Lesson6:
Modeling the Web as a graph
Unit1:
Reviewing basic terms from graph theory

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Introduction to Web Science Part 2

Emerging Web Properties

WeST
People and Knowledge Networks

Institute for Web Science and Technologies · University of Koblenz-Landau, Germany

Completing this unit you should

- Be familiar with a set theoretic way of denoting a graph
- Know at least 4 different types of graphs
- Have practiced your abilities in reading and writing mathematical formulas

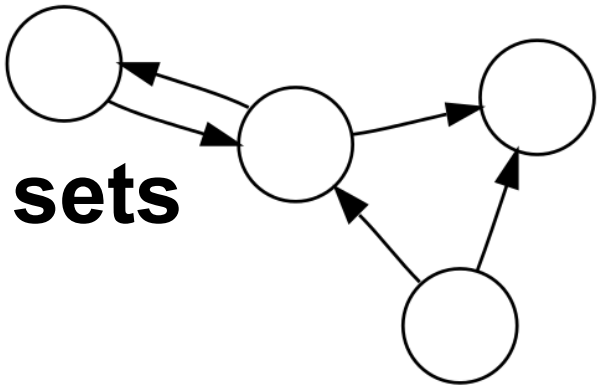
Let‘s approach graph based models like text

1. Descriptive modelming
   - Understand the topology
   - Look at distributions of occurence
   - find measures to quantify what we have seen

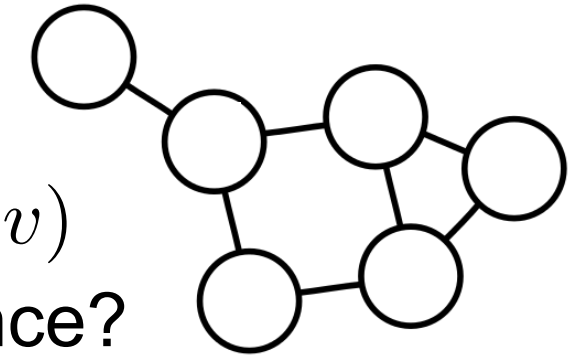
2. Linear algebra
   - Maybe useful for predictions

3. Generative modeling
   - Find a process to generate the descriptive model

Definition of a graph



- A **Graph** $G(V, E)$ consits of **two sets**
  - V the set of **vertices** or nodes
  - $E \subseteq V \times V$ the set of **edges**
  - V is usually finite, thus is E



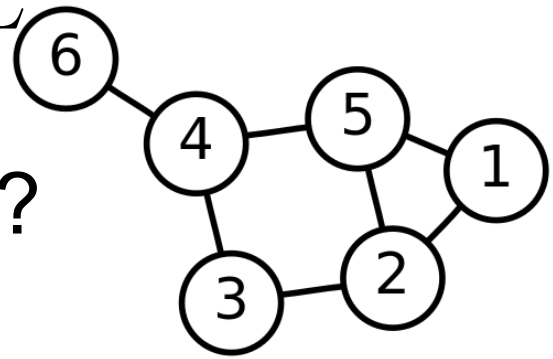
- A Graph is called **undirected** if:
  - $\forall e = (v, u) \in E \exists e' \in E : e' = (u, v)$
  - How it this expressed as a scentence?

Definition of a labeled graph

- A graph is called **labeled** if it is a **vertex-labeled** graph or an **edge-labeled** graph.

- A Graph $G(V, E)$ is called
  - **vertex-labeled** if there is a **labeling function** $l : V \longrightarrow L$ with L a set of labels.
  - **edge-labeled** if the labeling function has the edges as a domain i.e.: $l : E \longrightarrow L$

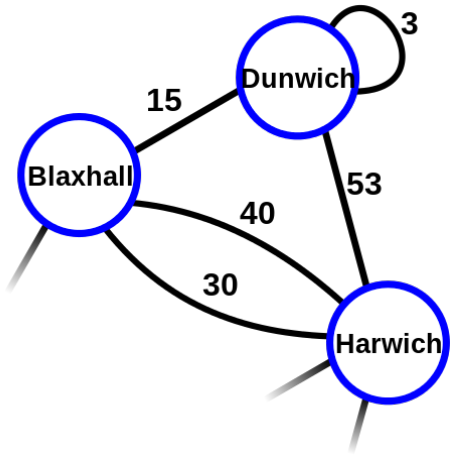
- Can you think of some examples?



Definition of weighted graphs

- A **weighted** Graph is an edge-labeled graph with a **labeling function** $\omega : E \longrightarrow \mathbb{R}$ such that every label is a real number.

- The following choices for L are pretty common
  - $L = \mathbb{N}$
  - $L = \{0, 1\}$
  - $L = \{-1, 1\}$



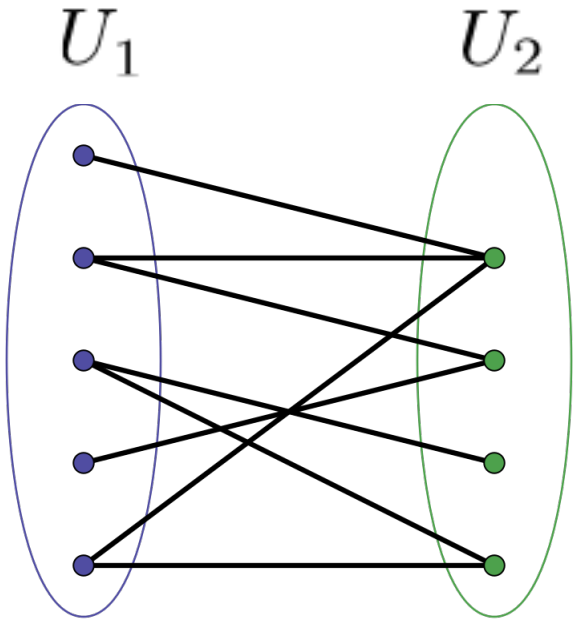
Definition of a graph

- A Graph $G(V, E)$ is called if and only if
  - Property 1
    - $\exists U_1, U_2 \subsetneq V$
    - $V = U_1 \cup U_2$
    - $U_1 \cap U_2 = \emptyset$
  - Property 2

$$\forall e = (u, v) \in E : u \in U_1 \wedge v \in U_2 \vee v \in U_1 \wedge u \in U_2$$

Definition of a bipartite graph

- A Graph $G(V, E)$ is called bipartite if and only if
  - Vertices have a **disjoint split**
    - $\exists U_1, U_2 \subsetneq V$
    - $V = U_1 \cup U_2$
    - $U_1 \cap U_2 = \emptyset$
  - Such that **all edges cross** the disjoint sets



$$\forall e = (u, v) \in E : u \in U_1 \wedge v \in U_2 \vee v \in U_1 \wedge u \in U_2$$

Thank you for your attention!

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