# Constraint Programming for Random Testing of a Trading System

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**Winner of SAIS Best AI Master's Thesis Award 2010**

*Roberto is awarded the prize for his excellent thesis that shows how constraint programming, a classical AI technique, can be used to allow automated random testing of a trading system. The thesis combines a strong theoretical foundation with a thorough empirical evaluation. The developed techniques also lead to the discovery of unknown faults and specification defects in a widely commercially deployed financial trading system.*

## Abstract

Financial markets use complex computer trading systems whose failures can cause serious economic damage, making reliability a major concern. Automated random testing has been shown to be useful in finding defects in these systems, but its inherent test oracle problem (automatic generation of the expected system output) is a drawback that has typically prevented its application on a larger scale.

Two main tasks have been carried out in this thesis as a solution to the test oracle problem. First, an independent model of a real trading system based on constraint programming, a method for solving combinatorial problems, has been created. Then, the model has been integrated as a true test oracle in automated random tests. The test oracle maintains the expected state of an order book throughout a sequence of random trade order actions, and provides the expected output of every auction triggered in the order book by generating a corresponding constraint program that is solved with the aid of a constraint programming system.

Constraint programming has allowed the development of an inexpensive, yet reliable test oracle. In 500 random test cases, the test oracle has detected two system failures. These failures correspond to defects that had been present for several years without being discovered neither by less complete oracles nor by the application of more systematic testing approaches.

The main contributions of this thesis are: (1) empirical evidence of both the suitability of applying constraint programming to solve the test oracle problem and the effectiveness of true test oracles in random testing, and (2) a first attempt, as far as the author is aware, to model a non-theoretical combinatorial double auction using constraint programming.