

# Distributed Constraint-Based Local Search

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**Abstract.** Distributed computing is increasingly important at a time when the doubling of the number of transistors on a processor every 18 months no longer translates in a doubling of speed but instead a doubling of the number of cores. Unfortunately, it also places significant conceptual and implementation burden on programmers. This paper aims at addressing this challenge for constraint-based local search (CBLS), whose search procedures typically exhibit inherent parallelism stemming from multistart, restart, or population-based techniques whose benefits have been demonstrated both experimentally and theoretically. The paper presents abstractions that allows distributed CBLS programs to be close to their sequential and parallel counterparts, keeping the conceptual and implementation overhead of distributed computing minimal. A preliminary implementation in COMET exhibits significant speed-ups in constraint satisfaction and optimization applications. The implementation also scales well with the number of machines. Of particular interest is the observation that generic abstractions of CBLS and CP, such as models and solutions, and advanced control structures such as events and closures, play a fundamental role to keep the distance between sequential and distributed CBLS programs small. As a result, the abstractions directly apply to CP programs using multistarts or restarts procedures.

## 1 Introduction

Moore's law [13], i.e., the prediction that the number of transistors per square inch on integrated circuits would double every 18 months used to translate into a doubling of speed. While it marches on, these additional transistors are now devoted to doubling the number of cores and gave rise to commodity multiprocessors. As a result, parallel and distributed computing now offer reasonably cheap alternatives to speed up computationally intense applications. However, parallel and distributed computing also places significant conceptual and implementation burden on programmers. The computational model adds another dimension in conceptual complexity (i.e., the need to handle multiple threads of executions) and programming abstractions are often expressed at a lower level of abstraction than their sequential counterparts. This has slowed the use of distributed computing, even for applications that exhibit natural parallelism as is typically the case in constraint satisfaction and optimization.

The parallelism exhibited in constraint satisfaction and optimization is often coarse-grained, requires minimal synchronization and coordination, and may

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**Raffaella Di Napoli**



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Answers to All Questions and Problems Aug 14, 2015 — CHAPTER 1. 1.1 In a few sentences, what were Mendel's key ideas about inheritance? ANS: Mendel postulated transmissible factors—genes—to.