What is a network?

A network (also called graph) is a purely formal representation consisting of a collection of **nodes** and associated **links**.

**Example of nodes:** persons, places, firms, countries, web pages, email addresses, electrical power stations, molecules,...

**Example of links:** trades, marriages, citations, letters sent, contiguity, group memberships, airline connections, friendships,...
Figure: Example of a simple statistical network
Examples of networks

- **Technological applications**
  - Transportation networks
  - Energy networks

- **Social networks**
  - friendships
  - memberships of people in clubs or companies
  - contacts between people

- **Biological networks**
  - regularity behaviour among genes
  - bindings among proteins
  - epidemiological networks
Typical Questions

- What are the structural characteristics of the network?
- How much traffic is flowing across the network?
- Which nodes are the most influential ones in the network?
- Is the graph clustered (i.e. are there groups/cliques in the network)?
- Is the network behaviour as expected?
- How can we measure the network dynamics?
- How can the relationships be modeled?
Some topics that will be discussed

- Concepts for representing networks
- Components and families of (sub)graphs
- Measuring network characteristics
- Incidence matrix and Graph Laplacian
- Cohesiveness and clustering over networks
- Centrality measures
- Network models
Literature

