15-816
Substructural Logics

Fall 2016

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My Responsibility

- Lectures Tue and Thu, 1:30-2:50
- Piazza cmu/fall2016/15816
- Office Hour, Tue 3:00-4:00 (GHC 7019)
  - Starting next week
- Website www.cs.cmu.edu/~fp/courses/15816-f16/

Your Responsibility

- Class participation
- Piazza participation
- Homework assignments (60%)
  - 6 weekly assignments up to midterm (individual)
  - 3 biweekly assignments after midterm (pairs)
- Midterm exam (15%), Tue Oct 18
  - Closed notes, in class (80 minutes)
- Final exam (25%), date TBA
- Waiting list

About Substructural Logics

- Linear Logic: Jean-Yves Girard (1987)
  - Inspired by a mathematical semantics
  - Changed the way we view logic and computation
  - Changed the way we approach proof theory
- My approach
  - Inspired by Dummett (1976) and Martin-Löf (1983)
  - Systematic internal justification of logical laws
- The family of substructural logics
  - Lambek calculus, affine logic, strict logic, relevance logic, ordered logic, bunched logic, separation logic, …

About Linear Logic

- A logic of state or resources
- Numerous applications in computer science
  - Logic programming (imperative, concurrent)
  - Functional programming (machines, complexity)
  - Concurrency (session types, geometry of interaction)
  - Object-oriented programming (typestate)
- Numerous applications in logic
  - Understanding structural rules
  - Focusing and polarization
  - Resource semantics
  - Knowledge and possession

Learning Objectives

- After taking this course, students can
  - Model stateful, concurrent, and resource-aware systems in substructural logic
  - Define and reason about programming languages using substructural operational semantics (SSOS)
  - Capture computational phenomena in substructural type theories
  - Apply judgmental methods to define logics and type theories
  - Appreciate the deep connections between logic and computation

Course Outline

- Part I: Fundamentals
  - Systematic development of substructural logics
  - Understanding their intrinsic properties
  - Intuition from guiding examples and applications
- Part II: Applications
  - Study selected applications
- Part III: The frontier
- Today: Deductive Inference