20 more years of bootstrapping

SBCL – past, present, future

Christophe Rhodes

April 1, 2019
Outline

Introduction
   Who am I?
   What is SBCL?

SBCL History
   Prehistory
   SBCL

SBCL Present
   2019 State of the system
   Issues raised by user survey

SBCL Future
   Roadmap
   Development
   Project
Contact details

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Contact details

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Contact details

wait, what?
Currently

Software Engineer, Android Developer Tools
Currently

Software Engineer, Android Developer Tools
Previously

Senior Lecturer, Deputy Head of Department, Computing, Goldsmiths
Who am I?

Previously

Senior Lecturer, Deputy Head of Department, Computing, Goldsmiths
Who am I?

Previously²

Chief Scientist, Chairman, Teclo Networks
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Chief Scientist, Chairman, Teclo Networks
Previously

Research Associate, Computer Music
Previously

Research Associate, Computer Music
Previously

PhD student, speculative cosmology
Who am I?

Previously

PhD student, speculative cosmology
Concurrently

SBCL developer and maintainer

» first patch: April 2001
  » (now old enough to vote!)

» commit access, March 2002
Concurrently

Theme: no-one employs me to write Common Lisp
  ▶ not likely to change any time soon
  ▶ not likely to negatively affect my ability to contribute to SBCL either
What is SBCL?

Steel Bank Common Lisp

A somewhat-optimising mostly-portable native code Common Lisp compiler

▶ ... and runtime
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- ... and runtime
- ... and garbage collector
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- ... and interpreter (or three)
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A somewhat-optimising mostly-portable native code Common Lisp compiler
- ... and runtime
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- ... and developer tools (profiler, stepper, tracer)
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- ... and contributed modules
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- ... and runtime
- ... and garbage collector
- ... and interpreter (or three)
- ... and developer tools (profiler, stepper, tracer)
- ... and language extensions
- ... and contributed modules
- ... and WARNINGz
What is SBCL?

Steel Bank Common Lisp

"im in ur implementation"

givin u WARNINGz
Prehistory

Prehistory: Spice Lisp

1980/1-1984/5
(I know very little about this period)
Prehistory: Carnegie-Mellon University Common Lisp

1984/5-

  - RT/Mach
Prehistory: Carnegie-Mellon University Common Lisp

1984/5-

  - RT/Mach

- [1992] Rob Maclachlan, *CMU Common Lisp user’s manual*
  - MIPS/Mach
  - SPARC/Mach

Google didn’t exist then (historical narrative mine)
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- [1994] DARPA funding for CMU CL stops

- [1997] Generational mostly-copying conservative garbage collector implementation (Douglas Crosher; see also Scieneer Common Lisp)
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- [1997] Generational mostly-copying conservative garbage collector implementation (Douglas Croscher; see also Scineeer Common Lisp)

- [1997ish] Dan Barlow, CMUCL-on-Linux-HOWTO
Some hints on building the system which you might find useful

1. *if you change the compiler, you will have to recompile all the sources before the change is reflected in the system* [...]  
2. *changing the miscops should be done with care* [...] *note that this requires building a new cold core file and a final core file before the change is reflected in the system* [...]  
3. *changing sources in the code directory should be fairly straightforward* [...] *if you change something that a lot of files depend on* [...] *you will have to recompile everything and build a new cold core file and a core file*  
4. *if you make a fairly major change, it is a good idea to go through the process of building a core file at least two or three times. If things are still working at the end of this, your change is probably correct and shouldn’t cause any serious trouble.*

– Macdonald, Fahlman and Wholey (1987)
Example: byte

- *(byte size position) ⇒ <implementation-defined>*
Example: byte

- `(byte size position) ⇒ <implementation-defined>
  - `(cons size position)` (SBCL)
  - `(ash (1- (ash 1 size)) position)` (CCL)
  - `(byte :size size :position position)` (CLISP?)
Example: byte

- (byte size position) $\Rightarrow$ <implementation-defined>
  - (cons size position) (SBCL)
  - (ash (1- (ash 1 size)) position) (CCL)
  - (byte :size size :position position) (CLISP?)
  - (cons position size) (SBCL, briefly)
Example: byte

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- `(ldb <byte> number) ⇒ very much standard-defined

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what is an optimizing cross-compiler to do?

- not optimize? Slow compiler, unhappy users
- try to optimize, get it wrong? No compiler, unhappy developers
- build a model of SBCL’s byte in the cross-compiler...
  - and use that for cross-compiler optimizations
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what is an optimizing cross-compiler to do?

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similar problem with boole, but luckily no-one uses that.
Example: defstruct-description

- `defstruct` parses its body to understand what structure it is defining
Example: defstruct-description

- defstruct parses its body to understand what structure it is defining
  - ... and stores that information in a structure
  - a defstruct-description structure
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- what happens when we discover a bug in defstruct?
Example: defstruct-description

- defstruct parses its body to understand what structure it is defining
  - ... and stores that information in a structure
  - a defstruct-description structure

- what happens when we discover a bug in defstruct?
  - we need to add a field to defstruct-description...
  - ... argh, we need to redefine the thing we’re using
Introduction

SBCL History

SBCL Present

SBCL Future

Prehistory

Example: defstruct-description

- defstruct parses its body to understand what structure it is defining
  - ... and stores that information in a structure
  - a defstruct-description structure
- what happens when we discover a bug in defstruct?
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what is a sanely-bootstrappable compiler to do?

- same solution as before: build a model of SBCL’s defstruct-description (represented as a host object), use it to cross-compile SBCL

Google didn’t exist then (historical narrative mine)
Example: **defstruct-description**

- `defstruct` parses its body to understand what structure it is defining
  - ... and stores that information in a structure
  - a `defstruct-description` structure
- what happens when we discover a bug in `defstruct`?
  - we need to add a field to `defstruct-description`...
  - ... argh, we need to redefine the thing we’re using

**what is a sanely-bootstrappable compiler to do?**

- same solution as before: build a model of SBCL’s `defstruct-description` (represented as a host object), use it to cross-compile SBCL
- here’s what happens if you don’t do that:
Example: defstruct-description

;; For bootstrapping the conc-name inheritance fix, part 1.
;;
;; You need to do a build loading just this file but NOT boot6-b.lisp.
;; The next build MUST NOT use this file and load up boot6-b
;; instead.

;; Use the CLOBBER-IT restart when prompted for a restart.

– CMUCL bootfiles/18d/boot6-a.lisp
Workarounds

don’t implement your lisp in itself:

▶ write eval in support language (e.g. C, C++ or Java)
  ▶ use that eval to bring up the rest of the system

▶ ECL, ABCL, CLASP, CLISP (and XCL, lisp500, Emacs Lisp)
Workarounds

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Bridge the gap with bootstrap files:

▶ Mutate the state of the compiling instance
▶ Examples:
  ▶ Mutate metadata about functions or structures
  ▶ Define a (maybe stub or no-op) function so that it can be called

▶ CCL, CMUCL, Lispworks*, Allegro*
Workarounds

Neither workaround is satisfactory:

- aesthetic / intellectual achievement of writing in the language you’re implementing

Google didn’t exist then (historical narrative mine)
Workarounds

Neither workaround is satisfactory:

- aesthetic / intellectual achievement of writing in the language you’re implementing
- barrier to entry: sustainability of software through ease of ability to reason about it

SBCL’s solution:

- Implement your lisp compiler in Common Lisp
- Use your lisp compiler to compile your lisp compiler
Workarounds

Neither workaround is satisfactory:

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SBCL’s solution:

- Implement your lisp compiler in Common Lisp
- Use your lisp compiler to compile your lisp compiler

(DANGER UNEXPLODED MINDS)
Announcement

Date: Tue, 14 Dec 1999 18:53:46 -0600
From: William Harold Newman <william.newman@airmail.net>
To: cmucl-imp@cons.org
Subject: It's alive! (SBCL, a CMU CL variant which bootstraps cleanly)

[...]

The differences are already significant enough that I believe that calling the new system CMU CL would cause confusion, so I'm tentatively calling it SBCL instead (for "Steel Bank Common Lisp", after the industries where Carnegie and Mellon made the big bucks).
Announcement

[slothrop] it's tough to build apparently
[slothrop] cmucl, I mean
[wnewman] I did finally figure out how to do it, in my own way.

▶ #lisp IRC, 2004-08-30
Wild West

Break all the things

- no users: break backwards compatibility all the time
  - freedom to make mistakes
- experiment with things, learn
Events

- UKUUG 2003: Dan Barlow, *n things every programmer should know about signal handling*
- ELSW 2004: *Grouping Common Lisp Benchmarks*
- ECLM 2005: *Recent developments in SBCL*
- ILC 2007: *User-extensible sequences in Common Lisp*
- SSS 2008: *A Sanely-Bootstrappable Common Lisp*
- ELS 2008: Jim Newton, *Custom specializers in object-oriented Lisp*
ITA, QPX and RES

- QPX: airfare search
  - originally: CMUCL and Allegro
  - SBCL eventually (2005ish?)
  - funded work for Nikodemus Siivola, Juho Snellman
  - significant work from Martin Cracauer and team
ITA, QPX and RES

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- RES: airport operations middleware
  - 2006 venture capital, project announcement, Air Canada partnership
  - 2009 suspension of Air Canada involvement
  - 2010 Google acquisition
Oh no, now we have users
Google Summer of Code

- Four students over two years:
  - efficient interpreter (Matthias Benkard, 2013)
  - modernising register allocation (Alexandra Barchunova, 2013)
  - Improving Unicode support in SBCL (Krzysztof Drewniak, 2014)
  - Speeding up constant division in SBCL (Erik Krisztián Varga, 2014)

- (also, under LispNYC)
  - SBCL Windows Threading (Elliot Slaughter, 2008)
SBCL birthday parties

2004 (5th birthday): Bay Area Lisnips

_Northern California party celebrating SBCL’s 5th birthday will be at 8pm tonight at Jupiters in Berkeley, CA. I’ll be there with my iBook._

– Thomas Burdick
SBCL birthday parties

2009 (10th birthday): sbcl10, Goldsmiths, London

- talks from Nick Levine and Martin Cracauer
SBCL birthday parties

2009 (10th birthday): sbcl10, Goldsmiths, London

- talks from Nick Levine and Martin Cracauer
- as-yet-unfinished hackday projects include
  - llvm backend
  - calling functions with unboxed arguments
  - multi-word compare-and-swap
  - faster aref on non-simple non-displaced arrays
  - incremental allocation for dynamic space
  - subclassable structures
SBCL birthday parties

2019 (20th birthday): ?
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1999-2019

[video]
2019 State of the system

User survey

- last done in 2010
- similar questions:
  1. Personal information (age, country)
  2. Uses of SBCL and why
  3. SBCL platforms, versions
  4. Communications channels
  5. Development
- over 300 responses
User survey: personal information

Country

SBCL users by country

Analysing survey data for myself
Introduction

User survey: personal information

Trade bloc

2019 State of the system

Analysing survey data for myself
User survey: personal information

Trade bloc (post-Brexit)
2019 State of the system

User survey: personal information

Age

Age density

Analyzing survey data for myself
User survey: personal information

Age on starting to use SBCL

![Age distribution chart](chart.png)
User survey: personal information

Age of IRC users
2019 State of the system

User survey: use of SBCL

Platforms

Analysing survey data for myself
2019 State of the system

User survey: use of SBCL

Uses

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<th>kind</th>
<th>count</th>
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<tbody>
<tr>
<td>Commercial (as a component of a product)</td>
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<td>Commercial (to support research or development)</td>
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<tr>
<td>Educational</td>
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<tr>
<td>Hobbyist</td>
<td>200</td>
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<tr>
<td>Open Source Projects</td>
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<tr>
<td>Research (academic and/or personal)</td>
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<tr>
<td>Side projects</td>
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</tbody>
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Analysing survey data for myself
User survey: use of SBCL

- game dev
- 3D graphics
- bioinformatics
- server-side
- numerical modelling
- server-side
- computer vision
- fintech
- quantum computing
- AI
- data analysis
- web
- NLP
- emulation
- window manager
- gamedev
- AI
- toolbuilding
- compilers

2019 State of the system

Analysing survey data for myself
2019 State of the system

User survey: development

Past and future development

- Stability
- Little things
- SBCL-specific
- Ports
- Performance
- Garbage collection
- Developer tools

Analysing survey data for myself
Issues raised by user survey

Stability, little things

- regular releases
- quick bug fixes
- papercuts
Issues raised by user survey

SBCL-specific extensions

- SIMD support
- threading
- embeddability
- tree shaker
Issues raised by user survey

Developer tools

- compile-time diagnostics
- debugger, stepper, profiler
- friendlier repl
Issues raised by user survey

Garbage collection

- large, resizeable heaps
- multicore, parallel, incremental
- precise
- NUMA awareness
Ceci n’est pas un roadmap
New ports

- ppc64: partly complete
  - (Google Intern project, Brian Bokser)
- riscv: mostly complete
  - (spontaneous project, karlosz on #sbcl)
- s390x: requested
Existing ports

- arm: threads
- arm64: neon
- OS X: improve support for deploying applications
- windows:
  - improve support for deploying applications
  - remove the warning banner
Platform support

- lightweight threads
- shared library
Developer tools

- defadvice
- better backtraces when non-Lisp is involved
- LSI, Jupyter integration
- stepper improvements
Garbage collection

- resizeable heap
Governance

Currently no formal project structure

- low barrier to (development) entry
- high barrier to feeling ownership?
- high bus factor?
  - kmr incommunicado: can’t add aliases to sbcl.org
  - admin access to sourceforge (project, mailing lists) vulnerable
- communication comes from individuals
  - lack of roadmap
Testimonials / Case studies

<Your case study goes here>
Onboarding

Growing new SBCL developers

- tangible project: new port
Onboarding

Growing new SBCL developers

- tangible project: new port
  - (oh no, run out of new platforms)
Onboarding

Growing new SBCL developers

- tangible project: new port
  - (oh no, run out of new platforms)
    - still some gaps in arch/OS combinations
    - finish ppc64, start s390x
  - possible to get quite stuck (buggy hardware, buggy kernel, buggy libc, buggy emulators, buggy debuggers)
  - only do this if you work (or plan to work) with that platform anyway
Onboarding

Growing new SBCL developers

- obviously impactful project: improve Windows support
  - combination of skills needed rare
    - SBCL has 25+ years of Unix heritage
    - Windows low-level programming quite different
  - userbase is large
  - much kudos available
Onboarding

Growing new SBCL developers

- simple, bounded project: find a bug, fix it
  - not all that much low-hanging fruit
  - long-standing bugs might be gnarly
- we (I) need to be better at responding to bug fixes
  - quick merge (retaining patch author metadata)
  - lower-overhead commit access
Onboarding

0.8: fewer bugs
Thank you

Comments or Questions?