End-of-semester logistics

- Office hours 2-3pm **on Zoom** (same as Monday link)
- HW5 Due tonight (Saturday with 2 late days)
- Late submissions not accepted – I need to post solutions

- Zoom office hours Monday
  - Come with any questions ahead of the final

- **Final:** Wednesday, May 1, 2:00-4:00pm, SB 238
- I'm assuming everyone is taking it in person unless I've heard from you already

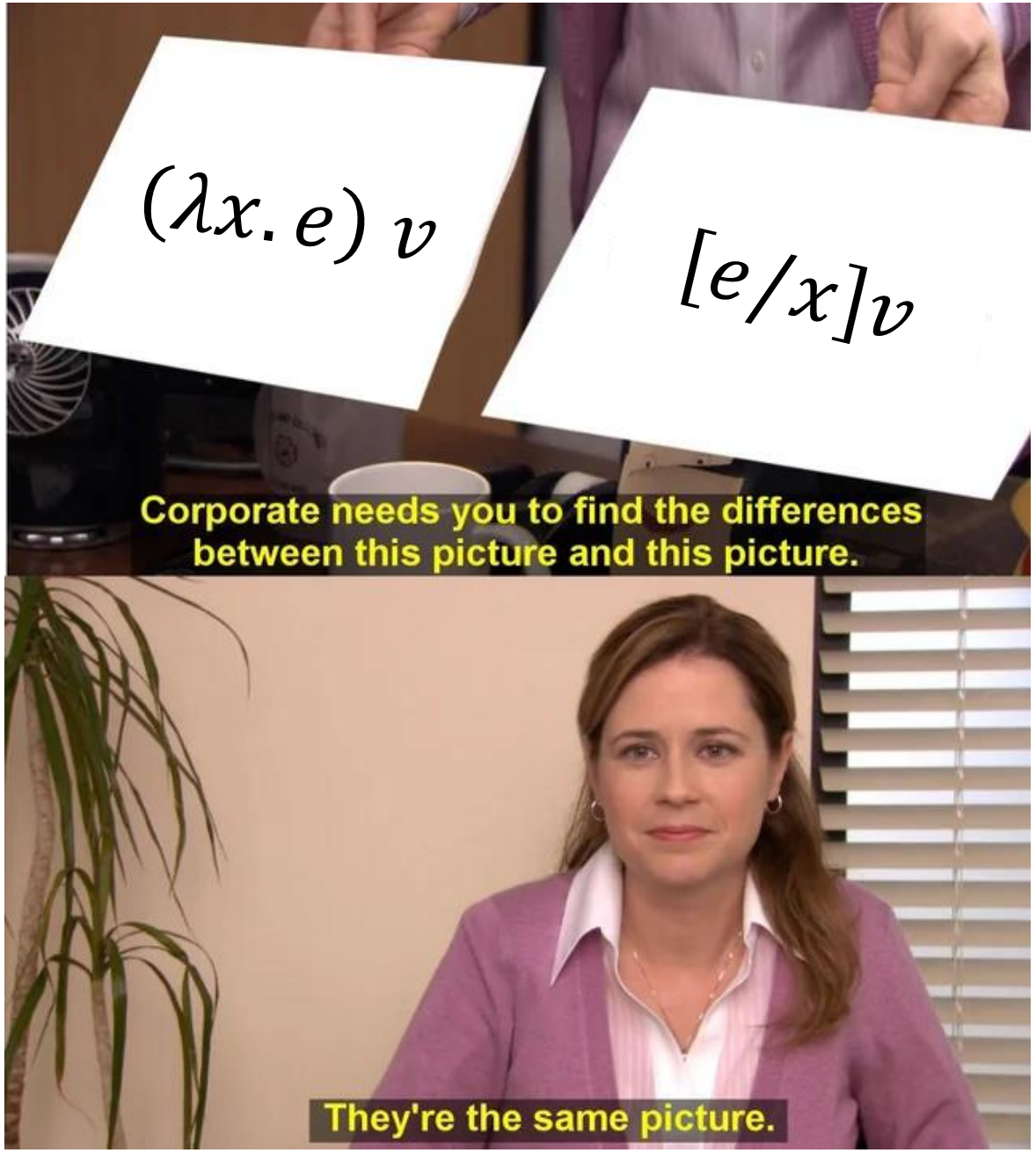
Final Exam

- All homeworks, all lectures (including lectures since HW5)
- **Three (3)** letter-size (8.5x11”) double-sided sheets of notes
- I’ll provide reference material (posted ahead of time on BB)

Tentative format:

- Short answer
- Type -> Expression, Expression -> Type
- 3-5 longer questions (like midterm, HW)

Today:
Equational Reasoning



Course Objectives

- Understand the models, notations and techniques used by Programming Languages researchers to formalize languages and systems.
- Formally prove properties about programming languages and programs.
- Use the above techniques to design new type systems and models to formalize and prove properties about new and existing language features and systems.
- Read and understand professional literature in the field of Programming Languages.

Understand the models, notations and techniques used by Programming Languages researchers to formalize languages and systems

- Inference Rules
- Rule Induction
- Language models
  - IMP
  - Lambda calculus
  - STLC
  - System F
- Dynamic Semantics
  - Small-step
  - Big-step
  - Evaluation contexts
  - Control stacks
  - Parallel semantics
- Static Semantics
  - Polymorphism
  - Recursive types
  - Subtyping
  - Dependent types
- Curry-Howard
- Equational Reasoning

Formally prove properties about programming languages and programs

- Type Safety
  - Progress
  - Preservation
- Memory Safety
- Security (noninterference)
- Resource usage
- Parametricity

Use the above techniques to design new type systems and models to formalize and prove properties about new and existing language features and systems

- Model garbage collection
- Type system for noninterference
- Static array bounds checking with dependent types
- Type system for amortized analysis

Read and understand professional literature in the field of Programming Languages

- Uh, well… try it (or doing research yourself!)

One recipe for a PL paper:

- Identify a problem (like out-of-bounds array accesses, resource usage, memory safety) you want to model or solve with PL techniques
- Sufficiently formalize the model
- Prove properties of interest