

6.001 Recitation 2: More Scheme

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Announcements / Notes

- Lecture 2, slide 29 has 4 missing parentheses.
- Sugarless lambda – (a) keeps it clear that creating a procedure and assigning it to a name are two distinct steps, and (b) often we don't need a name – we'll see many examples of this later.
- (if (is-serious?
 (scheduling-problem? you))
 (email dkauf@mit.edu)
 (attend-section-we-assigned you))
- First tutorial is **Monday** or **Tuesday**
- Mid-semester recitation feedback
- InstaQuiz returned
- DrScheme options: case sensitivity & rationality

The lambda Special Form

(lambda *parameters body*)

Creates a procedure with the given parameters and body. *parameters* is a list of names of variables. *body* is one or more scheme expressions. When the procedure is applied, the body expressions are evaluated in order and the value of the last one is returned.

Evaluate the following expressions:

```
(lambda (x) x)  
==> a procedure
```

```
((lambda (x) x) 17)  
==> 17
```

```
((lambda (x y) x) 42 17)  
==> 42
```

```
((lambda (x y) y) (/ 1 0) 3)  
==> error
```

```
((lambda (x y) (x y 3))  
  (lambda (a b) (+ a b)) 14)  
--> ((lambda (a b) (+ a b)) 14 3)  
--> (+ 14 3)  
==> 17
```

The if Special Form

(if *test consequent alternative*)

If the value of the test is not false (**#f**), evaluate the consequent, otherwise evaluate the alternative.

Why must this be a special form?

If we used a **lambda**, both the consequent and alternative would always be evaluated. This would result in infinite loops for recursive procedures.

Does if give us new functionality?

Yes, see the previous answer

Evaluate the following expressions (assuming x is bound to 3):

```
(if #t (+ 1 1) 17)  
==> 2
```

```
(if #f #f 42)  
==> 42
```

```
(if (> x 0) x (- x))  
==> 3
```

```
(if 0 1 2)  
==> 1
```

```
(if x 7 (7))  
==> 7
```

Write the body of the following procedure:

```
;; If x is not the same as the expected  
;; value, some illegal expression is  
;; evaluated.  
;;  
;; Hints: (equals? x y) can be used to test  
;; for equivalence and (not x) flips true/  
;; false values.  
(define (check x expected)  
  (if (not (equal? x expected))  
      ("error")))
```

The cond Special Form

```
(cond (test-expr1 expr ...)
      (test-expr2 expr ...)
      (else expr ...))
```

Evaluation rules:

1. Evaluate *test-expr1*
2. If the value is not false (**#f**), evaluate the rest of the **associated** expressions and return the last value.
3. Otherwise, continue to the next test expression and repeat.
4. If no test expressions are non-false, evaluate the **else** clause and return the value of the last expression, if an **else** clause exists.

Why must this be a special form?

For the same reasons **if** cannot be implemented with just **lambda**.

Does cond give us new functionality?

No, it's just a sugary way of doing complex **if** expressions.

Evaluate the following expressions (assuming x is bound to 3):

```
(cond ((= 1 x) "one")
      ((= 2 x) "two")
      ((= 3 x) "three"))
==> 3
```

```
(cond (((lambda (x) (= 3 x)) x) "three")
      (else "not_three"))
==> "three"
```

```
(cond ((lambda (x) (= 2 x)) "two")
      (else "not_two"))
==> "two"
```

Biggie Size!

Suppose we're designing a point-of-sale and order-tracking system for Wendy's¹. Luckily the Über-Qwick drive through supports only 4 options: Classic Single Combo (hamburger with one patty), Classic Double With Cheese Combo (2 patties), and Classic Triple with Cheese Combo (3 patties), Avant-Garde Quadruple with Guacamole Combo (4 patties). We shall encode these combos as 1, 2, 3, and 4 respectively. Each meal can be *biggie-sized* to acquire a larger box of fries and drink. A *biggie-sized* combo is represented by 5, 6, 7, and 8 respectively.



1. Write a procedure named **biggie-size** which when given a regular combo returns a *biggie-sized* version.

```
(define biggie-size
  (lambda (combo)
    (+ combo 4)))

;; tests
(check (biggie-size 1) 5) ; single -> biggie single
(check (biggie-size 4) 8) ; avant -> biggie avant
```

2. Write a procedure named **unbiggie-size** which when given a *biggie-sized* combo returns a non-*biggie-sized* version.

```
(define unbiggie-size
  (lambda (combo)
    (- combo 4)))

;; tests
(check (unbiggie-size 5) 1) ; single <- biggie single
(check (unbiggie-size 8) 4) ; avant <- biggie avant
```

3. Write a procedure named **biggie-size?** which when given a combo, returns true if the combo has been *biggie-sized* and false otherwise.

```
(define biggie-size?
  (lambda (combo)
    (> combo 4)))

;; tests
(check (biggie-size? 1) #f)
(check (biggie-size? 7) #t)
```

4. Write a procedure named **combo-price** which takes a combo and returns the price of the combo. Each patty costs \$1.17, and a *biggie-sized* version costs \$.50 extra overall.

```
(define combo-price
  (lambda (combo)
    (if (biggie-size? combo)
        (+ (combo-price (unbiggie-size combo)) 0.50)
        (* 1.17 combo))))

;; tests
(check (combo-price 1) 1.17)
(check (combo-price 2) 2.34)
(check (combo-price 5) 1.67)
```

5. An order is a collection of combos. We'll encode an order as each digit representing a combo. For example, the order 237 represents a Double, Triple, and *biggie-sized* Triple. Write a procedure named **empty-order** which takes no arguments and returns an empty order.

```
(define empty-order
  (lambda () 0))

;; no tests are practical yet
```

6. Write a procedure named `add-to-order` which takes an order and a combo and returns a new order which contains the contents of the old order and the new combo. For example, `(add-to-order 1 2)` \rightarrow 12.

```
(define add-to-order
  (lambda (order combo)
    (+ (* order 10) combo)))
;; tests
(check (add-to-order 1 2) 12)
```

7. *Write a procedure named `order-size` which takes an order and returns the number of combos in the order. For example, `(order-size 237)` \rightarrow 3. You may find `quotient` (integer division) useful.

```
(define order-size
  (lambda (order)
    (if (= 0 order)
        0
        (+ 1 (order-size (quotient order 10))))))
;; tests
(check (order-size (empty-order)) 0)
(check (order-size 237) 3)
(check (order-size (add-to-order (empty-order) 2)) 1)
(check (order-size (add-to-order (biggie-size 3) 2)) 2)
```

8. *Write a procedure named `order-cost` which takes an order and returns the total cost of all the combos. In addition to `quotient`, you may find `remainder` (computes remainder of division) useful.

```
(define order-cost
  (lambda (order)
    (if (= 0 order)
        0
        (+ (combo-price (remainder order 10))
            (order-cost (quotient order 10))))))
;; tests
(check (order-cost (empty-order)) 0)
(check (order-cost 1) 1.17)
(check (order-cost 12) (* 1.17 3))
(check (order-cost 58) (+ (* 1.17 5) (* 2 0.50)))
```