

CS 135 Fall 2015

Tutorial 4: Lists and Sorting

CS 135 Fall 2015

Lists and Sorting

1

Goals of this tutorial

You should be able to...

- use list abbreviations and quote notation for lists where appropriate.
- understand and use the principle of insertion sort to write functions.
- use the properties of sorted lists to improve efficiency.

CS 135 Fall 2015

Lists and Sorting

2

Review: List Abbreviation

List abbreviations are available in language level Beginning Student With List Abbreviations, and all subsequent levels.

The expression

```
(cons exp1 (cons exp2 (... (cons expn empty)...)))
```

can be abbreviated as

```
(list exp1 exp2 ... expn)
```

Example: `(cons 1 (cons 'a (cons 32 (cons "hello" empty))))`

is equivalent to `(list 1 'a 32 "hello")`

CS 135 Fall 2015

Lists and Sorting

3

Review: List Abbreviation

`cons` and `list` have different results and different purposes.

We use `list` to construct a list of fixed size (whose length is known when we write the program).

We use `cons` to construct a list from one new element (the first) and a list of arbitrary size (whose length is known only when the second argument to `cons` is evaluated during the running of the program).

Review: Quoting Lists

If lists built using `list` consist of just symbols, strings, and numbers, the list abbreviation can be further abbreviated using the quote notation we used for symbols.

`(cons 'red (cons 'blue (cons 'green empty)))` can be written `'(red blue green)`.

`(list 5 4 3 2)` can be written `'(5 4 3 2)`, because quoted numbers evaluate to numbers; that is, `'1` is the same as `1`.

Now we can write `empty` as `(list)` or `'()`.

Clicker Question - List Translation

Given this list:

`(list 1 'blue (list 2 3))`

What is the equivalent `cons` statement?

- A `(cons 1 (cons 'blue (cons (cons 2 (cons 3 empty)) empty)))`
- B `(cons 1 'blue (cons 2 3 empty) empty)`
- C `(cons 1 (cons 'blue (cons 2 (cons 3 empty))))`
- D `(cons 1 (cons 'blue (cons 2 3)))`
- E `(cons 1 (cons 'blue (cons (cons (cons 2 (cons 3 empty)) empty) empty) empty))`

Clicker Question - List Abbreviation

Given this list:

`(list)`

What is the equivalent statement?

- A `This gives an error`
- B `(cons empty)`
- C `(cons)`
- D `empty`
- E `(cons empty empty)`

CS 135 Fall 2015

Lists and Sorting

7

Group Problem - good-topping?

Consider the following definition of a pizza customer structure `customer`,

```
(define-struct customer (name fav-topping))  
;; A Customer is a (make-customer Sym Sym)
```

Write a function `good-topping?` that consumes a list of Customers and a Symbol representing a pizza topping. `good-topping?` should produce true only if at least one Customer's favourite topping is the given topping. Include a purpose, contract, and examples.

Do not use `equal?`.

CS 135 Fall 2015

Lists and Sorting

8

Insertion Sort Trace

We will perform a condensed trace of an insertion sort:

```
(define (sort lon)  
  (cond [(empty? lon) empty]  
        [else (insert (first lon) (sort (rest lon)))]))  
(define (insert n slon)  
  (cond [(empty? slon) (cons n empty)]  
        [(<= n (first slon)) (cons n slon)]  
        [else (cons (first slon) (insert n (rest slon)))]))  
(sort (list 5 3 9 2 5 7 1 4))
```

CS 135 Fall 2015

Lists and Sorting

9

Group Problem - Books

title	date
"Operating Systems Principles"	1973
"The Elements of Programming Style"	1982
"The Multics System"	1972
...	...

Write a structure definition, and a data definition for a structure called `book` for the above data. Also write a template for a list of `book` structures. Note that the date is given as a Natural number representing the year of publication.

Group Problem - sort-book

Given a list of `Book`, write a function `sort-book` that sorts the list into chronological order (oldest to newest). Include a purpose, contract, and examples. You may want to look at the insertion sort example in the slides.

Group Problem - books-published

Based on the template written earlier, write a function called `books-published` that consumes a number representing a year and a list of `Books`. `books-published` will produce a list of `Books` that contains all the books published in that year. Include a purpose, contract, and examples.

Group Problem - sbooks-published

Based on the template written earlier, write a function called `sbooks-published` that consumes a number representing a year and a list of Books which has already been date-sorted.

`sbooks-published` will produce a list of Books that contains all the books published in that year.

To improve efficiency, you should avoid searching through the whole list when possible.