CS 61A Scheme, Scheme, and More Scheme

Spring 2021 Lost 7: April 2, 2021

# 1 Learning Goals

- Learn the basics of Scheme
- Begin to see that Scheme is, in fact, beautiful

# 2 What Would Scheme Display

2.1 What would Scheme display? As a reminder, the built-in `quotient` function performs floor division.

```
scm> (define a (+ 1 2))
```

```
scm> a
```

```
scm> (define b (- (+ (* 3 3) 2) 1))
```

```
scm> (= (modulo b a) (quotient 5 3))
```

2.2 What would Scheme display?

```
scm> (cons 10 (cons 11))
```

```
scm> (car (cons 10 (cons 11 nil)))
```

```
scm> (cdr (cons 10 (cons 11 nil)))
```

```
scm> (cons 5 '(6 7 8))
```

```
scm> (define a 10)
a
scm> (list 8 9 a 11)    ; list procedure evaluates all operands
```

```
scm> '(8 9 a 11)        ; quote special form does not evaluate operand
```

*Note: This worksheet is a problem bank—most TAs will not cover all the problems in discussion section.*

```
scm> (list? (cons 1 2))
```

```
scm> (list? (cons 1 (cons 2 '())))
```

```
scm> (define null nil)
scm> (equal? null 'null)
```

```
scm> (equal? nil 'null)
```

```
scm> (equal? null 'nil)
```

```
scm> (equal? nil 'nil)
```

```
scm> (equal? 'nil ''nil)
```

```
scm> (equal? ''nil ''nil)
```

```
scm> (eqv? ''nil ''nil)
```

# 3 Intro-Level Practice

3.1 Write a function that returns the factorial of a number.

```
(define (factorial x)
```

3.2 Define `reduce`, where the first argument is a function that takes two arguments, the second is a starting value, and the third is a list. This should work like **Python**'s `reduce`.

```
(define (reduce fn s lst)

                                        )
```

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# 4 Exam-Level Prep

4.1 Write a function that takes a procedure and applies to every element in a given nested list.

The result should be a nested list with the same structure as the input list, but with each element replaced by the result of applying the procedure to that element.

Use the built-in `list?` procedure to detect whether a value is a list.

```
(define (deep-map fn lst)
```

```
scm> (deep-map (lambda (x) (* x x)) '(1 2 3))
(1 4 9)
scm> (deep-map (lambda (x) (* x x)) '(1 ((4) 5) 9))
(1 ((16) 25) 81)
```

4.2 **Fall 2019 Final, Question 7a: Mull It Over** Implement *mulxy*, which multiplies integers $x$ and $y$. **Hint**: (- 2) evaluates to -2.

```
;; multiply x by y (without using the * operator).
;; (mulxy 3 4) -> 12           ; 12 = 3 + 3 + 3 + 3
;; (mulxy (- 3) (- 4)) -> 12   ; 12 = - ( -3 + -3 + -3 + -3 )
(define (mulxy x y)

  (cond ((< y 0) (- ______________________________________________________________ ))

        ((= y 0) 0)

        (else ( __________________ x (mulxy x __________________________________ )))))
```