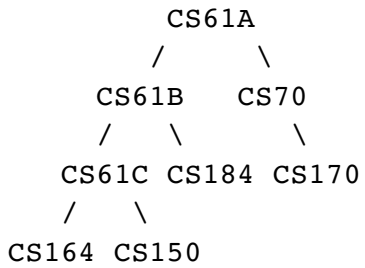
CS61A Notes – Week 08b: Review

QUESTION 1.
At Depth University, a student must complete at least one advanced class to graduate. However, every advanced class has a prerequisite, which may itself have a prerequisite, and so on. Write a procedure **fast-grad** that, given a prerequisite tree, with constructor **make-tree** and selectors **datum** and **children**, returns the shortest possible list of courses needed to graduate. If there is a tie, fast-grad may return any of the shortest lists. You may assume that all leaf nodes are advanced classes, and vice versa.

For example, **fast-grad** called on the following tree can return (CS61A CS70 CS170) or (CS61A CS61B CS184), either one is correct.



QUESTION 2.
We want to determine if there is a path from one building to another on campus. Connections are represented like this:

```
(connected Soda Cory)
(connected Cory Soda)  ;; two-way connection

(connected Cory Evans)
(connected Evans Cory) ;; two-way connection
```

Write rules for **is-connected** that takes a current location and an ending location and a list of future locations and checks if the list is a valid sequence of steps to get to the end location according to **connected.** (Since the final element is a list of FUTURE steps, the current location is NOT INCLUDED in the list, but the ending location matches the last element of the list.)

QUESTION 3.
What are the first 5 elements of the following stream?

```
(define powers (cons-stream 1 (stream-map *
                                (stream-map +
                                            ones
                                            ones
                                            ones
                                            ones)
                                powers)))
```

QUESTION 4.
We want to write a system to calculate the average grades of students. However, we'd like to be able to break them down by type of student: graduate student, undergraduate, lazy, motivated, and so on. A grade is a single number, and it is tagged with the type of student it is associated with:

```
(define lazy-grade (attach-tag 'lazy 60))
```

a) Write a procedure **populate-records** that takes a list of type-tagged student grades and populates a table using the **get** and **put** methods discussed in class. It should populate the table with a score total per type of student, and a number of appearances per type of student. For example:

```
> (define lazy1 (attach-tag 'lazy 60))
(lazy . 60)
> (define lazy2 (attach-tag 'lazy 70))
(lazy . 70)
> (define normal1 (attach-tag 'normal 85))
(normal1 . 85)
> (populate-records (list lazy1 lazy2 normal1))
okay ;; return value unimportant
> (get 'lazy 'total)
130 ;; 60 + 70
> (get 'lazy 'appearances)
2 ;; two lazy students
```

b) Using the **total** and **appearances** data, write a procedure **get-average** that takes in a type of student and returns their average performance. Continuing the example from above, (get-average 'lazy) would return 65. If the type of student did not appear, return 0.

QUESTION 5.
Fill in the blank in the following interaction with the metacircular evaluator:

```
;;; M-Eval input:
if
```

_____

QUESTION 6.
For each evaluator, will the following expression return a value or cause an error? Circle VALUE or ERROR for each.

```
> (let ((a 3)
        (b a))
    (+ a 4))
```

VALUE ERROR The MCE

VALUE ERROR Analyzing evaluator

VALUE ERROR Lazy evaluator

For each evaluator, will the following expression return a value or cause an error? Circle VALUE or ERROR for each.

```
> (let ((a 3)
        (b a))
    (+ a b)) ;; this line different from the one above
```

VALUE ERROR The MCE

VALUE ERROR Analyzing evaluator

VALUE ERROR Lazy evaluator

QUESTION 7.
Here is a transcript of a Scheme session. Fill in the blanks

```
> a
(1 2 (3 4 5) 6)
> b
(1 2 3 4 5)
> c
(1 2 (3 4 5) 6)
> (eq? (cddr b) (caddr a))
#T
> (eq? (caddr c) (caddr a))
#F
> (eq? (cdaddr c) (cdddr b))
#T
> (set-car! (caddr a) 7)
okay
> (set-car! (cdaddr a) 8)
okay
> b
```

_____
> c

_____

QUESTION 8.
Draw this baby, but stop drawing when you have a feel for how things will work out in the end.

```
(define x 4)

(define (define-x x) (define x x) x)

(define (confusing x y)
  (let ((z (x y)))
    (set! confusing z))
    (set! x 10)
    (confusing))

(confusing define-x (let ((total 0))
                      (lambda ()
                  (set! total (+ total x))
                  (confusing))))
```

QUESTION 9.
In the lazy evaluator you are given:

```
(define (actual-value exp env)
  (force-it (mc-eval exp env)))

(define (force-it obj)
  (if (thunk? obj)
    (actual-value (thunk-exp obj)
                  (thunk-env obj))
    obj))
```

Consider this modication in all capitals:

```
(define (force-it obj)
  (if (thunk? obj)
    (MC-EVAL (thunk-exp obj)
             (thunk-env obj))
    obj))
```

Assume the following functions are typed at the lazy prompt:

```
(define (identity x) x)

(define (foo a b)
  (+ (bar a) b))

(define (bar a) (* a a))
```

What is the value returned by the lazy evaluator for each of the following expressions? If something abnormal happens, please describe.

(a) (bar 3)

(b) ((lambda (x) (* x x)) ((lambda (x) x) 5))

```
(c) (foo 6 7)

(d) (let ((a +) (b 4))
       (+ b b))

(e) (identity (identity 6))
```

QUESTION 10.
Write a procedure **useless-square** that performs the squaring function correctly the first time you call it, and thereafter only returns what it returned the first time. For example,

```
> (useless-square 5)
25
> (useless-square 10)
25
> (useless-square 3)
25
```

QUESTION 11.
Write rules for the following query that flattens a list:

```
> (flatten (a (b c) d ((e))) ?what)
(flatten (a (b c) d ((e))) (a b c d e))
```