CSE 413: Programming Languages and their Implementation

Scheme - Lists

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Today’s Outline

- Administrative Info – Office Hours
- More Scheme
  - » cons, car, cdr
  - » Processing Lists

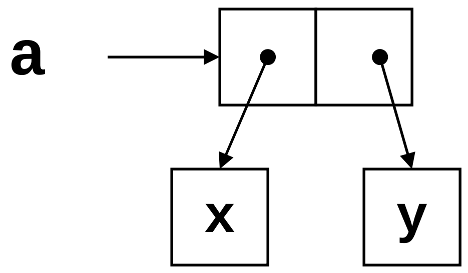
Office Hours &c.

- Office Hours
  - » Hal Perkins – CSE 548
    - Mon. after class to 5:30, Tue 2:00 – 3:00
  - » Laura Marshall – CSE 218
    - Thur. 1:30 – 3:00
- Assignment 1 is out – due next Thur., 11 pm
  - » Most everything needed by today; loose ends Monday
- Email
  - » Please put “413” somewhere in the subject
  - » We’re outnumbered & can’t be a 24/7 quick-response help desk. Take advantage of discussion list, references, online resources.

`(cons a b)`

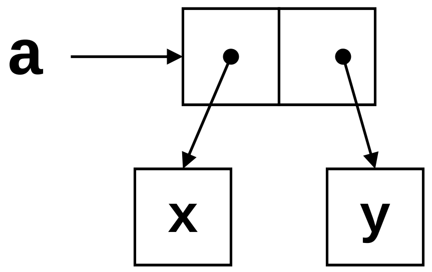
- Takes `a` and `b` as args, returns a compound data object that contains `a` and `b` as its parts
- We can extract the two parts with accessor functions `car` and `cdr`

```
(define a (cons ‘x ‘y))
```



`car` and `cdr`

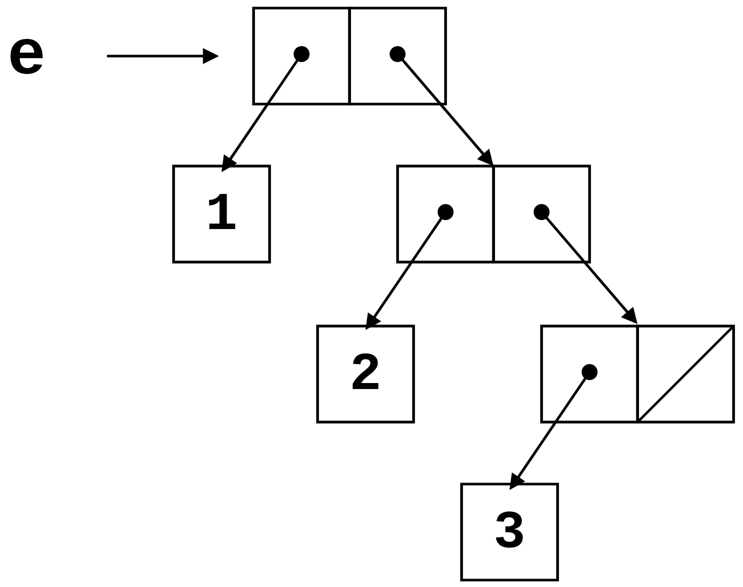
```
(define a (cons ‘x ‘y))

(car a)

(cdr a)
```



- We can build arbitrary pairs with `cons`, but the workhorse data structures in Scheme are proper lists

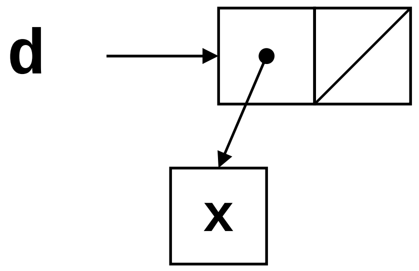
Lists

- By convention, a list is a sequence of linked pairs
  - » `car` of each pair is the data element
  - » `cdr` of each pair points to list tail or the empty list



nil

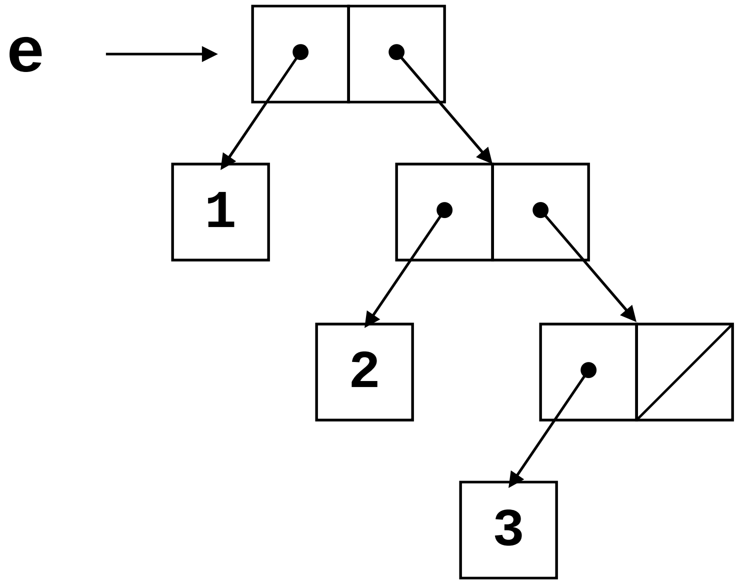
- if there is no element present for the car or cdr branch of a pair, we indicate that with the value nil
  - » nil (or null) represents the empty list '()
- (null? z) is true if z is nil



```
(define d (cons ‘x '()))
(car d)
(cdr d)
(null? (car d))
(null? (cdr d))
```

List construction

```
(define e (cons 1 (cons 2 (cons 3 '()))))
```



```
(define e (list 1 2 3))
```

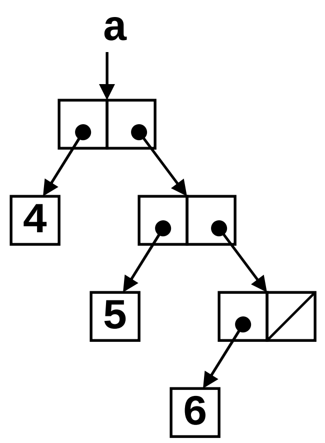
procedure `list`

`(list` *`a b c`* `...)`

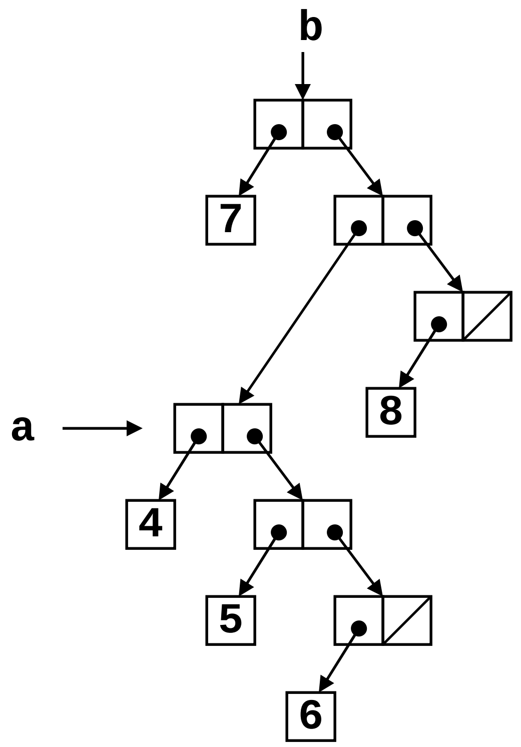
- `list` returns a newly allocated list of its arguments
  - » the arguments can be atomic items like numbers or quoted symbols
  - » the arguments can be other lists
- The backbone structure of a list is always the same
  - » a sequence of linked pairs, ending with a pointer to null (the empty list)
  - » the `car` element of each pair is the list item
  - » the list items can be other lists

List structure

```
(define a (list 4 5 6))
```

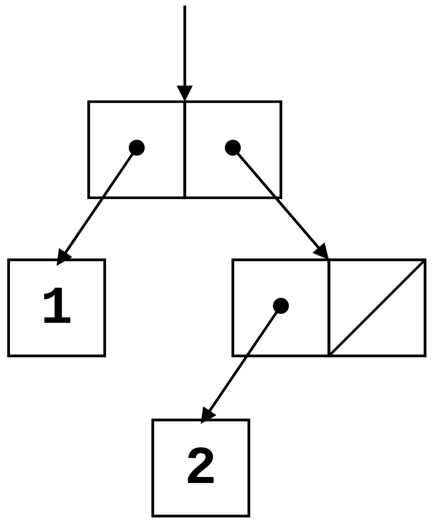


```
(define b (list 7 a 8))
```



Examples of list building

```
(cons 1 (cons 2 '()))

(cons 1 (list 2))

(list 1 2)
```



How to process lists?

- A list is zero or more connected pairs
- Each node is a pair
- Thus the parts of a list (this pair, following pairs) are lists
- A natural way to express list operations?

cdr down

```
(define (length m)
  (if (null? m)
      0
      (+ 1 (length (cdr m)))))
```

sum the items in a list

```
(add-items (list 2 5 4))
```