CS571 Homework 4

Due: Friday, April 26, 2024

1 Lazy vs. Strict Evaluation — 24 points

For each of the following programs, does the program terminate without error i) under lazy execution, and ii) under strict execution?

a)

```
let x = 1 : x in
let s n l = if n == 0 then 0
            else (head l) + (s (n-1) (tail l))
in
s 5 x
```

b)

```
let x _ = 1 : (x ()) in
let s n l = if n == 0 then 0
            else (head (l ())) + (s (n-1) (\_ -> tail (l ())))
in
s 5 x
```

c)

```
let x = 1 + x in
let y z = (z * 3) + 1 in
if (y 2) > 5 then 0 else x
```

d)

```
let x = 1 + x in
let y z = (z * 3) + 1 in
let myIf i t e = if i then t else e in
myIf ((y 2) > 5) 0 x
```

e)

```
let x = 1 + x in
let y z = (z * 3) + 1 in
```

```
let myIf i t e = if i then (t ()) else (e ()) in
myIf ((y 2) > 5) (\_ -> 0) (\_ -> x)
```

f)

```
let x = 1 + x in
let y z = z + x in
let a b = div 5 b in
let c k = k y a in
let d = \e -> e (\f -> \g -> g) in
d c 1
```

2 Tail Recursion — 4 points

For each of the following programs, is the program tail-recursive?

a)

```
hailstone n x =
  if x == 1 then n + 1
  else if (mod x 2) == 0 then (hailstone n (div x 2)) + 1
  else hailstone (n + 1) ((x * 3) + 1)
```

b)

```
mylength [] = 0
mylength (_:t) = (mylength t) + 1
```

c)

```
length' n [] = n
length' n (_:t) = length' (n+1) t

length'' = length' 0
```

3 Continuation-Passing Style — 15 points

Convert each of the following programs to continuation-passing style.
a)

```
fold f n [] = n
fold f n l =
    let n' = f n (head l) in
    fold f n' (tail l)
```

b)

```
filter f l =
    if f (head l) then head l : (filter f (tail l))
    else filter f (tail l)
```

c)

```
fib 0 = 0
fib 1 = 1
fib n = (fib (n-1)) + (fib (n-2))
```