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