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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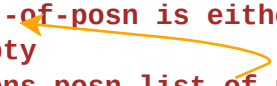
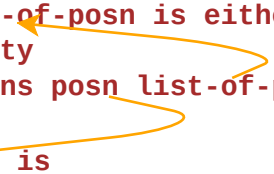


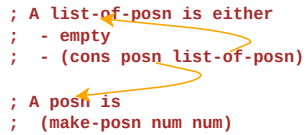
List-of-Posn

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

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



List-of-Posn



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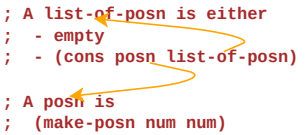
```
; func-for-lop : list-of-posn -> ...
(define (func-for-lop l)
  (cond
    [(empty? l) ...]
    [(cons? l) ...]))
```

List-of-Posn



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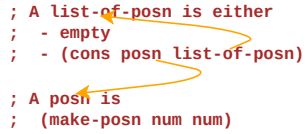
```
; func-for-lop : list-of-posn -> ...
(define (func-for-lop l)
  (cond
    [(empty? l) ...]
    [(cons? l)
     ... (first l)
     ... (rest l) ...]))
```

List-of-Posn



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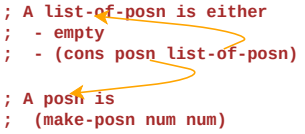
     ... (func-for-lop (rest l)) ...]))
```

List-of-Posn



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  (cond
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    [(cons? l)
     ... (func-for-posn (first l))
     ... (func-for-lop (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
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(define (func-for-lop l)
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; func-for-posn : posn -> ...
(define (func-for-posn p)
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```

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 1 to 10 look like?

```
(cons 0 (cons 1 (cons 2 (cons 3 (cons 4 (cons 5 (cons 6 (cons 7 (cons 8 (cons 9 (cons 10 empty))))))))))
```

Here's a shortcut:

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

The **list** operator takes any number of arguments and constructs a list

Still, DrScheme prints 11 **cons**es

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

```
(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:

```
'(apple banana)
```

is the same as

```
(list 'apple 'banana)
```

For consistency, `'1` is the same as `1`

Even Shorter

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

```
'((1 2 3) (2 4 6 8) (3 9 27))
```

which is the same as

```
(list (list 1 2 3) (list 2 4 6 8) (list 3 9 27))
```

which is the same as

```
(cons (cons 1 (cons 2 (cons 3 empty)))
      (cons (cons 2 (cons 4 (cons 6 (cons 8 empty))))
            (cons (cons 3 (cons 9 (cons 27 empty)))
                  empty)))
```