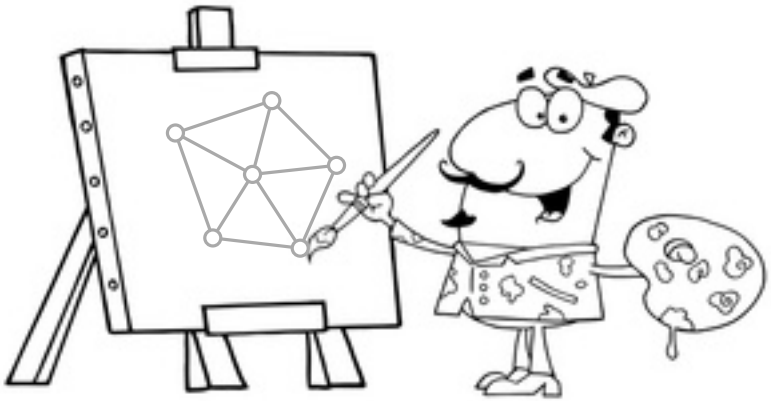
Karlsruhe Institute of Technology

Practical Course on Graph Visualization

Introduction

SUMMER SEMESTER 2014/2015

Tamara Mchedlidze – Martin Nöllenburg



VS

Organization

Instructors

- Tamara Mchedlidze
- mched@iti.uka.de
- Office 307

- Martin Nöllenburg
- noellenburg@kit.edu
- Office 319

Class meetings

- Tuesday 11:30 - 13:00
- Room SR301
- Detailed plan of meetings on the webpage

Organization

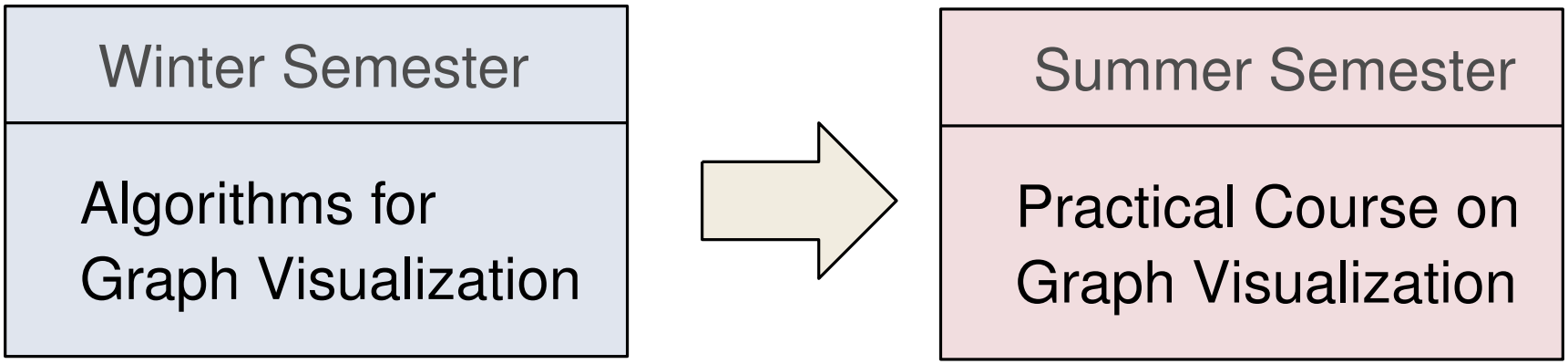
Web-page

http://i11www.iti.uni-karlsruhe.de/teaching/sommer2015/graphvis/

Information on the web-page

- Meeting dates (subject to change)
- Deadlines and goals
- Literature and reading material (...)

Practical Course on Graph Visualization



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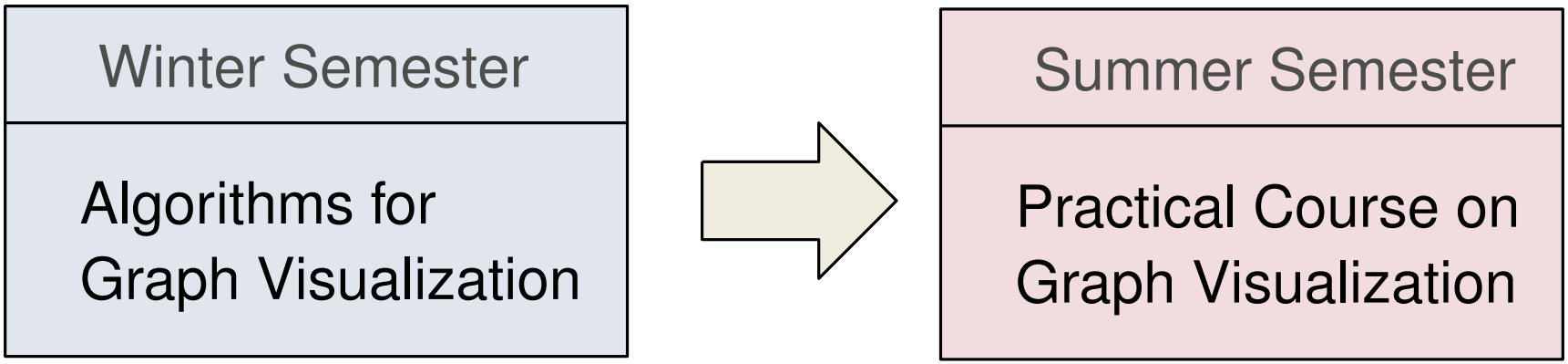
Practical Course on Graph Visualization



- Practical course is part of the module Theory and Practice of Graph Visualization (IN4INGTP)
- Module consists of the theory lecture (5 credits) and the practical course (5 credits)

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Practical Course on Graph Visualization

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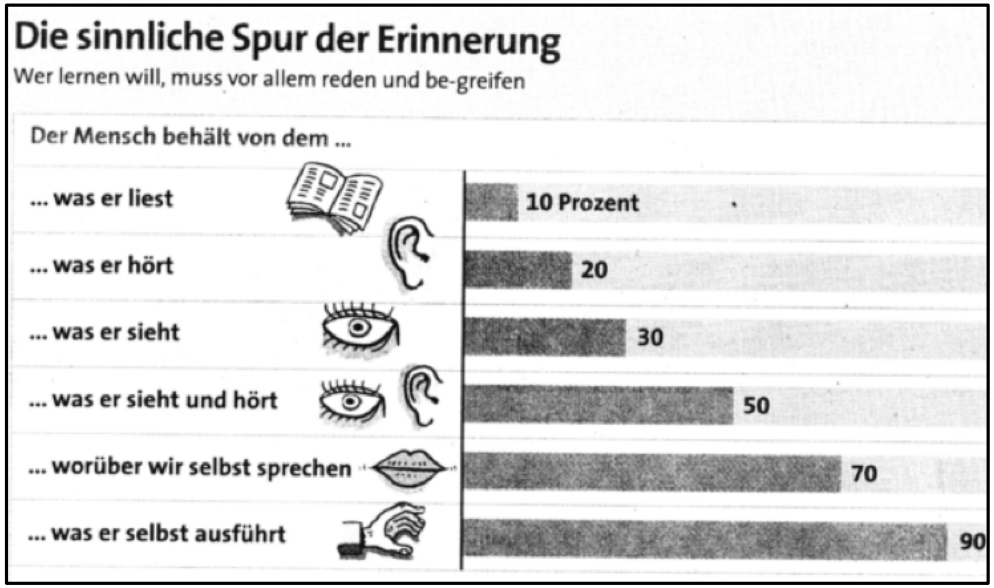
Winter Semester	Summer Semester
Algorithms for Graph Visualization	Practical Course on Graph Visualization



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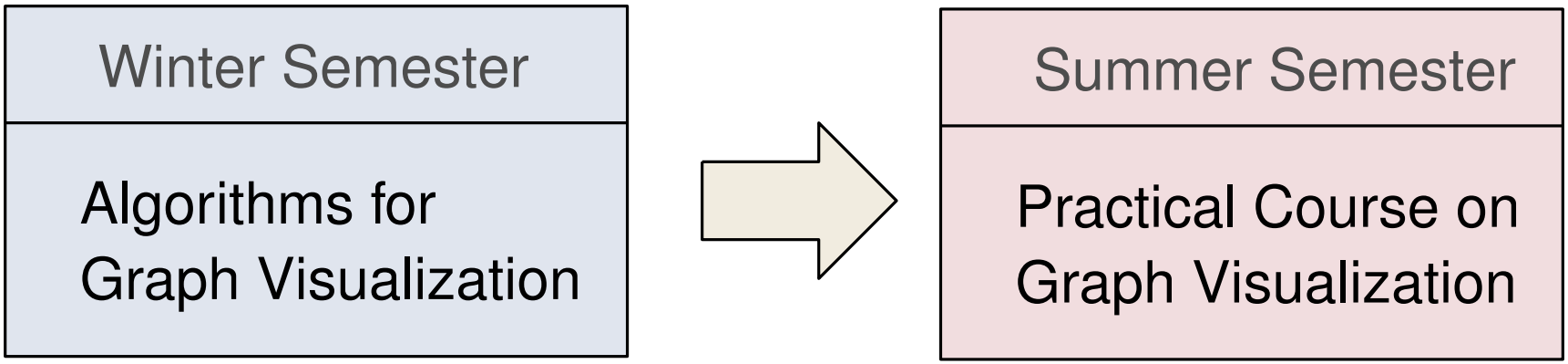

Learning outcome

- Deepen knowledge in Graph Visualization
- Concentrate on a particular topic
- Read, understand and apply scientific publications
- Adapt and combine existing algorithms
- Design new solutions - exact or heuristical

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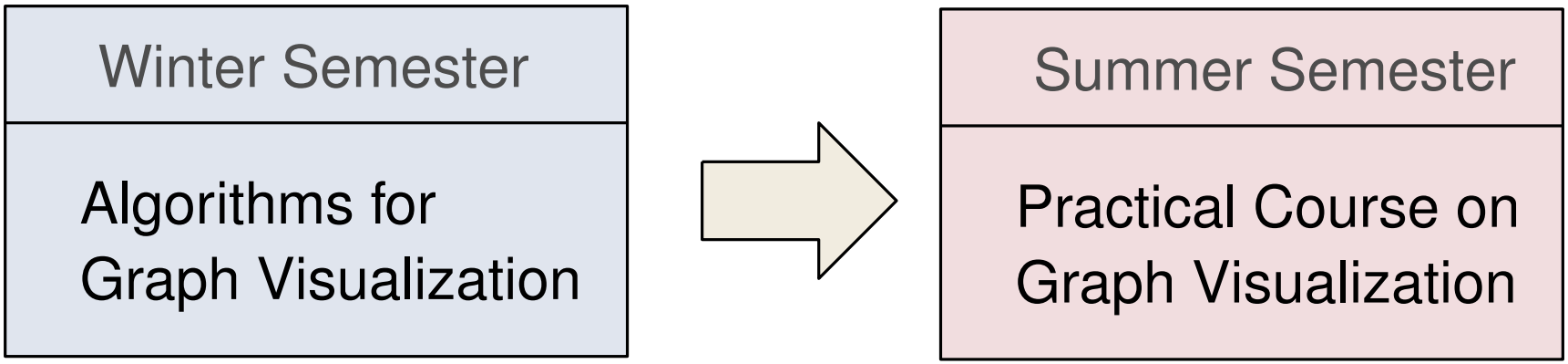

Learning outcome

- Implementation and evaluation of the developed solutions
- Create and manage a complex software project
- Work in a team

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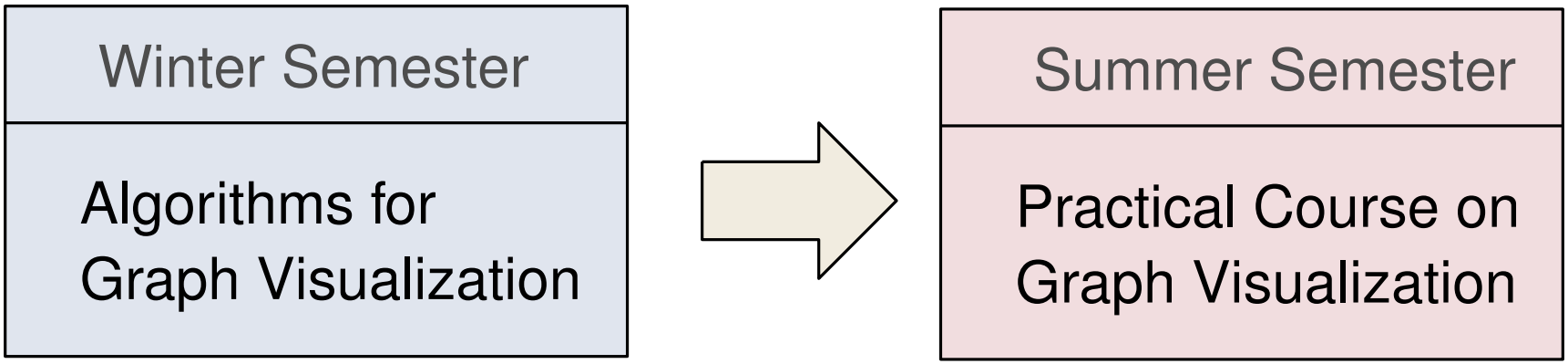

Motivating Goal

- Participation in Graph Drawing contest
- Holds during *23rd International Symposium on Graph Drawing and Network Visualization* - September 24-26
- For more info: http://www.csun.edu/gd2015/

Practical Course on Graph Visualization

Time Requirements

5LP = 150h

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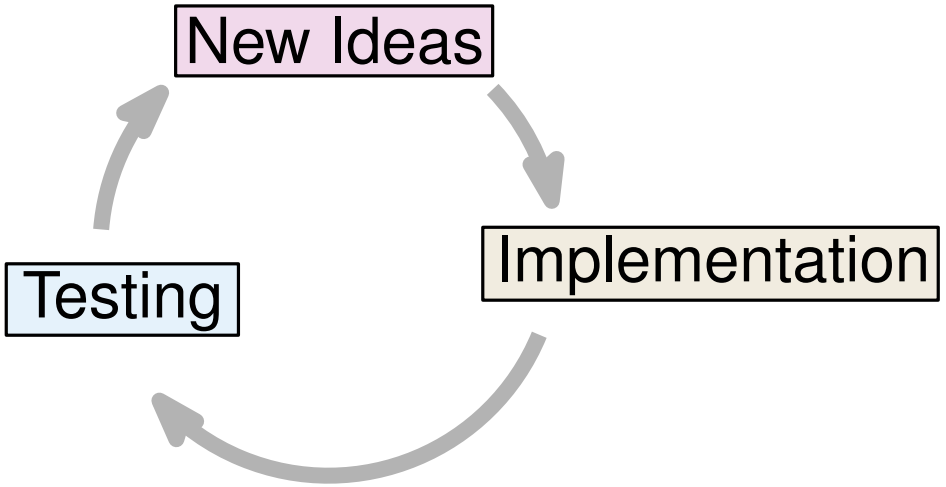
Practical Course on Graph Visualization

Time Requirements — 5LP = 150h

- Class meetings — 10h
- Literature reserach — 30h
- 

— 100h
- Presentation and Documentation — 10h

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Schedule

April 14 (today) _____ Organization and Introduction to the topic

Search, read and understand related work

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April 21 Discussion of the found work

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April 28 — Discussion of the found work, Distribution of topics

Detailed study, preparation of presentations

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May 12 — Presentations

Develop approaches

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Develop approaches

May 26 — Discuss approaches

Develop structure of the software

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June 2 — Discuss structure of the software

Implementation - Testing

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Implementation - Testing

June 16 — Questions

Implementation - Testing (till July 1) - Presentation preparation

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Implementation - Testing

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July 7 — Final Presentations

Software-final issues, Documentation

July 14 — Submit the software and the documentation

Grading

Scheme

- Successful completion of the project - 70%
- Final presentation - 20%
- Written documentation - 10%

Grading

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- Successful completion of the project - 70%
- Final presentation - 20%
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Successful completetion of the project

- Be present and active on meetings
- Contribute to literature search
- Contribute to discussions
- Contribute to coding
- Quality of the software
- Validity of the solution (all constraints are met)
- What if you do not ... ?

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Crossing Minimization in Book Embedding

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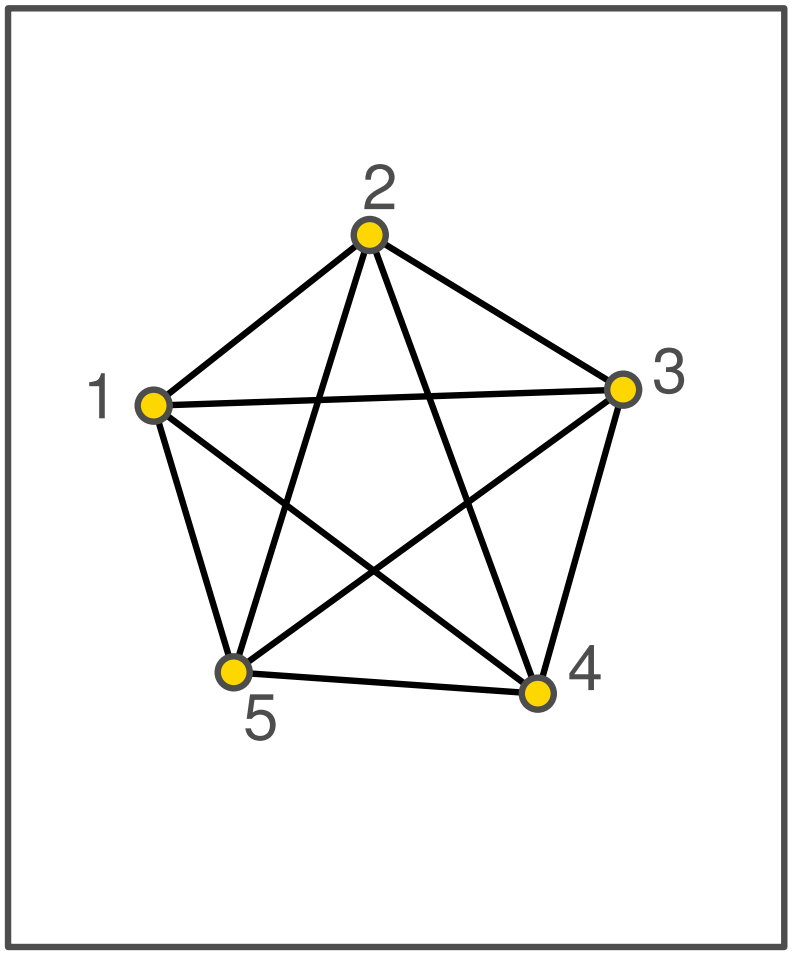
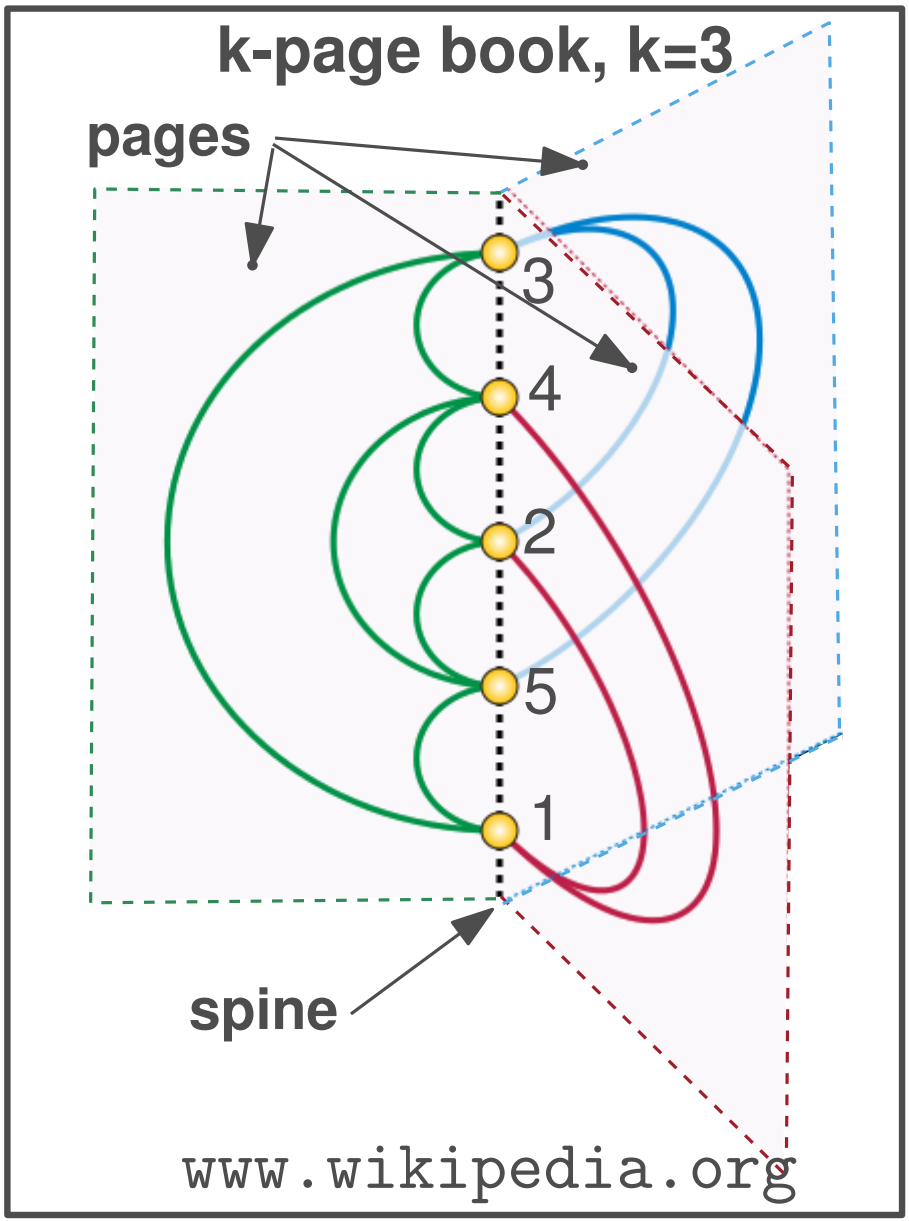
Introduction

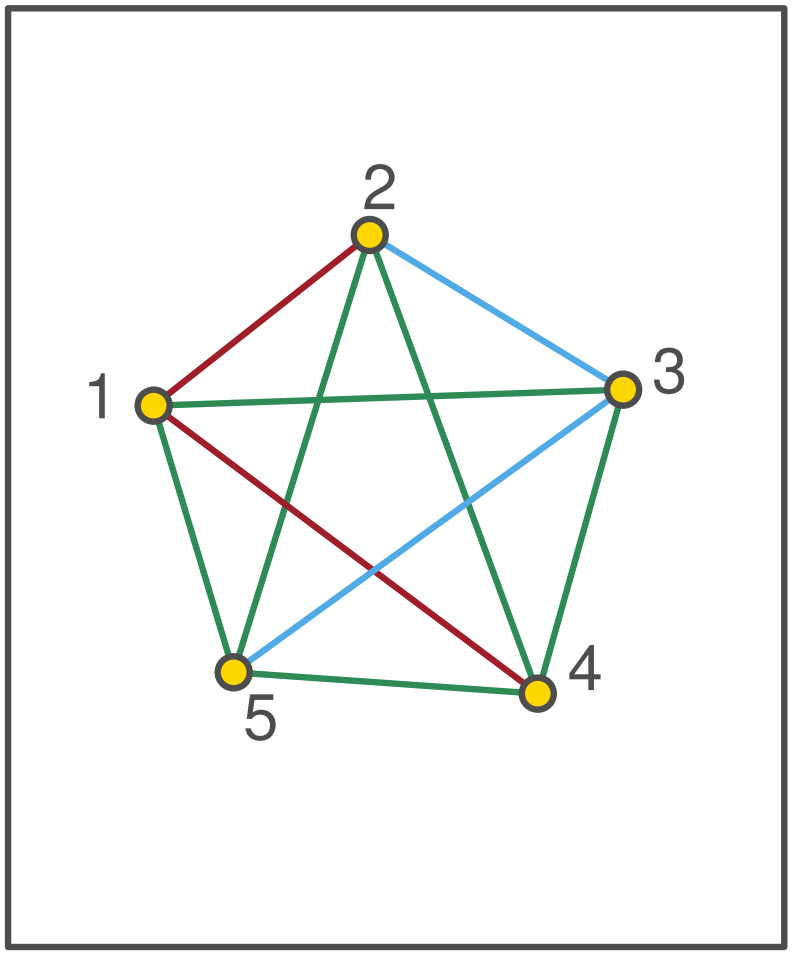
Book Embedding

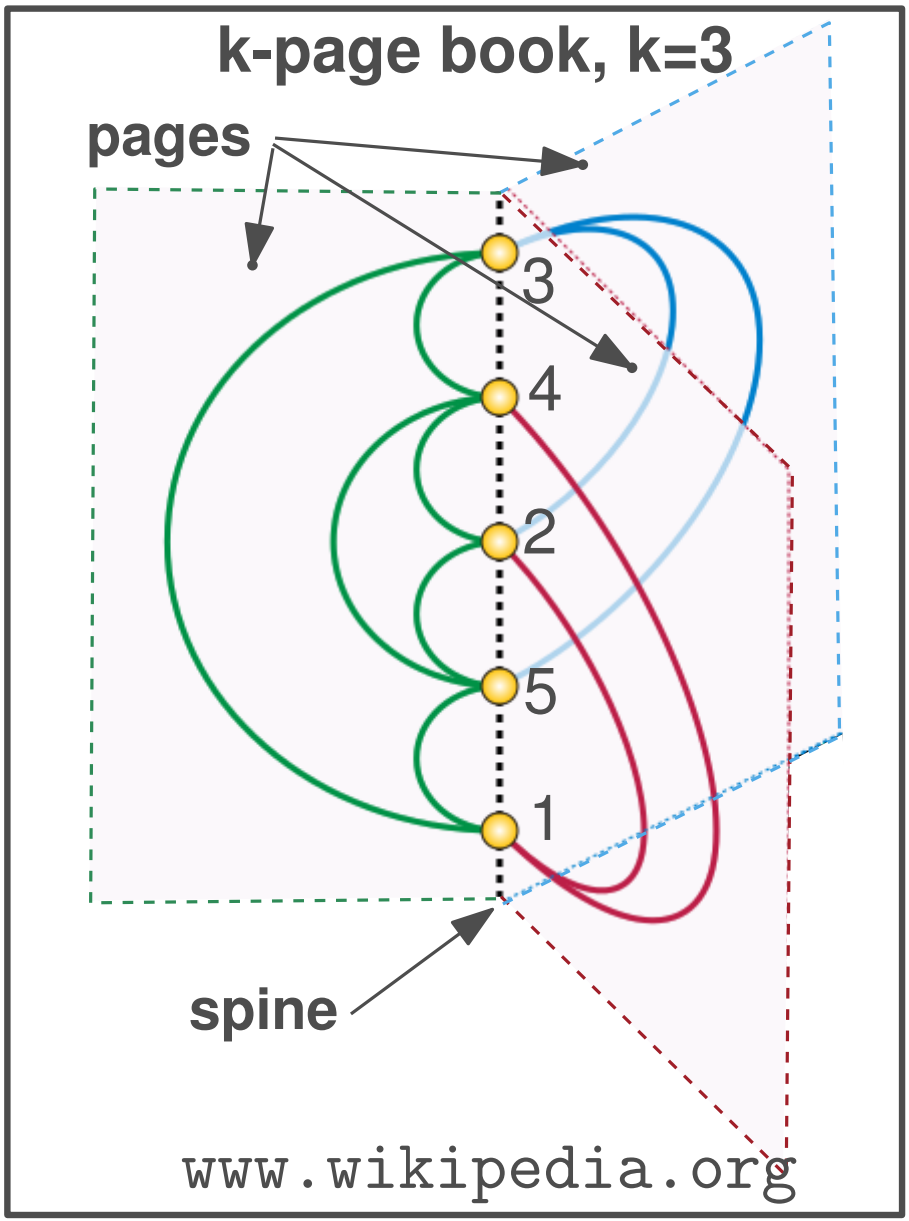




Introduction

Book Embedding





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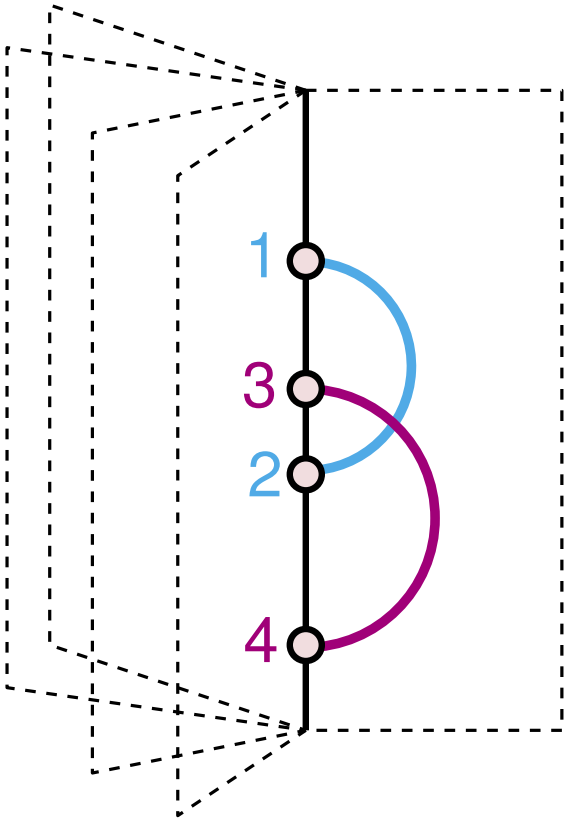
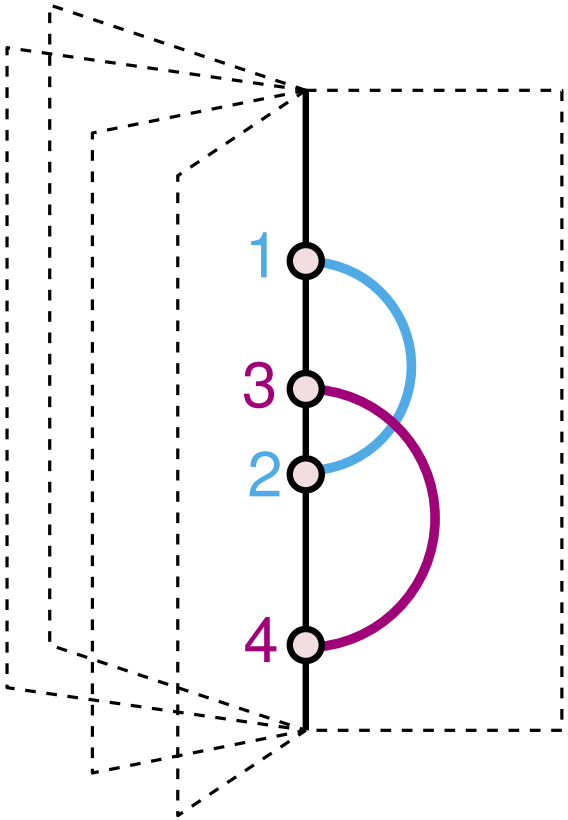


Can I always get a crossing-free drawing?

Introduction

Book Embedding



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Obviously, not!

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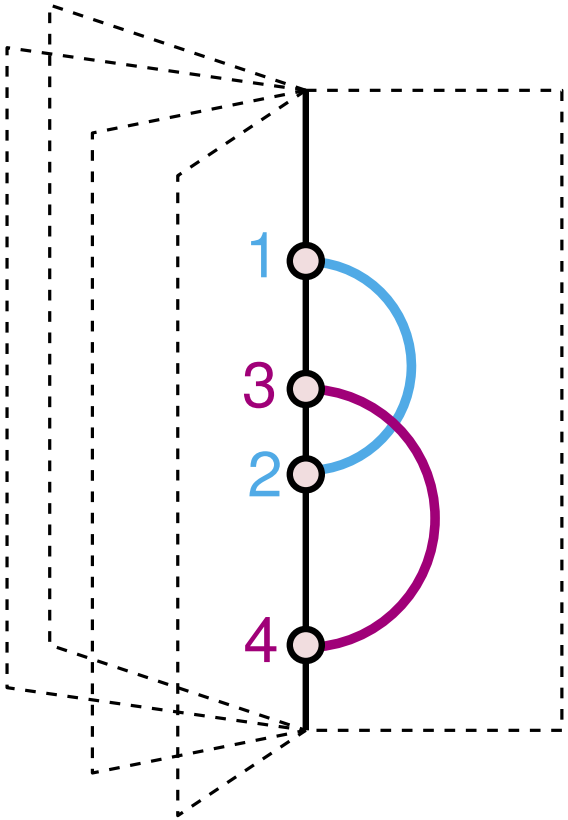

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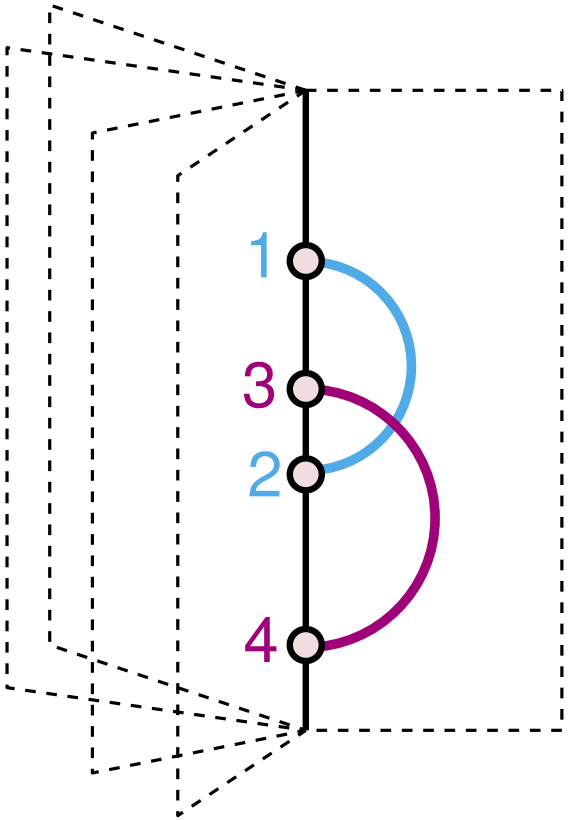
Given: Graph G and an integer $k > 0$

Introduction

Book Embedding



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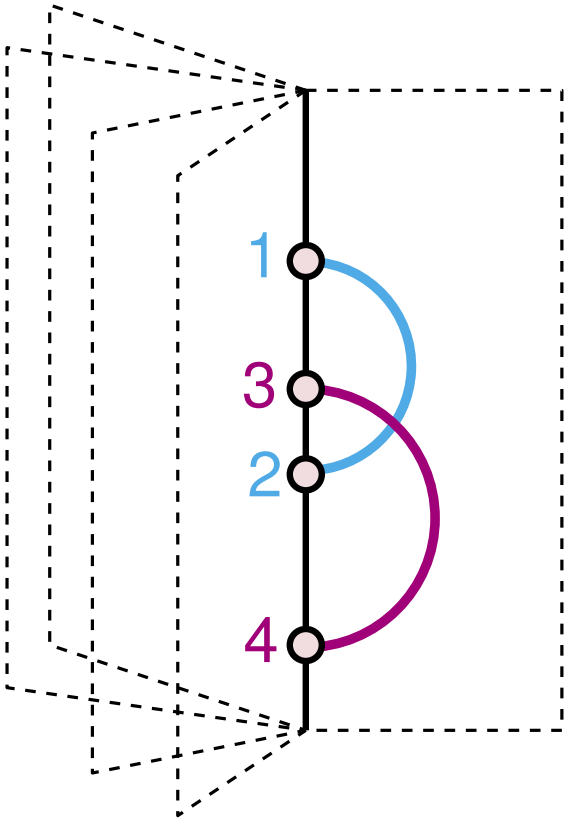
Crossing Minimization in Book Embedding:

Given: Graph G and an integer $k > 0$

Find: A k-page book embedding with minimum number of crossings

Introduction

Book Embedding



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Obviously, not!

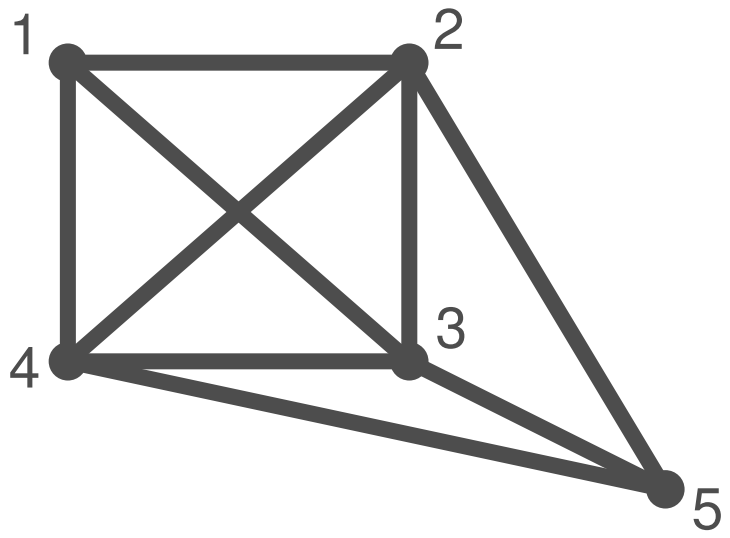
Crossing Minimization in Book Embedding:

Given: Graph G and an integer $k > 0$

Find: A k-page book embedding with minimum number of crossings

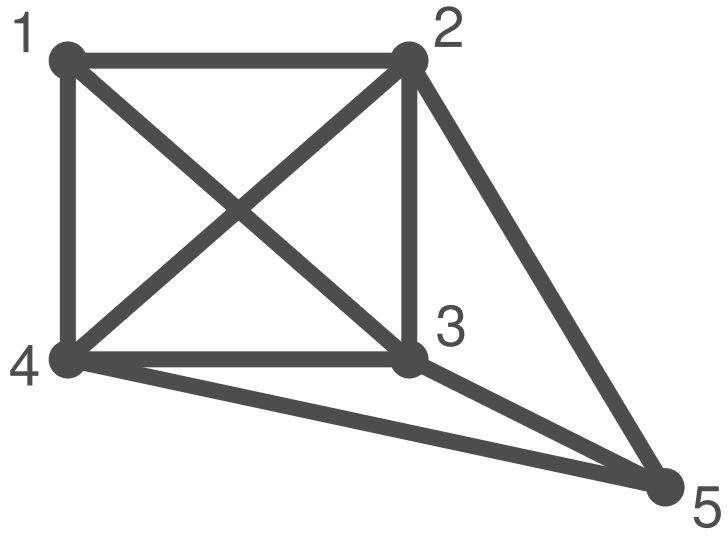
- Find a permutation of the nodes on the spine
- Find an assignment of the edges to the pages
- So that the total number of crossings is minimized

Examples



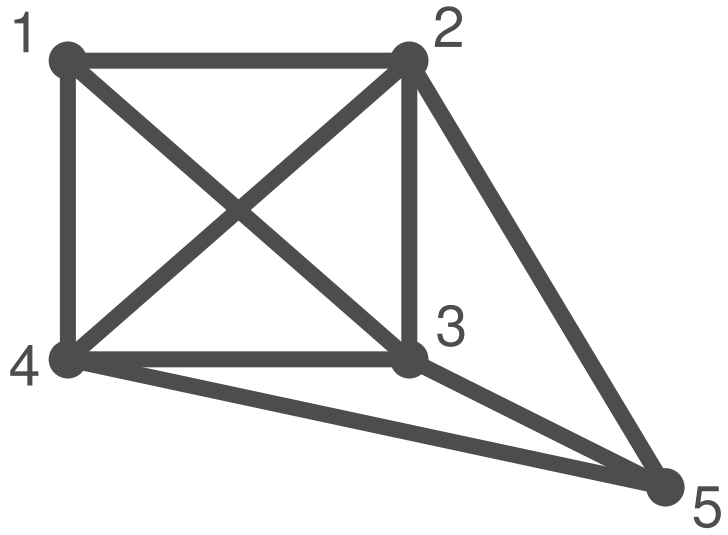
- k=2
- k=3

Examples



- k=2 Two crossings?
- k=3

Examples



- k=2 Two crossings?
- k=3 One crossing?

Input (and Output) format

```
# Lines starting with # are comments and ignored
 # First value is the number of nodes (N)
 6
# Second value is the number of pages (K)
 2
# Next N numbers describe a permutation of the nodes as they occur along the spine.
 0
1
...
# Remaining lines are the edges.
# The first value is the source node.
# The second value is the target node.
# The third value is enclosed in rectangular brackets and describes the page to which that edge is assigned.
 0 1 [1] # Edge between Node 0 and Node 1 on page 1
 0 3 [0] # Edge between Node 0 and Node 3 on page 0
 ...
```

Literature Study

- Summarize the key results (usually found in the abstract and introduction)

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To be discussed in the class meeting

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Literature Study

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- Use Google Scholar!

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Literature Study

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crossing minimization in k-page book embedding
k-page crossing number

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Literature Study

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Related problem: **Book thickness of a graph**

Given: A graph G

Find: Minimum $k > 0$, so that G has a k-page book embedding with zero crossings

Literature Study

- **How to start?**
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- **What to google for?**

Identical terms:

Planar k-book embedding = k-stack layout

Book thickness = pagenumber, stacknumber

$k \leq 2$: Book embedding = arc diagram, circular layout

Literature Study

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Testing whether there exists a planar 2-page book embedding **is equivalent to** testing whether the graph is **Planar Subhamiltonian**

Given: A planar graph G

Question: Can we add edges to G to make it hamiltonian without destroying the planarity

Literature Study

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$\mathcal{NP}$**-complete**

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Next Meeting

- Untill the next lecture - **Literature search**

Next Meeting

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- During the next meeting
  - Discuss the found results

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  - 10 min brainstorming: ”How to use what we have found?”

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