How (not) to create a language specification for Perl 6

Lessons learned

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Overview

What are language specifications?

Perl 6's design process, some mistakes

Important features of language specifications

Where to go from here

Talk history

Reflections on Perl 6 language specification

Imprecision in our discussions

Time to apply some rigor

Release of Perl 6.0.0 will require it

Opinions expressed here are solely those of the presenter

- May be unwise, untested, incorrect, etc.

Language specification basics

What is a “language specification”?

Many languages have them (Ada, Pascal, C)

Many languages don't have them

- Perl 5
- PHP prior to 2014

Different forms of specification

- Explicit definition using syntax and formal semantics
- Natural language description
- Model implementation

What is a “specification”?

From Wikipedia (italics added):

> Specification (often abbreviated as “spec”) may refer to an *explicit set of requirements to be satisfied* by a material, design, product, or service.

Specification generally contains requirements, not conjectures.

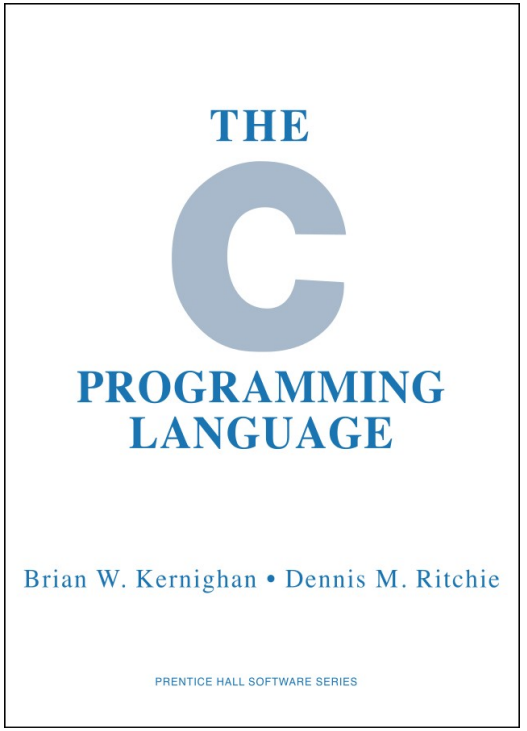
Example language specifications: C

The C Programming Language
Kernighan and Ritchie, 1978

ANSI C, C89, ISO/IEC 9899:1990

C99

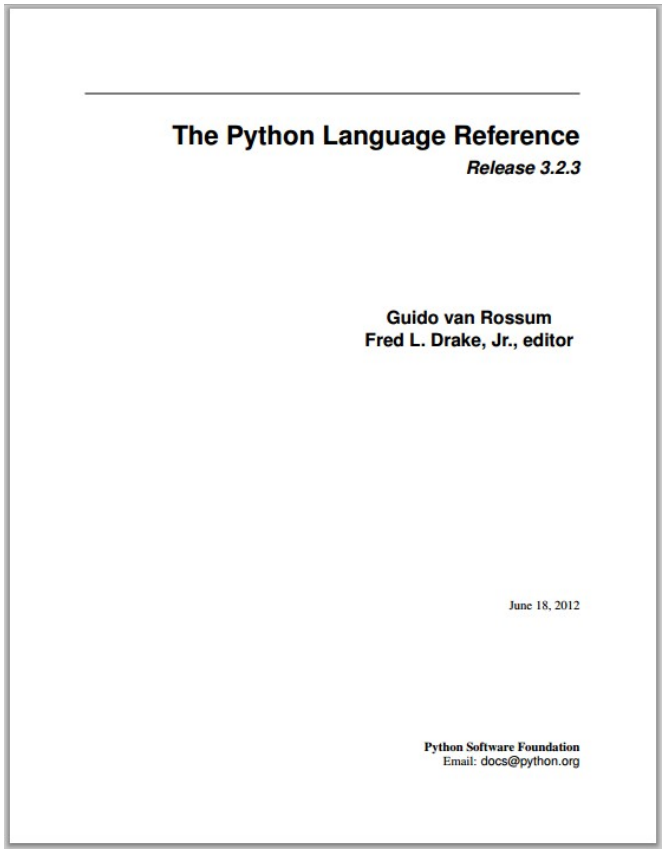
C11



Example language specifications: Python

Python doesn't have an official language specification

Python Language Reference describes the language, but leaves some details ambiguous



The Python Language Reference

Release 3.2.3

Guido van Rossum
Fred L. Drake, Jr., editor

June 18, 2012

Python Software Foundation
Email: docs@python.org

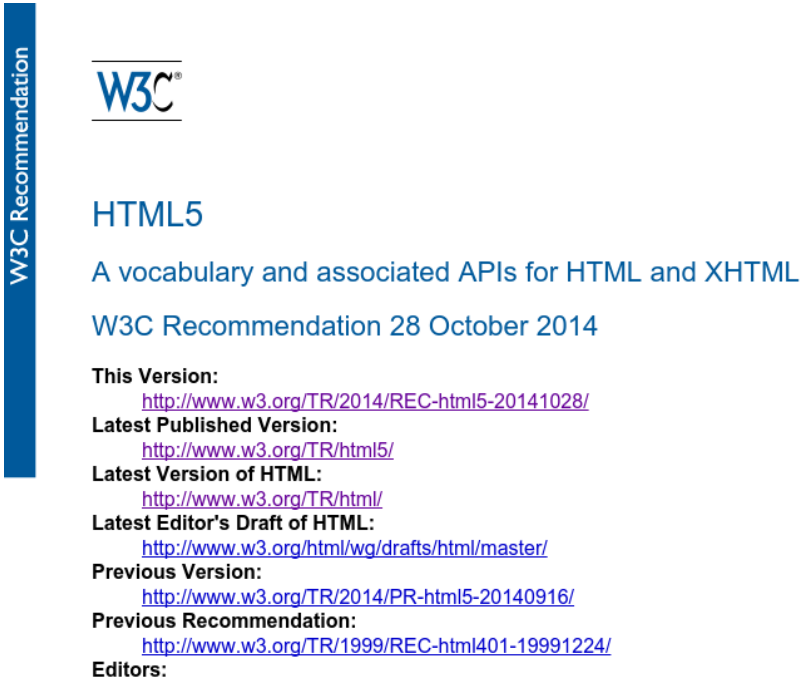
Example language specification: HTML / RFCs

HTML is in fact a language

It has a formal specification

Maintained by W3C

Early versions were RFCs



Many RFCs are specification documents

- HTTP, SMTP, URLs, etc.

Perl 5 language specification... ?

How is the Perl 5 language specified?

The camel book?

The interpreter?

The test suite?

Larry?

Perl 5

Perl 5 doesn't have a separate written language specification.

The Perl 5 interpreter and its functional tests serve as the *de facto* specification.

Whatever behavior the Perl 5 interpreter has, that's the “standard” behavior.

If Perl 5 misbehaves, see the previous rule. Even if Perl 5 changes its mind.

The Perl 6 language spec history

Brief Perl 6 history

Perl 6 announced July 2000

RFCs commissioned
361 submitted

Larry refined these into Apocalypses and Synopses

Unlike Perl 5:

- Perl 6 would first become a *specification*
- Then realized by one or more *implementations*

Oops.

Lesson learned

In retrospect,

targeting a “language specification”

before implementation

is a mistake.

Not a “specification”

“Specification” is too loaded with meaning

Implies a level of rigidity and permanence

“design plan”? Yes

“Synopses”? Sure, that works

Careless use of “Perl 6 specification” has led to much confusion about development of Perl 6

Confusion in the community

“When will Perl 6 be ready?”

“Is the Perl 6 specification finished yet?”

“Well, no wonder it's taking so long, if you can't even decide on a specification first.”

I've always disliked this one...

“Perl 6 needs to freeze a specification immediately, implement that, and release it.”

No.

Misunderstanding language design

Many assume a specification precedes language implementation

It's a common misconception

Descriptions of Perl 6 development reinforced this incorrect notion

… and still do!

Reality: Successful languages and systems are striking counter-examples:

Perl 5, PHP, C, Ruby, HTML, HTTP

Premature specification examples

HTML+ (1993)

Effectively delayed HTML and browser development

C99 (1999)

After C99, the C standards committee adopted guidelines to limit adoption of new features untested by implementations.

Premature specification

"Writing a specification before an implementation has largely been avoided since ALGOL 68 (1968), due to unexpected difficulties in implementation when implementation is deferred."

– Wikipedia

Lesson learned

Specification freezes aren't like code freezes.

Specification releases aren't like code releases.

Specs should be (very?) retrospective.

Illustration: Internet Standards Process

Proposals start as Internet Drafts

Become Requests for Comments (RFCs)

May be considered on the Standard Track as a "Proposed Standard"

Promotion to "Internet Standard" requires:

- Two independent operating implementations
- No errata against specification
- No unused features that increase complexity
- Two independent uses of any licensing restrictions

Key features of (Perl 6) specification

Lesson: Evolution is a constant

A programming language is never “frozen”

(until it's dead)

Perl 6 design explicitly recognizes evolution:

- Lexically scoped language modifications
- Versioned specification
- Versioned modules
- Macros
- Custom operators / parsing / DSLs
- Slangs
- Augmented classes / MONKEY_TYPING
- Classes are never “final”

Camelia, our queen of metamorphosis

Language lessons

Sharp distinction beween “specification” and “implementation”

“Perl 6” and “Perl 6.0.0” refer to the *language*

No “official” implementation of Perl 6

Multiple implementations are key to long-term adaptation, evolution, success

Lesson: Synopses should not be spec

Synopses were the original “Perl 6 specification”

These change frequently with language evolution and discovery

Difficult to version synopses as spec

Changed circa 2008 to:

> “Perl 6 is anything that passes the official test suite.”
>
> – Synopsis 1

Where we go next

More precision in description

Establish / release “Perl 6.0.0”

Better understanding of “Perl 6 spec”

Specification follows implementations

Specification is a set of tests...

...not the design documents

Remove false references

Some documents still refer to Synopses as “official Perl 6 specification”

- Various histories of Perl 6
- Wikipedia and similar articles

Fix these!

Attention!

Our GitHub repository for Synopses is (mis)named “specs”

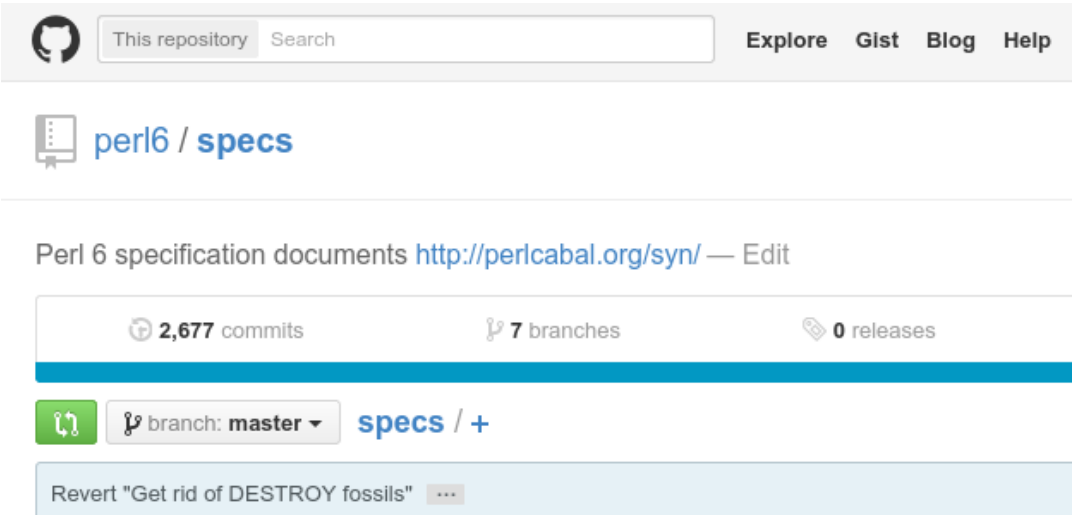
This bothers me

I *will* change this

Soon

Without further warning

Forgiveness > Permission



Specification toolchain

Perl 6 specification will be defined by test suite

Current test suite has things that are not yet “spec”

It will always have such “extra” tests

Mechanism to identify / extract the test suite for a given Perl 6 version

Git tags useful but likely not sufficient

Fudge factor

The “roast” test suite already exists in subsets

Per-implementation “todo” and “skip” markers pre-processed into test files

```
#?rakudo.moar todo “Not yet implemented"
```

May be able to use similar markers for Perl 6 versions

```
#?v6.0.0 omit 5 “Conjectural”
```

Consider feature lifetimes

Language features may have lifetimes:

- Conjecture
- Work in progress
- Adopted
- Discouraged
- Deprecated
- Retired

Perhaps specification should explicitly recognize this somehow

Version guidelines

Criteria for declaring new versions of Perl 6

Time-based language specification?

Tag Synopsis documents?

Develop way to tag Synopsis documents with language version information

Perhaps at section / paragraph level

Doesn't have to be static or snapshot, can evolve over time

Recap

Widespread misconceptions about the role of “specifications” in language development

Specifications work best as historical markers

Languages evolve

Perl 6 has robust features for evolution

Separate specification and implementation

Test-based specification

Need to design versioning standards

Thank you