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Supervisor:	Prof. Dr. Rolf H. Möhring
Field of Research:	Scheduling
Topic	Local Search Algorithms
PhD Student	at the program since March 2000

Field of Research and Results

The main part of my studies focuses on scheduling problems in AND/OR-networks with the objective to minimize the latest completion time of any job. AND/OR-networks constitute a useful generalization of standard project networks. Ordinary precedence constraints, represented by AND-nodes, require that the corresponding job has to wait for the completion of all its predecessors in the network before it can be started. In contrast, an OR-node models the situation where the corresponding job has to wait for the completion of only one of its immediate predecessors. An extensive analysis of feasibility, transitivity, earliest start schedules and related questions in AND/OR-networks can be found in [MSS00]. I have been studying longest paths and critical jobs in AND/OR-networks. Three different concepts of criticality, namely path-, cut-, and delay-critical jobs and sets, could be defined which are not equivalent in general. Nevertheless, the system of path- and cut-critical sets form a pair of blocking clutters. As I have already stated in the last report an open question was the gap between a maximal flow and a minimal cut in the system of paths and cuts in AND/OR-networks. I have shown that it is possible to encode a set cover problem into an AND/OR-network such that a maximal flow in the network corresponds to the fractional solution and the minimal cut corresponds to the integral solution of the set cover problem, thus inducing a gap logarithmic in the size of the network. An earlier proposed complexity result, stating that it is NP-complete to decide whether a given job is critical, could be improved to the case of strictly positive processing times.

In addition to this I became acquainted with problems of routing in rings, one of the research topics in Thomas Erlebach's group. A specific question of interest was the maximal path packing with prespecified paths in rings. Given a ring of edges with a fixed capacity on each edge and a number of paths in the ring, specified by the two endpoints and the direction in the ring, find the maximal number of paths that can be routed without violating the capacity constraints. It was open whether this problem can be solved in

polynomial time or whether it is NP-hard. In cooperation with the members of another research group, a polynomial time algorithm could be found which of course answers the open question.

In the following I will further concentrate on AND/OR-networks. I am interested in a detailed analyses of the time-cost-tradeoff curve and would like to answer some specific questions for the time-cost-tradeoff problem in AND/OR-networks.

Activities

- Academic guest in Thomas Erlebach's research group *Theory of Communication Networks* at ETH Zurich, July 23, 2001 – February 4, 2002
- *Mittagsseminar* of Emo Welzl's research group *Theory of Combinatorial Algorithms* at ETH Zurich
- Talk *Critical Jobs in AND/OR-networks* in Thomas Erlebach's group seminar at ETH Zurich, July 26, 2001
- CGC Fall School *Discrete Geometry - Triangulations from various points of view* in Alt-Ruppin, October 4 – 6, 2001
- Block courses of CGC's Pre-Doc program at ETH Zurich, October 22 – November 23, 2001:
  Randomized Algorithms by Emo Welzl and
  Topological Methods in Combinatorics and Geometry by Jiri Matousek
- Talk *Operations Research: Die Algorithmentheorie, ein Teilgebiet der Diskreten Mathematik, ermöglicht es, Projektabläufe optimal zu planen* in the *Hegau-Bodensee Seminar* in Konstanz, December 5, 2001
- Workshop on *Combinatorial Optimization* in Aussois, France, January 6 – 12, 2002

Literatur

[MSS00] R. H. Möhring, M. Skutella, and F. Stork. Scheduling with AND/OR-precedence constraints. *Technical Report* 689-2000, Technische Universität Berlin, 2000.