Introduction to Categorical Logic

80-514/814

Suggested Topics for Student Projects

Updated: March 28, 2023

Come talk to me for more information about any of these topics. And feel free to suggest others!

1. Lawvere Duality
    - Adamek, Lawvere, Rosicky: On the duality between varieties and algebraic theories, Algebra Universalis, 2003.
    - Adamek, Rosicky, Vitale: Algebraic theories, Cambridge University Press, 2010.
2. Gabriel-Ulmer duality
    - Makkai, Pitts, Some results on locally finitely presentable categories, Transactions of the AMS 1987.
    - Adamek, Rosicky, Vitale: Algebraic theories, Cambridge University Press, 2010.
3. Stone-type dualities for commutative rings, distributive lattices, Heyting algebras, etc.
    - P.T. Johnstone, Stone Spaces, Cambridge University Press, 1982.
    - M. Makkai and G. Reyes, Completeness results for intuitionistic and modal logic in a categorical setting, Annals of Pure and Applied Logic, Volume 72, Issue 1, 10 March 1995, Pages 25–101.

4. Bi-Heyting logic

    - F.W. Lawvere, Intrinsic Co-Heyting Boundaries and the Leibniz Rule in Certain Toposes, in A. Carboni, M. Pedicchio, G. Rosolini (eds.), Category Theory - Como 1990, LNM 1488 Springer Heidelberg 1991.
    - Gonzalo E. Reyes, Houman Zolfaghari, Bi-Heyting Algebras, Toposes and Modalities, J. Phi. Logic 25 (1996) pp. 25–43.
    - Kripke models of bi-Heyting logic (CMU MS thesis by J. Winkler).

5. Joyal's embedding theorem, completeness

    - M. Makkai and G. Reyes, Completeness results for intuitionistic and modal logic in a categorical setting, Annals of Pure and Applied Logic, Volume 72, Issue 1, 10 March 1995, Pages 25–101.
    - Topological completeness of IPC.
    - My Fischbachau notes.

6. Modal Logic

    - S. Awodey and K. Kishida, Topology and Modality: The Topological Interpretation of First-Order Modal Logic, Review of Symbolic Logic, 2008.
    - What is intuitionistic S4 modal logic?
    - Modal propositional logic: McKinsey-Tarski topological completeness.
    - Gödel translation of IPC into classical modal PC.

7. Lambda-calculus and CCCs

    - D.S. Scott. Relating theories of the λ-calculus. In R. Hindley and J. Seldin, editors, To H.B. Curry: Essays in Combinatory Logic, Lambda Calculus and Formalisms, pp. 403–450. Academic Press, 1980.
    - D.S. Scott, Lambda Calculus: Some Models, Some Philosophy, Studies in Logic and the Foundations of Mathematics, Volume 101, 1980, pp. 223–265

- S. Awodey, Topological representation of the λ-calculus, Math. Struct. in Comp. Science, 2000.
- λ-calculus with sums $A + B$.
- λ-theory of a tiny object/interval/tangent vector.
- Kripke models of some λ-theories: Scott reflexive object, etc.
- Untyped λ-calculus as a λ-theory (Scott, Lambek-Scott).
- Equilogical spaces (Scott's paper).
- Modal type theory (my NASLLI talk, other).

8. Some more topics:

    - Kripke and/or topological counter-models and correspondences
    - Free Heyting algebras
    - Linear logic (Shulman's paper)
    - Lawvere's paper "Adjointness in foundations", Reprints in Theory and Applications of Categories, No. 16, 2006, pp. 1–16.