

Recitation 1, February 7

Scheme Solutions

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Language Constructs

1. **Primitives:** simplest entities in the language

. evaluate to themselves (1) *self-evaluating primitives*: numbers, strings, booleans (true, false)
examples:

(2) *built-in procedures to manipulate primitives*

numbers: +, -, *, /, >, <, >=, <=, =

strings: string-length, string=?, ...

booleans: boolean/and, boolean/or, boolean/not

. evaluate to a procedure

examples: *symbols* +, -, ... are names for primitive procedures.

(look up procedures in a special table; see environment model later)

2. **Combinations:** compound elements built by combining smaller ones (primitive procedures and subexpressions)

(foo a b c) First expression after left parenthesis must be a procedure to be applied; a, b, c are subexpressions representing the procedure's arguments

. evaluate subexpressions, then apply value of the operator



(+ (+ 3 4) (+ 10 11) (+ 1 1))
(+ 7 21 2)

30

3. **Abstractions:** compound elements can be named and used as single entities

. needs a special form called define (why?) *because otherwise the subexpressions will be evaluated, and the second one hasn't been defined yet; it will give an unbound variable error.*

(define bar 4)

(define foo +)

(foo bar 3)

(define foo*2 (* foo 2))

(define foo*2 (* (foo 3 4) 2))

Examples

(* 5 99)

495

(+ 5 99)

error: $+5$ need space between symbols so + can evaluate to a procedure

(* (5 9))

error: procedure name expected after '('; 5 is not a procedure

(* -5 99)

-495

(* (- 5 99))

-94

What special characters have we seen so far in Scheme? *parens + space*

Problems

What is the result printed by the Scheme interpreter for each expression? Assume that the first 7 expressions are evaluated in order.

1. 42

42

2. (/ 5 2)

$2\frac{1}{2}$ (note: some implementations may leave this as $\frac{5}{2}$)

3. (+ (* 2 3) (- 4 8))

(+ $\underbrace{6}$ $\underbrace{-4}$)

2

4. +

#<primitive: +>

5. (define + (* 2 5))

nothing prints out; value is unspecified

6. (* 2 +)

\downarrow
10
20

7. (+ 2 5)

error: + is not a procedure anymore

8. Write the Scheme expression representing the following (assume that + has not been redefined):

$$\frac{5 + 4 + (2 - (3 - (6 + \frac{3}{4})))}{3(6 - 2)(2 - 7)}$$

(/ (+ 5 (+ 4 (- 2 (- 3 (+ 6 $\frac{3}{4}$))))))

(* 3 (* (- 6 2) (- 2 7)))

assumes
binary operators

or (/ (+ 5 4 (- 2 3 (+ 6 $\frac{3}{4}$)))

(* 3 (- 6 2) (- 2 7)))