Module IV - Basic Analysis

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Agenda for Module IV

Loading data from multiple sources

- Local network data files
- Connecting to a database
- Building directly from the Internet

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- Why it is so useful
- How `NetworkX` utilizes it

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Running basic centralities
- Degree, Closeness, Betweeness Eigenvector
- Calculating degree distribution
- Plotting statistics using `matplotlib`
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- Writing network data
- Saving network analysis statistics

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Basic visualization

- Review of `NetworkX`'s plotting algorithms
- Adding analysis to visualization

Loading a network file

As we have seen, one of the main advantages of working with `NetworkX` is that it can read many different network formats

- For those that are unfamiliar with working at the **command-line**, however, the process can be confusing

NX syntax for loading a file

$$\underset{\text{Net variable}}{\underset{\uparrow}{>>> G}} \quad = \quad \underset{\text{NX function, file directory path}}{\underset{\uparrow}{\text{read\_format(``path/to/file.txt''},}} \qquad \underset{\text{Graph type, nodes type, etc.}}{\underset{\uparrow}{\textit{...options...})}}$$

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Let's try!

- We will load the edge list of Hartford drug users network
- Specify that the network be a directed graph, and the nodes be integers
- Use `info()` to check that data has been loaded correctly

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It's time to fire up your console and load Python!

Loading the Hartford drug users network

Starting NetworkX and loading data

```
>>> from networkx import *
>>> hartford=read_edgelist("../../data/hartford_drug.txt",create_using=DiGraph(),nodetype=int)
>>> info(hartford)
Name:
Type:                   DiGraph
Number of nodes:        212
Number of edges:        337
Average in degree:      1.5896
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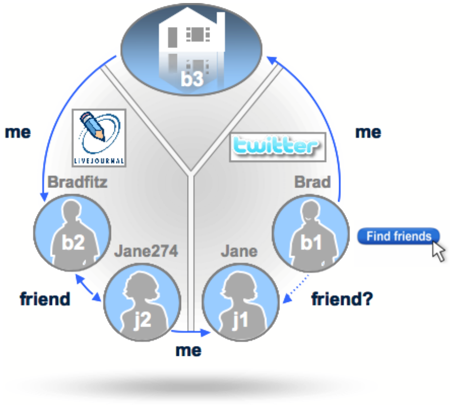
Some formats may have more or less options, **always check the documentations!**

Building a network from a database

As data sets become larger and persistently changing, it may make more sense to store them in a database rather than a single file

- As we have seen, Python provides binding to many modern database frameworks

Building the social network among LiveJournal users



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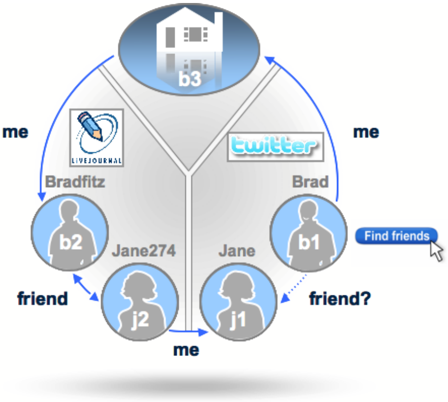

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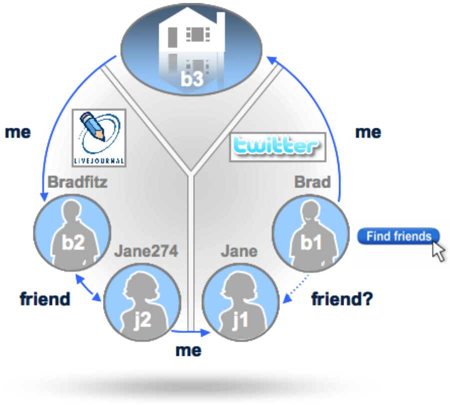

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- Using a "seed" user, we will build out a network

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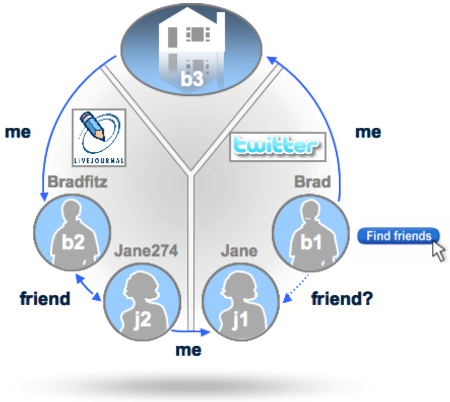

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- In Python, use `NetworkX`, `cjson` and a other standard scientific libraries to parse Google's SocialGraph data
- Using a "seed" user, we will build out a network
- Through a process called "k-snowball searching" *seed* $\longrightarrow$ *friend* $\longrightarrow \cdots \longrightarrow$ $friend_k$

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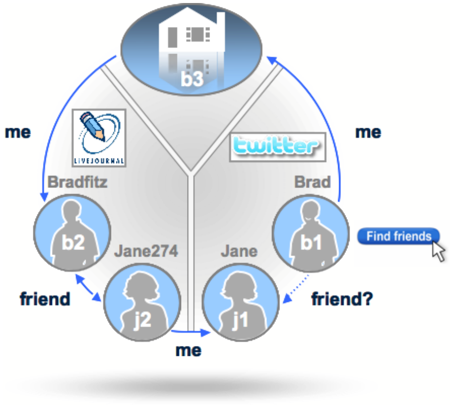

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  - Seed: imichaeldotorg.livejournal.com
  - $k = 3$

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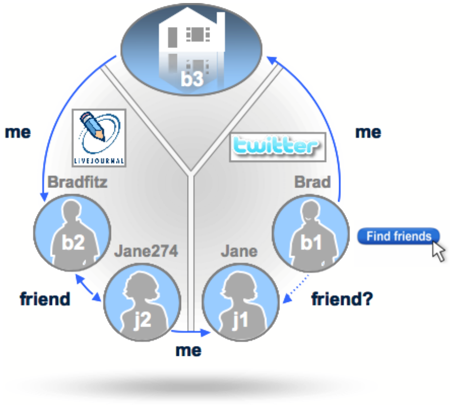

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- In Python, use `NetworkX`, `cjson` and a other standard scientific libraries to parse Google's SocialGraph data
- Using a "seed" user, we will build out a network
- Through a process called "k-snowball searching" $seed \longrightarrow friend \longrightarrow \cdots \longrightarrow friend_k$
  - Seed: imichaeldotorg.livejournal.com
  - $k = 3$
- Note the low value of k

The code, part 1

Loading the libraries and setting things up

```
from cjson import *
from urllib import *
from networkx import *
from time import *
from scipy import array,unique
...
if __name__ == "__main__":
    seed_url=‘‘http://imichaeldotorg.livejournal.com"
    sg=get_sg(seed_url)
    net,newnodes=create_egonet(sg)
    info(net)
```

Get the JSON from SocialGraph

```
def get_sg(seed_url):
  sgapi_url="http://socialgraph.apis.google.com/lookup?q="+seed_url+"&edo=1&edi=1&fme=1&pretty=0"
  try:
      furl=urlopen(sgapi_url)
      fr=furl.read()
      furl.close()
      return fr
  except IOError:
      print "Could not connect to website"
      print sgapi_url
      return
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```
Name:                  [‘http://imichaeldotorg.livejournal.com/’]
Type:                  DiGraph
Number of nodes:       5
Number of edges:       5
Average in degree:     1.0
Average out degree:    1.0
```

Get the JSON from SocialGraph

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def get_sg(seed_url):
  sgapi_url="http://socialgraph.apis.google.com/lookup?q="+seed_url+"&edo=1&edi=1&fme=1&pretty=0"
  try:
      furl=urlopen(sgapi_url)
      fr=furl.read()
      furl.close()
      return fr
  except IOError:
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```

Build egonet and snowball

Creating the egonet

```
def create_egonet(s):
    try:
        raw=decode(s)
        G=DiGraph()
        pendants=[]
        n=raw['nodes']
        nk=n.keys()
        G.name=str(nk)
        pendants=[]
        for a in range(0,len(nk)):
            for b in range(0,len(nk)):
                if a!=b:
                    G.add_edge(nk[a],nk[b])
        for k in nk:
            ego=n[k]
            ego_out=ego['nodes_referenced']
            for o in ego_out:
                G.add_edge(k,o)
                pendants.append(o)
            ego_in=ego['nodes_referenced_by']
            for i in ego_in:
                G.add_edge(i,k)
                pendants.append(i)
        pendants=array(pendants,dtype=str)
        pendants.flatten()
        pendants=unique(pendants)
        return G,pendants
    except DecodeError:
    ...
    except KeyError:
```

Rolling the snowball

```
def snowball_round(G,seeds,myspace=False):
    t0=time()
    if myspace:
        seeds=get_myspace_url(seeds)
    sb_data=[]
    for s in range(0,len(seeds)):
        s_sg=get_sg(seeds[s])
        new_ego,pen=create_egonet(s_sg)
        for p in pen:
                sb_data.append(p)
        if s<1:
            sb_net=compose(G,new_ego)
        else:
            sb_net=compose(new_ego,sb_net)
        del new_ego
        if s==round(len(seeds)*0.2):
            sb_net.name='20% complete'
            sb_net.info()
            print 'AT: '+strftime('%m/%d/%Y, %H:%M:%S', gmtime())
            print ''
    ...
    # More time keeping, probably a MUCH better way to do this
    sb_data=array(sb_data)
    sb_data.flatten()
    sb_data=unique(sb_data)
    sb_net.info()
    return sb_net,sb_data
```

Build the whole network

Step	Nodes	Edges	Mean Degree	Density
Seed	5	5	2.0	0.25
$k = 2$	75	115	3.0	0.02
$k = 3$	4,938	8,659	3.5	$3.6(10^{-4})$

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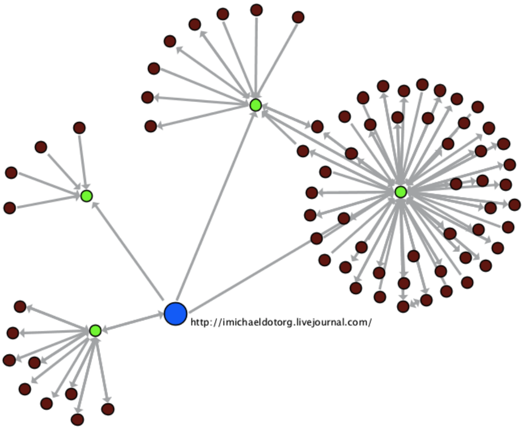
- Large jump after first snowball



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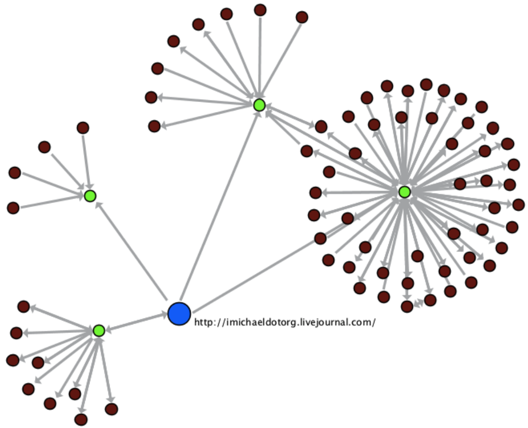
- Large jump after first snowball
- Massive structural leap at $k = 3$



The full network

To get a feeling for the size of the full network...