More List-of-Num Examples

; A list-of-num is either
;  - empty
;  - (cons num list-of-num)

• Implement the function `feed-fish`, which takes an aquarium and feeds each fish 1 lb of food

• Implement the function `large-fish`, which removes every fish that is less than 5 lbs from an aquarium
List-of-Posn

; A list-of-posn is either
;   - empty
;   - (cons posn list-of-posn)
List-of-Posn

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List-of-Posn

; A list-of-posn is either
;   - empty
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; A posn is
;   (make-posn num num)
List-of-Posn

; A list-of-posn is either
; - empty
; - (cons posn list-of-posn)

; A posn is
; (make-posn num num)

; func-for-lop : list-of-posn -> ...
(define (func-for-lop l)
  (cond
   [(empty? l) ...]
   [(cons? l) ...]))
List-of-Posn

; A list-of-posn is either
; - empty
; - (cons posn list-of-posn)

; A posn is
; (make-posn num num)

; func-for-lop : list-of-posn -> ...
(define (func-for-lop l)
  (cond
    [(empty? l) ...]
    [(cons? l)
      ... (first l)
      ... (rest l) ...]))
List-of-Posn

; A list-of-posn is either
;  - empty
;  - (cons posn list-of-posn)

; A posn is
;  (make-posn num num)

; func-for-lop : list-of-posn -> ...
(define (func-for-lop l)
  (cond
   [(empty? l) ...]
   [(cons? l)
    ... (first l)
    ... (func-for-lop (rest l)) ...]])
List-of-Posn

; A list-of-posn is either
; - empty
; - (cons posn list-of-posn)

; A posn is
; (make-posn num num)

; func-for-llop : list-of-posn --> ...
(define (func-for-llop l)
  (cond
    [(empty? l) ...]
    [(cons? l)
      ... (func-for-posn (first l))
      ... (func-for-llop (rest l)) ...]))

; func-for-posn : posn --> ...
(define (func-for-posn p)
  ... (posn-x p) ... (posn-y p) ...)
List-of-Posn

; A list-of-posn is either
;   - empty
;   - (cons posn list-of-posn)

; A posn is
;   (make-posn num num)

; func-for-llop : list-of-posn -> ...
(define (func-for-llop l)
  (cond
    [(empty? l) ...]
    [(cons? l)
     ... (func-for-posn (first l))
     ... (func-for-llop (rest l)) ...]]))

; func-for-posn : posn -> ...
(define (func-for-posn p)
  ... (posn-x p) ... (posn-y p) ...)
List-of-Posn Examples

• Implement the function `flip-posns`, which flips the X and Y parts of every posn in a list of posns
List-of-Grade Example

; A grade is either
;   - number
;   - empty

• Implement the function `all-passed?`, which takes a list of grades and determines whether all are passes
List-of-List-of-Num Example

; A list-of-lon is either
;  - empty
;  - (cons list-of-num list-of-lon)

• Implement the function **sums**, which takes a list of list-of-numbers and produces a list of sums
Writing Down Large Lists

What does the list containing 0 to 10 look like?

\[(\text{cons} \ 0 \ (\text{cons} \ 1 \ (\text{cons} \ 2 \ (\text{cons} \ 3 \ (\text{cons} \ 4 \ (\text{cons} \ 5 \ (\text{cons} \ 6 \ (\text{cons} \ 7 \ (\text{cons} \ 8 \ (\text{cons} \ 9 \ (\text{cons} \ 10 \ \text{empty}) ))))))))))\]

Here's a shortcut:

\[(\text{list} \ 0 \ 1 \ 2 \ 3 \ 4 \ 5 \ 6 \ 7 \ 8 \ 9 \ 10)\]

The \text{list} operator takes any number of arguments and constructs a list

Still, DrScheme prints 11 \text{conses}
Printing Large Lists

If you change DrScheme's language level to **Beginning Student with List Abbreviations**
then DrScheme prints using the shortcut

> (list 0 1 2 3 4 5 6 7 8 9 10)
(list 0 1 2 3 4 5 6 7 8 9 10)

> (cons 1 (cons 2 (cons 3 empty)))
(list 1 2 3)
When to Change Language Levels

1. You're not tempted to write examples like this:
   (feed-fish (cons 1 (cons 2 empty)))
   "should be" 2 3

2. Your eyes hurt when you see
   (cons 1 (cons 2))
because it isn't a list-of-num

3. When you see
   (list 1 2 3)
   (cons 1 (cons 2 (cons 3 empty)))
you recognize instantly that they're the same

Don't switch until you understand how list-of-... functions
match the shape of the data definition
Even Shorter

For the brave, there's an even shorter shortcut!

\[ '(1 \ 2 \ 3) \]

is the same as

\[
(\text{list } 1 \ 2 \ 3)
\]

The apostrophe above doesn't make a symbol — it makes a list because it precedes a parenthesis

Furthermore, the apostrophe gets distributed to everything inside:

\[ '(\text{apple \ banana}) \]

is the same as

\[
(\text{list } '\text{apple} \ '\text{banana})
\]

For consistency, \texttt{'1} is the same as \texttt{1}
Even Shorter

Here's a list-of-lon using the shortcut:

\[
\text{'' ((1 2 3) (2 4 6 8) (3 9 27))}
\]

which is the same as

\[
(\text{list (list 1 2 3) (list 2 4 6 8) (list 3 9 27))}
\]

which is the same as

\[
(\text{cons (cons 1 (cons 2 (cons 3 empty)))})
\]
\[
(\text{cons (cons 2 (cons 4 (cons 6 (cons 8 empty)))))}
\]
\[
(\text{cons (cons 3 (cons 9 (cons 27 empty)))})
\]
\[
\text{empty})}
\]