# Clojure Cheat Sheet (Clojure 1.6 - 1.9, sheet v44)

## Documentation

| | |
|---|---|
| clojure.repl/ | doc find-doc apropos dir source pst javadoc (foo.bar/ is namespace for later syms) |

## Primitives

### Numbers

| | |
|---|---|
| Literals | Long: 7, hex 0xff, oct 017, base 2 2r1011, base 36 36rCRAZY BigInt: 7N Ratio: -22/7 Double: 2.78 -1.2e-5 BigDecimal: 4.2M |
| Arithmetic | + - * / quot rem mod inc dec max min +' -' *' inc' dec' |
| Compare | == < > <= >= compare |
| Bitwise | bit-and bit-or bit-xor bit-not bit-flip bit-set bit-shift-right bit-shift-left bit-and-not bit-clear bit-test unsigned-bit-shift-right (see BigInteger for integers larger than Long) |
| Cast | byte short int long float double bigdec bigint num rationalize biginteger |
| Test | zero? pos? neg? even? odd? number? rational? integer? ratio? decimal? float? (1.9) double? int? nat-int? neg-int? pos-int? |
| Random | rand rand-int |
| BigDecimal | with-precision |
| Unchecked | *unchecked-math* unchecked-add unchecked-dec unchecked-inc unchecked-multiply unchecked-negate unchecked-subtract |

### Strings

| | |
|---|---|
| Create | str format "a string" "escapes \b\f\n\t\r\" octal \377 hex \ucafe" See also section IO/to string |
| Use | count get subs compare (clojure.string/) join escape split split-lines replace replace-first reverse (1.8) index-of last-index-of |
| Regex | #"pattern" re-find re-seq re-matches re-pattern re-matcher re-groups (clojure.string/) replace replace-first re-quote-replacement Note: \ in #"" is not escape char. (re-pattern "\\s*\\d+") can be written #"\s*\d+" |
| Letters | (clojure.string/) capitalize lower-case upper-case |
| Trim | (clojure.string/) trim trim-newline triml trimr |
| Test | string? (clojure.string/) blank? (1.8) starts-with? ends-with? includes? |

### Other

| | |
|---|---|
| Characters | char char? char-name-string char-escape-string literals: \a \newline (more at link) |
| Keywords | keyword keyword? find-keyword literals: :kw :my.name.space/kw ::in-cur-namespace ::namespace-alias/kw |
| Symbols | symbol symbol? gensym literals: my-sym my.ns/foo |
| Misc | literals: true false nil |

## Collections

### Collections

| | |
|---|---|
| Generic ops | count empty not-empty into conj (clojure.walk/) walk prewalk prewalk-demo prewalk-replace postwalk postwalk-demo postwalk-replace (1.9) bounded-count |
| Content tests | distinct? empty? every? not-every? some not-any? |
| Capabilities | sequential? associative? sorted? counted? reversible? |
| Type tests | coll? list? vector? set? map? seq? record? (1.8) map-entry? |

### Lists (conj, pop, & peek at beginning)

| | |
|---|---|
| Create | () list list* |
| Examine | first nth peek .indexOf .lastIndexOf |
| 'Change' | cons conj rest pop |

### Vectors (conj, pop, & peek at end)

| | |
|---|---|
| Create | [] vector vec vector-of mapv filterv (clojure.core.rrb-vector/) vector vec vector-of |
| Examine | (my-vec idx) → ( nth my-vec idx) get peek .indexOf .lastIndexOf |
| 'Change' | assoc assoc-in pop subvec replace conj rseq update-in (1.7) update |
| Ops | reduce-kv |

### Sets

| | |
|---|---|
| Create unsorted | #{} set hash-set |
| Create sorted | sorted-set sorted-set-by (clojure.data.avl/) sorted-set sorted-set-by (flatland.ordered.set/) ordered-set (clojure.data.int-map/) int-set dense-int-set |
| Examine | (my-set item) → ( get my-set item) contains? |
| 'Change' | conj disj |
| Set ops | (clojure.set/) union difference intersection select See also section Relations |
| Test | (clojure.set/) subset? superset? |
| Sorted sets | rseq subseq rsubseq |

### Maps

| | |
|---|---|
| Create unsorted | {} hash-map array-map zipmap bean frequencies group-by (clojure.set/) index |
| Create sorted | sorted-map sorted-map-by (clojure.data.avl/) sorted-map sorted-map-by (flatland.ordered.map/) ordered-map (clojure.data.priority-map/) priority-map (flatland.useful.map/) ordering-map (clojure.data.int-map/) int-map |
| Examine | (my-map k) → ( get my-map k) also (:key my-map) → ( get my-map :key) get-in contains? find keys vals |
| 'Change' | assoc assoc-in dissoc merge merge-with select-keys update-in (1.7) update (clojure.set/) rename-keys map-invert GitHub: Medley |
| Ops | reduce-kv |
| Entry | key val |
| Sorted maps | rseq subseq rsubseq |

### Queues (conj at end, peek & pop from beginning)

| | |
|---|---|
| Create | clojure.lang.PersistentQueue/EMPTY (no literal syntax or constructor fn) |
| Examine | peek |
| 'Change' | conj pop |

### Relations (set of maps, each with same keys, aka rels)

| | |
|---|---|
| Rel algebra | (clojure.set/) join select project union difference intersection index rename |

### Transients (clojure.org/reference/transients)

| | |
|---|---|
| Create | transient persistent! |
| Change | conj! pop! assoc! dissoc! disj! Note: always use return value for later changes, never original! |

### Misc

| | |
|---|---|
| Compare | = identical? not= not compare clojure.data/diff |
| Test | true? false? instance? nil? some? |

## Sequences

### Creating a Lazy Seq

| | |
|---|---|
| From collection | seq vals keys rseq subseq rsubseq sequence |
| From producer fn | lazy-seq repeatedly iterate |
| From constant | repeat range |
| From other | file-seq line-seq resultset-seq re-seq tree-seq xml-seq iterator-seq enumeration-seq |
| From seq | keep keep-indexed |

### Seq in, Seq out

| | |
|---|---|
| Get shorter | distinct filter remove take-nth for (1.7) dedupe random-sample |
| Get longer | cons conj concat lazy-cat mapcat cycle interleave interpose |
| Tail-items | rest nthrest next fnext nnext drop drop-while take-last for |
| Head-items | take take-while butlast drop-last for |
| 'Change' | conj concat distinct flatten group-by partition partition-all partition-by split-at split-with filter remove replace shuffle |
| Rearrange | reverse sort sort-by compare |
| Process items | map pmap map-indexed mapcat for replace seque |

### Using a Seq

| | |
|---|---|
| Extract item | first second last rest next ffirst nfirst fnext nnext nth nthnext rand-nth when-first max-key min-key |
| Construct coll | zipmap into reduce reductions set vec into-array to-array-2d mapv filterv |
| Pass to fn | apply |
| Search | some filter |
| Force evaluation | doseq dorun doall (1.7) run! |
| Check for forced | realized? |

## Transducers (clojure.org/reference/transducers)

| | |
|---|---|
| Off the shelf | map mapcat filter remove take take-while take-nth drop drop-while replace partition-by partition-all keep keep-indexed map-indexed distinct interpose (1.7) cat dedupe random-sample (1.9) halt-when |
| Create your own | (1.7) completing ensure-reduced unreduced See also section Concurrency/Volatiles |
| Use | into sequence (1.7) transduce eduction |
| Early termination | reduced reduced? deref |

## Spec (rationale, guide)

| | |
|---|---|
| Operations | valid? conform unform explain explain-data explain-str explain-out form describe assert check-asserts check-asserts? |
| Generator ops | gen exercise exercise-fn |
| Defn. & registry | def fdef registry get-spec spec? spec with-gen |
| Logical | and or |
| Collection | coll-of map-of every every-kv keys merge |
| Regex | cat alt * + ? & keys* |
| Range | int-in inst-in double-in int-in-range? inst-in-range? |
| Other | nilable multi-spec fspec conformer |
| Custom explain | explain-printer *explain-out* |

### Predicates with test.check generators

| | |
|---|---|
| Numbers | number? rational? integer? ratio? decimal? float? zero? (1.9) double? int? nat-int? neg-int? pos-int? |
| Symbols, keywords | keyword? symbol? (1.9) ident? qualified-ident? qualified-keyword? qualified-symbol? simple-ident? simple-keyword? simple-symbol? |
| Other scalars | string? true? false? nil? some? (1.9) boolean? bytes? inst? uri? uuid? |
| Collections | list? map? set? vector? associative? coll? sequential? seq? empty? (1.9) indexed? seqable? |
| Other | (1.9) any? |

## IO

| | |
|---|---|
| to/from ... | spit slurp (to writer/from reader, Socket, string with file name, URI, etc.) |
| to *out* | pr prn print printf println newline (clojure.pprint/) print-table |
| to writer | (clojure.pprint/) pprint cl-format also: (binding [*out* writer] ...) |
| to string | format with-out-str pr-str prn-str print-str println-str |
| from *in* | read-line (clojure.tools.reader.edn/) read |
| from reader | line-seq (clojure.tools.reader.edn/) read also: (binding [*in* reader] ...) java.io.Reader |
| from string | with-in-str (clojure.tools.reader.edn/) read-string |
| Open | with-open (clojure.java.io/) text: reader writer binary: input-stream output-stream |
| Binary | (.write ostream byte-arr) (.read istream byte-arr) java.io.OutputStream java.io.InputStream GitHub: gloss byte-spec |
| Misc | flush (.close s) file-seq *in* *out* *err* (clojure.java.io/) file copy delete-file resource as-file as-url as-relative-path GitHub: fs |
| Data readers | *data-readers* default-data-readers *default-data-reader-fn* |

## Functions

| | |
|---|---|
| Create | `fn defn defn- definline identity constantly memfn comp complement partial juxt memoize fnil every-pred some-fn` |
| Call | `apply -> ->> trampoline as-> cond-> cond->> some-> some->>` |
| Test | `fn? ifn?` |

## Abstractions (Clojure type selection flowchart)

### Protocols (clojure.org/reference/protocols)

| | |
|---|---|
| Define | `( defprotocol Slicey (slice [at]))` |
| Extend | `( extend-type String Slicey (slice [at] ...))` |
| Extend null | `( extend-type nil Slicey (slice [_] nil))` |
| Reify | `( reify Slicey (slice [at] ...))` |
| Test | `satisfies? extends?` |
| Other | `extend extend-protocol extenders` |

### Records (clojure.org/reference/datatypes)

| | |
|---|---|
| Define | `( defrecord Pair [h t])` |
| Access | `(:h (Pair. 1 2))` → `1` |
| Create | `Pair. ->Pair map->Pair` |
| Test | `record?` |

### Types (clojure.org/reference/datatypes)

| | |
|---|---|
| Define | `( deftype Pair [h t])` |
| Access | `(.h (Pair. 1 2))` → `1` |
| Create | `Pair. ->Pair` |
| With methods | `( deftype Pair [h t]`<br>`  Object`<br>`  (toString [this] (str "<" h "," t ">")))` |

### Multimethods (clojure.org/reference/multimethods)

| | |
|---|---|
| Define | `( defmulti my-mm dispatch-fn)` |
| Method define | `( defmethod my-mm :dispatch-value [args] ...)` |
| Dispatch | `get-method methods` |
| Remove | `remove-method remove-all-methods` |
| Prefer | `prefer-method prefers` |
| Relation | `derive underive isa? parents ancestors descendants make-hierarchy` |

## Macros

| | |
|---|---|
| Create | `defmacro definline` |
| Debug | `macroexpand-1 macroexpand (clojure.walk/) macroexpand-all` |
| Branch | `and or when when-not when-let when-first if-not if-let cond condp case when-some if-some` |
| Loop | `for doseq dotimes while` |
| Arrange | `.. doto -> ->> as-> cond-> cond->> some-> some->>` |
| Scope | `binding locking time with-in-str with-local-vars with-open with-out-str with-precision with-redefs with-redefs-fn` |
| Lazy | `lazy-cat lazy-seq delay` |
| Doc. | `assert comment doc` |

## Special Characters (clojure.org/reference/reader, guide)

| | |
|---|---|
| `,` | Comma reads as white space. Often used between map key/value pairs for readability. |
| `'` | `quote: 'form` → `( quote form)` |
| `/` | Namespace separator (see Primitives/Other section) |
| `\` | Character literal (see Primitives/Other section) |
| `:` | Keyword (see Primitives/Other section) |
| `;` | Single line comment |
| `^` | Metadata (see Metadata section) |
| `*foo*` | 'earmuffs' - convention to indicate dynamic vars, compiler warns if not dynamic |
| `@` | `Deref: @form` → `( deref form)` |
| `` ` `` | Syntax-quote |
| `foo#` | 'auto-gensym', consistently replaced with same auto-generated symbol everywhere inside same `( ... ) |
| `~` | Unquote |
| `~@` | Unquote-splicing |
| `->` | 'thread first' macro -> |
| `->>` | 'thread last' macro ->> |
| `>!! <!! >! <!` | `core.async channel macros >!! <!! >! <!` |
| `(` | List literal (see Collections/Lists section) |
| `[` | Vector literal (see Collections/Vectors section) |
| `{` | Map literal (see Collections/Maps section) |
| `#'` | `Var-quote #'x` → `( var x)` |
| `#"` | `#"`*p*`"` reads as regex pattern *p* (see Strings/Regex section) |
| `#{` | Set literal (see Collections/Sets section) |
| `#(` | `Anonymous function literal: #(...)` → `(fn [args] (...))` |
| `%` | `Anonymous function argument: %N` is value of anonymous function arg N. `%` short for `%1`. `%&` for rest args. |
| `#?` | (1.7) Reader conditional: `#?(:clj x :cljs y)` reads as x on JVM, y in ClojureScript, nothing elsewhere. Other keys: `:cljr :default` |
| `#?@` | (1.7) Splicing reader conditional: `[1 #?@(:clj [x y] :cljs [w z]) 3]` reads as `[1 x y 3]` on JVM, `[1 w z 3]` in ClojureScript, `[1 3]` elsewhere. |
| `#foo` | tagged literal e.g. `#inst #uuid` |
| `$` | `JavaContainerClass$InnerClass` |
| `foo?` | conventional ending for a predicate, e.g.: `zero? vector? instance?` (unenforced) |
| `foo!` | conventional ending for an unsafe operation, e.g.: `set! swap! alter-meta!` (unenforced) |
| `_` | conventional name for an unused value (unenforced) |
| `#_` | Ignore next form |

## Metadata (clojure.org/reference/reader, special_forms)

| | |
|---|---|
| General | `^{:key1 val1 :key2 val2 ...}` |
| Abbrevs | `^Type` → `^{:tag Type}`, `^:key` → `^{:key true}` |
| Common | `^:dynamic ^:private ^:doc ^:const` |
| Examples | `(defn ^:private ^String my-fn ...)  (def ^:dynamic *dyn-var* val)` |
| On Vars | `meta with-meta vary-meta alter-meta! reset-meta! doc find-doc test` |

## Special Forms (clojure.org/reference/special_forms)

`def if do let letfn quote var fn loop recur set!  throw try monitor-enter monitor-exit`

| | |
|---|---|
| Binding Forms / Destructuring | `(examples) let fn defn defmacro loop for doseq if-let when-let if-some when-some` |

## Vars and global environment (clojure.org/reference/vars)

| | |
|---|---|
| Def variants | `def defn defn- definline defmacro defmethod defmulti defonce defrecord` |
| Interned vars | `declare intern binding find-var var` |
| Var objects | `with-local-vars var-get var-set alter-var-root var? bound? thread-bound?` |
| Var validators | `set-validator! get-validator` |

## Namespace

| | |
|---|---|
| Current | `*ns*` |
| Create/Switch | `(tutorial) ns in-ns create-ns` |
| Add | `alias def import intern refer` |
| Find | `all-ns find-ns` |
| Examine | `ns-name ns-aliases ns-map ns-interns ns-publics ns-refers ns-imports` |
| From symbol | `resolve ns-resolve namespace the-ns` |
| Remove | `ns-unalias ns-unmap remove-ns` |

## Loading

| | |
|---|---|
| Load libs | `(tutorial) require use import refer` |
| List loaded | `loaded-libs` |
| Load misc | `load load-file load-reader load-string` |

## Concurrency

| | |
|---|---|
| Atoms | `atom swap! reset! compare-and-set! (1.9) swap-vals! reset-vals!` |
| Futures | `future future-call future-done? future-cancel future-cancelled? future?` |
| Threads | `bound-fn bound-fn* get-thread-bindings push-thread-bindings pop-thread-bindings thread-bound?` |
| Volatiles | `(1.7) volatile! vreset! vswap! volatile?` |
| Misc | `locking pcalls pvalues pmap seque promise deliver` |

### Refs and Transactions (clojure.org/reference/refs)

| | |
|---|---|
| Create | `ref` |
| Examine | `deref @` (`@form` → `(deref form)`) |
| Transaction | `sync dosync io!` |
| In transaction | `ensure ref-set alter commute` |
| Validators | `set-validator! get-validator` |
| History | `ref-history-count ref-min-history ref-max-history` |

### Agents and Asynchronous Actions (clojure.org/reference/agents)

| | |
|---|---|
| Create | `agent` |
| Examine | `agent-error` |
| Change state | `send send-off restart-agent send-via set-agent-send-executor! set-agent-send-off-executor!` |
| Block waiting | `await await-for` |
| Ref validators | `set-validator! get-validator` |
| Watchers | `add-watch remove-watch` |
| Thread handling | `shutdown-agents` |
| Error | `error-handler set-error-handler! error-mode set-error-mode!` |
| Misc | `*agent* release-pending-sends` |

## Java Interoperation (clojure.org/reference/java_interop)

| | |
|---|---|
| General | `.. doto Classname/ Classname. new bean comparator enumeration-seq import iterator-seq memfn set! class class? bases supers type gen-class gen-interface definterface` |
| Cast | `boolean byte short char int long float double bigdec bigint num cast biginteger` |
| Exceptions | `throw try catch finally pst ex-info ex-data (1.9) StackTraceElement->vec` |

### Arrays

| | |
|---|---|
| Create | `make-array object-array boolean-array byte-array short-array char-array int-array long-array float-array double-array aclone to-array to-array-2d into-array` |
| Use | `aget aset aset-boolean aset-byte aset-short aset-char aset-int aset-long aset-float aset-double alength amap areduce` |
| Cast | `booleans bytes shorts chars ints longs floats doubles` |

### Proxy (Clojure type selection flowchart)

| | |
|---|---|
| Create | `proxy get-proxy-class construct-proxy init-proxy` |
| Misc | `proxy-mappings proxy-super update-proxy` |

### Zippers (clojure.zip/)

| | |
|---|---|
| Create | `zipper seq-zip vector-zip xml-zip` |
| Get loc | `up down left right leftmost rightmost` |
| Get seq | `lefts rights path children` |
| 'Change' | `make-node replace edit insert-child insert-left insert-right append-child remove` |
| Move | `next prev` |
| Misc | `root node branch? end?` |

## Other

| | |
|---|---|
| XML | `clojure.xml/parse xml-seq` |
| REPL | `*1 *2 *3 *e *print-dup* *print-length* *print-level* *print-meta* *print-readably*` |
| Code | `*compile-files* *compile-path* *file* *warn-on-reflection* compile loaded-libs test` |
| Misc | `eval force hash name *clojure-version* clojure-version *command-line-args*` |
| Browser / Shell | (clojure.java.browse/) `browse-url` (clojure.java.shell/) `sh with-sh-dir with-sh-env` |