Student project on approximating the maximum independent set of rectangles (MISR)

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Maximum Independent Set of Rectangles (MISR)

Given a set $\mathscr{R} = \{R_1, \cdots, R_n\}$ of n axis-aligned rectangles of arbitrary size in the plane, the MISR problem is to find a maximum subset of rectangles of $\mathscr{R}$ that are pairwise disjoint. Since this problem is NP-hard and due to its many applications, much work has been dedicated to designing efficient approximation algorithms for MISR. Highlights include $(1+\epsilon)$-approximation algorithms for MISR in *quasi-polynomial time* (i.e. in $n^{\text{poly}(\log(n), 1/\epsilon)}$ time), $O(\log\log(n))$-approximation with respect to the natural LP-relaxation in polynomial time and, very recently, a constant factor approximation in polynomial time.

Objectives of the semester project

The main goal of this project is to understand the MISR problem and the various techniques used to tackle it. A tentative list of articles to be covered are as follows:

- NP-hardness of MISR, [FPT81].
- A (exact) sub-exponential time algorithm for MISR, [LW03].
- A $O(\log\log(n))$-approximation for MISR in polynomial time, [CC09].
- A constant factor approximation for MISR in polynomial time, [Mit21].

Evaluation

During the semester, the student has to give two talks of 20 minutes each. At the end of the semester, a report of approximately 20 pages must be submitted. The project will be evaluated based on the quality and originality of the talks and the report. There will be weekly meetings to discuss and present the progress and to set new goals for next week. The participation and motivation during these meetings will also be taken into consideration.

References

[CC09] P. Chalermsook and J. Chuzhoy. "Maximum Independent Set of Rectangles". In: *Proceedings of the Twentieth Annual ACM-SIAM Symposium on Discrete Algorithms*. SODA '09. New York, New York: Society for Industrial and Applied Mathematics, 2009, pp. 892–901.

[FPT81] R. J. Fowler, M. S. Paterson, and S. L. Tanimoto. "Optimal packing and covering in the plane are NP-complete". In: *Information Processing Letters* 12.3 (1981), pp. 133–137.

[LW03] A. Lingas and M. Wahlen. “Subexponential-Time Algorithms for Maximum Independent Set and Related Problems on Box Graphs”. In: *Computing and Combinatorics*. Ed. by T. Warnow and B. Zhu. Berlin, Heidelberg: Springer Berlin Heidelberg, 2003, pp. 50–56.

[Mit21] J. S. B. Mitchell. *Approximating Maximum Independent Set for Rectangles in the Plane*. 2021. arXiv: 2101.00326 [cs.CG].