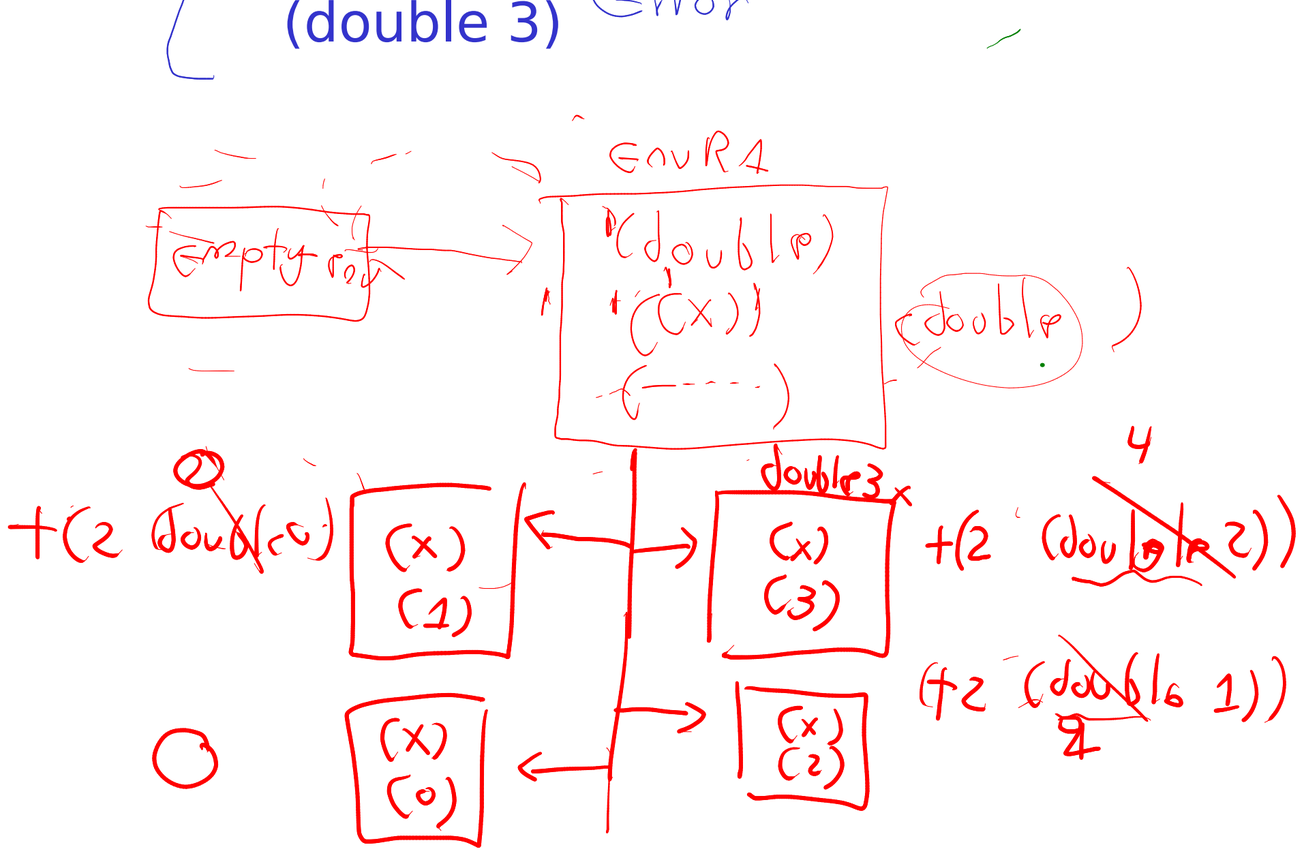
A

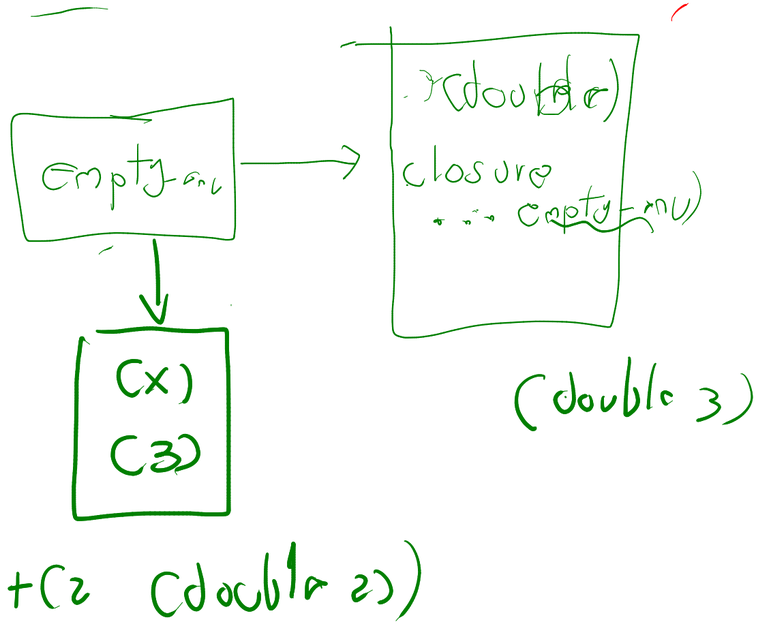
```
letrec
        double(x) = if >(x,0) then +(2, (double sub1(x))) else 0
in
   (double 3)
```

B

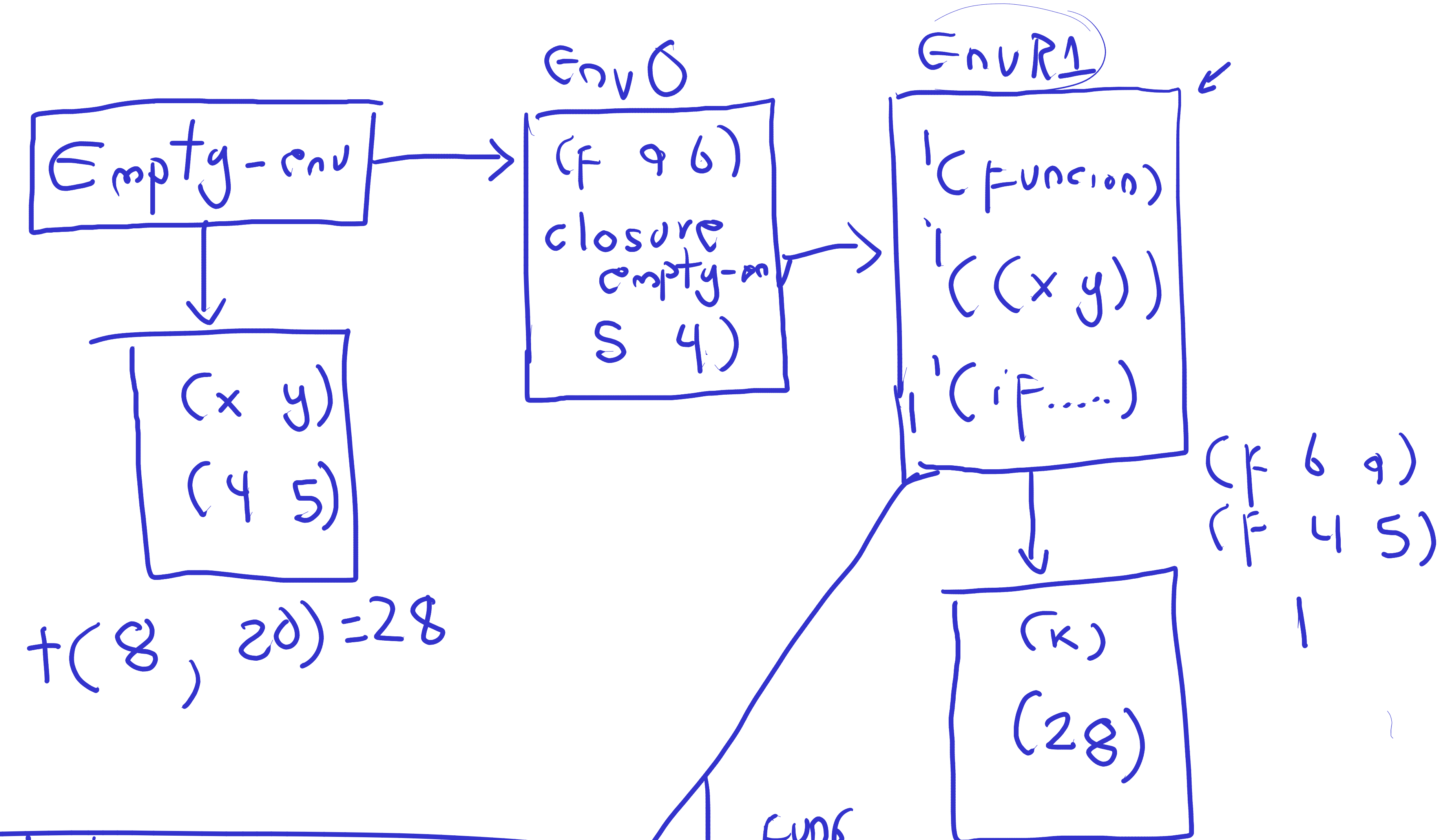
```
let
    double = proc(x) if >(x,0) then +(2, (double sub1(x))) else 0
in
   (double 3)
```

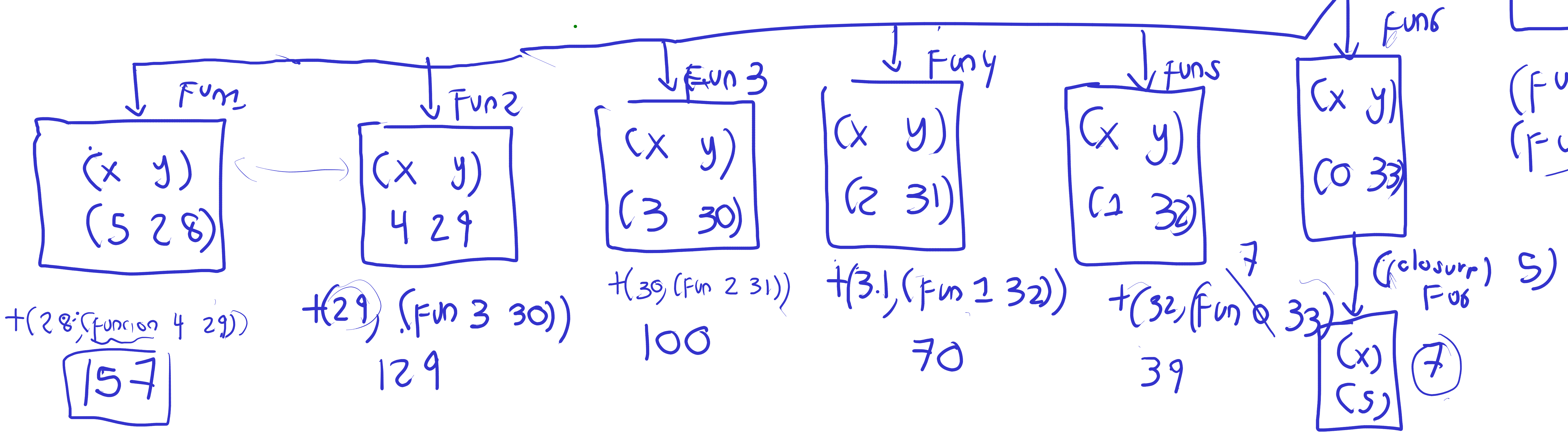
Error





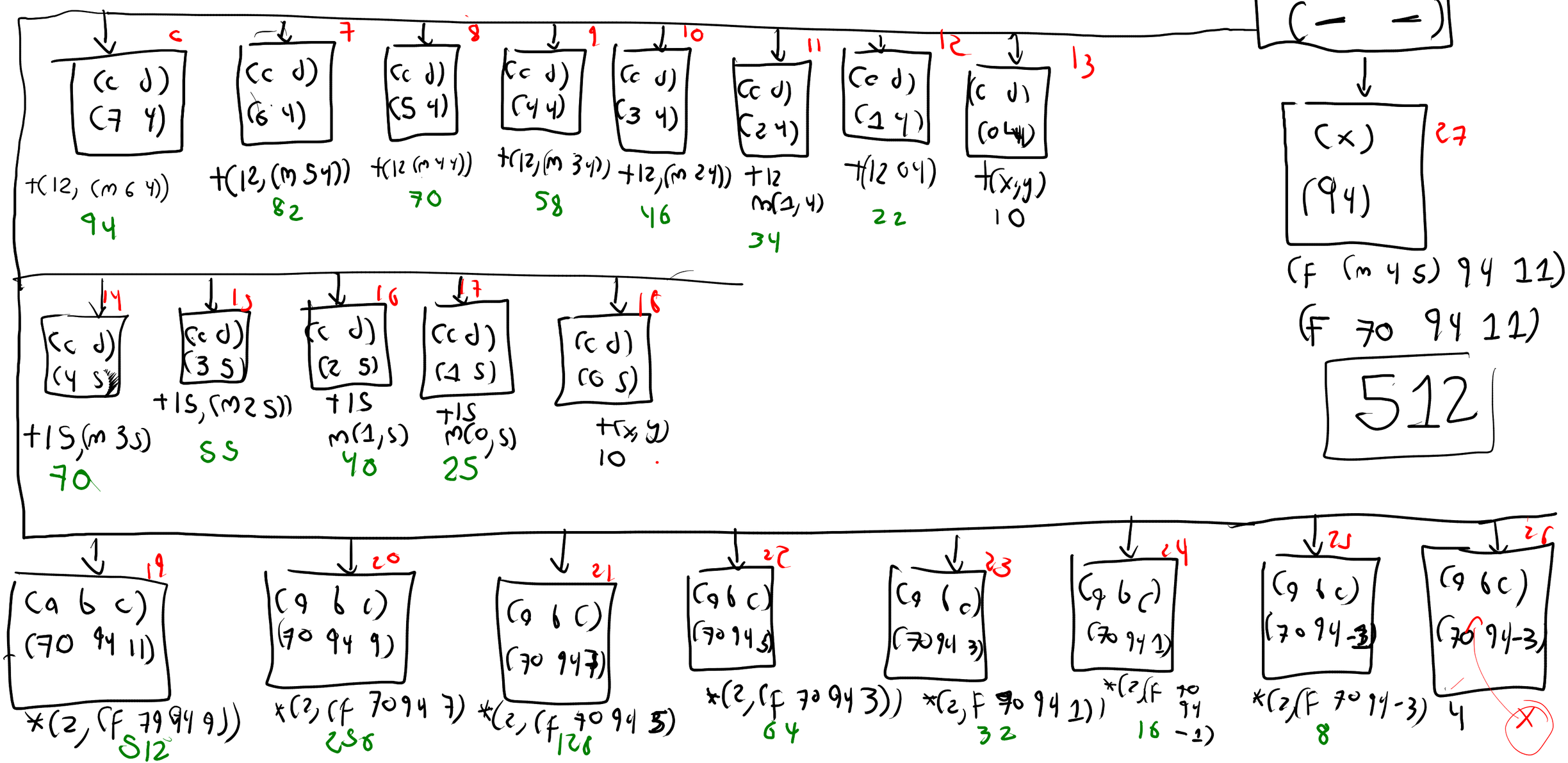
```
let
    f=proc(x, y) +(*(2,x),*(x,y))
    a = 5
    b = 4
    in
    letrec
        funcion(x,y) = if >(x,0)
                       then +(y, (funcion -(x,1) +(y,1)))
                       else (proc (x) +(x,2) a)
        in
          let
                  k = (f b a)
                  in     (funcion a k)
```





. (40 puntos) Dibuje los ambientes para la expresión: Considere la siguientes expresiones en el lenguaje visto en el curso (procedimientos), con ambiente inicial*env0* con identificadores **(x y z f)** y valores **(4 3 2(closure'(x y z) +(y,*(x,z)) empty-env))**

```
let
        x = 8
        y = 2
        z = (f x y z)
in
        letrec
                f(a, b, c) =
                        if >(c,-(x,10)) then *(2, (f a b -(c,2)))
                           else 4
                m(c, d) = if >(c,0) then +(*(3,d), (m -(c,1) d))
                    else +(x,y)
in
                let
                        x = (m 7 4)
                        in
                                (f (m 4 5) x z)
```



```
let
    f = proc(a b) *(2,+(b,a))
    g = proc(c d) *(c,+(d,2))
    x = 5
    in
      let
        h = proc(m n) +(m,(f m n))
        i = proc(o p) +(o,(g (g o p) p))
        y = (f x (g x x))
        in
          letrec
              j(q,r) = if q then +(r,(j -(q,1) +(r,2))) else (h (i x
                  y) y)
          in
              (j x y)
```

101455

17 ambiente

False si q=0
verdadero en otro caso

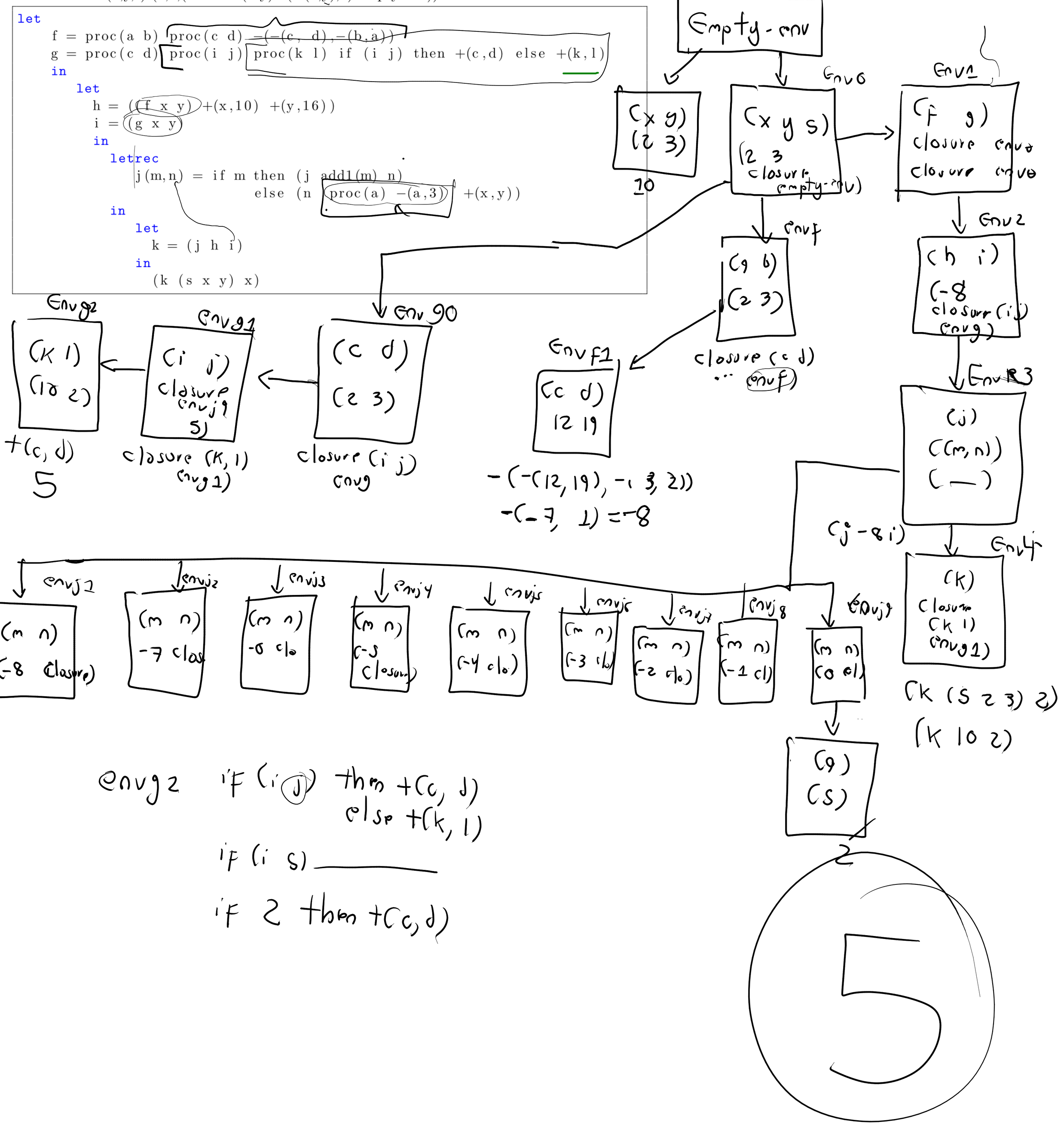
101035 + 88 + 86 + 84 + 82 + 80

101035 + 420

101455

2. **(35 puntos)** Dada la siguiente expresión en lenguaje visto en el curso, suponiendo como ambiente inicial (x,y,s) (2,3,(closure '(x y) *(+(x,y),2) empty-env))

```
let
    f = proc(a b) proc(c d) -(-(c, d),-(b,a))
    g = proc(c d) proc(i j) proc(k l) if (i j) then +(c,d) else +(k,l)
    in
       let
         h = ((f x y) +(x,10) +(y,16))
         i = (g x y)
         in
           letrec
              j(m,n) = if m then (j add1(m) n)
                               else (n proc(a) -(a,3) +(x,y))
           in
              let
                k = (j h i)
              in
                (k (s x y) x)
```



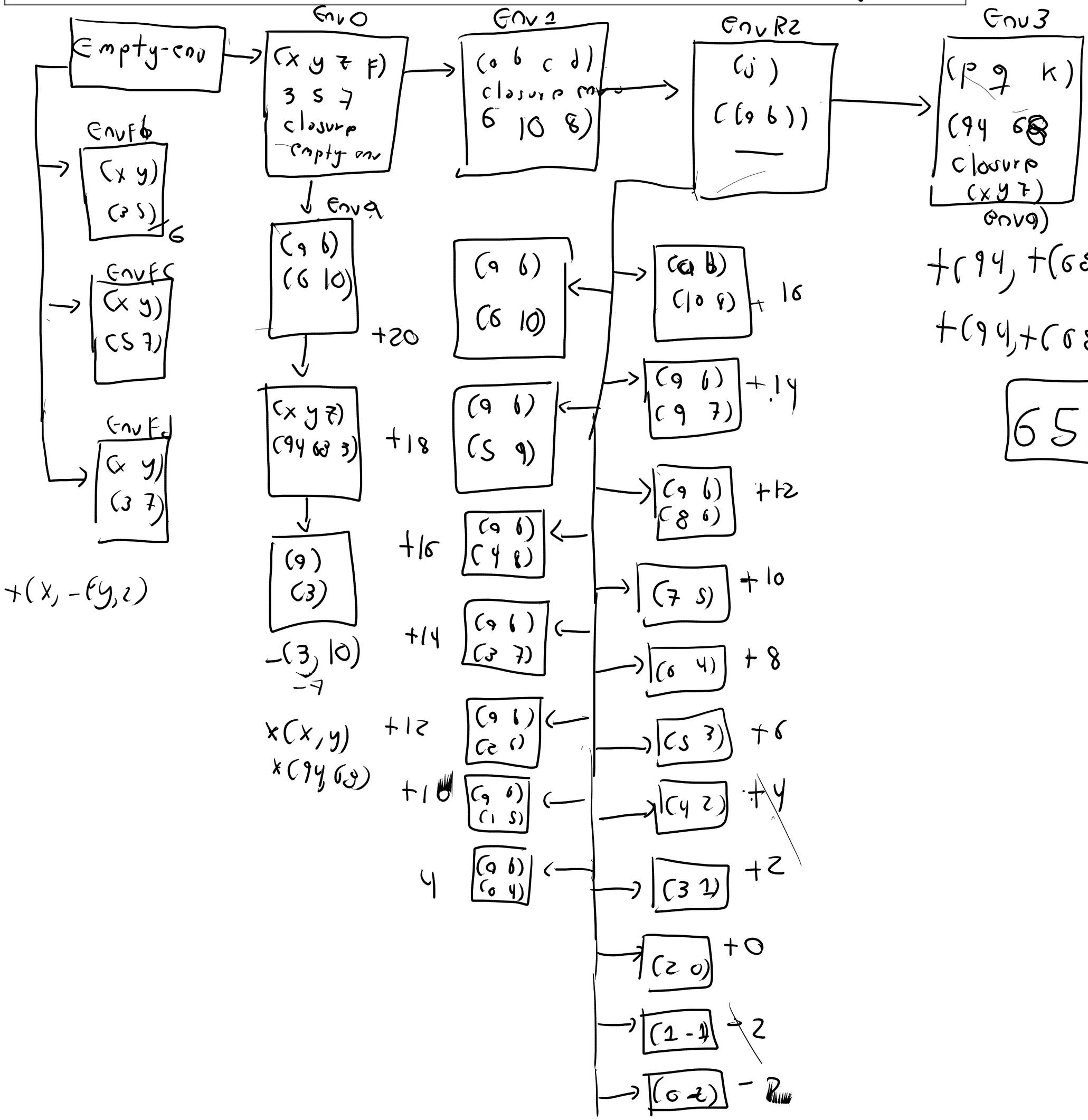
2. (30 puntos) Dado la siguiente expresión con ambiente inicial '((x y z f) (3 5 7 (closure '(x y) +(x,-(y,2))) empty-env))

```
let
  a = proc(a b) proc(x y z) if let a = 3 in -(a,b) then *(x,y) else *(y,z)
  b = (f x y)
  c = (f y z)
  d = (f x z)
  in
     letrec
          j(a,b) = if a then +( *(2,b), (j -(a,1) -(b,1))) else b
          in
             let
                p = (j b c)
                q = (j c d)
                k = (a b c)
                in
                  +(p,+(q,(k p q)))
```

k(p q x)

(j c d)

(j 10 8)



+(94, +(68 (k 94 68 3))

+(94, +(68 6392))

6554