CS7480 Special Topics in Programming Languages:
Categories for PL

- **Instructors*:*** Steven Holtzen s.holtzen@northeastern.edu
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- **Time**: Tues/Fri 3:25 pm - 5:05 pm
- **Session**: Fall 2025

Description

Category theory is a branch of abstract algebra that underlies many modern developments in the theory of programming languages (PL). The goal of this course is to introduce the basic concepts of category theory, with an eye towards applications to PL. We will introduce these ideas through programming exercises and proof-based assignments, with the goal of establishing a strong shared foundation in the language and ideas of category theory.

Topics will include: monads and algebras, with applications to effectful languages; monoidal categories, with applications to languages and logics for safe memory management; ends and coends, with applications to polymorphism; toposes, with applications to languages with complex recursive features. The course will consist of formal lectures as well as research presentations by students exploring research topics of their choice.

Prerequisites

The target audience for this course is advanced master's students and PhD. students in programming languages. No prior knowledge of category theory is expected. There are no formal prerequisites, but students are expected to be comfortable programming and have mathematical maturity. In particular, students should be familiar with the notion of mathematical proof and comfortable programming in at least one major programming language. Some programming experience in Haskell may be helpful but is not required.

Organization and materials

The course will consist in part of (1) lectures delivered by the instructors; (2) student presentations on chosen research papers.

The course will primarily be taught from course notes prepared by the instructors based in part on following textbooks:

- Lawvere, F. William, and Schanuel, Stephen H.. *Conceptual mathematics: a first introduction to categories*
- Riehl, Emily. *Category theory in context*.
- Goldblatt, Robert. *Topoi: the categorial analysis of logic.*

Evaluation

- Homework (roughly bi-weekly, consisting of proofs and programming exercises): 80%
- Course note feedback: 10%
- Presentations on research papers: 10%