Parallel all the way

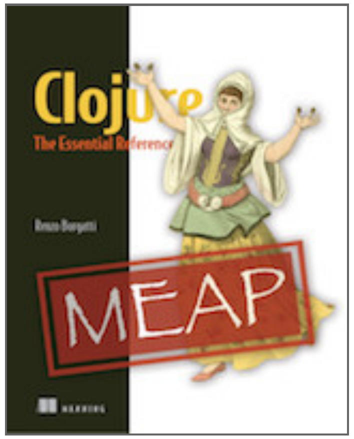
Shall we add a ‘p’?

Clojure eXchange 2018 - Renzo Borgatti - @reborg

About @reborg

- Software Engineer, www.droit.tech
- Of course we’re hiring!
- Organiser of the Papers We Love Meetup
- Clojure Pills on YouTube
- AKA Mr. “About to finish a book…”

When are you done with the book?



- "Clojure: The Essential Reference" by Manning
- 800+ pages, ~1500 hours of work.
- 42% discount with "ssborgatti".
- Content complete by XMas 2018 :)

Context

- Circa 2007-2008
- CPU top speed achieved
- Increasing number of cores
- Push to leverage multiple cores
- FP, The Return

Clojure Parallelism

- Comes with a set of parallel APIs
- `pmap`, `pvalues`, `pcalls` (lazy-sequential-chunked)
- `reducers/fold` (work-stealing fork-join)
- Build your own with `future`, `agent`, etc.
- `core.async` pipelines (external lib)

All nice stuff but

- Low level
- Not necessarily easy to use
- Even more to use correctly
- And what about stateful transducers?
- Dependency on chunk size

Thinking it differently

- Task oriented
- Predictable
- Easy to use
- Like the standard library …

🤔

how i met your mother
CHALLENGE
ACCEPTED

Principles

- Modelling standard library functions
- Drop-in replacement (if possible)
- Transducers support
- New functions on top
- Well documented, benchmarked, tested.

Current Line-up 1/4

Name	Description
`p/let`	Parallel `let` binding.
`p/slurp`	Parallel slurping files.
`p/do`	Parallel `do` forms.
`p/doto`	Parallel `doto` forms.
`p/count`	Transducer-aware parallel `core/count`.

Current Line-up 2/4

Name	Description
`p/frequencies`	Parallel `core/frequencies`
`p/group-by`	Parallel `core/group-by`
`p/update-vals`	Updates vals in a map parallel.
`p/sort`	Parallel `core/sort`.
`p/external-sort`	Memory efficient, file-based, parallel merge-sort.

Current Line-up 3/4

Name	Description
`p/fold`	Transducer-aware `r/fold`.
`p/transduce`	`transduce` based on `p/fold`.
`p/process-folder`	Process files in parallel.
`p/min` and `p/max`	Parallel `core/min` and `core/max`.
`p/distinct`	Parallel `core/distinct`

Current Line-up 4/4

Name	Description
`p/amap`	Parallel array transformation.
`p/armap`	Parallel array reversal transformation.
`xf/interleave`	`core/interleave`, transducer version.
`xf/pmap`	`core/pmap`, transducer version.
`xf/identity`	Alternative identity transducer

Quick REPL

Last.FM dataset

- Something more challenging.
- Interesting large data set.
- Play counts for 360k users (1.5G, 1.7M lines tsv)
- Detailed plays for 1k users (2.4G, 1.9M lines tsv)
- User demographics

Approaching the problem

- Laziness: load and process to reduce the dataset.
- Transients: create and return the initial collection.
- Transducers: avoid unnecessary sequence wrapping.
- Careful with eager functions (frequencies, sort, etc.)
- All the best practices and tricks I know!

More Demo

Gotchas #1

- There is definitely hope!
- Hide away complexity
- Parallel is semantically different
- “drop-ins” are just a few

Gotchas #2

- Not suitable for trivial computations
- Or small collections
- Nesting (Or how not to)
- Go mutable as an option
- Always use a profiler!

The Future

- More functions!
- Seamless integration sequential/parallel
- Reading large inputs in parallel (no splits)
- More lifting to files (sort, distinct, etc.)
- GPU? ClojureScript?

Resources

- https://github.com/reborg/parallel the library
- **A Java fork-join framework** paper by Doug Lea
- **Clojure Applied** book contains chapters dedicated to Transducers with core.async pipelines examples.
- **Clojure Essential Reference**, Chapter 7 Reducers and Transducers