Leibniz Universität Hannover

Institut für Theoretische Informatik

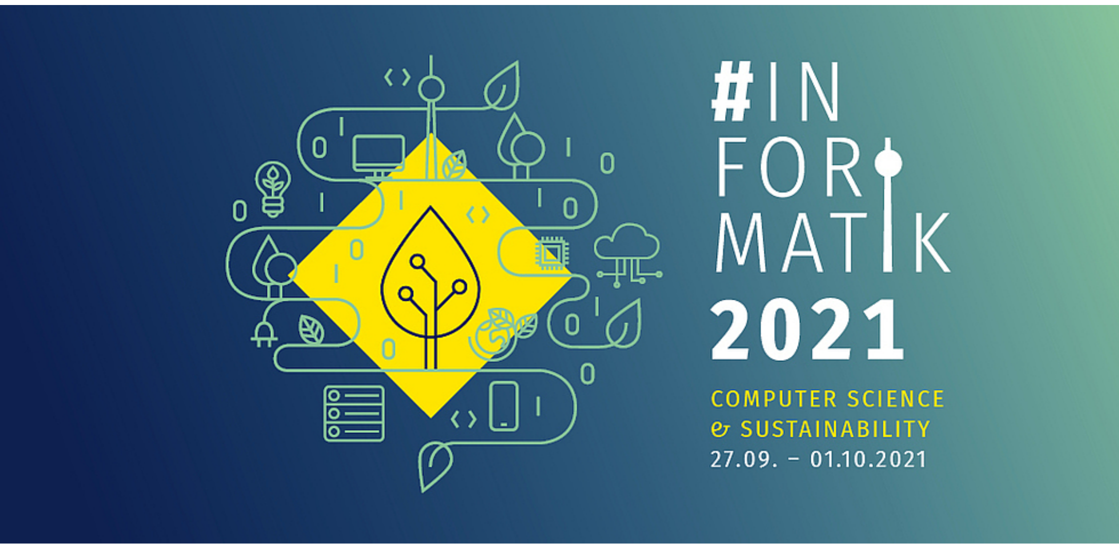
# 81. Theorietag

(28. September 2021)

Gesellschaft für Informatik

TheorieTag

## Program and Workshop Information



## Contents



# 1 Program

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|---|---|---|
| 9:20 | *Gathering in Big Blue Button (Sophie Willson)* | |
| 9:25 | Arne Meier *Welcome* | |
| 9:30 | Astrid Nieße (U Oldenburg):<br>On distributed algorithms in Digitalized Energy Systems | *(Invited Talk)* |
| 10:30 | *Break (30m)* | |
| 11:00 | Leon Kellerhals (TU Berlin):<br>Placing Green Bridges Optimally, with a Multivariate Analysis | |
| 12:00 | *Lunch Break (1h30m)* | |
| 13:30 | Florian Chudigiewitsch (U Hannover):<br>Computational Complexity of Deciding Provability in Linear Logic and Its Fragments | |
| 14:20 | *Break (10m)* | |
| 14:30 | Elias Dahlhaus (TU Darmstadt):<br>Covering Sets of Point Sets by Disjoint Convex Sets | |
| 15:20 | *Break (10m)* | |
| 15:30 | Pascal Kunz (TU Berlin):<br>The Parameterized Complexity of Multistage 2-Coloring | |
| 16:20 | Heribert Vollmer *Closing* | |

# 2 Overview of Talks

## Invited Talk: On distributed algorithms in Digitalized Energy Systems

Astrid Nieße (Carl von Ossietzky University of Oldenburg)

Distributed algorithms have been a research topic in both theoretical and applied computer science for many years. In cyber-physical energy systems, their application addresses many challenges that arise from the decentralization of the energy systems themselves both in generation and control: While the transformation of these systems lead to a physically highly distributed system, conventional control systems still follow a centralized or hierarchical control architecture. In the area of distributed algorithms, autonomous systems, multi-agent systems and distributed artifical intelligence though, great progress has been made, methodologically, but also in the domain-specific application. In the talk, an overview on the specific challenges in this field will be given, including examples from current research and development projects in the field.

## Placing Green Bridges Optimally, with a Multivariate Analysis

Leon Kellerhals (AKT, TU Berlin)

**Joint work with** Till Fluschnik
**Main Reference** Till Fluschnik and Leon Kellerhals. *Placing Green Bridges Optimally, with a Multivariate Analysis.* CiE 2021. URL: https://doi.org/10.1007/978-3-030-80049-9_19

We study the problem of placing wildlife crossings, such as green bridges, over human-made obstacles to challenge habitat fragmentation. The main task herein is, given a graph describing habitats or routes of wildlife animals and possibilities of building green bridges, to find a low-cost placement of green bridges that connects the habitats. We develop different problem models for this task and study them from a computational complexity and parameterized algorithmics perspective.

## Computational Complexity of Deciding Provability in Linear Logic and Its Fragments

Florian Chudigiewitsch (Institut für Theoretische Informatik, Gottfried Wilhelm Leibniz Universität Hannover)

Linear logic was conceived in 1987 by Girard and, in contrast to classical logic, restricts the usage of the structural inference rules of weakening and contraction. With this, atoms of the logic are no longer interpreted as truth values, but as information or resources. This interpretation makes linear logic a useful tool for formalisation in mathematics and computer science. Linear logic has, for example, found applications in proof theory, quantum logic, and the theory of programming languages. A central problem of the logic is the question whether a given list of formulas is provable with the calculus. In the research regarding the complexity of this problem, some results were achieved, but other questions are still open. In the talk, I present my master's thesis which consists of three main parts which build on each other:

- The presentation of the syntax, proof theory, and various approaches to a semantics for linear logic.
- The presentation of the current state of the complexity-theoretic characterization of the most important fragments of linear logic.
- An original complexity characterization of a fragment of the logic and ideas for a new, structural approach to the examination of provability in linear logic.

## Covering Sets of Point Sets by Disjoint Convex Sets

Elias Dahlhaus (Department of Computer Science, Darmstadt University of Technology, TU Darmstadt)

**Main Reference**

[BBBS13] Luis Barba, Alexis Beingessner, Prosenjit Bose, Michiel Smid. *Computing Covers of Plane Forests*, 25-th Canadian Conference on Computational Geometry (2013), pp. 2017-222.

[LT95] Mario Alberto Lopez, Ramakrishna Thurimella. *On Computing Connected Components of Line Segments*, IEEE-Transactions on Computers 44 (1995), pp. 597-601.

We are given a set **S** of sets of points in the plane.

- For each $S \in \mathbf{S}$, we determine its convex hull CH(S) and
- for each convex hull $A$ and each convex hull $B$ that are already formed, we form the convex hull of $A \cup B$, if they are not disjoint.

We are interested in the maximal convex hulls formed in that way. If $\mathbf{S}$ consists of pairwise disjoint trees, this problem can be solved in $O(n \log^2 n)$ time, by an algorithm of [BBBS13]. An improvement of the algorithm of [LT95] to compute the connected components of line segments makes it possible to get a time bound of $O(n \log^3 n)$ if $\mathbf{S}$ is any set of point sets in the plane.

## The Parameterized Complexity of Multistage 2-Coloring

Pascal Kunz (Technische Universität Berlin, Algorithmics and Computational Complexity, Berlin, Germany)

**Joint work with** Till Fluschnik (TU Berlin)

Temporal graphs are graphs that change over time. We consider the algorithmic complexity of recognizing bipartite temporal graphs. Rather than defining these graphs solely by their underlying graph or the individual layers, we define a bipartite temporal graph as one in which every layer can be 2-colored in a way that there are few changes to the coloring between any two consecutive layers. This follows the framework of multistage problems that has received a growing amount of attention in recent years. We investigate the complexity of recognizing these graphs. We show that this problem is NP-hard even for a lifetime of three or if only one change is allowed between consecutive layers. We then consider the parameterized complexity of the problem with respect to several structural graph parameters, which we transfer from the static to the temporal setting. Finally, we consider a version of the problem in which there is no restriction on the number of changes between any two consecutive layers, but on the total number of changes throughout the lifetime of the graph. We show that this variant is fixed-parameter tractable with respect to the number of changes.