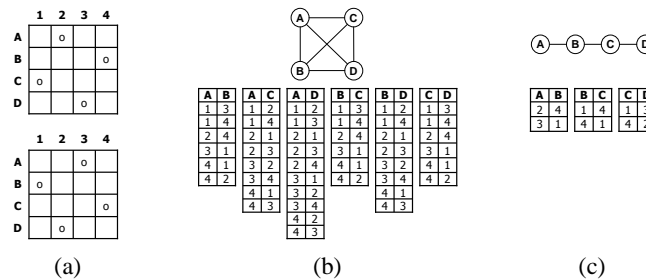


# AND/OR Search Spaces and the Semantic Width of Constraint Networks

Student: Robert Mateescu  
Supervisor: Rina Dechter

School of Information and Computer Science  
University of California, Irvine, CA 92697-3425  
{dechter, mateescu}@ics.uci.edu

The primary contribution of this paper consists in using the *AND/OR search* paradigm [1, 2] to define the new concept of *semantic width* of a constraint network. The well known parameter *tree-width* is graph based, and cannot capture context sensitive information. This often results in a very loose upper bound on the actual complexity of the problem. A typical example is the compact result of a compilation schemes such as *ordered binary decision diagram* (OBDD), in spite of a large *tree-width* (and *path-width*). The semantic width is based on the notion of equivalent constraint networks. The idea is to capture the intrinsic hardness of a problem by the smallest width equivalent network.



**Fig. 1.** The 4-queen problem

*Example 1.* Figure 1a shows the two solutions of the 4-queen problem. The problem is expressed by a complete graph of tree-width 3, given in Figure 1b. Figure 1c shows an equivalent problem, which has tree-width 1. The semantic-width of the 4-queen is 1.

This paper specializes the AND/OR formalism to constraint networks and elaborates the properties of AND/OR search graphs. The semantic width characterizes the size of the *minimal AND/OR graph* and it is clearly hard to compute. Nevertheless, the semantic width can explain why sometimes the minimal AND/OR graph or tree are much smaller than the upper bounds exponential in tree-width or path-width.

## References

1. R. Dechter and R. Mateescu. Mixtures of deterministic-probabilistic networks and their AND/OR search space. In *UAI'04*, 2004.
2. R. Dechter and R. Mateescu. The impact of AND/OR search spaces on constraint satisfaction and counting. In *CP'04*, 2004.