

CSE 21

Lecture 3: Graphs

Course Website

- Course details is available online:
<http://cseweb.ucsd.edu/classes/wi14/cse21-a/>
- Regular announcements will be made on the webpage
- First Assignment is uploaded
- Solutions to the assignment will be uploaded on Monday
- Discussion forum set up in Piazza

Quizzes

- There will be around 6 quizzes (5% each)
- Most of them will be in class.
- Some online quizzes will be given on WeBWork.
- Total marks for online quizzes will be 5%.
- First quiz will be on Wednesday (15th January) in class.

Representation of data

- Numbers - represented over any base. In particular one can represent a number over binary.
- Sets - binary vectors.
- Functions - Truth table.
- Relationship among elements -

Representation of relation among elements

- Vertices - set of elements.

$$V = \{v_1, \dots, v_n\}$$

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$$E = \{e_1, \dots, e_m\}$$

$$e_k = (v_i, v_j)$$

- Given the set of vertices and edges we have a graph

$$G = (V, E)$$

Basic Definitions

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- If $(u, v) \in E$ implies $(v, u) \in E$ then it is called an undirected graph.
- An weight can be assigned to each edge. In that case it is called an weighted graph.

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- If there is an edge from vertex u to v we say v is a neighbor of u
- For an undirected graph the total number of u such that $(u, v) \in E$ is called degree of v .

Example of a graph

a

Vertices

b

c

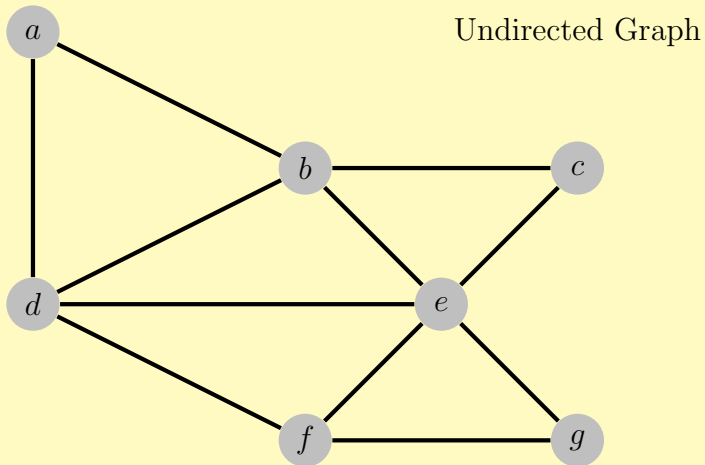
d

e

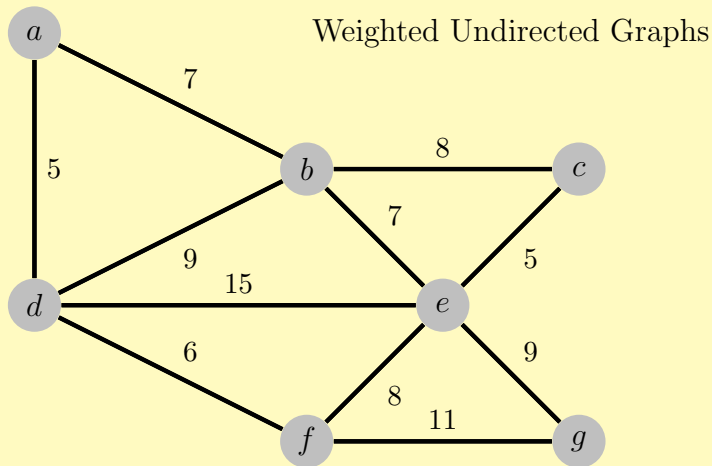
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g

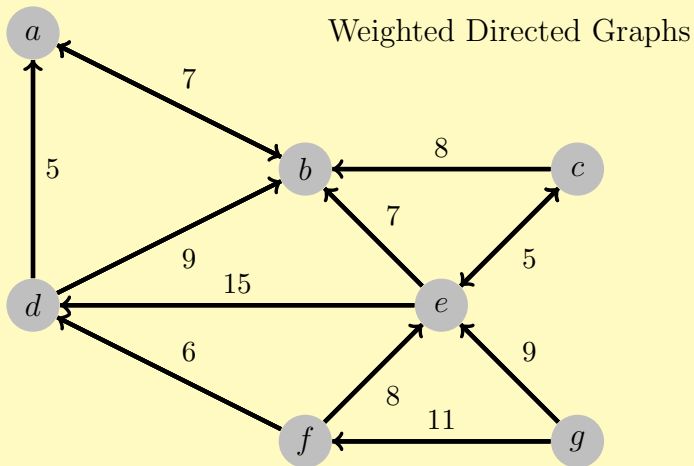
Example of a graph



Example of a graph



Example of a graph



How many edges can be there?

How many edges can be there is a simple undirected graph on n vertices?

Advantages of a graph

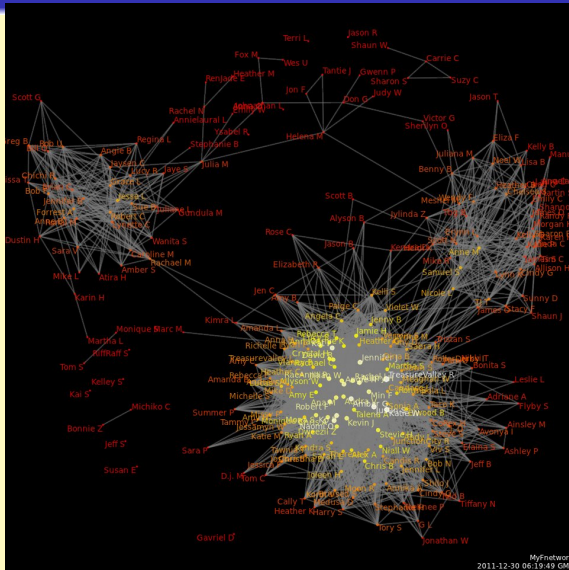
- Mathematical way of expressing relations among objects.
- Very simple.
- Very general.

Example: Friendship graph

- Each person is a vertex.
- If two person are friends then there is an edge between the respective vertices.

Used for understanding social networks, like facebook.

Example: Friendship graph

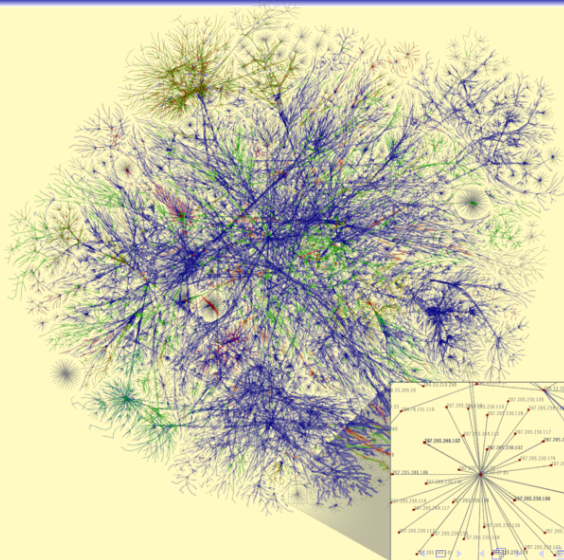


Example: Internet Graph

- Every website is a vertex.
- If a website has a link to another website then there is a directed edge from the first vertex to the second.

Used for web crawls by google.

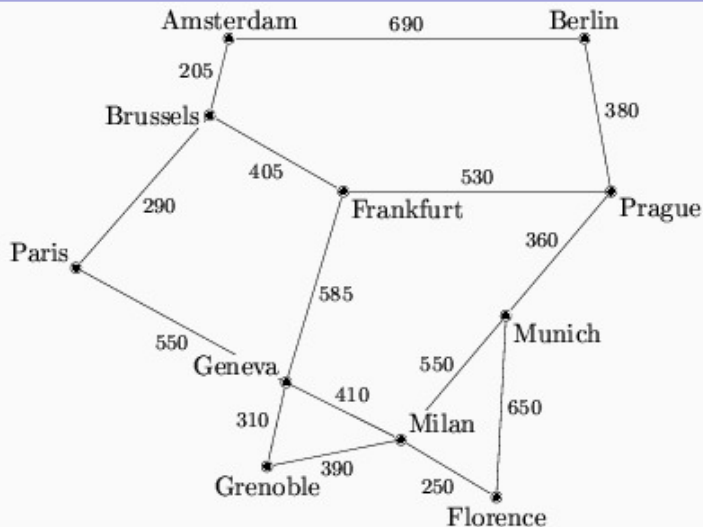
Example: Internet Graph



Example: Road Network

- Vertices are the cities
- Edges are the roads

Example: Road Network



Other Examples

- Many other problems in real life can be designed as a problem in graph theory.
- So studying the structure of graphs and designing algorithms for graph problems is an important field.

Graphs help us to visualize

In a room there are $2n$ people. Some of the people shake hand with each other in such a way that if persons A and B shake hand and persons B and C shake hand then person A and C does not shake hand.

What is the maximum number of handshakes possible in this case?

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Ans: n^2