Scheme

- Like ML, functional focus with imperative features
  - anonymous functions, function closures, etc.
  - but every binding is mutable

- A really minimalist syntax/semantics
  - In the LISP tradition
  - Current standard is 50 pages

- Dynamically typed, type safe
  - Less “compile-time” checking
  - Accepts more perfectly reasonable programs

- Some “advanced” features for decades
  - Programs as data, hygienic macros, continuations
Which Scheme?

Scheme has a few dialects and many extensions.

We will use “PLT → Pretty Big” for the language and DrScheme as a convenient environment. Available in the ugrad labs, or you can download it for a personal machine.

Most of what we do will be “pure Scheme”.

Good documentation available online, including the entire text of *Structure and Interpretation of Computer Programs* (linked from the 341 page)
Scheme syntax

Syntactically, a Scheme term is either an atom (identifier, number, symbol, string, ... ) or a sequence of terms \((t1 \ldots tn)\).

Note: Scheme used to get (still gets?) “paren bashed”, which is hilarious in an XML world.

Semantically, identifiers are resolved in an environment and other atoms are values.

The semantics of a sequence depends on \(t1\):

- certain character sequences are “special forms”
- otherwise a sequence is a function application. Semantics same as ML — evaluate them, then call function (call-by-value)
Some special forms

- define
- lambda
- if, cond, and, or
- let, let*, letrec
Some predefined values

- #t, #f
- (), cons, car, cdr, null?, list
- eq?, equal?
- a “numeric tower” (integer, rational, real, complex, number) with math operations (e.g., +, =, <) defined on all of them
- tons more (strings vs. symbols discussed later)

Note: Prefix and variable-arity help make lots of things functions.
Parens Matter

Every parenthesis you write has meaning – get used to that fast!

(define (fact n) (if (= n 0) 1 (* n (fact (- n 1))))) ; correct
(define (fact n) (if (= n 0) (1) (* n (fact (- n 1)))))
(define (fact n) (if = n 0 (1) (* n (fact (- n 1)))))
(define fact (n) (if (= n 0) 1 (* n (fact (- n 1)))))
(define (fact n) (if (= n 0) 1 (* n fact (- n 1))))
(define (fact n) (if (= n 0) 1 (* n ((fact) (- n 1)))))
Local bindings

There are 3 forms of local bindings with different semantics:

- let
- let*
- letrec

Also, in function bodies, a sequence of definitions is equivalent to letrec.

But at top-level redefinition is assignment!

This makes it ghastly hard to encapsulate code, but in practice:

- people assume non-malicious clients
- implementations provide access to “real primitives”

For your homework, assume top-level definitions are immutable.