

COURSE INFORMATION

Algebraic Linguistics
(Linguistics 681)
Winter 2009
5 credits

TIME: TR 1:30-3:18

PLACE: Jennings Hall 136

COURSE WEB SITE: <http://www.ling.ohio-state.edu/~plummer/ling681/>

INSTRUCTOR: Carl Pollard

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Office hours TBA and by appointment

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Prerequisite: Linguistics 680 or the equivalent. In practical terms this amounts to familiarity with basic concepts from logic, set theory, and abstract algebra. Some background in linguistics, especially syntax and semantics, is recommended but not technically required (though without linguistic background the motivation will sometimes be harder to grasp).

Content: This version of Linguistics 681 is the first half of a two-course sequence (the second half is Linguistics 820, taught in Spring 2009). The course deals with an interrelated set of concepts from algebra, logic, and category theory, and their application to formalizing theories about natural language. The main areas of linguistic application are syntax, its interfaces to semantics/pragmatics and phonology/prosody, and symbolic (as opposed to quantitative) computational linguistics.

Format: The course will start out in lecture mode and evolve gradually into seminar mode with student-led discussion of readings.

Requirements: Lots of reading, class presentation, and course paper/project.

Readings: There are two main texts: (1) my in-progress mathematical linguistics textbook *Formal Foundations for Linguistic Theory*, and Benjamin Pierce's textbook *Basic Category Theory for Computer Scientists*. Additionally, there will be a number of supplementary articles and suggestions for further reading.

Tentative Syllabus for Linguistics 681

1. Course overview; review of (pre-)(semi-)lattices
2. Positive intuitionistic propositional logic (PIPL): heyting presemilattice (HPS) semantics and Gentzen natural deduction.
3. Intuitionistic propositional logic (IPL) and classical proposition logic (CPL): algebraic semantics and natural deduction.
4. Typed lambda calculus (TLC) and its set-theoretic models.
5. The Curry-Howard correspondence between PIPL and TLC.

Question 1: what is the connection between these models and the HPS models of PIPL?

6. Introduction to substructural logics and their algebraic models.
7. Lambek Grammars and the (so-called) Curry-Howard Semantics

Question 2: If semantic interpretation is a function, what is its domain?

8. Extending the Curry-Howard correspondence to substructural logics.

Question 3: What are the models?

9. Graphs, deductive systems, and categories.
10. Basic categorial constructions.
11. Functors, natural transformations, and adjoints.
12. Cartesian closed categories (ccc's) and TLCs.

The answer to Question 1: HPS's and set-theoretic models of TLC are both ccc's.

13. Categorical models of substructural logics. Mondoidal and residuated categories.

The answer to Question 2: a model of a Lambek calculus is a residuated category.

14. The *real* Curry-Howard semantics.

The answer to Question 3: semantic interpretation is a structure-preserving (categorical) functor from a residuated category to a cartesian closed category.