

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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```



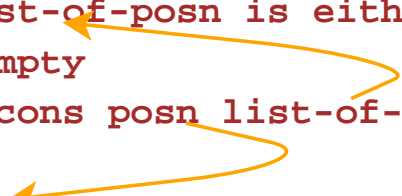
List-of-Posn

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

Two yellow arrows originate from the 'list-of-posn' definition. The first arrow starts at the word 'list-of-posn' in the second line and points to the word 'posn' in the fourth line. The second arrow starts at the word 'list-of-posn' in the third line and points to the word 'posn' in the fourth line.

List-of-Posn

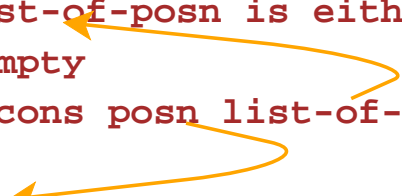
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; - empty  
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; A posn is  
; (make-posn num num)
```



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

List-of-Posn

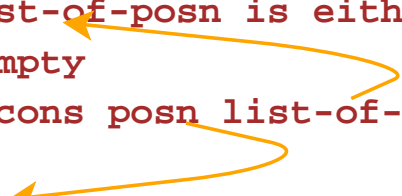
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```



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

List-of-Posn

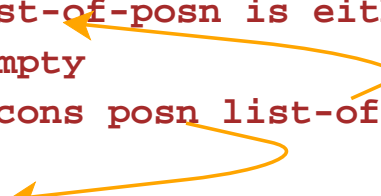
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(define (func-for-lop l)  
  (cond  
    [(empty? l) ...]  
    [(cons? l)  
     ... (first l)  
     ... (func-for-lop (rest l)) ...])))
```

List-of-Posn

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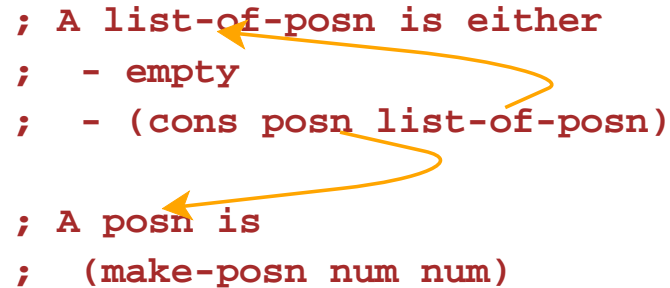
```
(define (func-for-lop l)  
  (cond  
    [(empty? l) ...]  
    [(cons? l)  
     ... (func-for-posn (first l))  
     ... (func-for-lop (rest l)) ...]))
```

```
; func-for-posn : posn -> ...
```

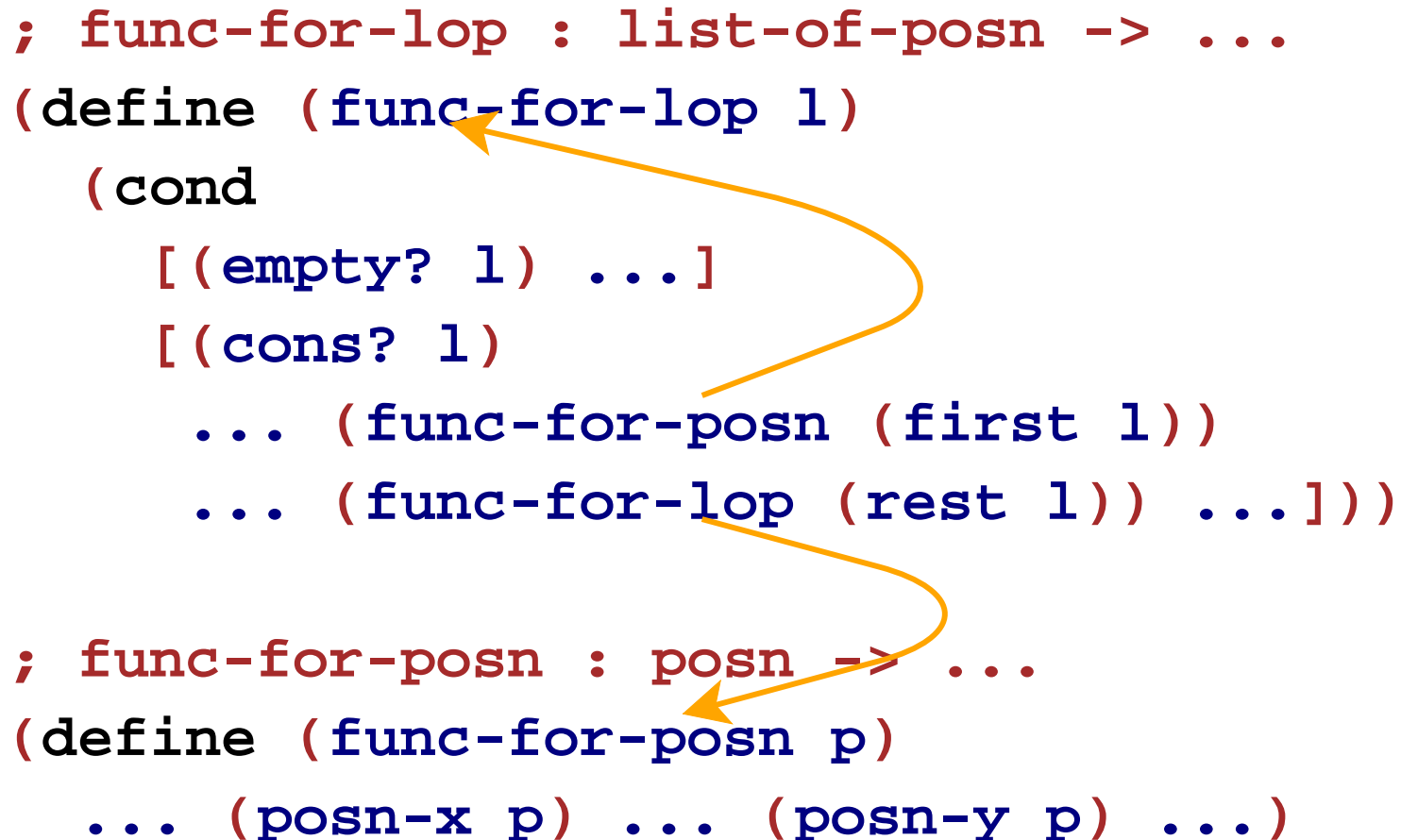
```
(define (func-for-posn p)  
  ... (posn-x p) ... (posn-y p) ...)
```


List-of-Posn

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

```
(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 `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
`(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)))
```