CSC 151 Spring 2020
Topic: Pairs

April 1, 2020

Day 25

Notes & Announcements

There have been a number of announcements on Piazza lately. Be sure you are aware of them.

Perhaps most pressingly, there is an opportunity to get some points back from Exam 2.

Lists and Pairs

This about the following questions:

What is a pair?

What is a list?

Are all lists pairs? Are all pairs lists?

Lists and Pairs

Write down your answers to each question. Paper is your friend!

Lists and Pairs

Can you come up with a counter-example to the last question?

Lists and Pairs

Are you ready for the answers?

Lists and Pairs

What is a pair?

When you call cons you get a pair. A pair holds two values together.

What is a list?

A sequence of values. There can be many more than two values in a list. Lists are build of pairs. A list is either null, or a pair of some value (in the car) and a list (in the cdr).

Are all lists pairs?

No. The empty list (null) is not a pair.

Are all pairs lists?

No. (cons ‘a ‘b) is not a list, because the cdr is not a list.

Box and Pointer Diagrams

Try to sketch a drawing of each pair structure below.

(list 1 2 3)

(cons 'a (cons (cons 'b 'c) ‘d))

(cons (cons (cons null 1) 2) 3)

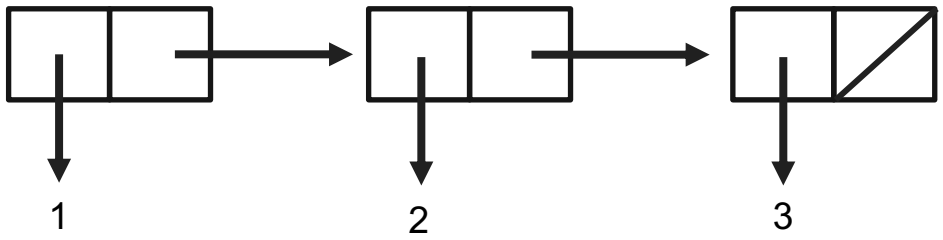
(list 1 2 3)

Notice that (list 1 2 3) = (cons 1 (cons 2 (cons 3 null)))

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This is the most basic format of pairs, where the car is a value, and the cdr points to another pair, and finally ends in null.



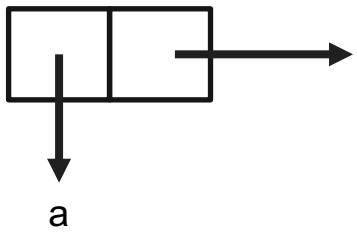
(cons 'a (cons (cons 'b 'c) 'd))

(cons 'a (cons (cons 'b 'c) 'd)) = ('a ('b . 'c) . 'd)

(cons 'a (cons (cons 'b 'c) 'd))

(cons 'a (cons (cons 'b 'c) 'd)) = ('a ('b . 'c) . 'd)

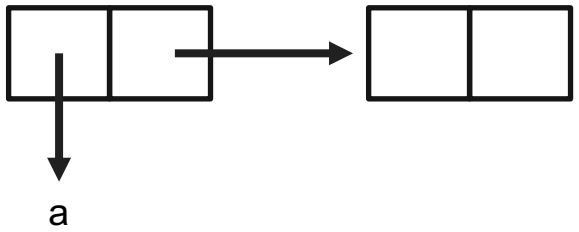
I like to start from the left, so we have (cons 'a _______), which means draw a pair with 'a in the car



(cons 'a (cons (cons 'b 'c) 'd))

(cons 'a (cons (cons 'b 'c) 'd)) = ('a ('b . 'c) . 'd)

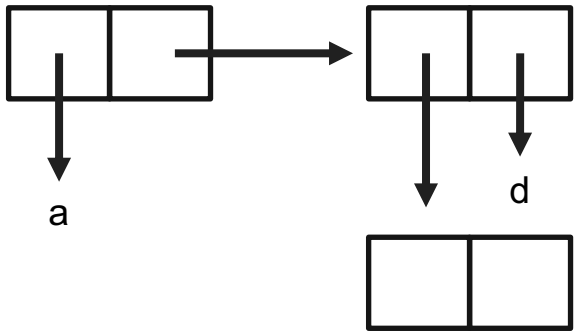
the cdr is now **(cons (cons 'b 'c) 'd)** , which is another pair (because of the cons).



(cons 'a (cons (cons 'b 'c) 'd))

(cons 'a (cons (cons 'b 'c) 'd)) = ('a ('b . 'c) . 'd)

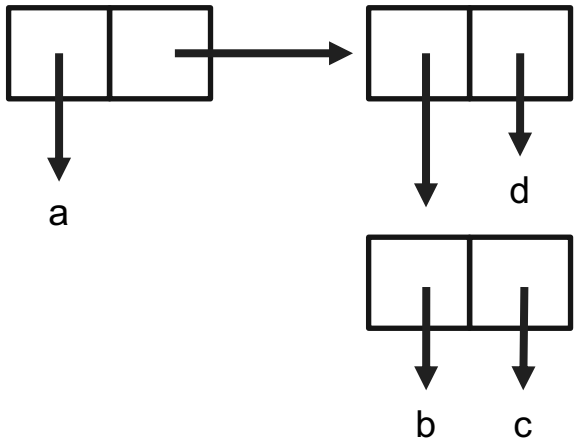
The car of this new pair is **(cons 'b 'c)** – another pair!!, while the cdr is **'d.**



(cons 'a (cons (cons 'b 'c) 'd))

(cons 'a (cons (cons 'b 'c) 'd)) = ('a ('b . 'c) . 'd)

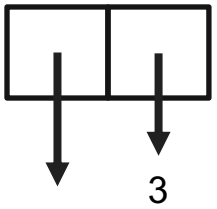
Finally, **(cons 'b 'c)** is a straightforward pair to fill in.



(cons (cons (cons null 1) 2) 3)

(cons (cons (cons null 1) 2) 3) = ((((() . 1) . 2) . 3)

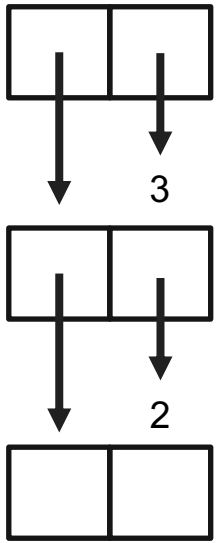
If we look closely at the structure, the first (left-most) cons has a large expression as the car, and 3 as the cdr.



(cons (cons (cons null 1) 2) 3)

(cons (cons (cons null 1) 2) 3) = ((((() . 1) . 2) . 3)

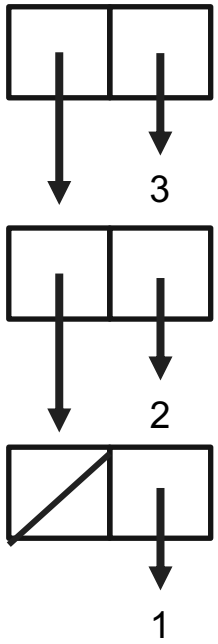
Similarly, the next inner-expression, **(cons (cons null 1) 2)**, has another pair as the car, and 2 as the cdr.



(cons (cons (cons null 1) 2) 3)

(cons (cons (cons null 1) 2) 3) = ((((() . 1) . 2) . 3)

Finally, the last inner-expression, **(cons null 1)**, is straightforward



Lab Time

Upcoming Work

Submit Exercises 2, 4, and 5 by Friday 4/3 at 10:30 pm Central Time. You don't need to include documentation this time.

To: csc-151-02-grader@grinnell.edu
Subject: CSC 151-02 Lab 4/1

Exam 2 Revisions are due 4/10 (Optional)