CSC151.02 2013F, Class 26: Recursion with Helper Procedures

Overview

- Admin.
- Basics of helper recursion.
- A term: Tail recursion.
- Lab.

Admin

- Pick new partners!
  - You must work with someone new
- Upcoming EC opportunities
  - Football, 1 pm, Saturday
  - Men’s soccer, 1:30 pm, Saturday
  - CS Table Friday: Ambient Belonging
    - ...
- Other upcoming stuff
  - Mentor session 7:30 pm Thursday
    - ...

Basics of helper recursion

```
#lang racket
(require gigls/unsafe)

(define sum1
  (lambda (lst)
    (if (null? lst)
        0
        (+ (car lst) (sum1 (cdr lst))))))

(define sum2
  (lambda (lst)
    (sum2-helper lst 0)))

(define sum2-helper
  (lambda (lst partial-sum)
    (if (null? lst)
        partial-sum
        (sum2-helper (cdr lst) (+ (car lst) partial-sum)))))
```
A term: Tail recursion

- In the original sum (sum1), we’ve delayed a lot of the work (sum (list 1 2 3 4)) => (+ 1 (+ 2 (+ 3 (+ 4 (sum1 null))))))
- In the new version, we do the work as we go, and when we reach the end, we have no work left to do (yay!)
- If you can write recursive procedures that don’t have delayed work when they reach the base case, they run a bit more efficiently.
- This is called "tail recursion"

Lab

- Consider 42 - -18 - 23 - 4
  - Do we interpret it as (((42 - -18) - 23) - 4)
  - Or as (42 - (-18 - (23 - 4)))
  - First interpretation, in Scheme (- (- (- 42 -18) 23) 4)
  - Second interpretation, in Scheme (- 42 (- -18 (- 23 4)))
- The brightest value (brightest '("0/0/0" "63/63/63" "127/127/127" "191/191/191" "255/255/255"))
- Let’s count total calls based on the length of the list
  - calls(1) = 1 ; Just the outermost
  - calls(2) = 1 + 2*1 = 3 ; The call plus the two recursive calls on length 1
  - calls(3) = 1 + 2*3 = 7 ; The call plus the two recursive calls on length 2
  - calls(4) = 1 + 2*7 = 15 ; The call plus the two recursive calls on length 3
  - calls(n) = 1 + 2*calls(n-1)

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