Proof Theory Presentations

Fall 2012

1. **Title**: Curry-Howard correspondence for Ni and Church-Rosser theorem
   Speaker(s): Johannes Emerich and Ignas Vysniauskas

   Abstract: We would like to illuminate the Curry-Howard correspondence for the intuitionistic natural deduction systems and the simply typed lambda calculus. For ease of exposition we would like to focus on natural deduction systems for propositional logic using implication as the only connective. This corresponds to -¿Npi in Troelstra-Schwichtenberg terminology.

   The two main goals of the presentation will be to develop and explain the proofs-as-programs interpretation and to further show the correspondence between the reduction of λ-terms and the normalisation of proofs in natural deduction systems in light of the Church-Rosser and Normalization theorems.

   References

   (a) Lectures on the Curry-Howard Isomorphism (1998) by Morten Heine B. Sørensen, Pawel Urzyczyn

   (b) Proofs and Types by Jean-Yves Girard, Yves Lafont and Paul Taylor

   (c) Basic Proof Theory by A. S. Troelstra, H. Schwichtenberg

2. **Title**: Cut Elimination and Strong Separation for Substructural Logics: an Algebraic Approach
   Speaker: Julia Ilin

   Abstract: Following the paper [a], I will introduce commutative residuated lattices as algebraic structures for the logic $\mathbf{FL_{ew}}$. The goal is to present a purely algebraic proof of the cut elimination theorem for the logic in question. I will also spell out the proof that $\mathbf{FL_{ew}}$ has the finite model property, i.e. if a sequent is not provable then there is a finite integral commutative residuated lattice in which the sequent does not hold. Possibly, I will also give an outlook how the the presented version of the Cut-elimination theorem can be extended to other logics. For the introductory part I will also refer to [b].

   References

   (a) N. Galatos and H. Ono, Cut Elimination and Strong Separation for Substructural Logics: an Algebraic Approach

   (b) H. Ono, Proof-theoretic methods for non classical logic: an introduction.

3. **Title**: Cut Elimination theorem for Non-Classical logics
   Speaker: Jetze Baumfalk

   Abstract: For a wide range of logics, the cut elimination theorem holds. For these logics a lot of properties, such as the subformula property, follow directly from the fact the the cut elimination theorem holds for those logics. However, it is not the case that only those logics have these properties. The aim for this project is to find out about which properties follow from cut-elimination and why. Aside from that, I also want to write about some logics that do not have cut-elimination, but do have some of the derivable properties and why they also have those properties.

   References

   (a) H. Ono, Proof-theoretic methods for nonclassical logic: an introduction, Theories of Types and Proofs (MSJ Memoirs 2), M. Taka-hashi, M. Okada and M. Dezani-Ciancaglini (eds.), Mathematical Society of Japan, (1998), pp. 207-254.

4. **Title**: Proof-theoretical Applications of Forcing
   Speaker: Krzysztof Mierzewski

   Abstract: I would like to work on the proof-theoretical applications of forcing. In [a], Jeremy Avigad provides a little survey in which he argues that forcing, originally a purely model-theoretic technique, has interesting applications in proof theory. In particular, I would like to study a proof (due to Avigad) of cut elimination for the classical and intuitionistic sequent calculi based on the use of forcing techniques. The idea is to start from a model-theoretic proof of cut elimination (using a tableau construction of the kind given by, e.g., Fitting [c]), which consists in showing (a) that the proof system with cut is sound with respect to the given semantics, and (b) that the proof system without cut is complete with respect to it. This is a non-constructive proof, as it does not explain how to transform derivations with cut into derivations without. Avigad [b] shows that it is possible to interpret the model-theoretic proof in terms of a syntactically defined forcing relation, and use this to give a more constructive proof of cut elimination. From it, he also extracts an explicit algorithm for eliminating cuts.

   References

   (a) Avigad, J. (2000), "Algebraic Proofs of Cut Elimination", CMU Technical Report No. CMU-PHIL-111, Carnegie Mellon University.
   (b) Avigad, J. (2004), "Forcing in Proof Theory", Bulletin of Symbolic Logic 10(3), pp.305-333.
   (c) Fitting, M. (1969), "Intuitionistic Logic, Model Theory and Forcing"

5. **Title**: Fuzzy Logics
   Speaker: Maaike Zwart

   Abstract: I would like to understand the proofs of Cut elimination and Density elimination (section 5.1 and 5.3 from [a]) For this, I will need have some idea of what Fuzzy Logics are, which logical connectives and how they are interpreted. This can be found in Chapter 2 of [a]. Also, [b] could be of help here. Then I need to understand hypersequents (chapter 4 of [1]), as these are better suited for Fuzzy Logics than sequents (apparently).

References

(a) G. Metcalfe, N. Olivetti, and D. Gabbay, Proof Theory for Fuzzy Logics, Volume 36 of Applied Logic. Springer, (2008)

(b) J Pavelka, On Fuzzy Logic I Many-valued rules of inference, Mathematical Logic Quarterly, Volume 25, Issue 3-6, pages 45-52, 1979.

6. **Title**: Solovay Theorems in Provability Logic
   Speaker(s): Justin Krager and Alexander Block

   Abstract: Our goal shall be to understand and present the proofs of the two Solovay theorems, i.e. a formula is provable in a suitable theory T of arithmetic under all arithmetic realizations iff it is provable in the modal logic L and that a formula is true under all arithmetic realizations iff it is provable in the modal logic S

   References

   (a) Chapter VII , The Logic of Provability

   (b) Chapter II (Proof Theory of Arithmetic) of the "Handbook of Proof Theory" by S. Buss.

7. **Title**: Proof-Theoretic methods in Dynamic Epistemic Logic
   Speaker: Cecilia Chavez

   Abstract: Dynamic Epistemic Logic enjoys of thousands of trees that had become semantically-driven research papers on it. In contrast, the proof-theoretic accounts have been less explored. In this project, we will present some of the things that have been done in this vein, some of the things that have not been done, the important properties that are needed to extend the existing work as well as some of the problems in doing so. Our aim is to contribute to the construction of this landscape either by proving some properties or going towards some extension. Here, [a] and [b] are the base bibliography for the logic.

   References

   (a) A. Baltag, L.S. Moss, and S. Solecki. 'The logic of public announcements, common knowledge and private suspicions'. CWI Technical Report, 1999.

   (b) Hans van Ditmarsch, Wiebe van der Hoek, and Barteld Kooi. Dynamic Epistemic Logic. Springer, 2008.

8. **Title**: A Completeness Theorem for Basic Linear Logic based on Pretopologies.
   Speaker: Francesco Gavazzo

   Abstract:The project is divided in three parts:

- basic linear logic: in which I briefly recall the rules of the sequent calculus for basic linear logic.
- pretopologies: in which I introduce pretopologies. The goal is to give the proofs of some of main properties of pretopologies.
- a completeness theorem: in which I give the proof a completeness theorem for basic linear logic.
The goal is to prove in detail this theorem.
References

(a) Giovanni Sambin, Pretopologies and completeness proofs

(b) Giovanni Sambin, Pretopologies and a uniform presentation of sup-semilattices, quantales and frames

9. **Title**: Display Logic
Speaker(s): Sanne Kosterman and Babette Paping

Abstract:
References

10. **Title**: Categorical Logic
Speaker: Frank feys

Abstract:
References

11. **Title**: Gentzen's consistency proof for PA
Speaker: Simon Docherty

Abstract:
References

12. **Title**: Strong Normalization Theorem for Lambda Calculus
Speaker: Jouke Witteveen

Abstract:
References

13. **Title**: Display Calculi for Modal Logic
Speaker: Malvin Gattinger

Abstract:
References

14. **Title**:
Speaker: Evante Garza-licudine

Abstract:
References