Lenguajes de Programación 2016-1
Tarea 3

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Problema I

Haga el juicio de tipo para la función fibonacci y el predicado empty?

```
(define fibonacci
  1 (lambda (n)
    2 (cond
      [ 3 (<= n 2)  4 1]
      [ 5 else  6 (+  7 (fibonacci  8 (- n 1))  9 (fibonacci  10 (- n 2)))])))
```

Acción	Stack	Sustitución
Inicio	$\llbracket 1 \rrbracket = [n] \to \llbracket 2 \rrbracket$ $\llbracket 3 \rrbracket = boolean$ $[<=] = [n] \to [2] \to \llbracket 3 \rrbracket = number \to number \to boolean$ $\llbracket 4 \rrbracket = number$ $[else] = \llbracket 5 \rrbracket = \llbracket 6 \rrbracket$ $[+] = \llbracket 7 \rrbracket \to \llbracket 9 \rrbracket \to \llbracket 6 \rrbracket = number \to number \to number$ $\llbracket 1 \rrbracket = \llbracket 8 \rrbracket \to \llbracket 7 \rrbracket$ $[-] = [n] \to [1] \to \llbracket 8 \rrbracket = [n] \to [2] \to \llbracket 10 \rrbracket = number \to number \to number$ $\llbracket 1 \rrbracket = \llbracket 10 \rrbracket \to \llbracket 9 \rrbracket$ $\llbracket 2 \rrbracket = \llbracket 4 \rrbracket = \llbracket 6 \rrbracket$	Vacio
Paso 3	$\llbracket 3 \rrbracket = boolean$ $[<=] = [n] \to [2] \to \llbracket 3 \rrbracket = number \to number \to boolean$ $\llbracket 4 \rrbracket = number$ $[else] = \llbracket 5 \rrbracket = \llbracket 6 \rrbracket$ $[+] = \llbracket 7 \rrbracket \to \llbracket 9 \rrbracket \to \llbracket 6 \rrbracket = number \to number \to number$ $[n] \to \llbracket 2 \rrbracket = \llbracket 8 \rrbracket \to \llbracket 7 \rrbracket$ $[-] = [n] \to [1] \to \llbracket 8 \rrbracket = [n] \to [2] \to \llbracket 10 \rrbracket = number \to number \to number$ $[n] \to \llbracket 2 \rrbracket = \llbracket 10 \rrbracket \to \llbracket 9 \rrbracket$ $\llbracket 2 \rrbracket = \llbracket 4 \rrbracket = \llbracket 6 \rrbracket$	$\llbracket 1 \rrbracket \mapsto [n] \to \llbracket 2 \rrbracket$

Paso 3	$[<=] = [n] \to [2] \to$ boolean $=$ number $\to$ number $\to$ boolean $\llbracket 4 \rrbracket =$ number $[else] = \llbracket 5 \rrbracket = \llbracket 6 \rrbracket$ $[+] = \llbracket 7 \rrbracket \to \llbracket 9 \rrbracket \to \llbracket 6 \rrbracket =$ number $\to$ number $\to$ number $[n] \to \llbracket 2 \rrbracket = \llbracket 8 \rrbracket \to \llbracket 7 \rrbracket$ $[-] = [n] \to [1] \to \llbracket 8 \rrbracket = [n] \to [2] \to \llbracket 10 \rrbracket =$ number $\to$ number $\to$ number $[n] \to \llbracket 2 \rrbracket = \llbracket 10 \rrbracket \to \llbracket 9 \rrbracket$ $\llbracket 2 \rrbracket = \llbracket 4 \rrbracket = \llbracket 6 \rrbracket$	$\llbracket 1 \rrbracket \mapsto [n] \to \boxed{2}$ $\llbracket 3 \rrbracket \mapsto$ boolean
Paso 5	$[n] =$ number $[2] =$ number $\llbracket 4 \rrbracket =$ number $[else] = \llbracket 5 \rrbracket = \llbracket 6 \rrbracket$ $[+] = \llbracket 7 \rrbracket \to \llbracket 9 \rrbracket \to \llbracket 6 \rrbracket =$ number $\to$ number $\to$ number $[n] \to \llbracket 2 \rrbracket = \llbracket 8 \rrbracket \to \llbracket 7 \rrbracket$ $[-] = [n] \to [1] \to \llbracket 8 \rrbracket = [n] \to [2] \to \llbracket 10 \rrbracket =$ number $\to$ number $\to$ number $[n] \to \llbracket 2 \rrbracket = \llbracket 10 \rrbracket \to \llbracket 9 \rrbracket$ $\llbracket 2 \rrbracket = \llbracket 4 \rrbracket = \llbracket 6 \rrbracket$	$\llbracket 1 \rrbracket \mapsto [n] \to \boxed{2}$ $\llbracket 3 \rrbracket \mapsto$ boolean
Paso 3	$[2] =$ number $\llbracket 4 \rrbracket =$ number $[else] = \llbracket 5 \rrbracket = \llbracket 6 \rrbracket$ $[+] = \llbracket 7 \rrbracket \to \llbracket 9 \rrbracket \to \llbracket 6 \rrbracket =$ number $\to$ number $\to$ number number $\to \llbracket 2 \rrbracket = \llbracket 8 \rrbracket \to \llbracket 7 \rrbracket$ $[-] =$ number $\to [1] \to \llbracket 8 \rrbracket =$ number $\to [2] \to \llbracket 10 \rrbracket =$ number $\to$ number $\to$ number number $\to \llbracket 2 \rrbracket = \llbracket 10 \rrbracket \to \llbracket 9 \rrbracket$ $\llbracket 2 \rrbracket = \llbracket 4 \rrbracket = \llbracket 6 \rrbracket$	$\llbracket 1 \rrbracket \mapsto$ number $\to \boxed{2}$ $\llbracket 3 \rrbracket \mapsto$ boolean $[n] \mapsto$ number
Paso 3	$\llbracket 4 \rrbracket =$ number $[else] = \llbracket 5 \rrbracket = \llbracket 6 \rrbracket$ $[+] = \llbracket 7 \rrbracket \to \llbracket 9 \rrbracket \to \llbracket 6 \rrbracket =$ number $\to$ number $\to$ number number $\to \llbracket 2 \rrbracket = \llbracket 8 \rrbracket \to \llbracket 7 \rrbracket$ $[-] =$ number $\to [1] \to \llbracket 8 \rrbracket =$ number $\to$ number $\to \llbracket 10 \rrbracket =$ number $\to$ number $\to$ number number $\to \llbracket 2 \rrbracket = \llbracket 10 \rrbracket \to \llbracket 9 \rrbracket$ $\llbracket 2 \rrbracket = \llbracket 4 \rrbracket = \llbracket 6 \rrbracket$	$\llbracket 1 \rrbracket \mapsto$ number $\to \boxed{2}$ $\llbracket 3 \rrbracket \mapsto$ boolean $[n] \mapsto$ number $[2] \mapsto$ number
Paso 3	$[else] = \llbracket 5 \rrbracket = \llbracket 6 \rrbracket$ $[+] = \llbracket 7 \rrbracket \to \llbracket 9 \rrbracket \to \llbracket 6 \rrbracket =$ number $\to$ number $\to$ number number $\to \llbracket 2 \rrbracket = \llbracket 8 \rrbracket \to \llbracket 7 \rrbracket$ $[-] =$ number $\to [1] \to \llbracket 8 \rrbracket =$ number $\to$ number $\to \llbracket 10 \rrbracket =$ number $\to$ number $\to$ number number $\to \llbracket 2 \rrbracket = \llbracket 10 \rrbracket \to \llbracket 9 \rrbracket$ $\llbracket 2 \rrbracket =$ number $= \llbracket 6 \rrbracket$	$\llbracket 1 \rrbracket \mapsto$ number $\to \boxed{2}$ $\llbracket 3 \rrbracket \mapsto$ boolean $[n] \mapsto$ number $[2] \mapsto$ number $\llbracket 4 \rrbracket \mapsto$ number
Paso 3	$[+] = \llbracket 7 \rrbracket \to \llbracket 9 \rrbracket \to \llbracket 6 \rrbracket =$ number $\to$ number $\to$ number number $\to \llbracket 2 \rrbracket = \llbracket 8 \rrbracket \to \llbracket 7 \rrbracket$	$\llbracket 1 \rrbracket \mapsto$ number $\to \boxed{2}$ $\llbracket 3 \rrbracket \mapsto$ boolean

Paso		
	$[-] =$ number $\to [1] \to [\![8]\!] =$ number $\to$ number $\to [\![10]\!] =$ number $\to$ number $\to$ number number $\to [\![2]\!] = [\![10]\!] \to [\![9]\!]$ $[\![2]\!] =$ number $= [\![6]\!]$	$[n] \mapsto$ number $[2] \mapsto$ number $[\![4]\!] \mapsto$ number $[\![5]\!] \mapsto [\![6]\!]$
Paso 5	$[\![7]\!] =$ number $[\![9]\!] =$ number $[\![6]\!] =$ number number $\to [\![2]\!] = [\![8]\!] \to [\![7]\!]$ $[-] =$ number $\to [1] \to [\![8]\!] =$ number $\to$ number $\to [\![10]\!] =$ number $\to$ number $\to$ number number $\to [\![2]\!] = [\![10]\!] \to [\![9]\!]$ $[\![2]\!] =$ number $= [\![6]\!]$	$[\![1]\!] \mapsto$ number $\to [2]$ $[\![3]\!] \mapsto$ boolean $[n] \mapsto$ number $[2] \mapsto$ number $[\![4]\!] \mapsto$ number $[\![5]\!] \mapsto [\![6]\!]$
Paso 3	$[\![9]\!] =$ number $[\![6]\!] =$ number number $\to [\![2]\!] = [\![8]\!] \to$ number $[-] =$ number $\to [1] \to [\![8]\!] =$ number $\to$ number $\to [\![10]\!] =$ number $\to$ number $\to$ number number $\to [\![2]\!] = [\![10]\!] \to [\![9]\!]$ $[\![2]\!] =$ number $= [\![6]\!]$	$[\![1]\!] \mapsto$ number $\to [2]$ $[\![3]\!] \mapsto$ boolean $[n] \mapsto$ number $[2] \mapsto$ number $[\![4]\!] \mapsto$ number $[\![5]\!] \mapsto [\![6]\!]$ $[\![7]\!] \mapsto$ number
Paso 3	$[\![6]\!] =$ number number $\to [\![2]\!] = [\![8]\!] \to$ number $[-] =$ number $\to [1] \to [\![8]\!] =$ number $\to$ number $\to [\![10]\!] =$ number $\to$ number $\to$ number number $\to [\![2]\!] = [\![10]\!] \to$ number $[\![2]\!] =$ number $= [\![6]\!]$	$[\![1]\!] \mapsto$ number $\to [2]$ $[\![3]\!] \mapsto$ boolean $[n] \mapsto$ number $[2] \mapsto$ number $[\![4]\!] \mapsto$ number $[\![5]\!] \mapsto [\![6]\!]$ $[\![7]\!] \mapsto$ number $[\![9]\!] \mapsto$ number
Paso 3	number $\to [\![2]\!] = [\![8]\!] \to$ number $[-] =$ number $\to [1] \to [\![8]\!] =$ number $\to$ number $\to [\![10]\!] =$ number $\to$ number $\to$ number number $\to [\![2]\!] = [\![10]\!] \to$ number $[\![2]\!] =$ number $=$ number	$[\![1]\!] \mapsto$ number $\to [2]$ $[\![3]\!] \mapsto$ boolean $[n] \mapsto$ number $[2] \mapsto$ number $[\![4]\!] \mapsto$ number $[\![5]\!] \mapsto$ number $[\![7]\!] \mapsto$ number $[\![9]\!] \mapsto$ number $[\![6]\!] \mapsto$ number
Paso 5	number $= [\![8]\!]$ $[\![2]\!] =$ number $[-] =$ number $\to [1] \to [\![8]\!] =$ number $\to$ number $\to [\![10]\!] =$ number $\to$ number $\to$ number number $\to [\![2]\!] = [\![10]\!] \to$ number $[\![2]\!] =$ number $=$ number	$[\![1]\!] \mapsto$ number $\to [2]$ $[\![3]\!] \mapsto$ boolean $[n] \mapsto$ number $[2] \mapsto$ number $[\![4]\!] \mapsto$ number $[\![5]\!] \mapsto$ number

		$[\![7]\!] \mapsto$ number
		$[\![9]\!] \mapsto$ number
		$[\![6]\!] \mapsto$ number
Paso 4	$[\![2]\!] =$ number $[\text{-}] =$ number $\to [1] \to$ number $=$ number $\to$ number $\to [\![10]\!] =$ number $\to$ number $\to$ number number $\to [\![2]\!] = [\![10]\!] \to$ number $[\![2]\!] =$ number $=$ number	$[\![1]\!] \mapsto$ number $\to [\![2]\!]$ $[\![3]\!] \mapsto$ boolean $[n] \mapsto$ number $[2] \mapsto$ number $[\![4]\!] \mapsto$ number $[\![5]\!] \mapsto$ number $[\![7]\!] \mapsto$ number $[\![9]\!] \mapsto$ number $[\![6]\!] \mapsto$ number $[\![8]\!] \mapsto$ number
Paso 3	$[\text{-}] =$ number $\to [1] \to$ number $=$ number $\to$ number $\to [\![10]\!] =$ number $\to$ number $\to$ number number $\to$ number $= [\![10]\!] \to$ number number $=$ number $=$ number	$[\![1]\!] \mapsto$ number $\to$ number $[\![3]\!] \mapsto$ boolean $[n] \mapsto$ number $[2] \mapsto$ number $[\![4]\!] \mapsto$ number $[\![5]\!] \mapsto$ number $[\![7]\!] \mapsto$ number $[\![9]\!] \mapsto$ number $[\![6]\!] \mapsto$ number $[\![8]\!] \mapsto$ number $[\![2]\!] \mapsto$ number
Paso 5	$[1] =$ number number $= [\![10]\!]$ number $\to$ number $= [\![10]\!] \to$ number number $=$ number $=$ number	$[\![1]\!] \mapsto$ number $\to$ number $[\![3]\!] \mapsto$ boolean $[n] \mapsto$ number $[2] \mapsto$ number $[\![4]\!] \mapsto$ number $[\![5]\!] \mapsto$ number $[\![7]\!] \mapsto$ number $[\![9]\!] \mapsto$ number $[\![6]\!] \mapsto$ number $[\![8]\!] \mapsto$ number $[\![2]\!] \mapsto$ number
Paso 3	number $= [\![10]\!]$ number $\to$ number $= [\![10]\!] \to$ number number $=$ number $=$ number	$[\![1]\!] \mapsto$ number $\to$ number $[\![3]\!] \mapsto$ boolean $[n] \mapsto$ number $[2] \mapsto$ number $[\![4]\!] \mapsto$ number $[\![5]\!] \mapsto$ number $[\![7]\!] \mapsto$ number $[\![9]\!] \mapsto$ number $[\![6]\!] \mapsto$ number $[\![8]\!] \mapsto$ number

		$\boxed{2}$ $\mapsto$ number
		$[1] \mapsto$ number
Paso 4	number $\to$ number = number $\to$ number number = number = number	$\boxed{1}$ $\mapsto$ number $\to$ number $\boxed{3}$ $\mapsto$ boolean [n] $\mapsto$ number [2] $\mapsto$ number $\boxed{4}$ $\mapsto$ number $\boxed{5}$ $\mapsto$ number $\boxed{7}$ $\mapsto$ number $\boxed{9}$ $\mapsto$ number $\boxed{6}$ $\mapsto$ number $\boxed{8}$ $\mapsto$ number $\boxed{2}$ $\mapsto$ number $[1] \mapsto$ number $\boxed{10}$ $\mapsto$ number
Paso 1	number = number = number	$\boxed{1}$ $\mapsto$ number $\to$ number $\boxed{3}$ $\mapsto$ boolean [n] $\mapsto$ number [2] $\mapsto$ number $\boxed{4}$ $\mapsto$ number $\boxed{5}$ $\mapsto$ number $\boxed{7}$ $\mapsto$ number $\boxed{9}$ $\mapsto$ number $\boxed{6}$ $\mapsto$ number $\boxed{8}$ $\mapsto$ number $\boxed{2}$ $\mapsto$ number $[1] \mapsto$ number $\boxed{10}$ $\mapsto$ number
Paso 1	vacio	$\boxed{1}$ $\mapsto$ number $\to$ number $\boxed{3}$ $\mapsto$ boolean [n] $\mapsto$ number [2] $\mapsto$ number $\boxed{4}$ $\mapsto$ number $\boxed{5}$ $\mapsto$ number $\boxed{7}$ $\mapsto$ number $\boxed{9}$ $\mapsto$ number $\boxed{6}$ $\mapsto$ number $\boxed{8}$ $\mapsto$ number $\boxed{2}$ $\mapsto$ number $[1] \mapsto$ number $\boxed{10}$ $\mapsto$ number

```
(define Empty?
  1 (lambda (l)
    2 (if 3 (= 4 (length l) 0) 5 true 6 false)))
```

Acción	Stack	Sustitución
Inicio	$\llbracket 1 \rrbracket = [l] \to \llbracket 2 \rrbracket$ $\llbracket 3 \rrbracket = \text{boolean}$ $[=] = \llbracket 4 \rrbracket \to [0] \to \llbracket 3 \rrbracket = \text{number} \to \text{number} \to \text{boolean}$ $[\text{length}] = [l] \to \llbracket 4 \rrbracket = \text{list} \to \text{number}$ $\llbracket 5 \rrbracket = \text{boolean}$ $\llbracket 6 \rrbracket = \text{boolean}$ $\llbracket 2 \rrbracket = \llbracket 5 \rrbracket \mid \llbracket 6 \rrbracket$	Vacío
Paso 3	$\llbracket 3 \rrbracket = \text{boolean}$ $[=] = \llbracket 4 \rrbracket \to [0] \to \llbracket 3 \rrbracket = \text{number} \to \text{number} \to \text{boolean}$ $[\text{length}] = [l] \to \llbracket 4 \rrbracket = \text{list} \to \text{number}$ $\llbracket 5 \rrbracket = \text{boolean}$ $\llbracket 6 \rrbracket = \text{boolean}$ $\llbracket 2 \rrbracket = \llbracket 5 \rrbracket \mid \llbracket 6 \rrbracket$	$\llbracket 1 \rrbracket \mapsto [l] \to \llbracket 2 \rrbracket$
Paso 3	$[=] = \llbracket 4 \rrbracket \to [0] \to \text{boolean} = \text{number} \to \text{number} \to \text{boolean}$ $[\text{length}] = [l] \to \llbracket 4 \rrbracket = \text{list} \to \text{number}$ $\llbracket 5 \rrbracket = \text{boolean}$ $\llbracket 6 \rrbracket = \text{boolean}$ $\llbracket 2 \rrbracket = \llbracket 5 \rrbracket \mid \llbracket 6 \rrbracket$	$\llbracket 1 \rrbracket \mapsto [l] \to \llbracket 2 \rrbracket$ $\llbracket 3 \rrbracket \mapsto \text{boolean}$
Paso 5	$\llbracket 4 \rrbracket = \text{number}$ $[0] = \text{number}$ $[\text{length}] = [l] \to \llbracket 4 \rrbracket = \text{list} \to \text{number}$ $\llbracket 5 \rrbracket = \text{boolean}$ $\llbracket 6 \rrbracket = \text{boolean}$ $\llbracket 2 \rrbracket = \llbracket 5 \rrbracket \mid \llbracket 6 \rrbracket$	$\llbracket 1 \rrbracket \mapsto [l] \to \llbracket 2 \rrbracket$ $\llbracket 3 \rrbracket \mapsto \text{boolean}$
Paso 3	$[0] = \text{number}$ $[\text{length}] = [l] \to \text{number} = \text{list} \to \text{number}$ $\llbracket 5 \rrbracket = \text{boolean}$ $\llbracket 6 \rrbracket = \text{boolean}$ $\llbracket 2 \rrbracket = \llbracket 5 \rrbracket \mid \llbracket 6 \rrbracket$	$\llbracket 1 \rrbracket \mapsto [l] \to \llbracket 2 \rrbracket$ $\llbracket 3 \rrbracket \mapsto \text{boolean}$ $\llbracket 4 \rrbracket \mapsto \text{number}$
Paso 3	$[\text{length}] = [l] \to \text{number} = \text{list} \to \text{number}$ $\llbracket 5 \rrbracket = \text{boolean}$ $\llbracket 6 \rrbracket = \text{boolean}$ $\llbracket 2 \rrbracket = \llbracket 5 \rrbracket \mid \llbracket 6 \rrbracket$	$\llbracket 1 \rrbracket \mapsto [l] \to \llbracket 2 \rrbracket$ $\llbracket 3 \rrbracket \mapsto \text{boolean}$ $\llbracket 4 \rrbracket \mapsto \text{number}$ $[0] \mapsto \text{number}$
Paso 5	$[l] = \text{list}$ $\llbracket 5 \rrbracket = \text{boolean}$ $\llbracket 6 \rrbracket = \text{boolean}$ $\llbracket 2 \rrbracket = \llbracket 5 \rrbracket \mid \llbracket 6 \rrbracket$	$\llbracket 1 \rrbracket \mapsto [l] \to \llbracket 2 \rrbracket$ $\llbracket 3 \rrbracket \mapsto \text{boolean}$ $\llbracket 4 \rrbracket \mapsto \text{number}$ $[0] \mapsto \text{number}$
Paso 3	$\llbracket 5 \rrbracket = \text{boolean}$ $\llbracket 6 \rrbracket = \text{boolean}$ $\llbracket 2 \rrbracket = \llbracket 5 \rrbracket \mid \llbracket 6 \rrbracket$	$\llbracket 1 \rrbracket \mapsto \text{list} \to \llbracket 2 \rrbracket$ $\llbracket 3 \rrbracket \mapsto \text{boolean}$ $\llbracket 4 \rrbracket \mapsto \text{number}$ $[0] \mapsto \text{number}$ $[l] \mapsto \text{list}$
Paso 3	$\llbracket 6 \rrbracket = \text{boolean}$ $\llbracket 2 \rrbracket = \text{boolean} \mid \llbracket 6 \rrbracket$	$\llbracket 1 \rrbracket \mapsto \text{list} \to \llbracket 2 \rrbracket$ $\llbracket 3 \rrbracket \mapsto \text{boolean}$

Paso		
		$\llbracket 4 \rrbracket \mapsto$ number
		$[0] \mapsto$ number
		$[l] \mapsto$ list
		$\llbracket 5 \rrbracket \mapsto$ boolean
Paso 3	$\llbracket 2 \rrbracket$ = boolean | boolean	$\llbracket 1 \rrbracket \mapsto$ list $\to \llbracket 2 \rrbracket$
		$\llbracket 3 \rrbracket \mapsto$ boolean
		$\llbracket 4 \rrbracket \mapsto$ number
		$[0] \mapsto$ number
		$[l] \mapsto$ list
		$\llbracket 5 \rrbracket \mapsto$ boolean
		$\llbracket 6 \rrbracket \mapsto$ boolean
Paso 3	Vacio	$\llbracket 1 \rrbracket \mapsto$ list $\to$ boolean
		$\llbracket 3 \rrbracket \mapsto$ boolean
		$\llbracket 4 \rrbracket \mapsto$ number
		$[0] \mapsto$ number
		$[l] \mapsto$ list
		$\llbracket 5 \rrbracket \mapsto$ boolean
		$\llbracket 6 \rrbracket \mapsto$ boolean
		$\llbracket 2 \rrbracket \mapsto$ boolean

Problema II

Considera el siguiente programa:

```
(+ 1 (first (cons true empty)))
```

Este programa tiene un error de tipos.

Genera restricciones para este programa. Aísla el conjunto mas pequeño de estas restricciones tal que, resultas juntas, identifiquen el error de tipos.

Siéntete libre de etiquetar las sub-expresiones del programa con superíndices para usarlos cuando escribas y resuelvas tus restricciones.

Respuesta:

$\boxed{1}$(+ $\boxed{2}$1 $\boxed{3}$ (first $\boxed{4}$ (cons $\boxed{5}$ true $\boxed{6}$ empty)))

Conjunto de Restricciones:

Si e1 y e2 expresiones cuales quiera dentro del lenguaje entonces:

1-[(+ e1 e2)]= number si [e1]= number y [e2]= number

2-Si e es un numero entonces [e]= number

3-[(first e)]= number si [e]= nlist

4-[(cons e1 e2)]= nlist si [e1]= number y [e2]= nlist

5- si e=true o e=false entonces [e]=boolean

Inferencia:

Tenemos que:

A)Para $\llbracket 1 \rrbracket$ =[(+ 1 (first (cons true empty)))] = number si [1] = number y [(first (cons true empty))]= number (1)

B)Para $\llbracket 2 \rrbracket$ = [1] number (2)

C)Para $\llbracket 3 \rrbracket$ = [(first (cons true empty))]= number si [(cons true empty)]=nlist (3)

D)Para $\llbracket 4 \rrbracket$ = [(cons true empty)]=nlist si [true]= number y [empty] = nlist (4)

E)Para $\llbracket 5 \rrbracket$ = [true]!=number sino que [true] = boolean (5)

Por E) tenemos que el programa no puede continuar debido al error de tipos dadas las reglas del conjunto de restricciones

Problema III

Considera la siguiente expresión con tipos:

```
{fun {f : C1 } : C2
  {fun {x : C3 } : C4
    {fun {y : C5 } : C6
      {cons x {f {f y}}}}}}
```

Dejamos los tipos sin especificar (Cn) para que sean llenados por el proceso de inferencia de tipos. Deriva restricciones de tipos para el programa anterior. Luego resuelve estas restricciones. A partir de estas soluciones, rellena los valores de las Cn. Asegúrate de mostrar todos los pasos especificados por los algoritmos (i.e., escribir la respuesta basándose en la intuición o el conocimiento es insuficiente). Deberás usar variables de tipo cuando sea necesario. Para no escribir tanto, puedes etiquetar cada expresión con una variable de tipos apropiada, y presentar el resto del algoritmo en términos solamente de estas variables de tipos.

Problema IV

Considera los juicios de tipos discutidos en clase para un lenguaje glotón (en el capitulo de **Juicios de Tipos** del libro de Shriram). Considera ahora la versión perezosa del lenguaje. Pon especial atención a las reglas de tipado para:

- definición de funciones

- aplicación de funciones

Para cada una de estas, si crees que la regla original no cambia, explica por que no (Si crees que ninguna de las dos cambia, puedes responder las dos partes juntas). Si crees que algún otro juicio de tipos debe cambiar, menciónalo también.

Problema V

¿Cuáles son las ventajas y desventajas de tener polimorfismo explícito e implícito en los lenguajes de programación?
Respuesta:
Polimorfismo Explicito:
Desventajas:
Poca legibilidad de código debido al hecho de poder tener diversas funciones con el mismo nombre.
Ventajas:
Permitir el reciclamiento de código
Polimorfismo Implicito:

Problema VI

Da las ventajas y desventajas de tener lenguajes de dominio especifico (DSL) y de propósito general. También da al menos tres ejemplos de lenguajes DSL, cada ejemplo debe indicar el propósito del DSL y un ejemplo documentando su uso.

Lenguajes de Dominio Especifico (DSL)

Ventajas	Desventajas
-Proporciona apropiadas abstracciones y anotaciones.	-Aprenderlo para que solo pueda resolver un problema espepecifico.
-Nos permiten seguridad en nivel de dominio, mientras los metodos del lenguaje esten seguros esto nos permitira seguridad cada vez que los usemos.	-Encontrar, ajustar o mantener un alcance adecuado.
-Es mas sencillo desarrollar programas en un area en especifico para programadores que no sean expertos en ella.	-Gente no experta en el lenguaje no puede modificar o crear codigo facilmente.

Lenguajes de Propisito General (GPL)

Ventajas	Desventajas
-Nos ayuda a resolver problemas de diferentes areas.	-?.
-?.	-?.
-?.	-?.

Ejemplos DSL:

1. SQL: Este lenguaje fue creado para acceder a bases de datos relacionales facilmente.
   Ejemplo:

   ```
   SELECT * FROM TABLA;
   ```

   nos da toda la info alamacenada en TABLA.

2. XML: es un lenguaje de marcas desarrollado por el World Wide Web Consortium (W3C) utilizado para almacenar datos en forma legible.
   Ejemplo:

   ```
   <?xml version="1.0"?>
   <catalog>
      <book id="bk101">
         <author>Gambardella, Matthew</author>
         <title>XML Developer's Guide</title>
       </book>
   </catalog>
   ```

   Almacena datos de un libro poniendo marcas al autor y titulo.

3. CSS: es un lenguaje usado para definir y crear la presentación de un documento estructurado escrito en HTML o XML Ejemplo:

   ```
   p {
     text-align: center;
     color: red;
   }
   ```

   Alinea la etiqueta p y le pone color rojo.