Writing More 'Fluent' Lisp

Samuel Flint
Computer Science and Engineering
University of Nebraska Lincoln

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In this document, I provide advice on how to improve your programming style in Lisp based on my experience grading your homework so far.

General Style

- Variable names can be long and descriptive. They should never be in `CamelCase`, instead they should be `separated-with-dashes`.
- Write code on multiple lines. While

  ```
  (defun avg (l) (/ (reduce #'+ l) (length l)))
  ```

  is fine, it is not a particularly good habit to be in. Instead, try indenting your code:

  ```
  (defun average (list)
         (/ (reduce #'+ list)
            (length list)))
  ```

  Because, in Lisp, indentation is communicates the 'structure' of the code and can dramatically improve readibility. If you do not want to manually indent your code, use `C-M-q` in Emacs.

Lispy Mechanics

- Instead of `(+ var 1)` or `(- var 1)` use `(1+ var)` and `(1- var)`, respectively.
- Be judicious with your control flow constructs.
  - Use `if` when you have *two* cases, a positive case and a negative case.
  - Use `when` when you have only a positive case.
  - Use `unless` when you have only a negative case.
  - Use `case` if you are checking to see if something matches one of several atomic options (like switch/-case in C).
  - Use `cond` in any case where you have more options.
- There are several forms of equal: `equal`, `eql`, `eq`, `equalp` and `=`.
  - `eq`: The two objects are at the same memory location. E.g.:

`(eq 'a 'a)` ⇒ `t`

`(eq 'a 'b)` ⇒ `nil`

`(defvar b 'a) (eq 'a b)` ⇒ `t`

- `eql`: Either the objects fulfill `eq` or they are numbers of the same type and value or are the same character.

  `(eql 2 2)` ⇒ `t`

  `(eql 2 2.0)` ⇒ `nil`

- `equal`: Numbers and Characters: `eql`; Symbols: `eq`; Otherwise: the objects are the same structurally.

  `(equal "abc""abc")` ⇒ `t`

  `(equal "abc""ABC")` ⇒ `nil`

  `(equal '(a (b c)) '(a (b c)))` ⇒ `t`

  `(equal '(a b c) '(a (b c)))` ⇒ `nil`

- `equalp`: `equal`; if character, then if `char-equal` (ignores case); if numbers, having the same numerical value (type notwithstanding).

  `(equalp #A#a)` ⇒ `t`

  `(equalp 2 #(2 0))` ⇒ `nil`

- `=`: Only to be used for numbers, follows `eql`.
- `string=`: Only to be used for strings. If you need to compare the equality of strings, use this

- `let`, `let*` – These are used to introduce bindings and restrict their lexical scoping. Use this form instead of `setf` at the start of a function. `let*` performs its bindings serially, so a later binding can rely on the value of an earlier binding.

```
(let ((a 1)
      (b 2))
  (+ a b))

(let* ((a 1)
       (b (1+ a)))
   (+ a b))
```

- `do`, `do*`, `dolist`, `dotimes` – `do` and `do*` work similarly, with the starred version binding in parallel. Syntax, generally is of the following form:

```
(do ((variable-1 init-form update-form)
     (variable-2 init-form update-form))
    (termination-condition return-value)
  code-here)
```

  `dolist` is exactly as it says, it does an action for each element of a list, e.g.,

```
(dolist (variable list return-value)
  code-here)
```

  Likewise, for `dotimes` with an `n` instead of `list`.

- `loop` – Avoid pretty generally, it is hard to debug, and un-lispy.
- `collect` – If you must use loop, you are likely using it for the sake of `collect`. Instead of something like:

```
(let (vals)
     (loop for i from n to m
           do (push i vals))
     (reverse vals))
```

use:

```
(loop for i from n to m collect i)
```

However, there are other uses for collect.

- The Higher-Order Functions:
  - `map` variants – Use these to apply a function to each element of a list (or lists) in turn. E.g.,

    ```
    (mapcar #'1+ '(1 2 3 4 5 6 7 8 9 10))
    ```

  - `reduce` – When you have a list of a single type of data `reduce` allows you to *reduce* the list into a single element using some binary function (i.e., a function that takes two arguments). For instance, given a function `function-name` that produces a list of integers, `(reduce #'+ function-name)` will provide the sum of the list returned.
  - `remove-if`, `remove-if-not`, `complement` – Avoid using `remove-if-not`, instead, use `complement`, for example, instead of

    ```
    (remove-if-not #'evenp list)
    ```

    use

    ```
    (remove-if (complement #'evenp) list)
    ```

    (the existence of `oddp` notwithstanding).
  - `funcall`, `apply` – If you are writing a function that accepts a function as an argument, use either `funcall` or `apply` to use the passed function.
- `lambda` – Use this construct, which a has syntax similar to that of `defun` to define anonymous functions. You may find this useful in `reduce`, `remove-if` or `map`. E.g.,

```
(lambda (n)
   (if (oddp n)
       (- n)
       n))
```