CLOX: Common Lisp Objects for XEmacs

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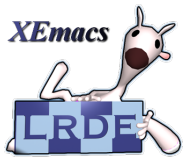

Overview

- **What is it ?**
  - An implementation of CLOS for XEmacs
  - Including the Meta-Object Protocol (MOP)
- **What's in it ?**
  - A port of Closette to Emacs Lisp
  - Deeper type/class integration
  - A comprehensive test suite

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Context
The state of XEmacs

- **About XEmacs**
  - Initially a fork of GNU Emacs v.19-to-be (1991)
  - Greatly diverged since then
  - User-level Emacs Lisp compatibility
  - ~~Internals compatibility~~
- **About the internals**
  - Very high level of abstraction
  - 111 opaque Lisp types, 35 user-level
  - Core in “C+”: data-abstraction and OO infrastructure

A couple of “C+” examples

So why not use C++ directly ? *plonk*

Polymorphism / Class-like abstraction

```
struct console
{
  enum console_variant    contype;
  void                   *console_data;
  struct console_methods *conmeths;
  /*  ...  */
}
```

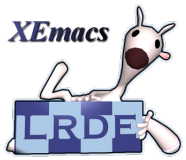
Dynamic method lookup

```
MAYBE_CONMETH (console, mark_console, ...);
```

Motivation

Bring the same level of abstraction to the Lisp layer

- **Why isn't it the case already ?**
  - GNU Emacs compatibility
  - Emacs Lisp *backward* compatibility
  - Less "OO pressure" at the Lisp level
    - Glue to the C level
    - Not the job of *package* authors
    - Requires more than the average coding skill
    - Ad-hoc abstraction easier to achieve in Lisp
- **What would be the benefits ?**
  - C-based features: abstract away the Lisp glue
  - Lisp features: improve maintainability / extensibility
  - Also for third-party packages (*e.g.* Gnus)

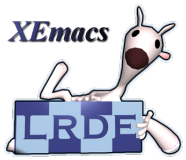


Why CLOS?
Arguments in favor of it

1. **Emacs Lisp**
   - Close to MacLisp and Common Lisp
   - Many developers familiar with Common Lisp
   - CL package dependency: 16% files, 27% LoC
2. **CLOS**
   - One of the most powerful object system around
   - Well documented
   - No need to start from scratch
3. Porting Common Lisp libraries to Emacs Lisp
4. Attract more Common Lisp developers
5. Gain expertise in CLOS and its MOP ;-)

Alternatives
Other available object systems

1. **EOOPS** (Emacs Lisp Object Oriented Programming System)
   - Message passing (Smalltalk style)
   - No activity since 1992
   - No known Emacs Lisp package using it
2. **EIEIO** (Enhanced Implementation of Emacs Interpreted Objects)
   - Active
   - Part of the CEDET package (70,000 LoC)
   - CLOS-like
   - Additional features (*e.g.* debugging support)
   - Doesn't aim at being *fully* compliant



Emacs Lisp *vs.* Common Lisp

All them dialects, they make my head swim

- **Fundamental differences**
  - Dynamic *vs.* lexical scope
  - No package system, Limited λ-list syntax
  - Different types, condition system, printing facilities *etc.*
- **Less obvious ones**
  - Different function names
  - Similar functions with different semantics
  - `function` is different
- **(X)Emacs Lisp evolution**
  - Self-evaluating keywords since 1996
  - `#'` syntax since XEmacs 19.8
  - Primitive `character` type since XEmacs 19.20
  - Built-in multiple values since a couple of months
- XEmacs no later than 21.5 ~~beta 29~~ `\today` is required

The CL package
Common Lisp emulation layer

- Provide missing standard utility functions or macros (*e.g.* `loop`)
- Extend existing but limited ones (*e.g.* ~~`mapcar*`~~)
- Support full λ-list syntax (`defun*`, `defmacro*` *etc.*)
- `typep`
- `setf` / `defsetf` (no setf functions)

Dynamic *vs.* lexical scope
A CLOXwork Orange

- CL's `lexical-let` to the rescue
- Not necessary in most cases
  - Local use of `let` bindings or function parameters
  - "Downward funargs" situations
  - "Upward funargs" situations in *some* cases
- Only 6 actual uses of `lexical-let`

Downward funargs: example

Look at the `required-classes` argument


```
(defun compute-applicable-methods-using-classes
    (gf required-classes)
  #|...|#
  (remove-if-not #'(lambda (method)
                     (every #'subclassp
                            required-classes
                            (method-specializers method)))
                 (generic-function-methods gf))
  #|...|#)
```

Upward funargs: example

Look at the `next-emfun` argument


```
(defun compute-primary-emfun (methods)
  (if (null methods)
      nil

    ;; Common Lisp version:
    (let ((next-emfun (compute-primary-emfun (cdr methods))))
      #'(lambda (args)
          (funcall (method-function (car methods))
                   args next-emfun)))

    ;; Partially evaluated Emacs Lisp version:
    (let ((next-emfun (compute-primary-emfun (cdr methods))))
      `(lambda (args)
        (funcall (method-function ',(car methods))
         args ',next-emfun)))
```

Upward funargs: explanation

Look at the `next-emfun` argument


```
;; Partially evaluated Emacs Lisp version:
(let ((next-emfun (compute-primary-emfun (cdr methods))))
  `(lambda (args)
     (funcall (method-function ',(car methods))
      args ',next-emfun)))
```

- `lambda` is self-quoting
- `(lambda ...)` is a function designator
  e.g. `(funcall '(lambda (x) x) 1)`
- `function` $\Longleftrightarrow$ `quote` + byte-compiler hint
- **Note:** use `byte-compile` on the resulting form

Full blown λ-lists

Emacs Lisp restricted to `&optional` and `&rest`

- CL provides the rest (`defun*` *etc.*)
- What about generic functions and methods ?
  - CL provides `cl-transform-lambda`
  - Use it in our `compute-method-function`

λ-list transformation example

```
;; (lambda (a &optional (b 'b) &key (key1 'key1)) #|...|#)
(lambda (a &rest --rest--39249)
  (let* ((b (if --rest--39249 (pop --rest--39249) (quote b)))
         (key1 (car (cdr (or (memq :key1 --rest--39249)
                             (quote (nil key1)))))))
    (let ((--keys--39250 --rest--39249))
      (while --keys--39250
        (cond ((memq (car --keys--39250)
                     (quote (:key1 :allow-other-keys)))
               (setq --keys--39250 (cdr (cdr --keys--39250))))
              ((car (cdr (memq :allow-other-keys --rest--39249)))
               (setq --keys--39250 nil))
              (t
               (error "Keyword argument %s not one of (:key1)"
                      (car --keys--39250))))))
    #|...|#))
```

Types

CLOX objects are vectors

- **Built-in types**
  - C level: integers, characters and `lrecord` types
  - User level: corresponding type predicate Lisp function
  - 30 LoC to filter them out
- **`type-of` doesn't work on CLOX objects**
  - Better not hide the *true* nature of Lisp objects
  - Not required to make CLOX work
  - Will work *eventually* (C level)
- **`typep` is provided by CL**
  - Need predicate functions:
    `(typep obj 'my-type)` $\Longleftrightarrow$ `(my-type-p obj)`
    - `ensure-class` creates them
  - Should work on class *objects*, not only *names*
    - CLOX-specific `defavice` around it

Generic functions specific problems

Generic function objects are funcallable in Common Lisp

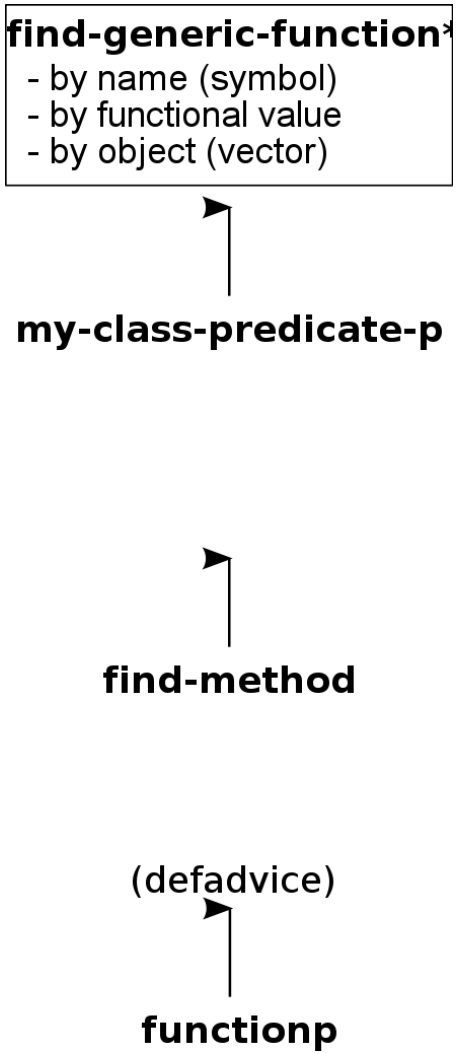
This is already working

```
(setq mygf (defgeneric gf #|...|#))
(typep mygf 'some-gf-class)
```

- *CLOX* generic functions are vectors
  - Not funcallable
  - $\neq$ discriminating function
- `function` $\approx$ `quote`
  - `function` doesn't return a functional value
  - `symbol-function` does

Solution

Handle all references to generic functions



This is now working

```
(typep (symbol-function 'gf) 'some-gf-class)
(typep #'gf 'some-gf-class) ;; or just 'gf
```

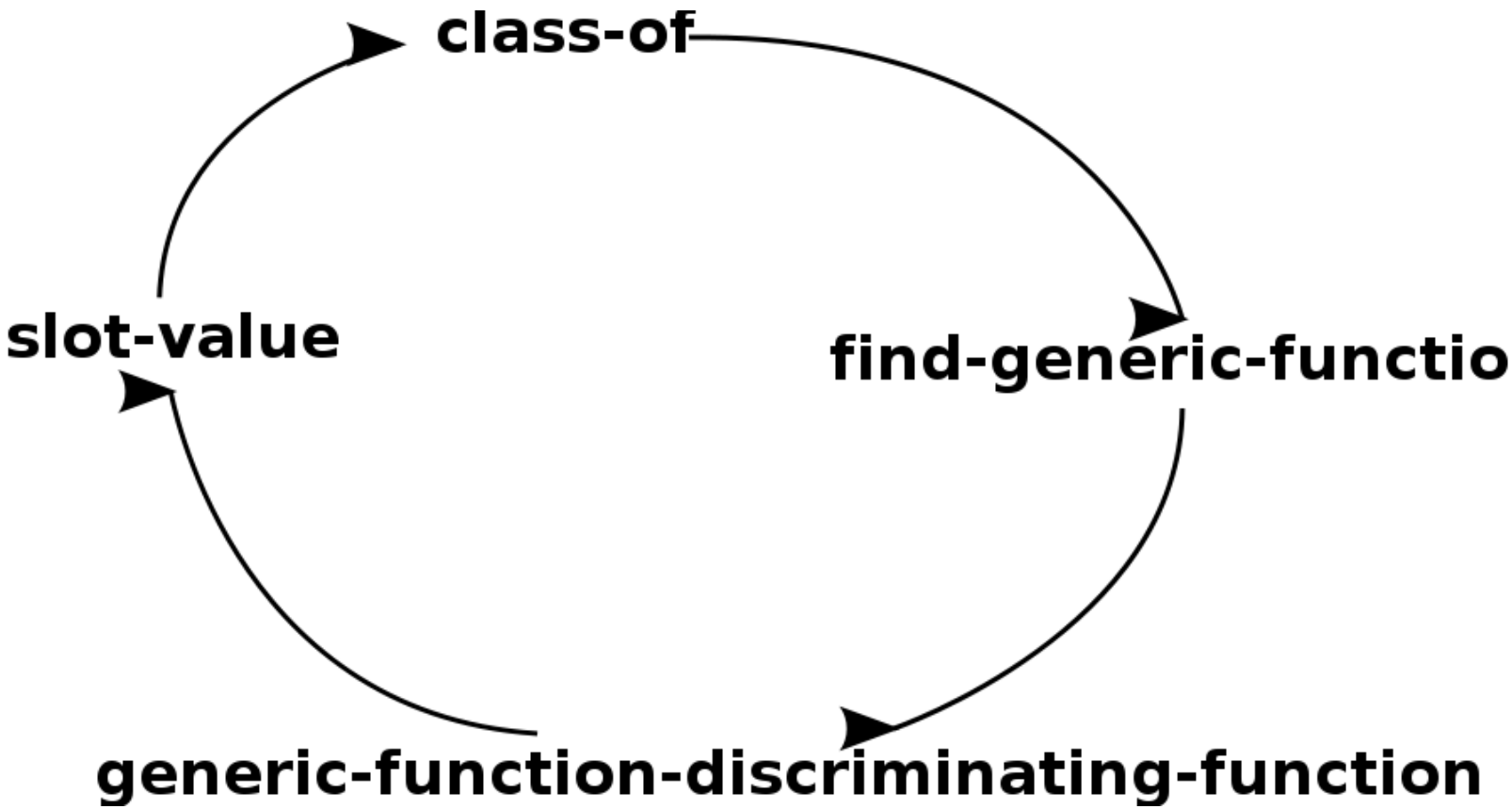
This as well

```
(find-method (symbol-function 'gf) ;; ...
(find-method #'gf ;; ... or just 'gf
```

And this

```
(typep (symbol-function 'gf) 'function)
(typep #'gf 'function) ;; or just 'gf
```

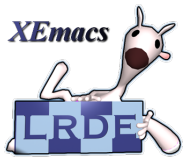
One (major) drawback
Rock around the CLOX



- Method specialization on functions *impossible*

Available Features...

- **Closette** (see section 1.1 of the AMOP)
  - Missing: class redefinition, non-standard method combinations, `eql` specializers and `:class` wide slots
- **And beyond**
  - `:method` option to `defgeneric`
  - Aware of the others `defgeneric` and slot options
  - `slot-unbound` protocol with emulated `unbound-slot-instance` and `cell-error-name`
  - Extended `slot-missing` protocol
  - Topmost class hierarchy (`class`, `built-in-class`, `function`, `generic-function` and `method`)
  - Almost complete type/class integration



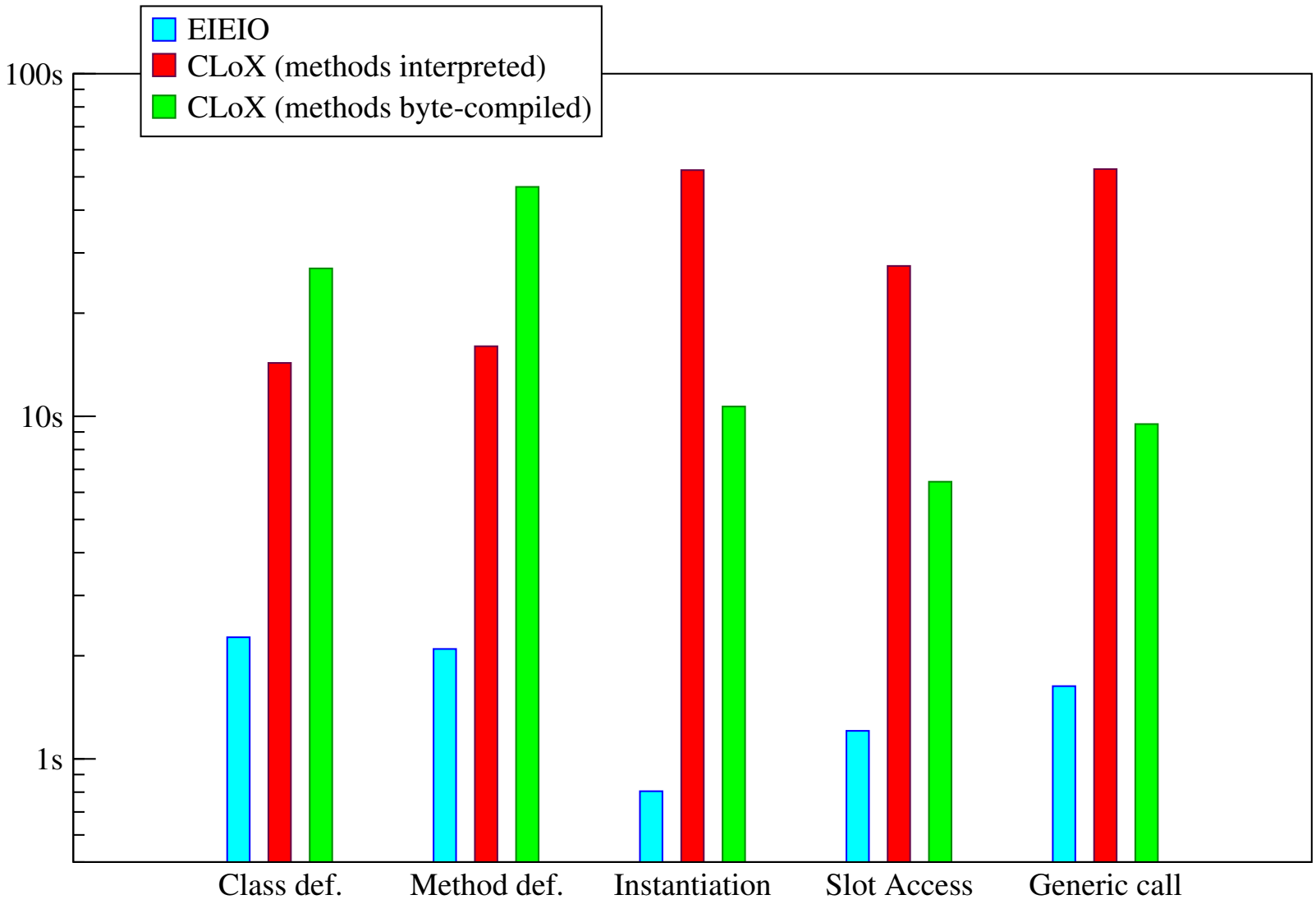
. . . Compared to EIEIO

- **What's missing**
  - No underlying MOP
  - No type/class integration
  - No `:around` methods
  - No `:method` option to `defgeneric` calls
  - Buggy λ-list support
  - Syntactic glitches
- **Additional bells'n whistles**
  - A class browser
  - Automatic TEX`info` documentation
  - `edebug` support
  - Abstract classes, static methods, C++-like slot protection

- **Why early testing ?**
  - No `edebug` support
  - Limited printing facility (circular structures)
  - `gensym` infestation
- **Paul Dietz's ANSI Common Lisp test suite**
  - 900 tests related to objects
  - Ported to Emacs Lisp
  - Corollary: `rt` package ported as well
- **Current status**
  - 50% of the tests pass
  - 100% of the tests that pass are ok ;-)
  - EIEIO: only 12%

Performance

GRR #2: it is better to be fast than to be slow (someday)



Conclusion

- **What we have**
  - An implementation of CLOS for Emacs Lisp
  - A comprehensive test suite
  - Corollary: an Emacs Lisp port of `rt`
- **Next steps**
  - Complete the feature set
  - Improve performance (C-level integration)
  - Port to GNU Emacs
- **Potential uses**
  - Core features (*e.g.* specifiers)
  - User libraries (*e.g.* Gnus `*Hmpf!*`)

Thanks !

That's all *FIOX* ...

Any quesλions ?

"And with a four-button mouse it gets even better.
I bound something to Ctrl-Meta-Hyper-Super-button4,
just because I could."

`-- Calle Dybbedahl`