

Lambda Calculus - 100

What the following code returns

```
(let ((a 3))
  (let ((a 4)
        (b a))
    (list a b)))
```

What is `(4 3)`

Lambda Calculus - 200

The value returned by this expression:

```
((lambda (x f)
  (f (f x)))
 3
 (lambda (y)
  (+ y y)))
```

What is `12`

Lambda Calculus - 300

Given the following definition of f:

```
(define f
  (lambda (x)
    (x (lambda (y) (* y 2))))))
```

It's the expression which, when f is applied to it, returns 6.

What is: `(lambda (z) (z 3))`

OR: `(lambda (z) 6)`

Lambda Calculus - 400

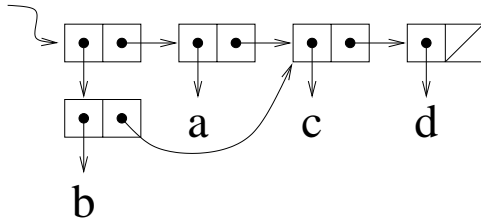
A function, that when applied to itself, returns a function, that when applied to 17 returns 17.

What is: `(lambda (x) x)`

OR: `(lambda (f) (lambda (y) 17))`

Lists - 100

The printed representation in Scheme of the following box and pointer diagram:



What is `((b c d) a c d)`

Lists - 200

The expression returned by the following code:

```
(define x '(a b x))
(define y (list x x (list 'x x)))
(set-cdr! (cdr y) (list 'w))
y
```

What is `((a b x) (a b x) w)`

Lists - DAILY DOUBLE

If we were to implement `cons`, `car`, and `cdr` as procedures, by writing `cons` as a procedure of its two arguments, like so:

```
(define (cons x y)
  (lambda (m) (m x y)))
```

then this is how “`cdr`” would be defined.

What is

```
(define (cdr l)
  (l (lambda (x y) y)))
```

Lists - 400

The missing expressions in this following definition

```
(define (accumulate f init lst)
  (if (null? lst)
      init
      (_____
        (accumulate f init
                     (cdr lst))))))
```

What are `f` and `(car lst)`

Environment Model - 100

The reason that the environmental model is useful:

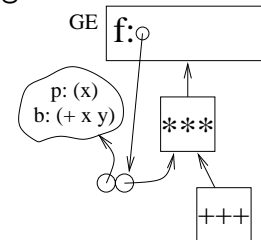
- (a) procedures may contain free variables
- (b) environments use frames
- (c) the substitution model is inadequate to deal with procedural side effects
- (d) your TA likes to see you extremely confused
- (e) garbage collection takes a shorter amount of time for environmental models

What is C

Environment Model - 200

The expressions that should appear in place of the asteriks and the pluses in the environment diagram below, corresponding to the following code:

```
(define (f x)
  (let ((y 10))
    (lambda (x) (+ x y))))
(define g (f 5))
```



What is (*) y:10 and (+) x:5

Environment Model - 300

In a lexically scoped language like scheme, this is, by definition, where free variables in procedures passed as arguments are looked up:

- (a) in the environment where the procedure is called
- (b) in the environment where the lambda expression was evaluated
- (c) in the global environment
- (d) in the primitive list of the global environment
- (e) in Billings, Montana

What is B

Environment Model - 400

These are the steps that result from applying a procedure in the environment model.

What are: (1) hang a frame, (2) bind formal parameters, (3) point back to where environment pointer of proc. object points, (4) evaluate body.

Register Machines - 100

It is the error in this statement:

```
(assign 1st (car (cdr (reg 1st))))
```

Register Machines - 200

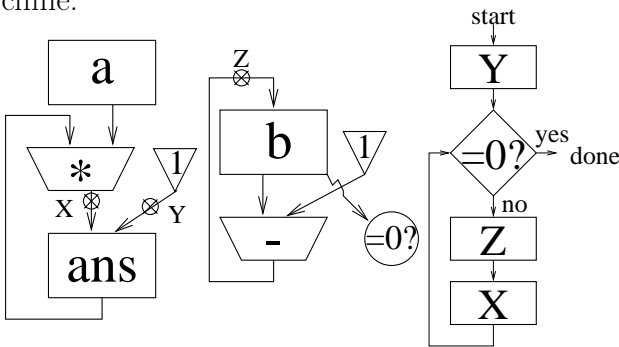
The definition of stack discipline.

What is “nested operations are not allowed”

What is Last In, First Out

Register Machines - 300

The function computed by the following machine:



What is $ans = a^b$

Register Machines - 400

The function performed on registers x and y by the following register machine.

```
(define-machine mystery
  (register x y aux val continue)
  (controller
    (assign continue (label mystery-done))
    mystery-loop
    (test (op null?) (reg x))
    (branch (label base-case))
    (assign aux (op car) (reg x))
    (save continue)
    (save aux)
    (assign x (op cdr) (reg x))
    (assign continue (label after-loop))
    (goto (label mystery-loop))
    after-loop
    (restore x)
    (restore continue)
    (assign val (op cons) (reg x) (reg aux))
    (goto (reg continue))
    base-case
    (assign val (reg y))
    (goto (reg continue))
    mystery-done))
```

What is (append x y)

Compilers - 100

Either of the two biggest advantages of a compiler over an interpreter.

What are shorter code and object code (also faster run-time)

Compilers - 300

When interpreted code and compiled code are compared, these are the instructions eliminated most often.

What are save and restore

Compilers - 200

The Scheme fragment that created the following code:

```
(assign proc (op lookup-variable-value) (const lst) (reg env))
(assign val (op lookup-variable-value) (const null?) (reg env))
(assign argl (op list) (reg val))
(test (op primitive-procedure?) (reg proc))
(branch (label prim-branch11))
compound-branch12
(assign continue (label after-call71))
(assign val (op compiled-procedure-entry) (reg proc))
(goto (reg val))
prim-branch11
(assign val (op apply-primitive-procedure) (reg proc) (reg argl))
after-call71
```

What is `(lst null?)`

Compilers - 400

The missing line in the code, which is the result of compiling `(f (+ 1 x) y)`:

```
(assign proc (op lookup-variable-value) (const f) (reg env))
(save proc)
(save env)
(assign proc (op lookup-variable-value) (const +) (reg env))
(assign val (op lookup-variable-value) (const x) (reg env))
(assign argl (op list) (reg val))
(assign val (const 1))
(assign argl (op cons) (reg val) (reg argl))
<apply-dispatch>
after-call21


---


(restore env)
(assign val (op lookup-variable-value) (const y) (reg env))
(assign argl (op cons) (reg val) (reg argl))
(restore proc)
<apply-dispatch>
```

What is

```
(assign argl (op list) (reg val))
```

Miscellaneous - 100

Carver Mead is now working on these; Alan Turing was working on the same when he died.

Miscellaneous - 200

Your recitation instructor's email address (spelled correctly)

What are Neural Networks

What is either `leventon@ai.mit.edu` or `leventon@mit.edu`

Miscellaneous - 300

This is commonly used to protect a disclosed invention from being used by others.

- (a) Copyright
- (b) Patent
- (c) Court Order
- (d) Jesse "The Body" Ventura
- (e) Trade Secret

Miscellaneous - 400

He developed LISP.

What is (b) a Patent

Who is John McCarthy

Orders of Growth - 100

The simplest way the following expression can be written in big theta notation:

$$n \log(n^2) + (\log(n))^2$$

What is $\Theta(n \log(n))$

Orders of Growth - 200

The orders of growth in time and space of:

```
(define (f n)
  (if (= n 0)
      1
      (f (- n 1)))))
```

What are $\Theta(n)$ time and $\Theta(1)$ space

Orders of Growth - 300

The orders of growth in time and space of:

```
(define (g n)
  (if (= n 0)
      1
      (+ (g (- n 1))
         (g (- n 1))))))
```

What are $\Theta(2^n)$ time and $\Theta(n)$ space

Orders of Growth - 400

The orders of growth in time and space of:

```
(define (h n)
  (if (= n 0)
      1
      (+ (h (quotient n 3))
         (h (quotient n 3))))))
```

What are $\Theta(n)$ time and $\Theta(\log(n))$ space

Streams - 100

It's the method streams use that prevents the need for repetitive calculations.

Streams - 200

The missing expressions in the definition below, which produces the following stream:

(2,1,4,3,6,5,8,7,10,...)

```
(define s
  (cons-stream 2
    (cons-stream 1
      (stream-map + _____ _____ ))))
```

What is memoization

What are `twos` and `s`

Streams - 300

Lists are to streams as _____ order is to _____ order.

Streams - 400

What the following mystery stream calculates:

```
(define foo
  (cons-stream 1
    (cons-stream 2
      (stream-map *
        (stream-cdr
          (stream-cdr integers))
        (stream-cdr foo))))))
```

What are applicative and normal

What is the factorial stream

(1 2 6 24 120 720 ...)

Object Oriented Programming - 100

In the following example, this class inherits from this (other) class:

```
(define (make-dairy-product name temp)
  (let ((container 'none)
        (bad false)
        (scent 'lemon)
        (food-obj (make-food name temp)))
    (lambda (message)
      (cond ((eq? message 'name) (lambda (self) name))
            ((eq? message 'scent) (lambda (self) scent))
            ((eq? message 'spoiled?)
             (lambda (self) (set! scent 'vile) true))
            (else (get-method food-obj message))))))
```

What is **dairy-product** inherits its traits from **food**

Object Oriented Programming - 300

By convention, we implement all methods in object- oriented code to accept an argument named “self” for this reason.

What is either (1) we need our objects to have access to “themselves” (as a variable that can be used in methods); or (2) we need a way to inherit (or gain use of) the structure and methods of a superclass.

Object Oriented Programming - 200

The value of inheritance in object oriented languages is that it makes it convenient to define new kinds of objects:

- (a) recursively
- (b) that send messages to other objects
- (c) that enable a student to pass 6.001
- (d) as variants of previously defined objects
- (e) without using applicative order

What is (d)

Object Oriented Programming - 400

In an effort to better integrate the worlds of biology and computer science, Ben Bitdiddle sets out to write a Scheme program which could be used to determine the gender of a woman’s imminent child, as an alternative to the more invasive clinical procedures:

```
(define (make-kid)
  (lambda (self msg)
    (cond ((eq? msg 'male?) (not (ask self 'female?)))
          ((eq? msg 'female?) (not (ask self 'male?))))))

(define (ask kid msg) (kid kid msg))

(define patients-kid (make-kid))

(ask patients-kid 'female?)
```

This would be the response:

- (a) true
- (b) false
- (c) no response (runs forever)
- (d) error response
- (e) none of the above

What is (d) Stack Overflow

Meta Circular Evaluator - 100

This is how environments are represented in our meta-circular evaluator.

What is

```
((var1 var2 ...) .
 (val1 val2 ...))
PARENT-ENV)
```

Meta Circular Evaluator - 300

The number of times the eval procedure is invoked when the following expression is entered into the evaluator:

```
((lambda (x) (* x 2)) 3)
```

What is 7.

(let f be the lambda expression: 1-(f 3),
2-f, 3-3, 4-(\times x 2), 5-*, 6-x, 7-2)

Meta Circular Evaluator - 200

The value of the following expression in a *dynamic-binding* Scheme:

```
(let ((x 20))
  (let ((f (lambda (y) (- y x))))
    (let ((x 10))
      (f 30))))
```

What is 20

Meta Circular Evaluator - Daily Double

The one and only line needed to modify the evaluator to handle define statements of the form:

```
(<variable> := <binding>)
```

What is this added to the cond clause:

```
((eq? (cadr exp)) ':=)
  (eval (list 'define
              (car exp)
              (caddr exp)) env)
```

Potpourri - 100

What LISP stands for

Potpourri - 200

Any one of Professor Grimson's bad jokes from lecture

What is LISt Processing

What are any of: "You'll be Scrod", "You hoser, Canadian Bacon is an unbound variable, eh?", "LISP stands for 'Lots of Insidious Silly Parentheses'." , "The recitation instructors are all asleep in the back", etc. etc.

Potpourri - 300

The inventors of Scheme.

Potpourri - 400

The person(s) to whom there is a seat dedicated in the 10-250 lecture hall.

- (a) Hal Abelson
- (b) Eric Grimson
- (c) Gerry Sussman
- (d) Ben and Alyssa P. (Hacker) Bitdiddle
- (e) Louis Reasoner

Who are Hal Abelson and Gerry Sussman

What is (D) - Ben and Alyssa P. (Hacker) Bitdiddle

Final Jeopardy - Lists

The value of the following expression:

```
(apply map  
  (cons list  
    (quote  
      ((good thanks have) (luck for a)  
        (on a fun) (the great summer)  
        (final semester break))))))
```

What is

```
((good luck on the final)  
 (thanks for a great semester)  
 (have a fun summer break))
```