Leo's Talk

Title: Formalizing Mathematics using the Lean Theorem Prover

Abstract:

Lean is a new open source theorem prover being developed at Microsoft Research and Carnegie Mellon University, with a small trusted kernel based on dependent type theory. It aims to bridge the gap between interactive and automated theorem proving, by situating automated tools and methods in a framework that supports user interaction and the construction of fully specified axiomatic proofs. The goal is to support both mathematical reasoning and reasoning about complex systems, and to verify claims in both domains.

In this talk, we provide a short introduction to the Lean theorem prover, describe how mathematical structures (e.g., groups, rings and fields) are encoded in the system, quotient types, the type class mechanism, and the main ideas behind the novel elaboration algorithm implemented in Lean. More information about Lean can be found at http://leanprover.github.io. The interactive book ``Theorem Proving in Lean'' (http://leanprover.github.io/tutorial) is the standard reference for Lean. The book is available in PDF and HTML formats. In the HTML version, all examples and exercises can be executed in the reader's web browser.

Bio:

Leonardo de Moura is a Principal Researcher in the RiSE group at Microsoft Research. He joined Microsoft in 2006, before that he was a Computer Scientist at SRI International. His research areas are automated reasoning, theorem proving, decision procedures, SAT and SMT. He is the main architect of Lean, Z3, Yices 1.0 and SAL. Lean is a new open source theorem prover. Z3 and Yices are SMT solvers, and SAL (the Symbolic Analysis Laboratory) is an open source tool suite that includes symbolic and bounded model checkers, and automatic test generators. Z3 has been open sourced (under the MIT license) in the beginning of 2015. Leonardo received the Haifa Verification Conference Award in 2010. In 2014, the TACAS conference (Tools and Algorithms for the Construction and Analysis of Systems) has given an award for "The most influential tool paper in the first 20 years of TACAS" to his paper "Z3: An Efficient SMT Solver". In 2015, Z3 received the Programming Languages Software Award from ACM SIGPLAN.

Josef's Talk

Title: Learning Intelligent Theorem Proving from Large Formal Corpora

Abstract:

The talk will discuss several AI methods used to learn proving of conjectures over large formal mathematical corpora. This includes (i) machine-learning methods that learn from previous proofs how to

suggest the most relevant lemmas for proving the next conjectures, (ii) methods that guide low-level proof-search algorithms based on previous proof traces, and (iii) methods that automatically invent suitable theorem-proving strategies on classes of problems. We will show examples of AI systems implementing positive feedback loops between induction and deduction, show the performance of the current methods over the Flyspeck, Isabelle, and Mizar libraries, and also mention emerging AI systems that combine statistical parsing of informal mathematics with such strong theorem proving methods.

Bio:

Josef Urban is a researcher at the Czech Institute of Informatics, Robotics and Cybernetics (CIIRC) heading the ERC-funded project AI4REASON. His main interest is development of combined inductive and deductive AI methods over large formal (fully semantically specified) knowledge bases, such as large corpora of formally stated mathematical definitions, theorems and proofs.

He received his PhD in Computers Science from the Charles University in Prague in 2004, and MSc in Mathematics at the same university in 1998. He worked as an assistant professor in Prague, and as a researcher at the University of Miami and Radboud University Nijmegen.

Ilias's Talk

Title: Computational Approaches to Open Problems in Combinatorics

Speaker: Ilias Kotsireas, Wilfrid Laurier University

Abstract: Combinatorics furnishes a wide spectrum of open problems and conjectures, that often lend themselves to computational approaches. We will discuss several such open problems that can be described in a unified manner via the periodic and aperiodic function associated to a finite sequence. We will also present traditional tools and techniques that are used in algorithmic schemes to tackle such problems. Arguably these traditional methodologies have reached a point of saturation, so we will present some new ideas that aim to bring into bear SAT solving in these hard combinatorial problems. Joint work with Vijay Ganesh et al.

Brief Bio:

Ilias Kotsireas serves as a Computer Science full professor at Wilfrid Laurier University since 2011. He has over 100 refereed journal and conference publications, edited books and special issues of journals in the areas of Computational Algebra, Metaheuristics, Dynamical Systems and

Combinatorial Design Theory. He serves on the Editorial Board of 4 international journals published by Elsevier and Springer. He has organized a large number of international conferences in Europe, North America and Asia, often serving as a Program Committee Chair or General Chair. He was a co-founder of the Computational Science seminar at Wilfrid Laurier University and has been coordinating the seminar activities on a monthly basis over the past 9 years. His research is and has been funded by NSERC and the European Union. He has received funding for conference organization from Maplesoft, the Fields Institute and several Wilfrid Laurier University offices. He is currently serving a 4-year term (2013-2017) as Chair of ACM SIGSAM.