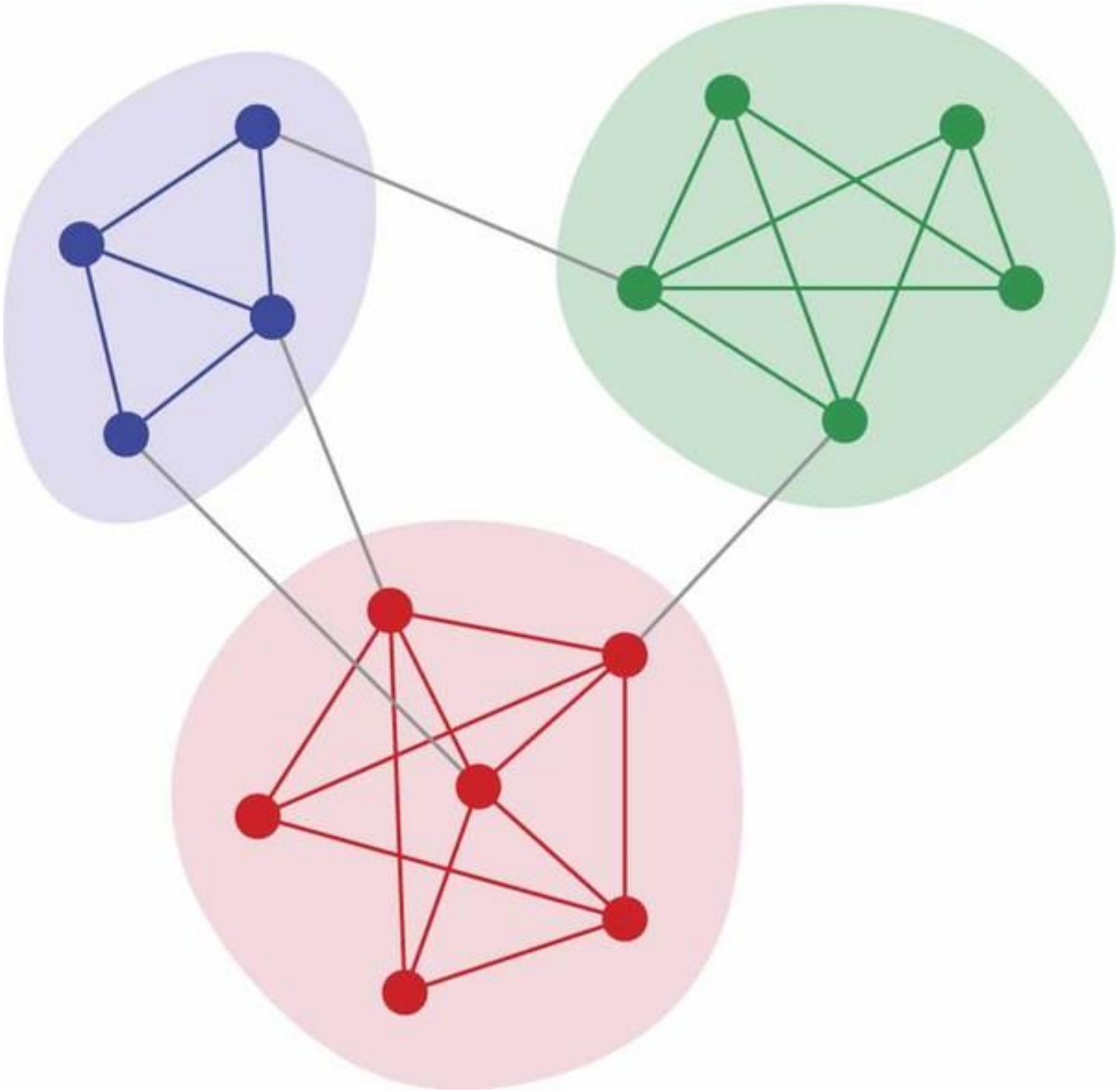

Kevin Bacon
(Actor)
Sean Connery
(Actor)
J.T. Walsh
(Actor)
Maury Chaykin
(Actor)
Ed Harris
(Actor)
Jay Mohr
(Actor)
Laurence Fishburne
(Actor)
Pietro Scalia
(Editor)
Robert De Niro
(Actor)
Donald Sutherland
(Actor)
Kevin Costner
(Actor)
Dustin Hoffman
(Actor)
Andy Garcia
(Actor)
Christian Slater
(Actor)
James Earl Jones
(Actor)
Frances Sternhagen
(Actress)
Jan de Bont
(Cinematographer)
Candice Bergen
(Actress)
Where the Truth Lies
Picture Perfect
Mystic River
Apollo 13
Sleepers
JFK
A Few Good Men
The Air I Breathe
Starting Over
The Magic 7
Murder in the First
Flatliners
Entrapment
Just Cause
The Rock
Playing by Heart
The First Great Train Robbery
The Untouchables
Family Business
The Name of the Rose
The Hunt for Red October
The Russia House
Outland
The Wind and the Lion

Common Measures

Degree

Path Length

Clustering



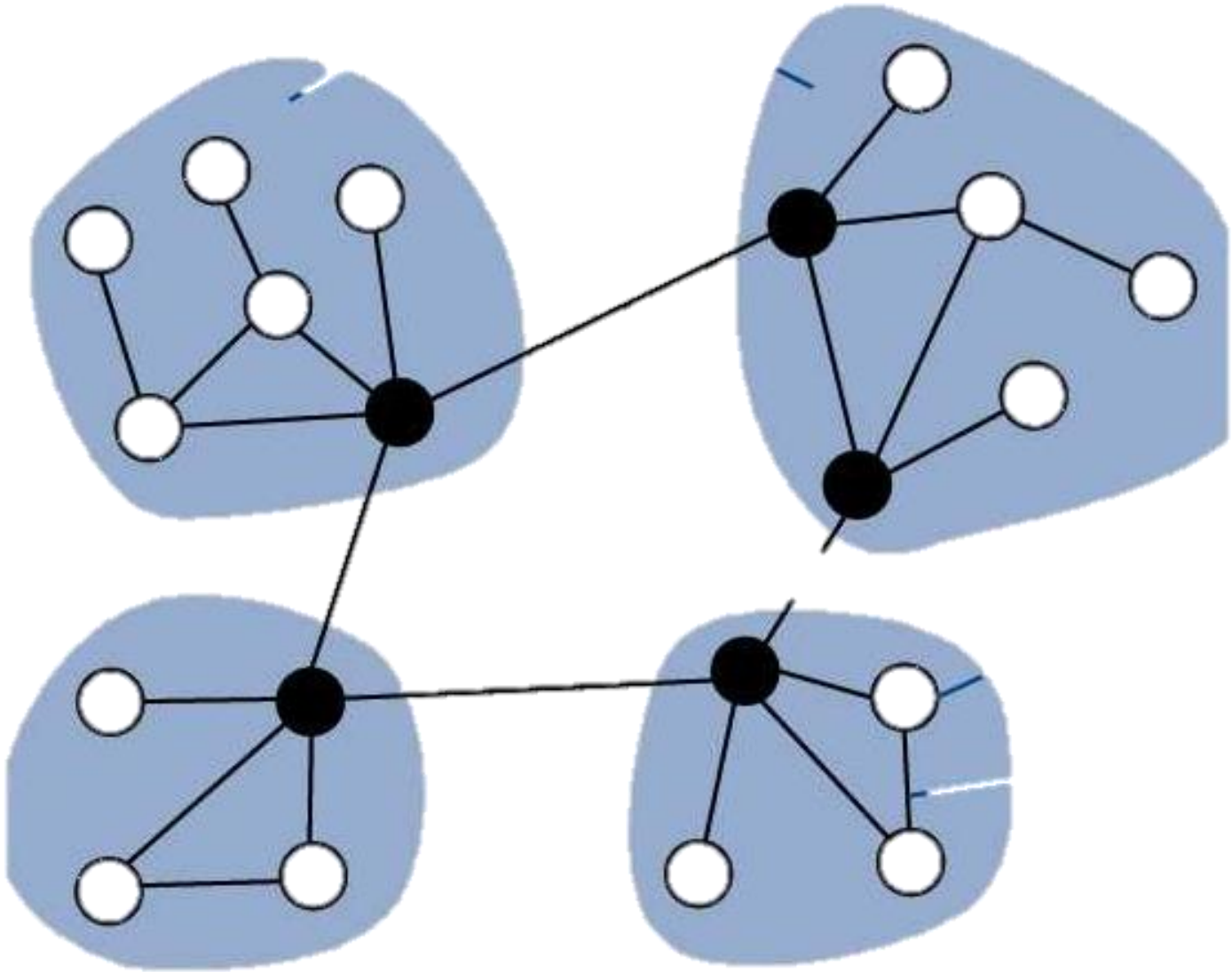
Common Measures

Degree

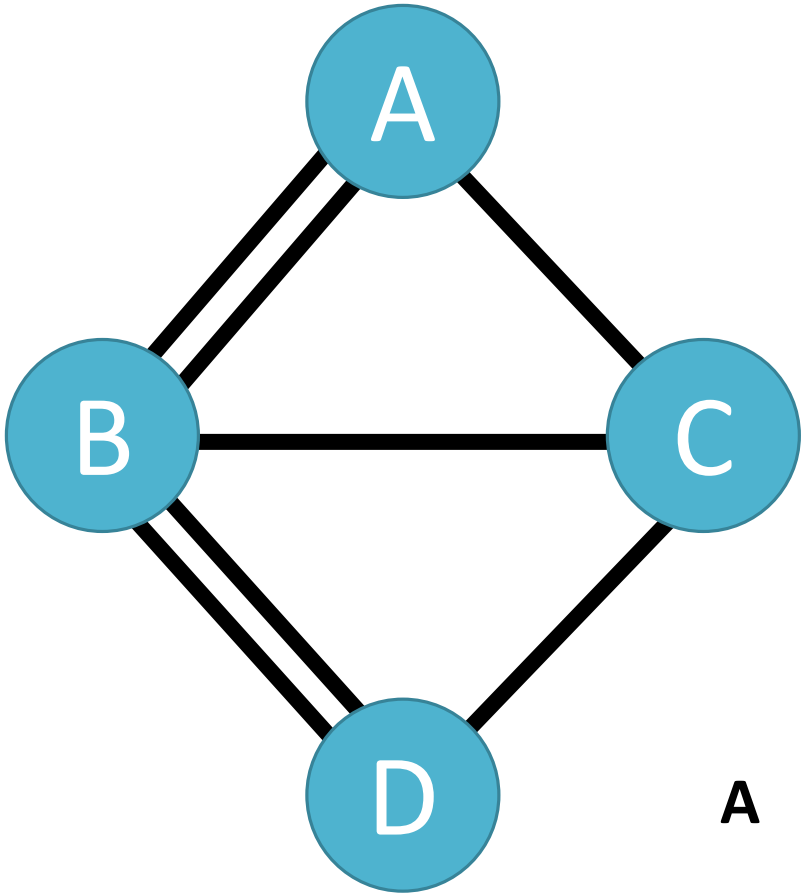
Path Length

Clustering

Centrality



Graphs as matrices



	A	B	C	D
A	-	2	1	0
B	2	-	1	2
C	1	1	-	1
D	0	2	1	-

Popular Pythonistas

1. What is a network?
2. Building graphs
3. Who's who in PyNash?

Guiding Question: Who are PyNash's "glue guys/gals"?

The MeetUp Data

Used MeetUp API to get the following information:

1. All groups within 25 miles of Nashville.
2. All members of those groups.
3. All events for each group and who RSVPed yes.

(Everything is on Github)

PyNash Relationships

We have >1400 members. But not all of them come to every meeting. (And many don’t come to any meetings.)

So we want to build a graph where…

1. each node is EITHER a person or event
2. Each edge represents attendance at that event

Building a graph: RSVP data

	event_id	member_id
74389	cldxflywnbgb	237869773
74390	cldxflywnbgb	53439252
74391	cldxflywnbgb	127214502
74392	cldxflywnbgb	156626172
74393	cldxflywnbgb	234179814

NetworkX

Software for complex networks

Stable (notes)

2.0 – September 2017

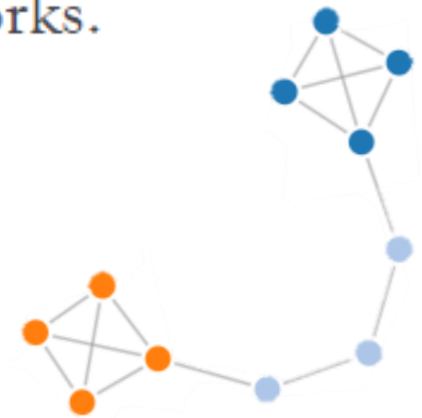
download | doc | pdf

Latest (notes)

2.1 development

github | doc | pdf

NetworkX is a Python package for the creation, manipulation, and study of the structure, dynamics, and functions of complex networks.



NetworkX Setup

NETWORKX FUNCTIONS

```
nx.Graph()
nx.DiGraph()

nx.degree(G)
nx.clustering(G)

nx.draw_networkx(G)
```

GRAPH METHODS / SLICING

```
G.nodes()
G.edges()
G.degree()


G[node]
G[node][node]
```

Building a graph: Declarative Syntax

```
# Create an (undirected) Graph instance.
g = nx.Graph()

# Add nodes - a few members and the event itself.
g.add_node(237869773)
g.add_node(53439252)
g.add_node(127214502)
g.add_node('cldxflywnbgb')

# Add edges between members and the event.
g.add_edge(127214502, 'cldxflywnbgb')
g.add_edge(53439252, 'cldxflywnbgb')
```

```
g
```

```
<networkx.classes.graph.Graph at 0x1a715fbf518>
```

Slicing the graph

Graphs are setup as dicts-of-dicts-of-dicts.

Source: Target: Attrs

```
g.nodes()
```

```
NodeView((237869773, 53439252, 127214502, 'cldxflywnbgb'))
```

```
g.edges()
```

```
EdgeView([(53439252, 'cldxflywnbgb'), (127214502, 'cldxfly
wnbgb')])
```

```
g[127214502]
```

```
AtlasView({'cldxflywnbgb': {}})
```

```
g[127214502]['cldxflywnbgb']
```

```
{}
```

Building a Graph: From Pandas DF

```
g = nx.from_pandas_dataframe(lunch_rsvps,
                             source = 'member_id',
                             target='event_id',
                             edge_attr=['group_urlname'])
```

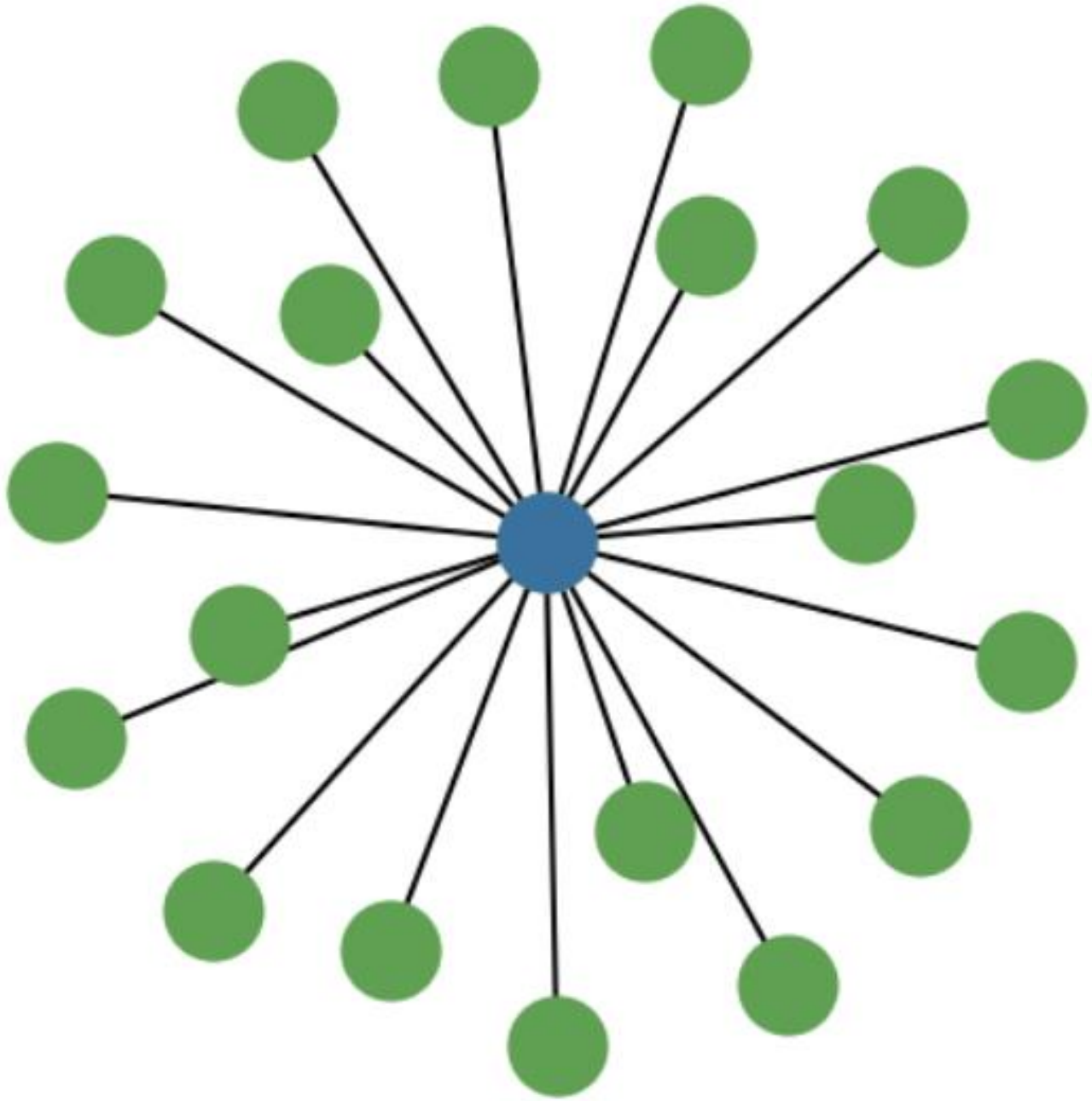
```
pprint(dict(g.edges()))
```

```
{('cldxflywnbgb', 2069): {'group_urlname': 'PyNash'},
 ('cldxflywnbgb', 2896514): {'group_urlname': 'PyNash'},
 ('cldxflywnbgb', 30123762): {'group_urlname': 'PyNash'},
 ('cldxflywnbgb', 53439252): {'group_urlname': 'PyNash'},
 ('cldxflywnbgb', 111917572): {'group_urlname': 'PyNash'},
 ('cldxflywnbgb', 127214502): {'group_urlname': 'PyNash'},
 (237869773, 'cldxflywnbgb'): {'group_urlname': 'PyNash'},
 ('cldxflywnbgb', 43237102): {'group_urlname': 'PyNash'},
 ('cldxflywnbgb', 156626172): {'group_urlname': 'PyNash'},
 ('cldxflywnbgb', 182591120): {'group_urlname': 'PyNash'},
 ('cldxflywnbgb', 183564319): {'group_urlname': 'PyNash'},
 ('cldxflywnbgb', 184389351): {'group_urlname': 'PyNash'},
 ('cldxflywnbgb', 191186119): {'group_urlname': 'PyNash'},
 ('cldxflywnbgb', 204129504): {'group_urlname': 'PyNash'},
 ('cldxflywnbgb', 230753190): {'group_urlname': 'PyNash'},
```

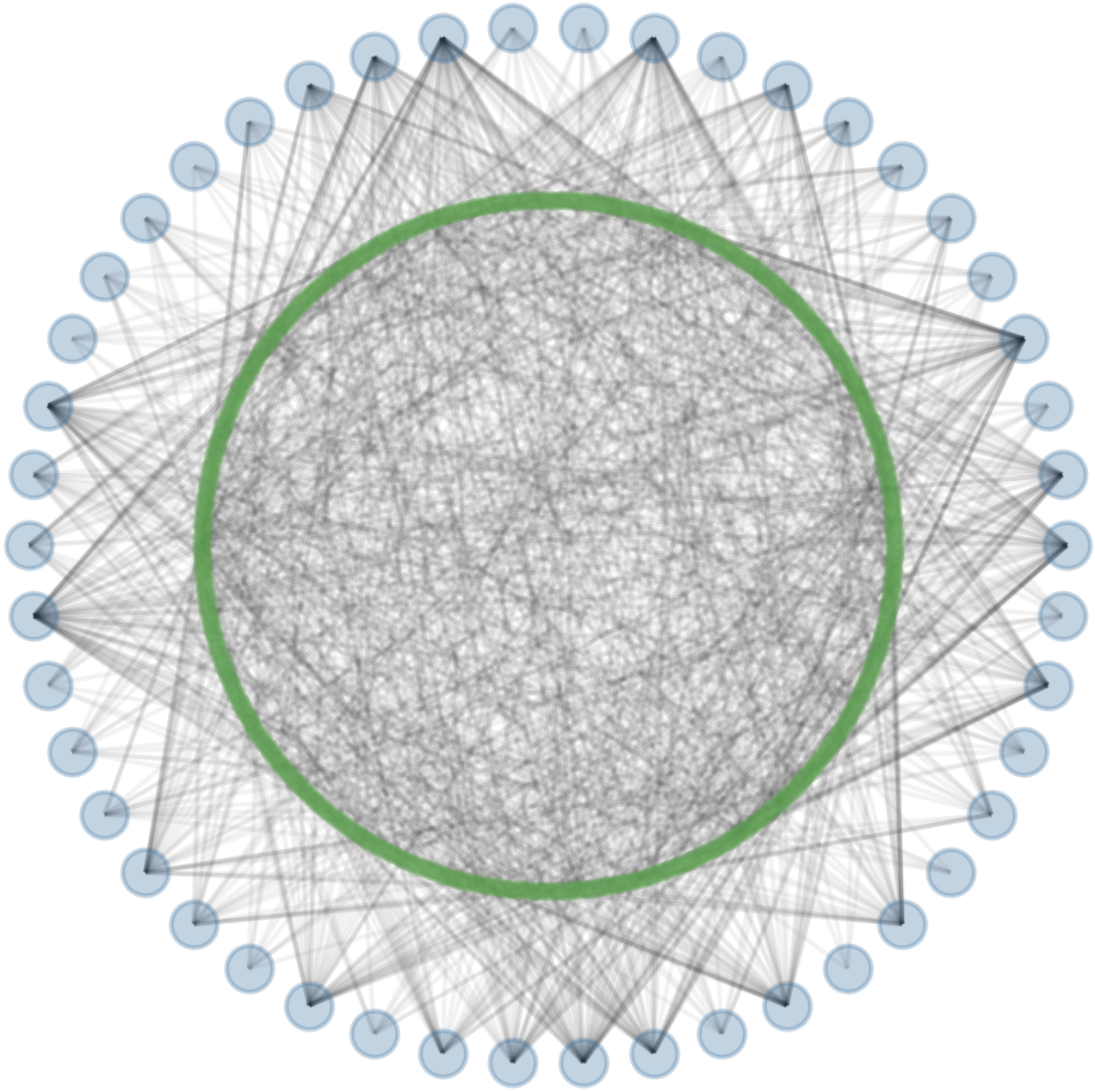
The lunch graph

Degree of the event = 19 (RSVPs)

Degree of the members = 1 (event attended)



Scaling it up to all events



Popular Pythonistas

1. What is a network?
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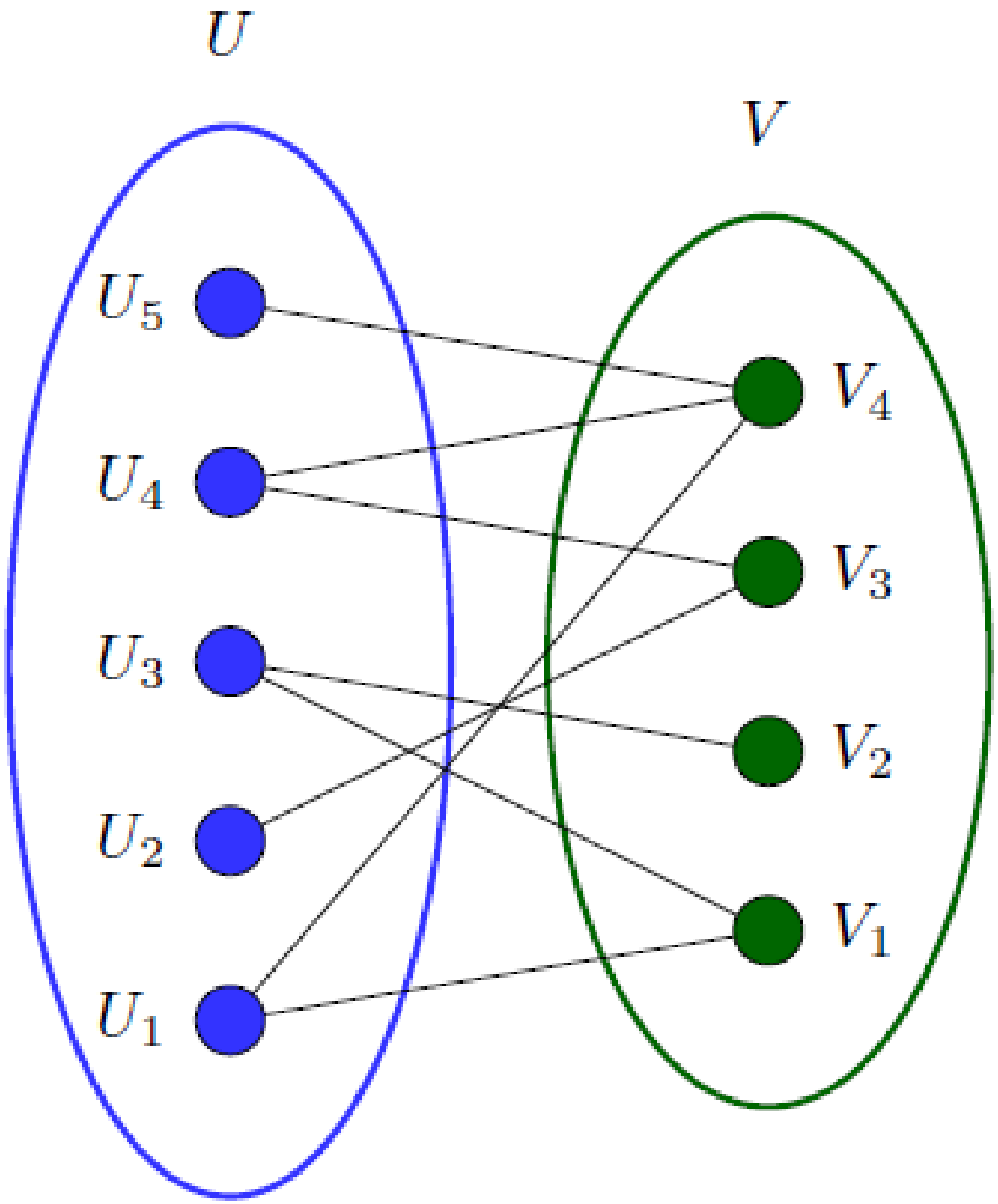
Bipartite Graphs

Great initial starting place for some datasets.

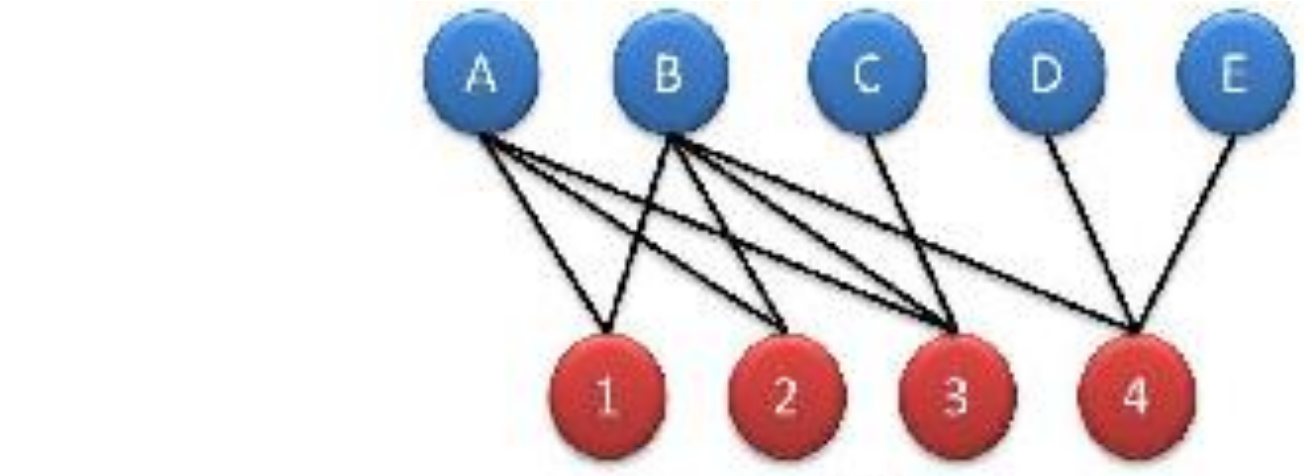
Can take the form of (Person node → Affiliation node)

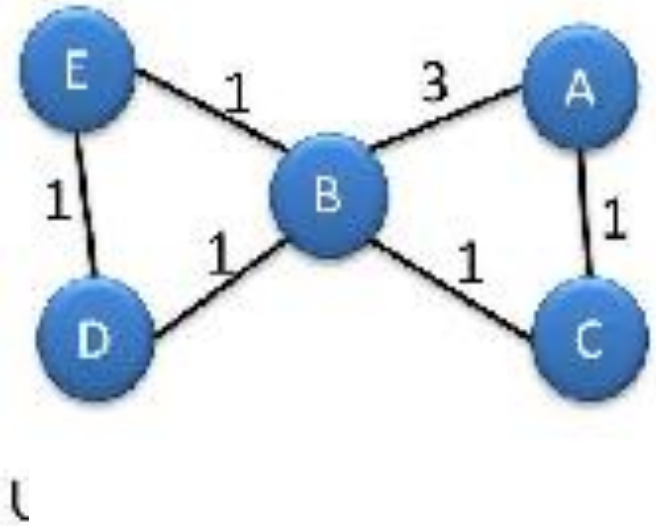
e.g. (Sports fan → Sports team)

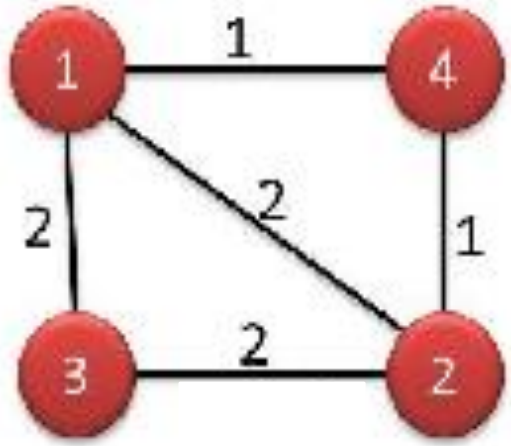


Projecting bipartiate graphs

(Person, Event) to (Person, Person)







Projecting the graph

```
gm = nx.bipartite.weighted_projected_graph(g, member_nodes, ratio=False)
ge = nx.bipartite.weighted_projected_graph(g, event_nodes, ratio=False)
```

```
print('There are {} members in the Member graph.'.format(len(gm.nodes)))
print('There are {} event in the Events graph.'.format(len(ge.nodes)))
```

```
There are 526 members in the Member graph.
There are 46 event in the Events graph.
```

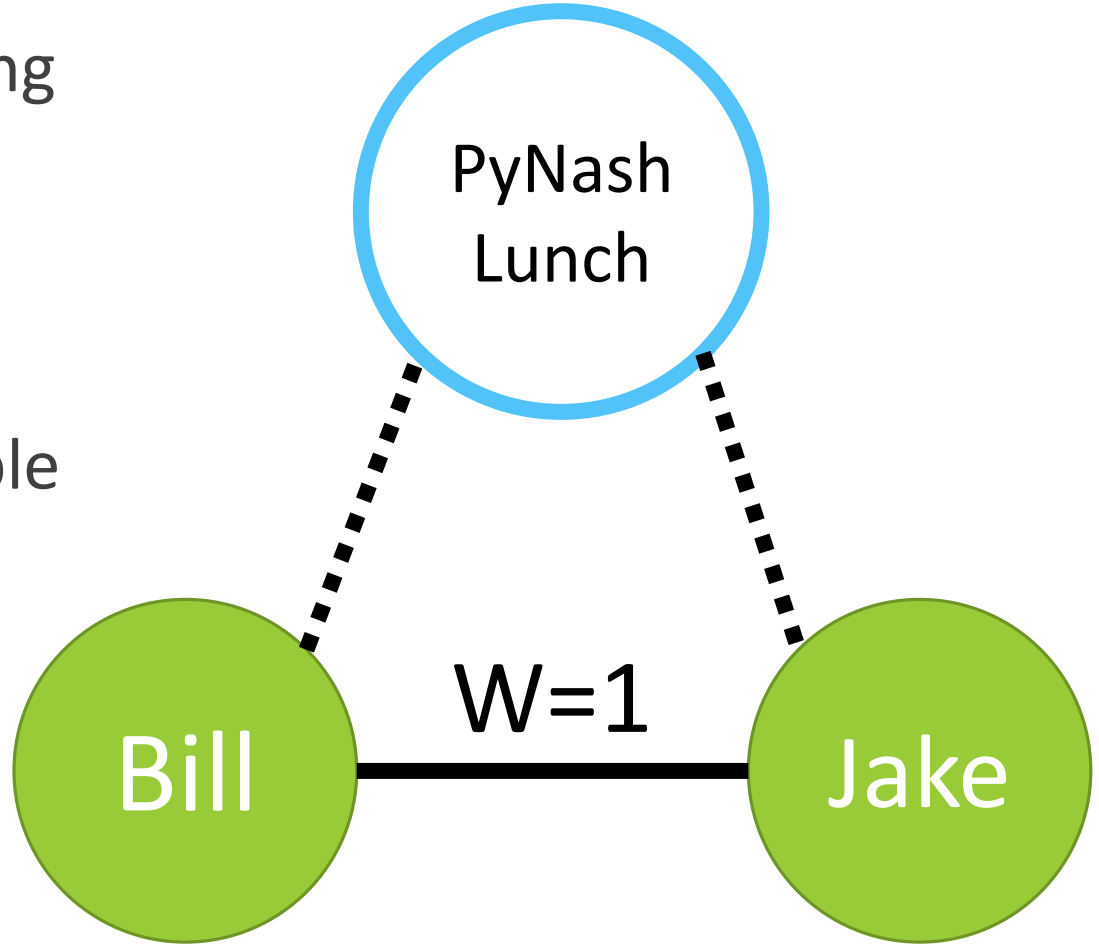
The “members” graph

Now we have a graph with the following attributes:

Node: a person who attended at least one event in the past two years

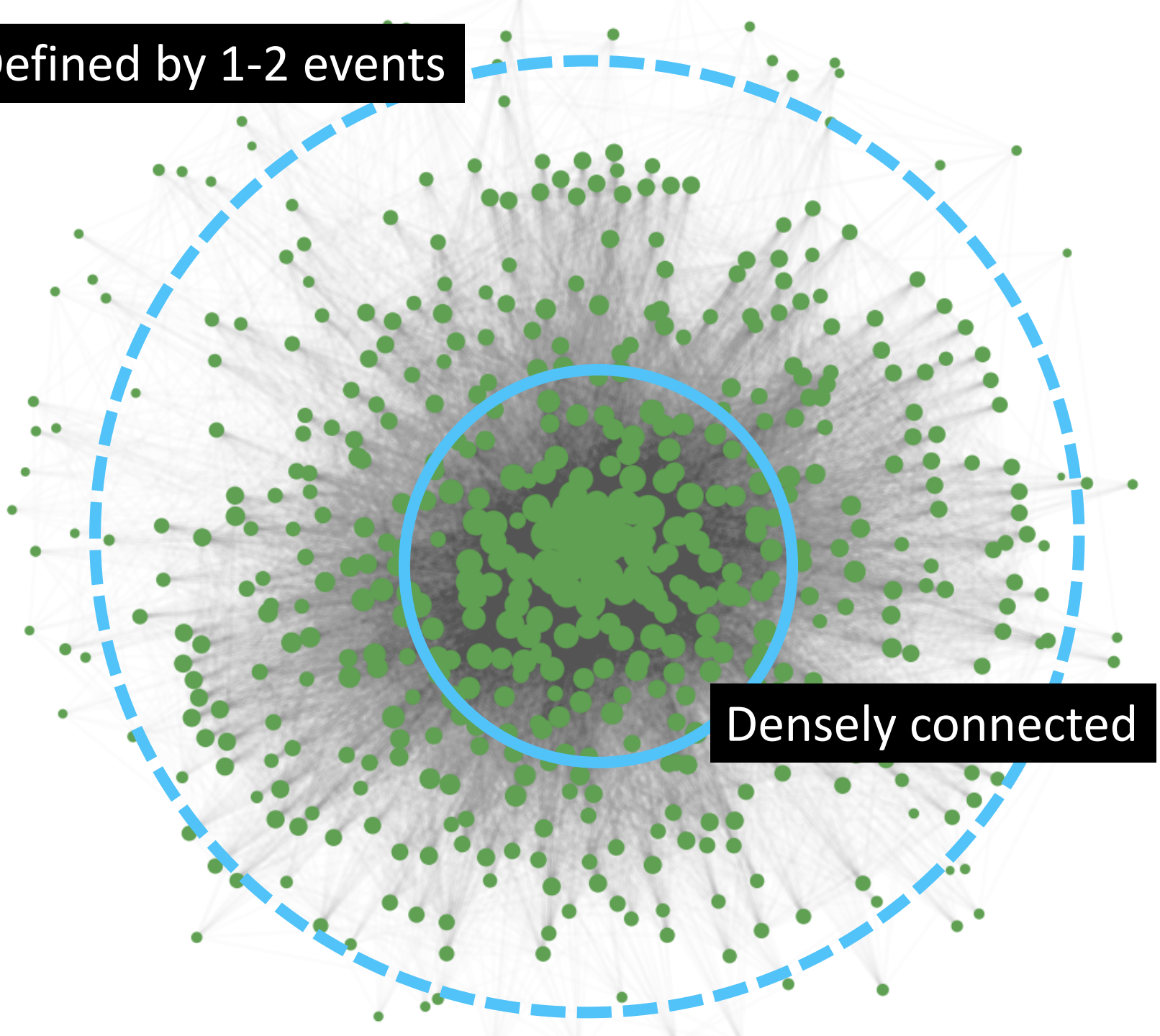
Edge: shared event between two people

Edge weight: the number of shared events



Member Structure

Large “core” of highly connected individuals, with many others on the periphery.

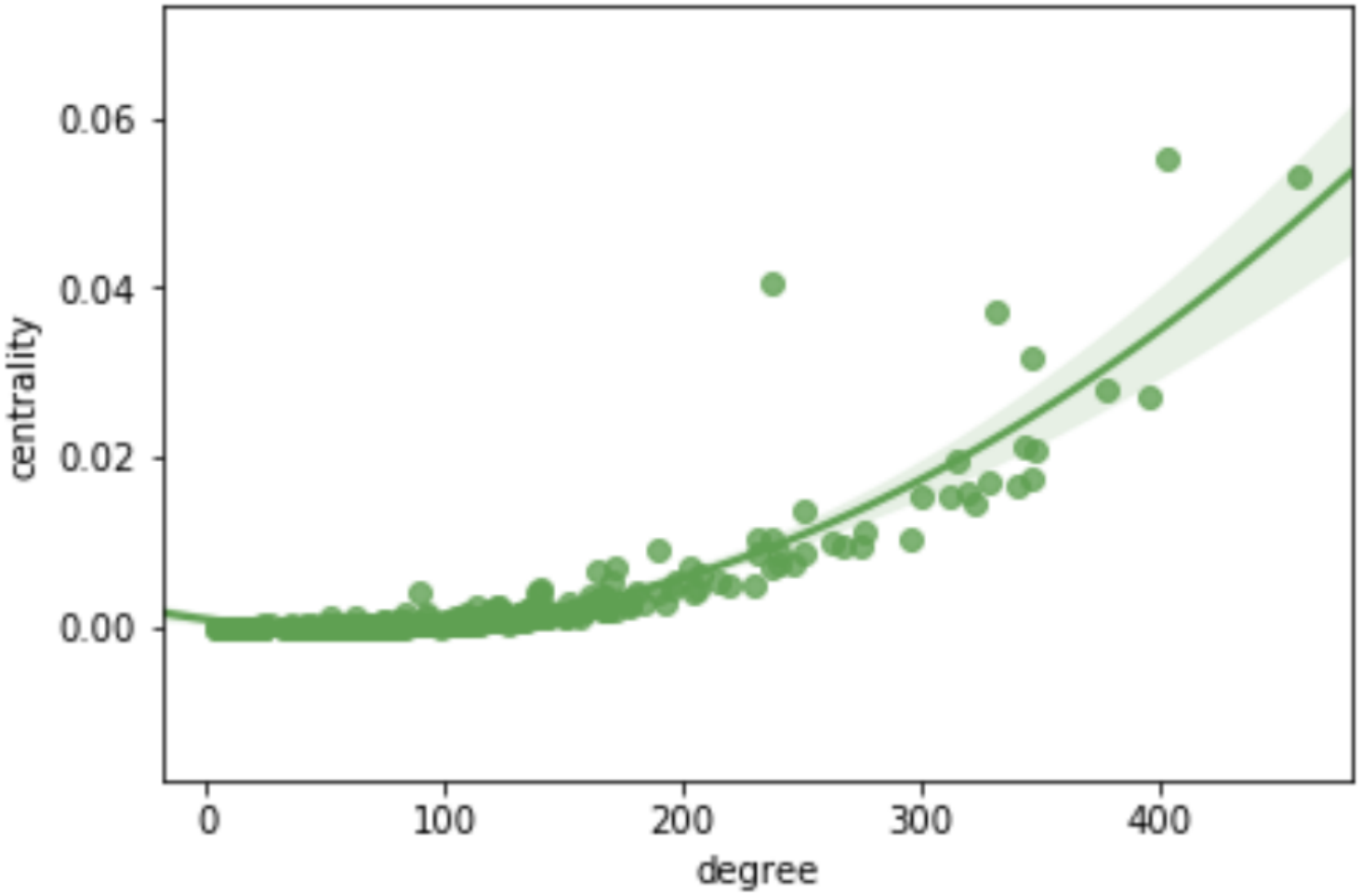


Getting network measures

Degree = number of members w/ shared attendance at an event

Centrality = how much a person “connects” two other people

```
nx.degree(gm)
nx.clustering(gm)
nx.betweenness_centrality(gm)
```



drumroll

Our top “connectors”

	name	num_events	degree	clustering	centrality
121334792	Greg Back	27	403	0.224732	0.055124
57907252	Chad Upjohn	25	459	0.203471	0.053080
30123762	Jason Myers	25	237	0.237753	0.040602
2896514	Trey Brooks	15	331	0.245372	0.037175
184547023	Chris Jarvis	19	347	0.264380	0.031768
12140530	Bill Israel	16	378	0.249323	0.028138
202882025	Michael mead	16	396	0.246465	0.027081
13606604	Alex Simonian	15	343	0.263362	0.021315
126309962	Aliya Gifford	15	348	0.269618	0.020821

Event Attendance for Upjohn and Myers

CHAD UPJOHN

DEGREE = 459

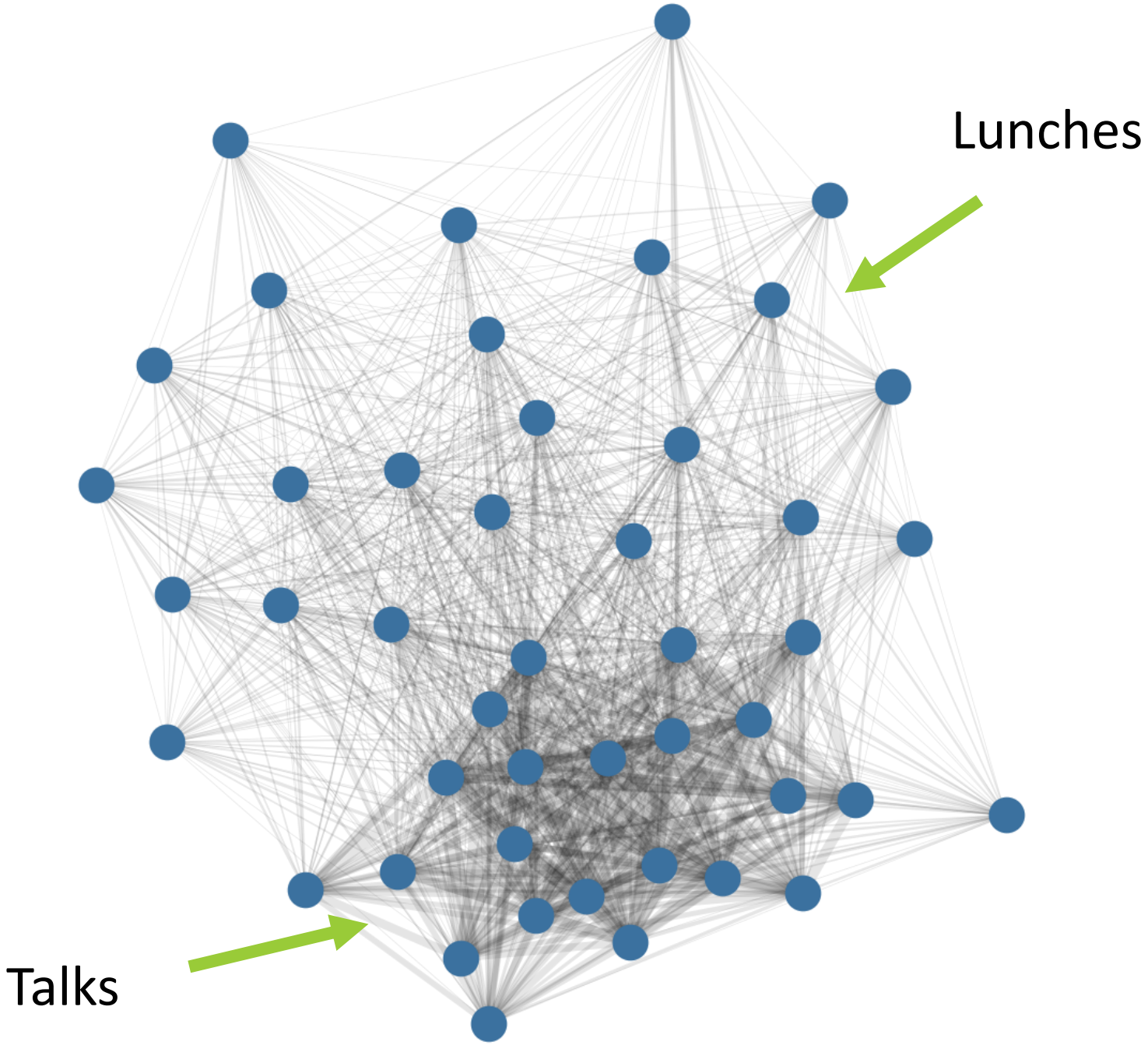
1. An October Two-fer: Refactoring, Extra Code Included / PDFs Against Humanity
2. Creating Better Beer Through Data Science
3. You and I and the PyNash API
4. PyNash x Penny U: An Evening of Learning
5. Interactive Python Environments: IPython, Jupyter, and Beaker, Oh My!
6. PyNash Lunch!
7. Logging beyond /dev/null -- ELK Stack for Log Visualization and Analysis
8. PyNash Lunch!

JASON MYERS

DEGREE = 237

1. PyNash Lunch!
2. PyNash Lunch!
3. You and I and the PyNash API
4. PyNash Lunch!
5. PyNash Lunch!
6. PyNash Lunch!
7. PyNash Lunch!
8. PyNash Lunch!

What about the events?



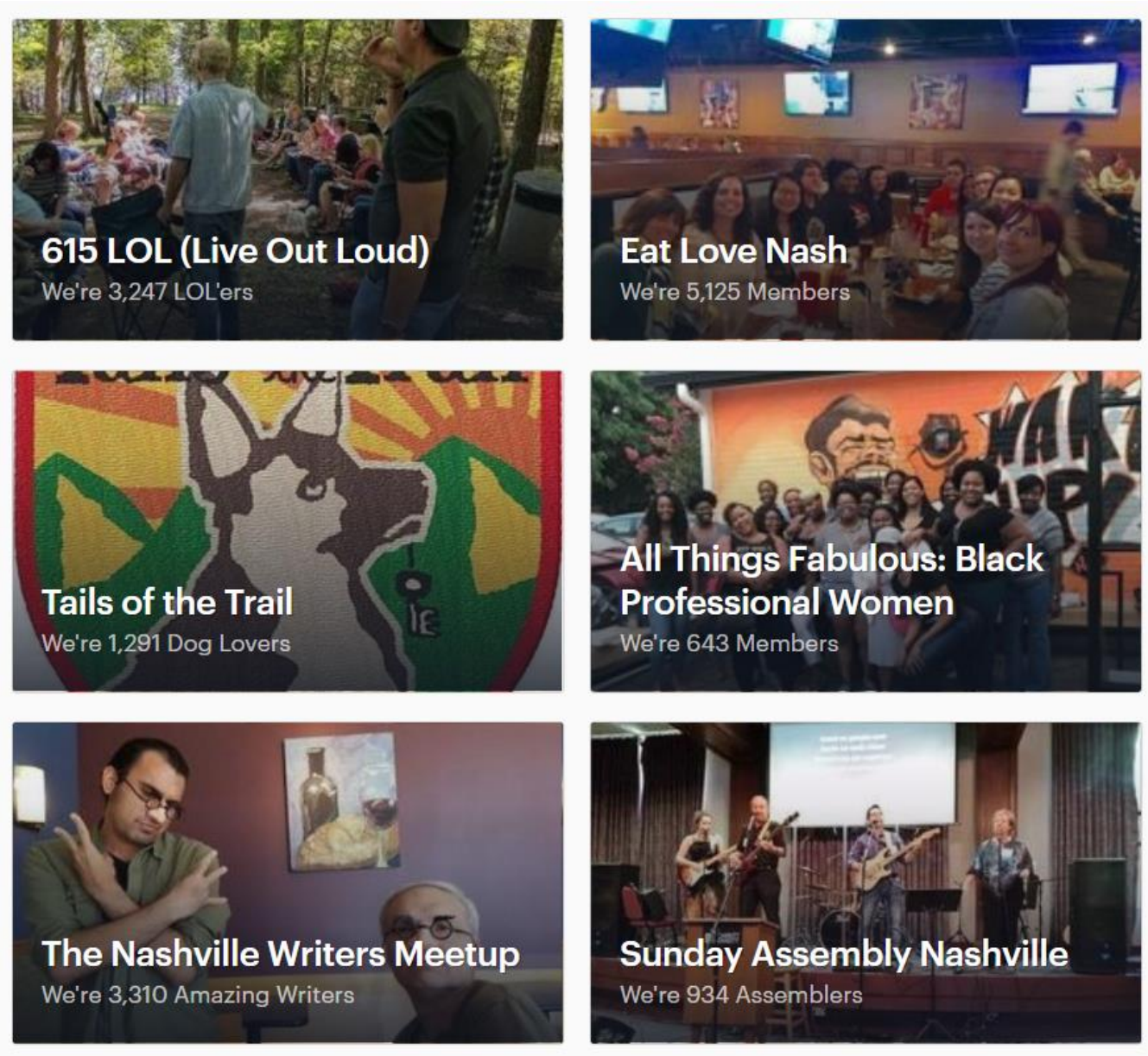
Now, to Nashville!

Making a splash

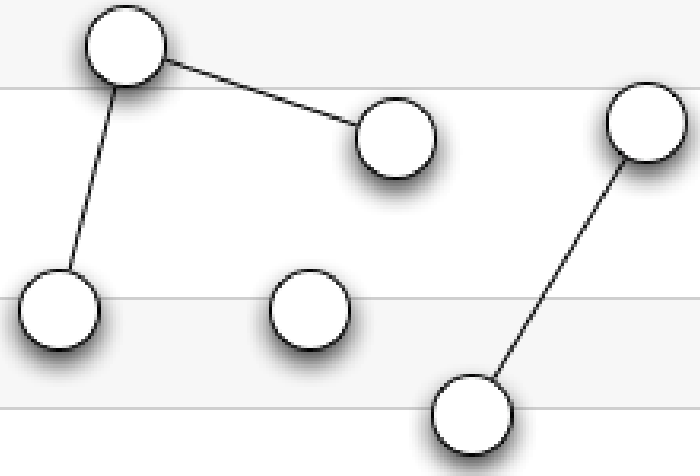
We now know who to get in touch within PyNash – but what about outside of PyNash?

There are likely going to be **clusters** of groups

- Tech groups
- Outdoors groups
- Professional groups



```
# Build DataFrame from pynash_rsvps
g = nx.from_pandas_dataframe(rsvps,
                             source='member_id',
                             target='event_id',
                             edge_attr='group_urlname')
```



A new problem!!

```
nx.is_connected(g)
```

```
False
```

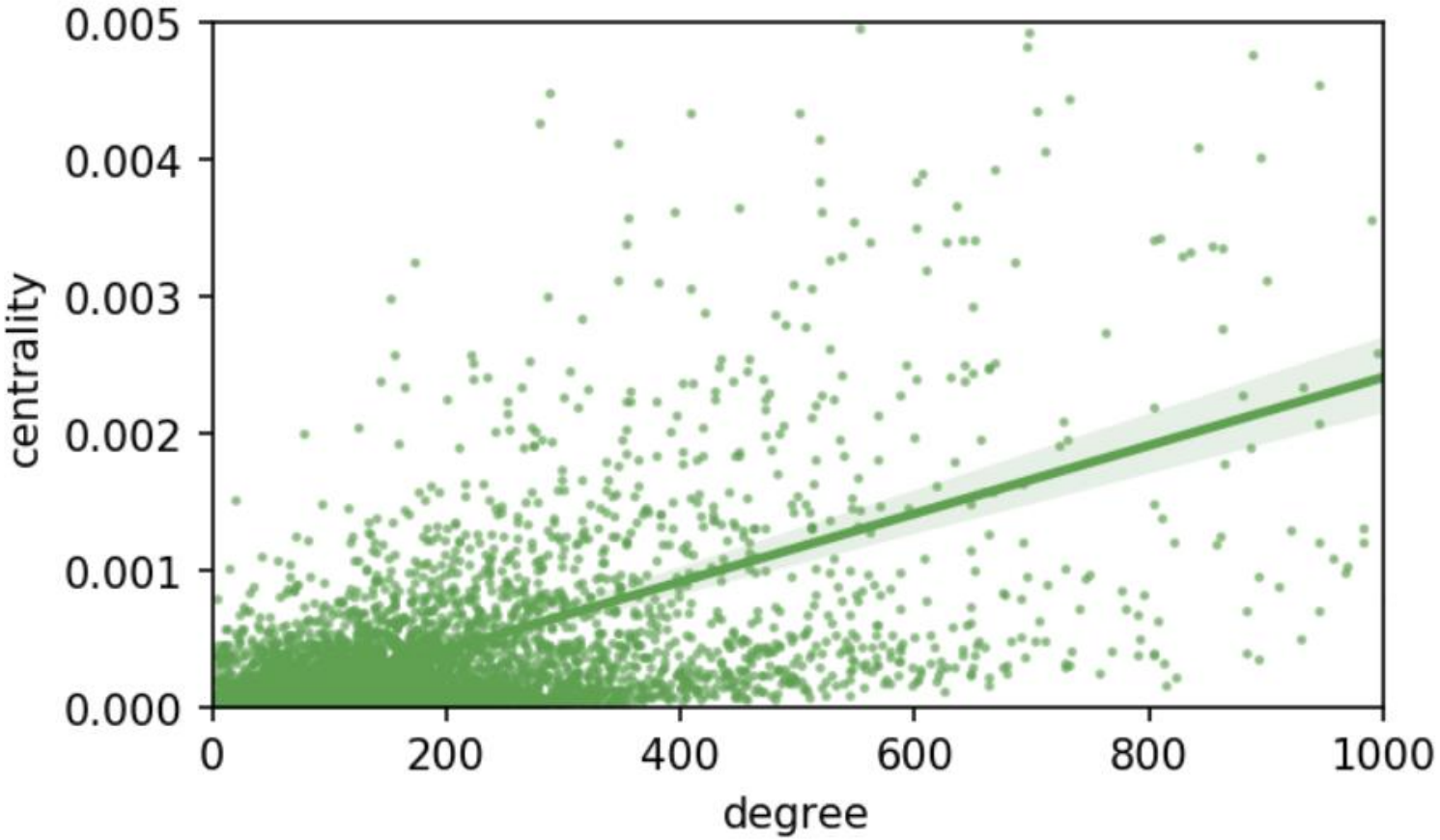
```
# Get the connected subcomponents of the main graph
components = list(nx.connected_components(g))
connected_nodes = sorted(components, key=len)[-1]
g = g.subgraph(connected_nodes)
```

Creating a metric DataFrame

```
df_members = pd.DataFrame(index=member_nodes)
df_members['in_pynash'] = [True if m in pynash_member_ids
                                else False for m in member_nodes]
df_members['num_events'] = pd.Series(dict(nx.degree(g, member_nodes)))
df_members['degree'] = pd.Series(dict(nx.degree(gm)))
df_members['clustering'] = pd.Series(nx.clustering(gm))
df_members['centrality'] = pd.Series(nx.betweenness_centrality(gm, k=3000,
                                                               normalized=True,
                                                               weight='weight'))
```

Takes a LONG time – can be parallelized.

In larger networks, there is a weaker relationship between degree and centrality



The best networked in the room are…

1. Bryan Overbey
2. Hameed Gifford
3. Jeremy
4. Josh E
5. Aliya Gifford
6. Kadu
7. Trev Lawson
8. Wayne Martin
9. Weston Hunter
10. Kate Brady

The best networked in the room are...

Bryan Overbey (129122472) has attended 27 events total in 22 different groups.

They have attended PyNash 1 time(s).

Top attendance:

- Nashville-Sailing: 5
- steppingoutsocialdance: 2
- Nashville-Free-Guitar-Lesson-Meetup: 1

The best networked in the room are...

Hameed Gifford (43237102) has attended 29 events total in 15 different groups.

They have attended PyNash 6 time(s).

Top attendance:

- PyNash: 6
- Nashville-soccer: 5
- nashjs: 3

The best networked in the room are…

Josh E (55029192) has attended 55 events total in 10 different groups.

They have attended PyNash 13 time(s).

Top attendance:

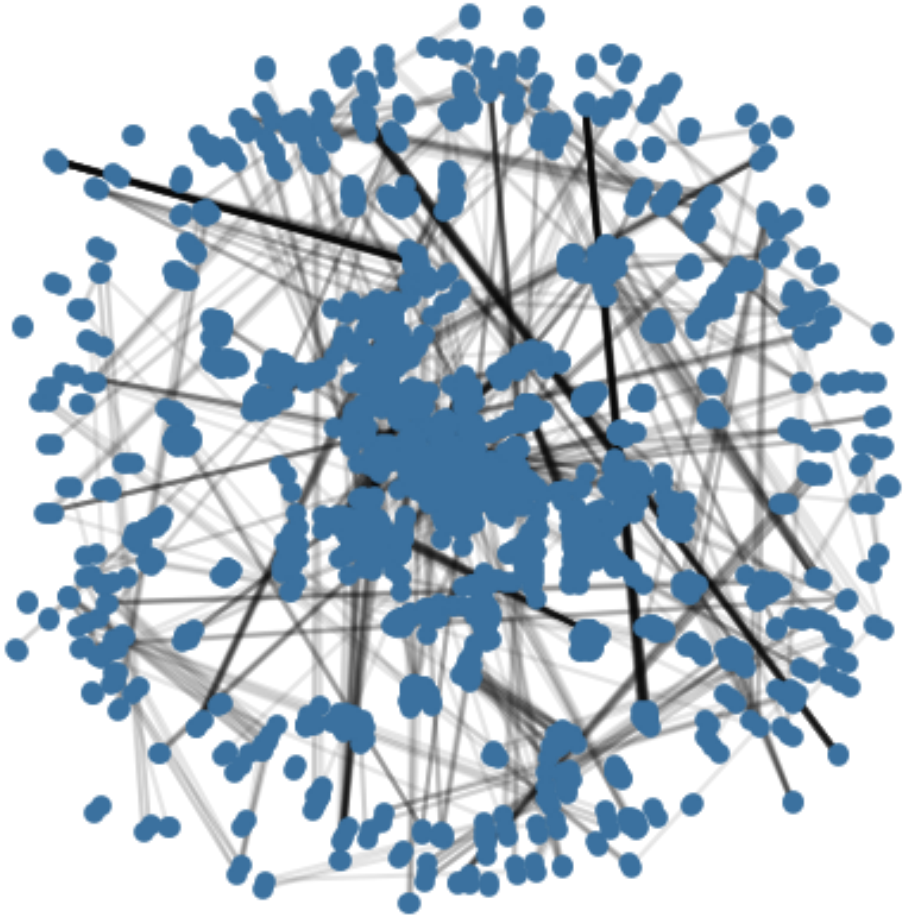
- PyNash: 13
- NashvilleMobileDotNet: 10
- Nashville-NET-User-Group: 9

How about the groups?

Event projection – edges represent shared members.

- **High degree** for an event means it has (at least one) shared attendees with a lot of other events.
- **Low clustering** means that it does not draw from the same pool of shared attendees each time.

Aggregated events by group and summarized!



LOWEST CLUSTERING (MOST “NEW PEOPLE”)	HIGHEST DEGREE (MOST SHARED ATTENDANCE)
MusicCityDrinkingBuddies	nashjs
Movie-Lovers	MTN-40
Nashville-Psychotherapy-Institute	Nashville-NET-User-Group
SavvyCoders	Sunday-Assembly-Nashville
Tennessee-Real-Estate-Investors	dnd-49
Free & Cheap Events	nashville-ux
NashvilleMusician	Data-Science-Nashville
funhappeningssocialgroup	NashvilleFlagFootball
paddleadventuresunlimited	steppingoutsocialdance

The big picture

APPLICATIONS

Recommendation engine – based on your interests, who might you connect with?

Social status measures beyond "number of events" attended.

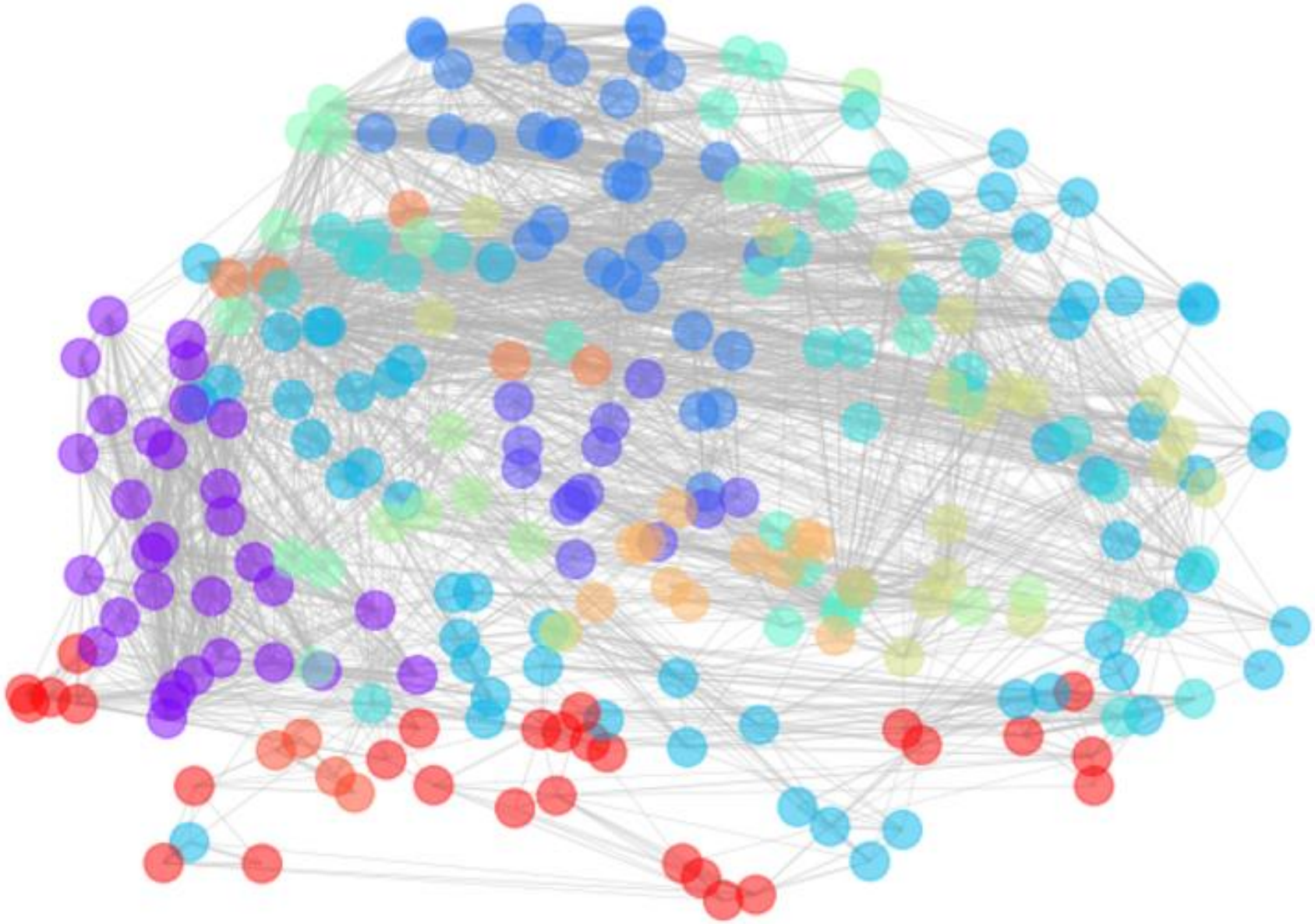
Target "influential" people for advertising / recruiting.

LIMITATIONS

This data is based on "rsvps" – may not reflect real attendance.

Attendance =/= participation

Wide number of connections does not represent influence – though it may represent persistence.



Recap of NetworkX

BUILD GRAPHS

```
g = nx.Graph()
g = nx.DiGraph()


nx.from_edge_list()
nx.from_pandas_dataframe()
```

INDEXING GRAPHS

```
n = g[node]
e = g[node][node]
w = g[node][node][attribute]


[n for n in g.nodes]
[e['weight'] for e in
                    g.edges]
```

Recap of NetworkX

BUILD GRAPHS

```
nx.degree(g)
nx.betweenness_centrality(g)
nx.clustering(g)
```

DRAW GRAPHS

```
pos = nx.spring_layout(g)
pos = nx.circular_layout(g)

nx.draw_networkx(g, pos)
```