

The DMCS Solver for Distributed Nonmonotonic Multi-Context Systems

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Multi-Context Systems (MCS)

- ▶ MCSen introduced by [Giunchiglia and Serafini, 1994]:
 - ▶ represent inter-contextual information flow
 - ▶ express reasoning w.r.t. contextual information
 - ▶ allow decentralized, pointwise information exchange
 - ▶ monotonic, homogeneous logic
- ▶ Framework extended for integrating **heterogeneous and nonmonotonic logics** [Brewka and Eiter, 2007]
- ▶ Our aim: **compute semantics** of heterogeneous and nonmonotonic MCS in a distributed way

MCS Overview

- ▶ MCS is a collection $M = (C_1, \dots, C_n)$
contexts are interlinked by bridge rules
- ▶ Context $C_k = (kb_k, br_k)$: abstraction for knowledge based systems
core notions:
 - ▶ knowledge base kb_k ,
 - ▶ bridge rules br_k ,
 - ▶ accepted belief sets

Heterogeneous: hosts default logic, classical logic, ASP, etc.

- ▶ Bridge rule adds information to context C_k

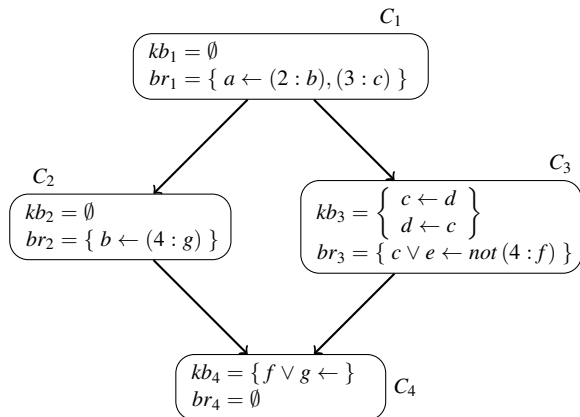
$$s \leftarrow (c_1 : p_1), \dots, (c_j : p_j), \text{not } (c_{j+1} : p_{j+1}), \dots, \text{not } (c_m : p_m)$$

... depending on beliefs p_i at other contexts c_i

- ▶ Semantics in terms of equilibria of form (S_1, \dots, S_n) :
i.e., a belief set S_k for each context C_k which is compliant with applicable bridge rules

The Diamond Example

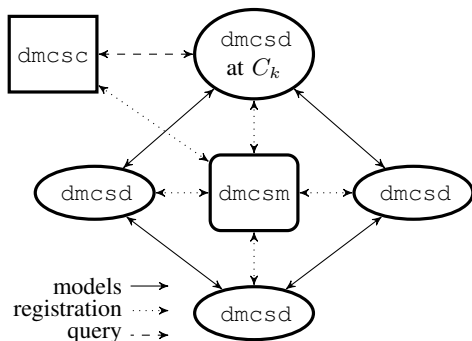
$M = (C_1, C_2, C_3, C_4)$, where each context is an answer set program



Equilibria:

- ▶ $(\emptyset, \emptyset, \emptyset, \{f\})$
- ▶ $(\emptyset, \{b\}, \{e\}, \{g\})$
- ▶ $(\{a\}, \{b\}, \{c, d\}, \{g\})$

System Architecture



Distributed system with:



- ▶ Server program for each context
- ▶ Client program for querying contexts
- ▶ Registration component

Demo Outline

- ▶ MCS is a general framework for integrating diverse formalisms
- ▶ First attempt for distributed MCS evaluation
- ▶ Initial experiments with a prototype implementation
- ▶ **Loop formulas for MCS**: compile KB + bridge rules into SAT
- ▶ **Decomposition** technique is encouraging:
MCS arranged in a binary tree with 600 contexts evaluated in 176s
- ▶ Project website with source code and detailed experiments:

<http://www.kr.tuwien.ac.at/research/systems/dmcs/>

References I

-  Gerhard Brewka and Thomas Eiter.
Equilibria in heterogeneous nonmonotonic multi-context systems.
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-  Fausto Giunchiglia and Luciano Serafini.
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