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Clojure Cookbook

Clojure经典实例 (影印版)

東南大學出版社

Luke VanderHart, Ryan Neufeld 著



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by Robert H. Fisher

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Preface

The primary goal of this book is to provide mid-length examples of Clojure code that go beyond the basics, with a focus on real-world, everyday applications (as opposed to more conceptual or academic issues).

Unlike many of the other books on Clojure written to date, the organizing theme of this book is not the language itself, or its features and capabilities. Instead, it focuses on specific *tasks* that developers face (regardless of what language they're using) and shows an example of how to use Clojure to solve each of those specific problems.

As such, this book is not and cannot be truly comprehensive; there are infinite possible example problems. However, we do hope we've documented some of the more common ones that most programmers encounter frequently, and that by induction readers will be able to learn some common patterns, approaches, and techniques that will serve them well as they design solutions for their own unique problems.

How This Book Was Written

An important thing you should understand about this book is that it is, first and foremost, a group effort. It is not authored by one or two people. It isn't even the work of a single, well-defined group. Instead, it is the collaborative product of more than 60 of the best Clojurists from all over the world, from all backgrounds. These authors use Clojure every day on real applications, ranging from aerospace to social media, banking to robotics, AI research to e-commerce.

As such, you will see a lot of diversity in the recipes presented. Some are quick and to the point. Others are more deliberate, presenting digestible yet penetrating insights into the philosophy and implementation of certain aspects of Clojure.

We hope that there is something in this book for readers of diverse interests. We believe that it will be useful not only as a reference for looking up solutions to specific problems, but also as a worthwhile survey of the variety and expressivity that Clojure is capable

of. As we edited submissions, we were astonished by the number of concepts and techniques that were new to us, and will hopefully be new to our readers as well.

Something else that we discovered while writing and editing was how difficult it was to draw a circumference around what we wanted to cover. Every single recipe is a beautiful, endless fractal, touching multiple topics, each of which deserves a recipe, a chapter, or a book of its own. But each recipe also needs to stand on its own. Each one should provide some useful nugget of information that readers can understand and take away with them.

We sincerely hope that we have balanced these goals appropriately, and that you find this book useful without being tedious, and insightful without being pedantic.

Audience

Anyone who uses Clojure will, we hope, be able to get something out of this book. There are a lot of recipes on truly basic things that beginners will find useful, but there are also many recipes on more specialized topics that advanced users should find useful for getting a head start on implementation.

That said, if you're completely new to Clojure, this probably isn't the book to start with—at least, not by itself. It covers a great many useful topics, but not as methodically or as thoroughly as a good introductory text. See the following section for a list of general Clojure books you may find useful as prior or supplemental texts.

Other Resources

One thing that this book is not, and could never be, is complete. There is too much to cover, and by presenting information in a task-oriented recipe format we have inherently precluded ourselves from methodical, narrative explanation of the features and capabilities of the whole language.

For a more linear, thorough explanation of Clojure and its features, we recommend one of the following books:

- *Clojure Programming* (O'Reilly, 2012), by Chas Emerick, Brian Carper, and Christophe Grand. A good, comprehensive, general-purpose Clojure book focusing on the language and common tasks, oriented toward beginner Clojure programmers.
- *Programming Clojure*, 2nd ed. (Pragmatic Bookshelf, 2012), by Stuart Halloway and Aaron Bedra. The first book on Clojure, this is a clear, comprehensive introductory tutorial on the Clojure language.
- *Practical Clojure* (Apress, 2010), by Luke VanderHart and Stuart Sierra. This is a terse, no-nonsense explanation of what Clojure is and what its features do.

- *The Joy of Clojure* (Manning, 2011), by Michael Fogus and Chris Houser. This is a slightly more advanced text that really digs into the themes and philosophies of Clojure.
- *ClojureScript: Up and Running* (O'Reilly, 2012), by Stuart Sierra and Luke VanderHart. While *Clojure Cookbook* and the other Clojure books listed here focus mainly or entirely on Clojure itself, ClojureScript (a dialect of Clojure that compiles to JavaScript) has gained considerable uptake. This book introduces ClojureScript and how to get started with it, and covers the similarities and differences between ClojureScript and Clojure.

Finally, you should look at the source code for this book itself, which is freely available on GitHub (<http://bit.ly/clj-ckbk>). The selection of recipes available online is larger than that in the print version, and we are still accepting pull requests for new recipes that might someday make it into a future edition of this book.

Structure

The chapters in this book are for the most part groupings of recipes by theme, rather than strictly categorical. It is entirely possible for a recipe to be applicable to more than one chapter—in these cases, we have simply tried to place it where we think the majority of readers will likely look first.

A *recipe* consists of three primary parts and one secondary: problem, solution, discussion, and “see also.” A recipe’s problem statement lays out a task or obstacle to be overcome. Its solution tackles the problem head-on, illustrating a particular technique or library that effectively accomplishes the task. The discussion rounds everything out, exploring the solution and any caveats that may come with it. Finally, we tie off each recipe with a “see also” section, pointing you, the reader, to any additional resources or recipes that will assist you in enacting the described solution.

Chapter Listing

The book is composed of the following chapters:

- Chapter 1, *Primitive Data*, and Chapter 2, *Composite Data*, cover Clojure’s built-in primitive and composite data structures, and explain many common (and less common) ways one might want to use them.
- Chapter 3, *General Computing*, is a grab bag of useful topics that are generally applicable in many different application areas and project domains, from Clojure features such as Protocols to alternate programming paradigms such as logic programming with `core.logic` or asynchronous coordination with `core.async`.

- Chapter 4, *Local I/O*, deals with all the ways in which your program can interact with the local computer upon which it is running. This includes reading from and writing to standard input and output streams, creating and manipulating files, serializing and deserializing files, etc.
- Chapter 5, *Network I/O and Web Services*, contains recipes with similar themes to Chapter 4, *Local I/O*, but instead deals with *remote* communication over a network. It includes recipes on a variety of network communication protocols and libraries.
- Chapter 6, *Databases*, demonstrates techniques and tools for connecting to and using a variety of databases. Special attention is given to Datomic, a datastore that shares and extends much of Clojure's underlying philosophy of value, state, and identity to persistent storage.
- Chapter 7, *Web Applications*, dives in-depth into one of the most common applications for Clojure: building and maintaining dynamic websites. It provides comprehensive treatment of Ring (the most popular HTTP server library for Clojure), as well as tools for HTML templating and rendering.
- Chapter 8, *Performance and Production*, explains what to do with a Clojure program once you have one, going over common patterns for packaging, distributing, profiling, logging, and associated ongoing tasks over the lifetime of an application.
- Chapter 9, *Distributed Computation*, focuses on cloud computing and using Clojure for heavyweight distributed data crunching. Special attention is given to Cascalog, a declarative Clojure interface to the Hadoop MapReduce framework.
- Last but not least, Chapter 10, *Testing*, covers a variety of techniques for ensuring the integrity and correctness of your code and data, ranging from traditional unit and integration tests to more comprehensive generative and simulation testing, and even optional compile-time validations using static typing with `core.typed`.

Software Prerequisites

To follow along with the recipes in this book you will need valid installations of the Java Development Kit (JDK) and Clojure's de facto build tool, Leiningen. We recommend version 7 of the JDK, but a minimum of 6 will do. For Leiningen, you should have at least version 2.2.

If you don't have Java installed (or would like to upgrade), visit the Java Download Page (<http://bit.ly/java-download>) for instructions on downloading and installing the Java JDK.

To install Leiningen, follow the installation instructions on Leiningen's website (<http://leiningen.org/>). If you already have Leiningen installed, get the latest version by exe-

cuting the command **lein upgrade**. If you aren't familiar with Leiningen, visit the tutorial (<http://bit.ly/lein-tutorial>) to learn more.

The one thing you *won't* need to manually install is Clojure itself; Leiningen will do this for you on an ad hoc basis. To verify your installation, run **lein repl** and check your Clojure version:

```
$ lein repl
# ...
user=> *clojure-version*
{:major 1, :minor 5, :incremental 1, :qualifier nil}
```



Some recipes have accompanying online materials available on GitHub. If you do not have Git installed on your system, follow the setup instructions (<https://help.github.com/articles/set-up-git>) to enable you to check out a GitHub repository locally.

Some recipes—such as the database recipes—require further software installations. Where this is the case, recipes will include additional information on installing those tools.

Conventions Used in This Book

Being a book full of solutions, you'll find no shortage of Clojure source code in this book. Clojure source code appears in a monospace font, like this:

```
(defn add
  [x y]
  (+ x y))
```

When a Clojure expression is evaluated for a return value, that value is denoted with a comment followed by an arrow, much like it would appear on the command line:

```
(add 1 2)
;; -> 3
```

Where appropriate, code samples may omit or ellipsize return value comments. The two most common places you'll see this are when defining a function/var or shortening lengthy output:

```
;; This would return #'user/one, but do you really care?
(def one 1)

(into [] (range 1 20))
;; -> [1 2 ... 20]
```

When an expression produces output to STDOUT or STDERR, it is denoted by a comment (**out** or **error**, respectively), followed by a comment with each line of output:

```
(do (println "Hello!")
    (println "Goodbye!"))
;; -> nil
;; *out*
;; Hello!
;; Goodbye!
```

REPL Sessions

Seeing that *REPL-driven development* is in vogue at present, it follows that this be a REPL-driven book. REPLs (read-eval-print loops) are interactive prompts that evaluate expressions and print their results. The Bash prompt, `irb`, and the python prompt are examples of REPLs. Nearly every recipe in this book is designed to be run at a Clojure REPL.

While Clojure REPLs are traditionally displayed as `user=> ...`, this book aims for readers to be able to copy and paste all of the examples in a recipe and see the indicated results. As such, samples omit `user=>` and comment out any output to make things easier. This is especially helpful if you're following along on a computer: you can blindly copy and paste code samples without worrying about trying to run noncode.

When an example is *only* relevant in the context of a REPL, we will retain the traditional REPL style (with `user=>`). What follows is an example of each, a REPL-only sample and its simplified version.

REPL-only:

```
user=> (+ 1 2)
3
user=> (println "Hello!")
Hello!
nil
```

Simplified:

```
(+ 1 2)
;; -> 3

(println "Hello!")
;; *out*
;; Hello!
```

Console/Terminal Sessions

Console sessions (e.g., shell commands) are denoted by monospace font, with lines beginning with a dollar sign (\$) indicating a shell prompt. Output is printed without a leading \$:

```
$ lein version
Leiningen 2.0.0-preview10 on Java 1.6.0_29 Java HotSpot(TM) 64-Bit Server VM
```

A backslash (\) at the end of a command indicates to the console that the command continues on the next line.

Our Golden Boy, lein-try

Clojure is not known for its extensive standard library. Unlike languages like Perl or Ruby, Clojure's standard library is comparatively small; Clojure chose *simplicity* and *power* instead. As such, Clojure is a language full of libraries, not built-ins (well, except for Java).

Since so many of the solutions in this book rely on third-party libraries, we developed `lein-try` (<https://github.com/rkneufeld/lein-try>). `lein-try` is a small plug-in for Leiningen (<http://leiningen.org/>), Clojure's de facto project tool, that lets you quickly and easily try out various Clojure libraries.

To use `lein-try`, ensure you have Leiningen installed, then edit your user profile (`~/.lein/profiles.clj`) as follows:

```
{:user {:plugins [[lein-try "0.4.1"]]]}
```

Now, inside of a project or out, you can use the **lein try** command to launch a REPL with access to whichever library you please:

```
$ lein try clj-time
#...
user=>
```

Long story short: where possible, you'll see instructions on which `lein-try` command to execute above recipes that use third-party libraries. You'll find an example of trying recipes with `lein-try` in Recipe 3.4, "Trying a Library Without Explicit Dependencies" on page 128.

If a recipe *cannot* be run via `lein-try`, we have made efforts to include adequate instructions on how to run that recipe on your local machine.

Typesetting Conventions

The following typographic conventions are used in this book:

Italic

Used for URLs, filenames, pathnames, and file extensions. New terms are also italicized when they first appear in the text, and italics are used for emphasis.

Constant width

Used for function and method names and their arguments; for data types, classes, and namespaces; in examples to show both input and output; and in regular text to show literal code.

Constant width bold

Used to indicate commands that you should enter literally at the command line.

<replaceable-value>

Elements of pathnames, commands, function names, etc. that should be replaced with user-supplied values are shown in angle brackets.

The names of libraries follow one of two conventions: libraries with proper names are displayed in plain text (e.g., “Hiccup” or “Swing”), while libraries with names meant to mimic code symbols are displayed in constant-width text (e.g., `core.async` or `cljs-commons-exec`).



This element signifies a tip or suggestion.



This element signifies a general note.



This element indicates a warning or caution.

Using Code Examples

Supplemental material (code examples, exercises, etc.) is available for download at <http://bit.ly/clj-ckbk>.

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Ryan Neufeld

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Luke VanderHart

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