Applying Decomposition Methods to Crossword Puzzle Problems

Student: Yaling Zheng
Supervisor: Berthe Y. Choueiry

Constraint Systems Laboratory, University of Nebraska-Lincoln
Email: yzheng|choueiry@cse.unl.edu

Structural decomposition methods have been proposed for identifying tractable Constraint Satisfaction Problems (CSPs) [1–5]. The basic principle is to decompose a CSP into tree-structured sub-problems. The subproblems are solved independently, then the original CSP is solved in a backtrack-free manner after the tree structure is made arc-consistent, as described in [1]. In [5], we proposed four decomposition methods: HINGE$^+$, CUT, TRAVERSE, and CaT and tested these methods on randomly generated CSPs. We compare these techniques on instances of the fully interlocked Crossword Puzzle Problems (CPPs) [6] taken from a public library [7] and identify special cases of the constraint hypergraphs where some decomposition techniques yield better results than others although in general the opposite holds. Our future work includes: 1) Identifying more such configurations, and building hybrid decompositions techniques that exploit this information; 2) Tailoring existing decomposition methods for fully interlocked CPPs so that every sub-problem, after backtrack search, has few solutions; and 3) Designing a heuristic for applying local search for fully interlocked CPPs. This work is supported by CAREER Award #0133568 from the National Science Foundation.

References

1. Dechter, R., Pearl, J.: Tree Clustering for Constraint Networks. Artificial Intelligence **38** (1989) 353–366
2. Gyssens, M., Jeavons, P.G., Cohen, D.A.: Decomposing Constraint Satisfaction Problems Using Database Techniques. Artificial Intelligence **66** (1994) 57–89
3. Jeavons, P.G., Cohen, D.A., Gyssens, M.: A Structural Decomposition for Hypergraphs. Contemporary Mathematics **178** (1994) 161–177
4. Gottlob, G., Leone, N., Scarcello, F.: A Comparison of Structural CSP Decomposition Methods. Artificial Intelligence **124** (2000) 243–282
5. Zheng, Y., Choueiry, B.Y.: New Structural Decomposition Techniques for Constraint Satisfaction Problems. Recent Advances in Constraints. LNAI Vol. 3419. Springer (2005) 113–127
6. CambonJensen, S.: Design and Implementation of Crossword Compilation Using Sequential Approaches Programs. Master's thesis, IMADA Odense University (1997)
7. CPPLibrary: Crossword Puzzle Grid Library. (http://puzzles.about.com/library) 2005