Knit, Chisel, Hack: Crafting with Guile Scheme

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I love craft!

Woodworking

Gardening

Grow-your-own

Brew-your-own

Knit-your-own

Sew-your-own

Roast-your-own

Repair-your-own

Build-your-own

Why?

crafty pleasures

Making and building

Quality of result

Expressive aspect: creativity

Fitness to purpose

Increasing skill

what’s
not
crafty?

what’s the difference?

Craft is produced on human scale (hand tools)

Craft is made to fit (own clothes)

Craft touches roots (grow your own)

Craft is generative (wearables)

craft

/krɑːft/

noun

1. an activity involving skill in making things by hand.
   "the craft of cobbling"
   synonyms: activity, pursuit, occupation, work, line, line of work, profession, job, business, line of business, trade, employment, position, post, situation, career, métier, vocation, calling, skill, field, province, walk of life; More

2. skill used in deceiving others.
   "her cousin was not her equal in guile and evasive craft"
   synonyms: cunning, craftiness, guile, wiliness, artfulness, deviousness, slyness, trickery, trickiness; More

craft

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ohai!

Guile co-maintainer since 2009

Publicly fumbling towards good Scheme compilers at `wingolog.org`

Thesis: Guile lets you build with craft

quick
demo

scheme expressions

Constants: `1`, `"ohai"`

Some constants need to be quoted: `'(peaches cream)`

Functions: `(lambda (a b) (+ a b))`

Calls: `(+ a b)`

Sequences: `(begin (foo) (bar))`

If: `(if (foo) (bar) (baz))`

Lexicals: `(let ((x (foo))) (+ x x))`

That’s (pretty much) it!

repl as workbench

```
,profile
,disassemble
,break
,time
,expand
,optimize
,bt
,help
```

building and growing

How to take a small thing and make it bigger?

How to preserve the crafty quality as we add structure?

scripts

Do more by leveraging modules

```
(use-modules (ice-9 match)
             (web client))

(match (program-arguments)
 ((arg0 url)
  (call-with-values
      (lambda () (http-get url))
    (lambda (response body)
      (display body)))))
```

built-in modules

POSIX

Web (client, server, http bits)

I/O (Binary and textual, all encodings)

XML (and SXML)

Foreign function interface (C libraries and data)

Read the fine manual!

from scripts to programs

Script: Up to a few pages of code, uses modules to do its job

Program: It’s made of modules

System: No one knows what it does

from scripts to programs

Programs more rigid, to support more weight

Separate compilation for modular strength

Programs need tooling to manage change

- Keyword arguments for extensibility
- Warnings from compiler
- Facilities for deprecating and renaming interfaces

what's a scripting language anyway

A sloppy language with a slow implementation

A historical accident

guile’s speed bridges the gap

Allocation rate: 700-800 MB/s

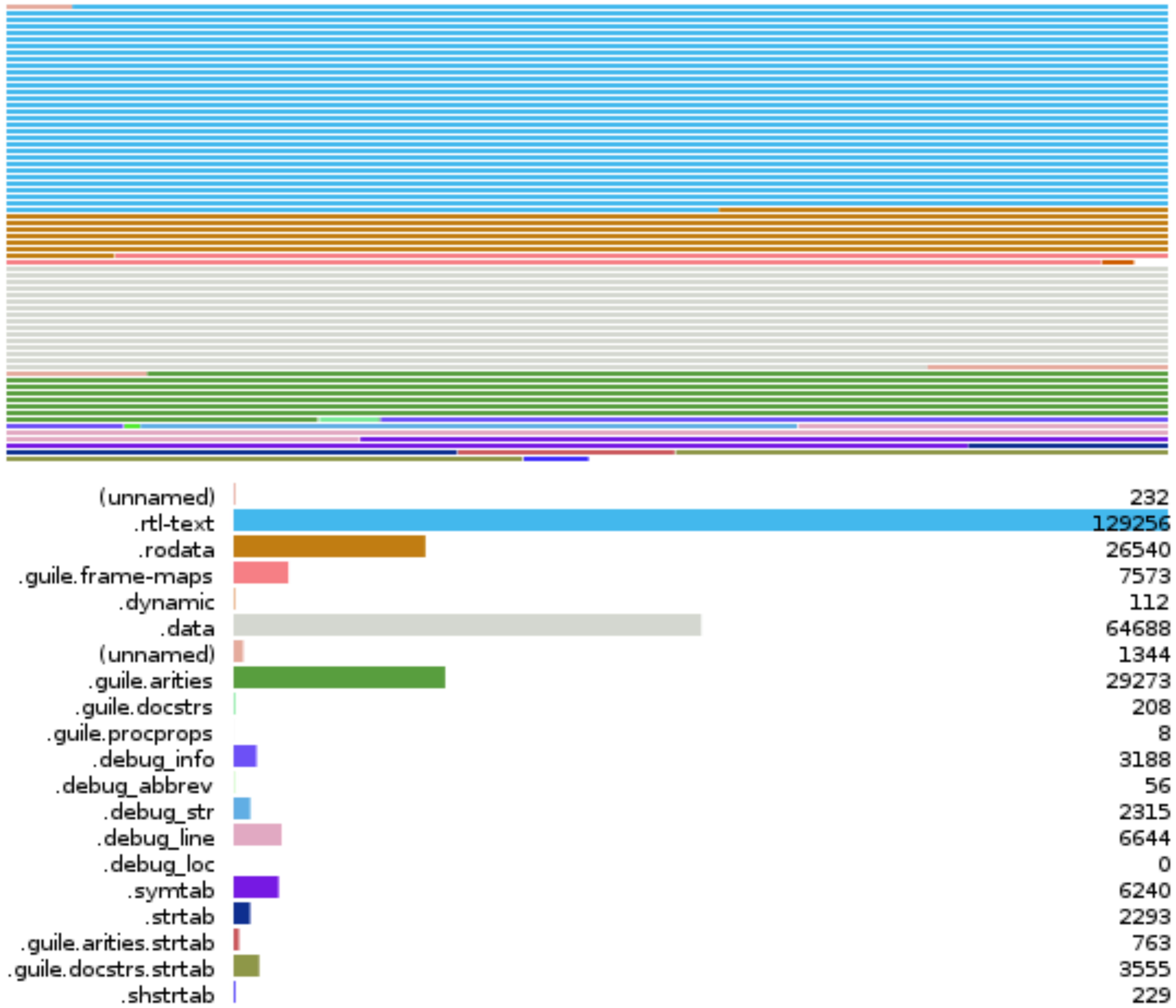
Instruction retire rate: 400M-500M Inst/s

Startup time: 8.8ms

Minimum memory usage (64-bit): 2.15 MB

Sharing data via ELF

http.go


(unnamed) 232
.rtl-text 129256
.rodata 26540
.guile.frame-maps 7573
.dynamic 112
.data 64688
(unnamed) 1344
.guile.arities 29273
.guile.docstrs 208
.guile.procprops 8
.debug_info 3188
.debug_abbrev 56
.debug_str 2315
.debug_line 6644
.debug_loc 0
.symtab 6240
.strtab 2293
.guile.arities.strtab 763
.guile.docstrs.strtab 3555
.shstrtab 229

versus other langs

(All the caveats)

```
# Python 3
for i in range(0, 1000000000):
  pass

;; Scheme
(let lp ((i 0))
  (when (< i #e1e9)
    (lp (1+ i))))

// C
for (long i = 0; i < 1000000000; i++)
  ;
```

versus other langs

Python 3: 81.2 cycles/iteration

Guile 2.0: 67.3 cycles/iteration

Guile 2.2: 12.1 cycles/iteration

gcc -O0: 5.66 cycles/iteration

gcc -O1: 0.812 cycles/iteration (3.7 IPC)

gcc -O2: friggin gcc

catching up on c

Native compilation coming in Guile 3

not catching up on c

Heap corruption

Stack smashing

Terrible errors

scale out

Guile has real threads and no GIL!

Processes too

But is it WEB SCALE?!?!?

tools for growth

Macros

Prompts

macros extend language syntax

Different kinds of `let`: `letpar`, `let-fresh`, ...

Pattern matchers: `match`, `sxml-match`, ...

Constructors: SQL queries, nested structured records, ...

Instrumentation: `assert-match`, `assert-index`, logging

“Decorators”: `define-deprecated`, `define-optimizer`, ...

Cut a language to fit your problem

prompts

```
/home/wingo% ./prog
```

Two parts: `system` and *`user`*

Delimited by prompt

prompts

```
try {
  foo();
} catch (e) {
  bar();
}
```

prompts in guile scheme

Early exit

Coroutines

Nondeterminism

make a prompt

```
(use-modules (ice-9 control))

(% expr
   (lambda (k . args) #f))
```

make a prompt

```
(use-modules (ice-9 control))

(let ((tag (make-prompt-tag)))
  (call-with-prompt tag
    ;; Body:
    (lambda () expr)
    ;; Escape handler:
    (lambda (k . args) #f)))
```

prompts: early exit

```
(use-modules (ice-9 control))

(let ((tag (make-prompt-tag)))
  (call-with-prompt tag
    (lambda ()
      (+ 3
         (abort-to-prompt tag 42)))
    (lambda (k early-return-val)
      early-return-val)))
;; => 42
```

prompts: early exit

```
(define-module (my-module)
  #:use-module (ice-9 control)
  #:export (with-return))

(define-syntax-rule
     (with-return return body ...)
  (let ((t (make-prompt-tag)))
    (define (return . args)
      (apply abort-to-prompt t args))
    (call-with-prompt t
      (lambda () body ...)
      (lambda (k . rvals)
        (apply values rvals)))))
```

prompts: early exit

```
(use-modules (my-module))

(with-return return
  (+ 3 (return 42)))
;; => 42

(with-return return
  (map return '(1 2 3)))
;; => it depends :)
```

prompts: what about k?

```
(use-modules (ice-9 control))

(let ((tag (make-prompt-tag)))
  (call-with-prompt tag
    (lambda () ...)
    (lambda (k . args) ...)))
```

First argument to handler is continuation

Continuation is delimited by prompt

prompts: what about k?

```
(use-modules (ice-9 control))

(define (f)
  (define tag (make-prompt-tag))
  (call-with-prompt tag
   (lambda ()
     (+ 3
        (abort-to-prompt tag)))
   (lambda (k) k)))

(let ((k (f)))
  (list (k 1) (k 2)))
;; => (4 5)
```

prompts: what about k?

When a delimited continuation suspends,

the first argument to the handler is

a function that can resume the continuation.

```
(let ((k (lambda (x) (+ 3 x))))
  (list (k 1) (k 2)))
;; => (4 5)
```

(For those of you that know `call/cc`: this kicks `call/cc` in the pants)

prompts enable go-style concurrency

Suspend “fibers” (like goroutines) when I/O would block

Resume when I/O can proceed

Ports to share data with world

No need to adapt user code!

- E.g. web server just works

Channels to share objects with other fibers

straight up network programs

```
(define (run-server)
  (match (accept socket)
    ((client . sockaddr)
     (spawn-fiber
      (lambda ()
        (serve-client client)))
     (run-server))))

(define (serve-client client)
  (match (read-line client)
    ((? eof-object?) #t)
    (line
     (put-string client line)
     (put-char client #\newline)
     (serve-client client))))
```

straight up network programs

50K+ reqs/sec/core (ping)

10K+ reqs/sec/core (HTTP)

Handful of words per fiber

WEB SCALE!?!?!?!?

work in progress

Still lots of work to do

- work-stealing
- fairness
- nice debugging
- integration into Guile core
- external event loops

`https://github.com/wingo/fibers`

then deploy

Use Guix! `https://gnu.org/s/guix/`

Reproducible, deterministic, declarative clean builds, in Guile Scheme

Distribute Guile and all dependent libraries with your program

Run directly, or build VM, or (in future) docker container

godspeed!

`https://gnu.org/s/guile/`

`#guile` on freenode

Share what you make!

@andywingo