Administrative Notes

Homework

- Short homework due Wednesday
- On the web site
- Worth five points

Exams

- Graded and returned Friday
- Statistics in slides for last class

(at the end)

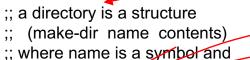
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Files and Directories

Simple model of a file system

- → Files represented as symbols
- → Directory is a list of its contents



;; contents is a list of files and directories (define-struct dir (name contents))

;; a lofd (list-of-files-and-directories) is one of

;; - empty, or

;; - (cons f r) where f is a file and r is an lofd, or

;; - (cons f r) where f is a dir and r is an lofd



;; a file is a symbol

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Files and Directories

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Template for File System

```
(define (f a-file ...) ...)
                                          ;; simple template for file
 (define (g a-dir ...)
                                          ;; structure template for dir
    ( ... (dir-name a-dir) ...
       ... (h (dir-contents a-dir)
 (define (h a-lofd ...)
                                            list of several types for lofd
   (cond
      [(empty? a-lofd)
      [(symbol? (first a-lofd))
            ... (f (first a-lofd) ... ) ...
            ... (h (rest a-lofd) ... ) ... ]
                                               Write the program
      [(dir? (first a-lofd))
            ... (g (first a-lofd) ... ) ...
                                              ;; Depth-dir : dir -> number
              (h (rest a-lofd) ... ) ... ]
                                              ;; Purpose: return nesting depth of
                                                   most deeply nested directory
                                              (define (count-files a-dir) ...)
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                                                                                   3
```

Files and Directories



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Depth-dir

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→ Write a program that consumes a dir and produces a number indicating how many levels of nested directories are in the tree



So far,

- Programs have consumed, at most, one complicated argument
- In flatten, you needed a helper that consumed two lists
 - → This lead to append

Notice how append uses list2

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Programs with Multiple Complex Arguments



```
;; append: list list -> list
;; Purpose: consumes two lists and produces a single list
;; that contains all the elements of the first argument
;; followed by all the elements of the second argument
(define (append list1 list2)
  (cond
  [(empty? list1) list2]
  [(cons? list1) (cons (first list1) (append (rest list1) list2))]
)
```

- In append, the second argument is never treated as a list
 - ightarrow Passed along as second argument in recursive call
- Append follows the standard list template



Another example

```
;; a point is
;; (make-point x y)
;; where x and y are numbers
(define-struct point (x y))
;; make-points: list-of-numbers list-of-numbers -> list-of-points
;; Purpose: consumes two lists of numbers, interprets the first as
;; a list of x coordinates, the second as a list of y coordinates,
;; and produces the corresponding list of points
(define (make-points x-list y-list ...)
```

What template should we use?

- Make-points manipulates both x-list and y-list
- Make-points only works if (= (length x-list) (length y-list))

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Programs with Multiple Complex Arguments



Another example

This simplifies the template

```
(define (f x-list y-list ...)

(cond

[(empty? x-list) ...]

[(cons? x-list) ... (first y-list) ...

... (f (rest x-list) (rest y-list) ... ]
```

- We can complete the program from the template
 - → Fill in the blanks
 - → Ellide unneeded stuff



But, ...

- Template contained problem specific-knowledge
 - → This violates our (previous) assumption that templates follow (just) the data structure
 - → Here, template depended on set of arguments to the program
- This is a leap from what we've done in the past

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Programs with Multiple Complex Arguments



Another example

```
;; merge: list-of-numbers list-of-numbers -> list-of-numbers
;; Purpose: consumes two lists of numbers, assumed to be in
;; ascending order by value, and produces a single list of
numbers that contains all the elements of the input lists
;; (including duplicates) in ascending order by value
(define (merge a-lon1 a-lon2) ...)
```

- Clearly, merge must look inside both lists
- · Clearly, the lists can have different length
 - → (merge empty (cons 1 empty)) should be (cons 1 empty)
- How do we write a template for this problem?
 - \rightarrow Study the possibilities



Merge

- Consider the possibilities
- 2 inputs, 2 cases in the definition \Rightarrow 4 cases & 4 examples

```
(merge empty empty) \Rightarrow empty
(merge empty (list 1 5)) \Rightarrow (list 1 5)
(merge (list 1 5) empty) \Rightarrow (list 1 5)
(merge (list 1 5) (list 3)) \Rightarrow (list 1 3 5)
```

- Merge must handle all of these possibilities
 - → Cond construct with four clauses
 - → Must work out tests that distinguish them

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Programs with Multiple Complex Arguments



Merge

Questions for list x list

	(empty? a-lon2)	(cons? a-lon2)
(empty? a-lon1)	(and (empty? a-lon1) (empty? a-lon2))	(and (empty? a-lon1) (cons? a-lon2))
(cons? a-lon1)	(and (cons? a-lon1) (empty? a-lon2))	(and (cons? a-lon1) (cons? a-lon2))

The template must include (and handle) all these cases



Merge - the template

Structure is clear, but where are the recursion relationships?

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Programs with Multiple Complex Arguments



Merge - the template

```
(define (f a-lon1 a-lon2)
                                                           Empty lists
 (cond
   [(and (empty? a-lon1) (empty? a-lon2))
                                                           implies no
                                               ...]
   [(and (empty? a-lon1) (cons? a-lon2))
                                                           Recursiona-lon2
         ... (first a-lon2) ... (rest a-lon2) ...]
                                                           and empty.
   [(and (cons? a-lon1) (empty? a-lon2))
                                                           Same case on
         ... (first a-lon1) ... (rest a-lon1) ...]
                                                           a-lon1
   [(and (cons? a-lon1) (cons? a-lon2))
                                                           Recur on both
         ... (first a-lon1) ... (first a-lon2) ...
                                                           several cases
         ... (rest a-lon1) ... (rest a-lon2) ...]
                                           (f a-lon1 (rest a-lon2))
                                           (f (rest a-lon1) a-lon2))
                                           (f (rest a-lon1) (rest a-lon2))
```



Merge - the template

You fill in the rest to make merge work

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