

# Introduction to Categorical Logic

80-514/814

## Suggested Topics for Student Projects

Updated: February 10, 2022

### 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. Exact categories / exact completions

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- Carboni and Vitali, Regular and exact completions, *Journal of Pure and Applied Algebra*, March 1998, pp. 79–116.
- Carboni and Rosolini, Locally cartesian closed exact completions, *Journal of Pure and Applied Algebra*, December 2000, pp. 103–116.

### 4. Hyperdoctrines

- F.W. Lawvere, Equality in hyperdoctrines and comprehension schema as an adjoint functor, Proceedings of the AMS Symposium on Pure Mathematics XVII (1970), 1–14.
- R.A.G. Seely, Hyperdoctrines, natural deduction, and the Beck condition, Zeitschrift für math. Logik und Grundlagen der Math., Band 29, 505–542 (1983).

#### 5. 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.

#### 6. Joyal’s embedding theorem

- 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

#### 7. Set-valued completeness for regular theories, classical completeness for Boolean theories:

- P.T. Johnstone, Sketches of an Elephant, section D1.5.

#### 8. Lambda-calculus and CCCs

- D.S. Scott. Relating theories of the  $\lambda$ -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  $\lambda$ -calculus, Math. Struct. in Comp. Science, 2000.

#### 9. Dependent type theory and LCCC (locally cartesian closed categories):

- R. A. G. Seely. Locally cartesian closed categories and type theory. Math. Proc. Camb. Phil. Soc., 95:33-48, 1984.
- S. Awodey and F. Rabe, Kripke Semantics for Martin-Löf's Extensional Type Theory, Log. Methods Comput. Sci., 2011.
- S. Awodey, N. Gambino, S. Hazratpour, Kripke-Joyal forcing for type theory and uniform fibrations, arXiv:2110.14576.

#### 10. Modal Logic

- S. Awodey and K. Kishida, Topology and Modality: The Topological Interpretation of First-Order Modal Logic, Review of Symbolic Logic, 2008.
- Modal Logic Project notes

#### 11. Some more topics:

- sheaves for a Grothendieck topology
- HOL and toposes
- Diaconescu cover
- Kripke completeness of IFOL
- algebraic models of IFOL
- gluing for IHOL