Conses in Ruby: So Much More Than Lists

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Ruby is my ~~most~~ ~~second~~ third favorite programming language of all time.

1. My own super-awesome programming language, Teepee
   (but it's not that awesome just yet)
2. Common Lisp
3. Ruby
4. Clojure

   .

   .

   .

999. Java

Nearly every programming language has some way to do things to a list/array/vector/whatever of things.

Ruby has arrays.

```
1 a = [1,2,3,4,5]
2 a.class # Array
3 a.length # 5
4 a.first # 1
5 a.map {|i| i*2} # [2,4,6,8,10]
```

Common Lisp prefers linked lists.

```
1 (setf a '(1 2 3 4 5))
2 (class-of a) ; #<BUILT-IN-CLASS COMMON-LISP:CONS>
3 (length a) ; 5
4 (first a) ; 1
5 (mapcar (lambda (i) (* 2 i)) a) ; '(2 4 6 8 10)
```

But Common Lisp also has vectors, which are basically the same as Ruby arrays.

```
1 (let v (vector 1 2 3 4 5))
2 (class-of v)
3 ;; #<BUILT-IN-CLASS COMMON-LISP:SIMPLE-VECTOR>
4 (length v) ; 5
5 (elt v 0) ; 1
6 (map 'vector (lambda (i) (* 2 i)) v)
7 ;; #(2 4 6 8 10)
```

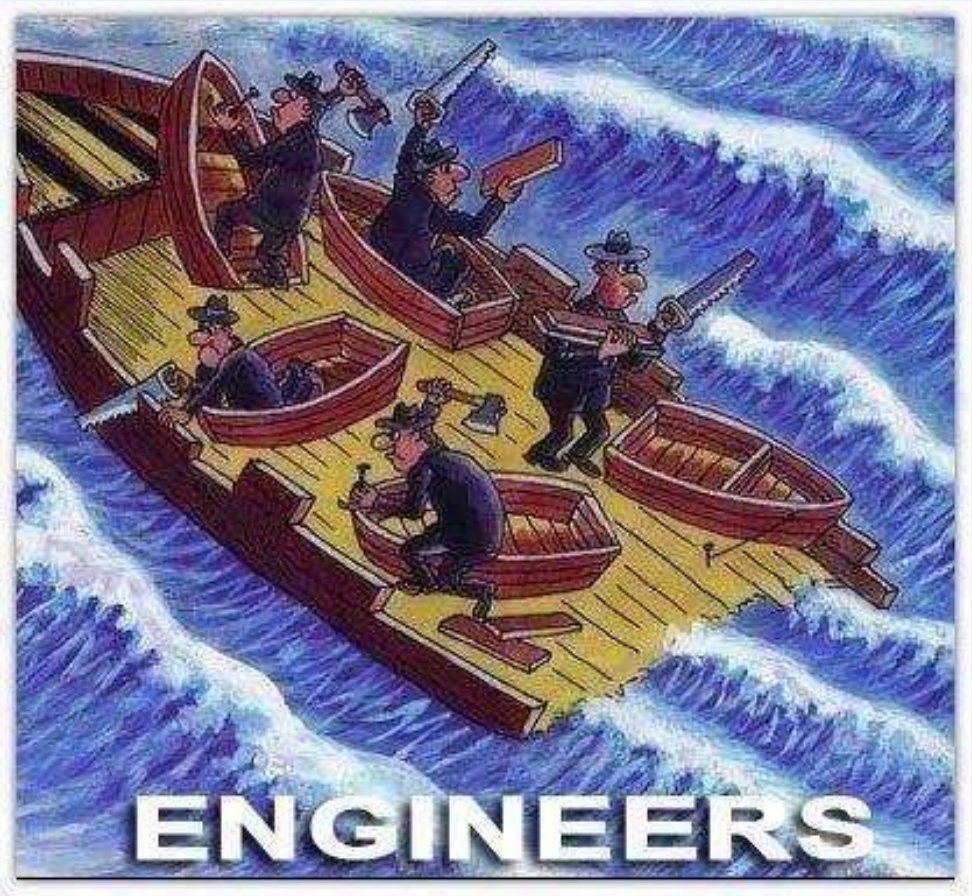
I'm wanting to add lisp-style lists to my language. *(There's no lists or arrays or anything like that yet.)*

It's written in Ruby, so I'm writing a Cons gem!

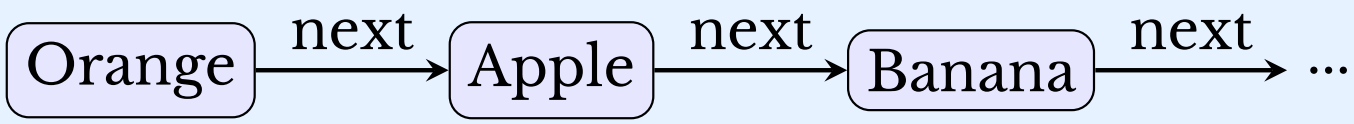
```
require 'cons'
c = [1,2,3,4,5].to_cons
c.class # Cons
c.length # 5
c.first # 1
c.map {|i| i*2} # Cons.list 2,4,6,8,10
```

Once the gem is complete, I can then use it in the language's implementation.

Just remember, yak shaving is only a bad thing if you are talking to a manager.



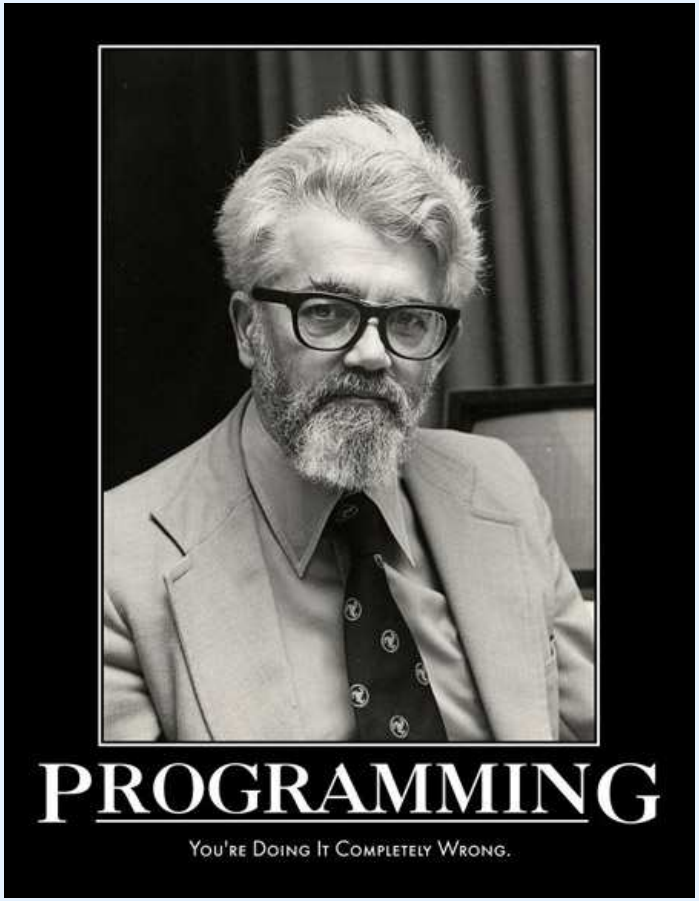
Remember linked lists?



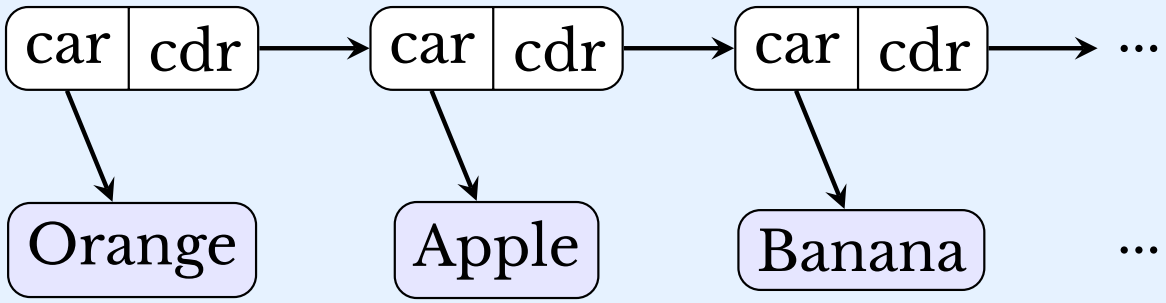
We can do this something like this in Ruby:

```
1 class LinkedList
2   attr_accessor :data, :next
3   def initialize data, next
4     @data, @next = data, next
5     ...
6   end
7   ...
8 end
```

Well, they don't work like that at all in Lisp.



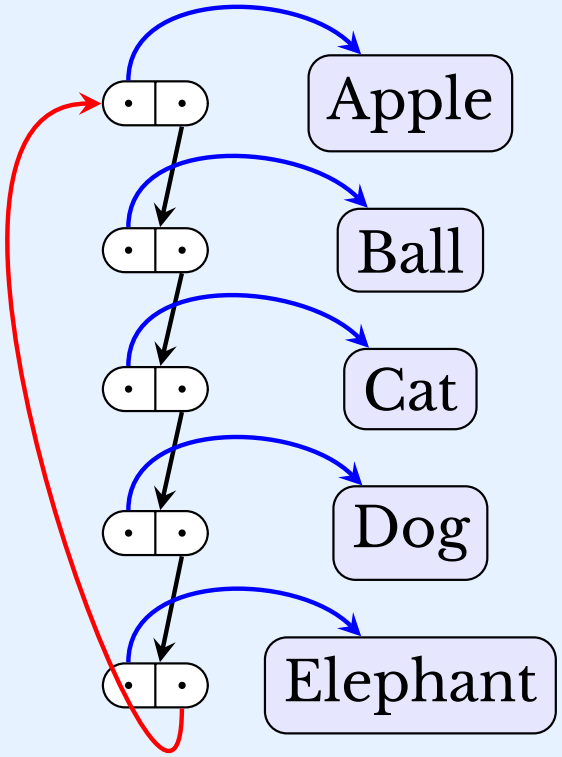
Lisp uses conses instead.
The data isn't in the cell, it's two pointers.



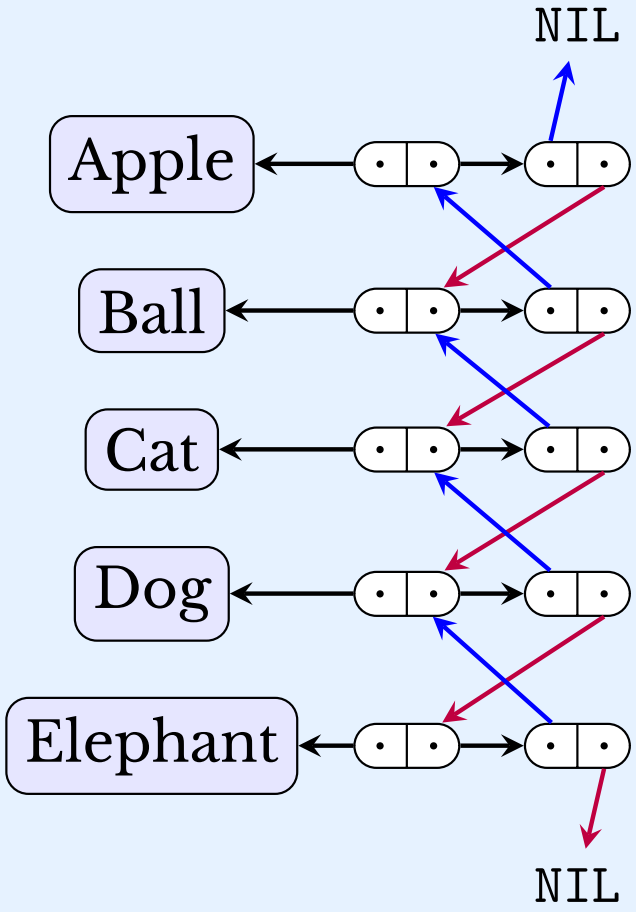
Say hello to the IBM Type 704
CAR: Contents of the Address Register
CDR: Contents of the Data Register

For similar reasons, every Linux box thinks your on one of these:

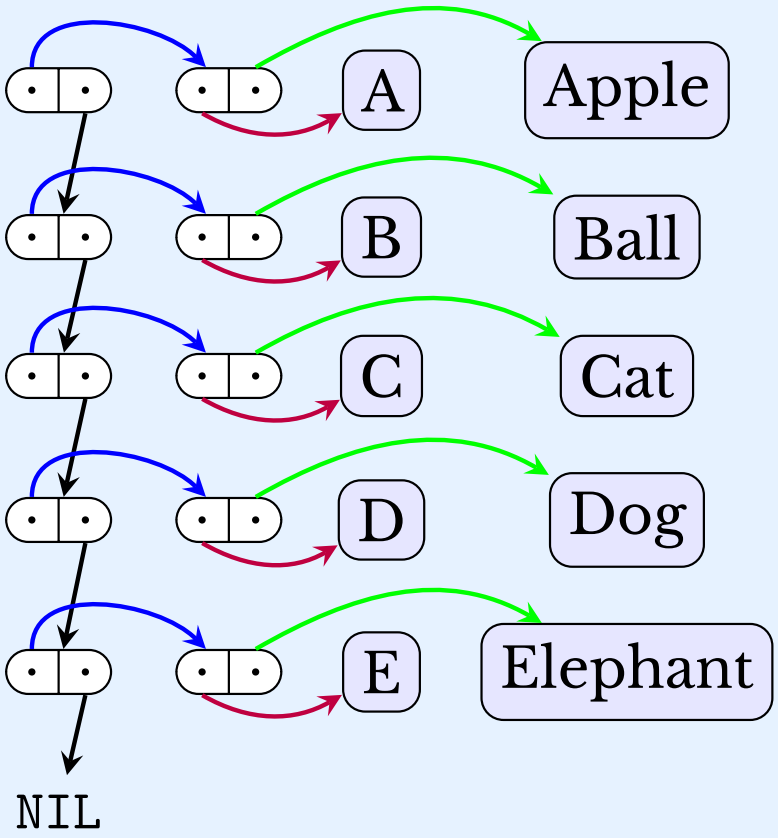
Why two pointers?
Because you can make ring buffers.



Why two pointers?
Because you can make doubly-linked lists.



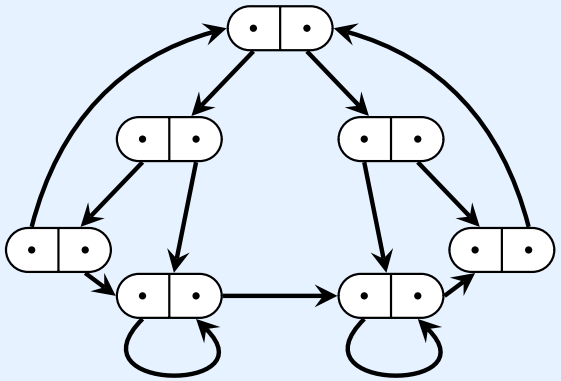
Why two pointers?
Because you can make alists.



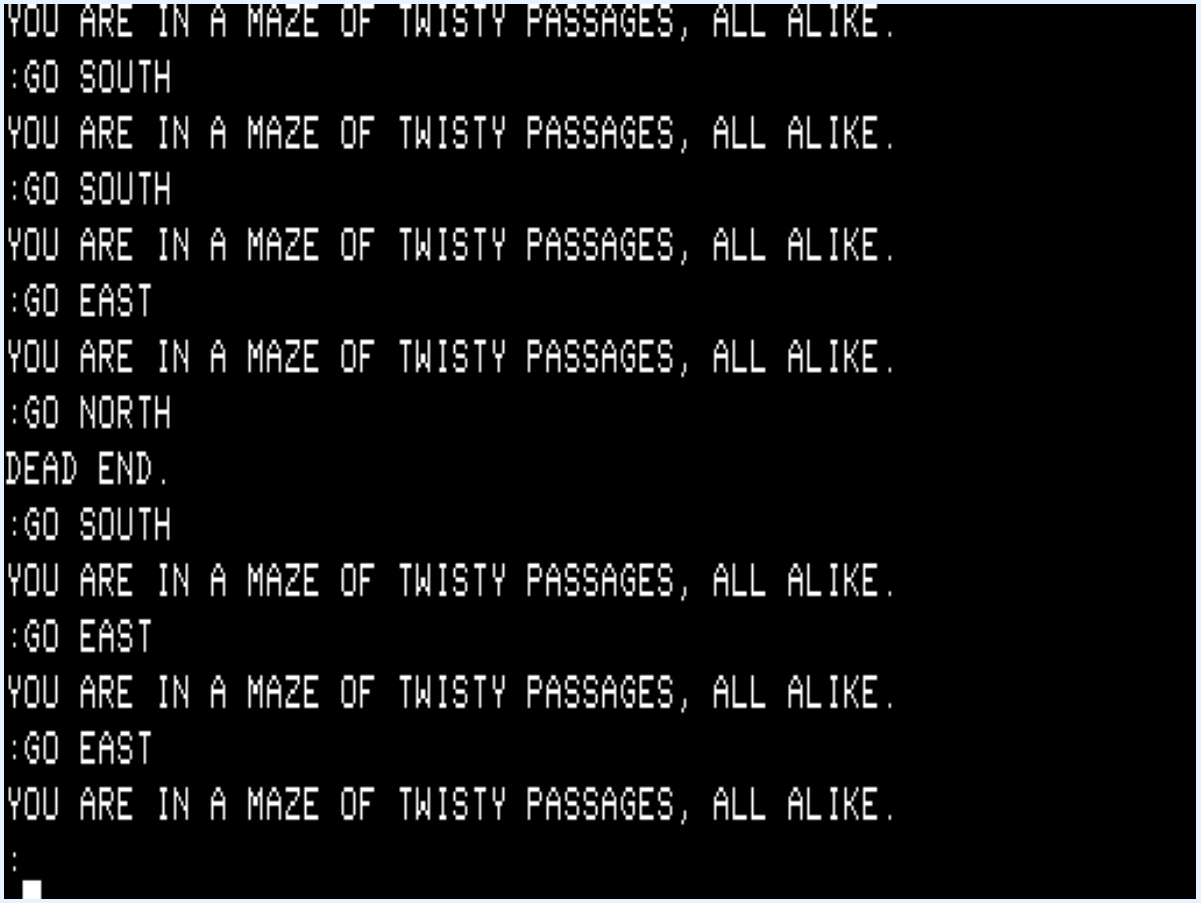
Alists, *association lists*, are how Lisp historically would create things we'd typically use hash maps for today.

```
'((A . Apple)
  (B . Ball)
  (C . Cat)
  (D . Dog)
  (E . Elephant))
```

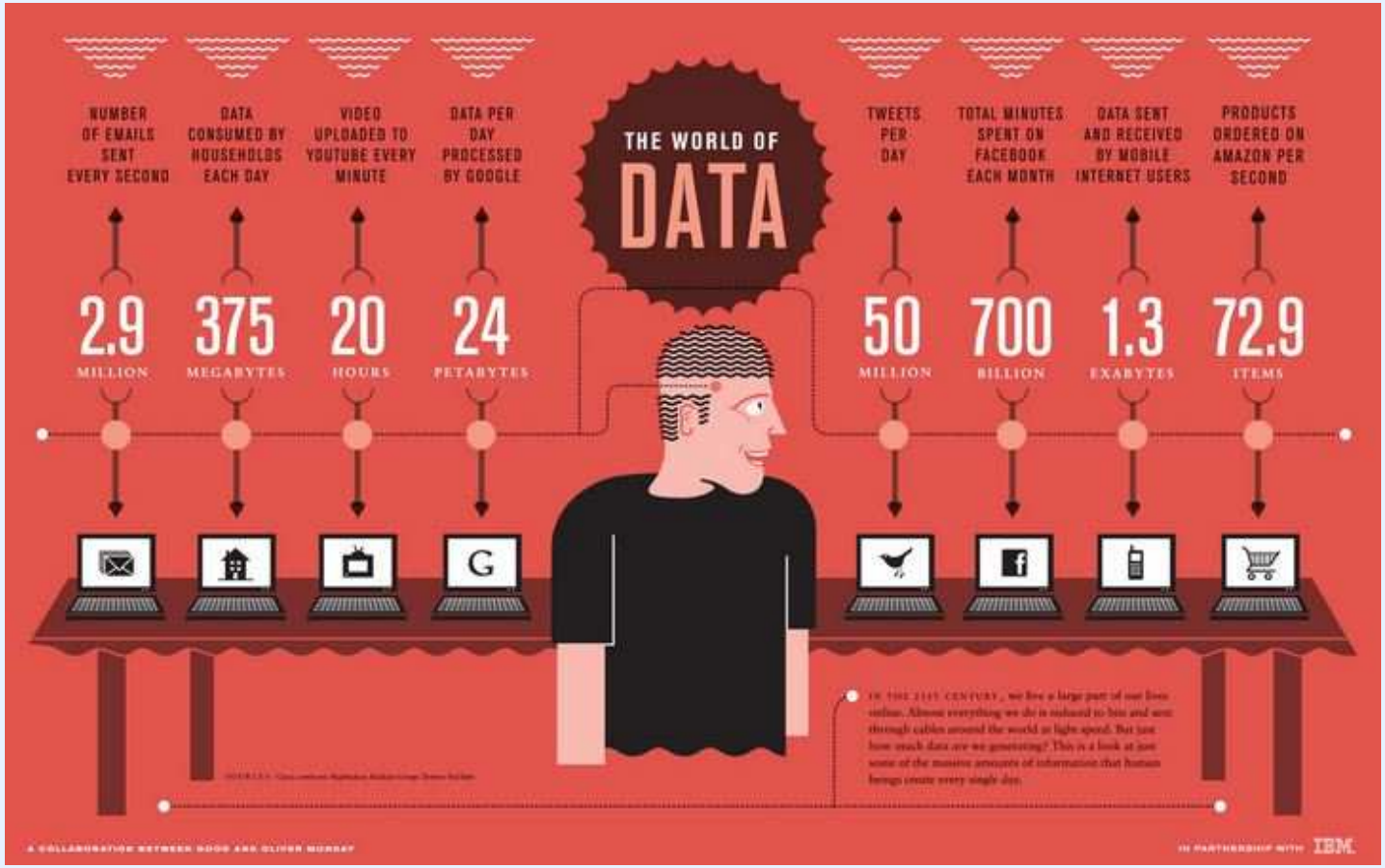
Why two pointers?
Because then you can do this:



Sometimes, exploring your data structures should be an adventure!



Why do I want conses?



Big Data

- There's no reason why the `car` or the `cdr` need to point to local memory.
- Why not point them to the hard drive?
- Why not point them to S3?
- Why not have something cool that points to local memory, or the hard drive, or S3, at it's discretion?

Then we can have ninety-nine quintillion kitten pictures in a big list!

We can easily do `Cons` in Ruby

```
1 class Cons
2   attr_accessor :car, :cdr
3   def initialize car, cdr
4     @car, @cdr = car, cdr
5     ...
6   end
7   ...
8 end
```

I've got a very basic implementation.

```
1 require 'cons' # Yay gems!
2 Cons.new 1, nil # Basic constructor
3 Cons[1,nil] # Or use the brackets
4 Cons[1] # nil is default
5 Cons[1,Cons[2,Cons[3]]] # a linked list
6 Cons.from_array [1,2,3] # from an array
7 [1,2,3].to_cons # monkey patching
```

Comparisons, `car`, and `cdr`

```
1 c = [1,2,3,4,5].to_cons
2 c.length # 5, assumes a linked list
3 d = [1,2,3,4,5].to_cons
4 c == d # true, but they're not identical
5 c.car # 1
6 c.cdr.car # 2
7 c.cdr.cdr.car # 3
8 c.cdr.cdr.cdr.car # 4
9 c.cdr.cdr.cdr.cdr.car # 5
```

Because sometimes English is easier:

```
1 c = [1,2,3,4,5].to_cons
2 c.first # 1
3 c.second # 2
4 c.third # 3
5 c.fourth # 4
6 c.fifth # 5
```

Umm, this is a thing?

```
1 c = [1,2,3,4,5].to_cons
2 c.car # 1
3 c.cdar # 2
4 c.cddar # 3
5 c.cdddar # 4
6 c.cddddar # What? That's crazy talk!
```

It's easy to get the `cdr`'s too.

```
1 c = [1,2,3,4,5].to_cons
2 c.cdr.to_a # 2,3,4,5]
3 c.rest.to_a # [2,3,4,5]
4 c.cddr.to_a # [3,4,5]
5 c.cdddr.to_a # [4,5]
6 c.cddddr.to_a # [5]
```

You can easily make assignments.

```
1 c = [1,2,3,4,5].to_cons
2 c.car # 1
3 c.car = "wow"
4 c.car # "wow"
5 c.cdar = "hey"
6 c.cddar = "cool"
7 c.to_a # ["wow","hey","cool",4,5]
```

Work in progress …

- Implement arbitrary `c*r` forms via `method_missing`? Maybe not?
- Smarter pretty printer.
- Lots of stuff for alists.
- Lots of stuff for lists as sets.
- Lots of other stuff from Common Lisp.
- Go to the hard drive!
- Go to S3!

Questions?