CS 360
Programming Languages
Lecture 3

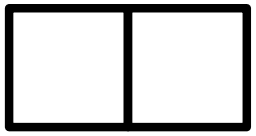
Swift

JavaScript

Dart

Review

- Cons cell: two-piece structure (like a 2-member class in Java)



  - Also called a pair. left side called "car"; right side called "cdr"
  - **`(cons e1 e2)`** constructs a new cons cell (and returns it)
  - **`(car e)`** returns the car part of **`e`**; **`(cdr e)`** returns the cdr of **`e`**

- **`'(v1 . v2)`** constructs a "literal" cons cell.
- Drawing cons cells:
  - **`(cons 1 2)`**
  - **`(cons 1 (cons 2 3))`**
  - **`(cons (cons 1 2) 3)`**

Lists

- Lists are built in Racket using linked lists of cons cells.

Need ways to *build* lists and *access* the pieces…

Building Lists

- The empty list is a value: `'()`

- In general, a list of values is a value; elements are separated by spaces:

```
'(v1 v2 ... vn)
```

- If **`e1`** evaluates to **`v1`** and **`e2`** evaluates to a list **`(v2 v3 … vn)`**, then **`(cons e1 e2)`** evaluates to **`(v v1 v2 v3 … vn)`**
  - Key to remember: If **`e2`** is a list, then **`cons`** makes a new list with **`e1`** at the front.

Accessing Lists

- **`(null? e)`** evaluates to **`#t`** if and only if **`e`** evaluates to **`'().`**

- If **`e`** evaluates to **`'(v1 v2 … vn)`** then **`(car e)`** evaluates to **`v1`**
  - throw exception if **`e`** evaluates to **`'()`**
  - Think of **`car`** as "get the first element of the list."

- If **`e`** evaluates to **`(v1 v2 … vn)`** then **`(cdr e)`** evaluates to **`(v2 … vn)`**
  - throw exception if **`e`** evaluates to **`'()`**
  - Think of **`cdr`** as "get everything but the first element of the list."
  - Notice result is a list

Box-and-pointer notation with lists

- Key to differentiating pairs from lists: lists never have dots in them.
- `'(1 . 2)` versus `'(1 2)`

- How would you create `'(1 . 2)` with call(s) to cons?

- How would you create `'(1 2)` with call(s) to cons?

- What does `(cons 1 '(2 3))` create?

- What does `(cons '(1) '(2 3))` create?

Two other ways to build lists

- **`list`** function
  - Makes a list out of all arguments.
  - Arguments can be of any data type.
  - **`(list e1 e2 … en)`** evaluates **`e1`** through **`en`** to values **`v1`** through **`vn`**; returns the list **`'(v1 v2 … vn)`**.
- **`append`** function
  - Concatenates values inside lists given as arguments.
  - Arguments *must* be lists.
  - **`(append e1 e2 … en)`** evaluates **`e1`** through **`en`** to values **`v1`** through **`vn`**;
  - If **`v1`** = **`(v11 v12 … )`** and **`v2`** = **`(v21 v22 … )`** etc, then return value is **`(v11 v12 … v21 v22 … )`**.

Exercises