

# ac ALGORITHMS AND COMPLEXITY GROUP



Institute of  
Computer Graphics and Algorithms  
186/1



# 186/1 timeline

... 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 ...

P. Mutzel

G. Raidl

S. Szeider

Algorithmen und Datenstrukturen



profs



Szeider



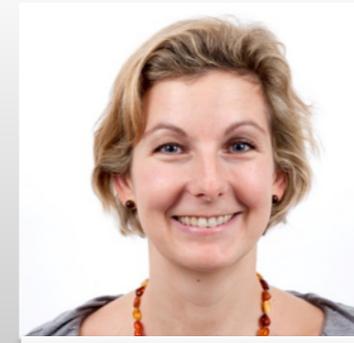
Raidl



Nöllenburg



Podlipnig  
teach



Dicklberger  
sek



Müller  
tech

post docs



Ganian



Ordyniak



Slivovsky



Bova



Sridharan



Fleischner

pre docs



Bacher



Klute



Riedler



Biesinger



Lodha



Eiben

3rd party

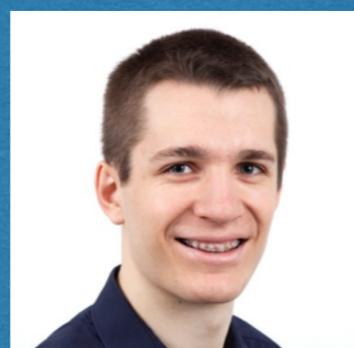
global  
budget



Kloimüller



De Haan



Klocker



Peitl



Maschler



Bagheri

profs



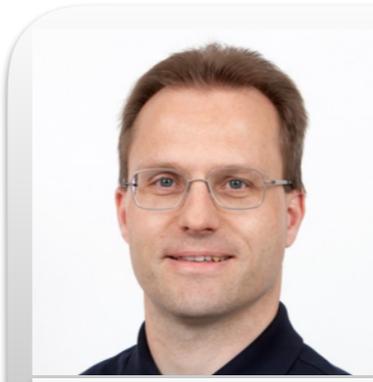
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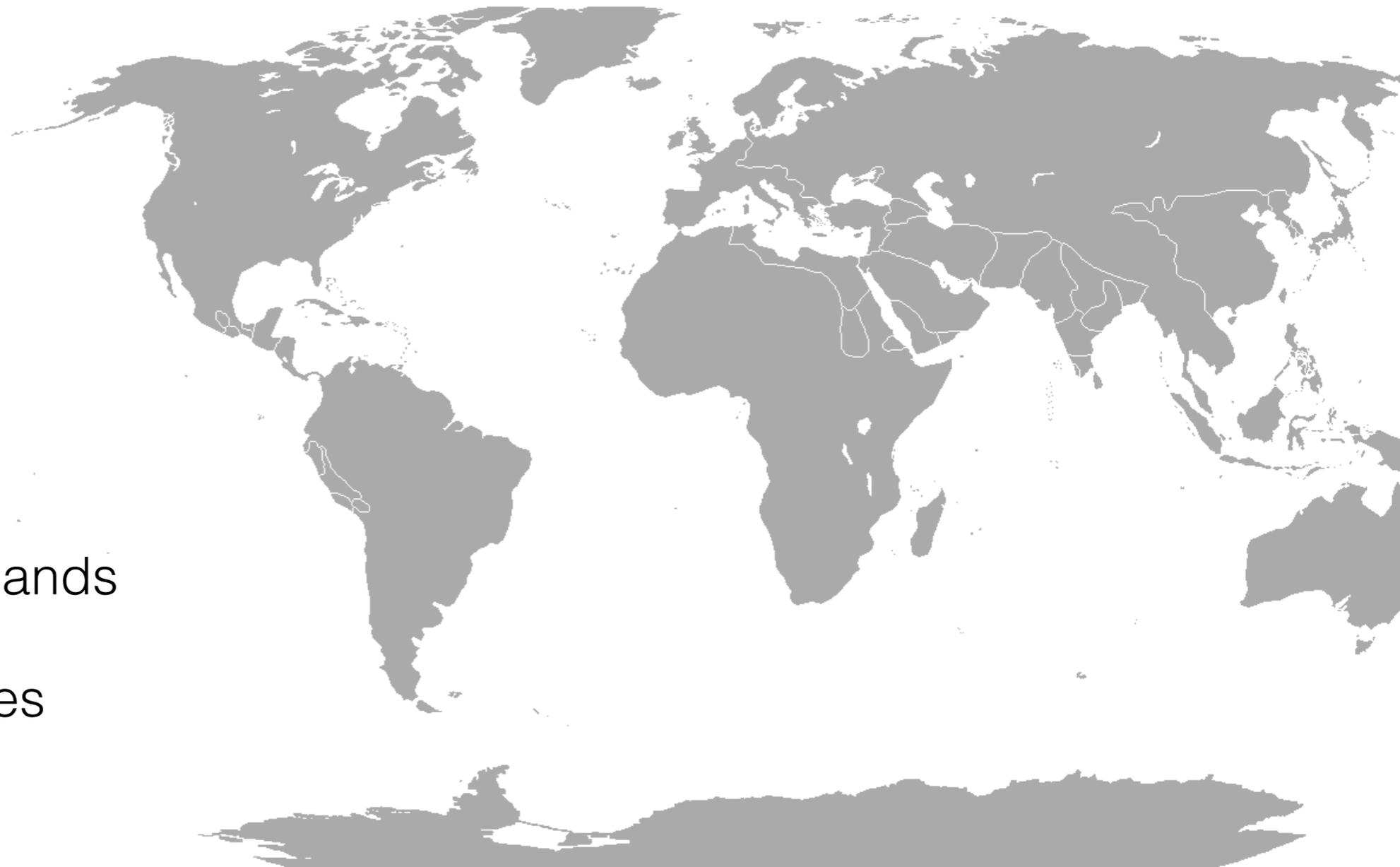
Maschler



Bagheri

# International Team

- Austria
- Germany
- India
- Iran
- Italy
- Slovakia
- The Netherlands
- United States



# Research Topics

- Faculty's research area **Logic and Computation**
- Theoretical and applied areas of **algorithms and complexity**
- Algorithms for **hard problems**: practical algorithms and algorithm engineering, worst case guarantees, algorithm analysis, upper and lower bounds
- Keywords: meta-heuristics, meta-theorems, logical methods, parameterized algorithms, graph drawing, geometric algorithms, satisfiability, constraints

# Research Output

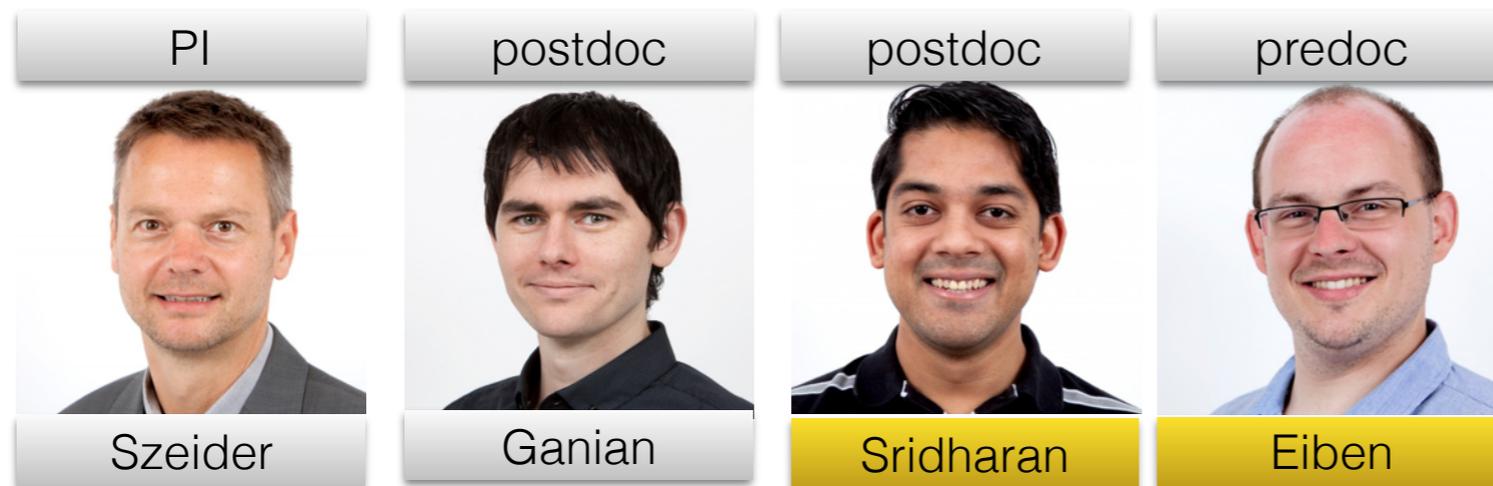
- A lot of **third-party research funding** (FWF, FFG, Google, MedAustron, ...)
- **Many publications** (2015: 75 papers)
- Publications at **top-ranked venues (many A\* and A)**
- many **PC memberships**
- **PC chairing** (IPEC13, MIC13, EvoStar13, WS-FLOC14, TAMA-CAST15, TAMA-CAST17, GD16, Dagstuhl, VCLA-Symposia,...)

# Editorial Boards

- Evolutionary Computation Journal
- Fundamenta Informaticae
- INFORMS Journal on Computing
- Journal of Applied Metaheuristic Computing
- Journal of Artificial Evolution and Applications, Memetic Computing
- Journal of Artificial Intelligence Research
- Journal of Computer and System Sciences
- Journal of Discrete Algorithms
- Journal of Metaheuristics

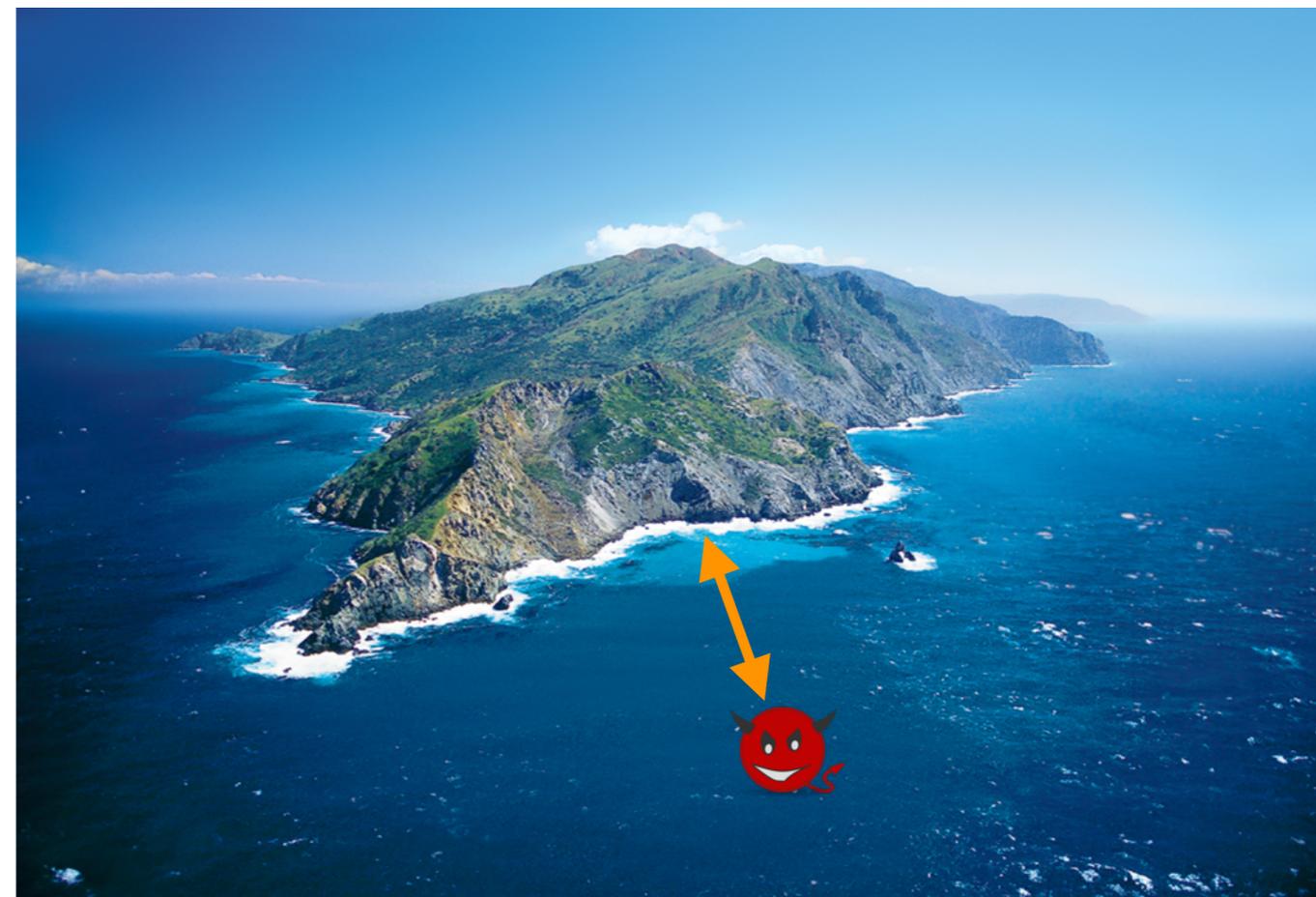
# Active Research Projects

# Exploiting New Types of Structure for Fixed Parameter Tractability

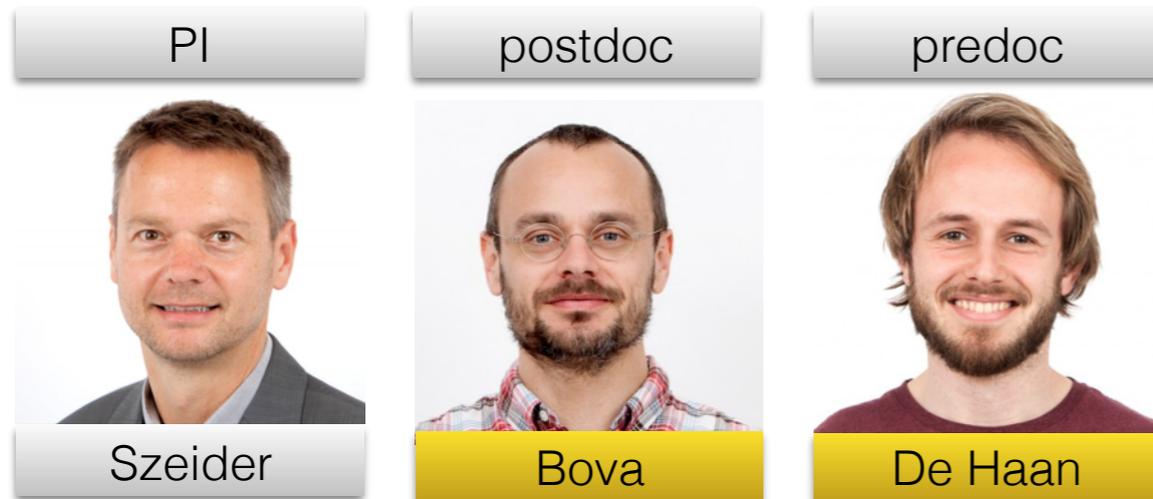


FWF 2014-2017  
€ 330k

- intractable problems on graphs and constraints
- islands of tractability
- exploit distance to island



# Parameterized Compilation



FWF 2014-2017  
€ 347k

- Knowledge Compilation: compile data to make hard queries easy
- main appl: probabilistic data bases, model counting, machine learning
- project: extend the classical framework, make more instances compilable



# Variable Dependencies of Quantified Boolean Formulas

PI



Szeider

postdoc



Slivovsky

predoc



Peitl

FWF 2015-2018  
€ 346k

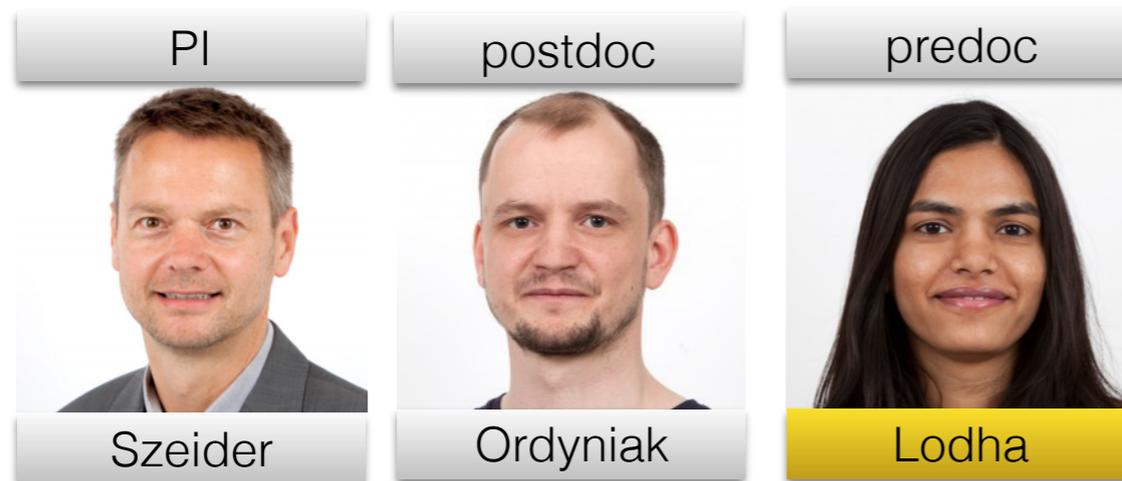
- QBF: succinct representation of hard problems (PSPACE)
- Main appl: verification
- Exploit independence of variables
- Make QBF-Solver faster,



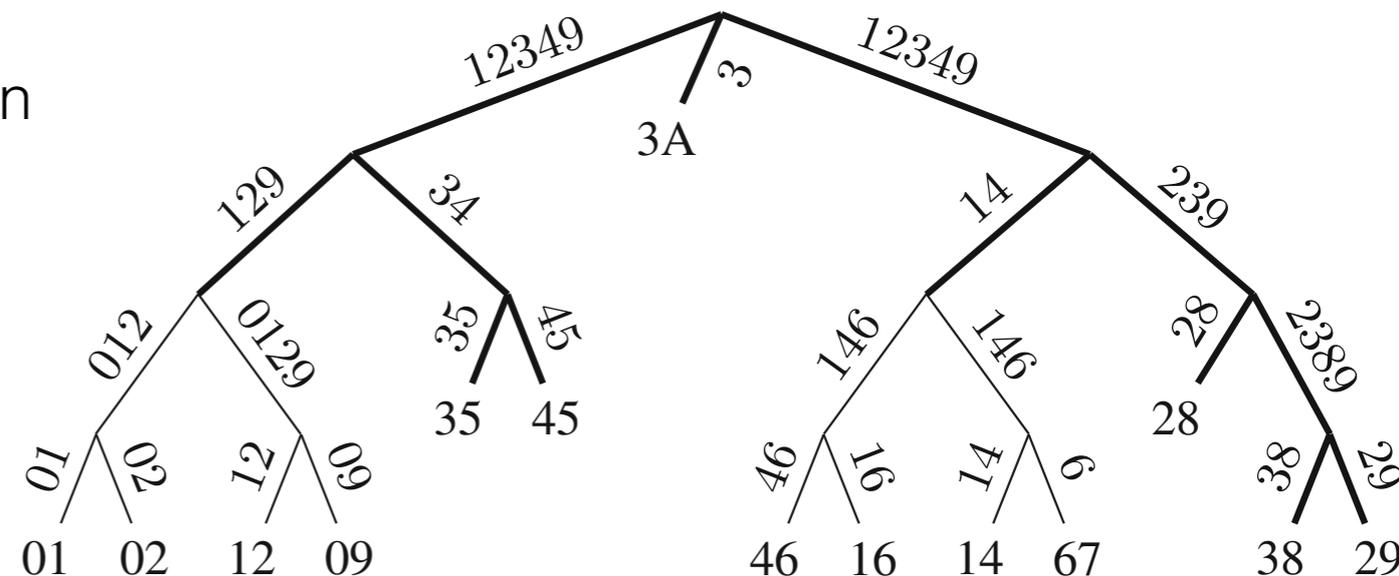
# Doctoral College Logical Methods in Computer Science (LogiCS)

Sub-Project: Structural decompositions via SAT

FWF 2014-2017  
€ 2.7m /10  
Szeider: speaker



- Use SAT-solver for problem decomposition
- main Appl: optimisation (TSP), Bayesian networks
- New method: SAT-based local improvement

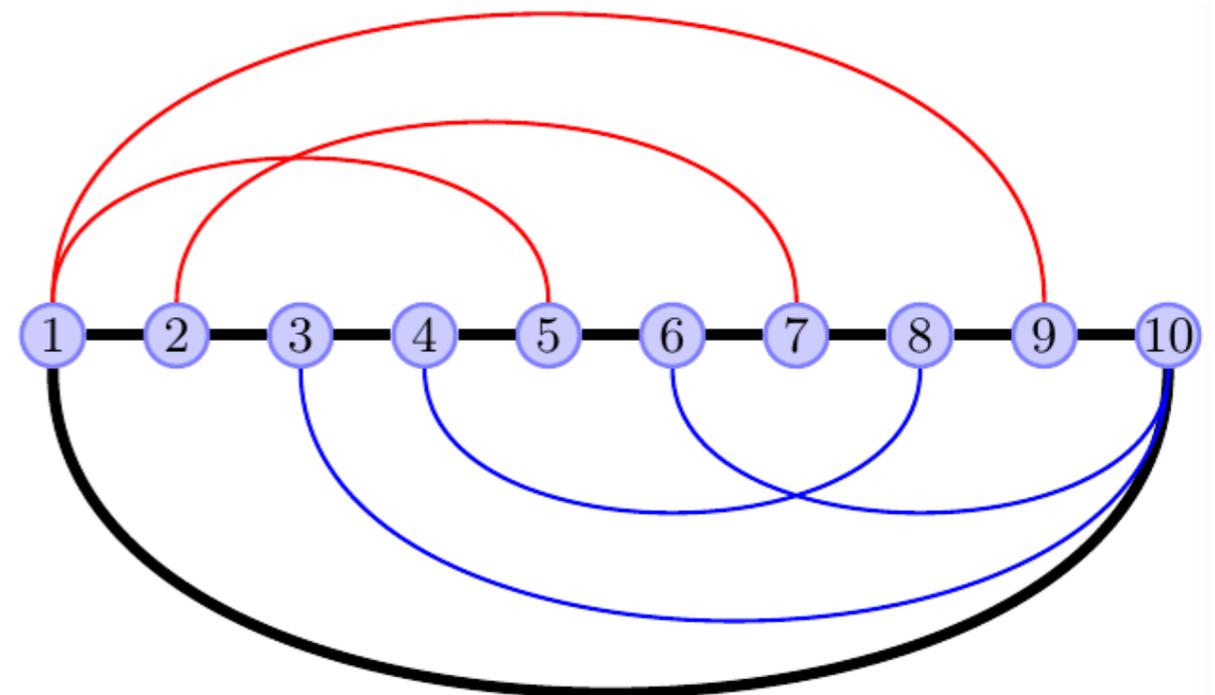


# Cycles in Graphs and Properties of Graphs with Special Cycle Structures

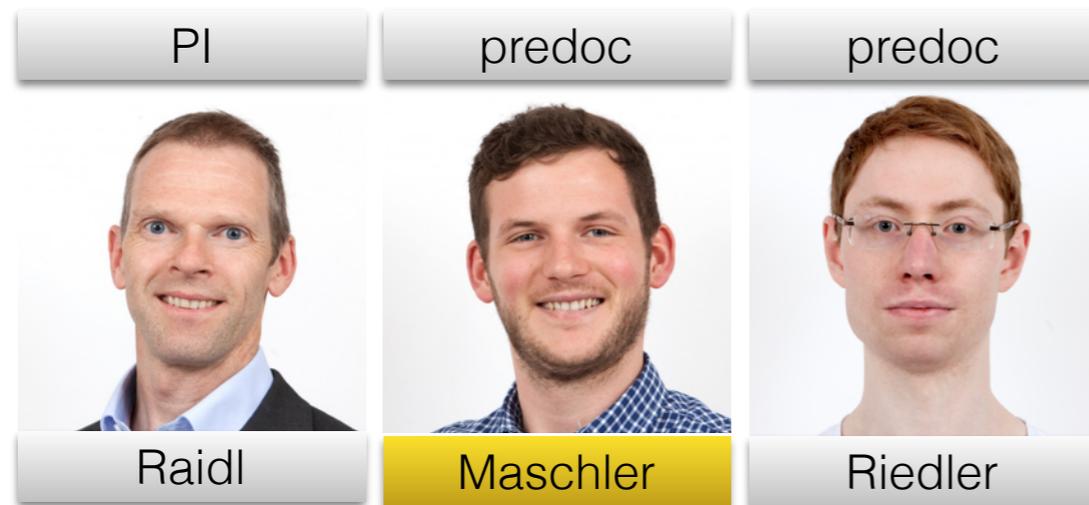


FWF 2015-2017  
€ 315k

- Proving or disproving graph theoretic conjectures
- on a theoretical basis
- and/or with computational methods from combinatorial optimization

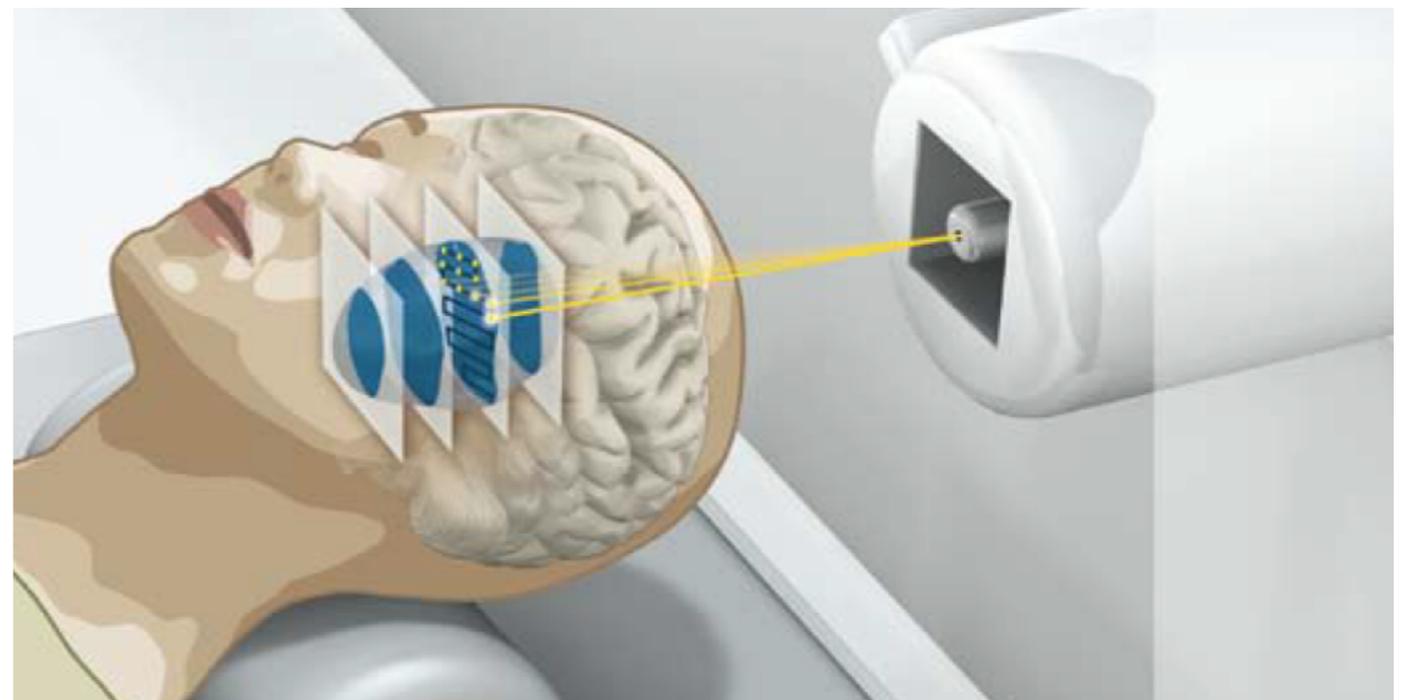


# Large Scale Radio Therapy Scheduling



MedAustron 2015-2018  
€ 350k

- Algorithms for solving large scale scheduling problems
- arising in particle/ radio therapy scheduling





# Station Planning for Public Bicycle Sharing Systems



FFG 2015-2017  
€180k

- Statistical modeling
- Optimization algorithms for stochastic location problems
- Rebalancing issues
- Collaboration with FH OÖ, AIT, Rosinak & Parnter ZT GmbH

**B**lan  
**i**SS

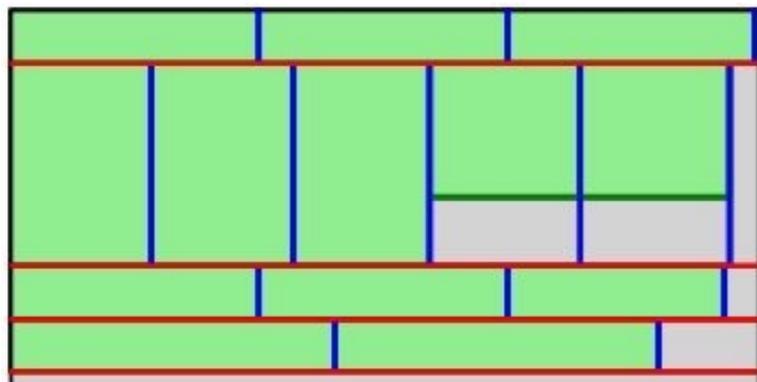


# Misc. Contract Research



## k-Staged 2D Bin Packing

- for Lodestar Technologies GmbH
- Algorithms for finding efficient cutting patterns for wood and glass manufacturing
- 2014-2016



## Districting and Routing for Security Control

- for CAPLAS GmbH
- Metaheuristic algorithms for partitioning and vehicle routing with time-windows
- 2015-2016



# Vienna Graduate School on Computational Optimization

Faculty Member



Raidl

FWF DK  
IST+UWien+TUW  
€1.6 m / 8  
starts Oct 2016

- Broad range of topics in optimization
- on our side focus on combinatorial optimization
- speaker: Georg Pflug

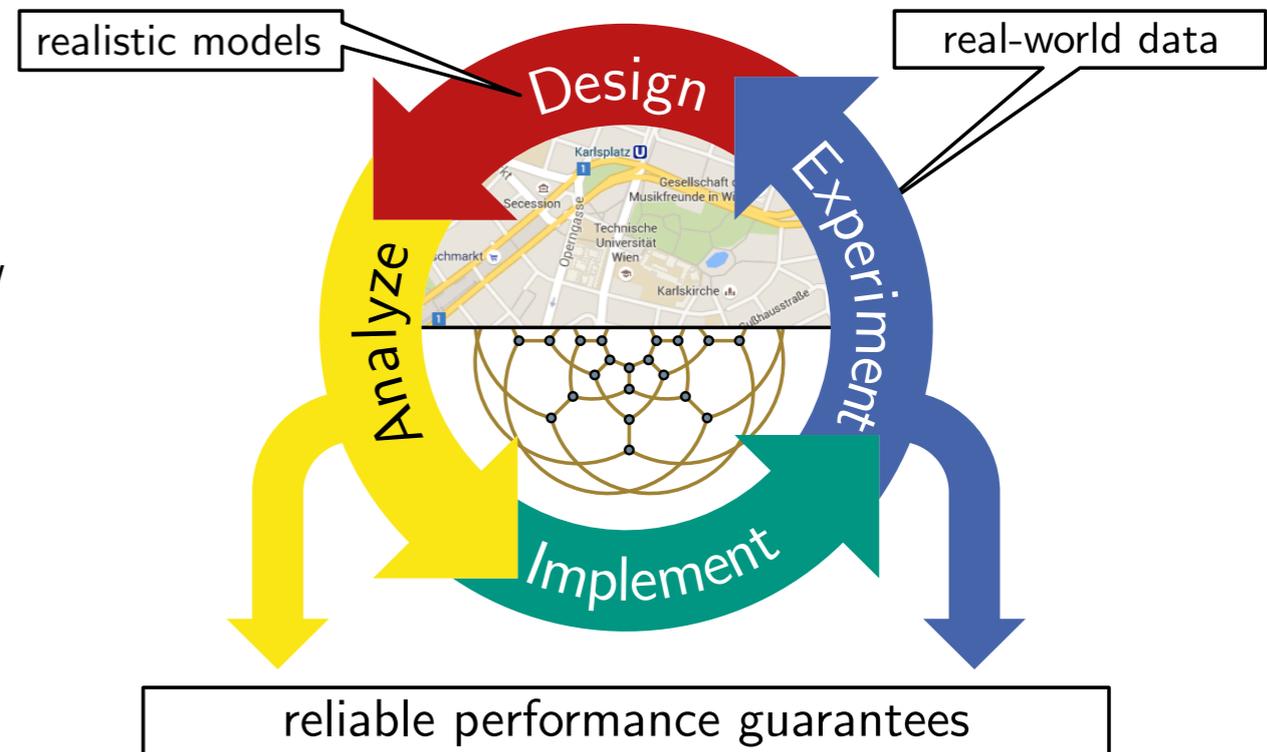


# Geometric and Graph Algorithms



Supported by  
Google Research Award  
US\$ 85k

- Algorithm Engineering for Information Visualization
- Applications: network visualization, dynamic/schematic maps
- Methods: graph drawing, computational geometry, combinatorial optimization
- Goals: formal performance guarantees and empirical evaluation



# Computing Cluster

- We need a lot of computing power
- 2016: “Sonderinvestition” new computing cluster
- EUR 74.000 + 20% Eigenmittel
- Many thanks to the Dean Team for making this possible!

Teaching

# Compulsory Courses

- VU Algorithmen und Datenstrukturen 1 (6 etcs)  
SS16: **606** active students bachelor's
- VU Algorithmen und Datenstrukturen 2 (3 etcs)  
SS16: **553** active Students bachelor's
- VU Algorithmics (6 etcs)  
WS15/16: **77** active students master's

# Algorithmen und Datenstrukturen 1+2



Szeider



Raidl



Podlipnig



Nöllenburg



Ganian



Ordyniak



Bacher



Klute



Riedler

- Restructured and modernised material
- Based on material used at Princeton and Stanford
- Over **650** new high quality slides
- New exercise material
- Delivery of course involves over **2000** working hours
- We have to run **25** exercise classes in parallel

World-class material

# Algorithmics



Szeider

network  
Flows



Raidl

random  
algorithms  
and planarity



Ganian

fixed-  
parameter  
algorithms

integer  
programming



Riedler

geometric  
algorithms



Nöllenburg



Ordyniak

structural  
decompositions

- Restructured and modernised material
- Flagship course of our group's masters teaching
- 6 blocks of 3 lectures each
- Exercise class for each block

# Further Courses



Nöllenburg

- **VU Algorithmic Geometry** (New Material)
- **VU Algorithmic Visualisation** (Planned for SS 2017)

- VU Algorithms in Graph Theory
- VU Approximation Algorithms
- VU Mathematical Programming
- VU Networks: Design and Analysis
- VU Optimization in Transport and Logistics
- VU Heuristic Optimization Techniques



Ordyniak

- VU Modeling and Solving Constrained Optimization Problems

- **VU Structural Decompositions and Algorithms** (New Course)



Ganian

- **VU Fixed-Parameter Algorithms and Complexity** (New Course)

- SE Wissenschaftliches Arbeiten
- SE Seminar aus Algorithmik

*You do a lot of teaching!*  
—Christian Huemer

# Service to the Faculty

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- Contribution to Grundlehre (all scientific global budget staff)
- Contribution to Faculty's international reputation (all scientific staff)



# Service to the Faculty

- Fakultätsrat Vollmitglied (Szeider)
- Fakultätsrat Ersatzmitglied (Nöllenburg)
- Senat Vollmitglied (Szeider)
- EPILOG Jury (Nöllenburg, Raidl, Szeider)
- Div. Berufungskommisionen (Raidl, Szeider)
- Div. Habilkommisionen (Raidl, Szeider)
- AG Code of Conduct (Szeider)
- Vienna Center for Logic and Algorithms chair (Szeider)
- DK LogiCS speaker (Szeider)
- Vienna Gödel Lectures, coorganizer (Szeider)
- TU Vision 2025 panel member (Szeider)
- Stuko AG Programmieren und Algorithmen (Podlipnig, Raidl, Szeider)
- ALGO 2017 organisers (Szeider, Raidl, Nöllenburg, Ganian, Ordyniak)

**ALGO** 2017

August 22-26, Vienna, Austria

8 participating conferences



# ac ALGORITHMS AND COMPLEXITY GROUP



## Summary:

Strong group at a core area of Informatics

- World Class Research
- World Class Teaching
- Service to the Faculty

# Wo drückt der Schuh?

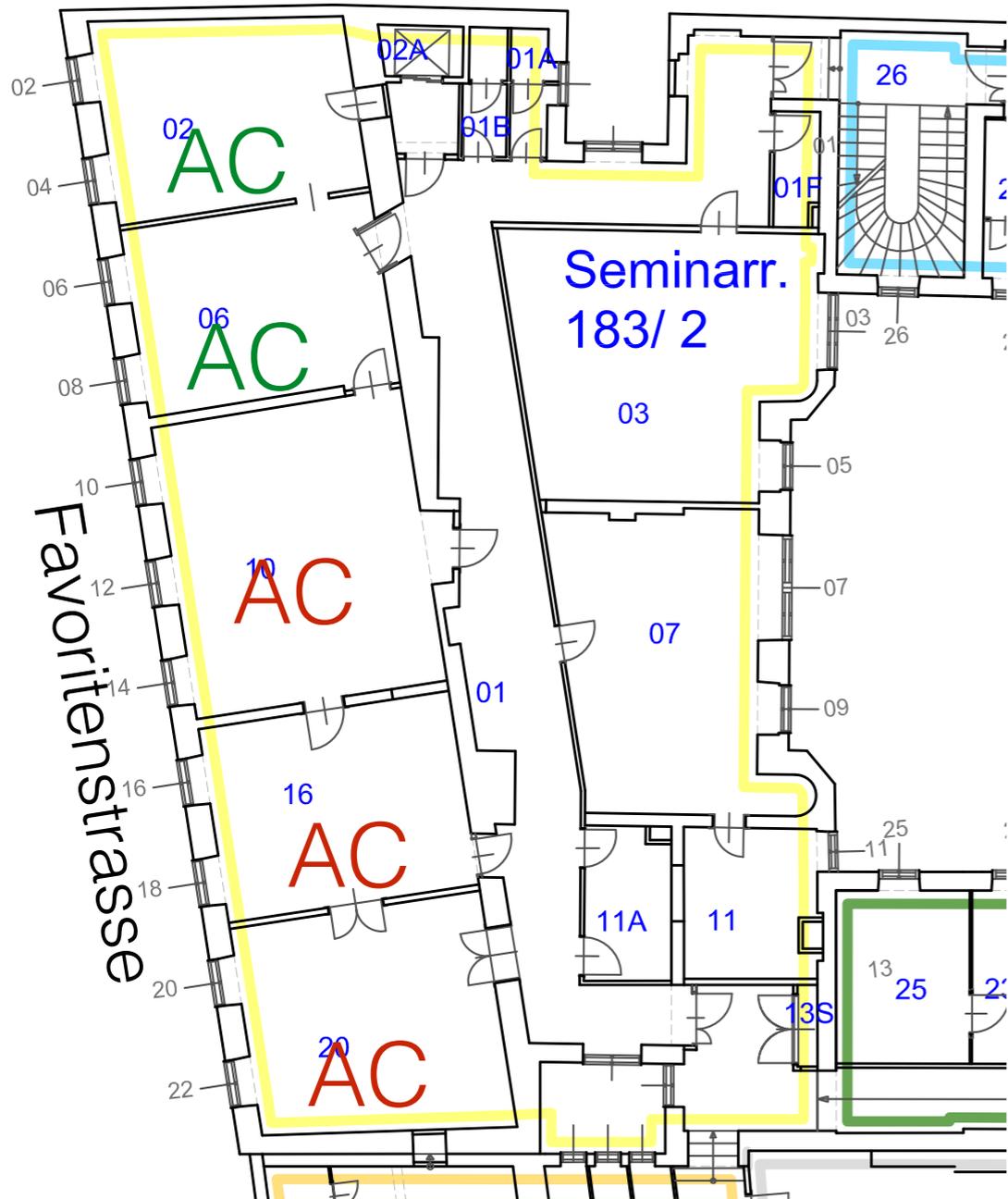
Continuity and Consolidation

# Continuity in Teaching

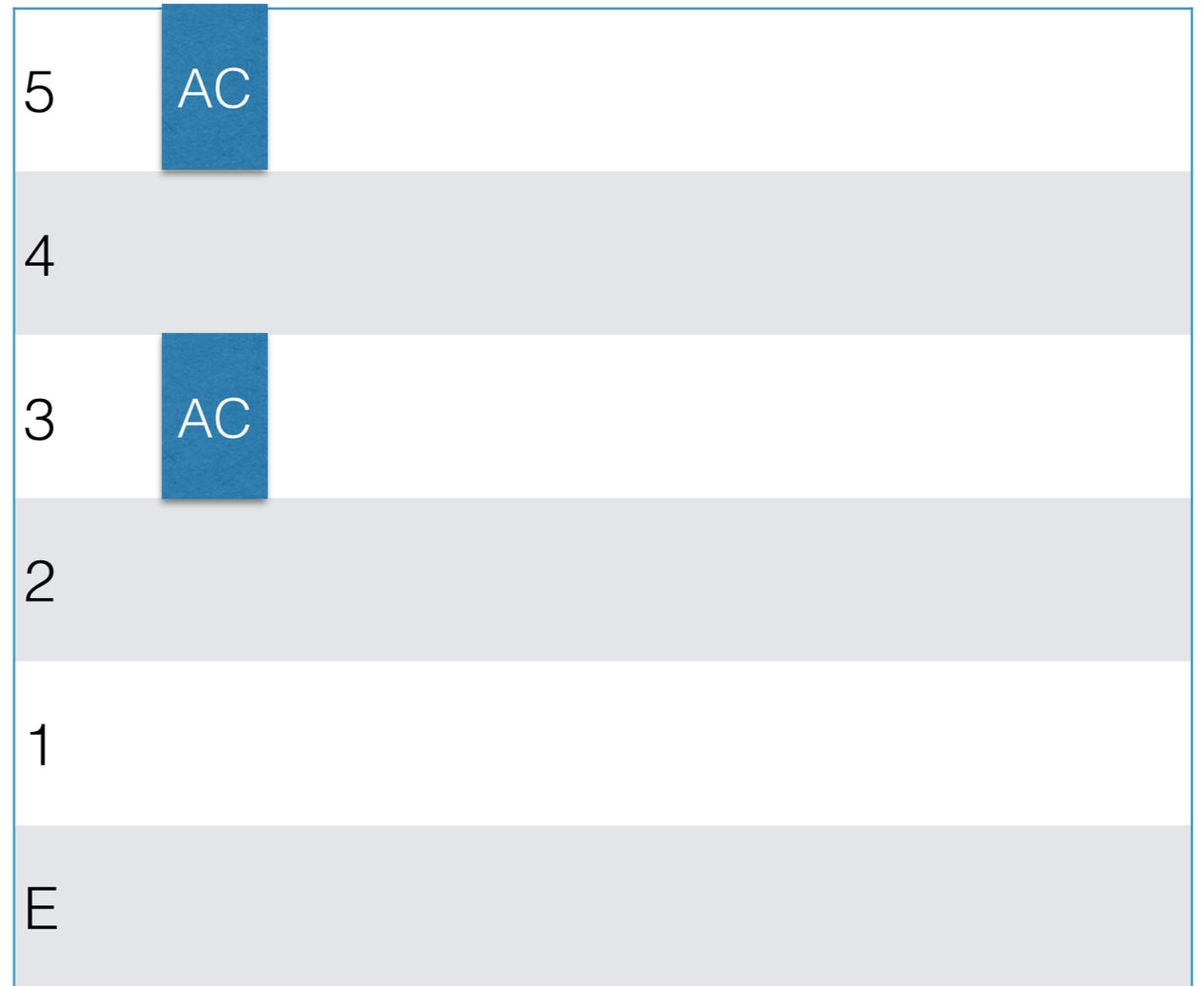
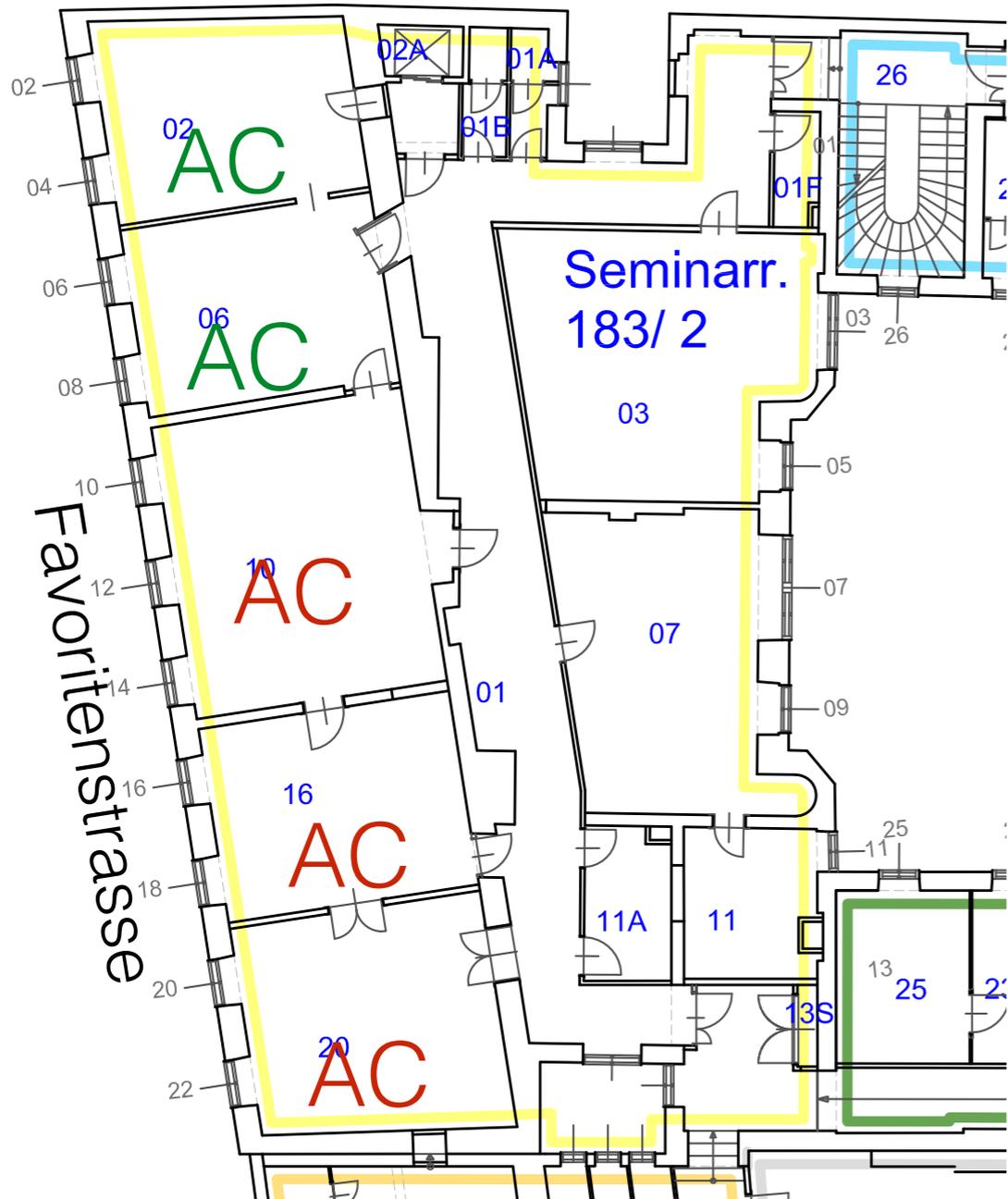
- AlgoDat Teaching
- We need to **count** on Stefan Podlipnig!
- Continuity, quality guarantee,...
- AlgoDat should stay in 1st year



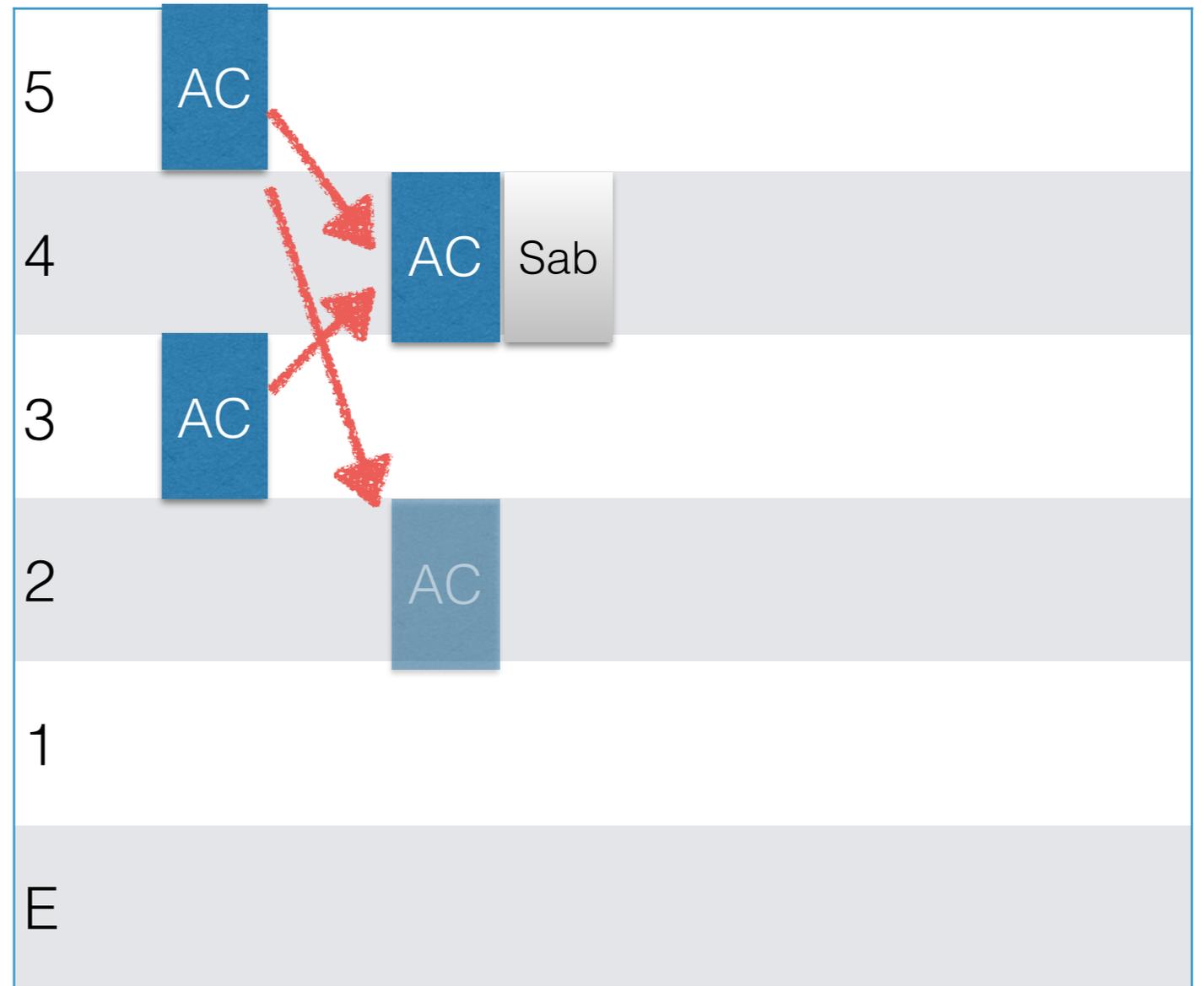
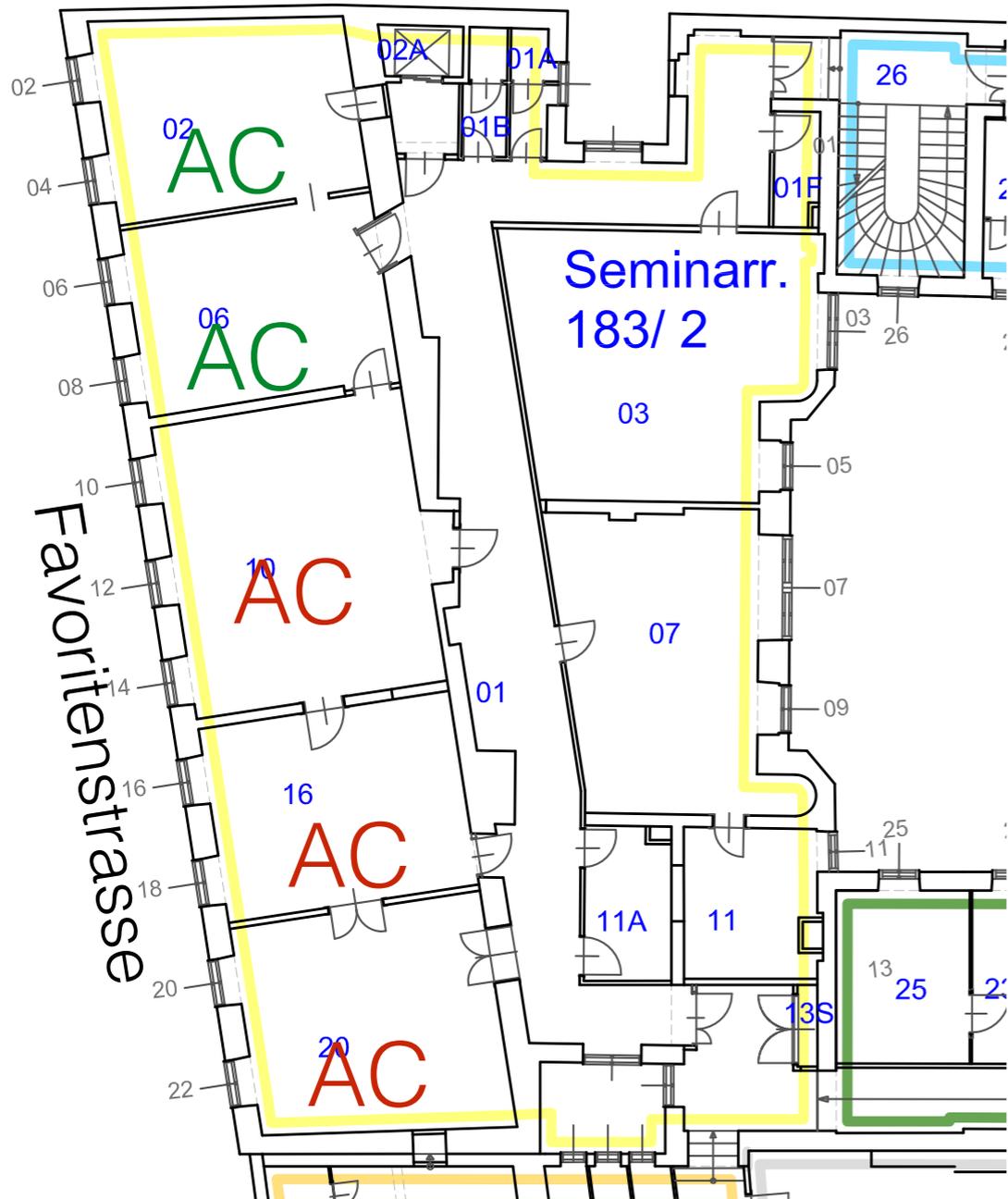
# Eventually: all on 4th Floor



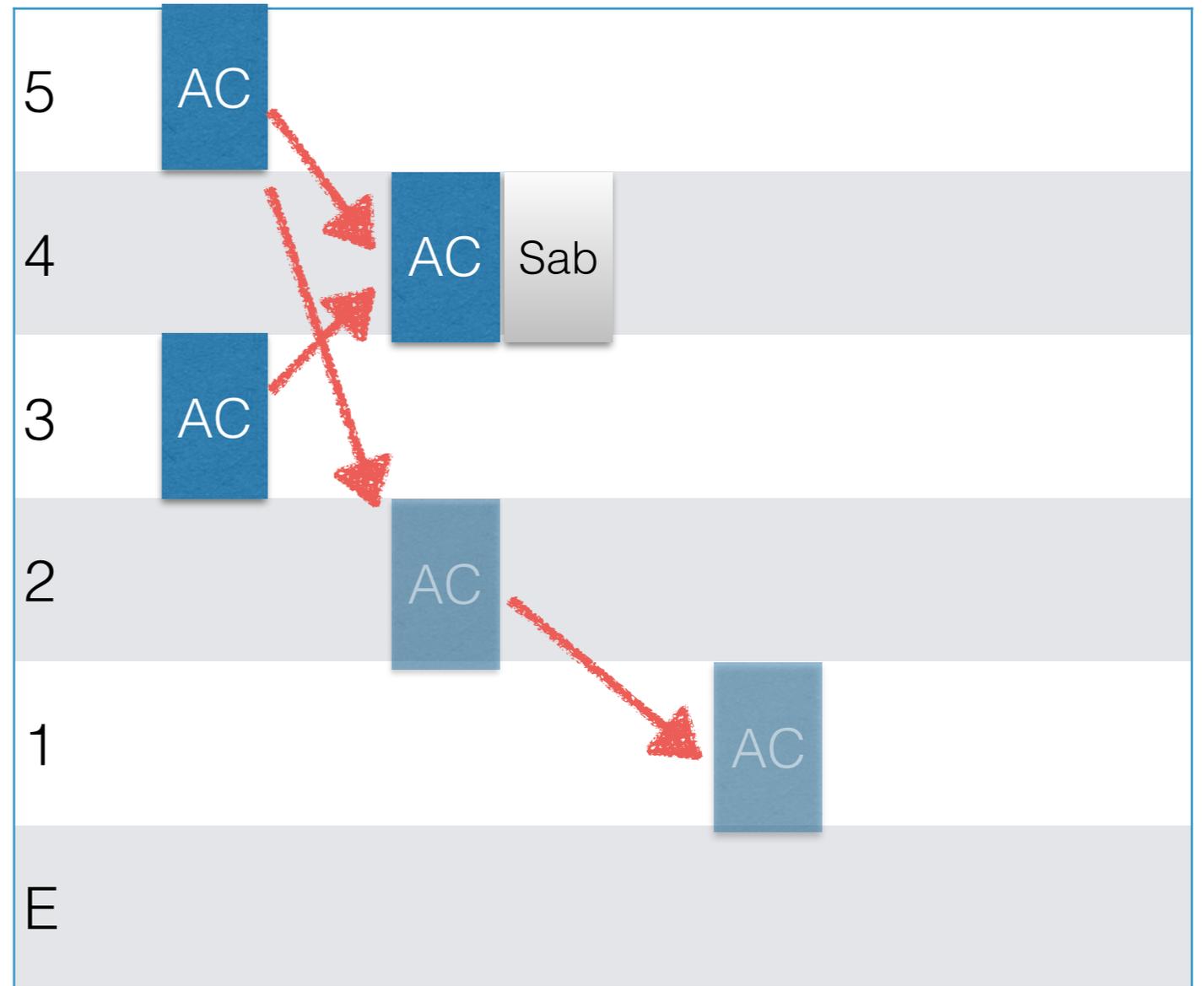
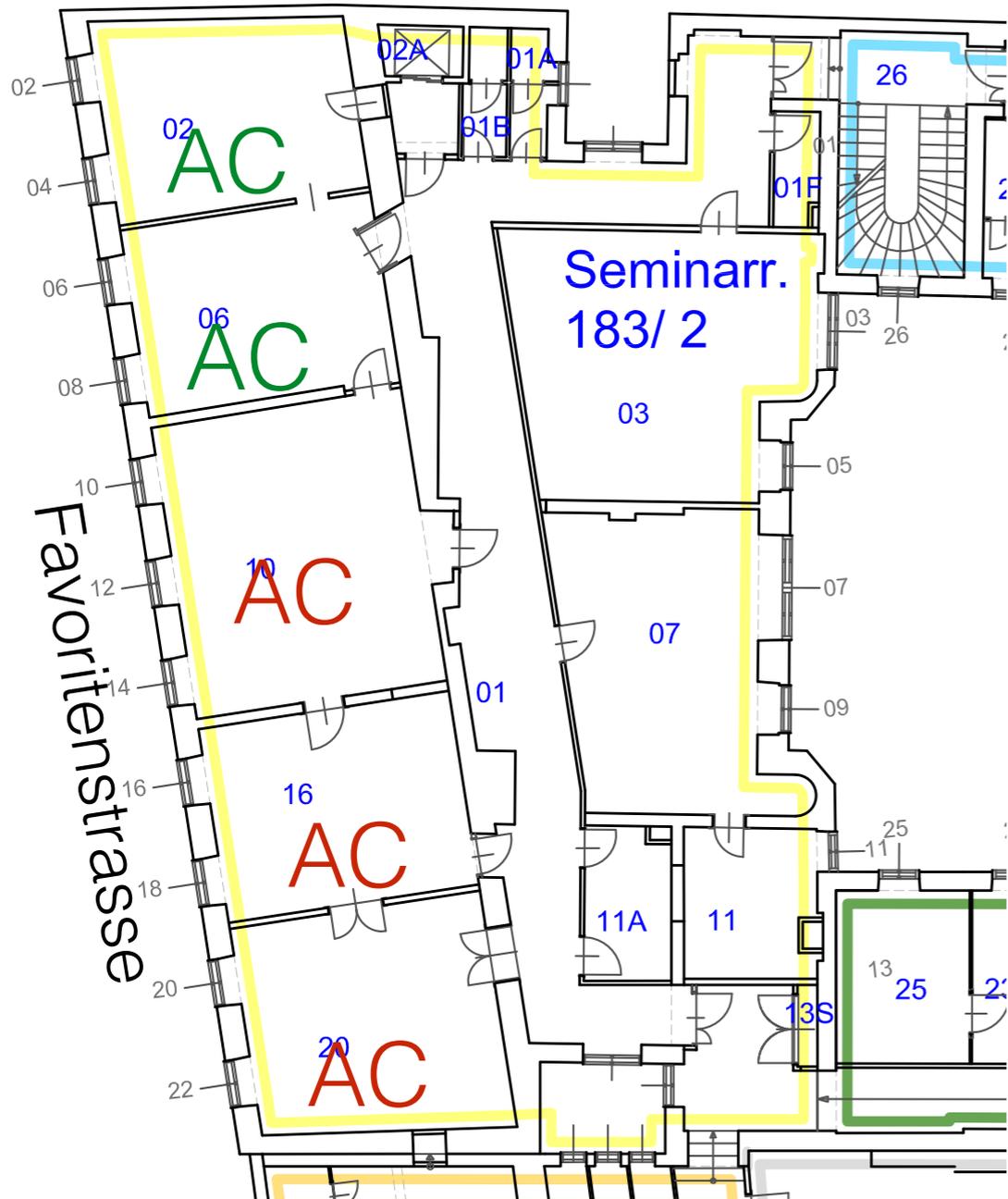
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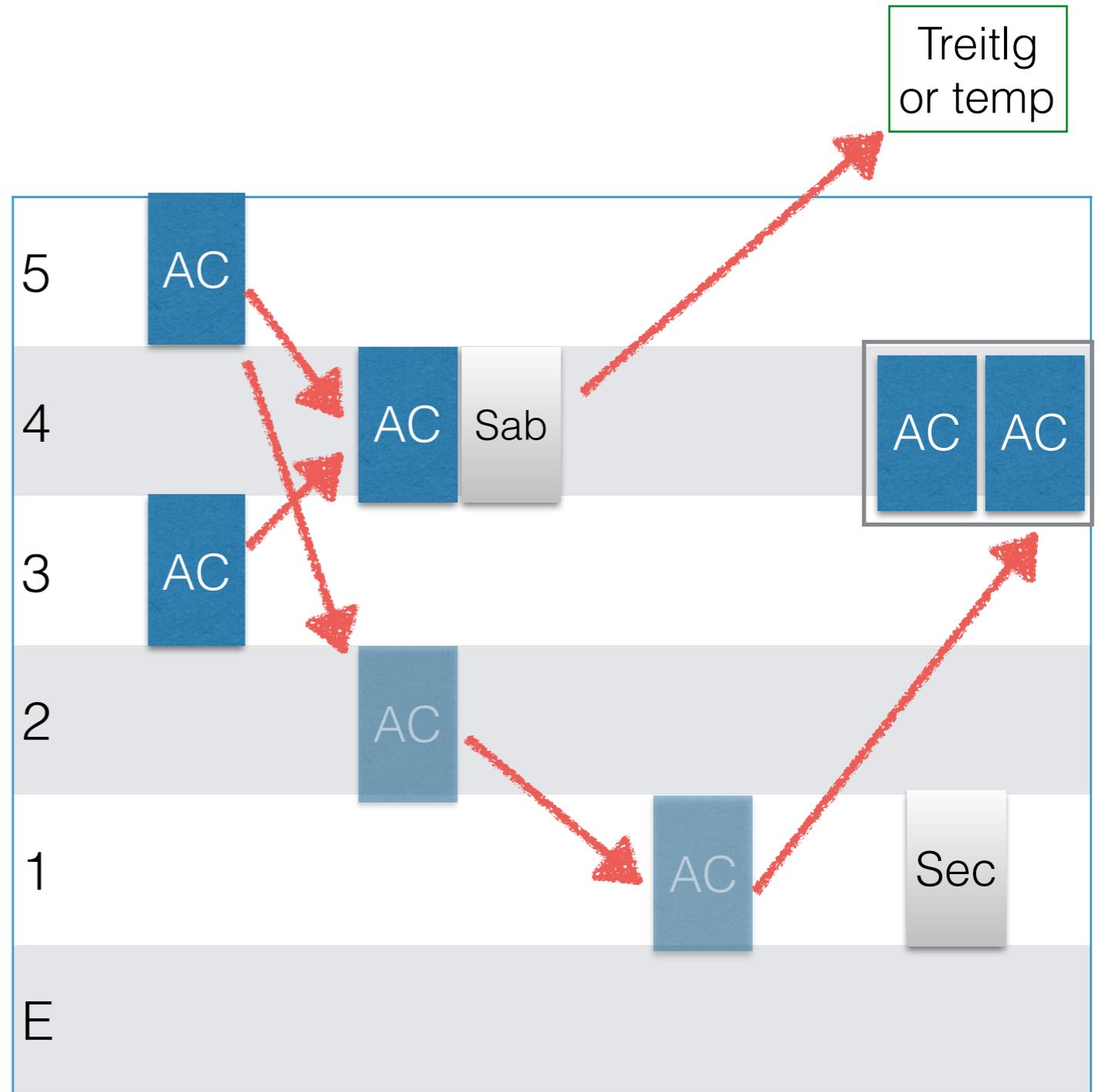
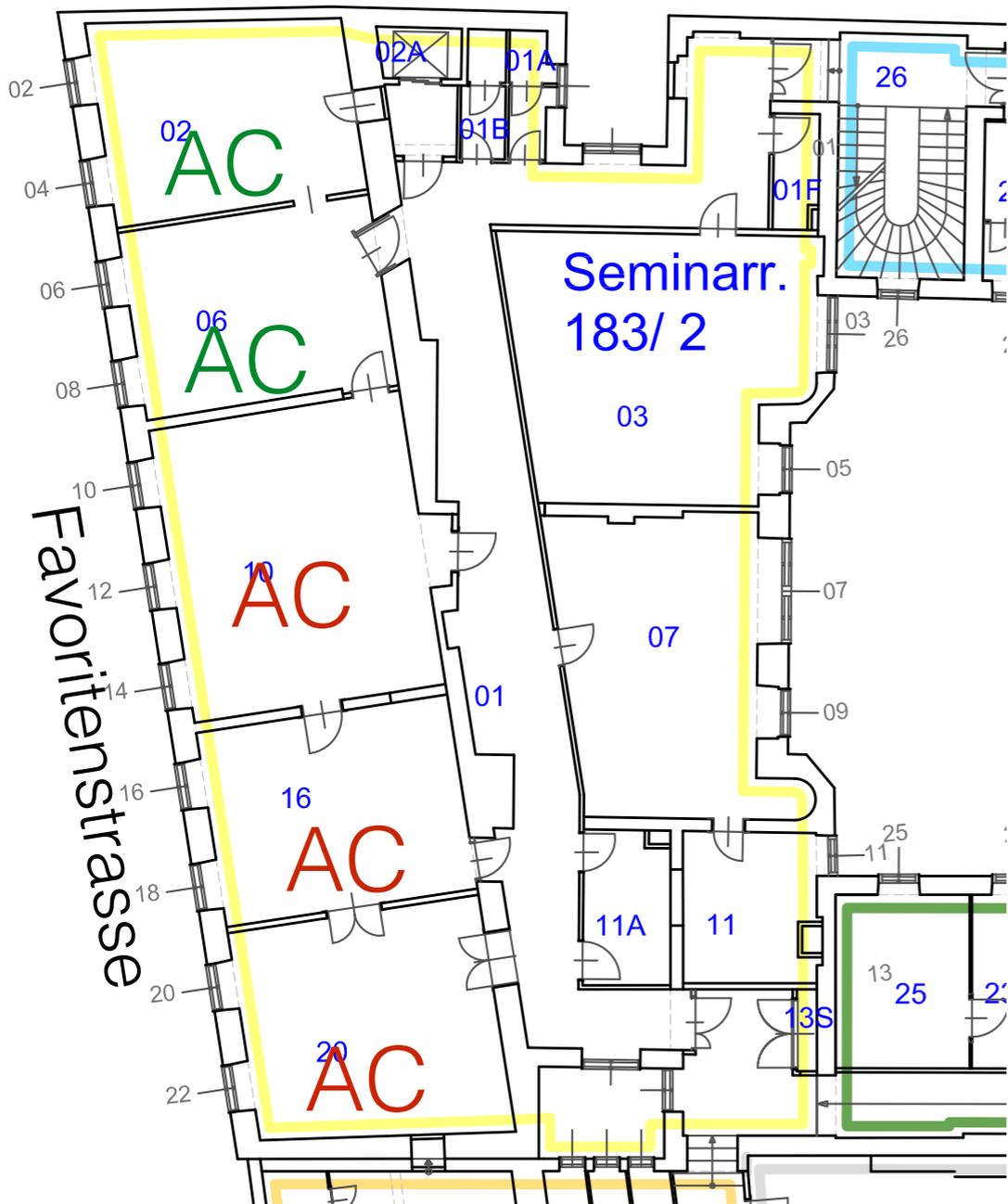
# Eventually: all on 4th Floor



# Eventually: all on 4th Floor



# Eventually: all on 4th Floor





# Sustainable Funding

- currently global budget is heavily subsidised by Berufungsbudget

	2013	2014	2015	2016
Global Budget	31.200	27.600	25.300	25.300
Staff (Global)		12(8)		24(11)

# Career Perspectives

- We have excellent scientific staff without tenure track positions
- Dedicated or open tenure track positions needed
- Tenure for holders of highly competitive research grants

# Issues

- Continuity in teaching
- Working space: keep agreement
- Global budget: sustainable funding
- Perspectives for excellent scientific staff