Social Network Analysis

WISERD Training

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2021-10-06

Programme

09:30-09:45 Welcome

09:45-10:30 Fundamentals of Social Network Analysis I

10:30-10:45 Tea Break

10:45-11:30 Fundamentals of Social Network Analysis II

11:30-12:00 Tea Break

12:00-12:45 Practical Demonstration

12:45-13:00 Conclusions and Reflections

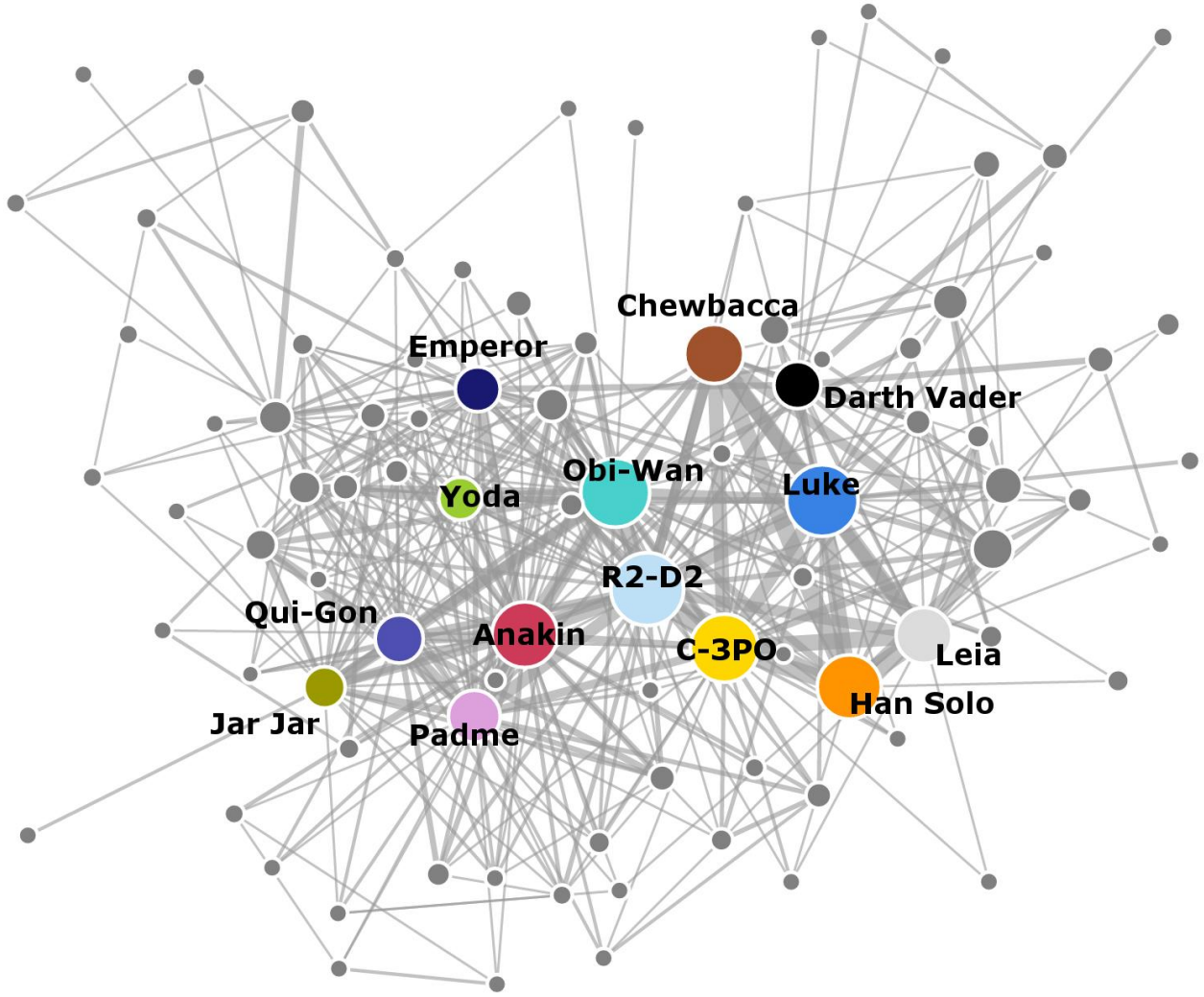
Overview

Why do some training?

Many who have seen the potential offered by network analysis have found it difficult to come to grips with the highly technical and mathematical language that necessarily characterises much of the discussion in the technical literature.

(Scott, 2017: 3)

In a social network far, far away…



What is Social Network Analysis?

Social Network Analysis (SNA) is a methodological and conceptual toolbox for the measurement, systematic description, and analysis of patterns in relational structures in the social world (Caiani, 2014).

A relation is a distinctive type of connection or tie between two entities (Wasserman & Faust, 1994).

Relations are the building blocks of networks, and thus SNA is concerned with and most appropriate for analyses of data capturing relations between units of analysis (Scott, 2017).

Reasons to consider SNA

$$Y = a + BX + e$$

A social network is the phenomenon you are trying to describe and explain (*Y*).

Features or properties of a social network help you describe and explain a different phenomenon (*X*).

Reasons to consider SNA

illness, disability, health behaviors, health care use, and death in one person are associated with similar outcomes in numerous others to whom that person is tied, and there can be a nonbiological transmission of illness.

(Smith & Christakis, 2008: 420)

When to use SNA

When you are dealing with **relational data** i.e., data capturing relationships and connections between units of analysis.

This is in contrast to attributional data , which captures the attributes – characteristics, demographics etc – of your units of analysis.

When to use SNA

name	sex	age	employed
John	male	52	yes
Joan	female	45	yes
Jenny	female	25	no
Juliet	female	67	yes
Jack	male	19	no

	John	Joan	Jenny	Juliet	Jack
John	--	Friend	Colleague	Stranger	Stranger
Joan	Friend	--	Stranger	Spouse	Stranger
Jenny	Colleague	Stranger	--	Friend	Stranger
Juliet	Stranger	Spouse	Friend	--	Stranger
Jack	Stranger	Stranger	Stranger	Stranger	--

What does SNA involve?

Identifying and visualising patterns of relations between units of analysis.

Examining structural properties/characteristics of these relations.

Analysing implications of these relations on outcomes experienced by units of analysis (Scott, 2017).

As a result of its focus on the relational characteristics of the units of analysis, SNA requires distinctive data structures, methods of analysis and data visualisation techniques (Caiani , 2014).

How do you implement SNA in your research?

Hanneman & Riddle (2005), Owen Smith (2017):

1. Pose a carefully articulated research question that requires understanding and/or analysis of a network.
2. Decide which units of analysis and types of relations to analyse i.e., who is connected and which relationships matter?
3. Collect or obtain a data set that provides relational data on your units of analysis.
4. Summarise the network and its key features using appropriate measures e.g., network size, density, cohesion etc.

Key concepts

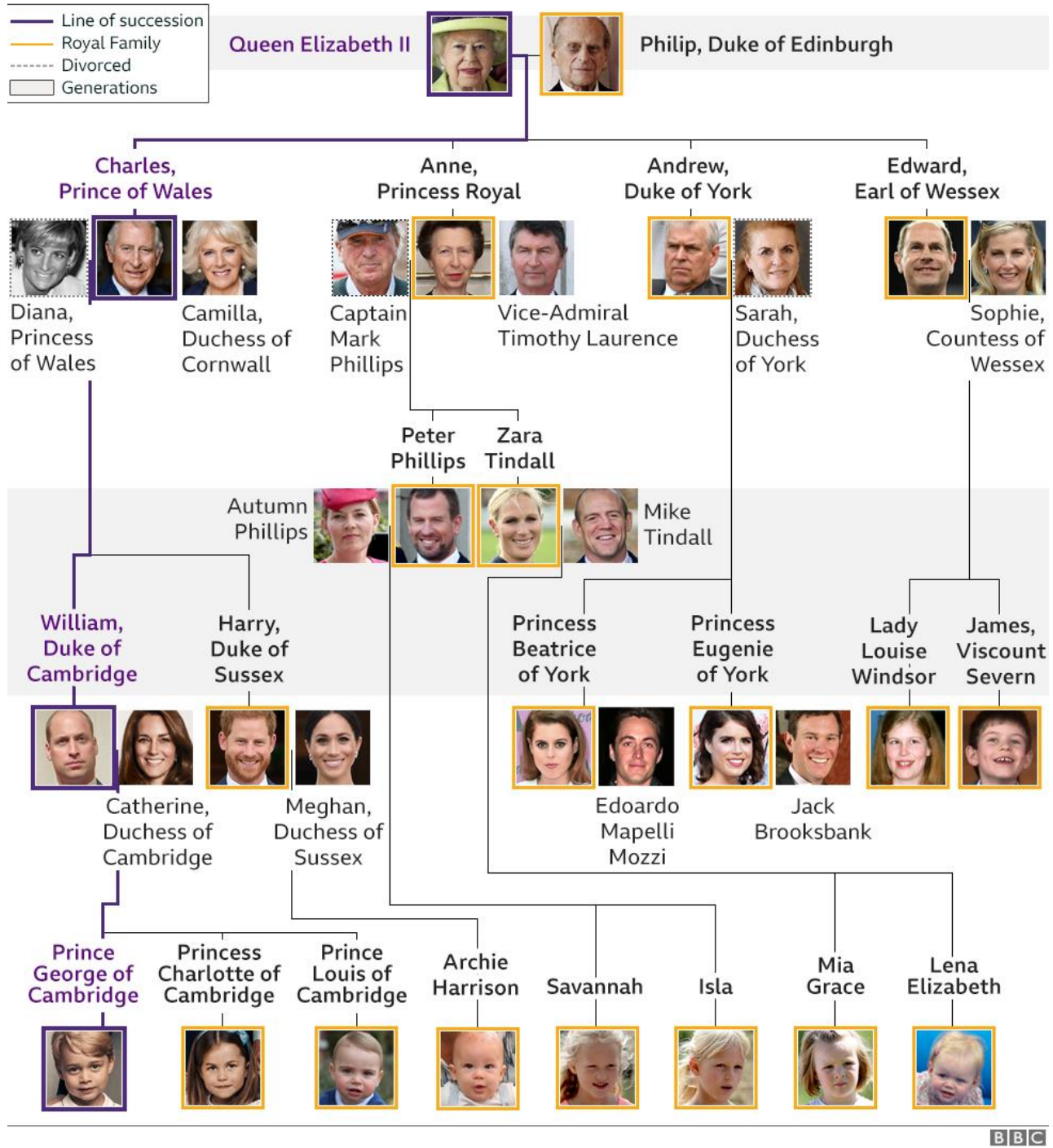
Networks in a nutshell

A network whether social, physical, biological etc is constructed from two main building blocks (Owen Smith, 2017):

1. The **entities** that are (or can be) connected in a network.
2. The **connections** that exist (or could exist) between entities.

Therefore a network is an aggregation or representation of these entities and their connections.

For example, a family tree is a network containing individuals (**entities**) that are related through some type of familial tie (**connection**).


Line of succession
Royal Family
Divorced
Generations
Queen Elizabeth II
Philip, Duke of Edinburgh
Charles, Prince of Wales
Anne, Princess Royal
Andrew, Duke of York
Edward, Earl of Wessex
Diana, Princess of Wales
Camilla, Duchess of Cornwall
Captain Mark Phillips
Vice-Admiral Timothy Laurence
Sarah, Duchess of York
Sophie, Countess of Wessex
Peter Phillips
Zara Tindall
Autumn Phillips
Mike Tindall
William, Duke of Cambridge
Harry, Duke of Sussex
Princess Beatrice of York
Princess Eugenie of York
Lady Louise Windsor
James, Viscount Severn
Catherine, Duchess of Cambridge
Meghan, Duchess of Sussex
Edoardo Mapelli Mozzi
Jack Brooksbank
Prince George of Cambridge
Princess Charlotte of Cambridge
Prince Louis of Cambridge
Archie Harrison
Savannah
Isla
Mia Grace
Lena Elizabeth

Networks in a nutshell

Networks tend to be multi-modal:

One-mode network contains one type of node (e.g., pupils) - this is also known as a **unipartite** network.

Two-mode network contains two types of node (e.g., pupils and schools) - this is also known as a **bipartite** or **affiliate** network.

Networks in a nutshell

It is important to distinguish between different types of networks types:

Whole network: interested in the totality of connections between a set of entities.

Ego-centric network/egonet: interested in a focal entity (ego) and what other entities are part of its network.

Networks in a nutshell

Simple network contains only one type of connection between entities.

Complex network contains more than one type of connection between entities.

Entities

The entities included in a network are known as **nodes**.

Nodes can be individuals, organisations, countries, animals, events, computers, train stations etc.

Nodes of particular interest are known as **ego** or **focal nodes**; nodes that are or could be connected to an ego are referred to as **alters**.

Two nodes that are or could be connected are called a **dyad**, while three nodes that are or could be connected are called a **triad**.

Entities

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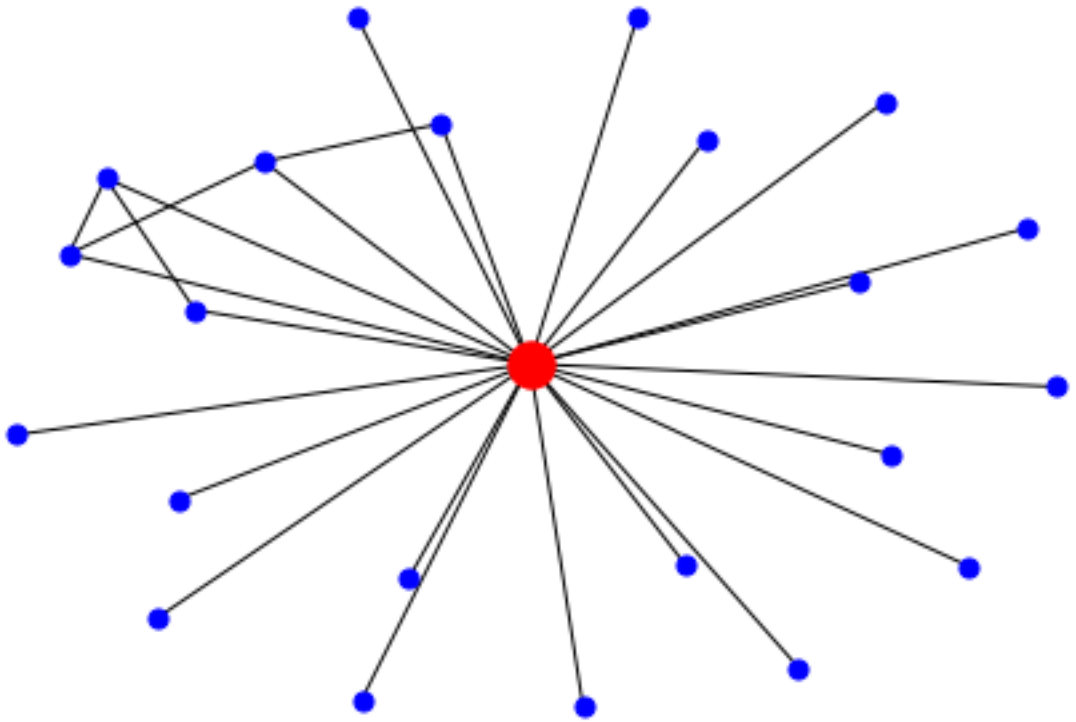
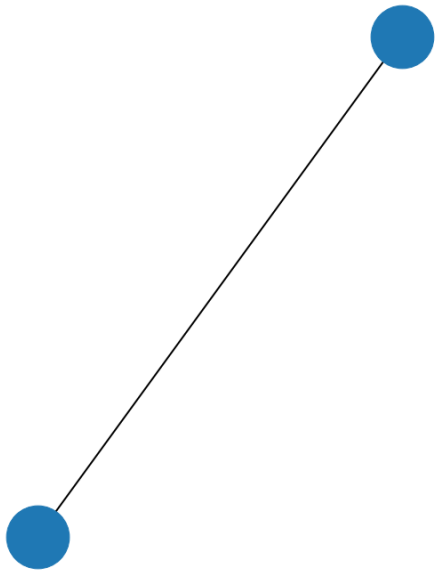
Entities

Ego Network



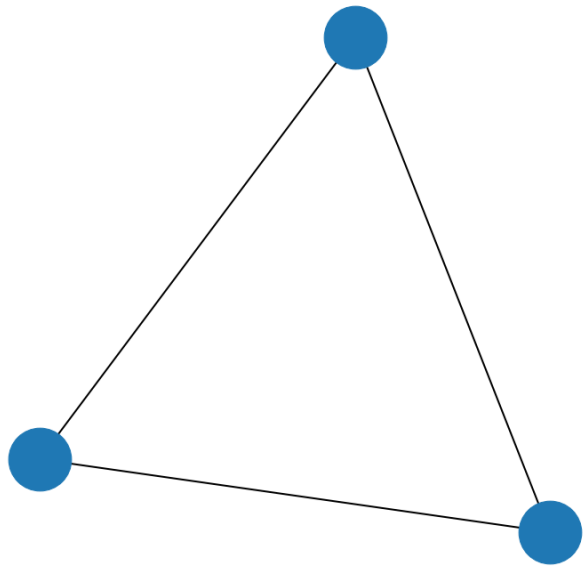
Entities

Dyad



Entities

Triad



Connections

Connections or relations between entities are known as **ties**.

There are a multitude of different types of ties present in the social world e.g., family relations, friendships, event attendance, club memberships, communal living, collegial etc.

It is possible for two entities to be connected by many different types of ties.

Important to acknowledge that your data will only capture a sample of **all** possible ties that exist between your nodes.

Connections

Ties have two dimensions:

1. Directionality

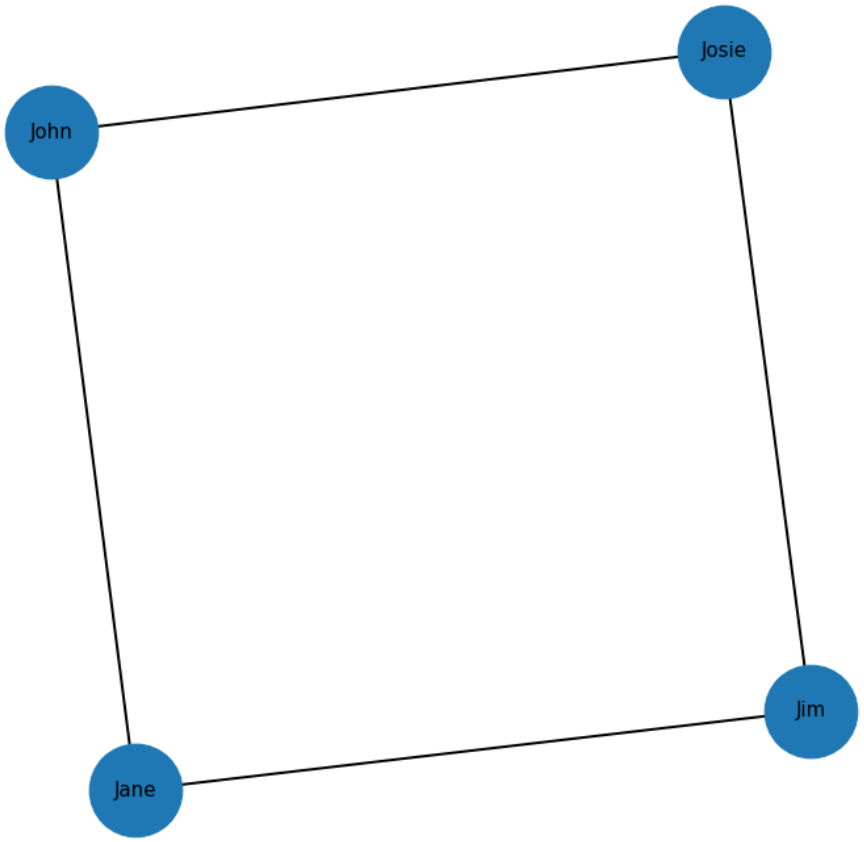
- Undirected
- Directed

2. Numeration / Strength

- Binary
- Valued

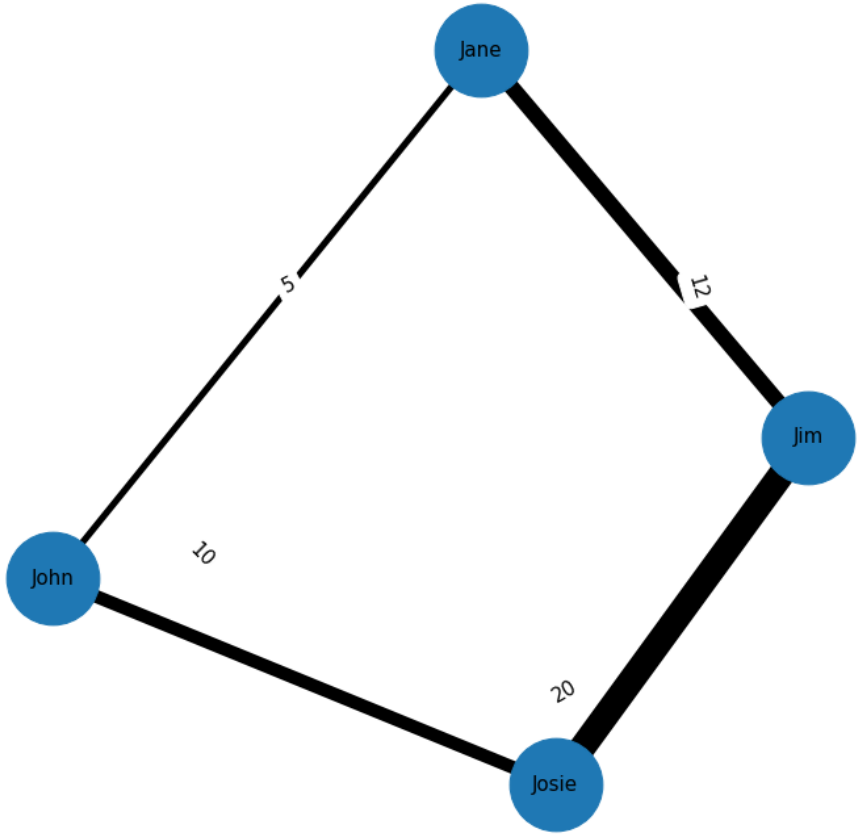
Connections

Undirected and Binary



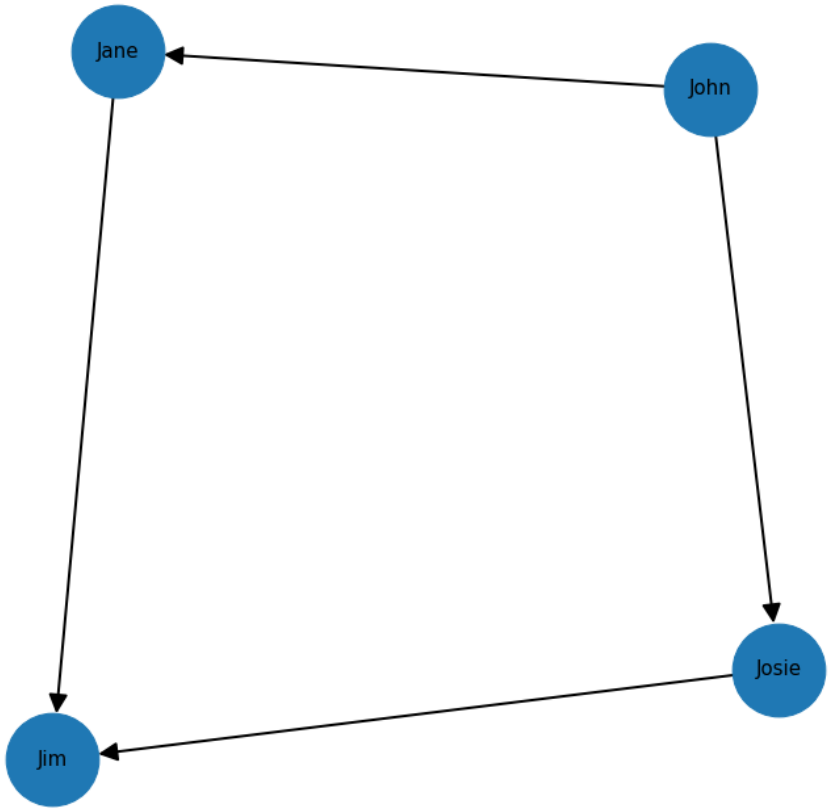
Connections

Undirected and Valued



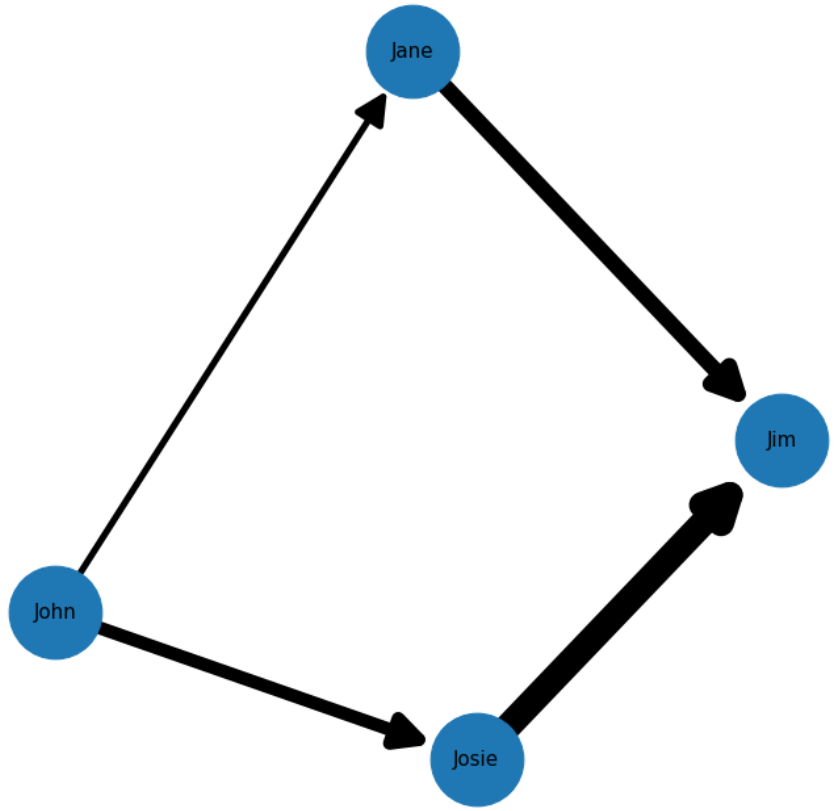
Connections

Directed and Binary



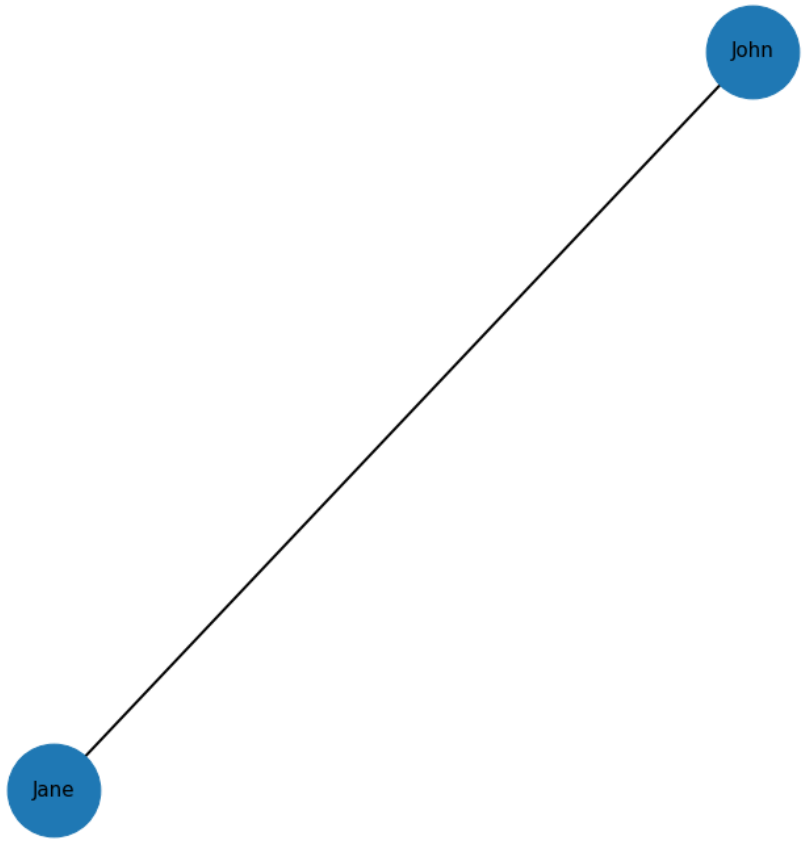
Connections

Directed and Valued



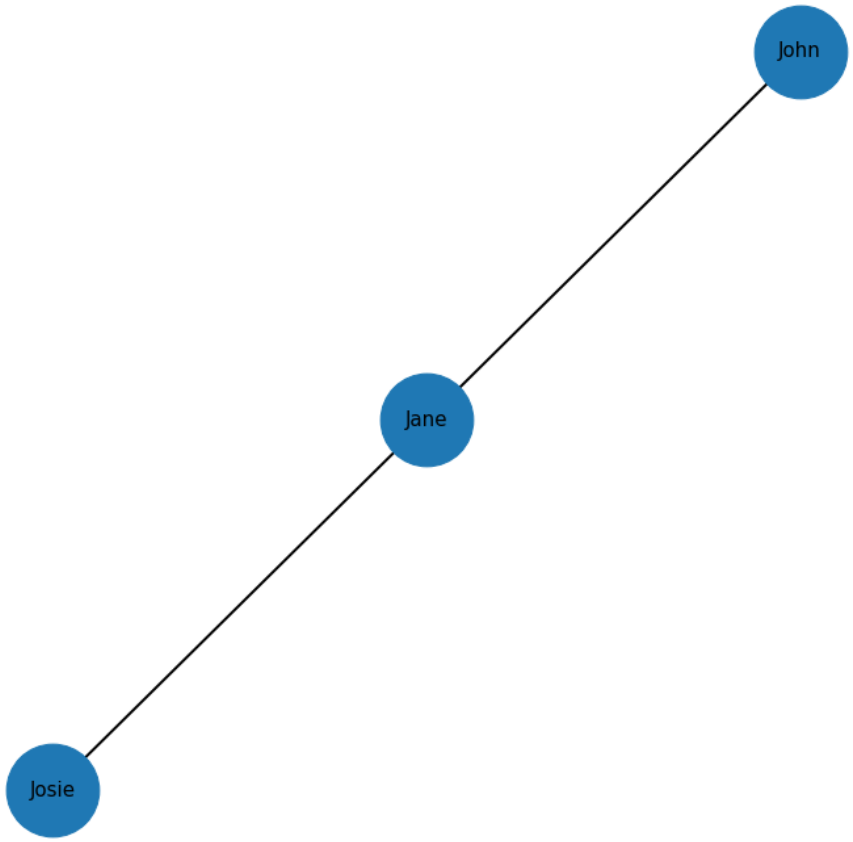
Connections

Direct Tie



Connections

Indirect Tie



Representing networks

Representing networks

Networks can be represented using three formats:

1. Matrices
2. Edgelists
3. Graphs

Matrices

A matrix (X) is an arrangement of elements into rows (i) and columns (j).

Social networks can be represented as matrices also:

- Every row is a node
- Every column is a node
- And every value captures the directionality/numeration of the relation between two nodes

Let’s take a small social network as an example.

Matrices

Undirected and Binary

	Wife	Aunt	Cousin	Gran	Sister-in-law
Wife	--	1	1	0	1
Aunt	1	--	0	0	0
Cousin	1	0	--	1	1
Gran	0	0	1	--	1
Sister-in-la	1	0	1	1	--

Matrices

Undirected and Valued

	Wife	Aunt	Cousin	Gran	Sister-in-law
Wife	--	4	1	0	2
Aunt	4	--	0	0	0
Cousin	1	0	--	1	5
Gran	0	0	5	--	1
Sister-in-la	2	0	1	1	--

Matrices

Directed and Binary

	Wife	Aunt	Cousin	Gran	Sister-in-law
Wife	--	1	1	0	1
Aunt	0	--	0	0	0
Cousin	0	0	--	1	1
Gran	0	0	1	--	1
Sister-in-la	0	0	1	1	--

Matrices

Directed and Valued

	Wife	Aunt	Cousin	Gran	Sister-in-law
Wife	--	4	1	0	2
Aunt	0	--	0	0	0
Cousin	0	0	--	1	5
Gran	0	0	1	--	1
Sister-in-la	0	0	3	1	--

Edgelist

An edgelist is simply a list of the ties in a network, with the ties represented as pairs of nodes.

source	target	weight
Wife	Cousin	2
Wife	Sister-in-law	1
Aunt	Gran	3
Aunt	Cousin	4
Cousin	Gran	1
Gran	Wife	1
Sister-in-law	Wife	2

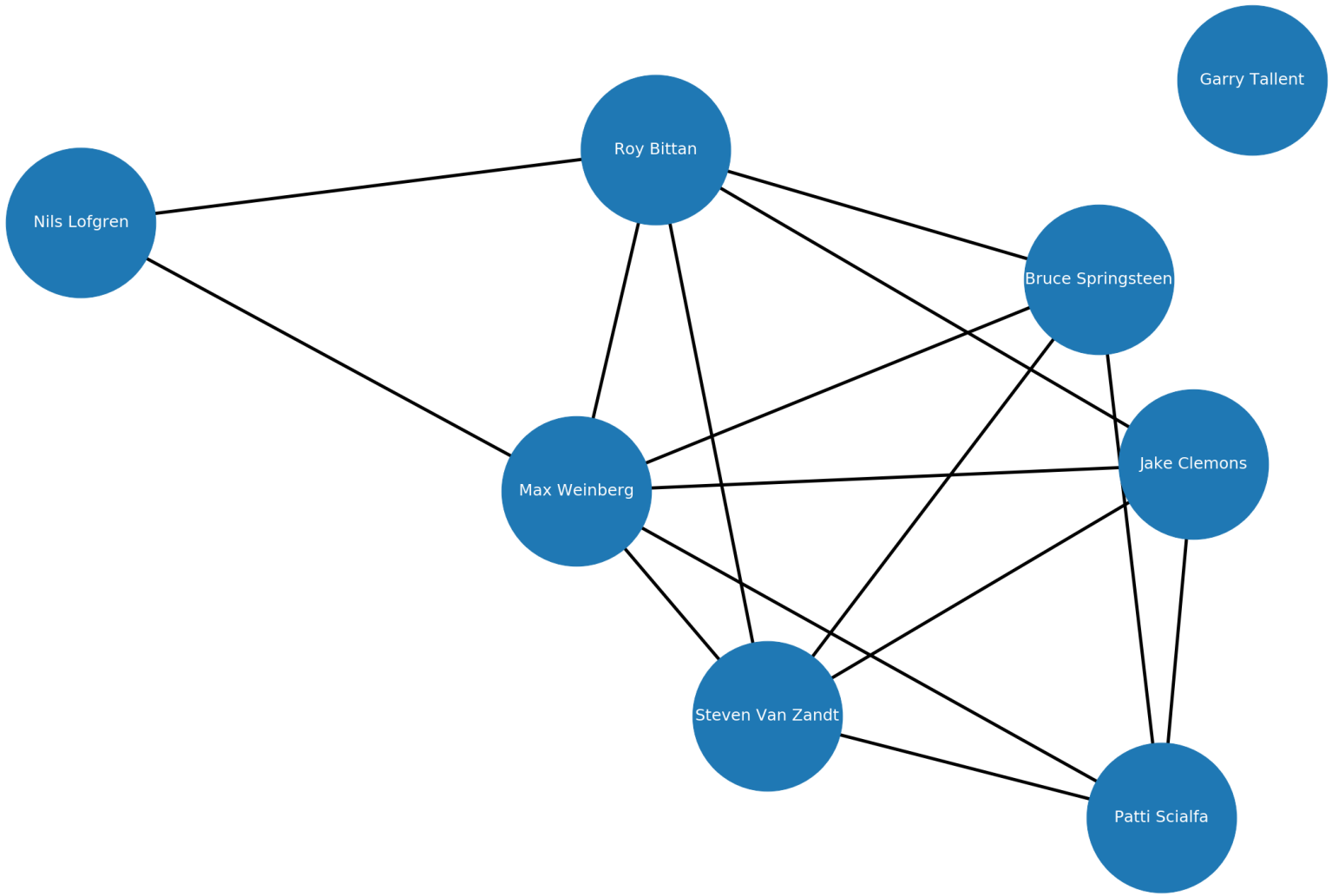
Graphs

Visual representation of a social network is known as a **graph** or **sociogram**.

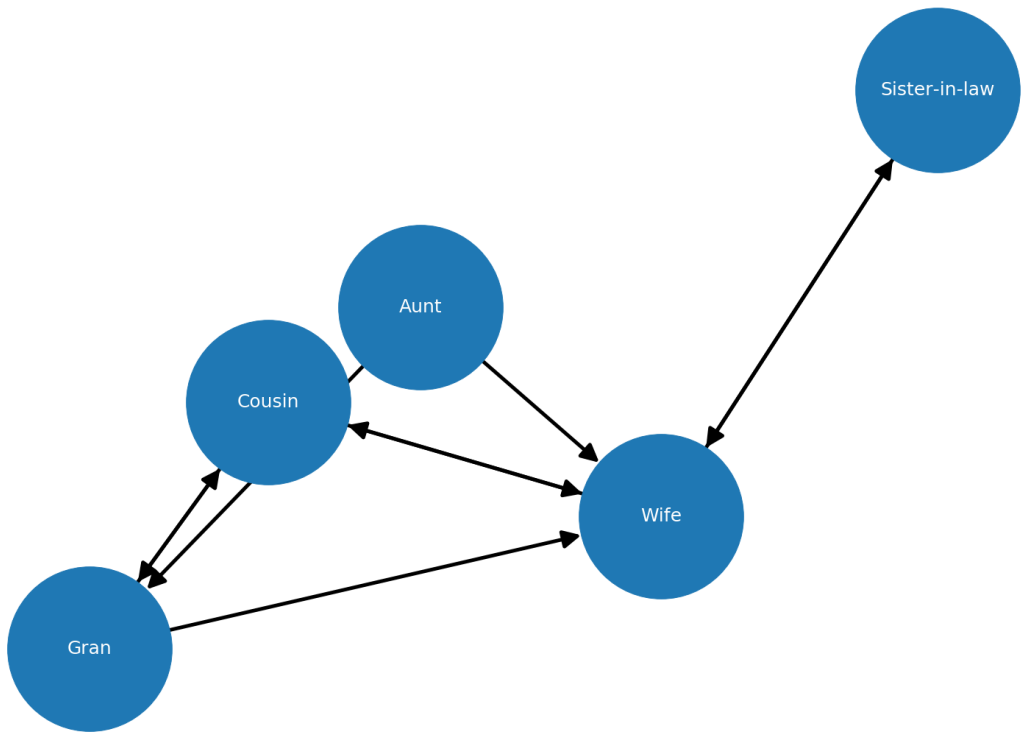
A graph is a set of lines connecting points.

- Nodes are represented as circles.
- Ties are represented as lines (with arrow heads if the tie is directed).
- Colours, shapes and sizes can be used to differentiate nodes by their attributes or network characteristics.
- Colours, shapes and sizes can also be used to differentiate relations by their type or amount (Hanneman & Riddle, 2005)

Graphs


Garry Tallent
Roy Bittan
Nils Lofgren
Bruce Springsteen
Jake Clemons
Max Weinberg
Steven Van Zandt
Patti Scialfa

Graphs



Conclusion