1 Scheme

1.1 What would Scheme do?

```
scm> (and 0 2 200)
200

scm> (or True (/ 1 0))
True

scm> (and False (/ 1 0))
False

scm> (not 3)
#f
```

1.2 What would Scheme display?

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

scm> a
3
                       9     16
scm> (define b (+ (* 3 3) (* 4 4)))
b                       25

scm> (+ a b)
28
              1             1
scm> (= (modulo 10 3) (quotient 5 3))
#t                    17
                    20
scm> (even? (+ (- (* 5 4) 3) 2))
#f

scm> (if (and #t (/ 1 0)) 1 (/ 1 0))
error                                3+4+6 =13
               5          10
scm> (if (> (+ 2 3) 5) (+ 1 2 3 4) (+ 3 4 (* 3 2)))
13

scm> ((if (< 9 3) + -) 4 100)
-96

scm> (if 0 #t #f)
#t
```

1.3 Write two Scheme expressions that are equivalent to the following Python statement - one defining a function directly, and the other creating an anonymous lambda that is then bound to the name `cat`:

```
cat = lambda meow, purr: meow + purr
```

(define cat ((lambda (meow ,purr) (+ meow purr)))

1.4 Spot the bug(s). Test out the code and your fixes in the scheme interpreter! (https://scheme.cs61a.org/)

```
(define (sum-every-other lst)
 (cond ((null? lst) lst)
       (else (+ (cdr lst)
                (sum-every-other (caar lst)) )))
```

if

car

cdr

1.5 Define **sixty-ones**, a funcion that takes in a list and returns the number of times that 1 follows 6 in the list.

```
> (sixty-ones '(4 6 1 6 0 1))
1
> (sixty-ones '(1 6 1 4 6 1 6 0 1))
2
> (sixty-ones '(6 1 6 1 4 6 1 6 0 1))
3
```

(define (sixty-ones lst)
(cond ((null? (cdr lst)) '())
((= (car lst) 6 and (= (car (cdr lst)) 1))
(+ 1 sixty-ones (cdr (cdr lst)))
(else (sixty-ones (cdr lst))))

1.6 Define **no-elevens**, a function that takes in a number n, and returns a list of all distinct length-n lists of 1s and 6s that do not contain two consecutive 1s.

```
> (no-elevens 2)
((6 6) (6 1) (1 6))
> (no-elevens 3)
((6 6 6) (6 6 1) (6 1 6) (1 6 6) (1 6 1))
> (no-elevens 4)
((6 6 6 6) (6 6 6 1) (6 6 1 6) (6 1 6 6) (6 1 6 1) (1 6 6 6) (1 6 6 1) (1 6 1 6))
```

(define (no-elevens n)
(if ((= n 0)
'()
(append (map (lambda (x) ((cons 6 x))
(no-elevens (- n 1)))
(map (lambda (x) (append (cons 1 6) x))
(no-elevens (- n 2)))

1. Define `remember`, a function that takes in another zero-argument function `f`, and returns another function `g`. When called for the first time, `g` will call `f` and pass on its return value. When called subsequent times, `g` will remember its previous return value and return it directly, without calling `f` again.

(Hint: look up `set!` in the Scheme spec!)

```
(define (remember f)
    (set! f (f)))
)
```

```
scm> (define (f) (print "hello!") 5)
scm> (define g (remember f))
scm> (f)
hello!
5
scm> (g)
hello!
5
scm> (g)
5
```

Check your understanding

- How are call expressions (like `(+ 1 2 3)`) evaluated? What about special forms, like `(or #f #t (/ 1 0))`
- What is the purpose of the `quote` special form?

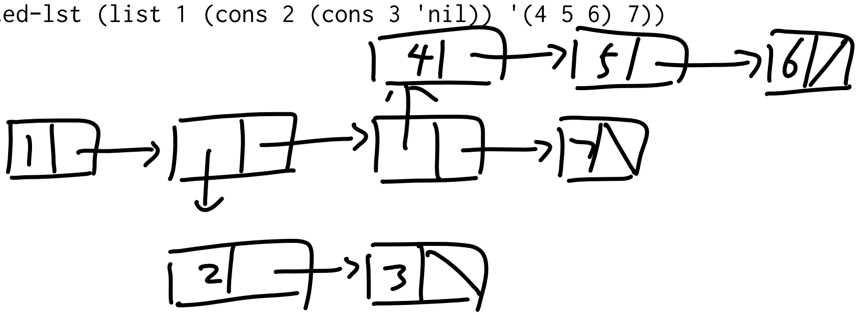
1. first evaluate the operator, and then we combine the oprands (and the operator, to evaluate.

2. ① print directly
② list easily

2 Scheme Lists

2.1 Draw out a box-and-pointer diagram for the following list:

```
scm> (define nested-lst (list 1 (cons 2 (cons 3 'nil)) '(4 5 6) 7))
nested-lst
```



Then, write out what Scheme would display for the following expressions:

```
scm> (cdr nested-lst)
```

((cons(cons 3 'nil) '(4 5 6) 7)

```
scm> (cdr (car (cdr nested-lst)))
```

3

```
scm> (cons (car nested-list) (car (cdr (cdr nested-list))))
```

(1 4 5 6)

Extra

2.2 Notice that the builtin `append` takes in, not a *list* of lists, but an *arbitrary* number of lists as arguments, which it then concatenates together. Implement `better-append`, which behaves in such a manner, allowing the caller to pass in an arbitrary number of arguments. You may use `concat` from the previous question.

(Hint: look up "variadic functions" in the Scheme spec!)

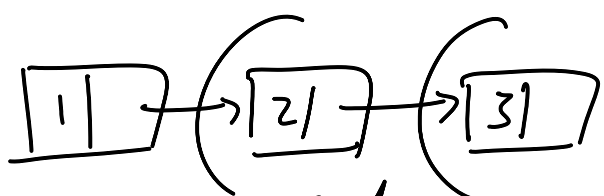
```
scm> (better-append '(1 2 3))
(1 2 3)
scm> (better-append '(1 2 3) '(2 3 4))
(1 2 3 2 3 4)
scm> (better-append '(1 2 3) '(2 3 4) '(3 4 5))
(1 2 3 2 3 4 3 4 5)
```

Check your understanding

- How can you get the third element of a Scheme list? Draw out a box-and-pointer diagram if you aren't sure.
- What is the difference between `eq?` and `equal?` in the context of Scheme lists? Construct two lists `lst1` and `lst2` such that `(equal? lst1 lst2)` is `#t` but `(eq? lst1 lst2)` is `#f`.

None

(Car(Cad(cdr lst)))



eq? is used to ~~test~~ wether two elements is the same object in memory

equal? is used to test ~~whe~~ whether two elements lists which elements are same, or vector, etc