Linear logic as a logical framework

by Dale Miller, Inria

Abstract to be presented at SD 2017: Structures & Deduction

Logical frameworks have seen three decades of design, theory, implementation, and applications. An early example of such a framework was LF (Honsell, Harper, & Plotkin, LICS 1987): that dependently typed λ-calculus provided a framework for defining the syntax of terms and formulas as well as natural deduction proofs in various intuitionistic logics.

In a series of papers starting in 1994, several researchers (see references below) have also made use of linear logic (with or without subexponentials) as a framework for specifying a range of proof systems. Simple theories in linear logic are able to specify various proof systems for first-order logics that include sequent calculus (both single-conclusion and multiple-conclusion), natural deduction (possibly with generalized elimination rules), free deduction, and tableaux. There is also a simple decision procedure that can guarantee the admissibility of cuts and (non-atomic) initials rules by analyzing the linear logic specification of rules. Finally, since proof search in linear logic can be implemented, computer systems exist that can emulate these various proof systems given their linear logic specification.

In this talk, I plan to overview this work and attempt to find a more lightweight formulation of this logical framework that does not need to explicitly reference a metalogic involving linear logic and subexponentials.

References

[1] A. S. Henriksen. Using LJF as a Framework for Proof Systems. Technical Report, University of Copenhagen, 2009.

[2] B. Lellmann, C. Olarte, and E. Pimentel. A uniform framework for substructural logics with modalities. In LPAR-21, pages 435–455. 2017.

[3] B. Lellmann and E. Pimentel. Proof search in nested sequent calculi. LPAR-20, pages 558–574, 2015.

[4] D. Miller. A Multiple-Conclusion Meta-Logic. In LICS 1994, pages. 272–281.

[5] D. Miller and E. Pimentel. A formal framework for specifying sequent calculus proof systems. *Theoretical Computer Science*, 474:98–116, 2013.

[6] V. Nigam and D. Miller. A framework for proof systems. *J. of Automated Reasoning*, 45(2):157–188, 2010.

[7] V. Nigam, E. Pimentel, and G. Reis. Specifying proof systems in linear logic with subexponentials. In LSFA 2010, ENTCS 269, pages 109–123, 2011.