Semester Report SS03 of Manuel Bodirsky

Name:	Manuel Bodirsky
Supervisor:	Prof. Dr. Hans Jürgen Prömel
Topics:	Graph Algorithms for Constraint Satisfaction;
	Generation of Random Planar Structures;
PhD Student	At the program since April 2001

Fields of Research and Results

I continued my work on algebraic characterizations of the expressive power of fragments of first-order logic that have applications to constraint satisfaction. Our result I mentioned in my last report can be extended considerably for all ω-categorical relational structures S: A relation has a primitive positive definition in S if and only if it is preserved by all polymorphisms of S. A variant of the corresponding Galois connection Inv-Pol is the following result, which seams to be folklore reformulation of the theorem of Ryll-Nardzevski in model theory: A structure is ω-categorical if and only if the first-order definable relations in S are the relations preserved by all automorphisms of S. Here we see that with respect to first-order definability the assumption of ω-categoricity is the best possible generalization of the corresponding results that are well-known for finite structures S.

These results I wrote down with Jaroslav Nešetřil and they will be presented at the conference *Computer Science Logic* in Vienna. There we also discussed the complexity of the constraint satisfaction problems of homogeneous digraphs, which includes the interesting case CSP(S(2)) which is NP-hard by simulation of the known hard constraint satisfaction problem *Betweenness*. Im working on applications of the above mentioned powerful Galois connection to generalize and simplify the classification of the tractable cases of Allens Intervall Algebra. Finally I'm preparing the previous results mentioned in earlier reports to compile them in my dissertation.

Generation of Random Structures. We worked out the details for the efficient generation of labeled planar graphs uniformly at random, and I presented this joint work with Clemens Gröpl and Mihyun Kang at ICALP03 in Eindhoven. We are planing to write a long version with an improved result: we can generate labeled planar structures in *deterministic* polynomial time, and we do no longer rely on the generation algorithm for 3-connected maps

of Gilles Shaeffer.

The generation of unlabeled planar graphs is challenging. We therefore restricted first to connected cubic planar graphs. Still, the problem is that for 3-connected rooted cubic graphs we cannot directly use the knowledge about embedded rooted graphs, since there might be a sense reversing automorphism or not. Therefore we separately show how to count *symmetric* 3-connected cubic planar graphs. We do this via a bijection to so-called *colored* networks, which we can again decompose along the connectivity structure. This work will be presented at EUROCOMB 03 in Prague.

Activities

I gave talks at the following events:

- *Countable homogeneous structures, local clones, and constraint satisfaction*, 65th Workshop on General Algebra, 18th Conference for Young Algebraists, in Potsdam, March 21-23, 2003.
- Invited talk *Constraint Satisfaction with Countable Homogeneous Templates* at the Graduiertenkolleg an der Fakultät Informatik der TU Dresden, April 27, 2003.
- *The Polymorphism Clones of omega-Categorical Structures*, 66th Workshop on General Algebra, in Klagenfurt, June 19-22, 2003.
- *Generating Labeled Planar Graphs Uniformly at Random*, ICALP2003 Thirtieth International Colloquium on Automata, Languages and Programming Eindhoven, June 30 - July 4, 2003.
- Talk in the graduate program of the CGC.
- Organized the seminar *the strange logic of random graphs* (jointly with Mihyun Kang).

Attended lectures, schools, workshops, conferences:

- Workshop in Prag: STTI03 - Současné trendy teoretické informatiky, Vila Lanna, May 22-23 2003.
- Berliner Algorithmen Tag (BAT), July 11, 2003 at HU Berlin.

- Czech lecture at FU Berlin.
- Forschungskolloqium Algorithmen und Komplexität at HU Berlin.

Preview

- Algebra and discrete mathematics in Hattingen, July 26-31, 2003.
- Computer Science Logic (CSL03) in Vienna, August 25-30, 2003.
- EUROCOMB03 in Prag, September 8-12, 2003.