Julius-Maximilians-
UNIVERSITÄT
WÜRZBURG

Lehrstuhl für
INFORMATIK I
Effiziente Algorithmen und
wissensbasierte Systeme

Institut für Informatik

Visualisierung von Graphen

Wintersemester 2019/2020

Einführungsveranstaltung am 15. Oktober 2019

Lehrstuhl für Informatik I

Steven Chaplick Philipp Kindermann Alexander Wolff

Agenda

1. Thema und Konzept
2. Ablauf des Seminars
3. Vorstellung der Vortragsthemen
4. Themenverteilung

Konzept

„Forschungsseminar“ – Was heißt das?

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Ziel: SeminarteilnehmerInnen einen Eindruck von Forschungsarbeit vermitteln

Kursraum in Moodle

wue campus Meine Kurse Dieser Kurs Deutsch (de)

WS19:Seminar Visualisierung von Graphen

Startseite > Meine Kurse > WS19_Sem_GraphVis

Ankündigungen

Diskussionsforum

Seminar: Visualisierung von Graphen

Umfang:	5 ECTS, 2 SWS
Zeit & Ort:	dienstags, 14:15–15:45 Uhr, SE III
Voraussetzung:	Algorithmische Graphentheorie (empfohlen)
Zielgruppe:	Master Informatik (empfohlen), Bachelor Informatik
Dozenten:	Steven Chaplick, Philipp Kindermann und Alexander Wolff

Der erste Termin ist am Di, 15.10.2019. An diesem Termin bitten wir um vollständige **Anwesenheit**, da wir den Ablauf des Seminars besprechen und die folgenden Vortragsthemen vorstellen und verteilen.

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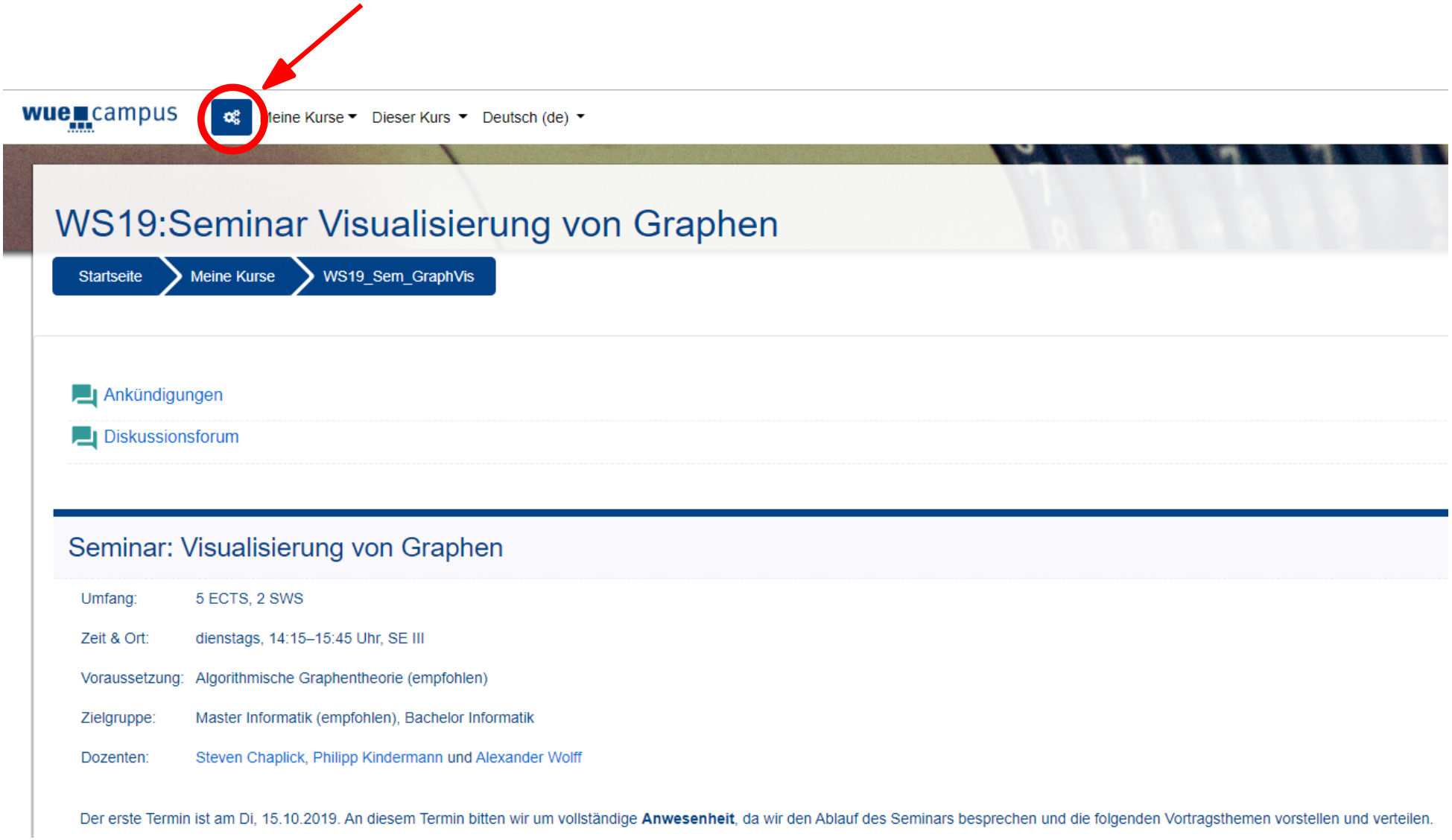

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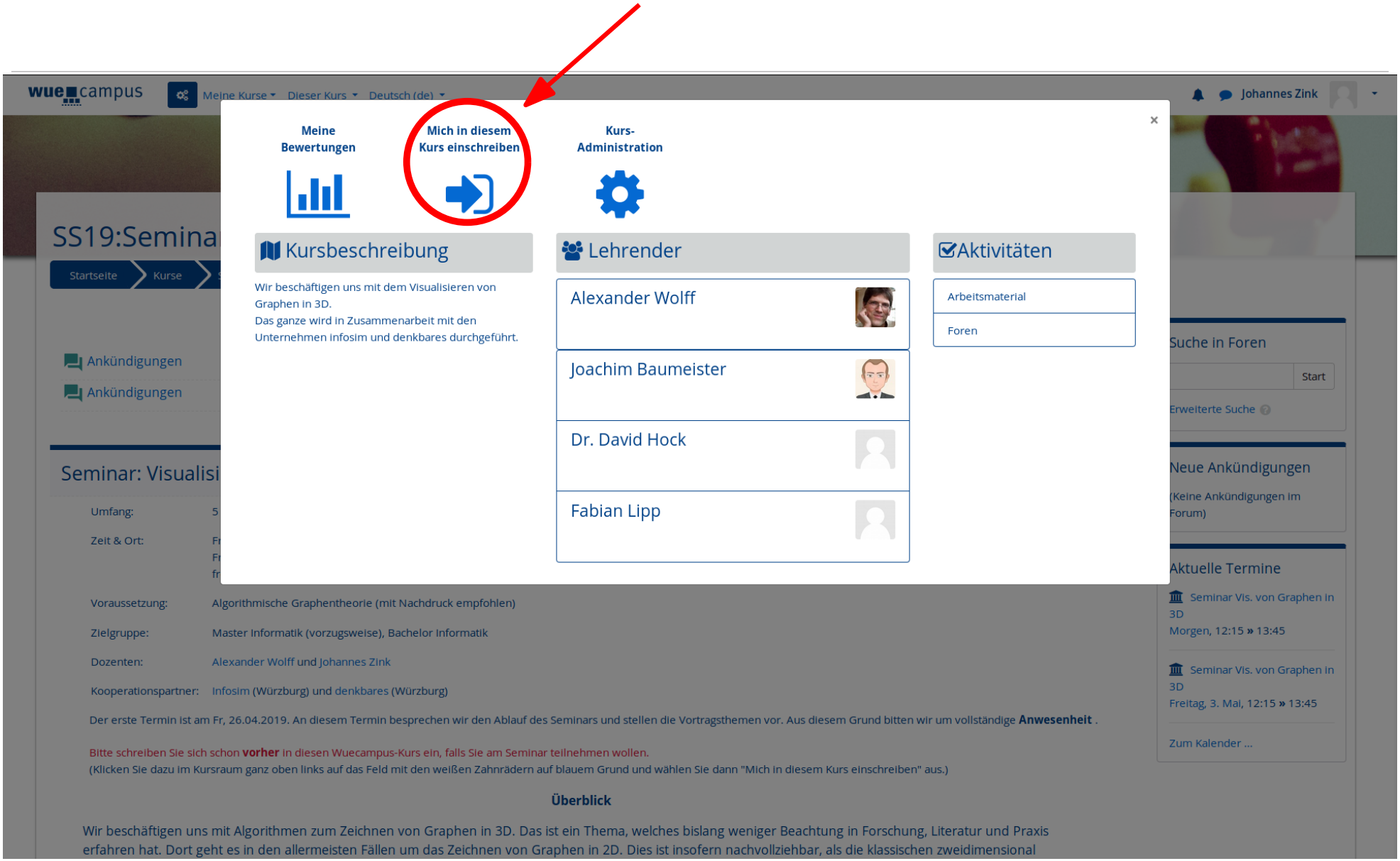

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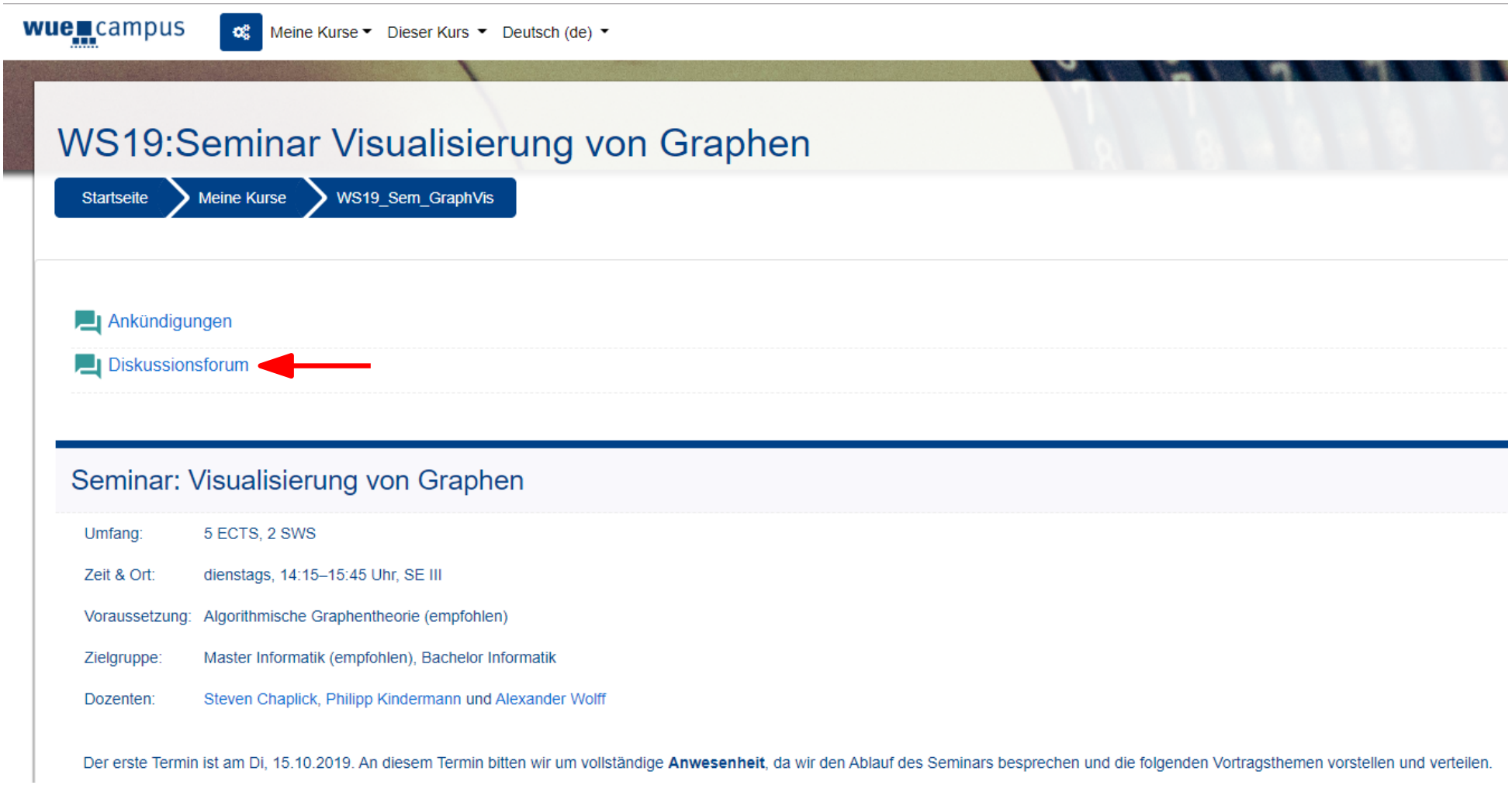

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Ziele:

- Zeitnah einarbeiten
- Themenauswahl prüfen
- Vortrag üben
- Feedback bekommen ohne Bewertung

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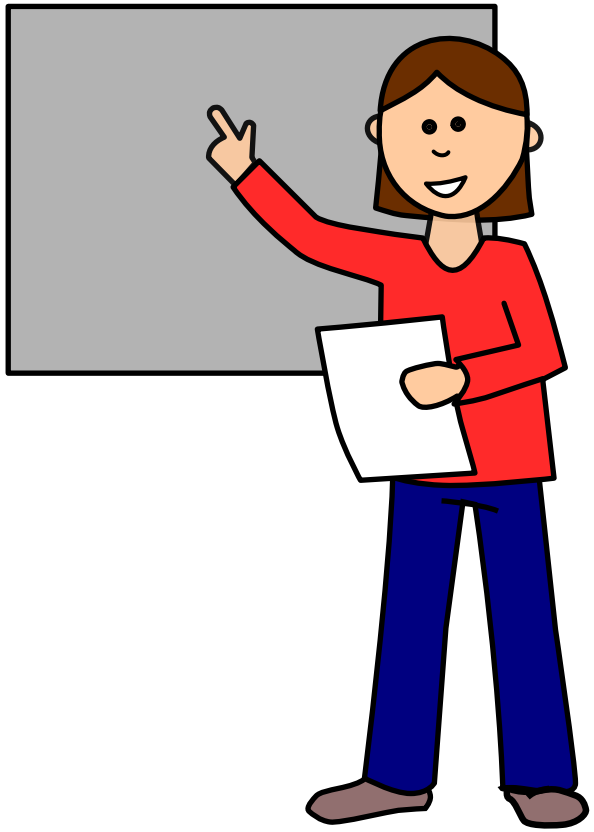

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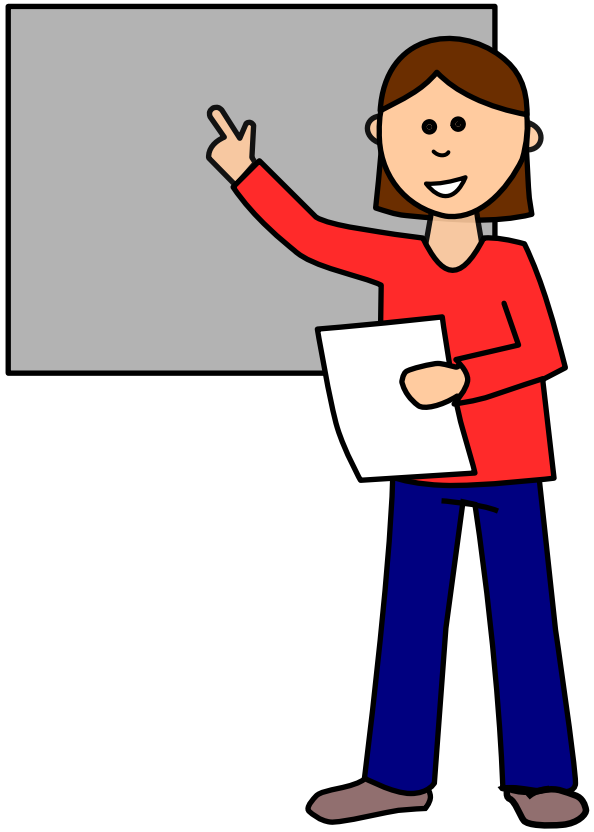
- anschließend:
  Treffen zur weiteren **Forschung**
  Abgabe der **Ausarbeitungen**



Vorträge

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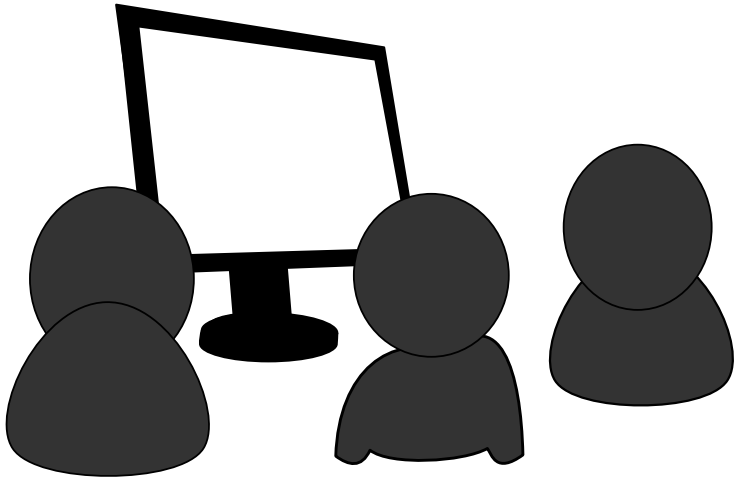

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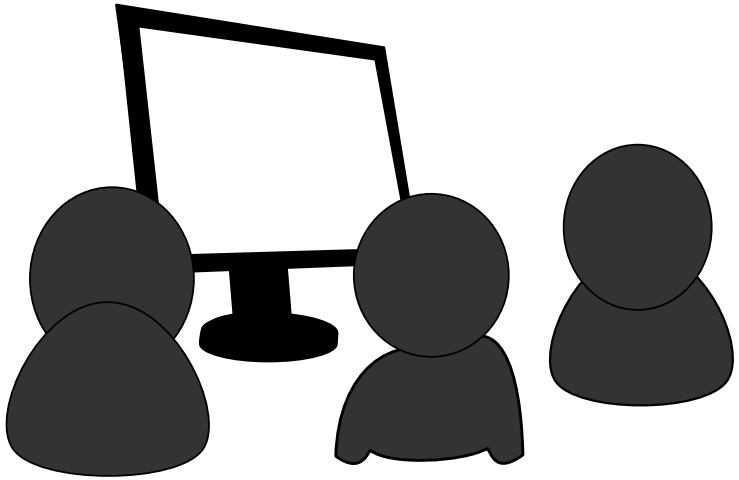

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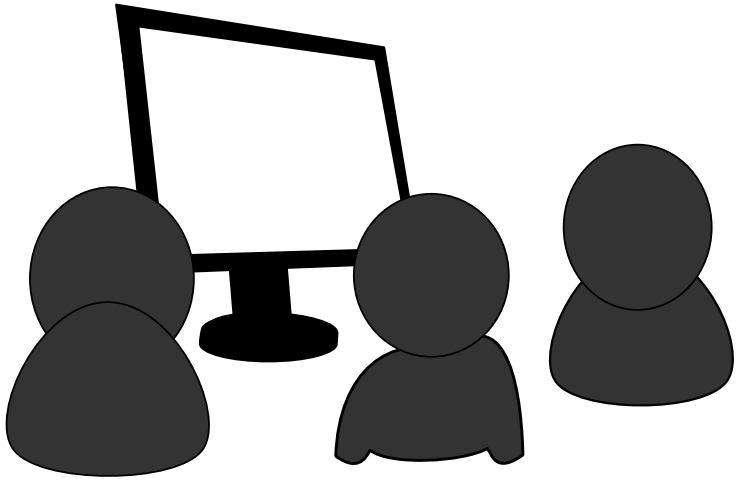

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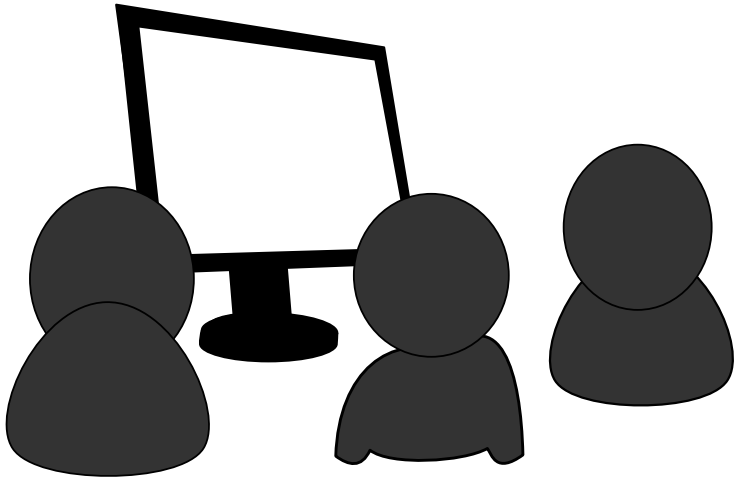

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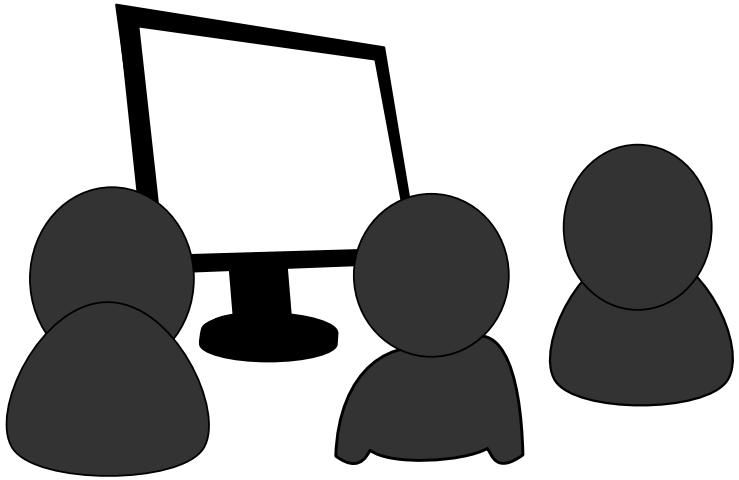

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Diese Termine sind strikt (außer für den 1. Vortrag)!

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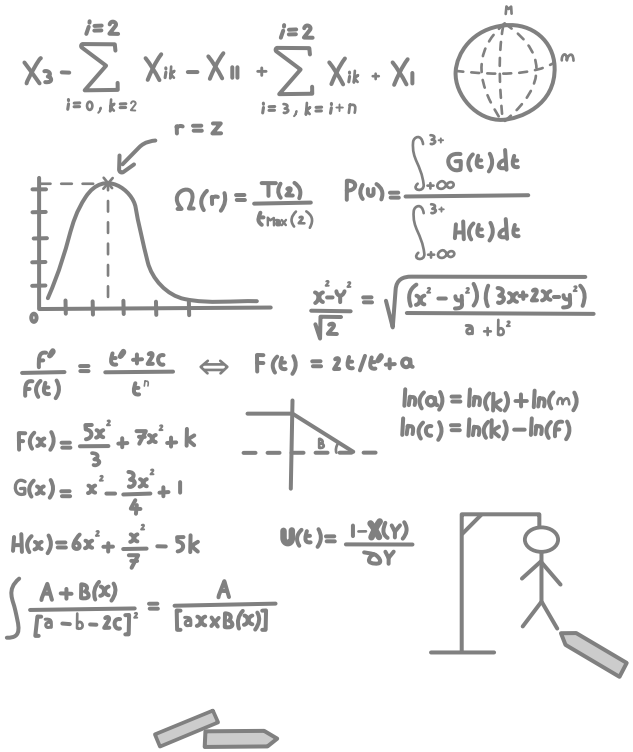
- LaTeX-Vorlage
- Abgabe: **Di, 14.01.2020 (?)**

Forschung

Wie soll das etwa ablaufen?

- wöchentliche Treffen
- Diskussion von Lösungsansätzen
- Hausaufgaben:
  - Lösungen aufschreiben
  - Durchdenken von weiteren Lösungsansätzen
  - Weiterdenken
- ggf. nach dem Ende der Vorlesungszeit: Aufschreiben der Resultate als Artikel



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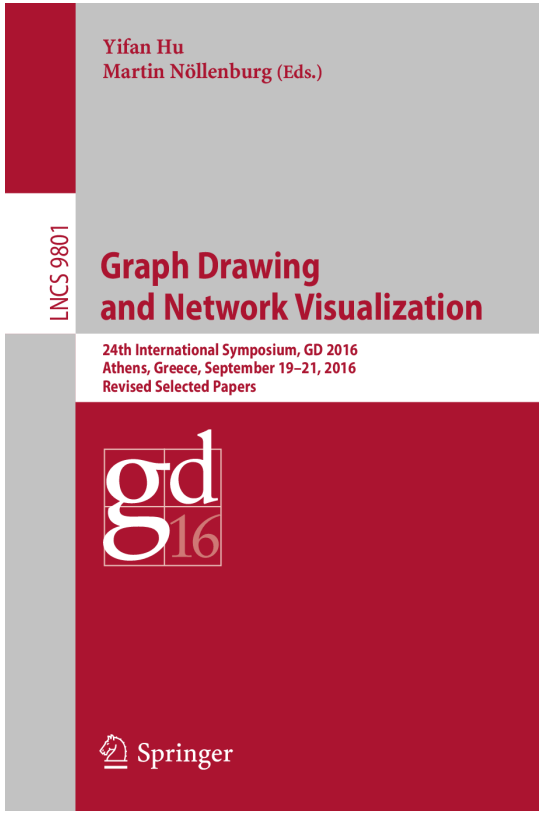

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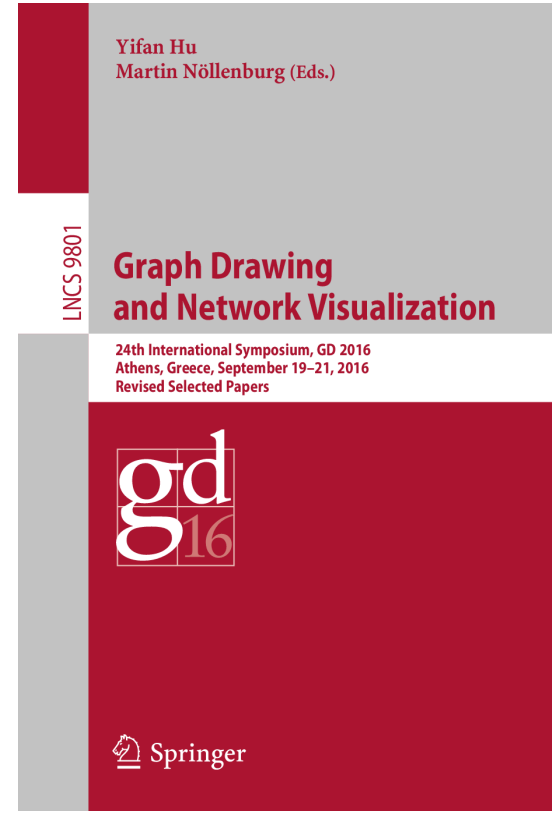

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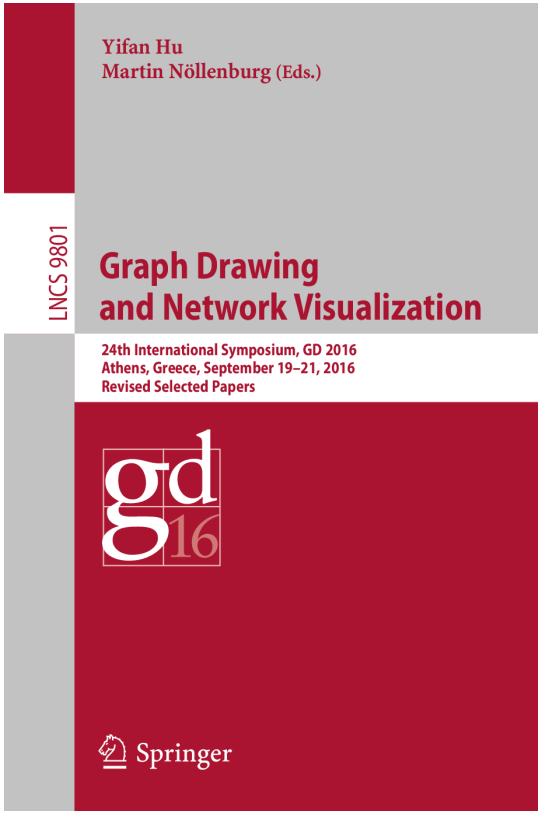

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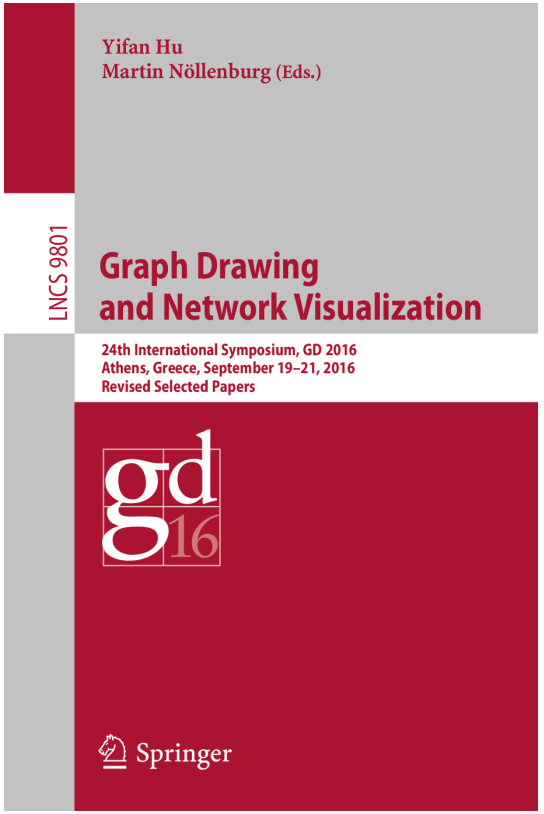

- Z.B. WS 2018/19:
  Ergebnis: Paper bei der GD 2019
  Stick Graphs with Length Constraints
  Inklusive Einladung zum Special Issue

Bestehen & Bewertung

Voraussetzungen für das Bestehen des Seminars

- Halten einer Präsentation zum gewählten Thema
- Anfertigen einer Ausarbeitung
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Bewertung

- Vortrag (Inhalte, Gestaltung der Folien, Verständlichkeit)
- Ausarbeitung (Inhalte, sprachliche Darstellung, Rechtschreibung, Verbindungen zu anderen Vortragsthemen)
- 50 : 50

Vortragsthemen

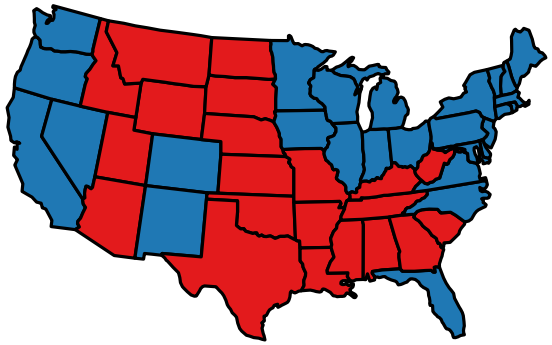
Allgemeines

- Wir geben für jedes Thema ein Buchkapitel/einen Artikel vor.
- Eigene Literaturrecherche
- Ausgangspunkt können Referenzen im Artikel sein.

Themenübersicht

1. Computing Stable Demers Cartograms (PK)
2. Parameterized Algorithms for Book Embedding Problems (PK)
3. Local and Union Page Numbers (PK)
4. Level-Planar Drawings with Few Slopes (PK)
5. Optimal Morphs of Planar Orthogonal Drawings II (SC)
6. Exact Crossing Number Parameterized by Vertex Cover (SC)
7. Homotopy Height, Grid-Major Height and Graph-Drawing Height (SC)
8. On the Edge-Length Ratio of (Outer-)Planar Graphs (AW)
9. ChordLink: A New Hybrid Visualization Model (AW)
10. 4-Connected Triangulations on Few Lines (AW)

Computing Stable Demers Cartograms



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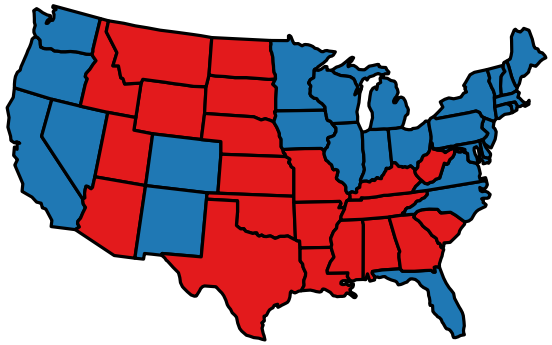

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4	Arkansas	96948.2	98955.3	97058.9	10169
5	California	1955856	1990678.2	1920061.8	1974614.5
6	Colorado	246043.5	255566.8	248593.6	255140.
7	Connecticut	237542.7	240910.9	236393.2	237653
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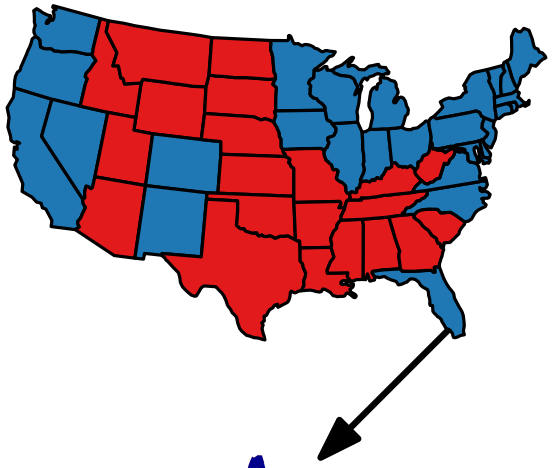

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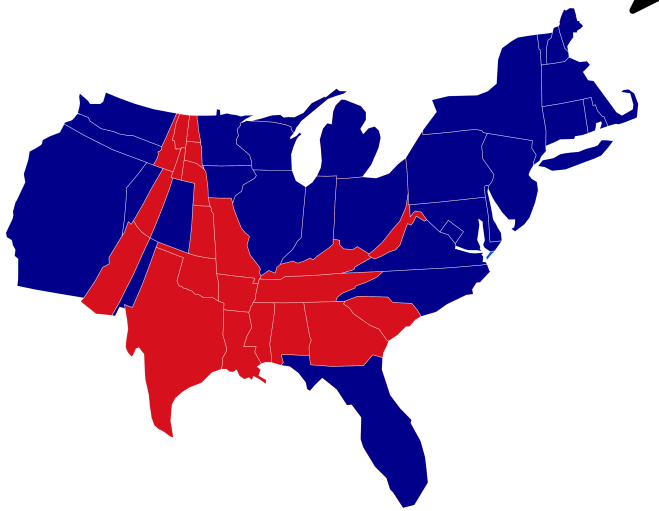

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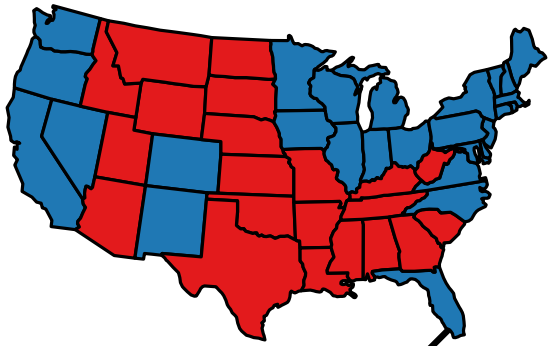

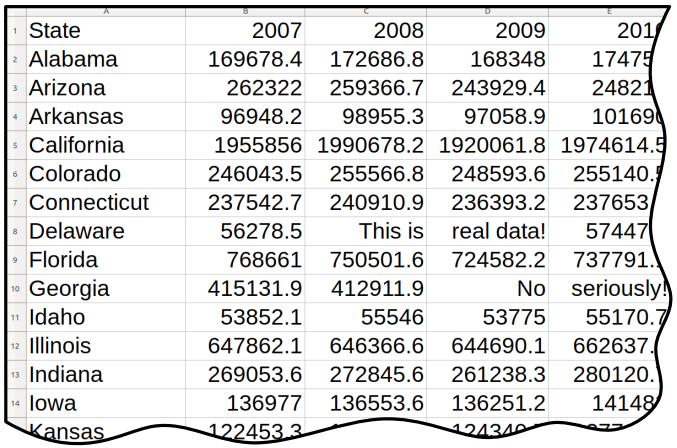

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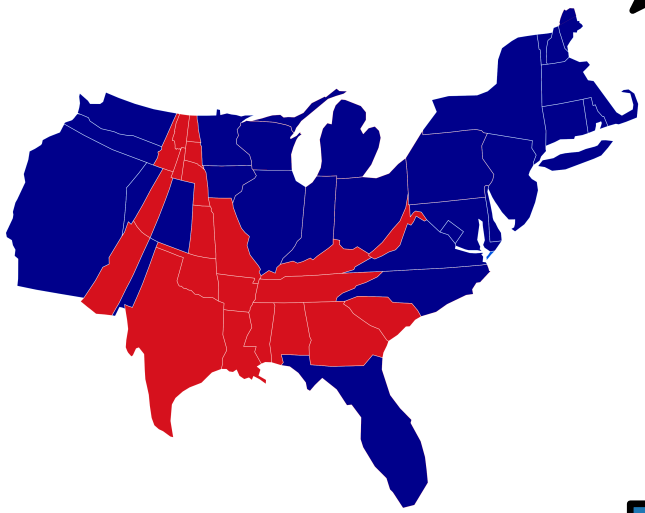

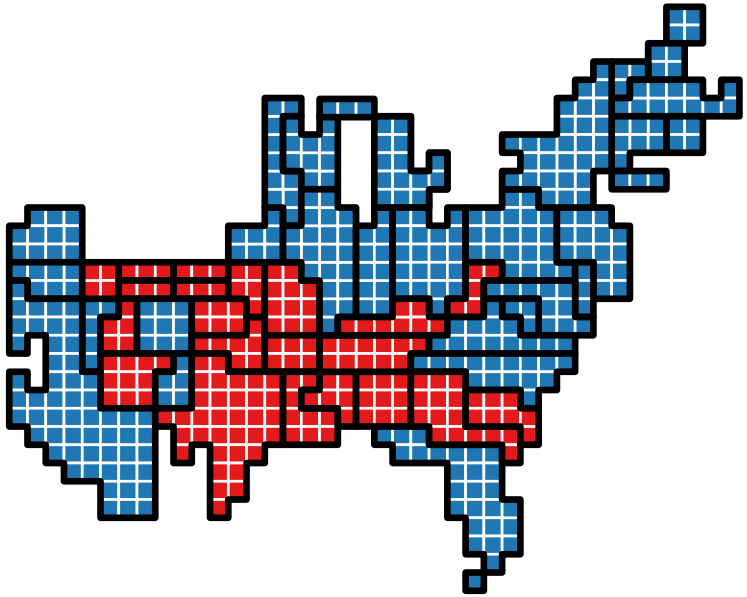

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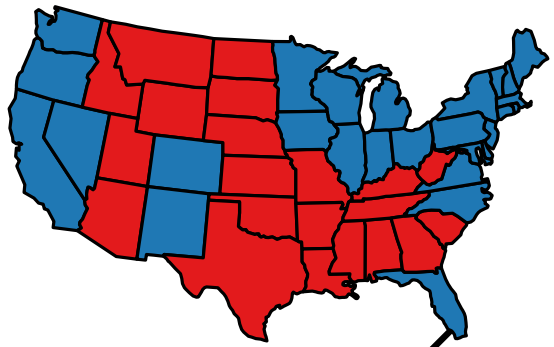

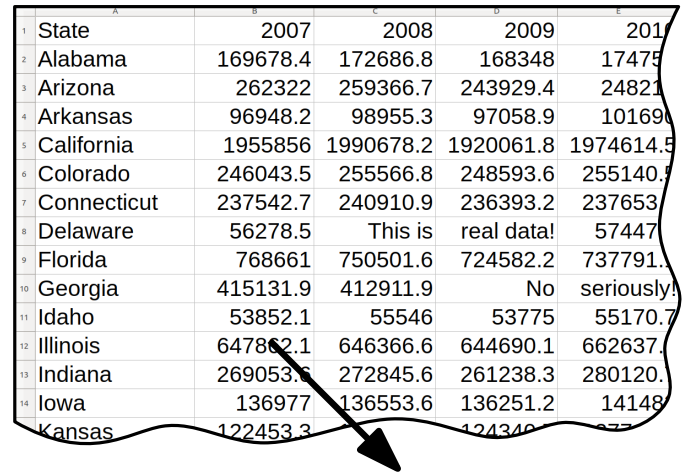

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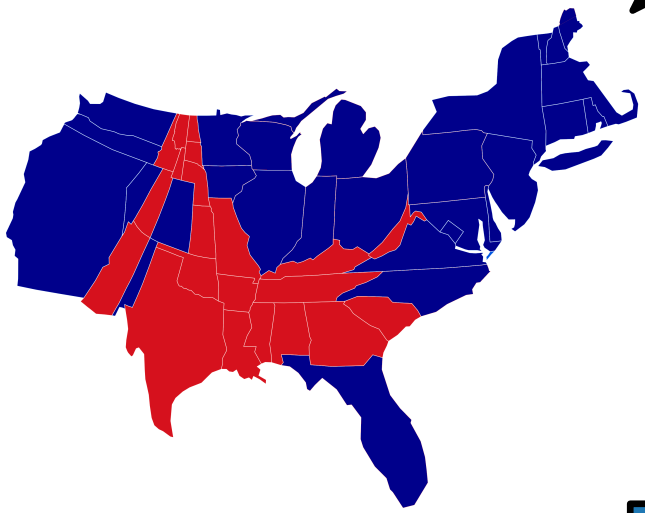
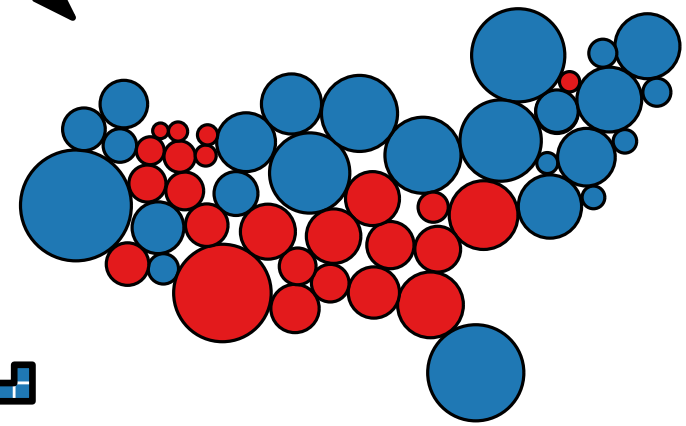
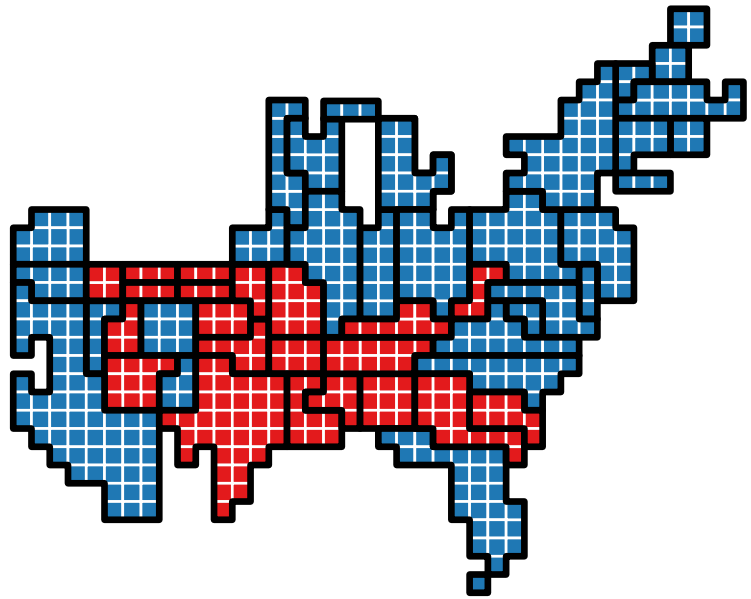
6	Colorado	246043.5	255566.8	248593.6	255140.
7	Connecticut	237542.7	240910.9	236393.2	237653
8	Delaware	56278.5	This is	real data!	57447
9	Florida	768661	750501.6	724582.2	737791.
10	Georgia	415131.9	412911.9	No	seriously!
11	Idaho	53852.1	55546	53775	55170.7
12	Illinois	647862.1	646366.6	644690.1	662637.
13	Indiana	269053.6	272845.6	261238.3	280120.
14	Iowa	136977	136553.6	136251.2	14148
	Kansas	122453.3		124340	

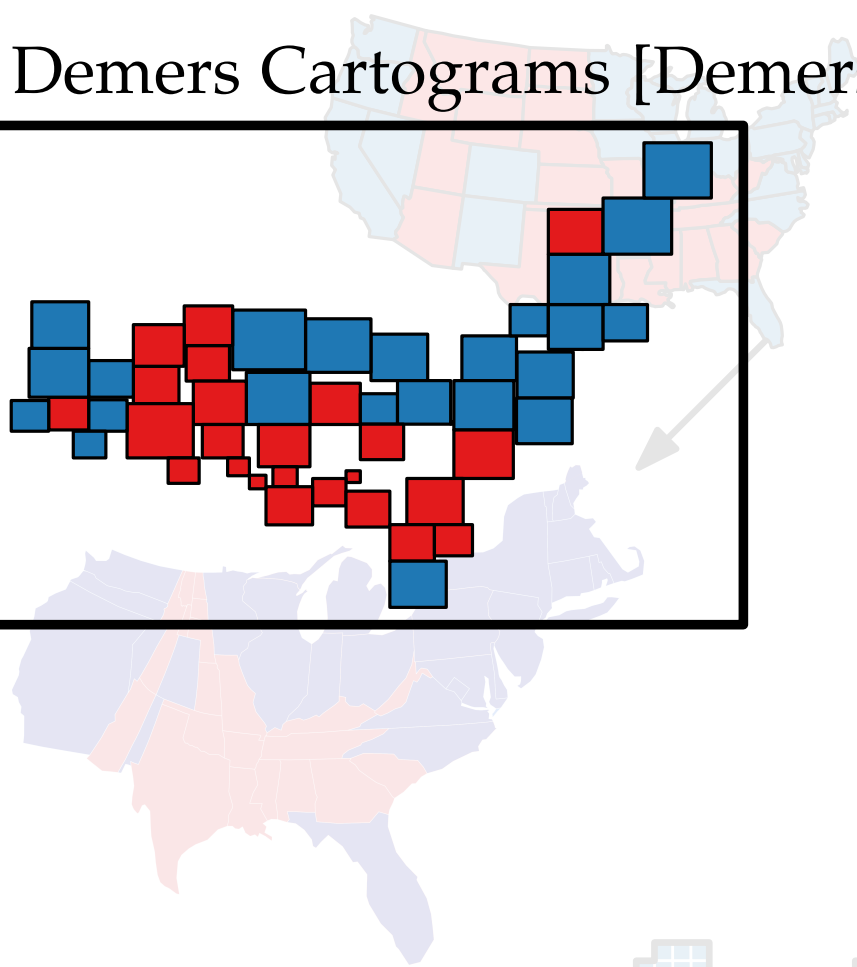


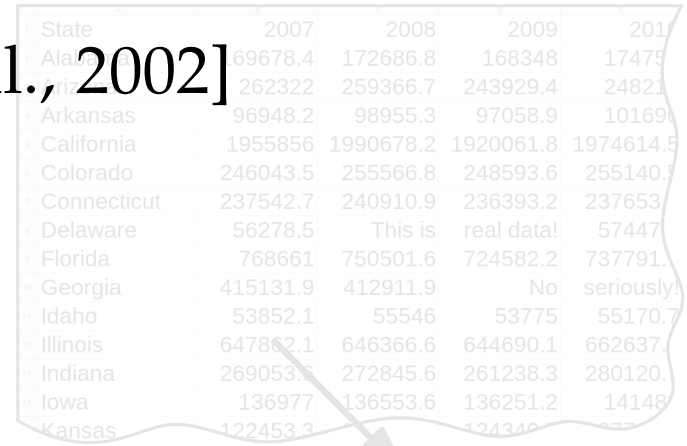




Computing Stable Demers Cartograms

Demers Cartograms [Demers et al., 2002]





State	2007	2008	2009	201
Ala	69678.4	172686.8	168348	17475
Ari	262322	259366.7	243929.4	24821
Arkansas	96948.2	98955.3	97058.9	10169
California	1955856	1990678.2	1920061.8	1974614.5
Colorado	246043.5	255566.8	248593.6	255140.
Connecticut	237542.7	240910.9	236393.2	237653
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Indiana	269053.6	272845.6	261238.3	280120.
Iowa	136977	136553.6	136251.2	14148
Kansas	122453.3		124340	373

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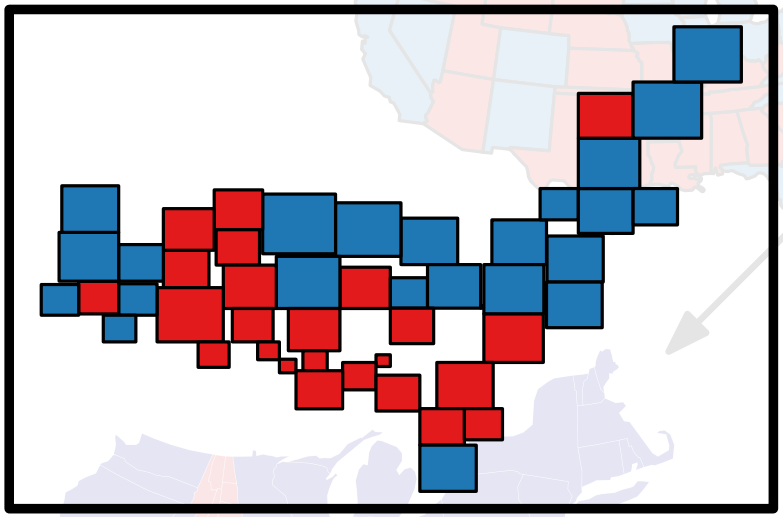

- Regions: non-overlapping squares

Computing Stable Demers Cartograms

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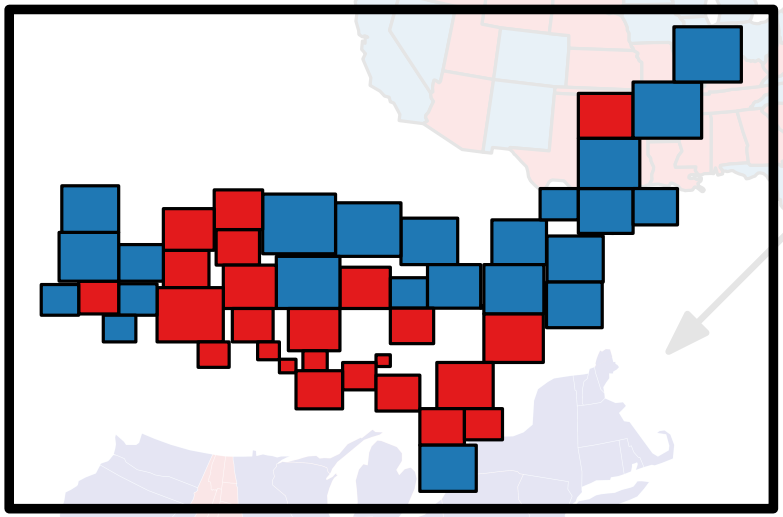
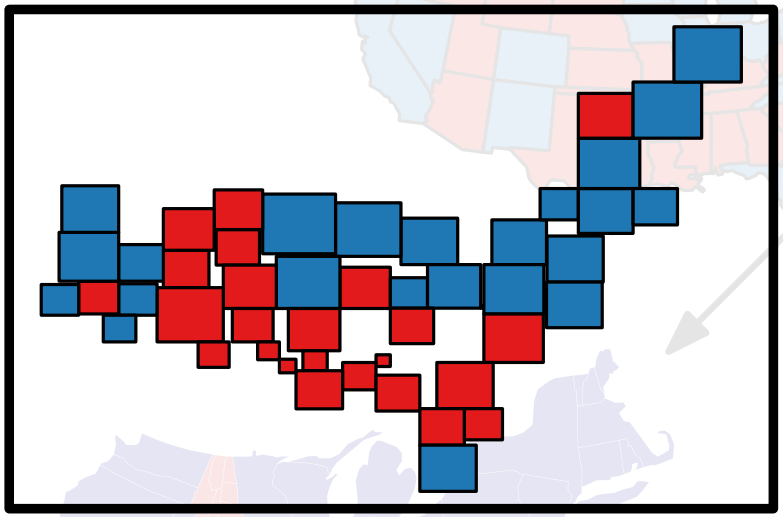


- Regions: non-overlapping squares
- Size proportional to data

Computing Stable Demers Cartograms

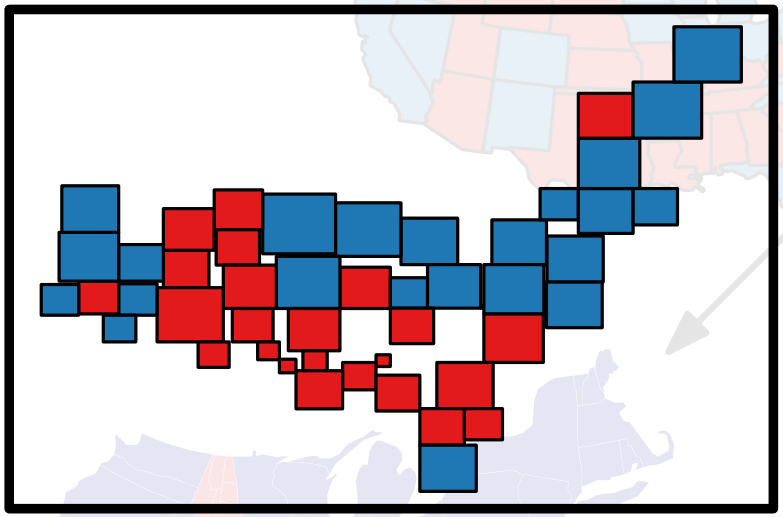
Demers Cartograms [Demers et al., 2002]



- Regions: non-overlapping squares
- Size proportional to data
- Contact if regions are neighbours

Computing Stable Demers Cartograms

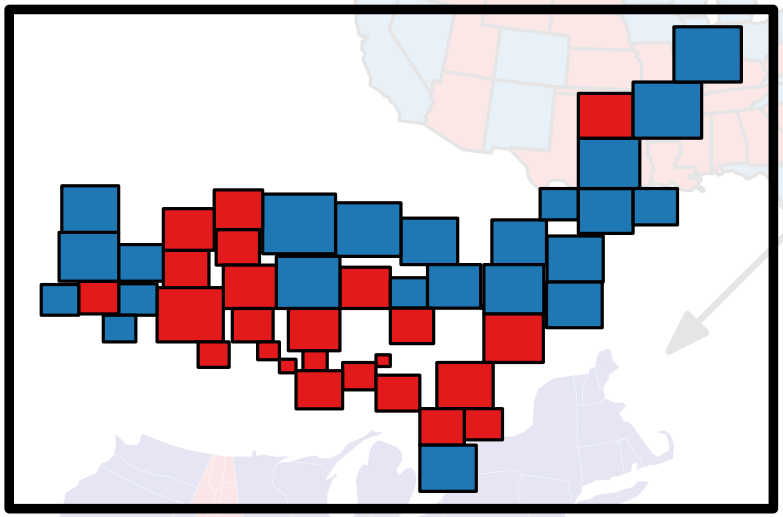
Demers Cartograms [Demers et al., 2002]



- Regions: non-overlapping squares
- Size proportional to data
- Contact if regions are neighbours
- Square contact representation

Computing Stable Demers Cartograms

Demers Cartograms [Demers et al., 2002]



- Regions: non-overlapping squares
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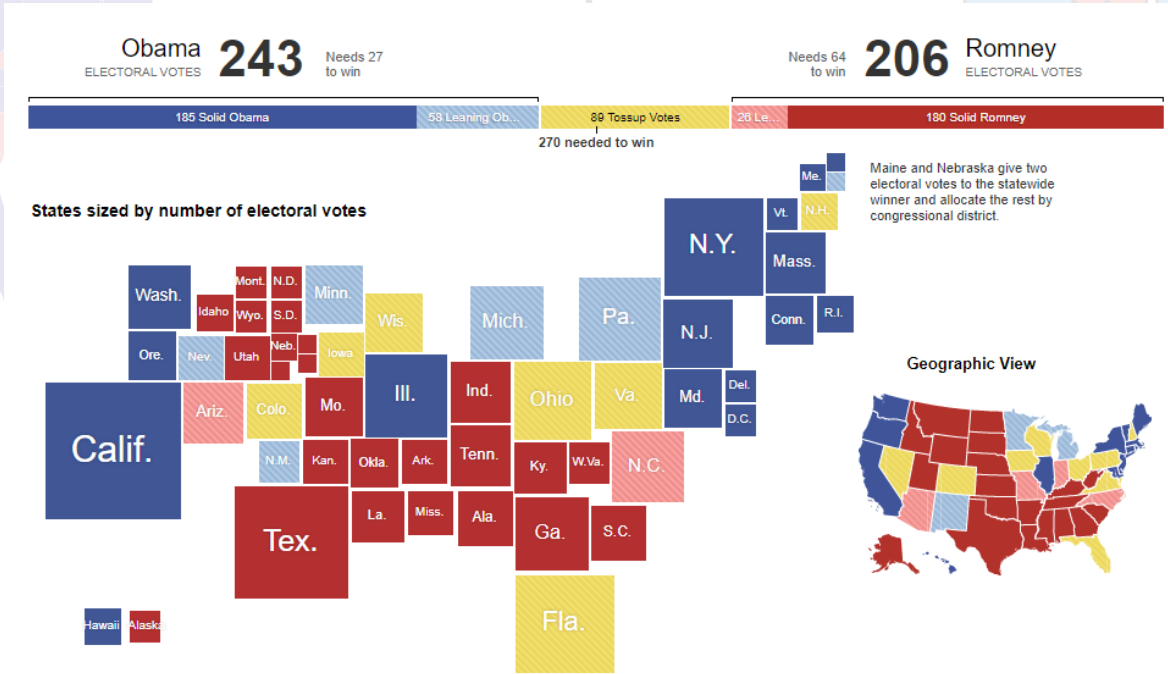
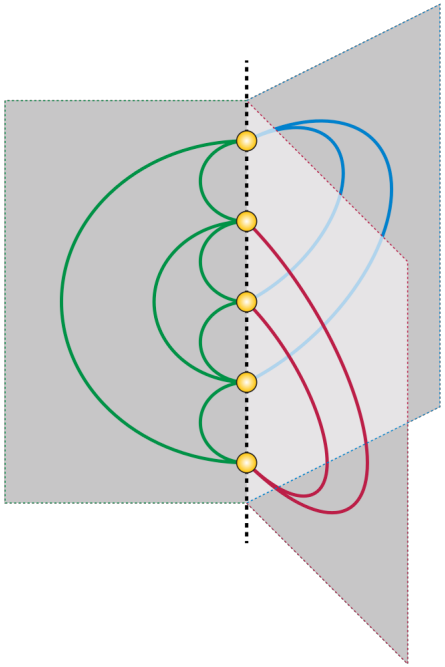
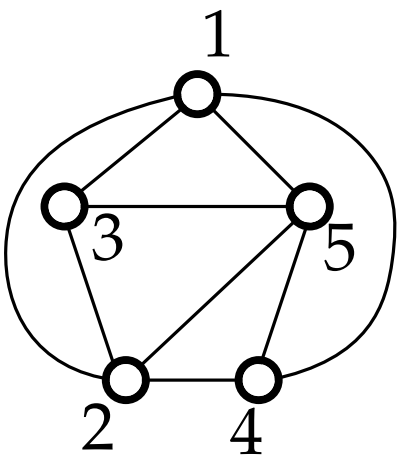
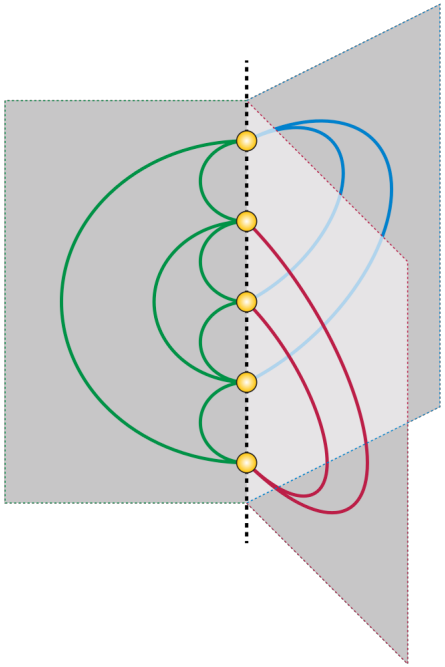


Parameterized Algorithms for Book Embedding Problems



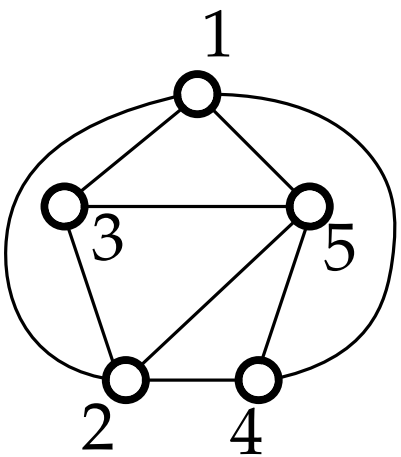
Parameterized Algorithms for Book Embedding Problems

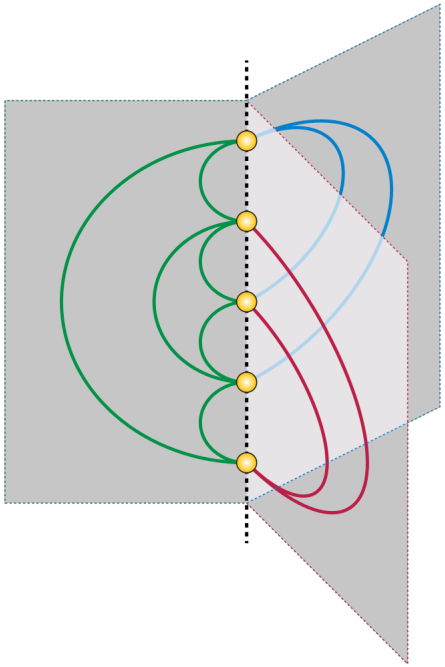




Parameterized Algorithms for Book Embedding Problems

Fixed-order book thickness:





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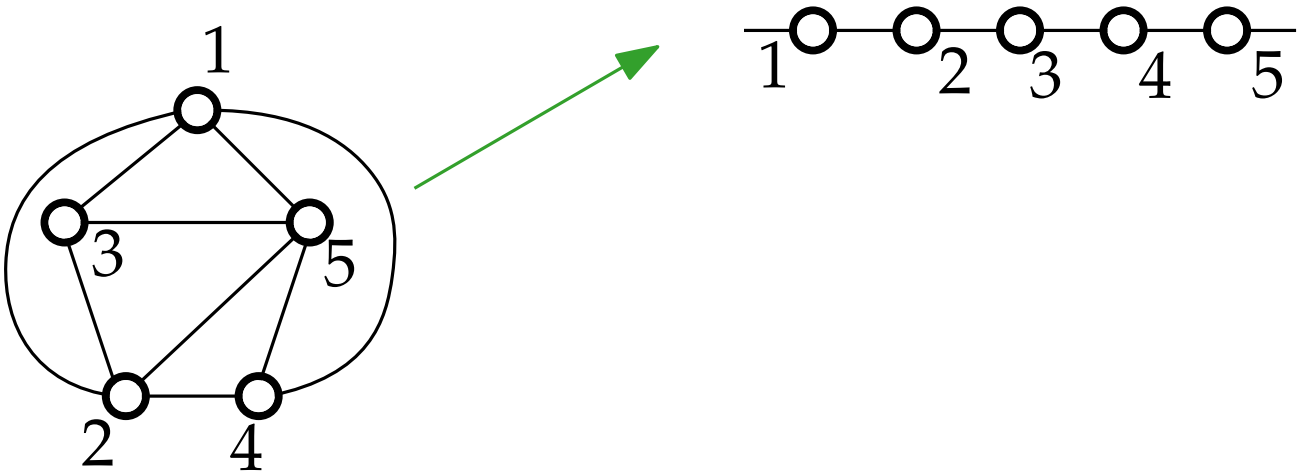
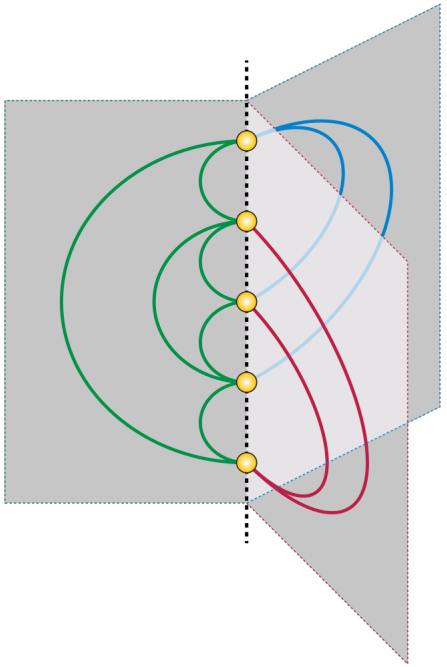
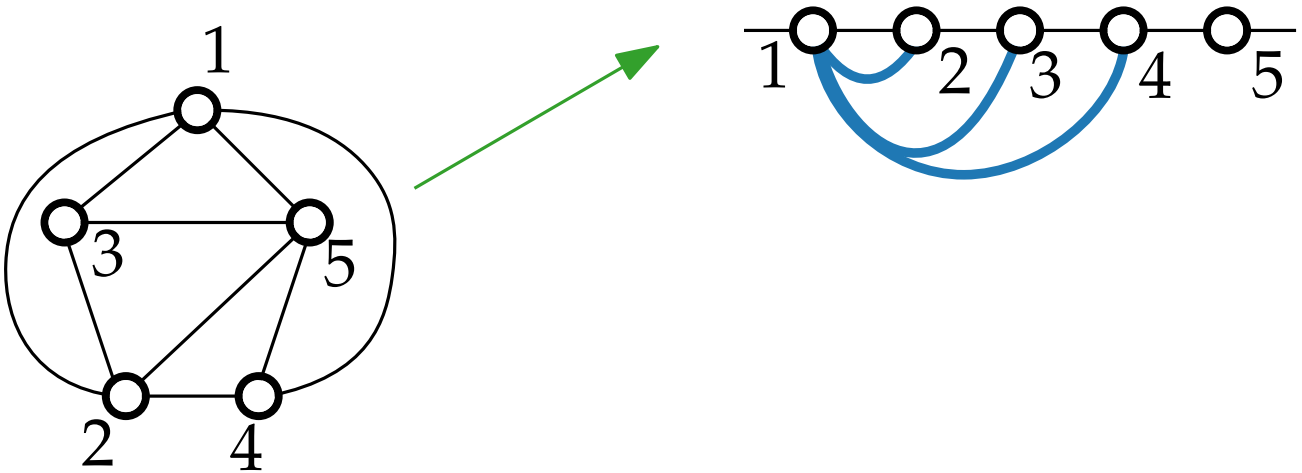
Fixed-order book thickness:

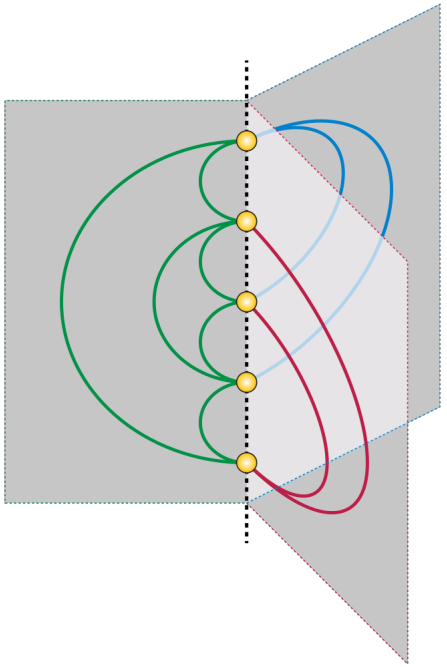




Parameterized Algorithms for Book Embedding Problems

Fixed-order book thickness:





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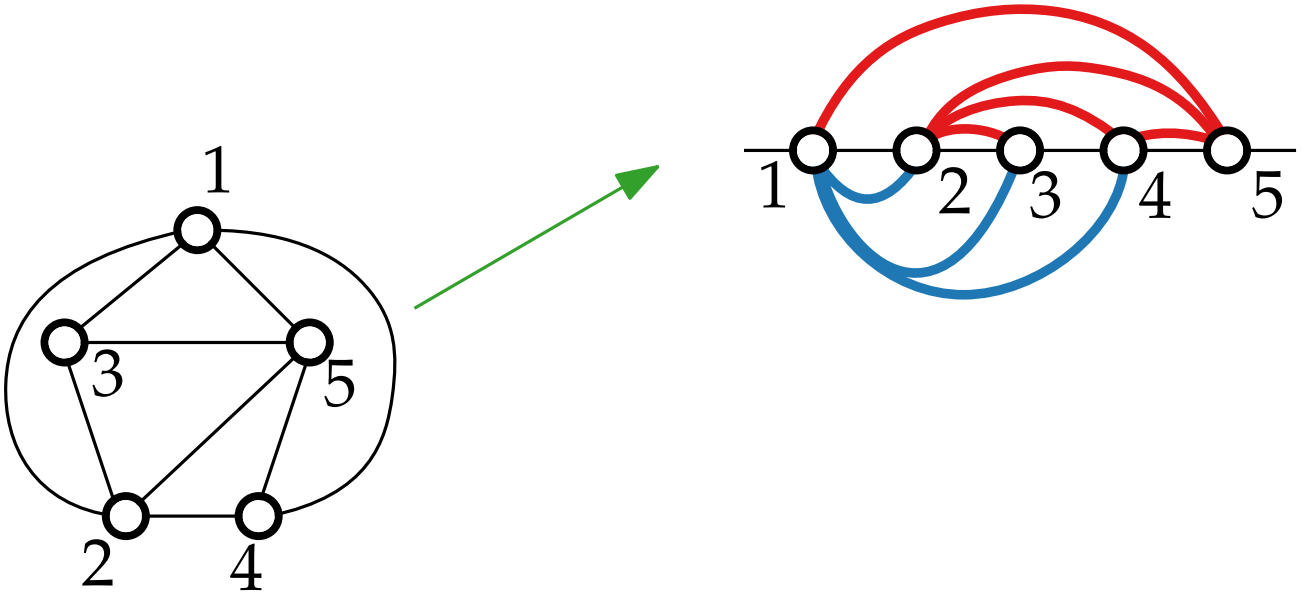

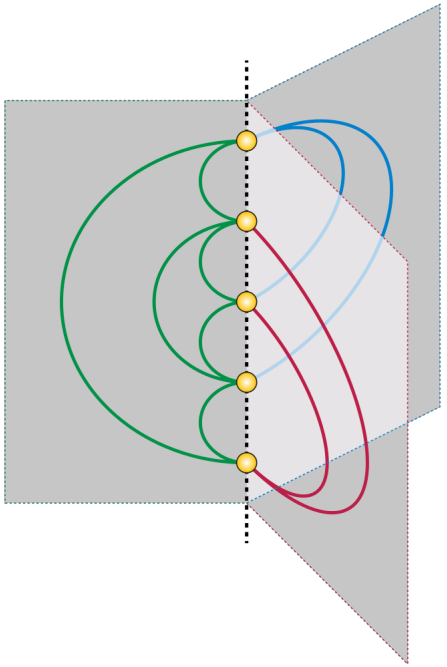

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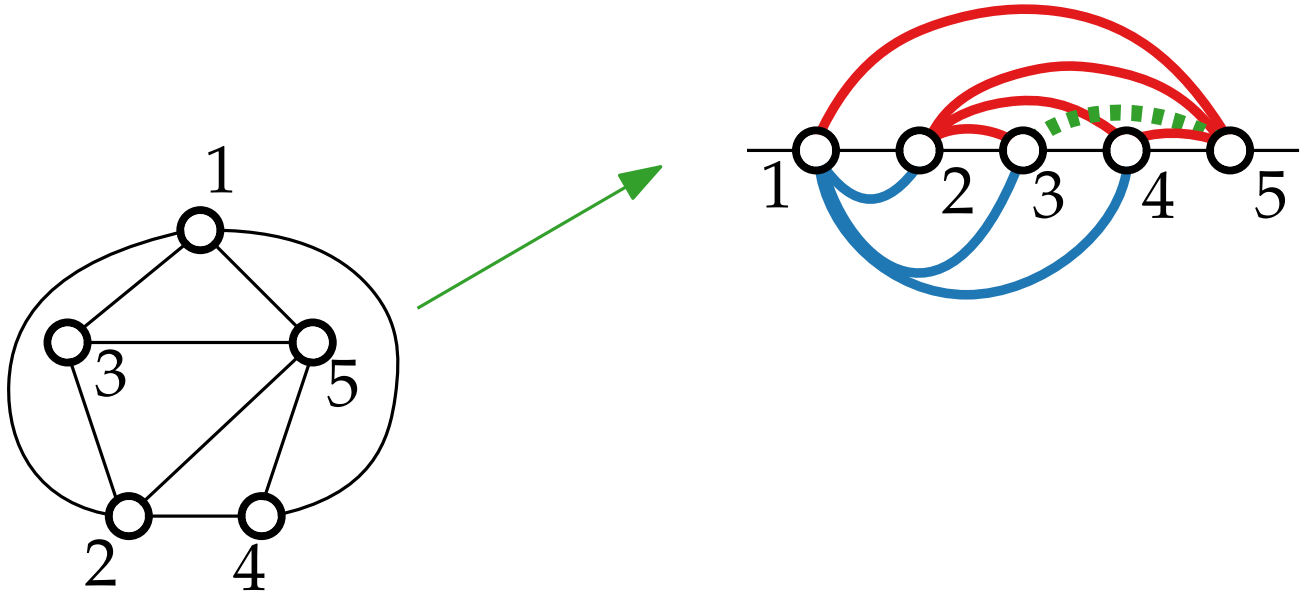
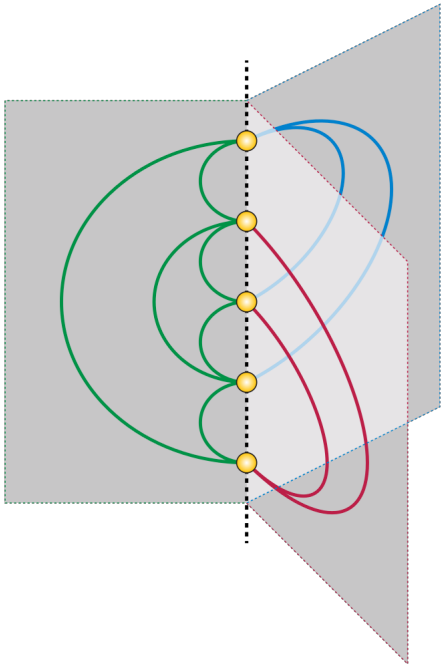
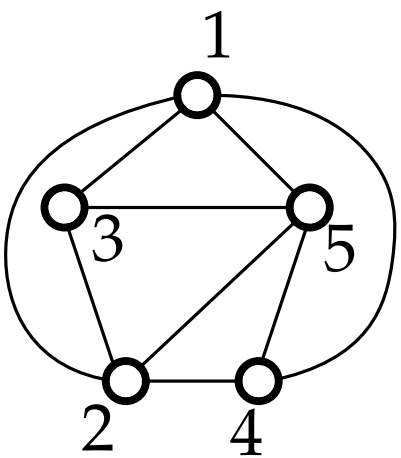
Fixed-order book thickness:

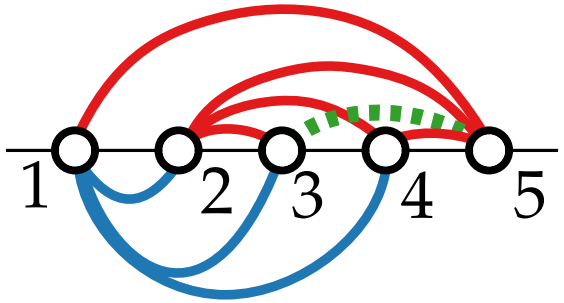


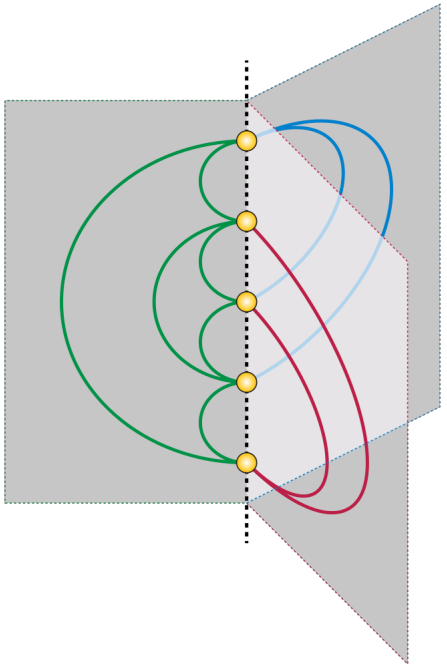


Parameterized Algorithms for Book Embedding Problems

Fixed-order book thickness: 3

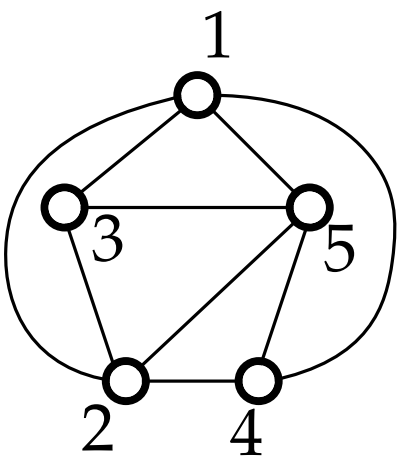


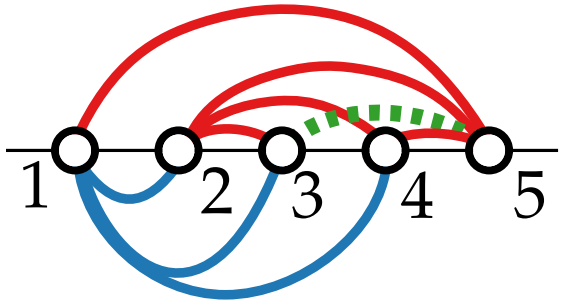




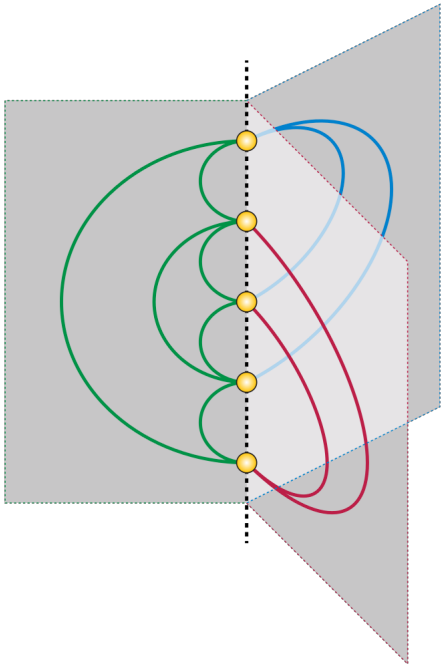
Parameterized Algorithms for Book Embedding Problems

Fixed-order book thickness: 3





Book thickness:



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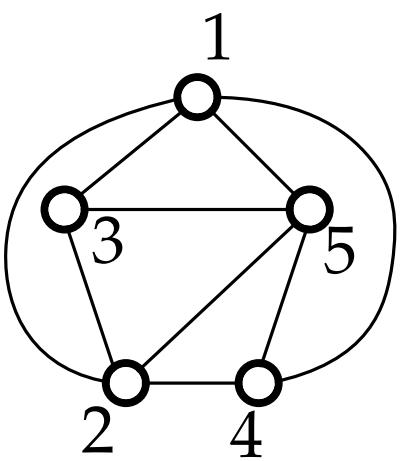

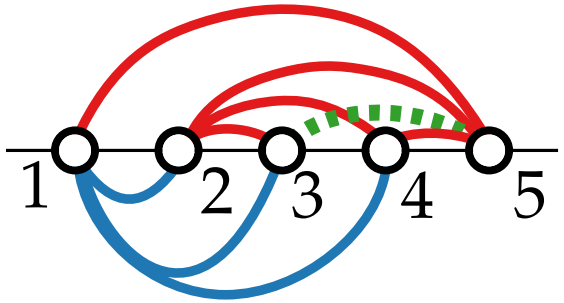

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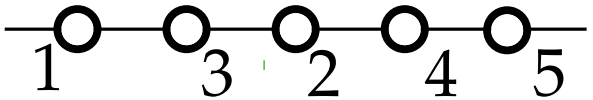

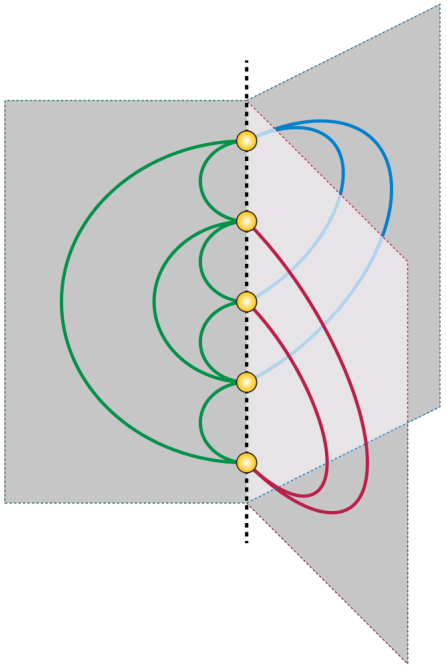

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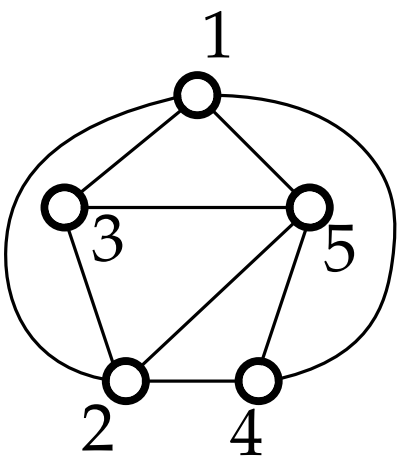
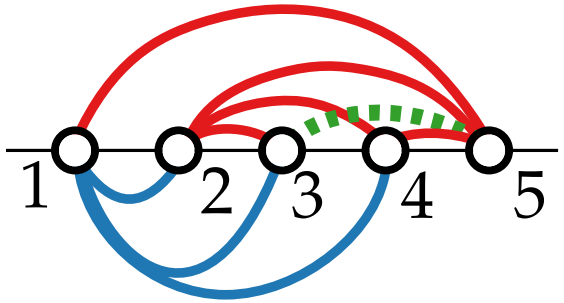
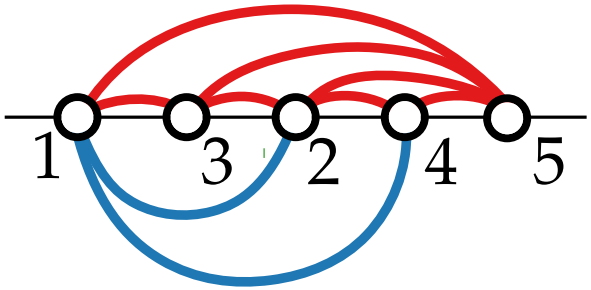
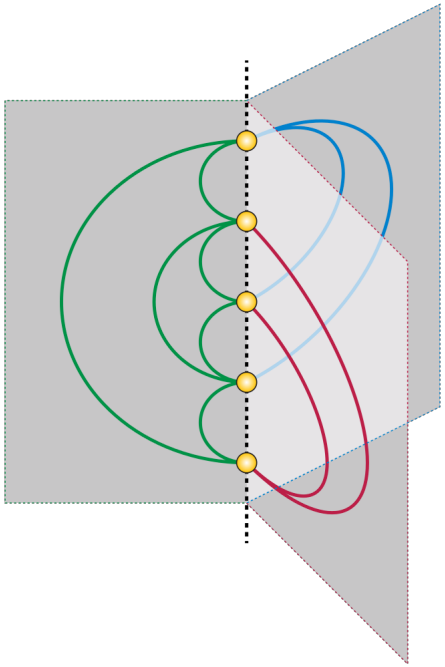


Fixed-order book thickness: 3



Book thickness:





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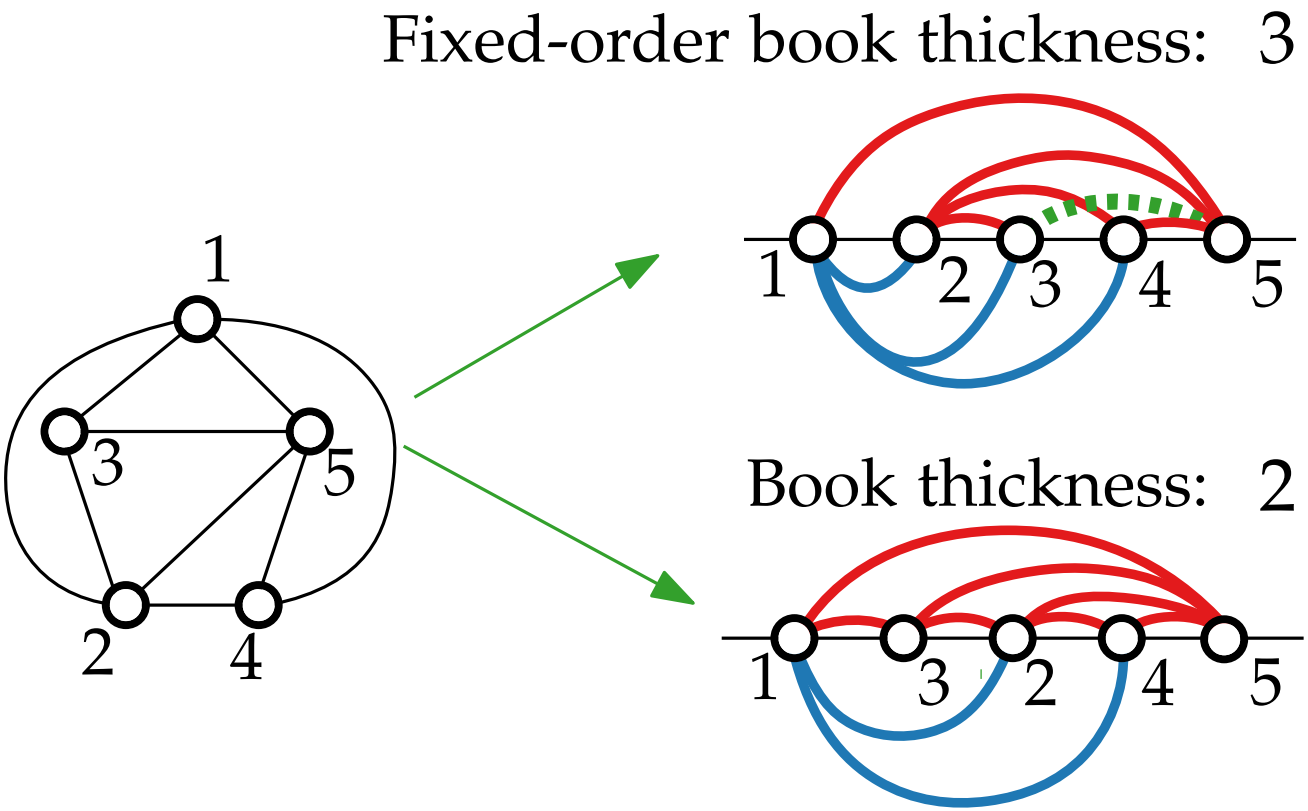

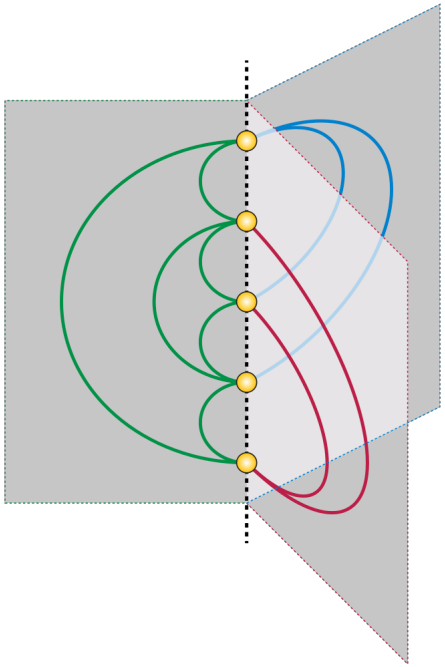

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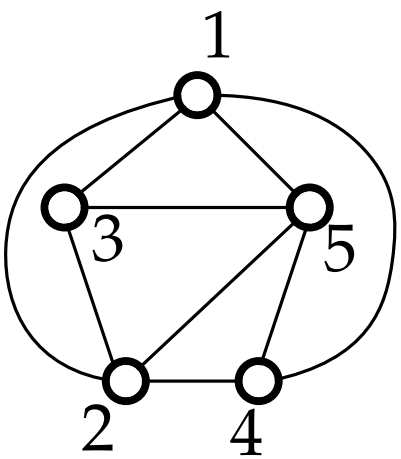
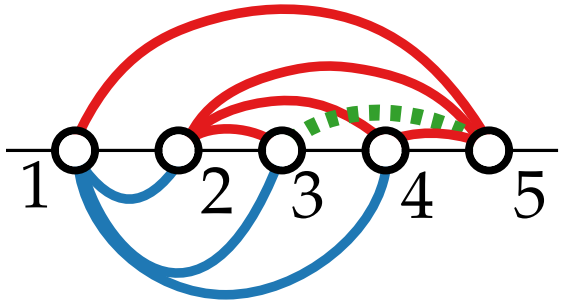
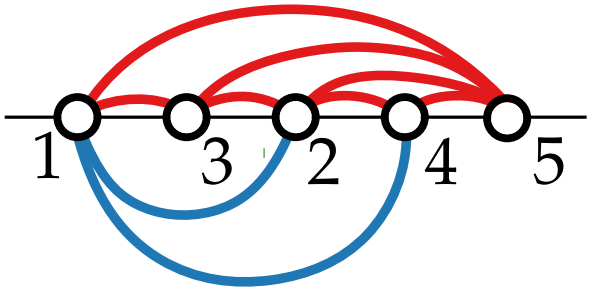
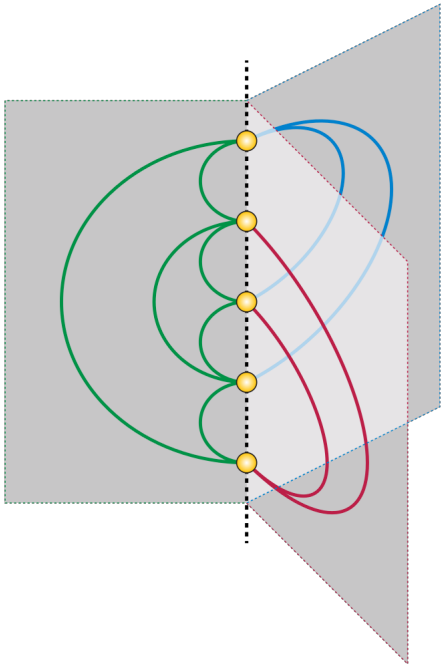


Fixed-order book thickness: 3



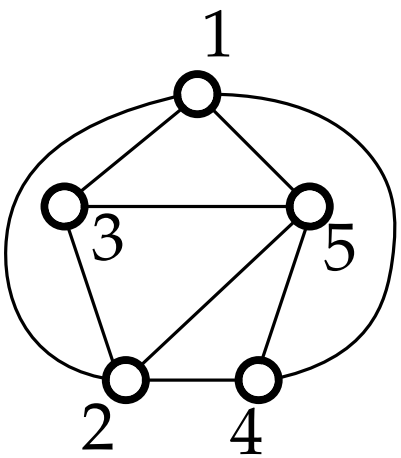
Book thickness: 2



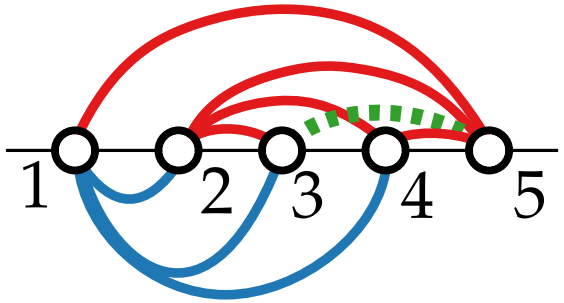


Both NP-complete $\Rightarrow$ FPT algorithms

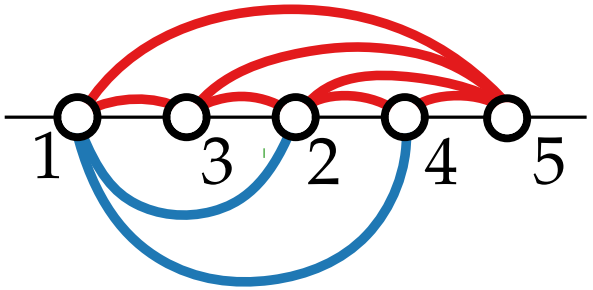
Local and Union Page Numbers

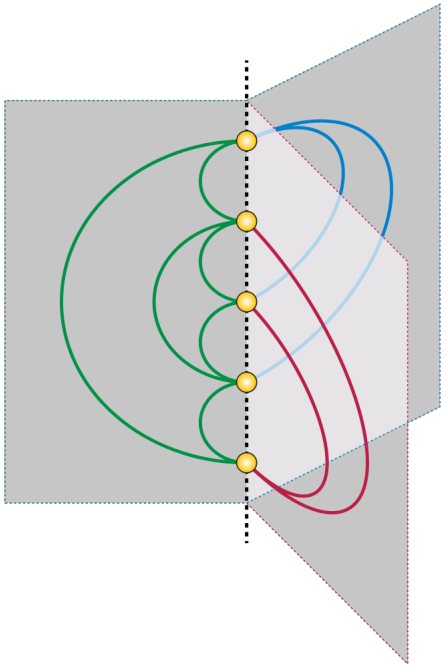


Fixed-order book thickness: 3



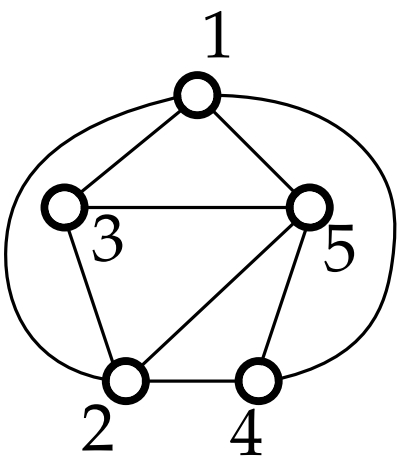
Book thickness: 2

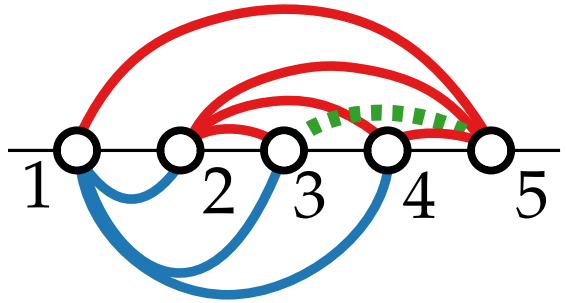


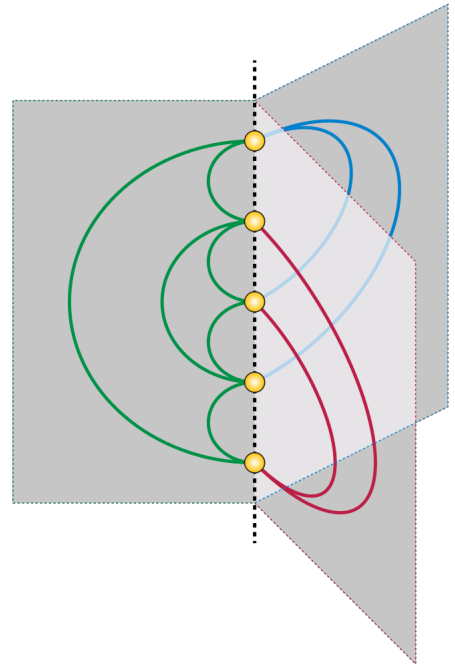


Local and Union Page Numbers

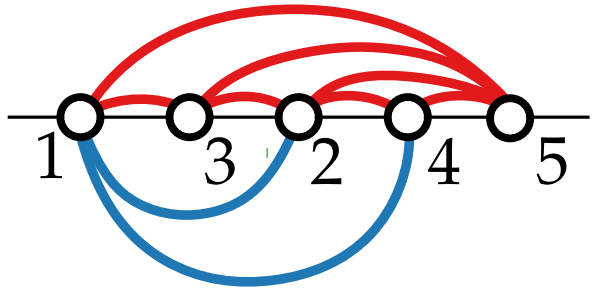
Fixed-order book thickness: 3



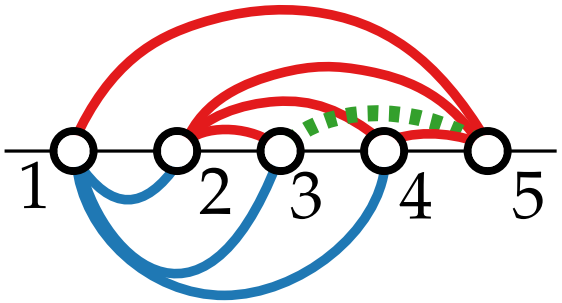




Book thickness: 2

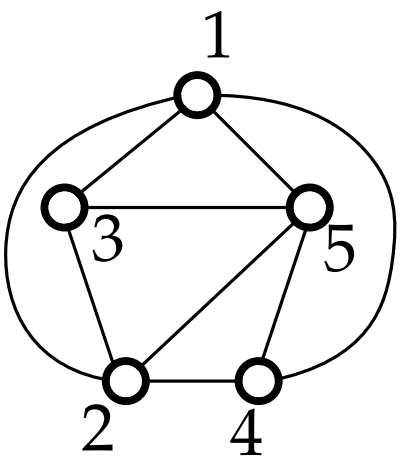


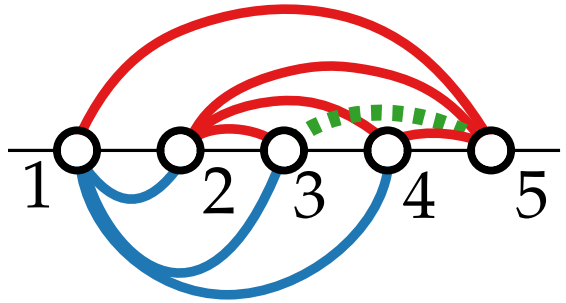
local book thickness: num. of pages per vertex

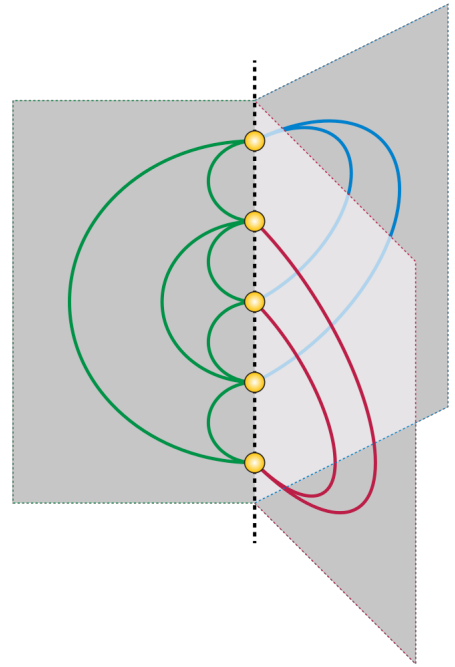


Local and Union Page Numbers

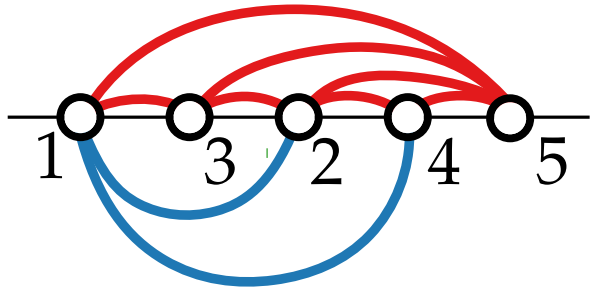
Fixed-order book thickness: 3



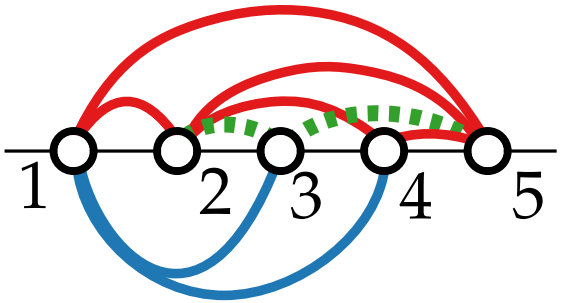




Book thickness: 2



local book thickness: num. of pages per vertex



Local and Union Page Numbers

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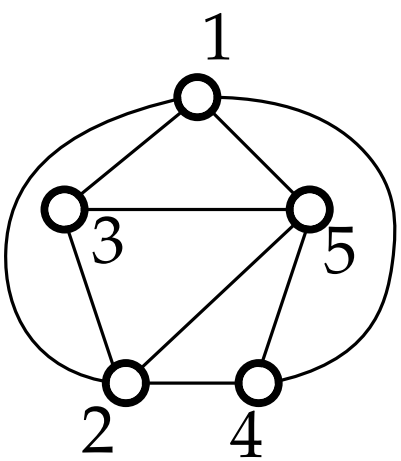

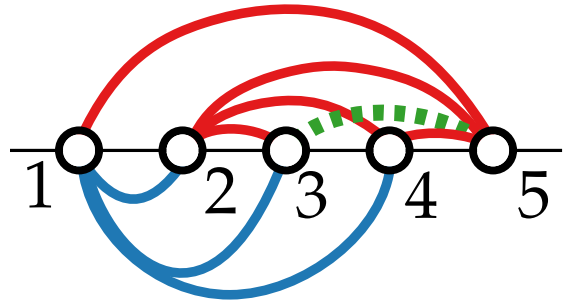

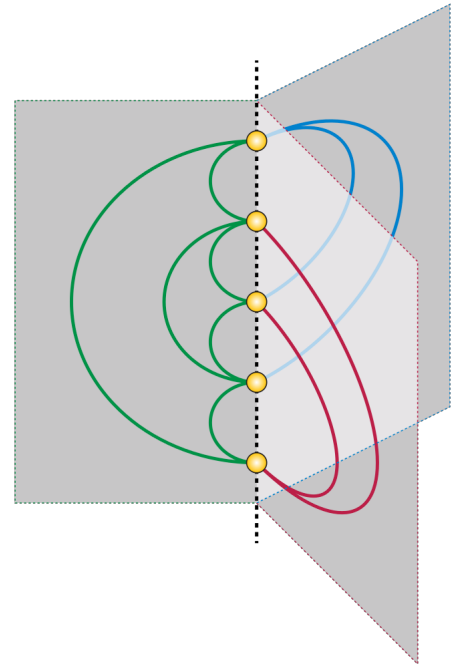

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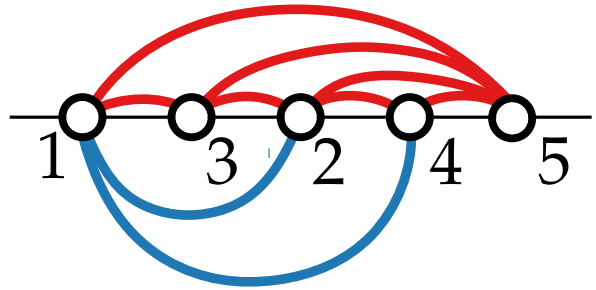

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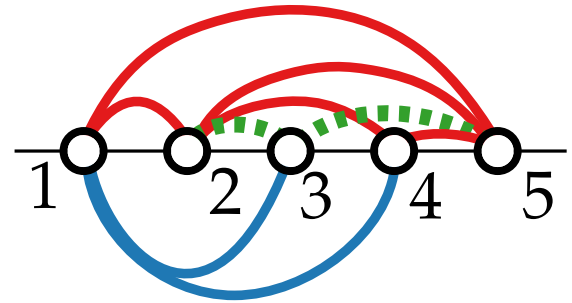

union book thickness: only conn. components planar

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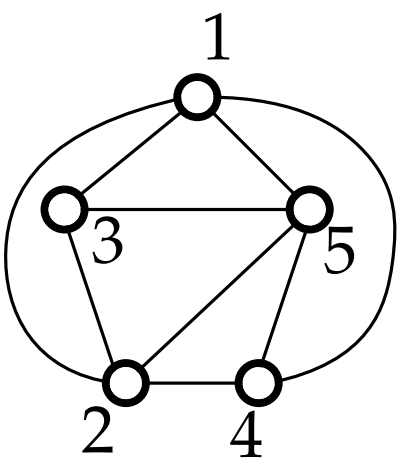

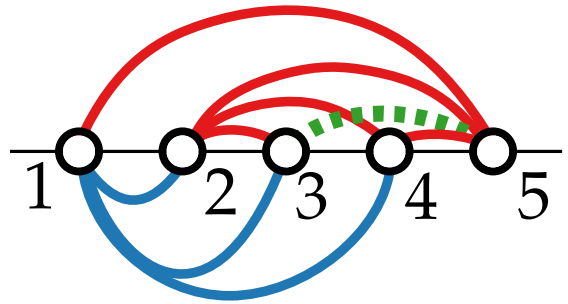

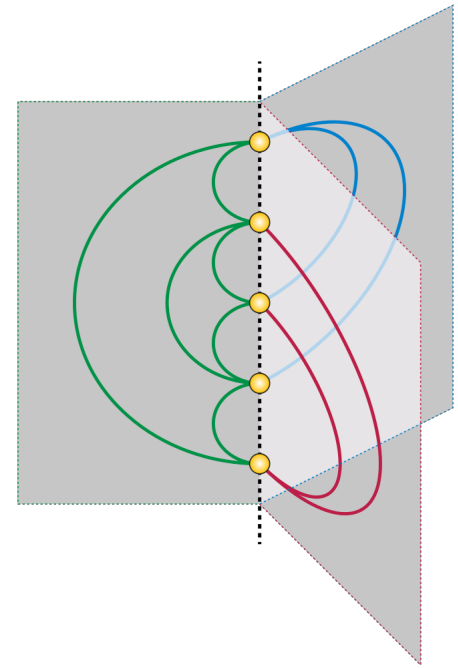

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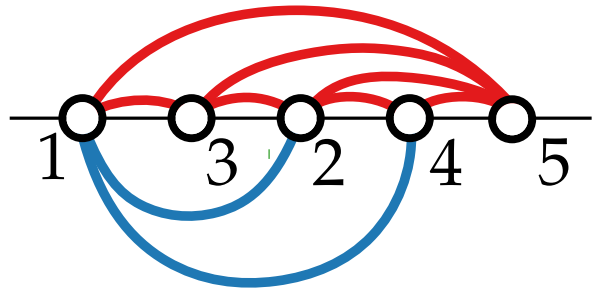

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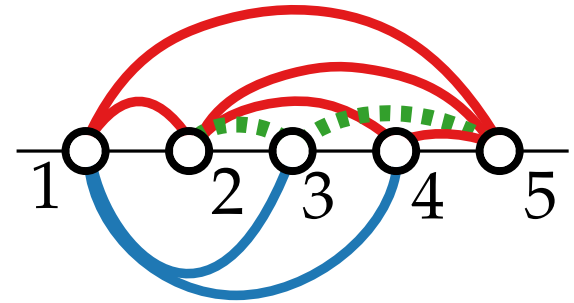

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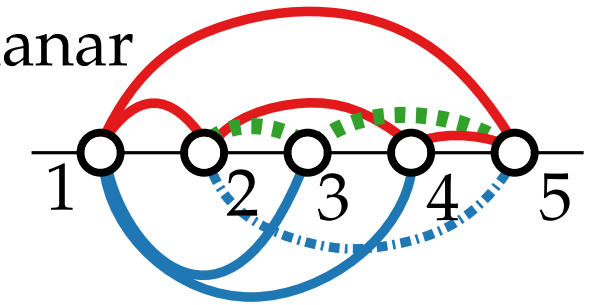
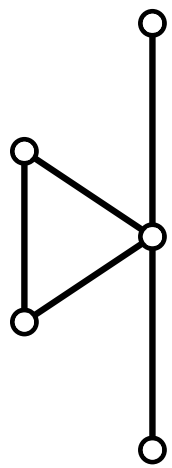


Level-Planar Drawings with Few Slopes



Given:

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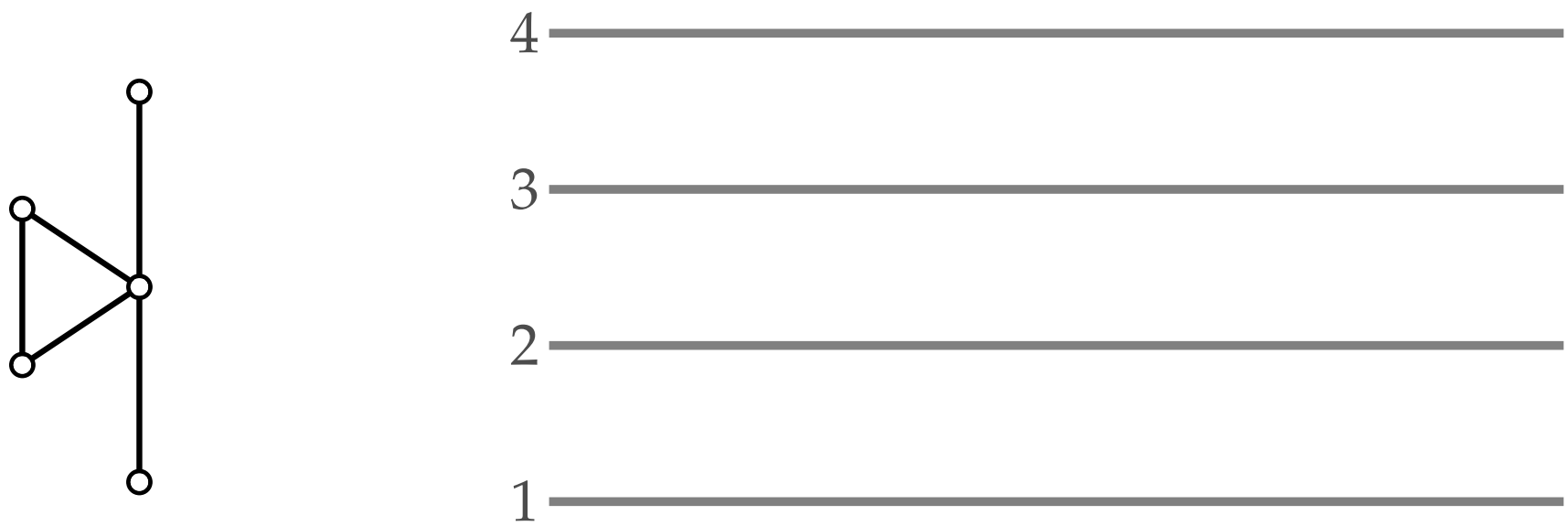

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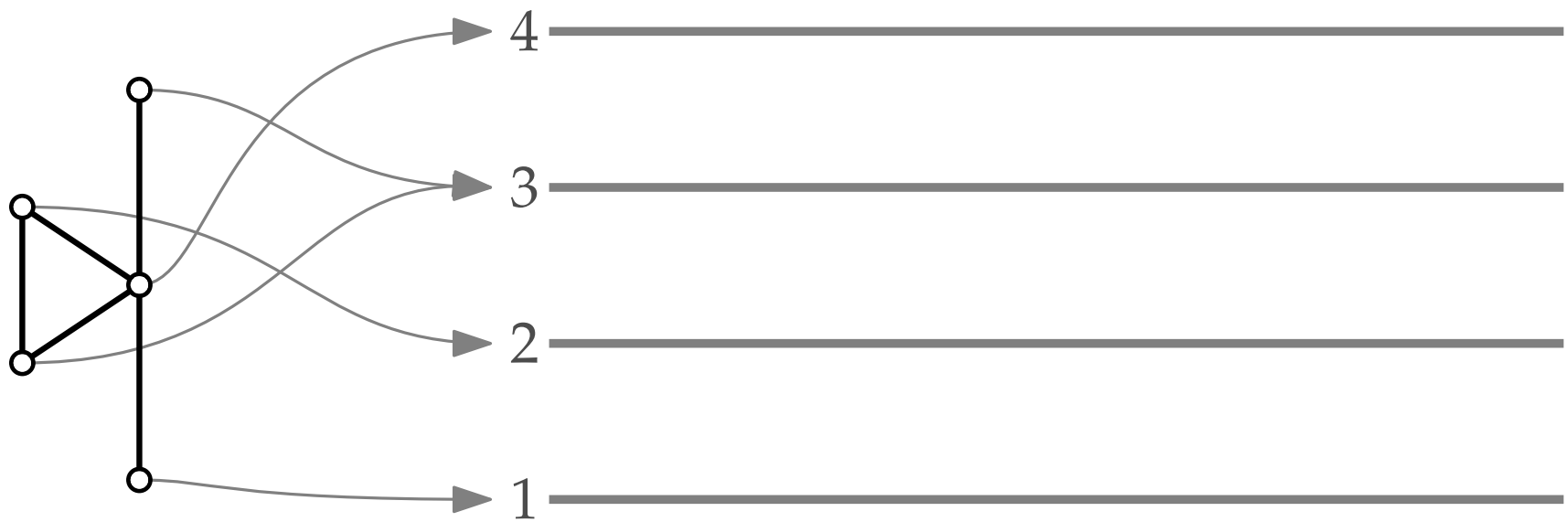

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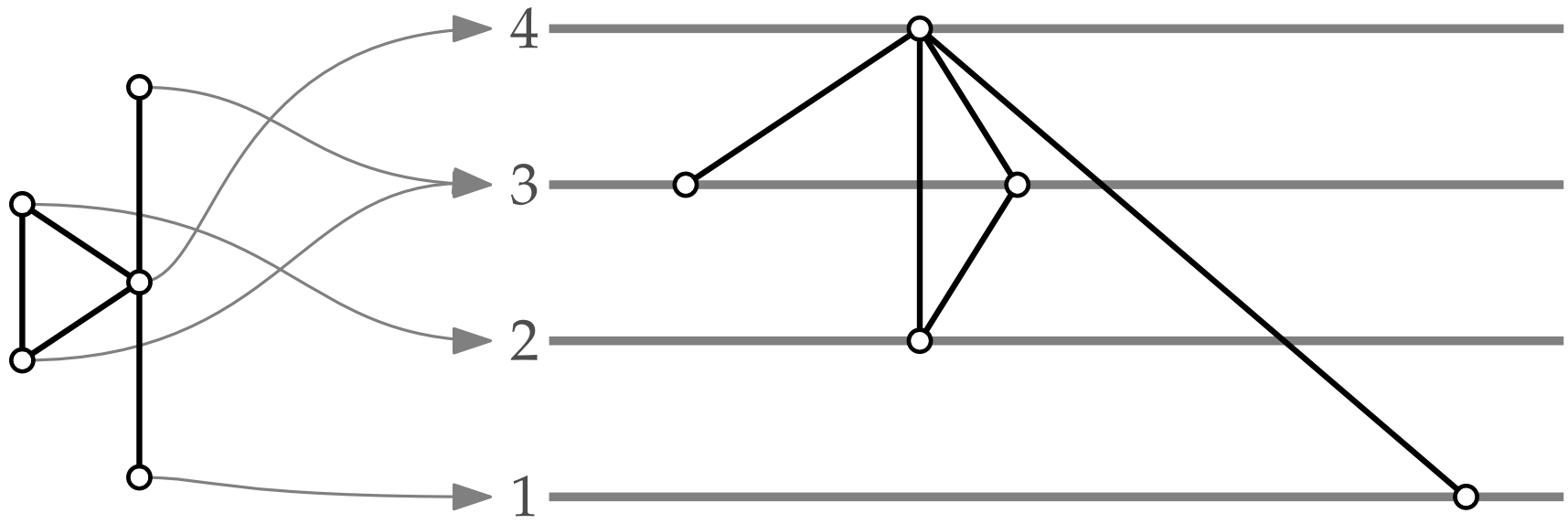

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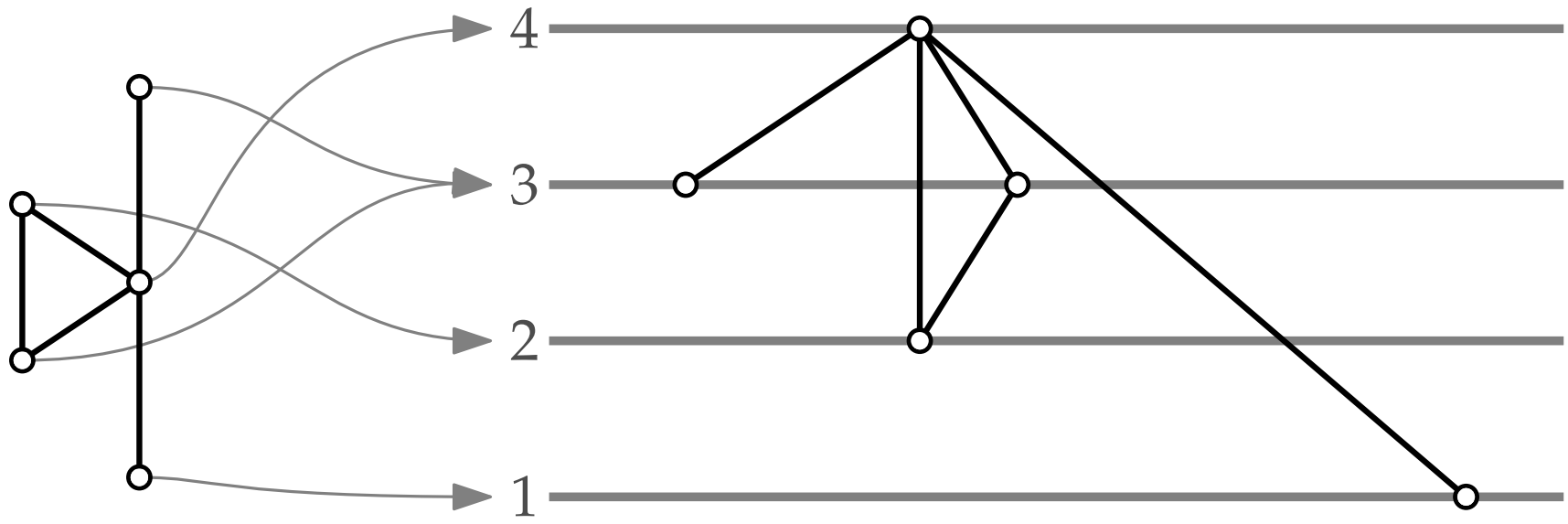

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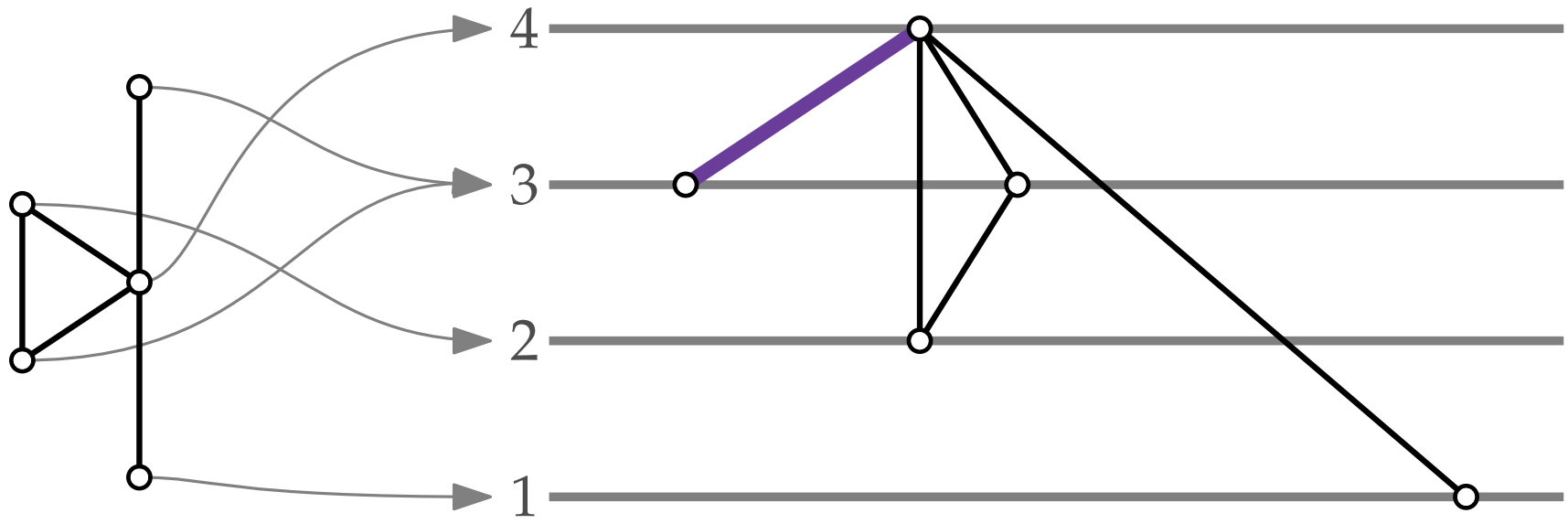

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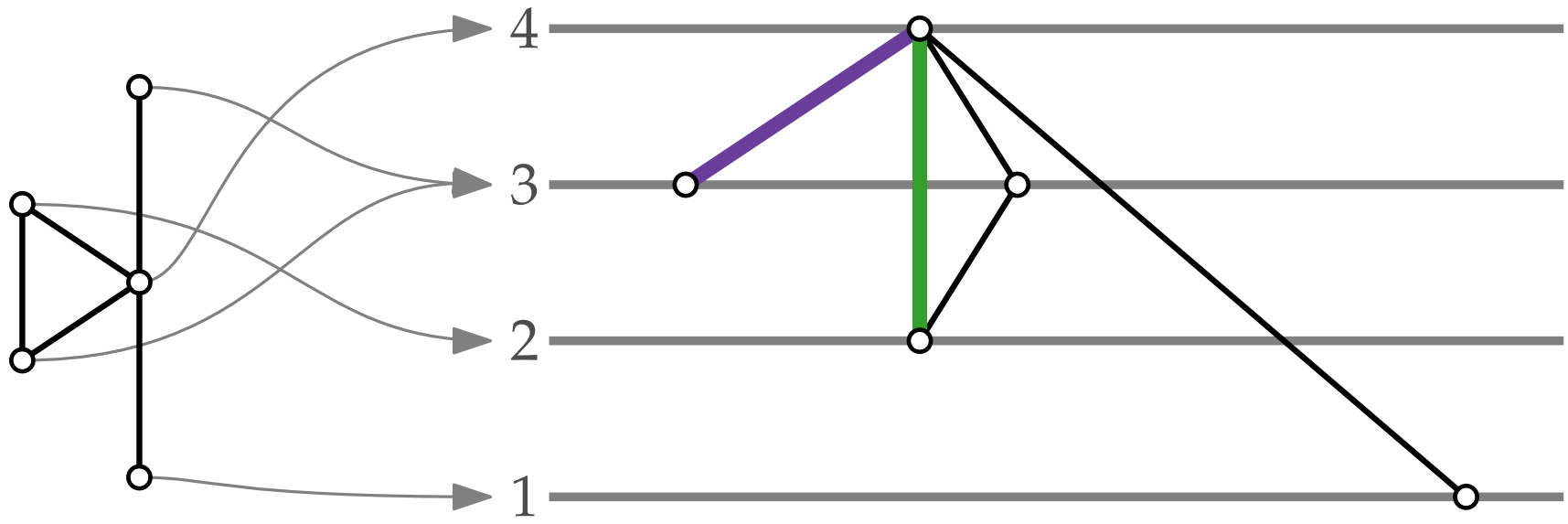

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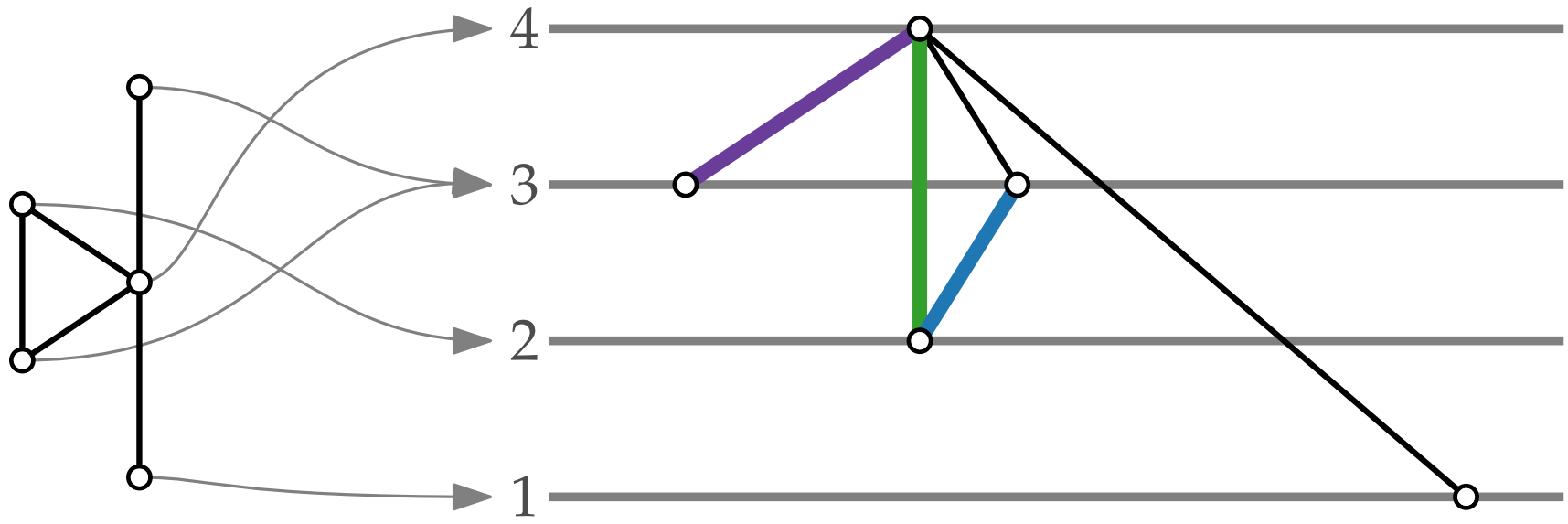

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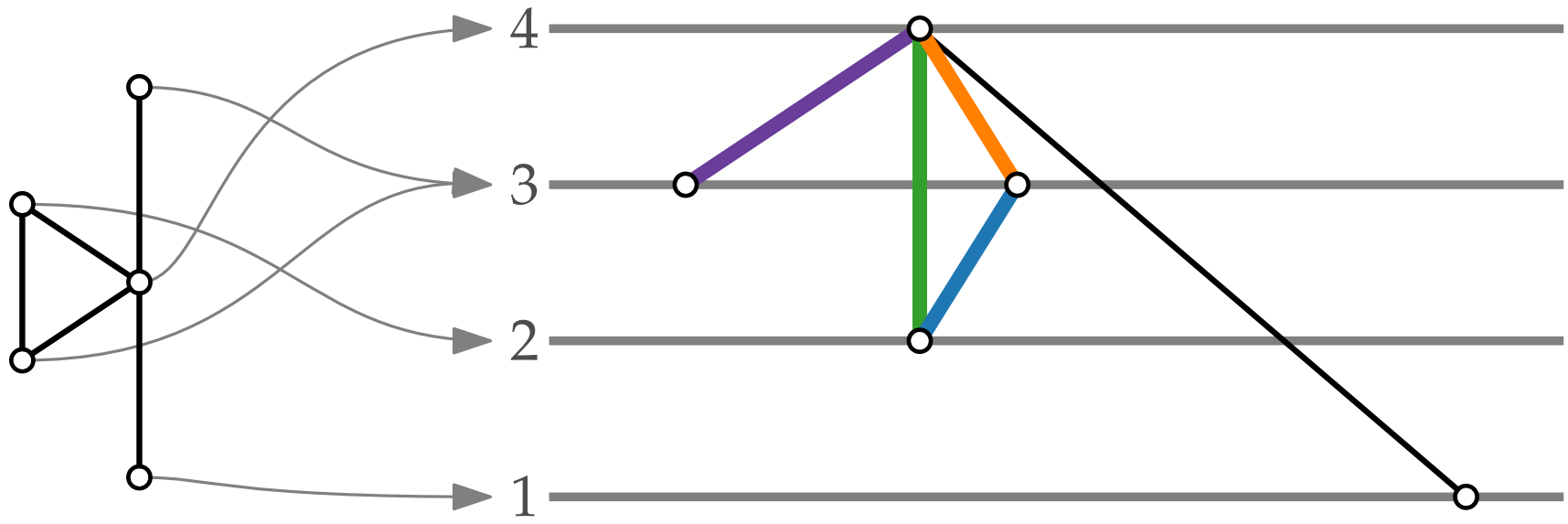

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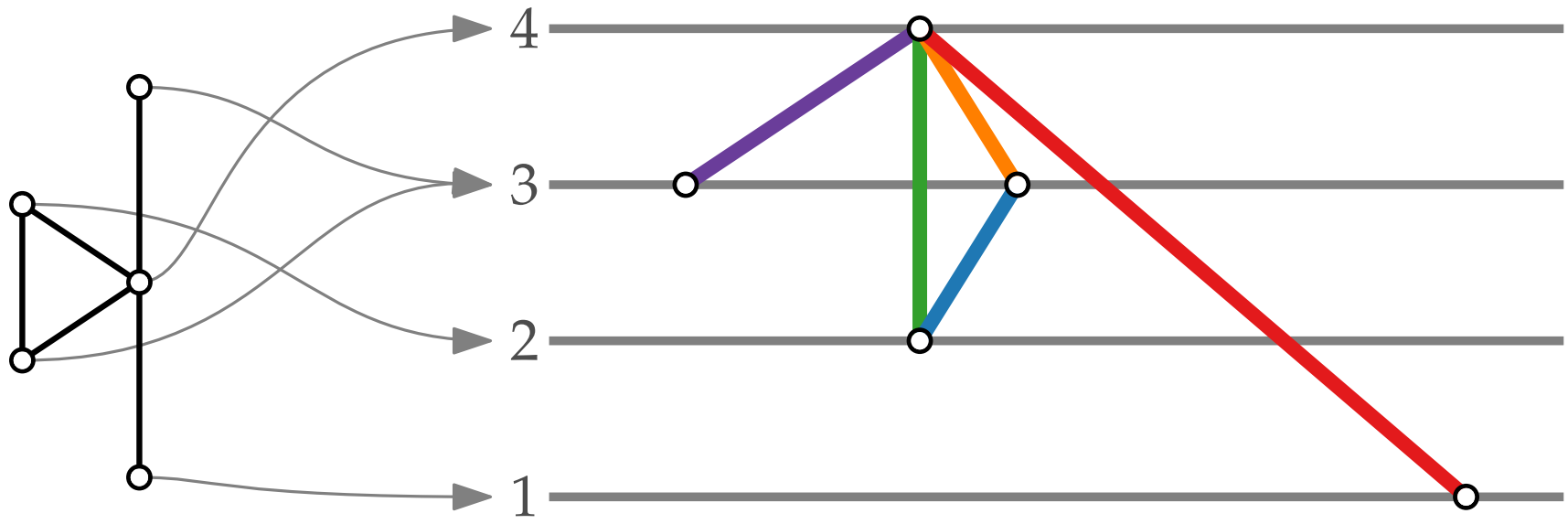

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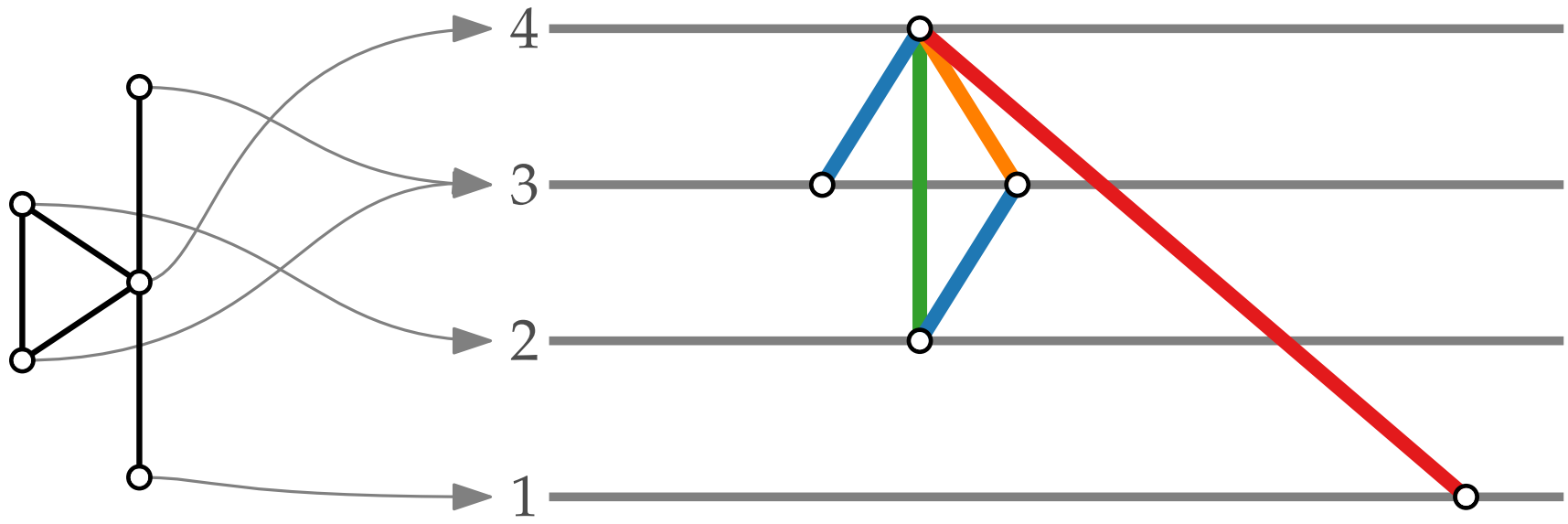

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Optimal Morphs of Planar Orthogonal Drawings II

https://youtu.be/n0ZaPtfg9TM

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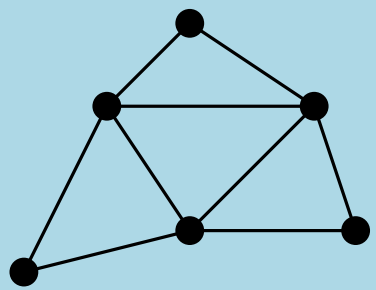

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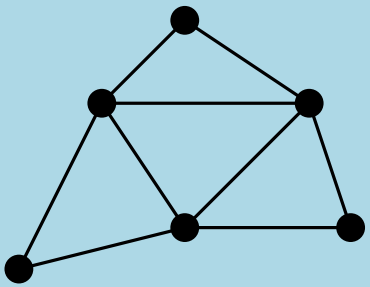
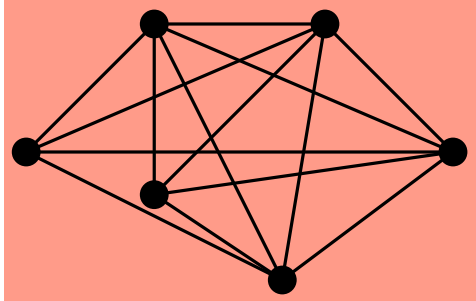


Many graphs are non-planar ...



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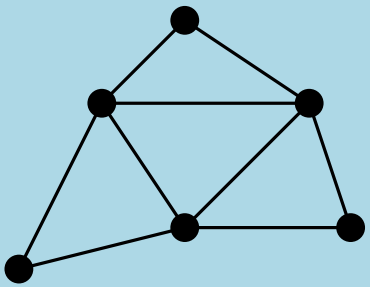

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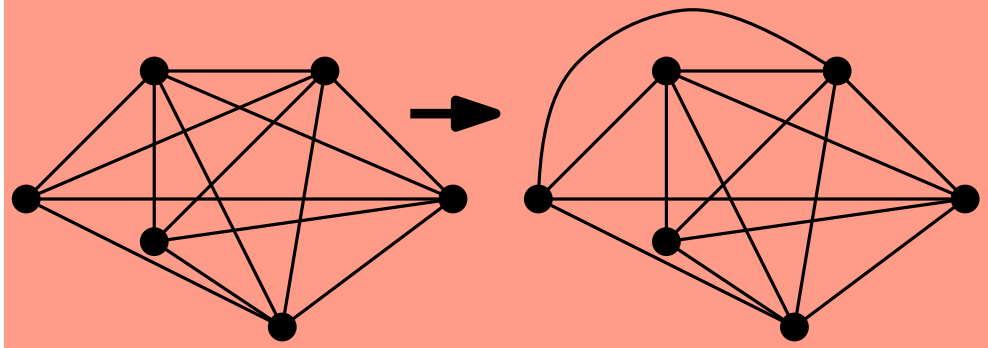

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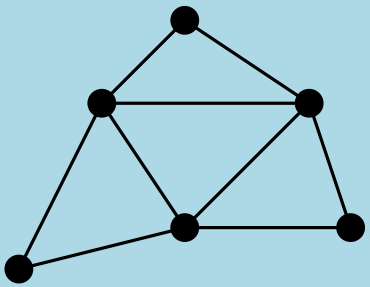

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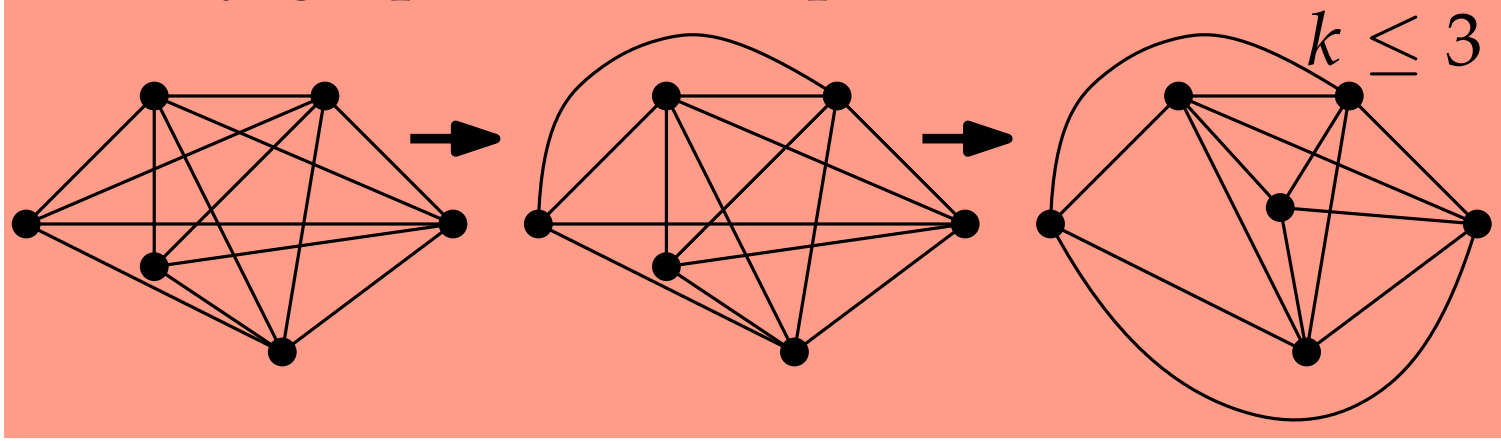

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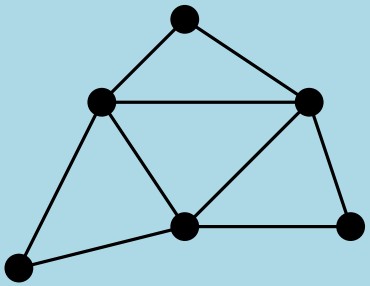

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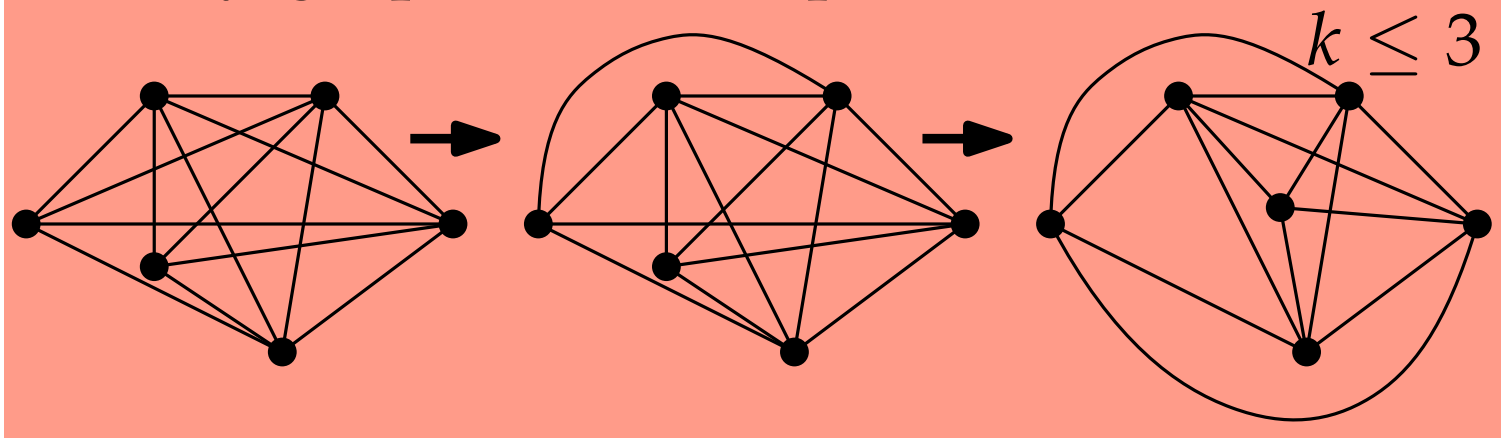

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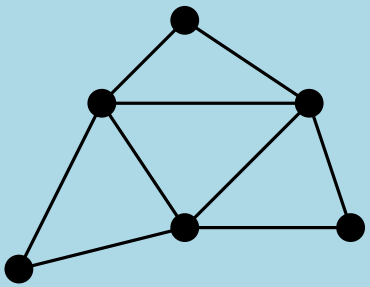

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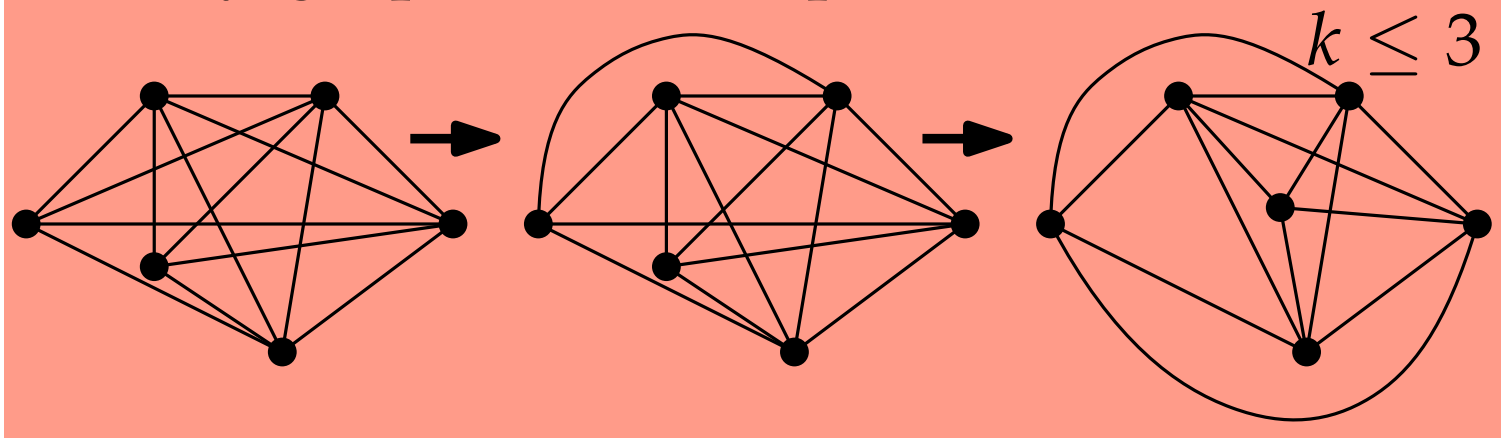

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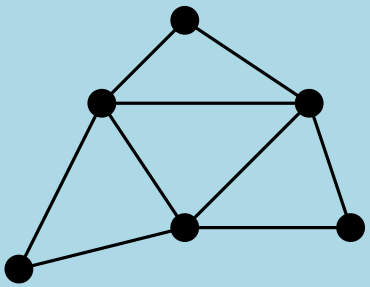

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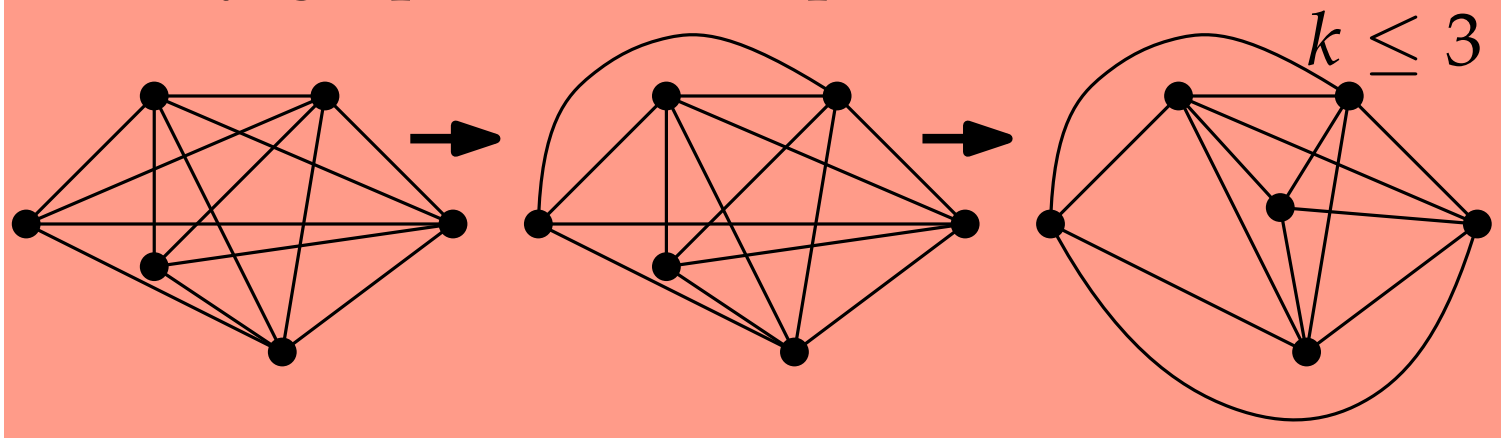

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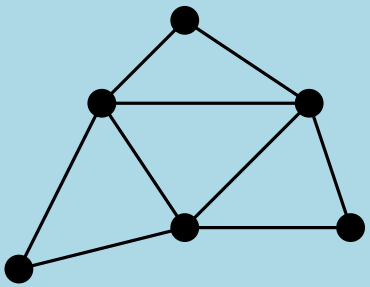

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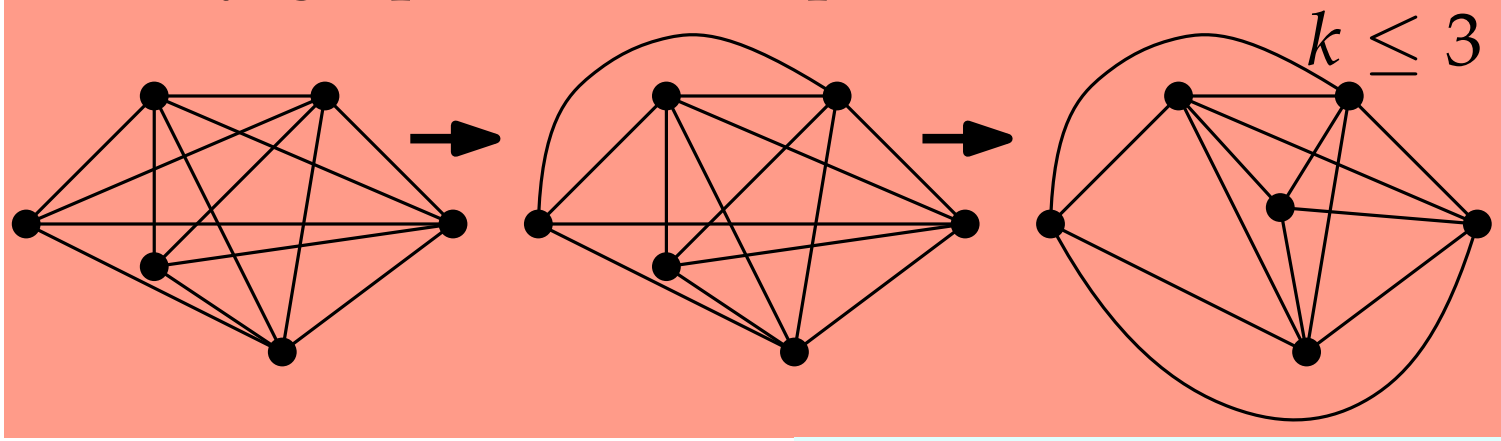

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Goes via *Integer Quadratic Programming*, for more, pick this paper!

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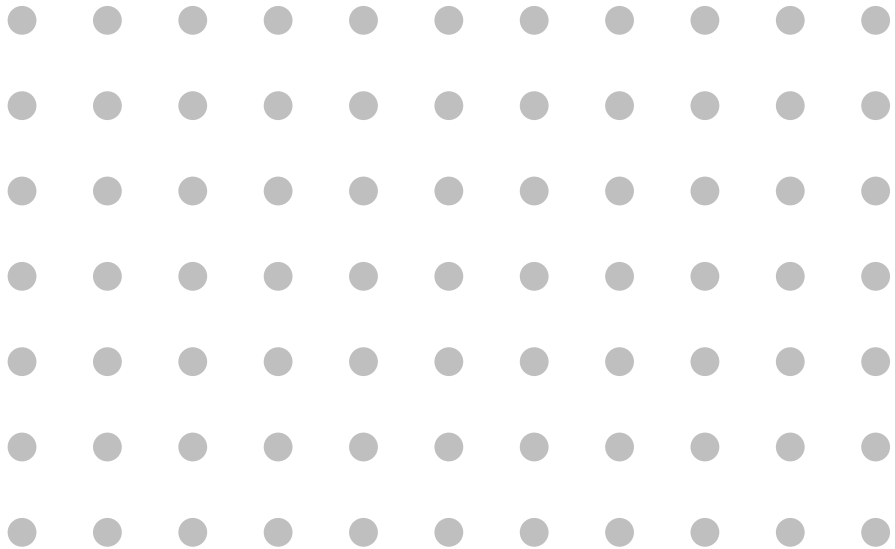
Grid-major height NEW!

WxH gridpoints

$\{1, \ldots, W\} \times \{1, \ldots, H\}$



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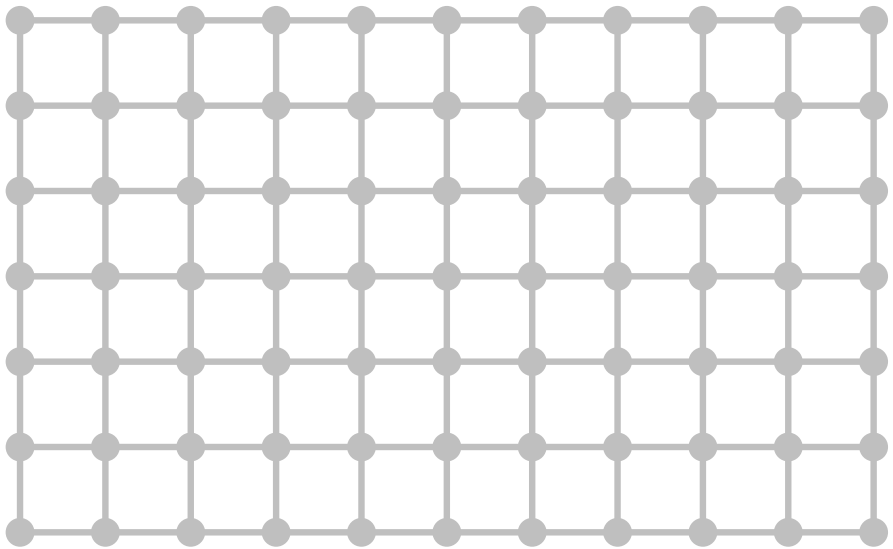

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WxH grid

graph on gridpoints, edges between points at distance 1

Grid-major height

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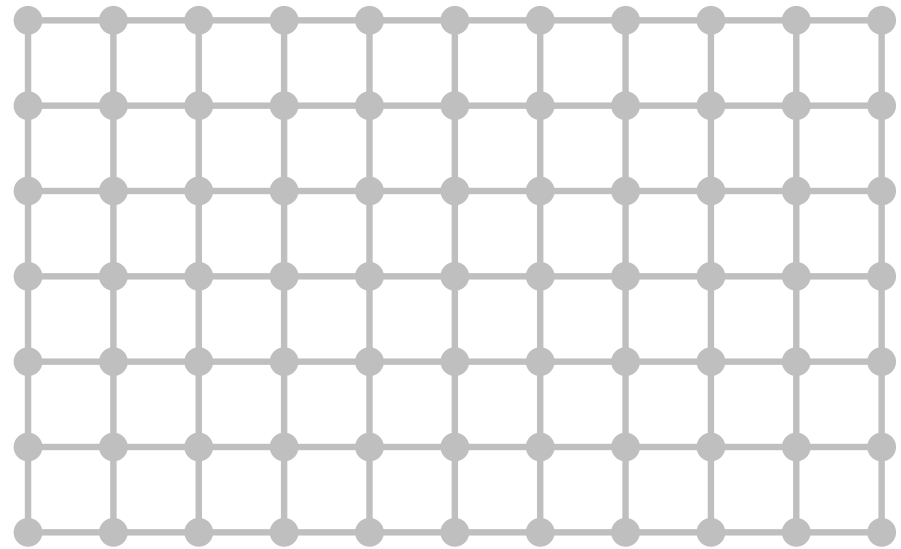

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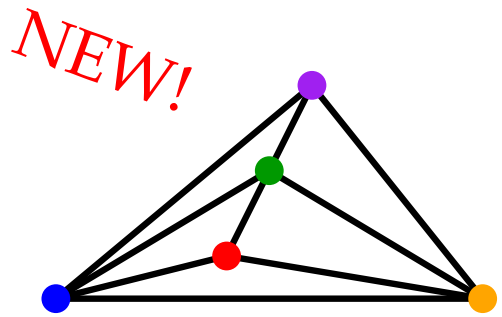
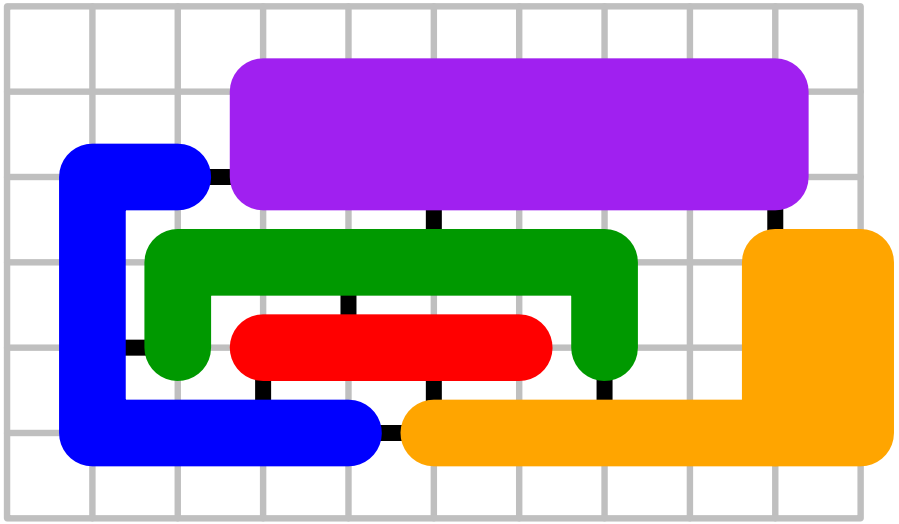
Grid-major height (of a planar graph G)

minimum h s.t. G is a minor of Wxh grid

Homotopy Height, Grid-Major Height and Graph-Drawing Height

Grid-major height





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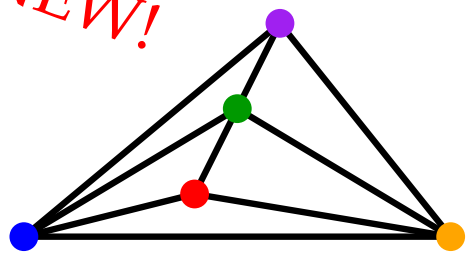
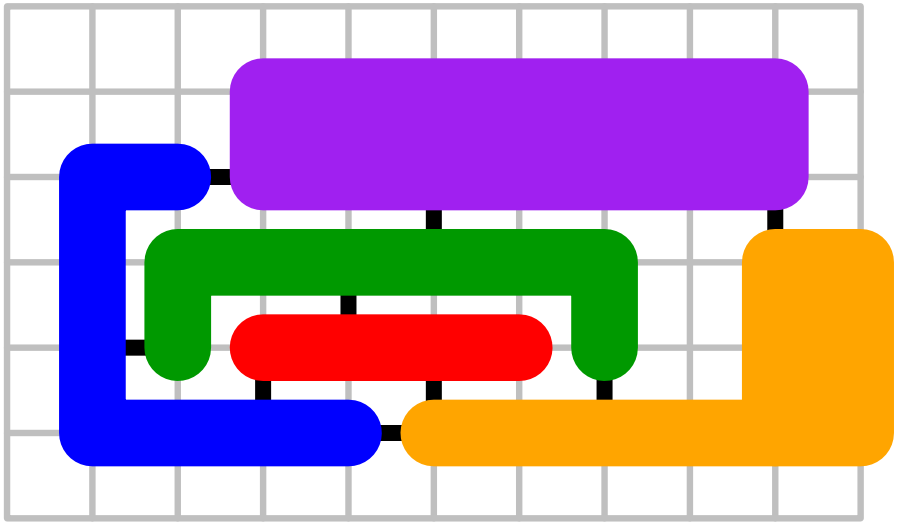




*W*x*H* gridpoints

$\{1, \ldots, W\} \times \{1, \ldots, H\}$

*W*x*H* grid

graph on gridpoints, edges between points at distance 1

Grid-major height (of a planar graph G)

minimum h s.t. G is a minor of Wxh grid

Minor (of graph H)

graph obtained from H by

contracting edges

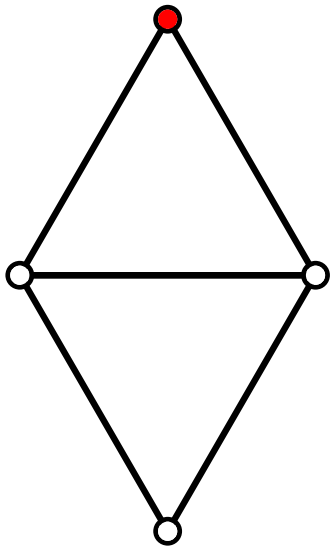
removing edges/vertices

To see how to use this, and the other concept (Homotopy-Height) to draw graphs, pick this paper!

Edge-Length Ratio of (Outer-)Planar Graphs

Def. Sei G ein (planarer) Graph.

Sei Z eine geradlinige (planare) Zeichnung von G.



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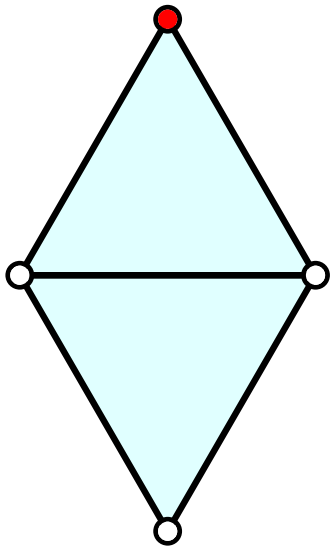

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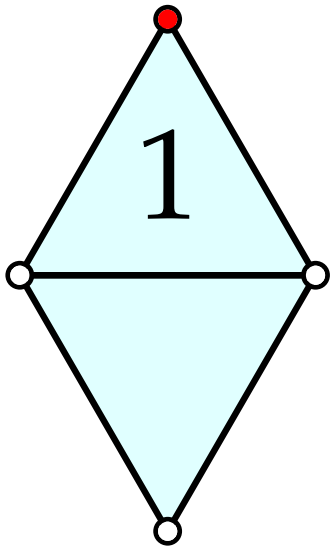

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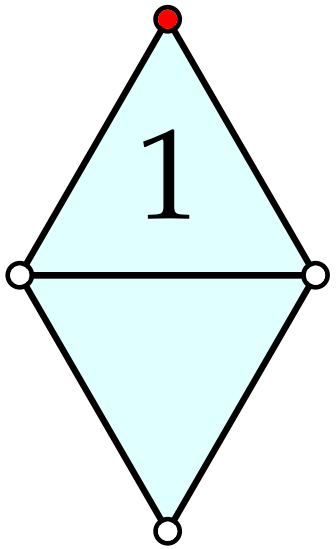

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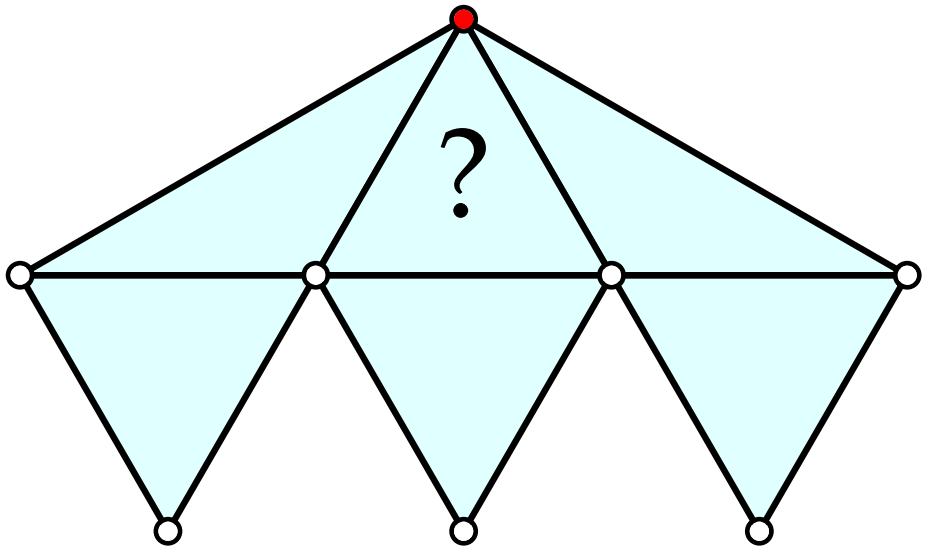

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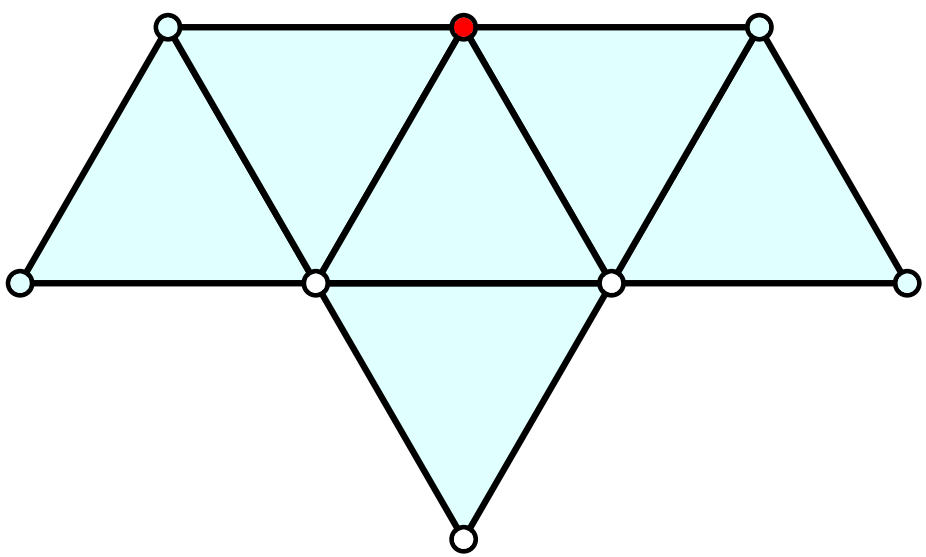

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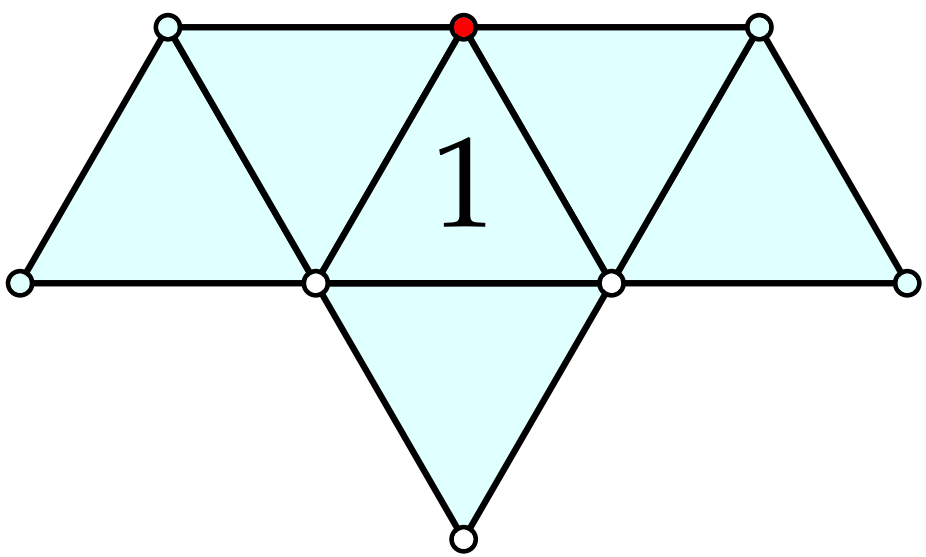

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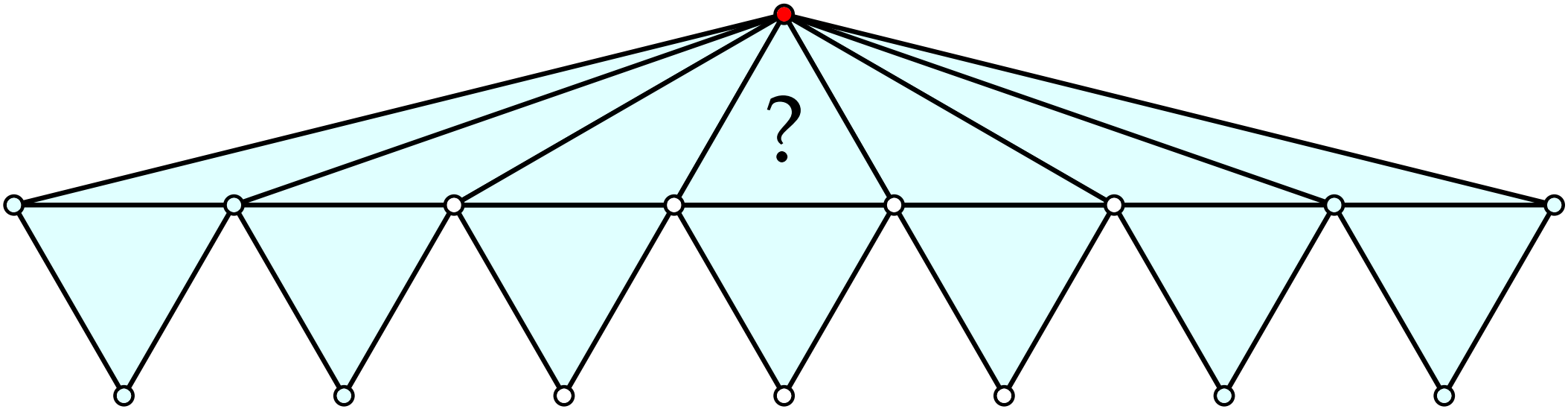
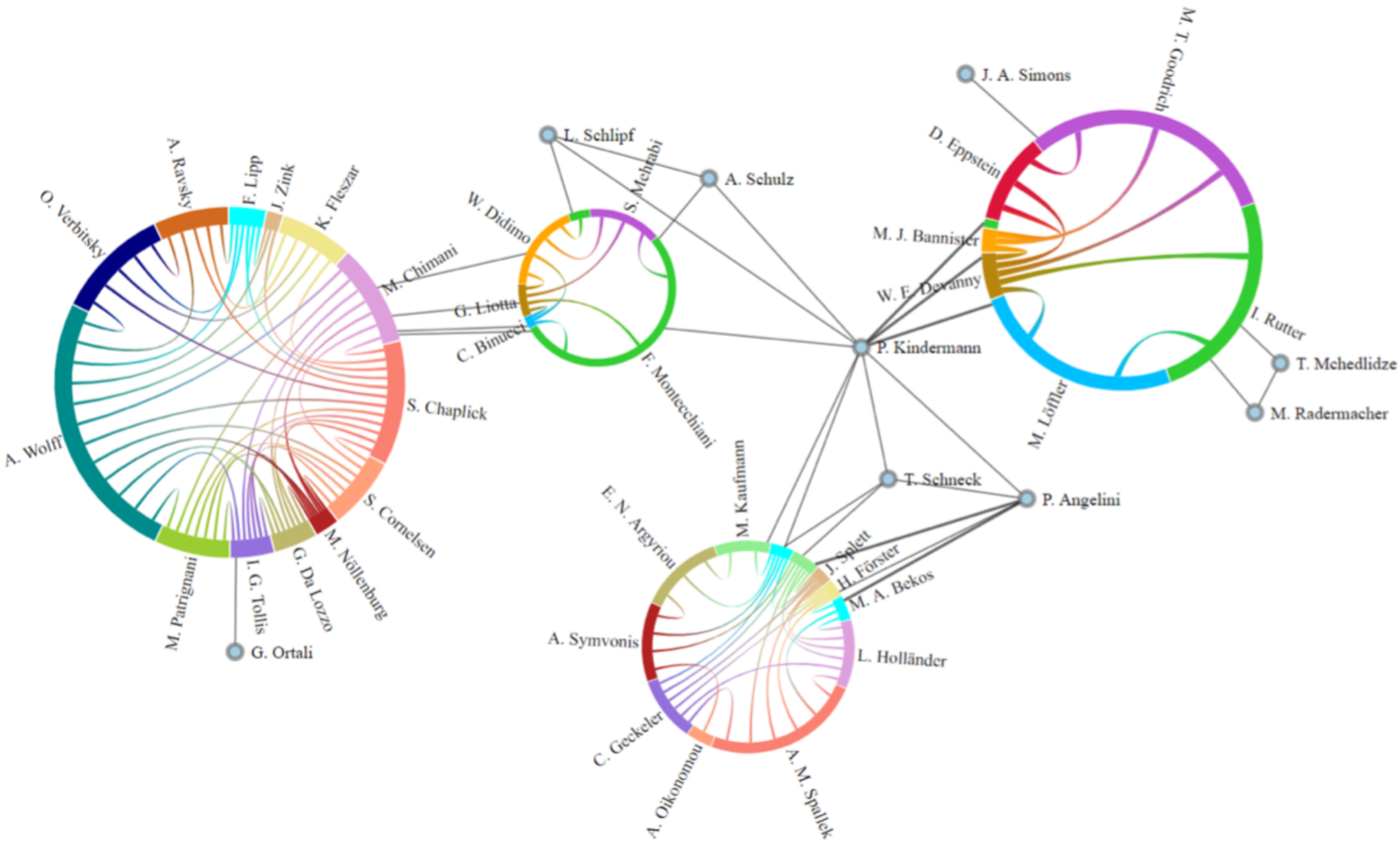


ChordLink: A New Hybrid Visualization Model



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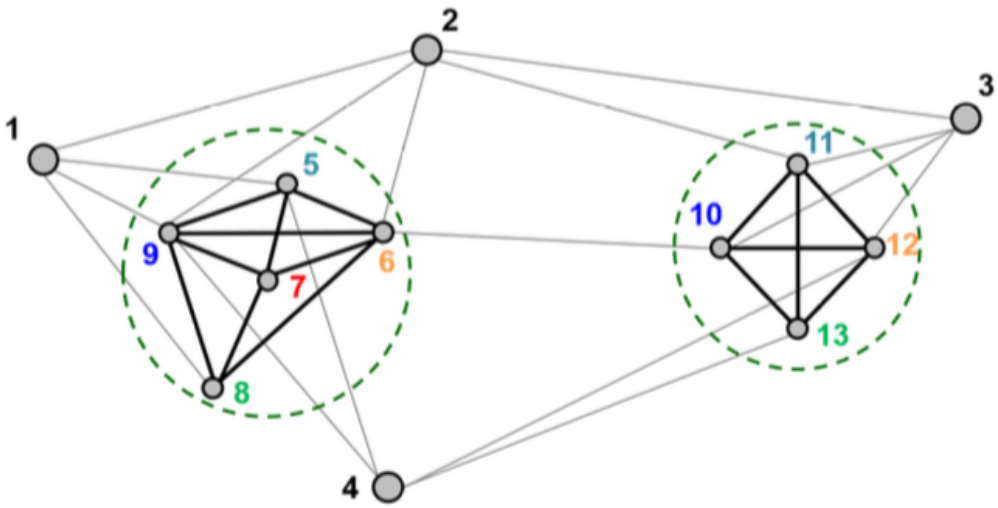
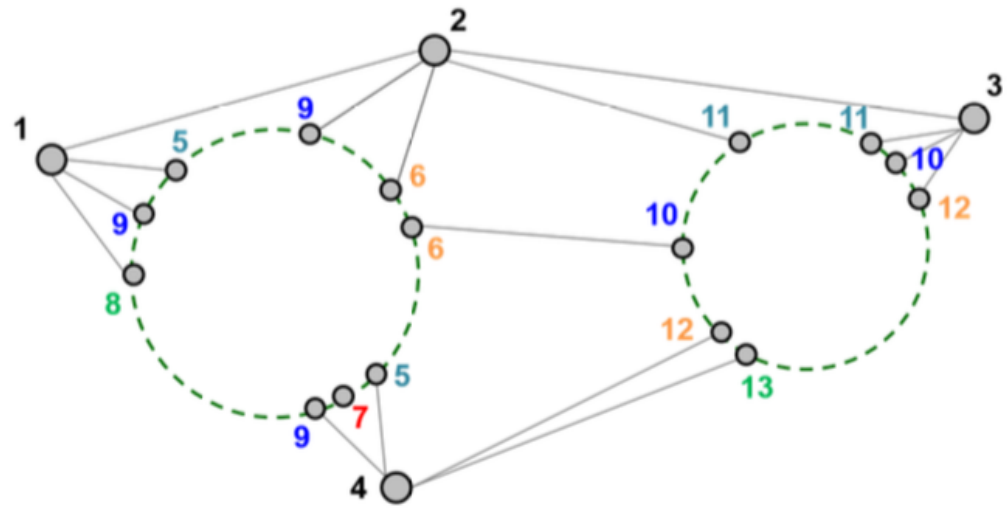
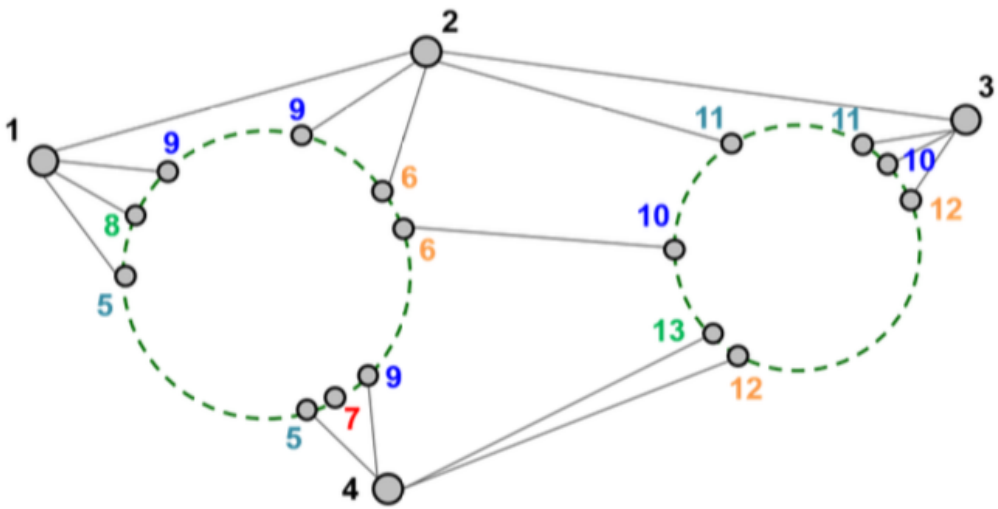


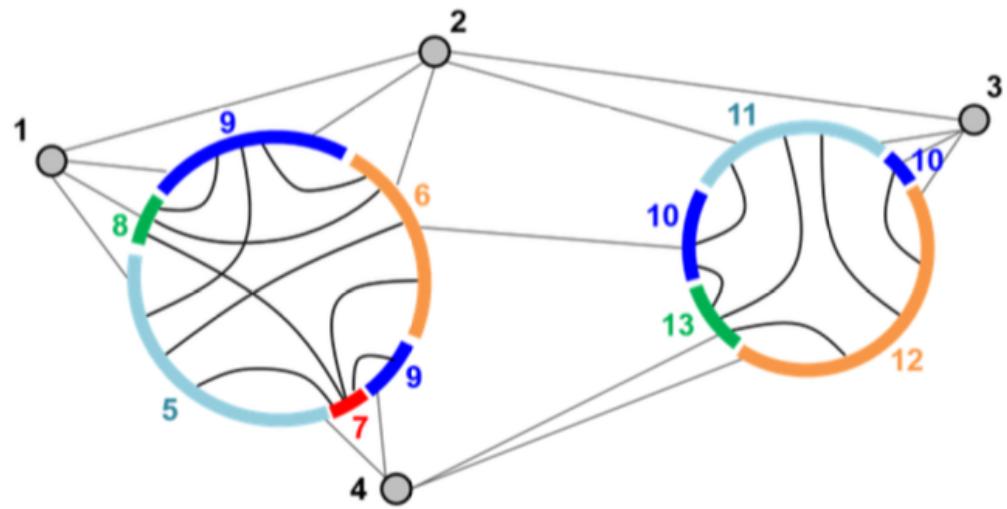
(a) Initial Drawing



(b) NodeReplication

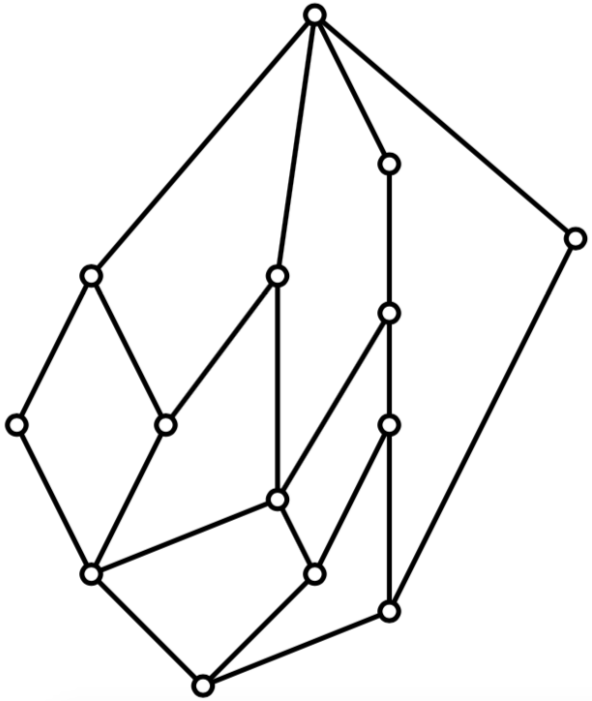


(c) NodePermutation



(d) NodeMerging+ChordInsertion

4-Connected Triangulations on Few Lines



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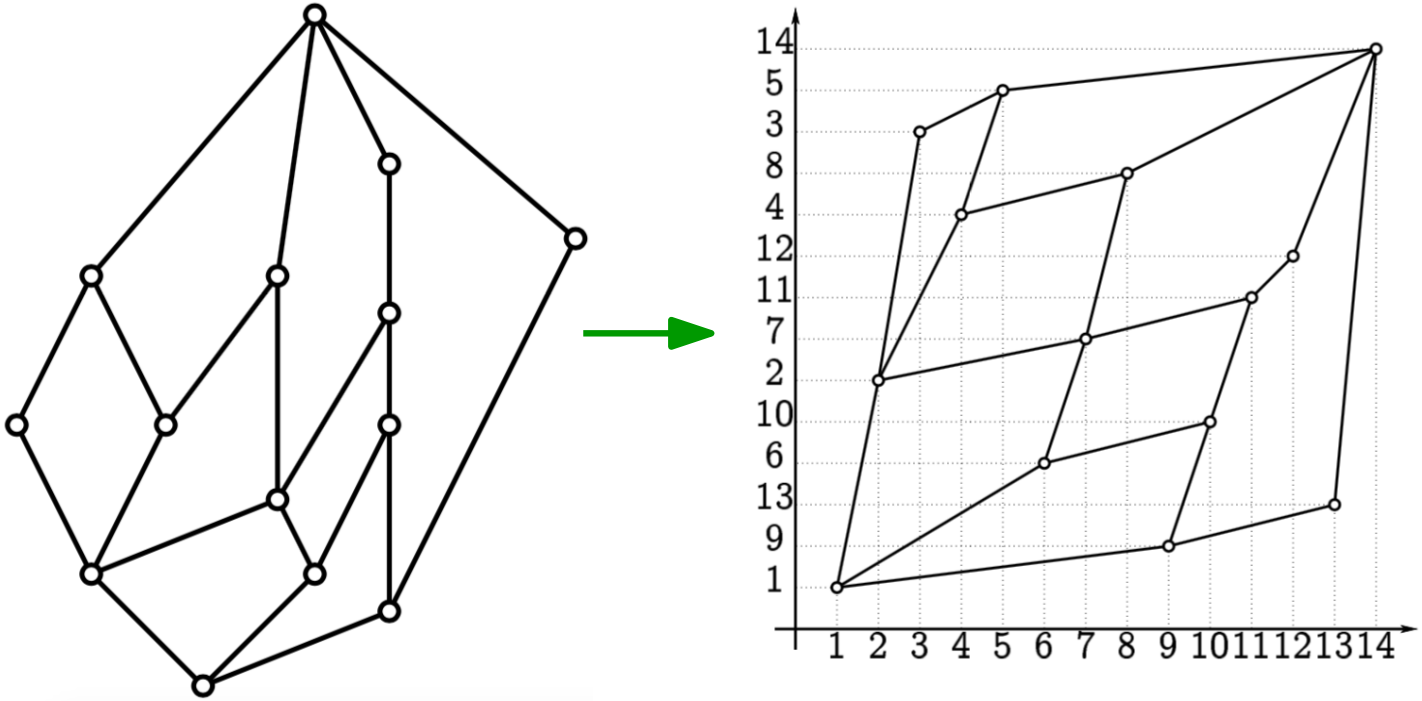

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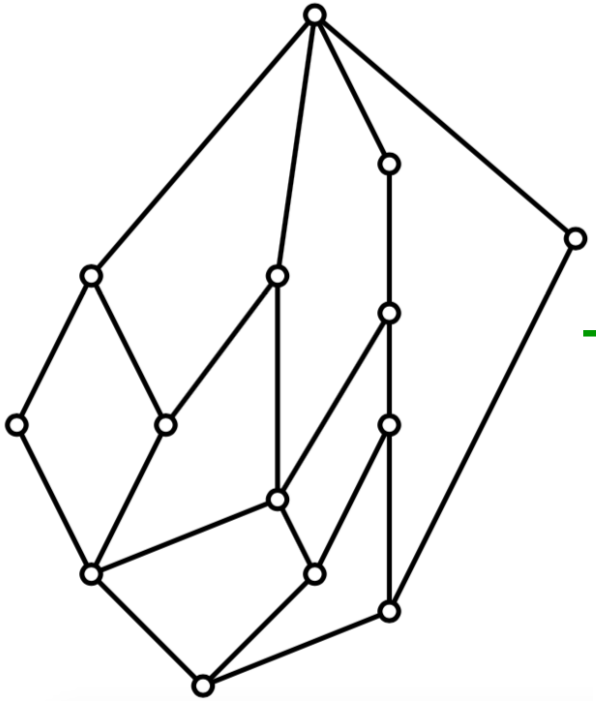

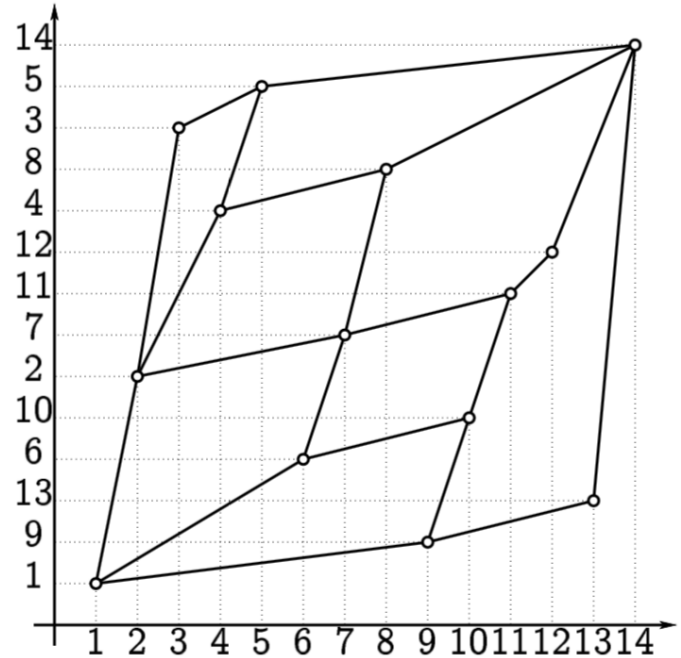

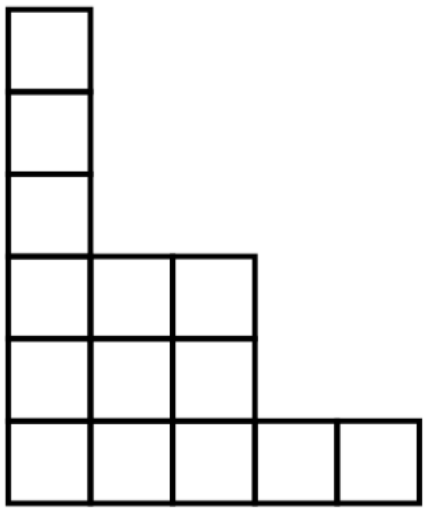

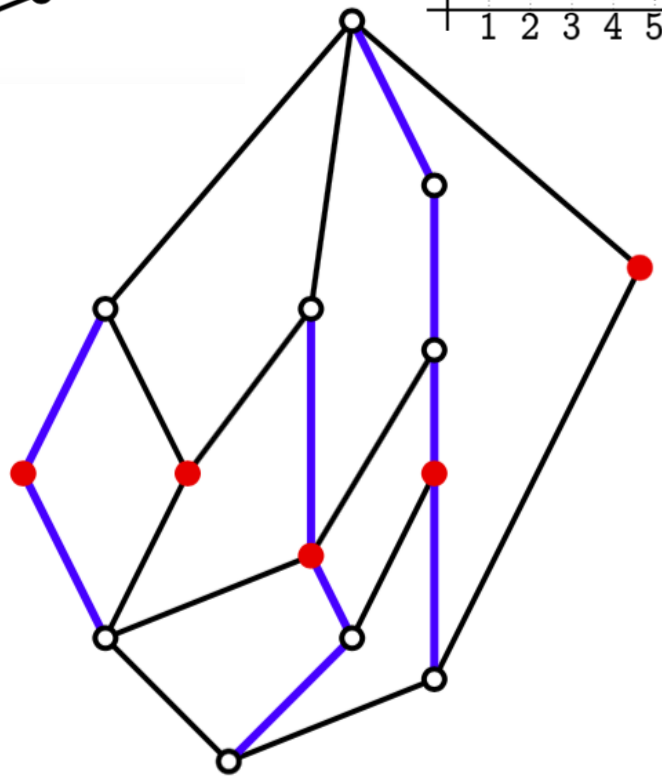

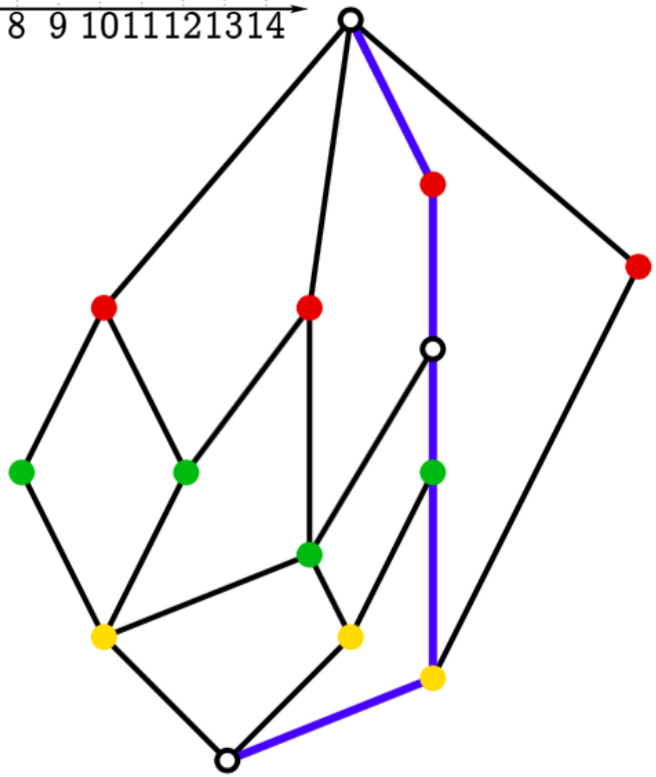

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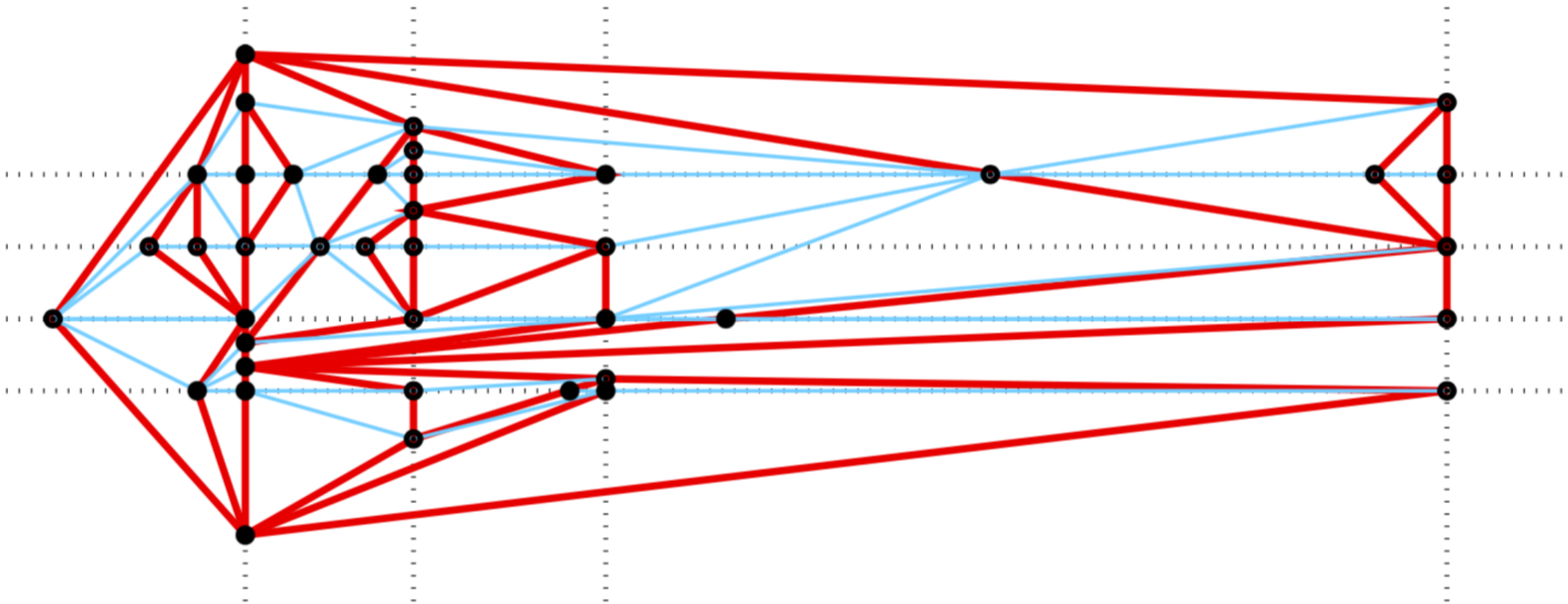

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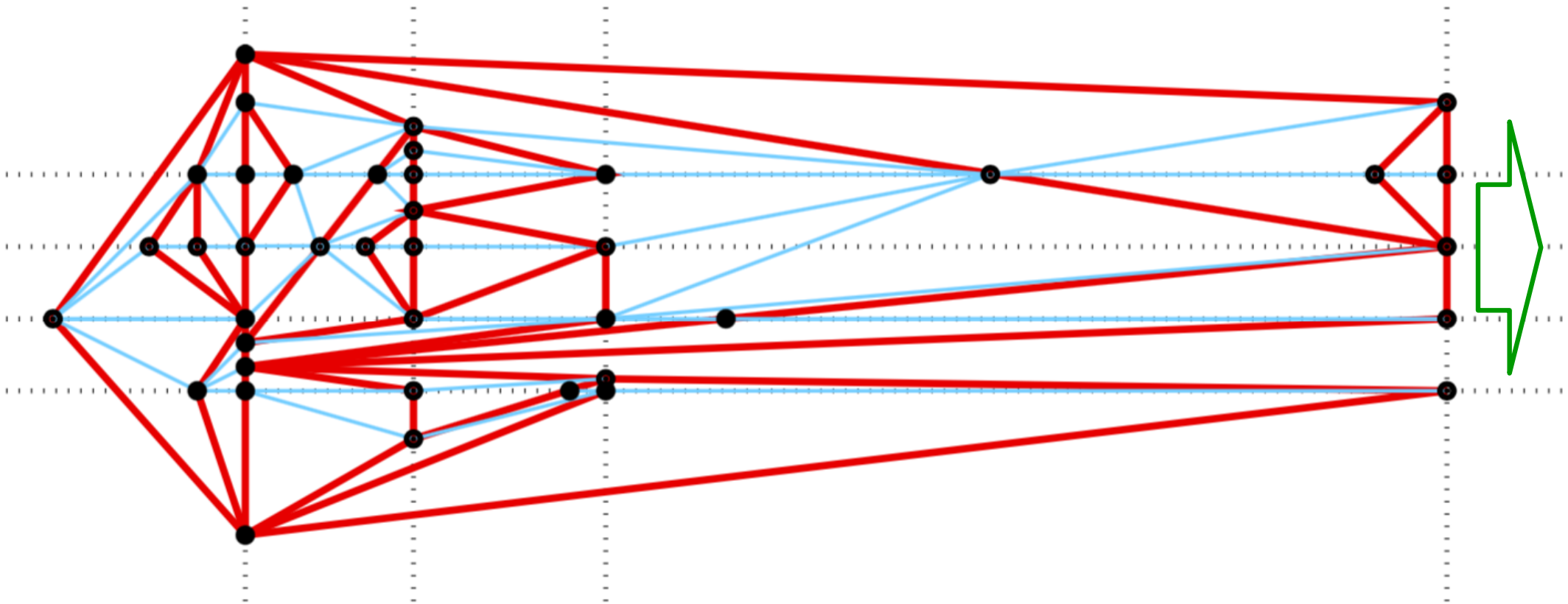

Themenübersicht

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2. Parameterized Algorithms for Book Embedding Problems (PK)
3. Local and Union Page Numbers (PK)
4. Level-Planar Drawings with Few Slopes (PK)
5. Optimal Morphs of Planar Orthogonal Drawings II (SC)
6. Exact Crossing Number Parameterized by Vertex Cover (SC)
7. Homotopy Height, Grid-Major Height and Graph-Drawing Height (SC)
8. On the Edge-Length Ratio of (Outer-)Planar Graphs (AW)
9. ChordLink: A New Hybrid Visualization Model (AW)
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