

Wrap-Up and Outlook

Lecture Graph Drawing Algorithms · 192.053

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ALGORITHMS AND
COMPLEXITY GROUP

Objectives: At the end of the course you will be able to...

- explain concepts, structures, and problem definitions
- understand the discussed algorithms, explain them intuitively, analyze them formally and prove their properties
- use graph drawing tools and libraries to create your own visualizations
- select and adapt appropriate graph drawing algorithms
- analyze new graph drawing problems and build abstract models
- develop and analyze efficient algorithms in these models

Graph visualization problem

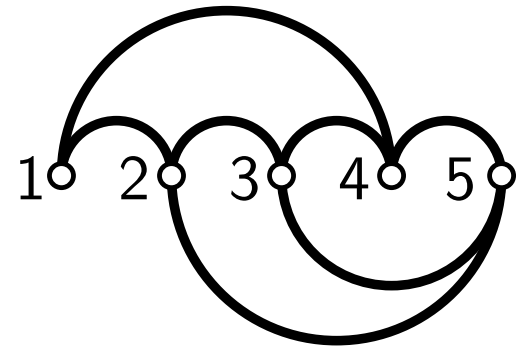
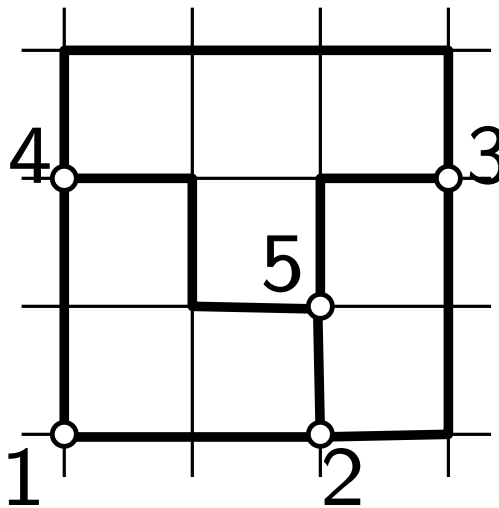
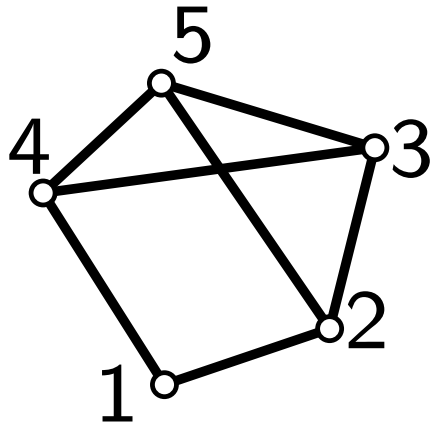
given: graph $G = (V, E)$

find: drawing Γ of G that

- complies with the given drawing conventions
- optimizes the given aesthetics
- satisfies the partial/local constraints

1) **Drawing conventions**, required properties, for example

- straight-line edges
- orthogonal edges (with 90° bends)
- grid drawings
- crossing-free
- ...



2) **Aesthetics** (to be optimized), for example:

-
- The image displays 15 distinct geometric graphs, each represented by black vertices and edges. The graphs include:
- A graph with 6 vertices and 8 edges, featuring a cycle of 5 vertices with an additional vertex connected to two of them.
 - A cycle graph with 8 vertices and 8 edges, forming a regular octagon.
 - A graph with 6 vertices and 7 edges, consisting of a path of 5 vertices with a sixth vertex connected to the second and fourth vertices.
 - A graph with 5 vertices and 4 edges, forming a path of 4 vertices with a fifth vertex connected to the second vertex.
 - A graph with 5 vertices and 4 edges, forming a path of 4 vertices with a fifth vertex connected to the third vertex.
 - A graph with 5 vertices and 4 edges, forming a path of 4 vertices with a fifth vertex connected to the first vertex.
 - A graph with 5 vertices and 4 edges, forming a path of 4 vertices with a fifth vertex connected to the fourth vertex.
 - A graph with 5 vertices and 4 edges, forming a path of 4 vertices with a fifth vertex connected to the first and third vertices.
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Quality Criteria for Graph Drawings

- 1) **Drawing conventions**, required properties
- 2) **Aesthetics** (to be optimized)
- 3) **Partial/local constraints**, for example:
 - constraints on positions of some vertices
 - constrained relative positions of vertices
 - groups of vertices drawn close to each other

Summary – Mind Map

graph classes

algorithms

techniques

aesthetics

trees

divide & conquer
e.g. Reingold /
Tilford

force-based

crossings

planar max deg 4

dynamic
progr.

decomposition
tree

large angles

series parallel

iterative
algorithms

Sugiyama
framework

bends

directed graphs

ILP

canonical
ordering

area

planar graphs

distances

arbitrary graphs

incremental
algorithm

topological sorting

edge lengths

vertex distribution

network flow

Quad Trees

Schneider realizer

...
not complete!

Exam dates^{*}:

- July 10
- September 18

Content:

- material discussed and presented in class
- textbooks/further reading helpful, but not required

Format:

- 15–20 minutes
- English or German
- counts for 70% of the grade (plus 30% from exercises)
- explain and analyze layout algorithms and problems
- aesthetics, applicability, comparisons, properties, limitations, proof ideas, ...

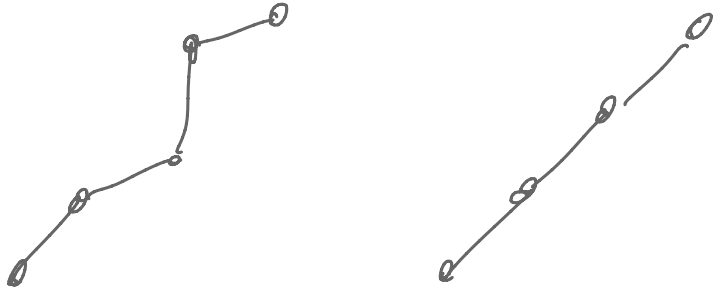
★ in exceptional cases individual exam date

“Hot” Research Topics in Graph Drawing

- Beyond-planar graphs

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- Beyond-planar graphs
- Drawings with low visual complexity



“Hot” Research Topics in Graph Drawing

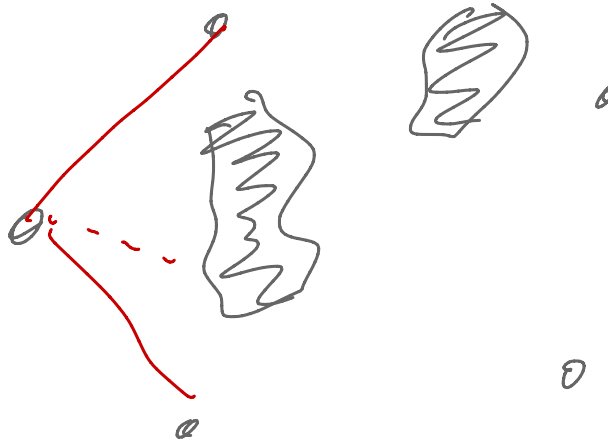
- Beyond-planar graphs
- Drawings with low visual complexity
- Representations of large graphs

“Hot” Research Topics in Graph Drawing

- Beyond-planar graphs
- Drawings with low visual complexity
- Representations of large graphs
- Layout of clustered graphs

“Hot” Research Topics in Graph Drawing

- Beyond-planar graphs
- Drawings with low visual complexity
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- Layout of clustered graphs
- Visibility representations



“Hot” Research Topics in Graph Drawing

- Beyond-planar graphs
- Drawings with low visual complexity
- Representations of large graphs
- Layout of clustered graphs
- Visibility representations
- Dynamic graphs

- Next week: exercise presentations
- September 15: optional submission (Game of Thrones / Math Genealogy) for GD contest



- Please perform the lecture evaluation in TISS to give us (anonymous) feedback by June 29.

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Upcoming semesters

- 186.862 Seminar in Algorithms: Graphs and Geometry
- Topics for Master theses in Graph Drawing