Introduction to Networks

NETWORK ANALYSIS IN PYTHON (PART 1)

Eric Ma

Data Carpentry instructor and author of nxviz package

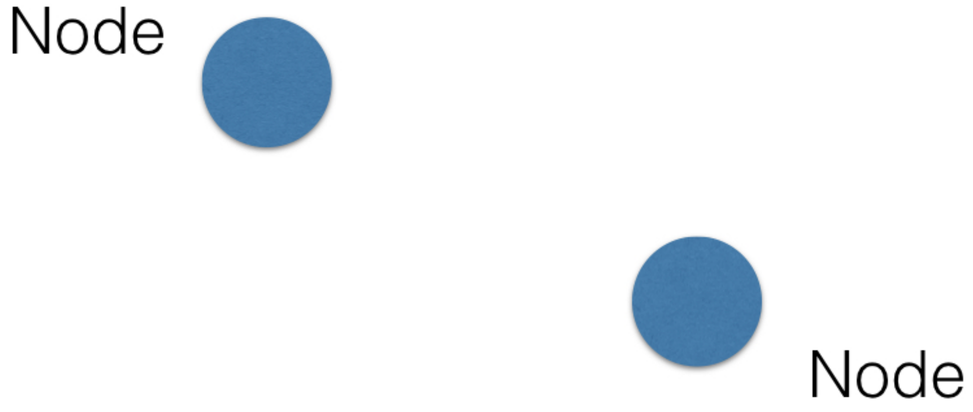
Networks!

- Examples:
  - Social
  - Transportation
- Model relationships between entities

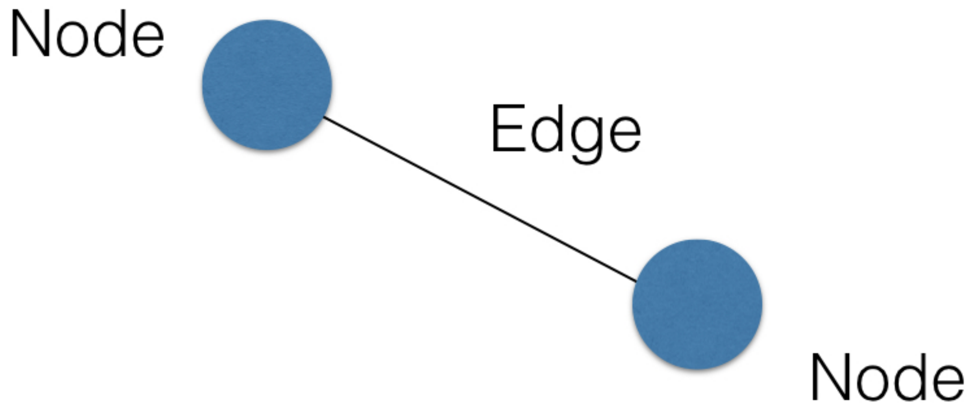
Networks!

- Insights:
- Important entities: influencers in social network
- Pathfinding: most efficient transport path
- Clustering: finding communities

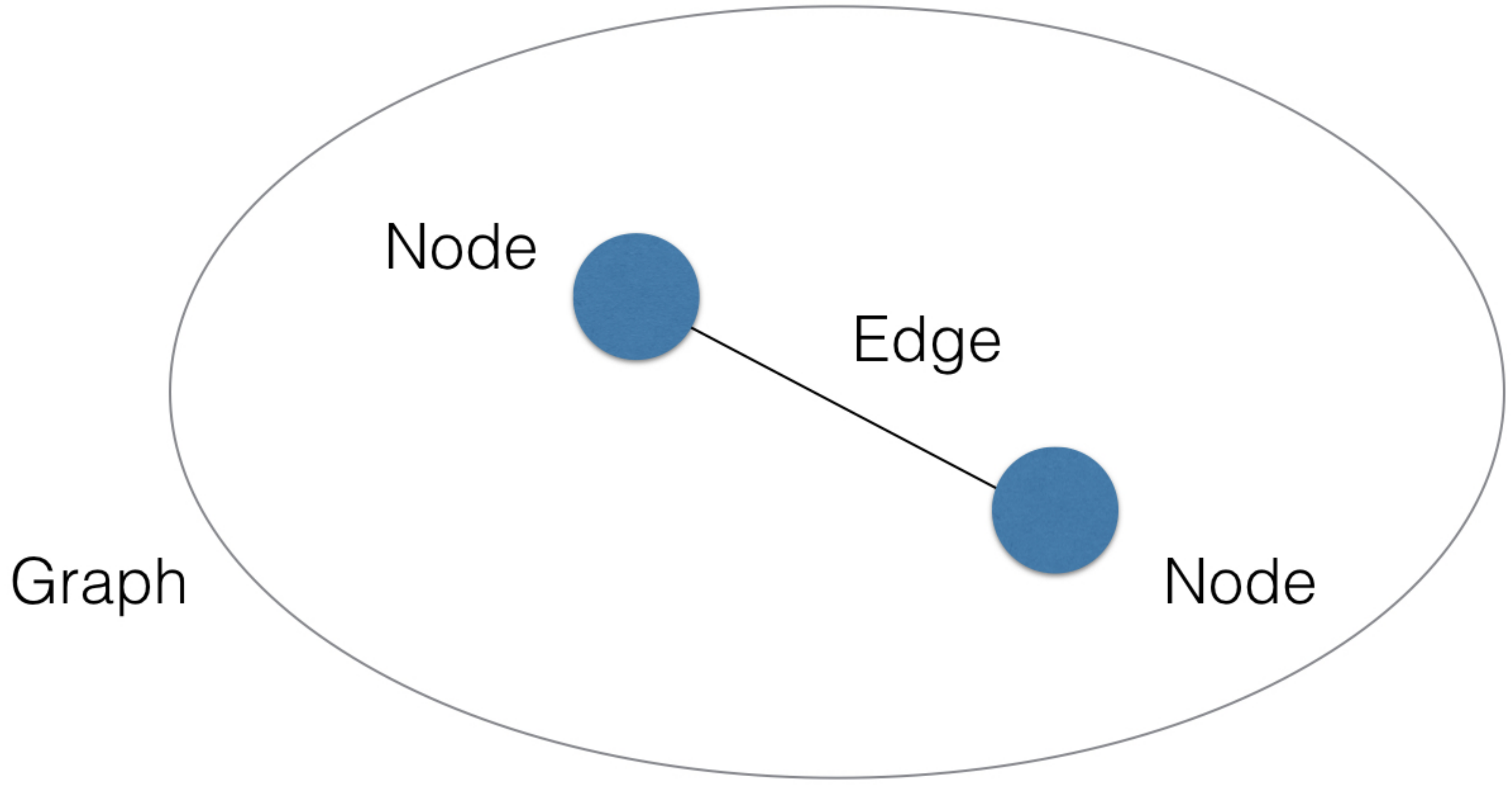
Network Structure



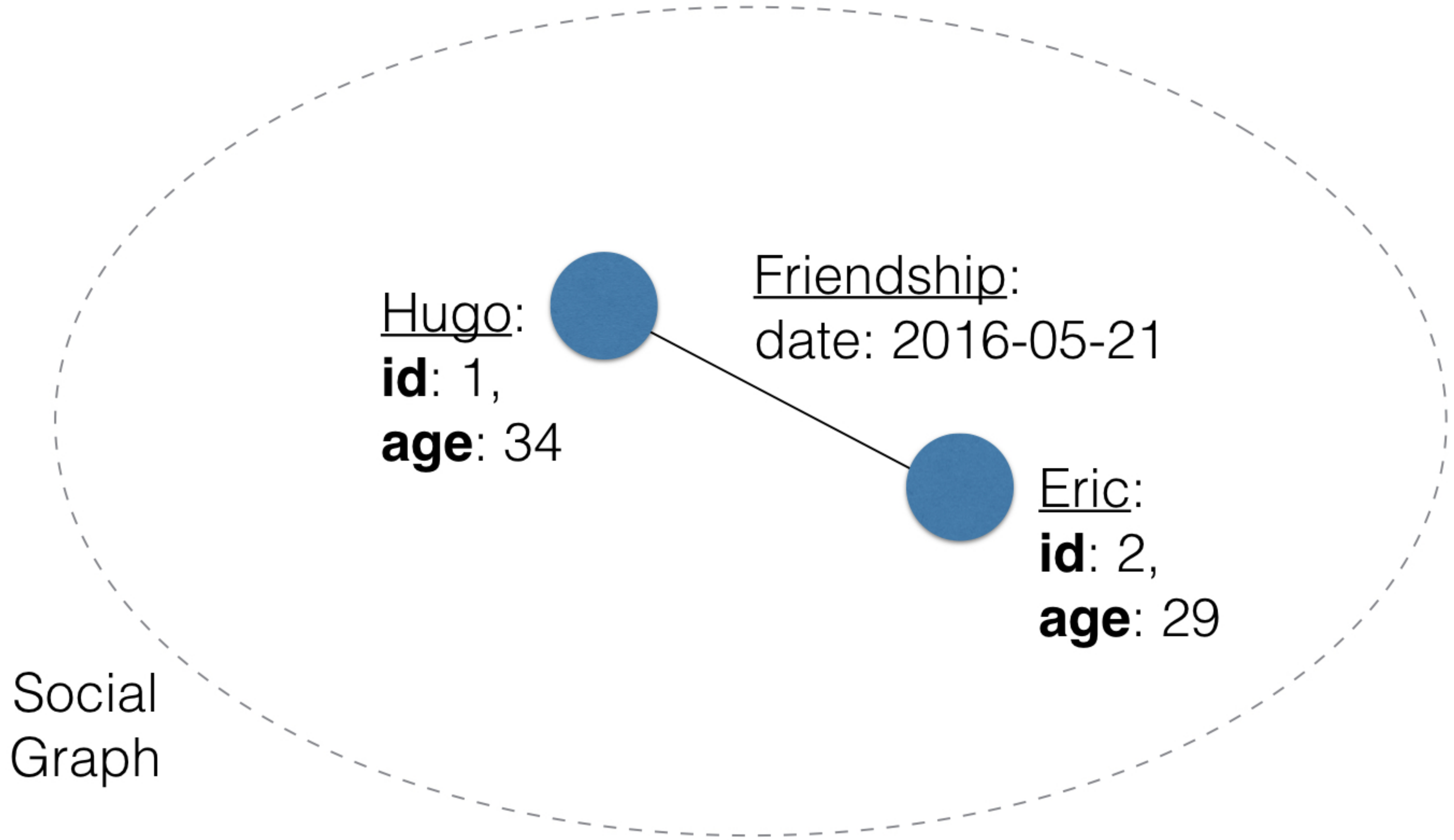
Network Structure



Network Structure



Network Structure



NetworkX API Basics

```
import networkx as nx

G = nx.Graph()

G.add_nodes_from([1, 2, 3])

G.nodes()
```

```
[1, 2, 3]
```

```
G.add_edge(1, 2)

G.edges()
```

```
[(1, 2)]
```

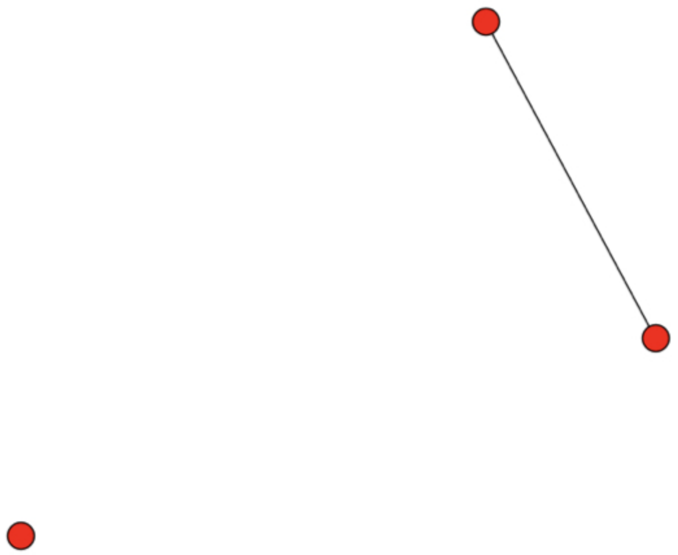
NetworkX API Basics

```
G.node[1]['label'] = 'blue'

G.nodes(data=True)
```

```
[(1, {'label': 'blue'}), (2, {}), (3, {})]
```

NetworkX API Basics

```
nx.draw(G)

import matplotlib.pyplot as plt
plt.show()
```



Let's practice!

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Types of graphs

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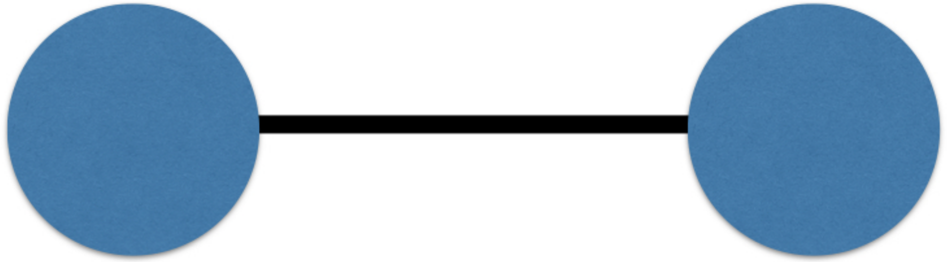
Undirected graphs

- Facebook social graph



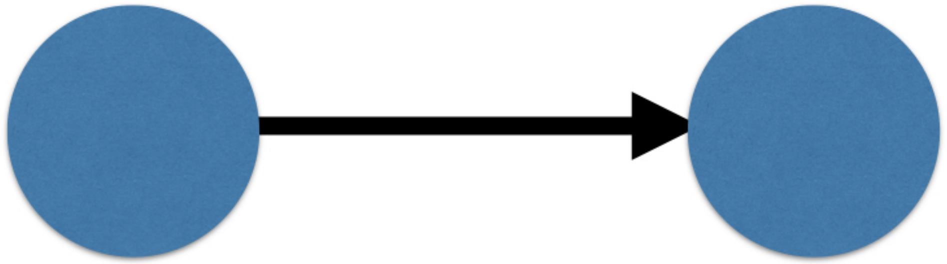
Undirected graphs

```
import networkx as nx
G = nx.Graph()
type(G)
```

```
networkx.classes.graph.Graph
```

Directed graphs

- Directed: Twitter social graph



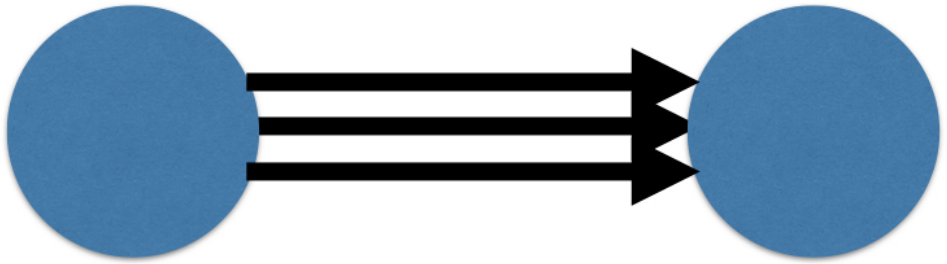
Directed graphs

```
D = nx.DiGraph()
type(D)
```

```
networkx.classes.digraph.DiGraph
```

Types of graphs

- Multi(Di)Graph: Trip records between bike sharing stations



Multi-edge (Directed) graphs

```
M = nx.MultiGraph()

type(M)
```

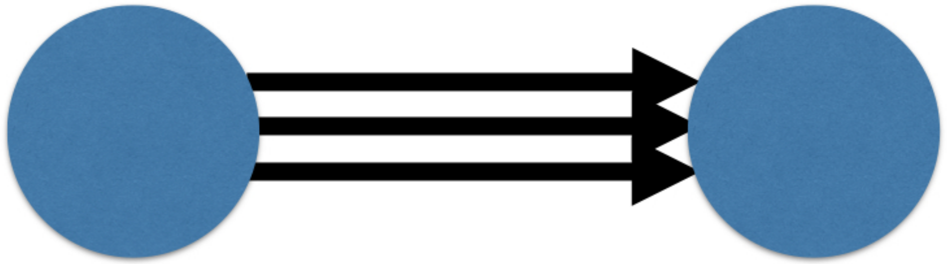
```
networkx.classes.multigraph.MultiGraph
```

```
MD = nx.MultiDiGraph()
type(MD)
```

```
networkx.classes.multidigraph.MultiDiGraph
```

Weights on graphs

- Edges can contain weights



Weights on graphs

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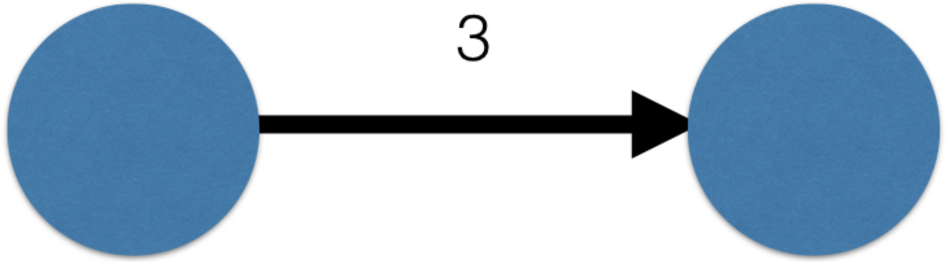
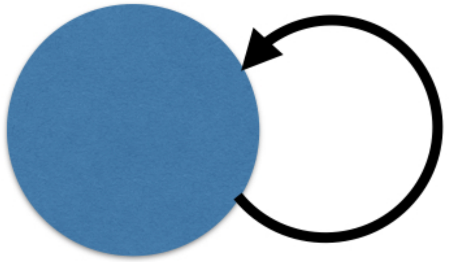
Weights on graphs

- Edges can contain weights



Self-loops

- Nodes that are connected to themselves



Let's practice!

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Network visualization

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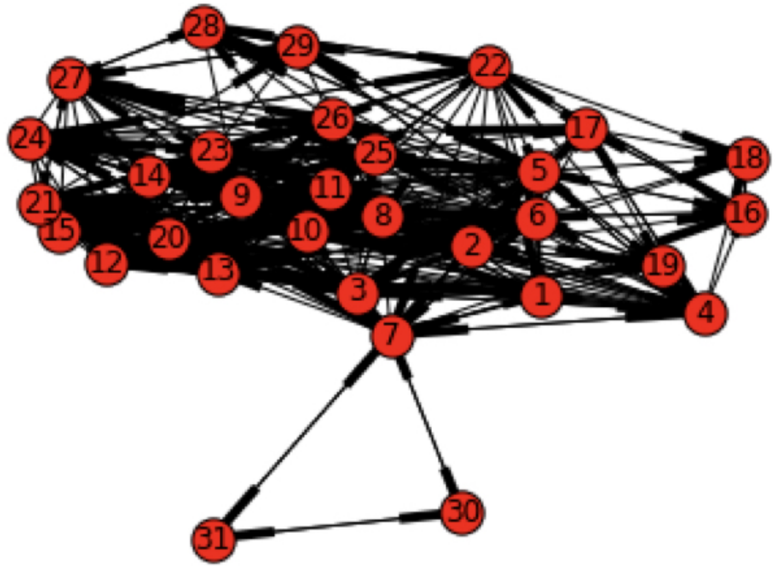
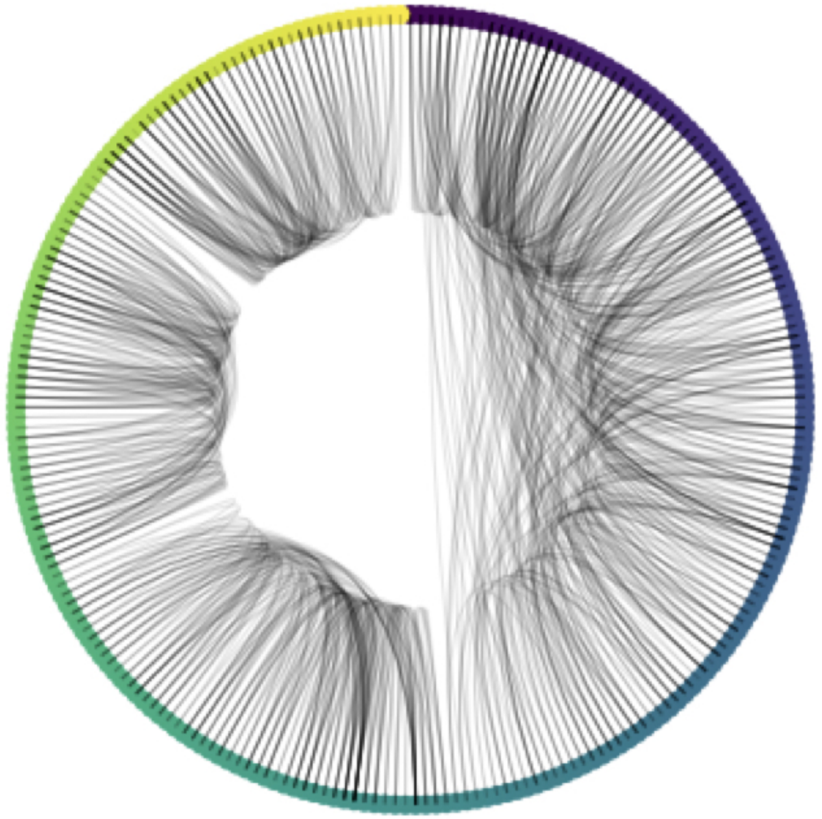
Irrational vs. Rational visualizations





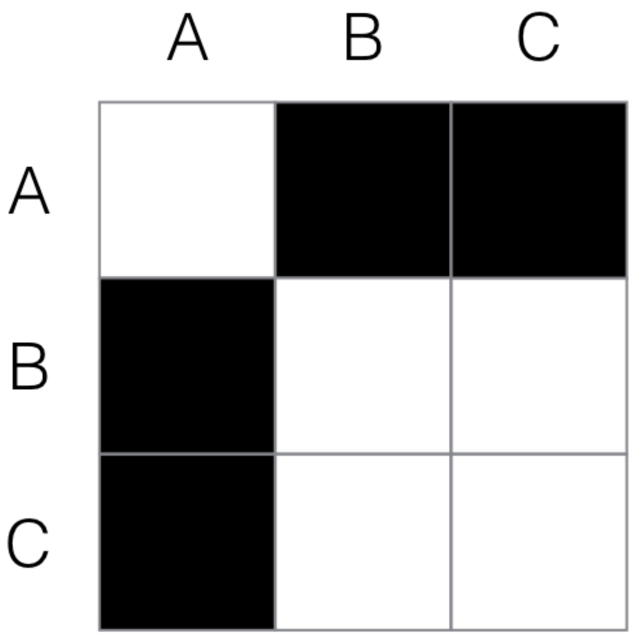
Visualizing networks

- Matrix plots
- Arc plots
- Circos plots

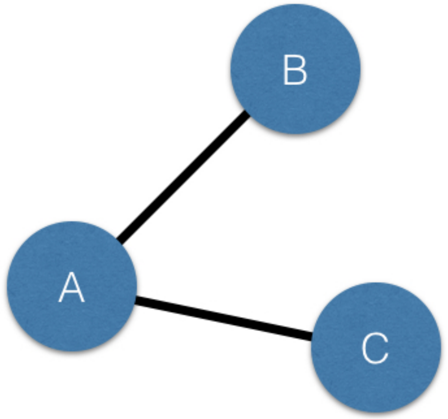
Visualizing networks

- **Matrix plots**
- Arc plots
- Circos plots

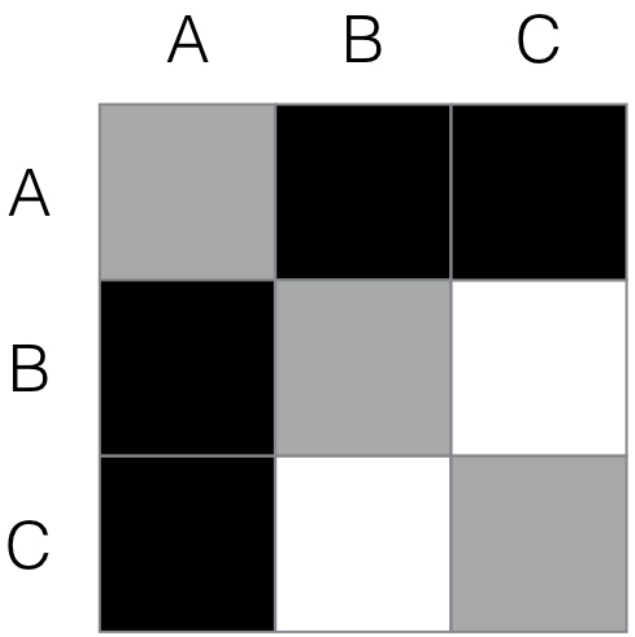
Matrix plot

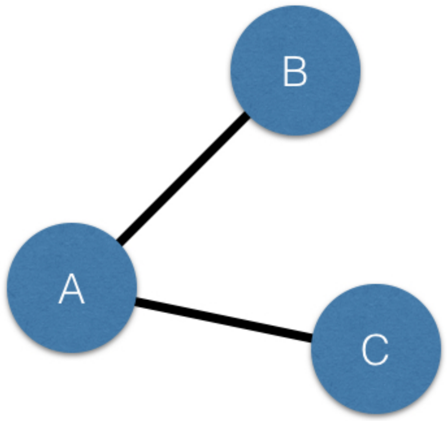


	A	B	C
A	□	■	■
B	■	□	□
C	■	□	□

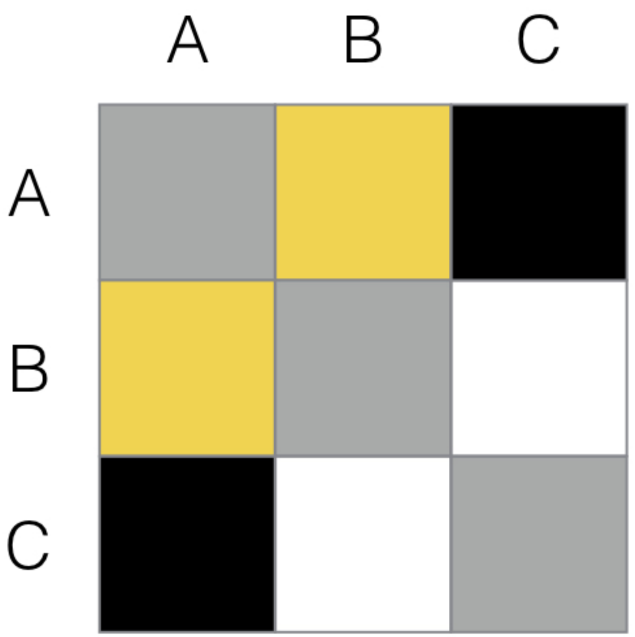


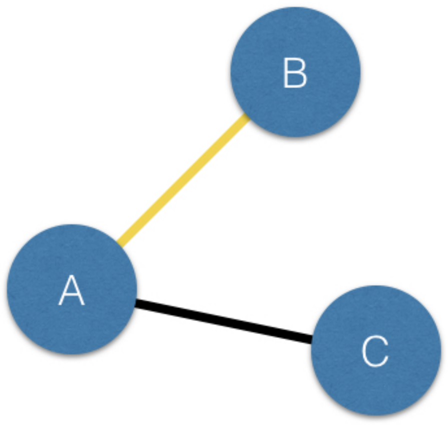
Matrix plot



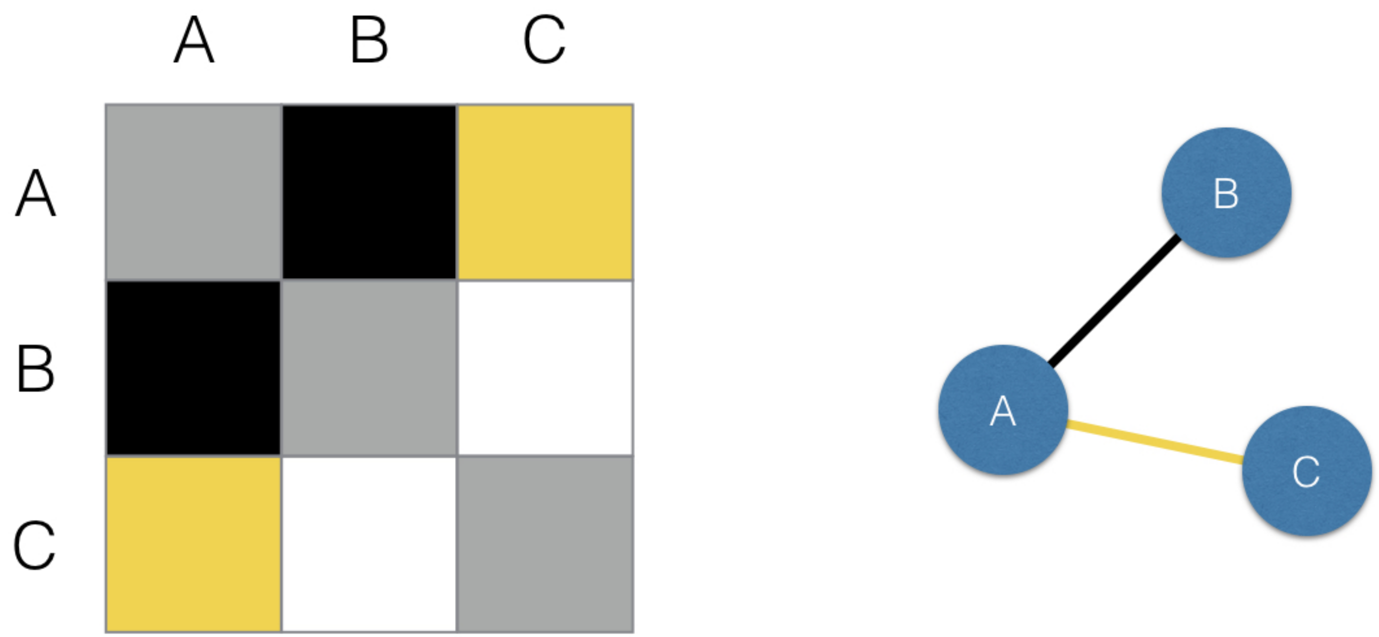


Matrix plot

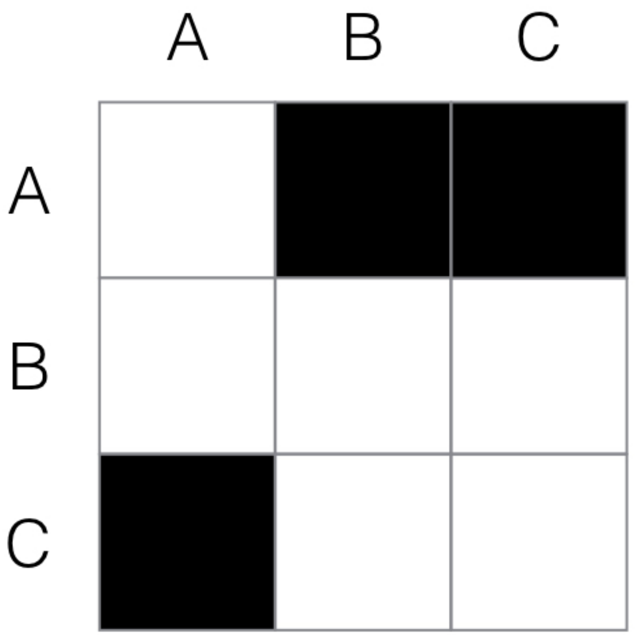




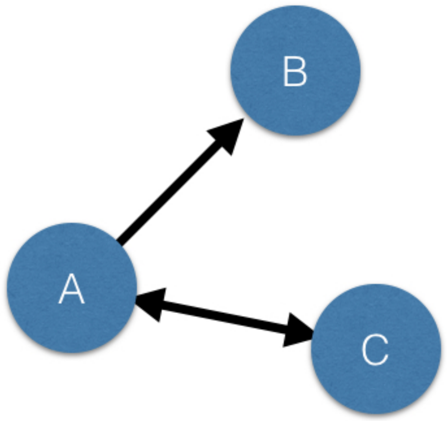
Matrix plot



Directed matrices



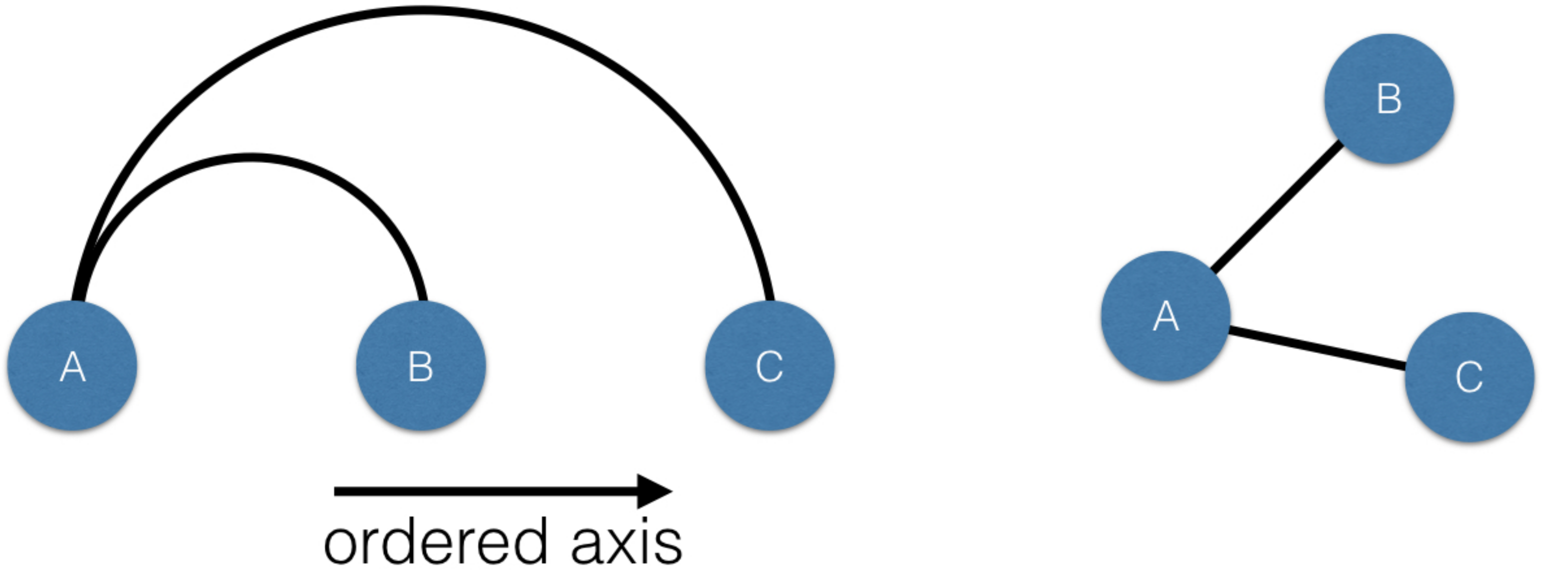
	A	B	C
A		■	■
B			
C	■		



Visualizing networks

- Matrix Plots
- **Arc Plots**
- Circos Plots

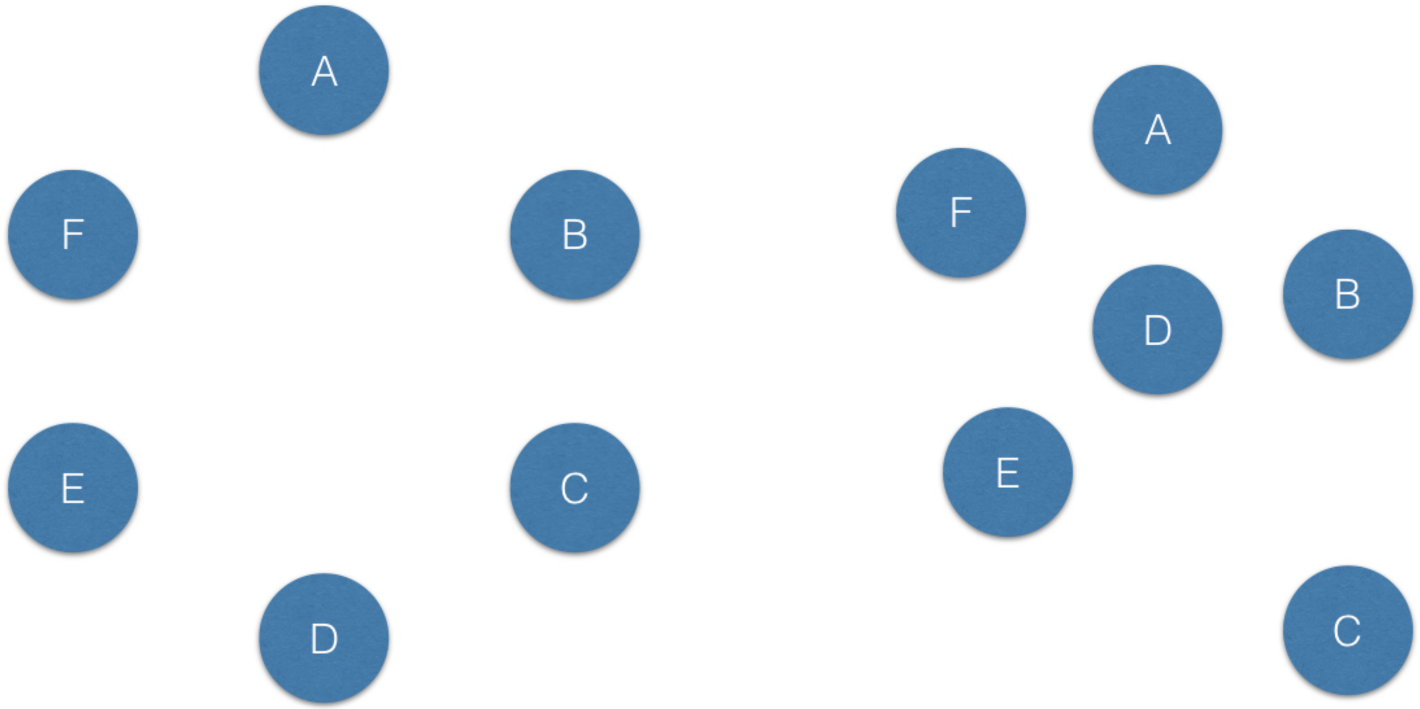
Arc plot



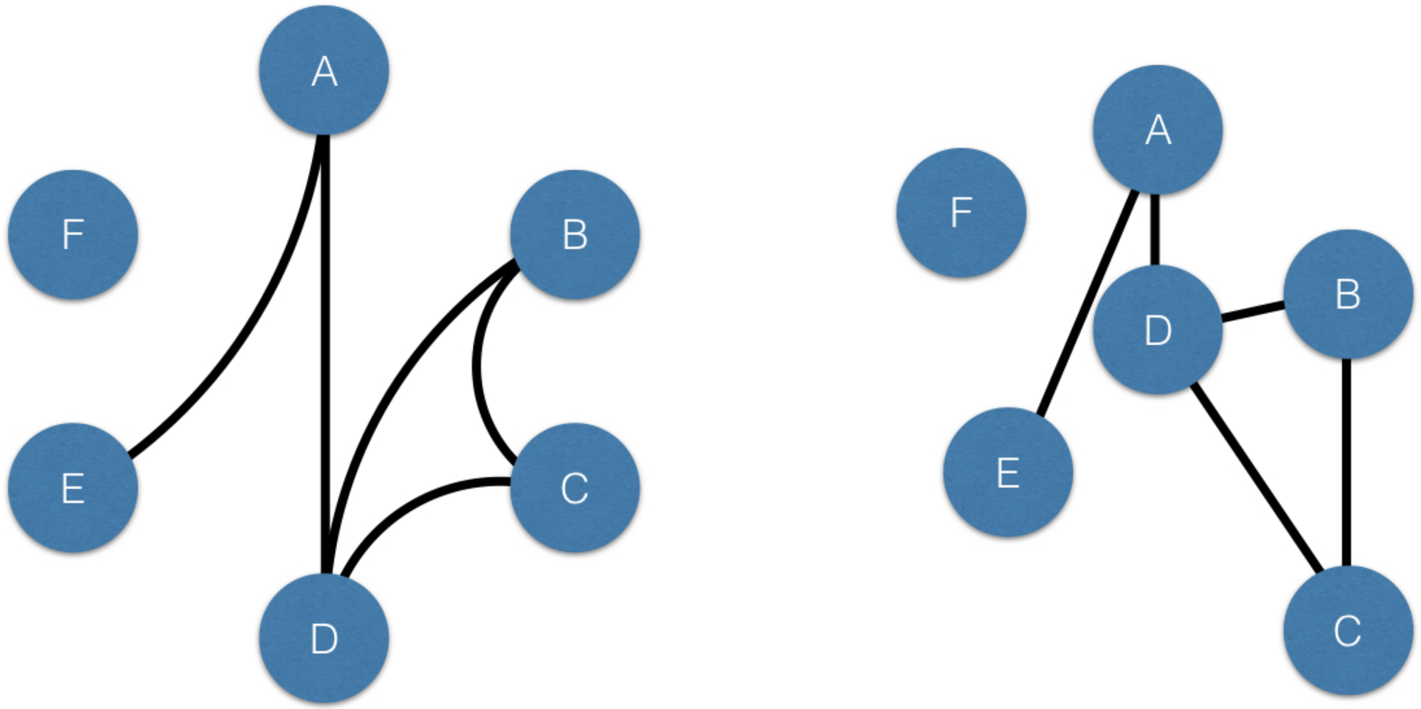
Visualizing networks

- Matrix Plots
- Arc Plots
- **Circos Plots**

Circos plot



Circos plot



nxviz API

```python
import nxviz as nv
import matplotlib.pyplot as plt

ap = nv.ArcPlot(G)

ap.draw()
plt.show()
```

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