

Introduction to Networks

INTRODUCTION TO NETWORK ANALYSIS IN PYTHON



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

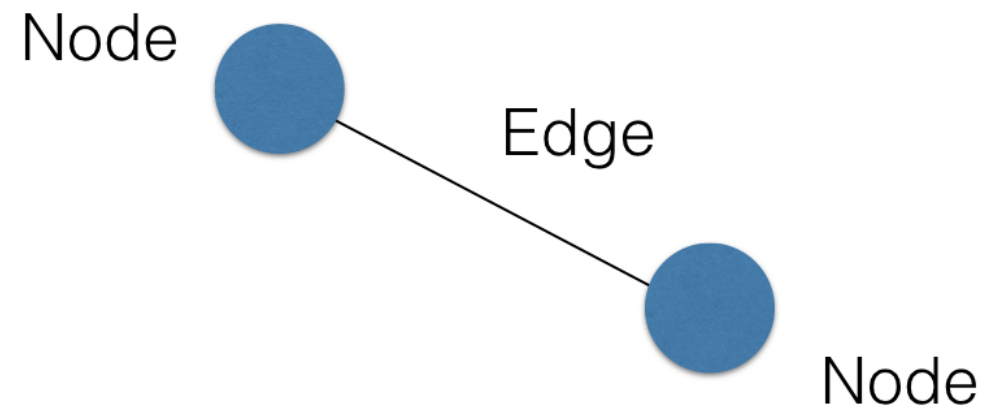
Network Structure

Node

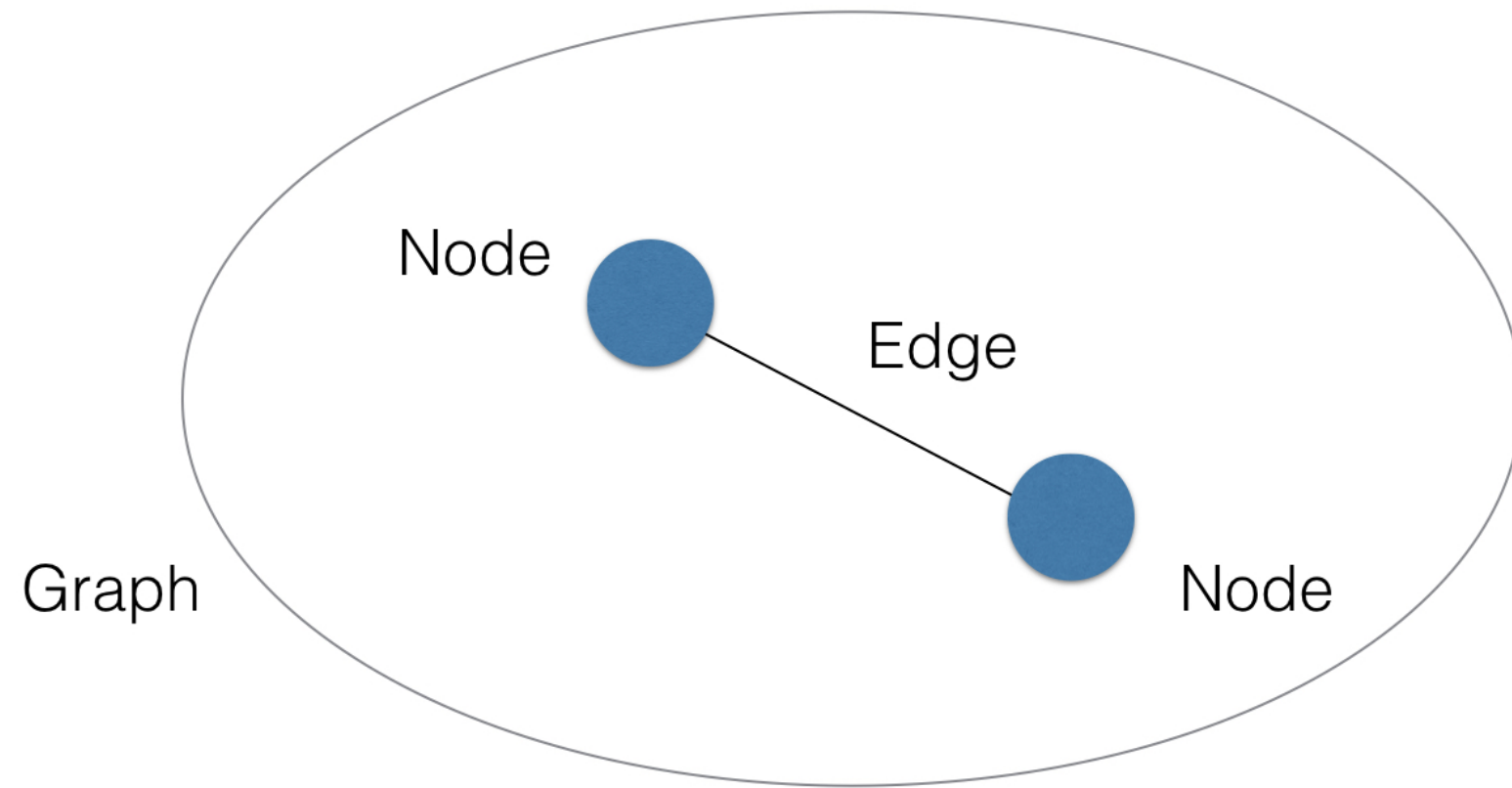


Node

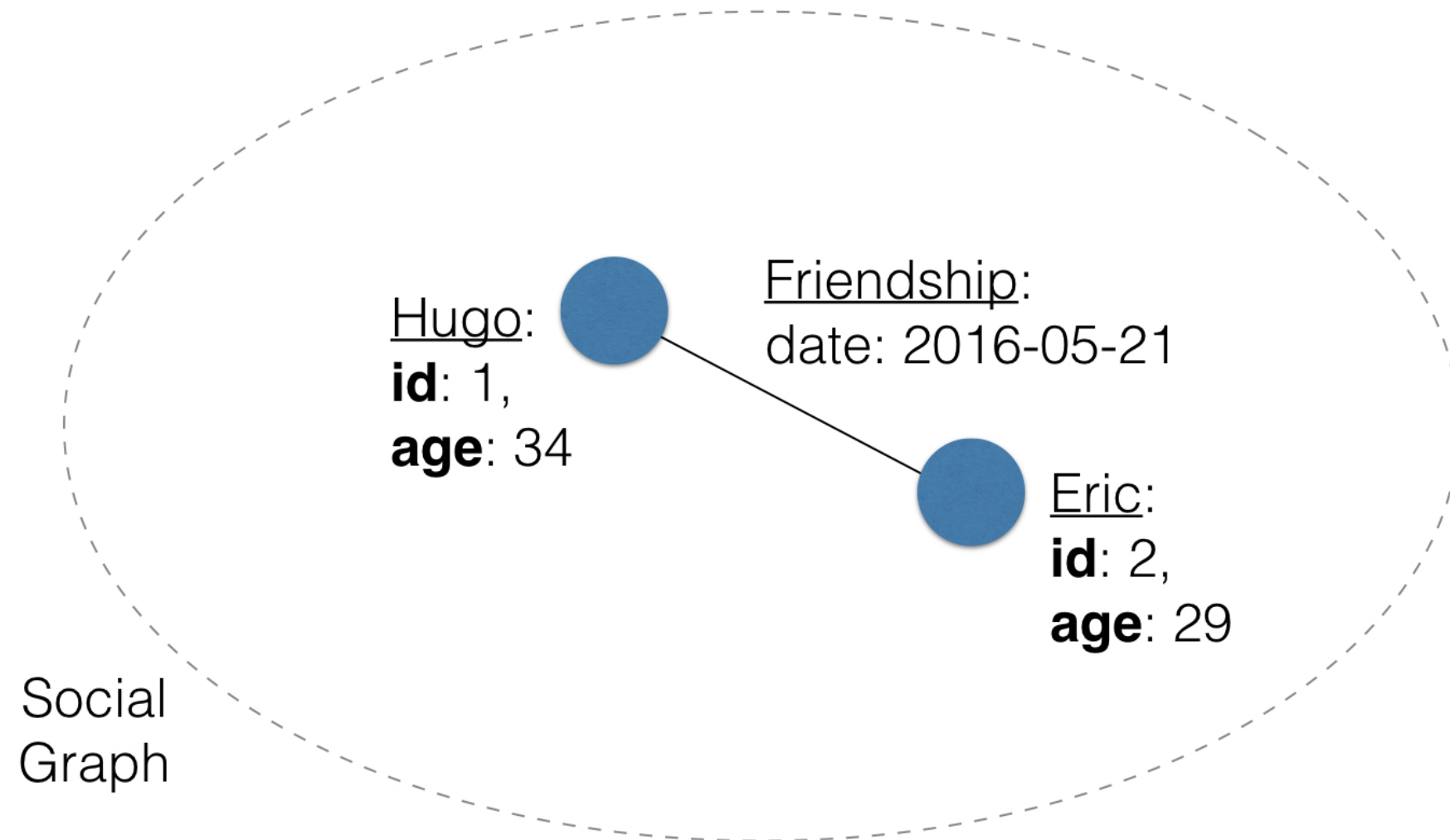
Network Structure



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)]
```

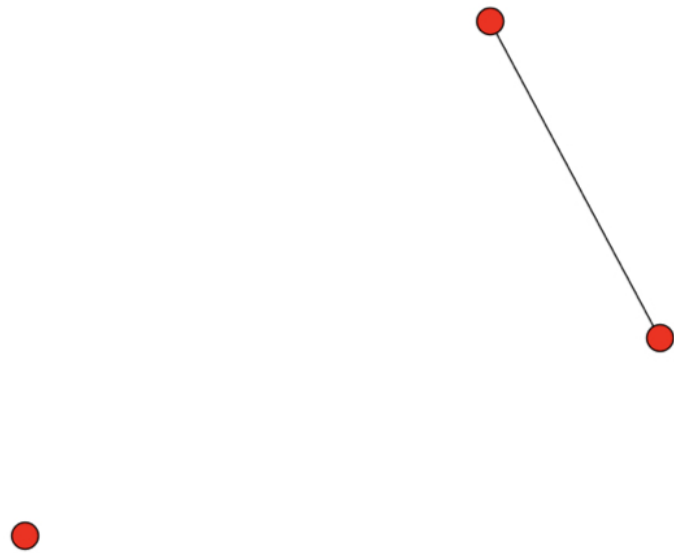

NetworkX API Basics

```
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()
```

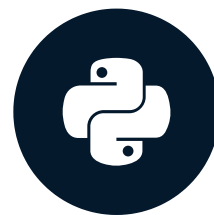


Let's practice!

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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



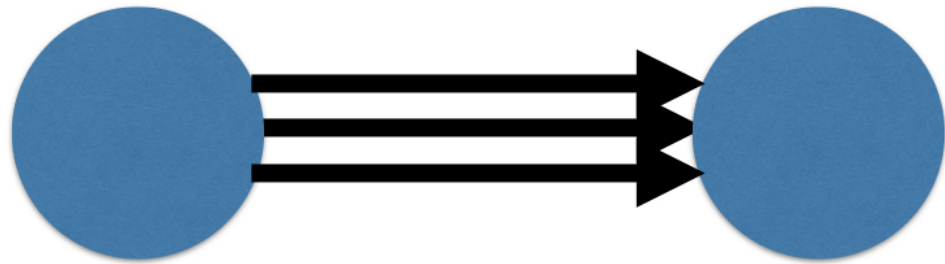
Directed graphs

```
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)
```

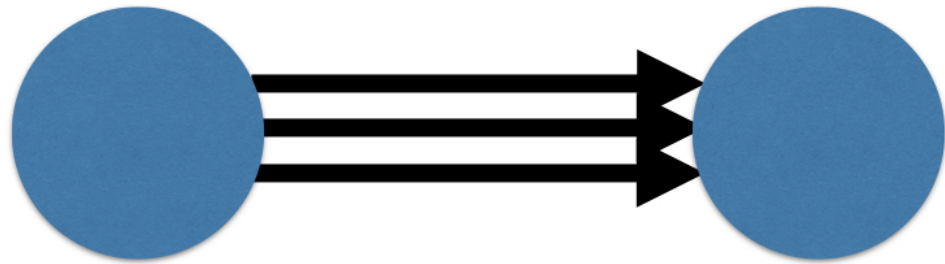
```
networkx.classes.multigraph.MultiGraph
```

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

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

Weights on graphs

- Edges can contain weights



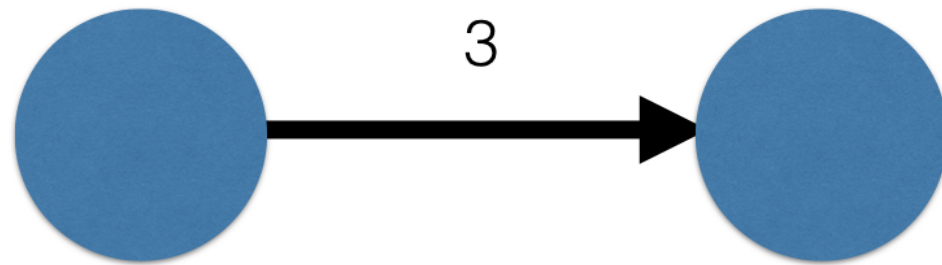
Weights on graphs

- Edges can contain weights



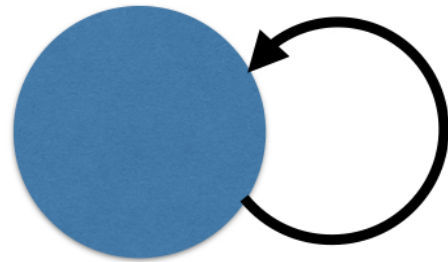
Weights on graphs

- Edges can contain weights



Self-loops

- Nodes that are connected to themselves



Let's practice!

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Network visualization

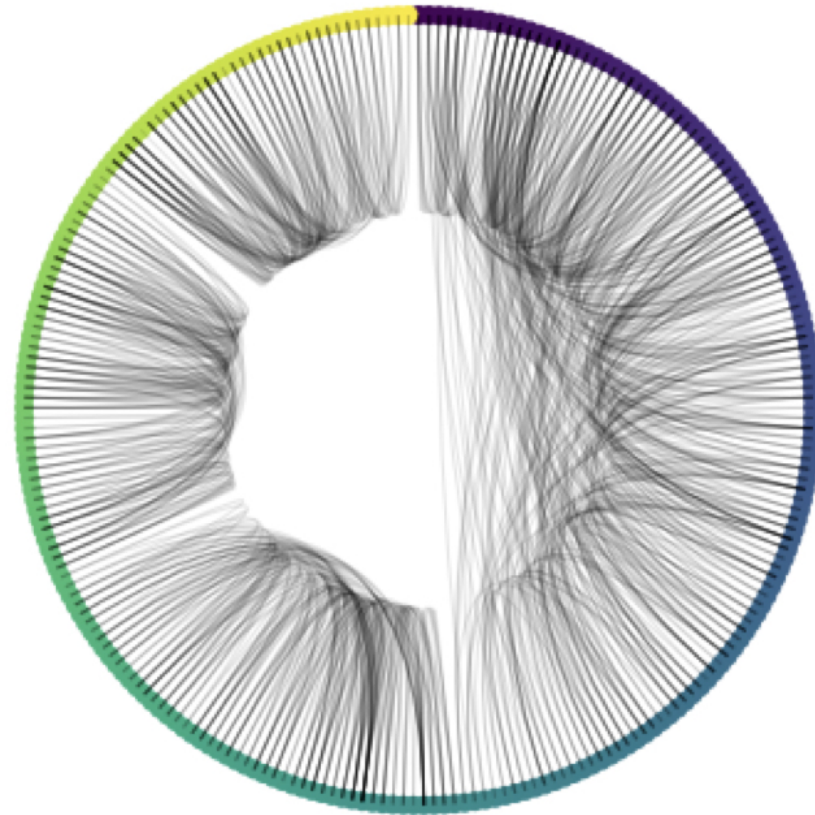
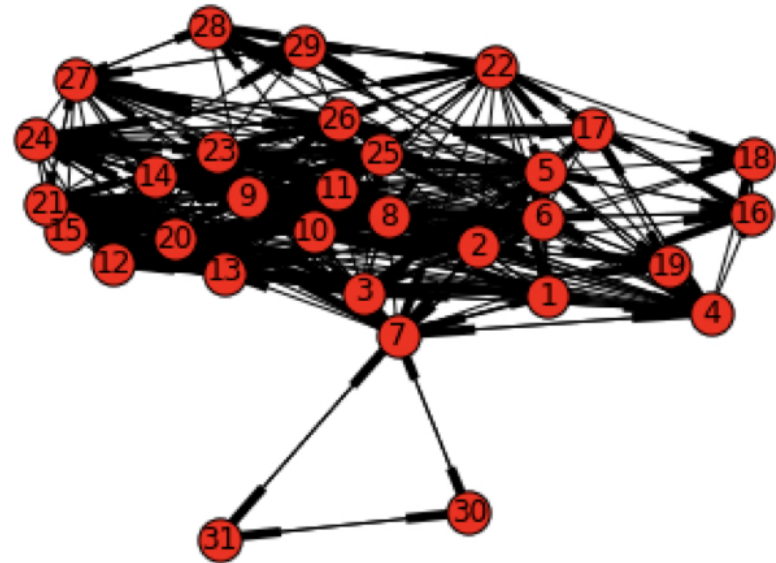
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Irrational vs. Rational visualizations



Visualizing networks

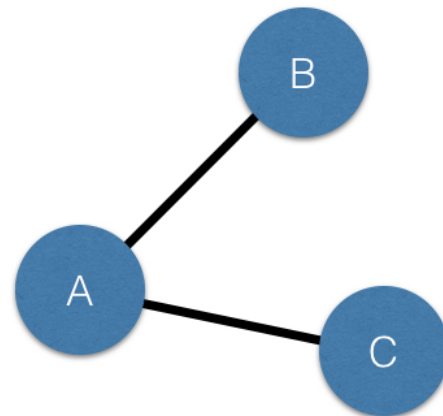
- Matrix plots
- Arc plots
- Circos plots

Visualizing networks

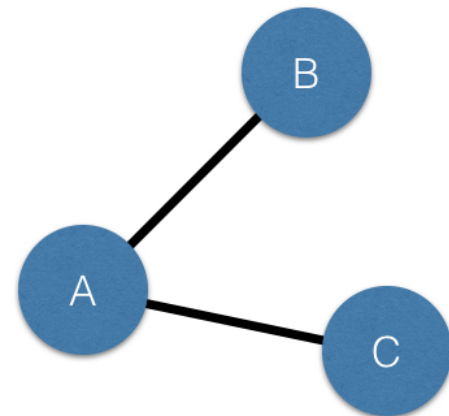
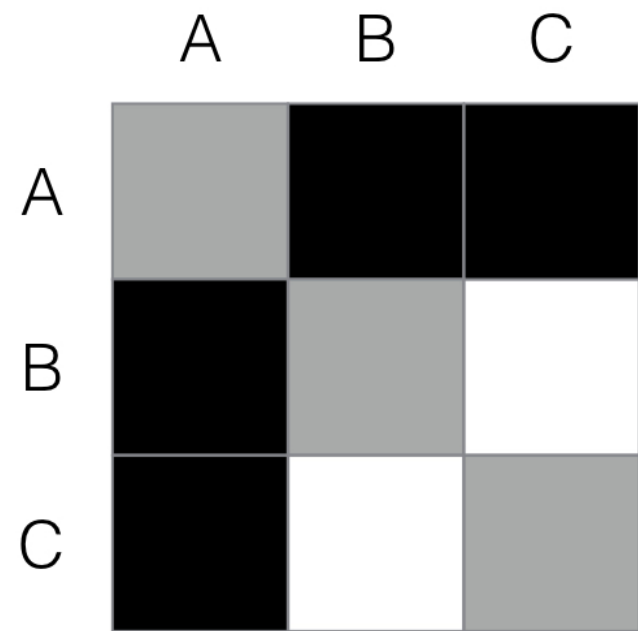
- Matrix plots
- Arc plots
- Circos plots

Matrix plot

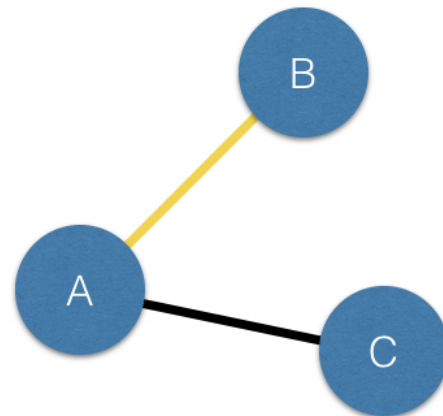
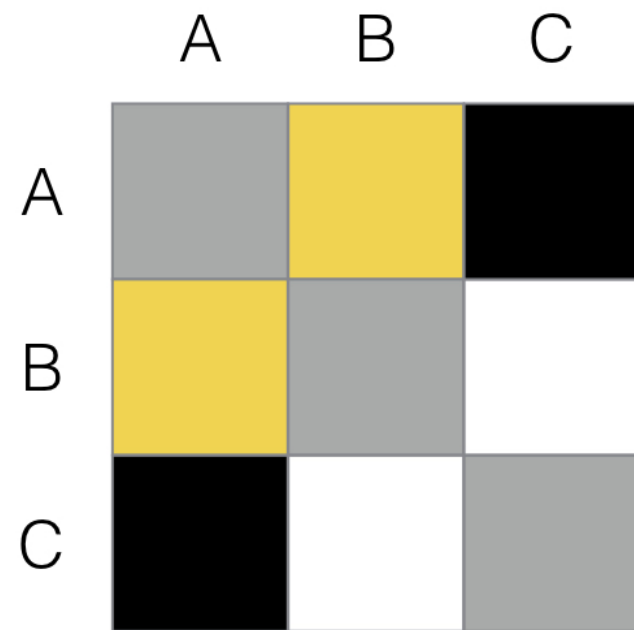
	A	B	C
A			
B			
C			



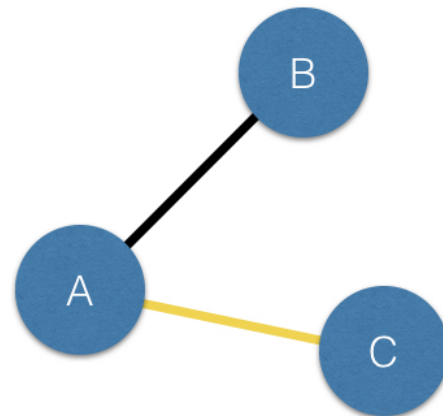
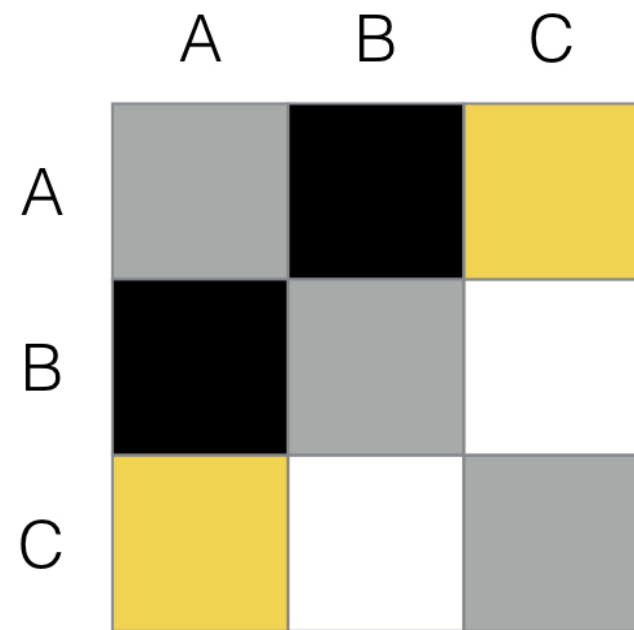
Matrix plot



Matrix plot

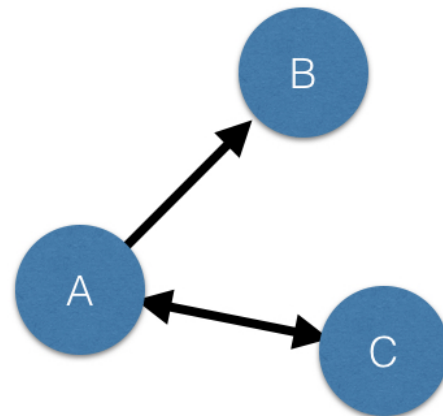


Matrix plot



Directed matrices

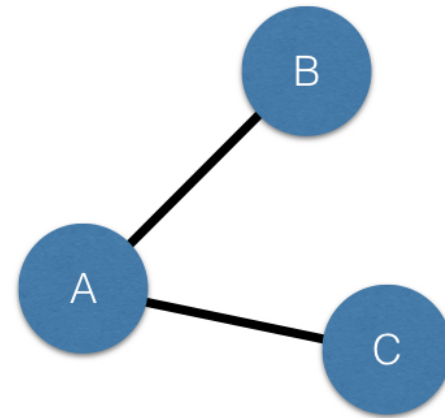
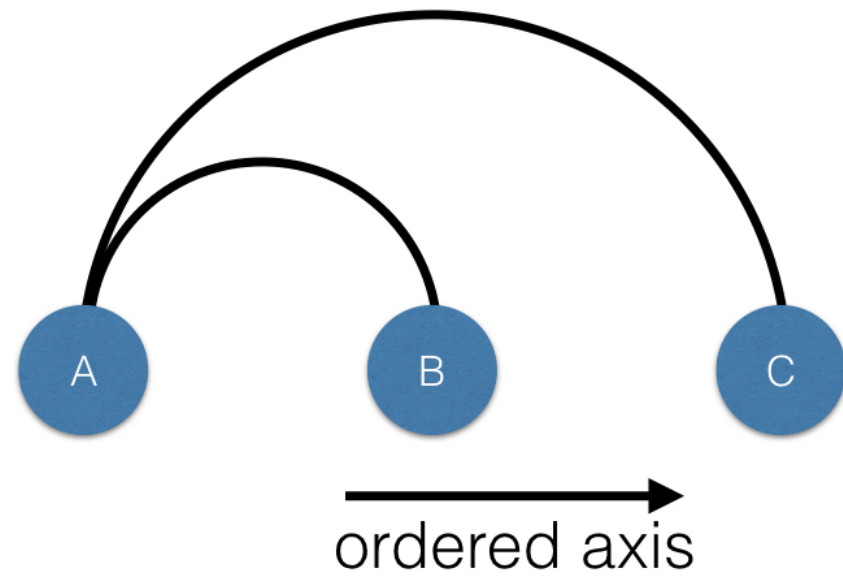
	A	B	C
A			
B			
C			



Visualizing networks

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

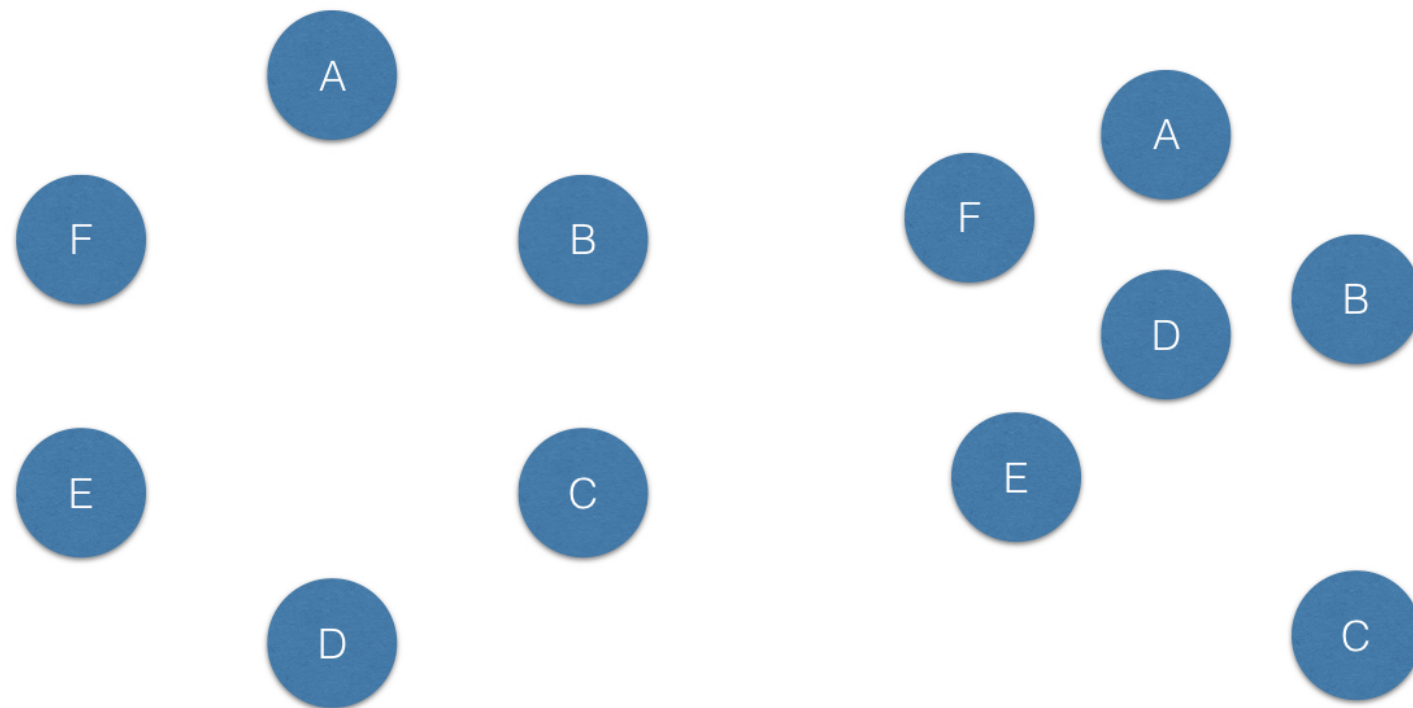
Arc plot



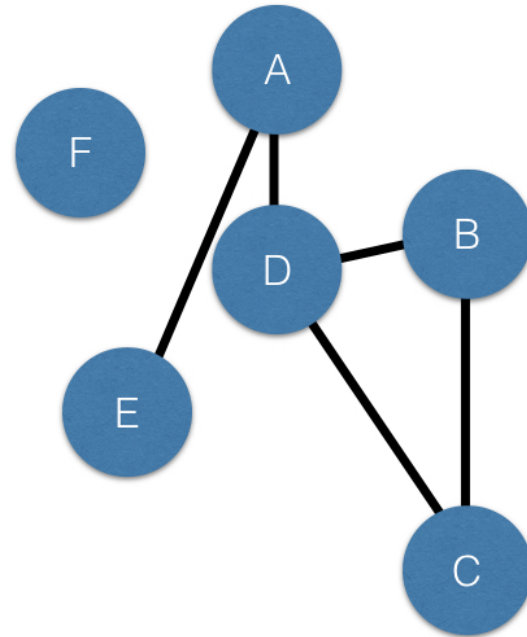
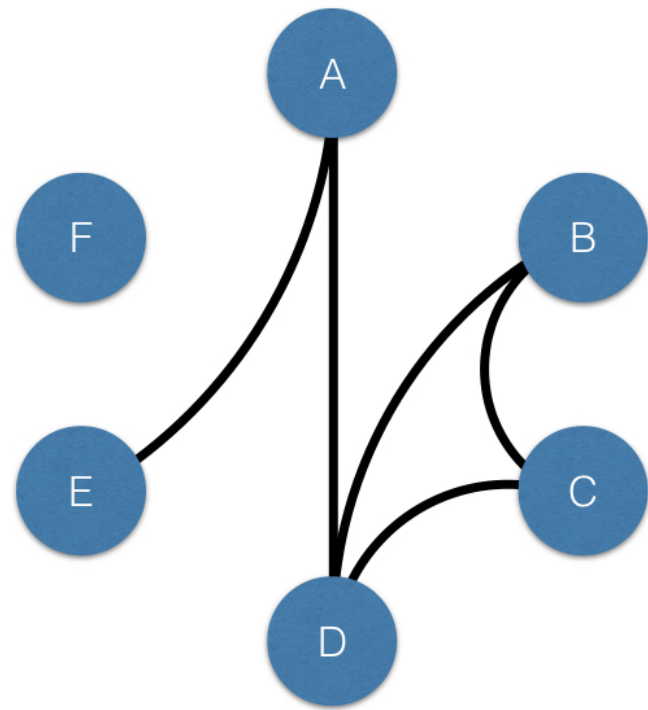
Visualizing networks

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

Circos plot



Circos plot



nxviz API

```
import nxviz as nv
import matplotlib.pyplot as plt
ap = nv.ArcPlot(G)
ap.draw()
plt.show()
```

Let's practice!

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