

# Babashka Babooka

Write Command-Line Clojure



a Brave Clojure Quest  
by Daniel Higginbotham



# Table of Contents

Babashka Babooka: Write Command-Line Clojure .....	1
Introduction .....	2
Sponsor .....	3
What is Babashka? .....	3
Why should you use it? .....	4
Installation .....	6
Your first script .....	7
Babashka's output .....	8
Namespace is optional .....	9
What about requiring other namespaces? .....	9
Make your script executable .....	10
Summary .....	10
Working with files .....	12
Creating an interface for your script .....	14
parsing options with babashka.cli .....	15
dispatching subcommands with babashka.cli .....	17
Summary .....	18
Organizing your project .....	20
File system structure .....	20
Namespaces .....	22
Summary .....	24
Adding dependencies .....	25
Pods .....	26
Pod usage .....	26
Pod implementation .....	27
Summary .....	28
Other ways of executing code .....	29
Direct Expression Evaluation .....	29

Invoking a Clojure function . . . . .	29
Tasks . . . . .	32
A basic task . . . . .	32
How to require namespaces for tasks . . . . .	33
Use <code>exec</code> to parse arguments and call a function . . . . .	33
Task dependencies, parallel tasks, and more . . . . .	35
Summary . . . . .	35
Additional Resources . . . . .	36
Acknowledgments . . . . .	37

# Babashka Babooka: Write Command-Line Clojure

Daniel Higginbotham

# Introduction

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There are two types of programmers in the world: the practical, sensible, shell-resigned people who need to google the correct argument order for `ln -s`; and those twisted, Stockholmed souls who will gleefully run their company's entire infrastructure on 57 commands stitched together into a single-line bash script.

This guide is for the former. For the latter: sorry, but I can't help you.

[Babashka](#) is a Clojure scripting runtime that is a powerful, delightful alternative to the shell scripts you're used to. This comprehensive tutorial will teach you:

- What babashka is, what it does, how it works, and how it can fit into your workflow
- How to write babashka scripts
- How to organize your babashka projects
- What pods are, and how they provide a native Clojure interface for external programs
- How to use tasks to create interfaces similar to `make` or `npm`

If you'd like to stop doing something that hurts (writing incomprehensible shell scripts) and start doing something that feels great (writing Babashka scripts), then read on!

## NOTE

If you're unfamiliar with Clojure, Babashka is actually a great tool for learning! [This crash course](#) and [this chapter on namespaces](#) cover what you need to understand the Clojure used here. There are many good editor extensions for working with Clojure code, including [Calva for VS Code](#) and [CIDER for emacs](#). If you're new to the command line, check out [Learn Enough Command Line to be Dangerous](#).

## Sponsor

If you enjoy this tutorial, [consider sponsoring me, Daniel Higginbotham, through GitHub sponsors](#). As of April 2022 I am spending two days a week working on free Clojure educational materials and open source libraries to make Clojure more beginner-friendly, and appreciate any support!

Please also [consider sponsoring Michiel Borkent, aka borkdude, who created babashka](#). Michiel is doing truly incredible work to transform the Clojure landscape, extending its usefulness and reach in ways that benefit us all. He has a proven track record of delivering useful tools and engaging with the community.

## What is Babashka?

From a user perspective, babashka is a scripting runtime for the Clojure programming language. It lets you execute Clojure programs in contexts where you'd typically use bash, ruby, python, and the like. Use cases include build scripts, command line utilities, small web applications, git hooks, AWS Lambda functions, and everywhere you want to use Clojure where fast startup and/or low resource usage matters.

You can run something like the following in a terminal to immediately execute your Clojure program:

```
bb my-clojure-program.clj
```

If you're familiar with Clojure, you'll find this significant because it eliminates the startup time you'd otherwise have to contend with for a JVM-compiled Clojure program, not to mention you don't have to compile the file. It also uses much less memory than running a jar. Babashka makes it feasible to use Clojure even more than you already do.

If you're unfamiliar with Clojure, using Babashka is a great way to try out the language. Clojure is a *hosted* language, meaning that the language is defined independently of the underlying runtime environment. Most Clojure programs are compiled to run on the Java Virtual Machine (JVM) so that they can be run

anywhere Java runs. The other main target is JavaScript, allowing Clojure to run in a browser. With Babashka, you can now run Clojure programs where you'd normally run bash scripts. The time you spend investing in Clojure pays dividends as your knowledge transfers to these varied environments.

From an implementation perspective, Babashka is a standalone, natively-compiled binary, meaning that the operating system executes it directly, rather than running in a JVM. When the babashka binary gets compiled, it includes many Clojure namespaces and libraries so that they are usable with native performance. You can [check out the full list of built-in namespaces](#). Babashka can also include other libraries, just like if you're using deps.edn or Leiningen.

The binary also includes the [Small Clojure Interpreter \(SCI\)](#) to interpret the Clojure you write and additional libraries you include on the fly. Its implementation of Clojure is nearly at parity with JVM Clojure, and it improves daily thanks to [Michiel Borkent](#)'s ceaseless work. It's built with GraalVM. This guide is focused on becoming productive with Babashka and doesn't cover the implementation in depth, but you can learn more about it by reading [this article on the GraalVM blog](#).

## Why should you use it?

I won't go into the benefits of Clojure itself because there are plenty of materials on that [elsewhere](#).

Beyond the fact that it's Clojure, Babashka brings a few features that make it stand apart from contenders:

**First-class support for multi-threaded programming.** Clojure makes multi-threaded programming simple and easy to write and reason about. With Babashka, you can write straightforward scripts that e.g. fetch and process data from multiple databases in parallel.

**Real testing.** You can unit test your Babashka code just as you would any other Clojure project. How do you even test bash?

**Real project organization.** Clojure namespaces are a sane way to organize your

project's functions and build reusable libraries.

**Cross-platform compatibility.** It's nice not having to worry that an OS X-developed script is broken in your continuous integration pipeline.

**Interactive Development.** Following the lisp tradition, Babashka provides a read-eval-print loop (REPL) that gives you that good good bottom-up fast-feedback feeling. Script development is inherently a fast; Babashka makes it a faster.

**Built-in tools for defining your script's interface.** One reason to write a shell script is to provide a concise, understandable interface for a complicated process. For example, you might write a build script that includes **build** and **deploy** commands that you call like

```
./my-script build  
./my-script deploy
```

Babashka comes with tools that gives you a consistent way of defining such commands, and for parsing command-line arguments into Clojure data structures. Take that, bash!

**A rich set of libraries.** Babashka comes with helper utilities for doing typical shell script grunt work like interacting with processes or mucking about with the filesystem. It also has support for the following without needing extra dependencies:

- JSON parsing
- YAML parsing
- Starting an HTTP server
- Writing generative tests

And of course, you can add Clojure libraries as dependencies to accomplish even more. Clojure is a gateway drug to other programming paradigms, so if you ever wanted to do e.g. logic programming from the command line, now's your chance!



**Good error messages.** Babashka's error handling is the friendliest of all Clojure implementations, directing you precisely to where an error occurred.

## Installation

Installing with brew is `brew install borkdude/brew/babashka`.

For other systems, see [Babashka's complete installation instructions](#).

# Your first script

Throughout this tutorial we're going to play with building a little CLI-based dream journal. Why? Because the idea of you nerds recording your weird little subconscious hallucinations is deeply amusing to me.

In this section, you're going to learn:

- How to write and run your first Babashka script
- How default output is handled
- A little about how Babashka treats namespaces

Create a file named `hello.clj` and put this in it:

```
(require '[clojure.string :as str])  
(str/join " " ["Hello" "inner" "world!"])
```

Now run it with `bb`, the babashka executable:

```
bb hello.clj
```

You should see it print the text `"Hello inner world!"`.

There are a few things here to point out for experienced Clojurians:

- You didn't need a `deps.edn` file or `project.clj`
- There's no namespace declaration; we use `(require ...)`
- You didn't need to print the string for the string to be printed
- It's just Clojure

I very much recommend that you actually try this example before proceeding because it *feels* different from what you're used to. It's unlikely that you're used to throwing a few Clojure expressions into a file and being able to run them immediately.

When I first started using Babashka, it felt so different that it was disorienting. It was like the first time I tried driving an electric car and my body freaked out a little because I wasn't getting the typical sensory cues like hearing and feeling the engine starting.

Babashka's like that: the experience is so quiet and smooth it's jarring. No `deps.edn`, no namespace declaration, write only the code you need and it runs!

That's why I included the "It's just Clojure" bullet point. It might feel different, but this is still Clojure. Let's explore the other points in more detail.

## Babashka's output

Here's what's going on: `bb` interprets the Clojure code you've written, executing it on the fly. It prints the last value it encounters to `stdout`, which is why `"Hello, inner world!"` is returned in your terminal.

### NOTE

When you print text to `stdout`, it gets printed to your terminal. This tutorial doesn't get into what `stdout` actually is, but you can think of it as the channel between the internal world of your program and the external world of the environment calling your program. When your program sends stuff to `stdout`, your terminal receives it and prints it.

Notice that the quotes are maintained when the value is printed. `bb` will print the *stringified representation of your data structure*. If you updated `hello.clj` to read

```
"Hello, inner world!"  
["It's" "me," "your" "wacky" "subconscious!"]
```

Then `["It's" "me," "your" "wacky" "subconscious!"]` would get printed, and `"Hello, inner world!"` would not.

If you want to print a string without the surrounding quotes, you can use

```
(println "Hello, inner world!")
```

```
nil
```

With `nil` as the last form, `bb` does not print to `stdout` on exit.

## Namespace is optional

As for the lack of namespace: this is part of what makes Babashka useful as a scripting tool. When you're in a scripting state of mind, you want to start hacking on ideas immediately; you don't want to have to deal with boilerplate just to get started. Babashka has your back.

You *can* define a namespace (we'll look at that more when we get into project organization), but if you don't then Babashka uses the `user` namespace by default. Try updating your file to read:

```
(str "Hello from " *ns* ", inner world!")
```

Running it will print `"Hello from user, inner world!"`. This might be surprising because there's a mismatch between filename (`hello.clj`) and namespace name. In other Clojure implementations, the current namespace strictly corresponds to the source file's filename, but Babashka relaxes that a little bit in this specific context. It provides a scripting experience that's more in line with what you'd expect from using other scripting languages.

## What about requiring other namespaces?

You might want to include a namespace declaration because you want to require some namespaces. With JVM Clojure and Clojurescript, you typically require namespaces like this:

```
(ns user
  (:require
    [clojure.string :as str]))
```

It's considered bad form to require namespaces by putting `(require`

'[clojure.string :as str]) in your source code.

That's not the case with Babashka. You'll see (`require ...`) used liberally in other examples, and it's OK for you to do that too.

## Make your script executable

What if you want to execute your script by typing something like `./hello` instead of `bb hello.clj`? You just need to rename your file, add a shebang, and `chmod +x` that bad boy. Update `hello.clj` to read:

```
#!/usr/bin/env bb

(str "Hello from " *ns* ", inner world!")
```

### NOTE

The first line, `#!/usr/bin/env bb` is the "shebang", and I'm not going to explain it.

Then run this in your terminal:

```
mv hello{.clj,}
chmod +x hello
./hello
```

First you rename the file, then you call `chmod +x` on it to make it executable. Then you actually execute it, saying hi to your own inner world which is kind of adorable.

## Summary

Here's what you learned in this section:

- You can run scripts with `bb script-name.clj`
- You can make scripts directly executable by adding `#!/usr/bin/env bb` on the top line and adding the `execute` permission with `chmod +x script-name.clj`

- You don't have to include an `(ns ...)` declaration in your script. But it still runs and it's still Clojure!
- It's acceptable and even encouraged to require namespaces with `(require ...)`.
- Babashka writes the last value it encounters to `stdout`, except if that value is `nil`

# Working with files

Shell scripts often need to read input from the command line and produce output somewhere, and our dream journal utility is no exception. It's going to store entries in the file `entries.edn`. The journal will be a vector, and each entry will be a map with the keys `:timestamp` and `:entry` (the entry has linebreaks for readability):

```
[{:timestamp 0
  :entry "Dreamt the drain was clogged again, except when I went to unclog
         it it kept growing and getting more clogged and eventually it
         swallowed up my little unclogger thing"}
 {:timestamp 1
  :entry "Bought a house in my dream, was giving a tour of the backyard and
         all the... topiary? came alive and I had to fight it with a sword.
         I understood that this happens every night was very annoyed that
         this was not disclosed in the listing."}]
```

To write to the journal, we want to run the command `./journal add --entry "Hamsters. Hamsters everywhere. Again."`. The result should be that a map gets appended to the vector.

Let's get ourselves part of the way there. Create the file `journal` and make it executable with `chmod +x journal`, then make it look like this:

```
#!/usr/bin/env bb

(require '[babashka.fs :as fs])
(require '[clojure.edn :as edn])

(def ENTRIES-LOCATION "entries.edn")

(defn read-entries
  []
  (if (fs/exists? ENTRIES-LOCATION)
      (edn/read-string (slurp ENTRIES-LOCATION))
      []))

(defn add-entry
  [text]
```

```
(let [entries (read-entries)]
  (spit ENTRIES-LOCATION
    (conj entries {:timestamp (System/currentTimeMillis)
                  :entry      text}))))

(add-entry (first *command-line-args*))
```

We require a couple namespaces: `babashka.fs` and `clojure.edn`. `babashka.fs` is a collection of functions for working with the filesystem; check out its [API docs](#). When you're writing shell scripts, you're very likely to work with the filesystem, so this namespace is going to be your friend.

Here, we're using the `fs/exists?` function to check that `entries.edn` exists before attempting to read it because `slurp` will throw an exception if it can't find the file for the path you passed it.

The `add-entry` function uses `read-entries` to get a vector of entries, uses `conj` to add an entry, and then uses `spit` to write back to `entries.edn`. By default, `spit` will overwrite a file; if you want to append to it, you would call it like

```
(spit "entries.edn" {:timestamp 0 :entry ""} :append true)
```

Maybe overwriting the whole file is a little dirty, but that's the scripting life babyyyyyy!



# Creating an interface for your script

OK so in the last line we call `(add-entry (first \*command-line-args*))`. `\*command-line-args*` is a sequence containing, well, all the command line arguments that were passed to the script. If you were to create the file `args.clj` with the contents `\*command-line-args*`, then ran `bb args.clj 1 2 3`, it would print `("1" "2" "3")`.

Our `journal` file is at the point where we can add an entry by calling `./journal "Flying\!! But to Home Depot?"`. This is almost what we want; we actually want to call `./journal add --entry "Flying\!! But to Home Depot?"`. The assumption here is that we'll want to have other commands like `./journal list` or `./journal delete`. (You have to escape the exclamation marks otherwise bash interprets them as history commands.)

To accomplish this, we'll need to handle the command line arguments in a more sophisticated way. The most obvious and least-effort way to do this would be to dispatch on the first argument to `\*command-line-args*`, something like this:

```
(let [[command _ entry] *command-line-args*]
  (case command
    "add" (add-entry entry)))
```

This might be totally fine for your use case, but sometimes you want something more robust. You might want your script to:

- List valid commands
- Give an intelligent error message when a user calls a command that doesn't exist (e.g. if the user calls `./journal add-dream` instead of `./journal add`)
- Parse arguments, recognizing option flags and converting values to keywords, numbers, vectors, maps, etc

Generally speaking, **you want a clear and consistent way to define an interface for your script**. This interface is responsible for taking the data provided at the command line — arguments passed to the script, as well as data

piped in through `stdin` — and using that data to handle these three responsibilities:

- Dispatching to a Clojure function
- Parsing command-line arguments into Clojure data, and passing that to the dispatched function
- Providing feedback in cases where there's a problem performing the above responsibilities.

The broader Clojure ecosystem provides at least two libraries for handling argument parsing:

- [clojure.tools.cli](#)
- [nubank/docopt.clj](#)

Babashka provides the [babashka.cli library](#) for both parsing options and dispatches subcommands. We're going to focus just on `babashka.cli`.

## parsing options with `babashka.cli`

The [babashka.cli docs](#) do a good job of explaining how to use the library to meet all your command line parsing needs. Rather than going over every option, I'll just focus on what we need to build our dream journal. To parse options, we require the `babashka.cli` namespace and we define a *CLI spec*:

```
(require '[babashka.cli :as cli])
(def cli-opts
  {:entry  {:alias  :e
            :desc   "Your dreams."
            :require true}
   :timestamp {:alias :t
               :desc   "A unix timestamp, when you recorded this."
               :coerce {:timestamp :long}}})
```

A CLI spec is a map where each key is a keyword, and each value is an *option spec*. This key is the *long name* of your option; `:entry` corresponds to the flag

`--entry` on the command line.

The option spec is a map you can use to further config the option. `:alias` lets you specify a *short name* for you options, so that you can use e.g. `-e` instead of `--entry` at the command line. `:desc` is used to create a summary for your interface, and `:require` is used to enforce the presence of an option. `:coerce` is used to transform the option's value into some other data type.

We can experiment with this CLI spec in a REPL. There are many options for starting a Babashka REPL, and the most straightforward is simply typing `bb repl` at the command line. If you want to use CIDER, first add the file `bb.edn` and put an empty map, `{}`, in it. Then you can use `cider-jack-in`. After that, you can paste in the code from the snippet above, then paste in this snippet:

```
(cli/parse-opts ["-e" "The more I mowed, the higher the grass got :("] {:spec cli-opts})  
;; =>  
{:entry "The more I mowed, the higher the grass got :("}
```

Note that `cli/parse-opts` returns a map with the parsed options, which will make it easy to use the options later.

Leaving out a required flag throws an exception:

```
(cli/parse-opts [] {:spec cli-opts})  
;; exception gets thrown, this gets printed:  
❗ Required option: :entry user
```

`cli/parse-opts` is a great tool for building an interface for simple scripts! You can communicate that interface to the outside world with `cli/format-opts`. This function will take an option spec and return a string that you can print to aid people in using your program. Behold:

```
(println (cli/format-opts {:spec cli-opts}))  
;; =>  
-e, --entry    Your dreams.
```

`-t, --timestamp` A unix timestamp, when you recorded this.

## dispatching subcommands with `babashka.cli`

`babashka.cli` goes beyond option parsing to also giving you a way to dispatch subcommands, which is exactly what we want to get `./journal add --entry "..."` working. Here's the final version of `journal`:

```
#!/usr/bin/env bb

(require '[babashka.cli :as cli])
(require '[babashka.fs :as fs])
(require '[clojure.edn :as edn])

(def ENTRIES-LOCATION "entries.edn")

(defn read-entries
  []
  (if (fs/exists? ENTRIES-LOCATION)
      (edn/read-string (slurp ENTRIES-LOCATION))
      []))

(defn add-entry
  [{:keys [opts]}]
  (let [entries (read-entries)]
    (spit ENTRIES-LOCATION
          (conj entries
                (merge {:timestamp (System/currentTimeMillis)} ;; default timestamp
                      opts)))))

(def cli-opts
  {:entry   {:alias :e
             :desc  "Your dreams."
             :require true}
   :timestamp {:alias :t
               :desc  "A unix timestamp, when you recorded this."
               :coerce {:timestamp :long}}})

(defn help
  [_]
  (println
   (str "add\n"
        (cli/format-opts {:spec cli-opts}))))
```

```
(def table
  [{:cmds ["add"] :fn add-entry :spec cli-opts}
   {:cmds [] :fn help}])

(cli/dispatch table *command-line-args*)
```

Try it out with the following at your terminal:

```
./journal
./journal add -e "dreamt they did one more episode of Firefly, and I was in it"
```

The function `cli/dispatch` at the bottom takes a dispatch table as its first argument. `cli/dispatch` figures out which of the arguments you passed in at the command line correspond to commands, and then calls the corresponding `:fn`. If you type `./journal add ...`, it will dispatch the `add-entry` function. If you just type `./journal` with no arguments, then the `help` function gets dispatched.

The dispatched function receives a map as its argument, and that map contains the `:opts` key. This is a map of parsed command line options, and we use it to build our dream journal entry in the `add-entry` function.

And that, my friends, is how you build an interface for your script!

## Summary

- For scripts of any complexity, you generally need to *parse* the command line options into Clojure data structures
- The libraries `clojure.tools.cli` and `nubank/docopts` will parse command line arguments into options for you
- I prefer using `babashka.cli` because it also handles subcommand dispatch, but really this decision is a matter of taste
- `cli/parse-opts` takes an *options spec* and returns a map
- `cli/format-opts` is useful for creating help text
- Your script might provide *subcommands*, e.g. `add` in `journal add`, and you will

need to map the command line arguments to the appropriate function in your script with `cli/dispatch`

# Organizing your project

You can now record your subconscious's nightly improv routine. That's great! High on this accomplishment, you decide to kick things up a notch and add the ability to list your entries. You want to run `./journal list` and have your script return something like this:

```
2022-12-07 08:03am
```

```
There were two versions of me, and one version baked the other into a pie and ate it.  
Feeling both proud and disturbed.
```

```
2022-12-06 07:43am
```

```
Was on a boat, but the boat was powered by cucumber sandwiches, and I had to keep  
making those sandwiches so I wouldn't get stranded at sea.
```

You read somewhere that source files should be AT MOST 25 lines long, so you decide that you want to split up your codebase and put this list functionality in its own file. How do you do that?

You can organize your Babashka projects just like your other Clojure projects, splitting your codebase into separate files, with each file defining a namespace and with namespaces corresponding to file names. Let's reorganize our current codebase a bit, making sure everything still works, and then add a namespace for listing entries.

## File system structure

One way to organize our dream journal project would be to create the following file structure:

```
./journal  
./src/journal/add.clj  
./src/journal/utils.clj
```

Already, you can see that this looks both similar to typical Clojure project file structures, and a bit different. We're placing our namespaces in the `src/journal`

directory, which lines up with what you'd see in JVM or ClojureScript projects. What's different in our Babashka project is that we're still using `./journal` to serve as the executable entry point for our program, rather than the convention of using `./src/journal/core.clj` or something like that. This might feel a little weird but it's valid and it's still Clojure.

And like other Clojure environments, you need to tell Babashka to look in the `src` directory when you require namespaces. You do that by creating the file `bb.edn` in the same directory as `journal` and putting this in it:

```
{:paths ["src"]}
```

`bb.edn` is similar to a `deps.edn` file in that one of its responsibilities is telling Babashka how to construct your classpath. The classpath is the set of the directories that Babashka should look in when you require namespaces, and by adding `"src"` to it you can use `(require '[journal.add])` in your project. Babashka will be able to find the corresponding file.

Note that there is nothing special about the `"src"` directory. You could use `"my-code"` or even `"."` if you wanted, and you can add more than one path. `"src"` is just the convention preferred by discerning Clojurians the world over.

With this in place, we'll now update `journal` so that it looks like this:

```
#!/usr/bin/env bb

(require '[babashka.cli :as cli])
(require '[journal.add :as add])

(def cli-opts
  {:entry   {:alias :e
             :desc  "Your dreams."
             :require true}
   :timestamp {:alias :t
               :desc  "A unix timestamp, when you recorded this."
               :coerce {:timestamp :long}}})

(def table
  [{:cmds ["add"] :fn add/add-entry :spec cli-opts}])
```



```
(cli/dispatch table *command-line-args*)
```

Now the file is only responsible for parsing command line arguments and dispatching to the correct function. The add functionality has been moved to another namespace.

## Namespaces

You can see on line 4 that we're requiring a new namespace, `journal.add`. The file corresponding to this namespace is `./src/journal/add.clj`. Here's what that looks like:

```
(ns journal.add
  (:require
    [journal.utils :as utils]))

(defn add-entry
  [opts]
  (let [entries (utils/read-entries)]
    (spit utils/ENTRIES-LOCATION
      (conj entries
        (merge {:timestamp (System/currentTimeMillis)} ;; default timestamp
          opts)))))
```

Look, it's a namespace declaration! And that namespace declaration has a `(:require ...)` form. We know that when you write Babashka scripts, you can forego declaring a namespace if all your code is in one file, like in the original version of `journal`. However, once you start splitting your code into multiple files, the normal rules of Clojure project organization apply:

- Namespace names must correspond to filesystem paths. If you want to name a namespace `journal.add`, Babashka must be able to find it at `journal/add.clj`.
- You must tell Babashka where to look to find the files that correspond to namespaces. You do this by creating a `bb.edn` file and putting `{:paths ["src"]}` in it.

To finish our tour of our new project organization, here's `./src/journal/utils.clj`:

```
(ns journal.utils
  (:require
    [babashka.fs :as fs]
    [clojure.edn :as edn]))

(def ENTRIES-LOCATION "entries.edn")

(defn read-entries
  []
  (if (fs/exists? ENTRIES-LOCATION)
      (edn/read-string (slurp ENTRIES-LOCATION))
      []))
```

If you call `./journal add -e "visited by the tooth fairy, except he was a balding 45-year-old man with a potbelly from Brooklyn"`, it should still work.

Now let's create a the `journal.list` namespace. Open the file `src/journal/list.clj` and put this in it:

```
(ns journal.list
  (:require
    [journal.utils :as utils]))

(defn list-entries
  [_]
  (let [entries (utils/read-entries)]
    (doseq [{:keys [timestamp entry]} (reverse entries)]
      (println timestamp)
      (println entry "\n"))))
```

This doesn't format the timestamp, but other than that it lists our entries in reverse-chronological order, just like we want. Yay!

To finish up, we need to add `journal.list/list-entries` to our dispatch table in the `journal` file. That file should now look like this:

```
#!/usr/bin/env bb
```

```

(require '[babashka.cli :as cli])
(require '[journal.add :as add])
(require '[journal.list :as list])

(def cli-opts
  {:entry    {:alias :e
              :desc  "Your dreams."
              :require true}
   :timestamp {:alias :t
               :desc  "A unix timestamp, when you recorded this."
               :coerce {:timestamp :long}}})

(def table
  [{:cmds ["add"] :fn #(add/add-entry (:opts %)) :spec cli-opts}
   {:cmds ["list"] :fn #(list/list-entries nil)}])

(cli/dispatch table *command-line-args*)

```

## Summary

- Namespaces work like they do in JVM Clojure and Clojurescript: namespace names must correspond to file system structure
- Put the map `{:paths ["src"]}` in `bb.edn` to tell Babashka where to find the files for namespaces

# Adding dependencies

You can add dependencies to your projects by adding a `:deps` key to your `bb.edn` file, resulting in something like this:

```
{:paths ["src"]  
 :deps {medley/medley {:mvn/version "1.3.0"}}}
```

What's cool about Babashka though is that you can also add deps directly in your script, or even in the repl, like so:

```
(require '[babashka.deps :as deps])  
(deps/add-deps '[:deps {medley/medley {:mvn/version "1.3.0"}}])
```

This is in keeping with the nature of a scripting language, which should enable quick, low-ceremony development.

At this point you should be fully equipped to start writing your own Clojure shell scripts with Babashka. Woohoo!

In the sections that follow, I'll cover aspects of Babashka that you might not need immediately but that will be useful to you as your love of Clojure scripting grows until it becomes all-consuming.

# Pods

Babashka *Pods* introduce a way to interact with external processes by calling Clojure functions, so that you can write code that looks and feels like Clojure (because it is) even when working with a process that's running outside your Clojure application, and even when that process is written in another language.

## Pod usage

Let's look at what that means in more concrete terms. Suppose you want to encrypt your dream journal. You find out about [stash](#), "a command line program for storing text data in encrypted form." This is exactly what you need! Except it's written in Haskell, and furthermore it has a *terminal user interface* (TUI) rather than a command-line interface.

That is, when you run `stash` from the command line it "draws" an ascii interface in your terminal, and you must provide additional input to store text. You can't store text directly from the command line with something like

```
stash store dreams.stash \  
  --key 20221210092035 \  
  --value "was worried that something was wrong with the house's foundation,  
          then the whole thing fell into a sinkhole that kept growing until  
          it swallowed the whole neighborhood"
```

If that were possible, then you could use `stash` from within your Bashka project by using the `babashka.process/shell` function, like this:

```
(require '[babashka.process :as bp])  
(bp/shell "stash store dreams.stash --key 20221210092035 --value \"...\")
```

`bp/shell` lets you take advantage of a program's command-line interface; but again, `stash` doesn't provide that.

However, `stash` provides a *pod interface*, so we can use it like this in a Clojure file:

```
(require '[babashka.pods :as pods])
(pods/load-pod 'rorokindim/stash "0.3.1")
(require '[pod.rorokindim.stash :as stash])

(stash/init {"encryption-key" "foo"
            "stash-path" "foo.stash"
            "create-stash-if-missing" true})

(stash/set 20221210092035 "dream entry")
```

Let's start at the last line, `(stash/set 20221210092035 "dream entry")`. This is the point of pods: they expose an external process's commands as Clojure functions. They allow these processes to have a *Clojure interface* so that you can interact with them by writing Clojure code, as opposed to having to shell out or make HTTP calls or something like that.

In the next section I'll explain the rest of the snippet above.

## Pod implementation

Where does the `stash/set` function come from? Both the namespace `pod.rorokindim.stash` and the functions in it are dynamically generated by the call `(pods/load-pod 'rorokindim/stash "0.3.1")`.

For this to be possible, the external program has to be written to support the *pod protocol*. "Protocol" here does not refer to a Clojure protocol, it refers to a standard for exchanging information. Your Clojure application and the external application need to have some way to communicate with each other given that they don't live in the same process and they could even be written in different languages.

By implementing the pod protocol, a program becomes a pod. In doing so, it gains the ability to tell the *client* Clojure application what namespaces and functions it has available. When the client application calls those functions, it encodes data and sends it to the pod as a message. The pod will be written such that it can listen to those messages, decode them, execute the desired command internally, and send a response message to the client.

The pod protocol is documented in [the pod GitHub repo](#).

## Summary

- Babashka's pod system lets you interact with external processes using Clojure functions, as opposed to shelling out with `babashka.process/shell` or making HTTP requests, or something like that
- Those external processes are called *Pods* and must implement the *pod protocol* to tell client programs how to interact with them

# Other ways of executing code

This tutorial has focused on helping you build a standalone script that you interact with like would a typical bash script: you make it executable with `chmod +x` and you call it from the command line like `./journal add -e "dream entry"`.

There are other flavors (for lack of a better word) of shell scripting that bash supports:

- Direct expression evaluation
- Invoking a Clojure function
- Naming tasks

## Direct Expression Evaluation

You can give Babashka a Clojure expression and it will evaluate it and print the result:

```
$ bb -e '(+ 1 2 3)'
9

$ bb -e '(map inc [1 2 3])'
(2 3 4)
```

Personally I haven't used this much myself, but it's there if you need it!

## Invoking a Clojure function

If we wanted to call our `journal.add/add-entry` function directly, we could do this:

```
bb -x journal.add/add-entry --entry "dreamt of foo"
```

When you use `bb -x`, you can specify the fully-qualified name of a function and Babashka will call it. It will parse command-line arguments using `babashka.cli`



into a Clojure value and pass that to the specified function. See [the -x section of the Babashka docs](#) for more information.

You can also use `bb -m some-namespace/some-function` to call a function. The difference between this and `bb -x` is that with `bb -m`, each command line argument is passed unparsed to the Clojure function. For example:

```
$ bb -m clojure.core/identity 99
"99"

$ bb -m clojure.core/identity "[99 100]"
"[99 100]"

$ bb -m clojure.core/identity 99 100
----- Error -----
Type:      clojure.lang.ArityException
Message:   Wrong number of args (2) passed to: clojure.core/identity
Location:  <expr>:1:37
```

When using `bb -m`, you can just pass in a namespace and Babashka will call the `-main` function for that namespace. Like, if we wanted our `journal.add` namespace to work with this flavor of invocation, we would write it like this:

```
(ns journal.add
  (:require
    [journal.utils :as utils]))

(defn -main
  [entry-text]
  (let [entries (utils/read-entries)]
    (spit utils/ENTRIES-LOCATION
      (conj entries
        {:timestamp (System/currentTimeMillis)
         :entry      entry-text}))))
```

And we could do this:

```
$ bb -m journal.add "recurring foo dream"
```

Note that for `bb -x` or `bb -m` to work, you must set up your `bb.edn` file so that the namespace you're invoking is reachable on the classpath.

# Tasks

Another flavor of running command line programs is to call them similarly to `make` and `npm`. In your travels as a programmer, you might have run these at the command line:

```
make install
npm build
npm run build
npm run dev
```

Babashka allows you to write commands similarly. For our dream journal, we might want to be able to execute the following in a terminal:

```
bb add -e "A monk told me the meaning of life. Woke up, for got it."
bb list
```

We're going to build up to that in small steps.

## A basic task

First, let's look at a very basic task definition. Tasks are defined in your `bb.edn` file. Update yours to look like this:

```
{:tasks {welcome (println "welcome to your dream journal")}}
```

Tasks are defined using a map under the `:tasks` keyword. Each key of the map names a task, and it should be a symbol. Each value should be a Clojure expression. In this example, the `welcome` names a task and the associated expression is `(println "welcome to your dream journal")`.

When you call `bb welcome`, it looks up the `welcome` key under `:tasks` and evaluates the associated expression. Note that you must explicitly print values if you want them to be sent to `stdout`; this wouldn't print anything:

```
{:tasks {welcome "welcome to your dream journal"}}
```

## How to require namespaces for tasks

Let's say you wanted to create a task to delete your journal entries. Here's what that would look like:

```
{:tasks {welcome (println "welcome to your dream journal")
           clear  (shell "rm -rf entries.edn")}}
```

If you run `bb clear` it will delete your `entries.edn` file. This works because `shell` is automatically referred in namespaces, just `clojure.core` functions are.

If you wanted to delete your file in a cross-platform-friendly way, you could use the `babashka.fs/delete-if-exists` function. To do that, you must require the `babashka.fs` namespace. You might assume that you could update your `bb.edn` to look like this and it would work, but it wouldn't:

```
{:tasks {clear (do (require '[babashka.fs :as fs])
                   (fs/delete-if-exists "entries.edn"))}}
```

Instead, to require namespaces you must do so like this:

```
{:tasks {:requires ([babashka.fs :as fs])
           clear    (fs/delete-if-exists "entries.edn")}}
```

## Use `exec` to parse arguments and call a function

We still want to be able to call `bb add` and `bb list`. We have what we need to implement `bb list`; we can just update `bb.edn` to look like this:

```
{:paths ["src"]
 :tasks {:requires ([babashka.fs :as fs]
                   [journal.list :as list])
```

```
clear    (fs/delete-if-exists "entries.edn")
list     (list/list-entries nil)}}
```

In the previous task examples I excluded the `:paths` key because it wasn't needed, but we need to bring it back so that Babashka can find `journal.list` on the classpath. `journal.list/list-entries` takes one argument that gets ignored, so we can just pass in `nil` and it works.

`journal.add/add-entries`, however, takes a Clojure map with an `:entries` key. Thus we need some way of parsing the command line arguments into that map and then passing that to `journal.add/add-entries`. Babashka provides the `exec` function for this. Update your `bb.edn` like so, and everything should work:

```
{:paths ["src"]
 :tasks {:requires ([babashka.fs :as fs]
                   [journal.list :as list])
         clear    (fs/delete-if-exists "entries.edn")
         list     (list/list-entries nil)
         add      (exec 'journal.add/add-entry)}}
```

Now we can call this, and it should work:

```
$ bb add --entry "dreamt I was done writing a tutorial. bliss"

$ bb list
1670718856173
dreamt I was done writing a tutorial. bliss
```

The key here is the `exec` function. With `(exec 'journal.add/add-entry)`, it's as if you called this on the command line:

```
$ bb -x journal.add/add-entry --entry "dreamt I was done writing a tutorial. bliss"
```

`exec` will parse command line arguments in the same way as `bb -x` does and pass the result to the designated function, which is `journal.add/add-entry` in this example.

# Task dependencies, parallel tasks, and more

Babashka's task system has even more capabilities, which I'm not going to cover in detail but which you can read about in the [Task runner section of the Babashka docs](#).

I do want to highlight two very useful features: *task dependencies* and *parallel task execution*.

Babashka lets you define task dependencies, meaning that you can define `task-a` to depend on `task-b` such that if you run `bb task-a`, internally `task-b` will be executed if needed. This is useful for creating compilation scripts. If you were building a web app, for example, you might have separate tasks for compiling a backend jar file and frontend javascript file. You could have the tasks `build-backend`, `build-frontend`, and then have a `build` task that depended on the other two. If you were to call `bb build`, Babashka would be able to determine which of the other two tasks needed to be run and only run them when necessary.

Parallel task execution will have Babashka running multiple tasks at the same time. In our build example, `bb build` could run `build-backend` and `build-frontend` at the same time, which could be a real time saver.

## Summary

- You define tasks in `bb.edn` under the `:tasks` key
- Task definitions are key-value pairs where the key is a symbol naming the task, and the value is a Clojure expression
- Add a `:requires` key under the `:tasks` key to require namespaces
- `exec` executes functions as if invoked with `bb -x journal.add/add-entry`; it parses command line args before passing to the function
- You can declare task dependencies
- You can run tasks in parallel

# Additional Resources

- [Bash and Babashka equivalents](#) is indispensable for transferring your Bash knowledge to Babashka

# Acknowledgments

The following people read drafts of this and gave feedback. Thank you!

- Michiel Borkent @borkdude
- Marcela Poffalo
- Gabriel Horner @cldwalker
- @geraldodev
- Andrew Patrick @Ajpatri
- Alex Gravem @kartesus
- Inge Solvoll @ingesol
- @focaskater
- @[monkey1@fosstodon.org](mailto:monkey1@fosstodon.org)
- Kira McLean