GRAPHS

(MTAT.05.080, 4 AP/6 ECTS)

Lectures: Fri 12:15, aud. 405 (lecturer: Jan Willemson)

Tutorials: Mon 14:15, aud. 403 (tutor: Meelis Kull)

Thu 12:15, aud. 206 (tutor: Liina Kamm)

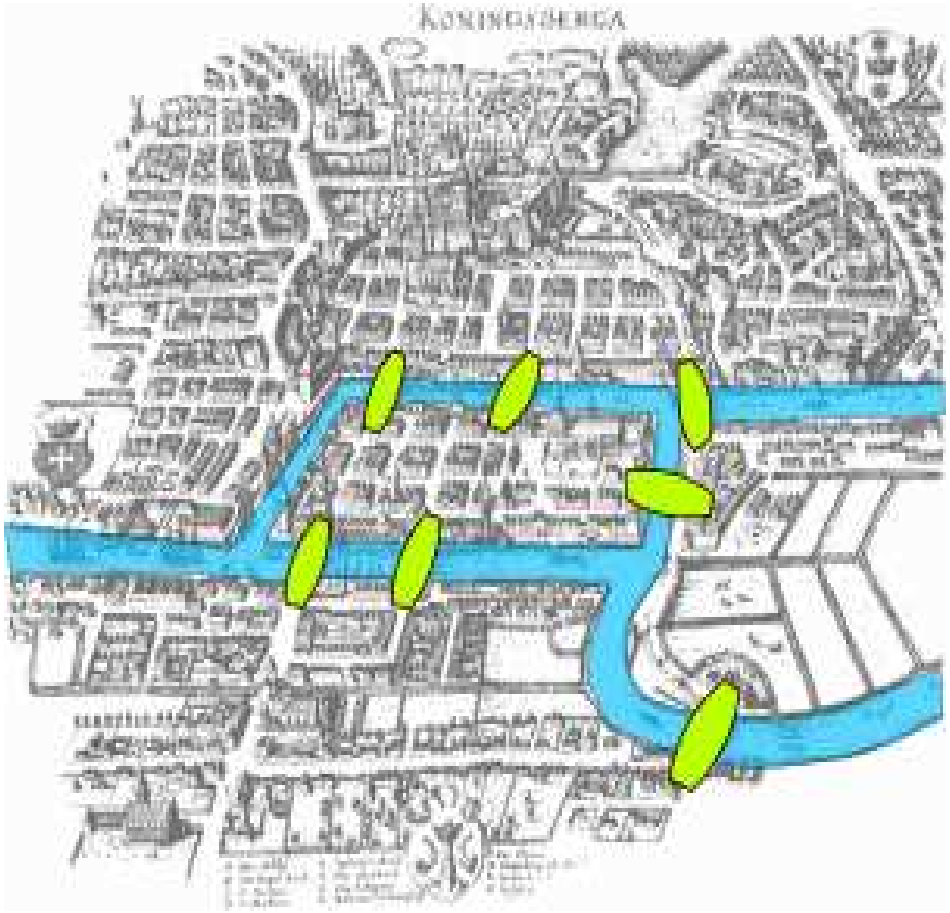
Homepage:

`http://www.ut.ee/~jan/graafid/`

(including study materials)

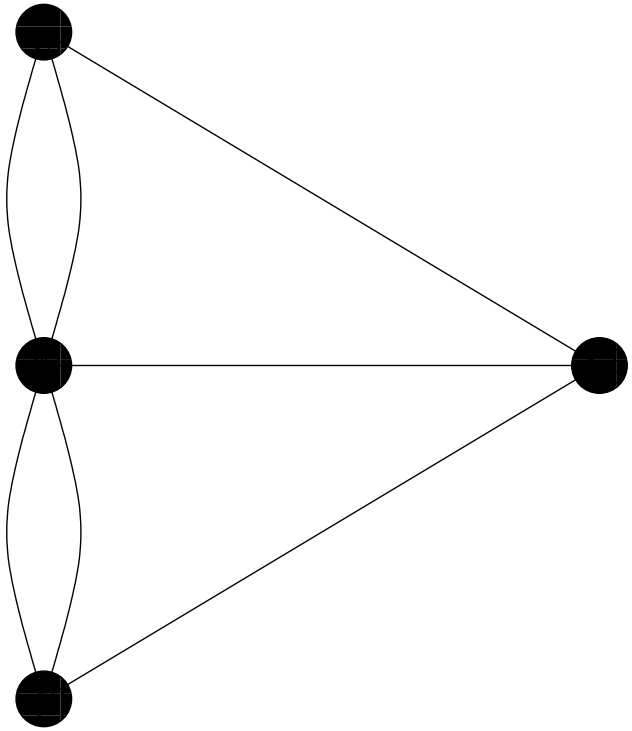
In order to pass: 4 tests **or** examination.

Königsberg, 1736



Does there exist a walk that would cross every bridge exactly once and return to the beginning?

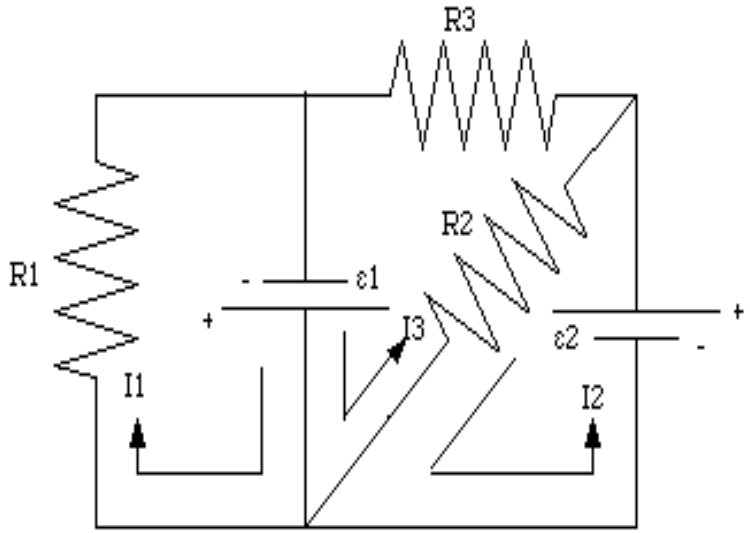
Graphical representation of the Königsbergi bridge problem:



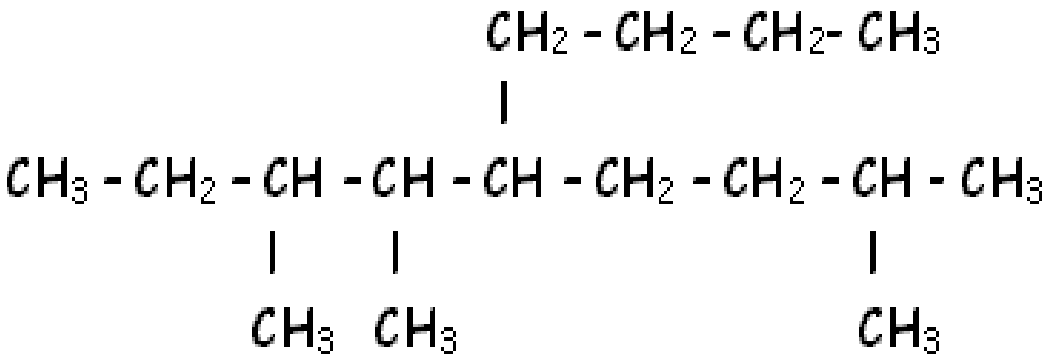
Euler: “Such a walk is impossible!”

Kirchhoff laws (1847):

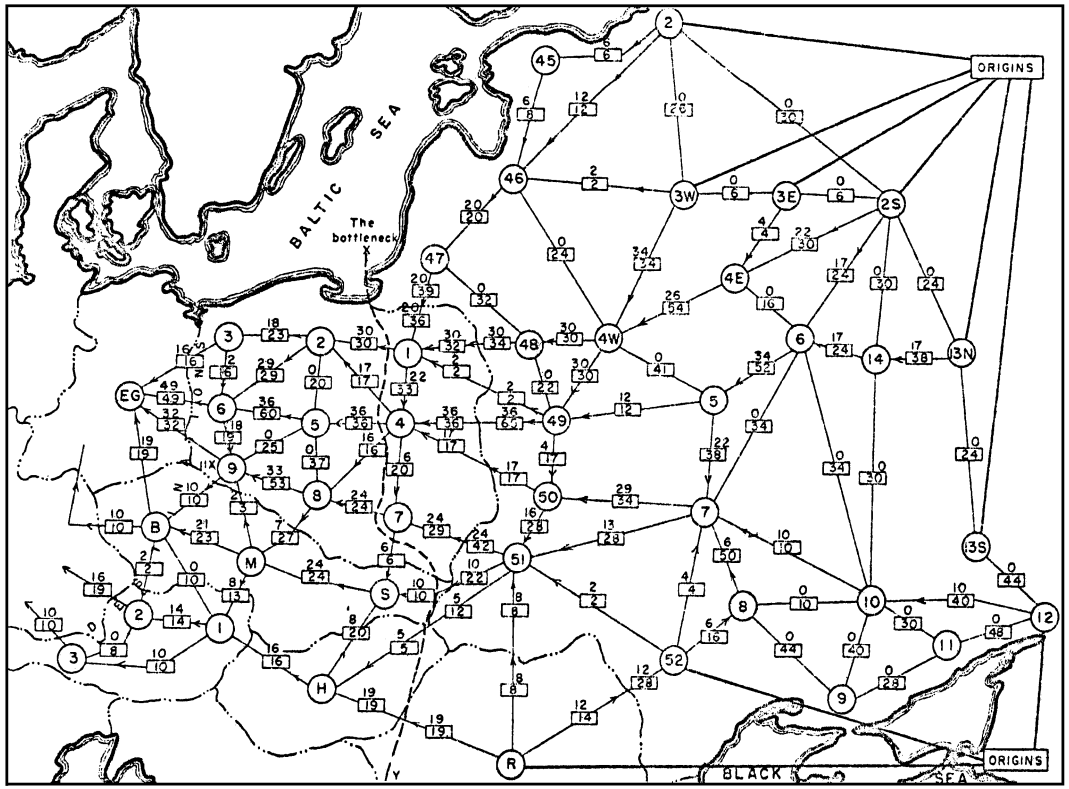
- At any point in an electrical circuit, the sum of currents flowing towards that point is equal to the sum of currents flowing away from that point.
- The directed sum of the electrical potential differences around a circuit must be zero.



Sir Arthur Cayley (1857): “How many isomers of alcanes C_nH_{2n+2} are there?”



USA army (1955): “How fast is it possible to transport supplies from Soviet Union to Eastern Europe?”



Ford&Fulkerson: “Using the railway system, up to 163000 tons as a time.”

Graph is an abstraction that can be used to study objects and binary relations between them.

The objects we are interested in will be called *vertices* of the graph and the pairs of objects in the relation will be called *edges* of the graph.

Since relations may be different, the correcponding graphs may or may not have certain properties, e.g.

- orientation
- multiplicity of the edges
- loops
- finiteness

A graph with finite number of vertices, undirected edges, without multiple edges and loops is called a simple graph.

Simple graph G consist og two sets:

- *vertex set* V (or $V(G)$) and
- *edge set* E (or $E(G)$), such that $E \subseteq \mathcal{P}_2(V)$, where $\mathcal{P}_2(V)$ denotes the set of 2-element subsets of V.