

# Semester Report WS05/06 of Dirk Schlatter

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Field of Research: Random Discrete Structures  
Topic: Planar Graphs  
PhD Student at the program from December 2002  
until November 2005

## Field of Research

Part of my research has been concerned with the following constrained random graph process: Starting from an empty graph on  $n$  vertices, in each step, choose a random edge (of  $K_n$ ) and insert it into the present graph if it remains planar. The probability of an edge being inserted at a certain stage in this process is of course highly dependent on the previous choices, quite contrary to the situation in the standard random graph model.

The main result, proven in a joint paper [3] with Stefanie Gerke, Angelika Steger (both ETH Zürich), and Anusch Taraz (TU München), is that this random planar graph process a.a.s. contains linearly many copies of a given planar graph already when  $(1 + \varepsilon)n$  edges have been accepted. Along the way, we also showed that the latter event a.a.s. only occurs after  $\delta n^2$  edges have been tested. This may seem somewhat surprising if one keeps in mind that, due to the connectivity threshold of the unconstrained random graph process, we a.a.s. know that after  $n \log n$  edges have been tested, at least  $n - 1$  of them were accepted.

I have extended these results to a considerably more general class of constrained random graph processes, namely those where the structural property to be preserved can be characterized by forbidding a finite set of 2-connected graphs as minors. In addition, I have been investigating different kinds of constraints, e.g. forbidding a finite set of graphs as subgraphs. Some research in this direction has already been done, giving mainly bounds on the number of edges in the final random graph ([1, 2, 4, 5, 6]). There is reason to believe that some of these processes do *not* a.a.s. contain any given ‘admissible’ graph.

## Activities

### Conferences and Workshops

- AUGUST 1 – 5 12th International Conference on *Random Structures and Algorithms* in Poznań
- SEPTEMBER 5 – 9 *European Conference on Combinatorics, Graph Theory and Applications* in Berlin
- SEPTEMBER 25 – 28 Annual CGC Workshop on Hiddensee

### Lectures and Seminars

- WEEKLY seminars of the research group *Algorithms and Complexity* at HU Berlin
- WEEKLY lecture and colloquium of the CGC

### Research stay

- NOVEMBER 17 – 20 with Angelika Steger at ETH Zürich

## Preview

I plan to hand in my PhD thesis in March 2006.

## References

- [1] B. Bollobás and O. Riordan, *Constrained graph processes*, Electronic Journal of Combinatorics **7**, #R18, 2000.
- [2] P. Erdős, S. Suen, and P. Winkler, *On the size of a random maximal graph*, Random Structures & Algorithms **6**, 309-318, 1995.
- [3] S. Gerke, A. Steger, D. Schlatter, and A. Taraz, *The Random Planar Graph Process*, <http://www.informatik.hu-berlin.de/~schlatte/publication.php>.
- [4] J. H. Kim, *The Ramsey number  $R(3, t)$  has order of magnitude  $t^2 / \log t$* , Random Structures & Algorithms **7**, 173-207, 1995.

- [5] D. Osthus and A. Taraz, *Random maximal  $H$ -free graphs*, *Random Structures & Algorithms* **18**, 61-82, 2001.
- [6] A. Ruciński and N. C. Wormald, *Random graph processes with degree restrictions*, *Combinatorics, Probability & Computing* **1**, 169-180, 1992.