

# Minimalist Syntax and Mathematics

## A practical approach to Hopf-Algebraic Minimalism in the Classroom

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LIN-397-01 IP: New Minimalism & Alg Frm

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# Introduction and Motivations

# What: Math and Linguistics at Grinnell College

# So What: Mathematical Literacy

# Now What: A Course on MCB!

# Course Syllabus

# Year Overview

## Unit 1 Scientific Modeling

- 1** Types of Scientific Models
- 2** Examples of Scientific Models

## Unit 2 Models of Syntax

- 1** Examples in Generative Linguistics
- 2** The Minimalist Program and its Models

## Unit 3 Comparative Review

- 1** Chomsky's New Minimalism
- 2** Constituency (Merge)
- 3** X-Linguistic Similarities (Features)
- 4** Word Order (Linearization)
- 5** Grammaticality (Filtering)
- 6** Paraphrases (Possible Derivations)

# Unit 1: Scientific Modeling

Takeaways:

- 1 A mathematical model is a type of scientific model
- 2 Models are dogmatic. No model is a perfect model.
- 3 A mathematical model can be evaluated on its expressive power, cost, and empirical soundness.
- 4 A mathematical model is defined by its objects and axioms.

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# Unit 2: Models of Syntax

## Takeaways:

- 1 There exist many models of syntax, particularly in generative linguistics.
- 2 Chomsky's Hierarchy is a method of evaluating a grammar's expressive power.
- 3 "Minimalism" is not one theory, but a guiding set of principles for several models of syntax.

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# Unit 3: Comparative Review

## Takeaways:

- 1 “New minimalism” is Chomsky’s recent revision of the Minimalist Program.
- 2 Ed Stabler’s “Computational Minimalism” and Marcoli, Chomsky, and Berwick’s Hopf-Algebraic Minimalism are two approaches to modelling the minimalist program.
- 3 Computational minimalism aligns closer to the “90s formulation” of minimalism, whereas Hopf-Algebraic minimalism aligns closer to “New minimalism.”

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# Optional Unit: Mathematical Prerequisites

Course equivalences:

- MAT-322 “Advanced Topics in Abstract Algebra”

Covers:

- Elementary Category Theory
- Algebras, Bialgebras, Hopf Algebras, and Universal Algebras
- Modules over Algebras

# Optional Unit: Minimalist Prerequisites

Course equivalences:

- LIN-216 “Syntax”
- LIN-375 “Advanced Linguistic Analysis” in Syntax
- LIN-295/LIN-395 Special Topic in Syntax

Covers:

- P&P Architecture
- Governor-Binding Theory
- 90s Minimalism

# Formatted Examples

# Example Essay Prompt

In three double-spaced pages, answer the following:

- What is the SMT? How does it relate to the miracle creed?
- Are you convinced by the concept of the miracle creed? Why or why not?
- Give one example for and one example against the existence of the miracle creed in your area of interest. E.g. in Mathematics, one may write about complex-analytic series expansions and Gödel's incompleteness theorem.

You may cite “The Miracle Creed and SMT” [3], *Merge and the Strong Minimalist Thesis* [4], or other resources should you find them useful.

## Example Worksheet Questions

On the  $\mathbb{Q}$ -vector space of workspaces  $\mathcal{WS} := \mathcal{V}(\mathcal{F}_{SO_0})$ , Marcolli, Chomksy, and Berwick defines a product  $\sqcup$ , coproduct  $\Delta$ , antipode  $S$ , and unit and counit  $\epsilon, \eta$ . Prove that these operations compatibly form a Hopf Algebra. That is, show that the hexagon

$$\begin{array}{ccccc} \mathcal{WS} \otimes \mathcal{WS} & \xrightarrow{S \otimes \text{id}} & \mathcal{WS} \otimes \mathcal{WS} & & \\ \Delta \nearrow & & & \searrow \sqcup & \\ \mathcal{WS} & \xrightarrow{\epsilon} & \mathbb{Q} & \xrightarrow{\eta} & \mathcal{WS} \\ \Delta \searrow & & & \nearrow \sqcup & \\ \mathcal{WS} \otimes \mathcal{WS} & \xrightarrow{\text{id} \otimes S} & \mathcal{WS} \otimes \mathcal{WS} & & \end{array}$$

commutes.

# Example Lecture Notes Excerpt

## Future Directions

# A course for Grinnell

# A course for the public

# It's your turn!

# Bibliography I

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- [2] Noam Chomsky. *The Minimalist Program*. The MIT Press, 1995.
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“Modeling Externalization”. In preparation.
- [7] Edward P. Stabler. “Oxford Handbook of Linguistic Minimalism”. In: Oxford University Press, 2010.  
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pp. 616–641.