MASSACHVSETTS INSTITVTE OF TECHNOLOGY
Department of Electrical Engineering and Computer Science
6.001—Structure and Interpretation of Computer Programs
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**Lecture Notes, September 9**

# Scheme Basics

## Language Components

- Primitives
- Means of combination
  - procedure application
  - compound data structures
- Means of abstraction
  - naming
  - procedures
  - data abstractions

## Rules for Scheme

1. (Almost) Every *expression* has a *value* (which is returned when the expression is *evaluated*).
2. Every value has a *type*.

## Rules for Evaluation

1. If expression is *self-evaluating*, return value.
2. If a *name*, return value associated with that name in the environment.
3. If a *special form*, do something special.
4. If a *combination*, then
   (a) *Evaluate* all of the subexpressions of the combination (in any order).
   (b) *Apply* the *operator* to the values of the *operands* (the arguments) and return the result.

## Rules for Application

1. If procedure is *primitive* (built-in), just do it.
2. If procedure is a *compound procedure*, then *evaluate* the *body* of the procedure with each *formal parameter* replaced by the corresponding *actual argument* value.

## Taxonomy of Expressions

- Primitive Expressions
  - Constants (self-evaluating)
    - Numerals, e.g. `7` == Sch-Num 7
    - Strings, e.g. `"hello"` == Sch-String hello
    - Booleans, e.g. `#f #t` == Sch-Bools
  - Names
    - e.g. `+` == primitive procedure
    - e.g. `x` == variable created by `define` or procedure application
- Compound Expressions
  - Combinations: `(<operator> <operand> <operand> ...)`
  - Special Forms
    - define: `(define <name> <exp>)`
    - lambda: `(lambda (<formal1> <formal2> ...) <body>)`
    - if: `(if <predicate> <consequent> <alternative>)`
    - ... more to come! ...

## Approximations for Square Root

```
(define try
  (lambda (guess x)
    (if (good-enuf? guess x)
        guess
        (try (improve guess x) x))))

(define improve
  (lambda (guess x)
    (average guess (/ x guess))))

(define average
  (lambda (a b)
    (/ (+ a b) 2)))

(define good-enuf?
  (lambda (guess x)
    (< (abs (- (square guess) x)) 0.001)))

(define sqrt
  (lambda (x) (try 1 x)))
```