Clojure

UNLEASH THE POWER WITHIN
(11 years and counting, a tribute)

fby.by 2019 - Мінск, Беларусь


LONDON PRIDE
GUINNESS
Duvel
Leffe
HONEY DEW
SIERRA NEVADA
ESB
CHIMAY
Hoegaarden
BECKS
Corona Extra
LAKELAND
CERES
13

About @reborg

- Dev at **http://droit.tech**
- Regulations as a service
- It's mainly a Clojure (and other FP) shop
- We're hiring! (NYC/London, please ask)
- Organiser of **Papers We Love London**
- **Clojure Pills** screencast on YouTube
- **http://github.com/reborg/parallel**

We know the basics already

- It’s a Lisp! It’s functional!
- First class persistent data structures
- Great JVM interoperability
- Concurrent and generally fast
- REPL, macros and much more…

Reflecting on 11 years of Clojure

- Innovation, impact, expressiveness…
- What was Clojure able to achieve?
- When it wasn’t, why not?
- The list is long (and subjective)

A word about the examples/demo

- I’m mainly searching for the principles
- Code shown could be about initial sketches
- For any serious development go to latest!
- **Hang tight!** We are going to cover a lot.

2008-2010: Origins.

- **Compojure** (2008) and **Ring** (2009)
- **Leininghen** (2009)
- **Cascalog** (2010)
- -> **Core.Logic** (2010)

Compojure

```
(defroutes app
  (GET "/:x/:y"
       [x y :<< #(Integer/parseInt %)]
    "<h1>Hello World</h1>")
  (route/not-found
    "<h1>Page not found</h1>"))
```

Leiningen

```
(defproject clojure-unleash-power-within-talk "0.1.0-SNAPSHOT"
  :description "Slides and examples."
  :url "github.com/reborg/clojure-unleash-power-within-talk"
  :license {:name "Eclipse Public License"
            :url "http://www.eclipse.org/legal/epl-v10.html"}
  :jvm-opts ["-Xmx1g" "-server"]
  :dependencies [[org.clojure/clojure "1.10.0"]
                 [org.clojure/core.async "0.4.490"]
                 [org.clojure/core.logic "0.8.11"]
                 [criterium "0.4.4"]])
```

Cascalog

```
(?<- (stdout)
     [?word ?count]
     (sentence ?line)
     (tokenise ?line :> ?word)
     (c/count ?count))
```

Core.Logic

- Logic programming implementation (miniKanren)
- Express programs in terms of “relations”
- Prolog-like approach to problem solving
- A tree walk of substitution chains

Core.Logic Demo

- Start REPL
- Open `src/corelogic.clj`
- Evaluate snippets on the fly
- Deeper look: `src/corelogic_basic.clj`
- Bonus: `src/sudoku.clj`

Core.Logic Resources

- **Mini Kanren**
- **Core.Logic Tutorial**
- **Logos Early Sketches**


SPACE IS THE PLACE
SUN RA

2011: Let the fun begin

- **Midje**
- **Storm**
- **Pallet**
- -> **ClojureScript**

Midje

```
(facts "about migration"
  (fact "Migration produces a new left and right map"
    (migrate {:a 1} :a {})
    => {:new-left {} :clashes #{} :new-right {:a 1}})
  (fact "multiple keys can be moved at once"
    (migrate {:a 1, :b 2} :a :b {})
    => {:new-left {} :clashes #{} :new-right {:a 1 :b 2}}))
```

Storm

```
(topology
 {"1" (spout-spec sentence-spout)
  "2" (spout-spec (sentence-spout-parameterized
                   ["the cat jumped over the door"
                    "greetings from a faraway land"])
                   :p 2)}
 {"3" (bolt-spec {"1" :shuffle "2" :shuffle}
                 split-sentence
                 :p 5)
  "4" (bolt-spec {"3" ["word"]}
                 word-count
                 :p 6)})
```

Pallet

```
(defn tomcat-deploy
  "Tomcat deploy as ROOT application"
  [request path]
  (-> request
      (tomcat/settings {})
      (tomcat/deploy "ROOT" :local-file path :clear-existing true)))

(defn haproxy
  "haproxy server with app1 on port 80."
  [request]
  (-> request
      (haproxy/install-package)
      (haproxy/configure
       :listen {:app1 {:server-address "0.0.0.0:80"
                       :balance "roundrobin"}})))
```

ClojureScript 1/2

- Initial concept late 2008
- Officially reworked in 2011
- A Clojure to JavaScript compiler
- Core functionality in ~350 LOC

ClojureScript 2/2

- Standard parse-analyze-emit recursion
- The AST is Clojure data structures
- Heavy use of Clojure polymorphism
- The language becomes the DSL!

ClojureScript Demo

- Open up REPL
- (load-file “src/clojurescript.clj”)
- Follow examples at the bottom.

ClojureScript Resources

- **Rationale and Design**
- **Initial Implementation**
- **Main Website**
- **ClojureScript Release Presentation**


Logos Island
Nil Point
Audit Trail
Vast Typeless Traps
Software Pirates Cove
Opaque View
Ivory Towers
Abstraction Peaks
Mother Lode
Code Walk
User Desert
Loophole Lair
IO Stream
Lazy Swamp
Optimization Rapids
Monomorphic Valley
Buggy Bight
Binary Jungle
Cannibals
Critical Path
Impenetrable Pointer Forest
Coral Reef
Memory Leaks
Pfhd Springs
Intermittent Faults
Scope Nest
Slippery Slopes
Performance Tall
Doped Silicon Mines
Guru's Bluff
Compiler Pass
Great Ad-Hoc Volcano
Data Flow
Control Flow
Laptop Beach
Bottomless Methodology Caves
Temple of the Zillionth Feature
Bay of Naïveté
Considerable Coast
Brown-out Current
Electric Sea
N
R
Q
Z

2012: Going enterprise.

- **Core.Typed**
- **EDN**
- **Reducers**
- -> **Codeq**
- -> **Datomic**

Core.Typed

```
(ns codearena.handler
  (:use compojure.core)
  (:require [yesql.core :refer [defquery]]
            [compojure.handler :as handler]
            [compojure.route :as route]
            [ring.middleware.edn :as middleware]
            [clojure.core.typed]))

(let [db-host "localhost"
      db-port 3306
      db-name "codearena"]
  (def db {:classname "com.mysql.jdbc.Driver"
           :subprotocol "mysql"
           :subname (str "//" db-host ":" db-port "/" db-name)
           :user "s"
           :password ""}))

;; Stuff that isn't really important enough to be stored

(def memory-db (atom
                {:blocked {}}))

(defn edn-response [data & [status]]
  {:status (or status 200)
   :headers {"Content-Type" "application/edn"}
   :body (pr-str data)}) []

(defquery q-select-repos "queries/selectrepos.sql")

(defquery q-select-active-repos "queries/selectactiverepos.sql")

(defquery q-select-users "queries/selectusers.sql")

(defn add-blacklist! [req]
  (update-in memory-db assoc-in [:blocked]))

(defn add-comment! [req])

(defn add-rating! [req])

(defn add-repo! [req])

(defn add-user! [req])

(defn view-blacklist [req])

(defn view-repos [req])

-:---  handler.clj    Top (7,34)    Git:master  (Clojure Typed Keys Project Helm Paredit GitGutter cider ElDoc) [???]
```

Extensible Data Notation

- JS: https://github.com/shaunxcode/jsedn
- Go: https://github.com/go-edn/edn
- C++: https://github.com/shaunxcode/edn-cpp
- Haskell: http://hackage.haskell.org/package/hedn
- Scala: https://github.com/martintrojer/edn-scala
- ....

Reducers

```
(defn count-occurrences [words]
  (r/fold
    (r/monoid #(merge-with + %1 %2) (constantly {}))
    (fn [m [k cnt]] (assoc m k (+ cnt (get m k 0))))
    (r/map #(vector % 1) words)))

(defn word-count [s] (count-occurrences (s/split s #"\s+")))
(def war-and-peace "http://www.gutenberg.org/files/2600/2600-0.txt")
(def book (slurp war-and-peace))
(def freqs (word-count book))
(freqs "Andrew")
```

Datomic

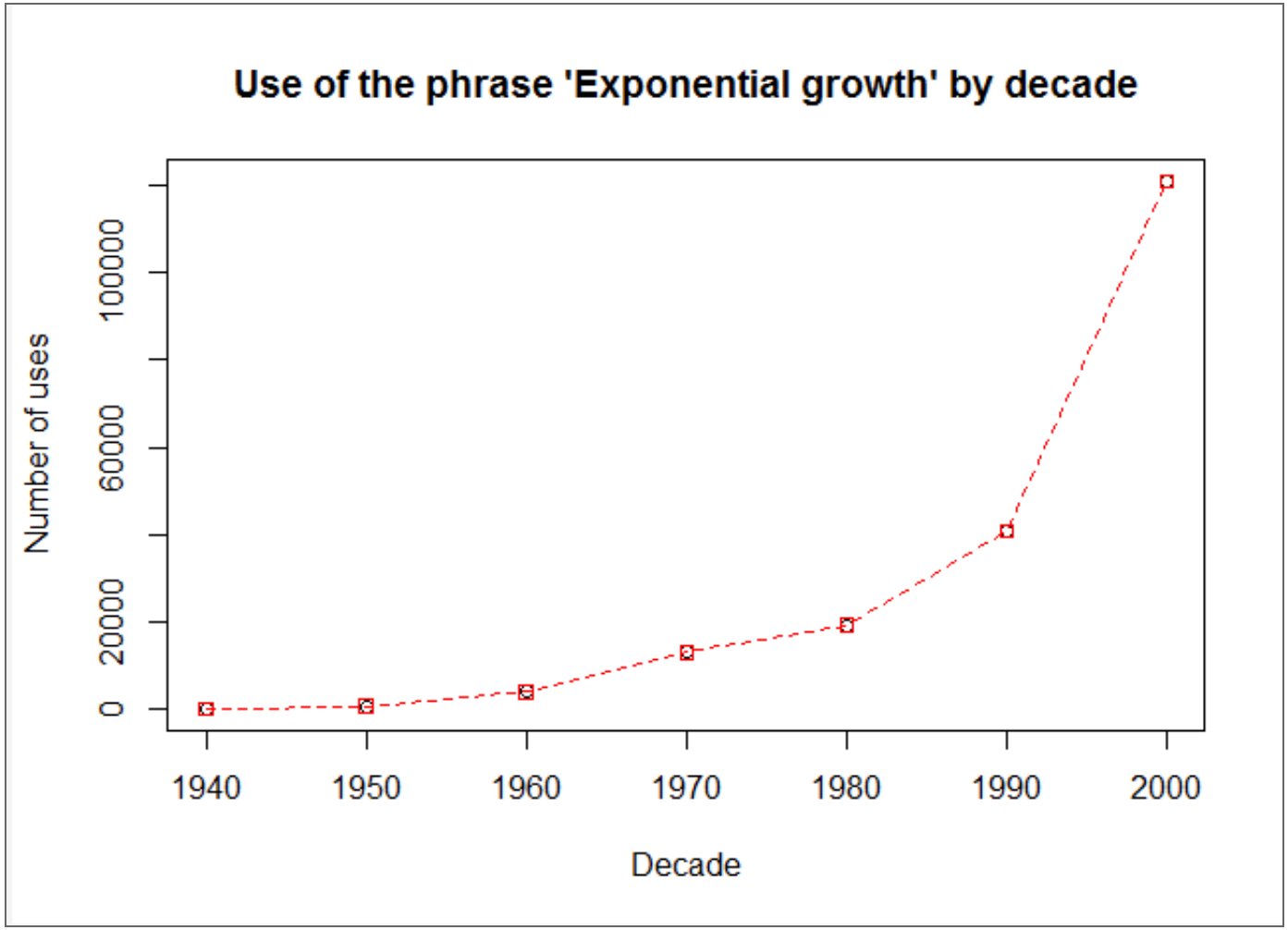
- Distributed, transactional, time-aware DB
- Database as immutable “value”
- Datalog query interface
- RDF inspired relations
- Efficient B-Tree implementation

Codeq

- Semantic analysis of source code
- Functional definitions as unit of change
- Based on Datomic

Datomic Demo

- Run `src/datomic.sh` (done)
- Open up browser at http://localhost:9256/browse
- Open `src/datomic.clj`
- And `src/datomic_codeq.clj`


Use of the phrase 'Exponential growth' by decade
Number of uses
0
20000
60000
100000
1940
1950
1960
1970
1980
1990
2000
Decade

2013: Annus Mirabilis

- **LightTable**
- **CinC**
- **Om**
- **Components**
- -> **Core.Async**

LightTable

- Just a sec, making it bigger.

CinC (aka reader/analyzer/jvm)

```
(ast/nodes (analyze '[1 (+ 1 2)]))
({:op        :vector,
  :top-level true,
  :items
  [{:op   :const,
    :type :number,
    :val  1,
    ...}
   {:op     :static-call,
    :class  clojure.lang.Numbers,
    :method add,
    :form   (. clojure.lang.Numbers (add 1 2)),
    :args   ...,
   ...
```

Om

```
(defui Hello
  Object
  (render [this]
    (dom/h1 nil "Hello, world!")))

(def hello (om/factory Hello))

(.render js/ReactDOM (hello) (gdom/getElement "example"))
```

Stuart Sierra Component

```
(defrecord Database [host port connection]

  component/Lifecycle

  (start [component]
    (println ";; Starting database")
    (let [conn (connect-to-database host port)]
      (assoc component :connection conn)))

  (stop [component]
    (println ";; Stopping database")
    (.close connection)
    (assoc component :connection nil)))
```

Core.Async 1/2

- Beginning of 2013
- Need for non-blocking “await” threads
- Inspired by F#, C# then Scala async/await
- Plus “Channels” from CSP
- Avoid ClojureScript/JS callback hell

Core.Async 2/2

- Transform blocking calls into state assignment
- Parse Clojure into SSA (Static Single Assignment) form
- Create a state for each await/pause/channel write/read
- Run thread (from pool) with callback into state
- Clojure macrology in action!

Core.Async Demo

- Open up REPL
- Open `src/coreasync.clj`
- Follow examples at the bottom.
- Open `src/coreasync_workers.clj`
- More examples at the bottom.

Core.Async Resources

- **Initial version of async/go macro**
- **C Sharp State Machine Writer**
- **What is SSA?**

2014-Today

- **ClojureCLR** (day 1)
- **Arcadia** (2014)
- **Transducers** (2014)
- **Core.Spec** (2016)

ClojureCLR

```
(definterface I1
  (^Int32 m1 [^Int32 x ^String y])
  (^Int32 m1 [^String x ^Int32 y])
  (^Int32 m2 [^Int32 x ^String y]))

(definterface I2
  (^Int32 m1 [#^Int32 x ^String y])
  (^String m2 [#^Int32 x ^String y])
  (m3 [x y]))
```

Arcadia

- Just a sec, making it bigger.

Transducers

```
(def x-form
  (comp
    (comp (map inc)
          (comp (filter even?)
                (mapcat range)))
    (partition-by #(< (apply + %) 7))
    (comp (keep-indexed #(when (even? %1) (* %1 %2)))
          (replace {2 "two" 6 "six" 18 "eighteen"}))
    (take-while #(not= 300 %))
    (drop 1)
    (remove string?)))

(transduce x-form + (vec (interleave (range 18) (range 20))))
```

Core.Spec

```
(def domain
  (gen/fmap #(keyword "my.domain" %)
    (gen/such-that #(not= % "")
      (gen/string-alphanumeric))))

(gen/sample domain 5)
;; (:my.domain/O :my.domain/b
;;   :my.domain/ZH :my.domain/31
;;   :my.domain/U)
```

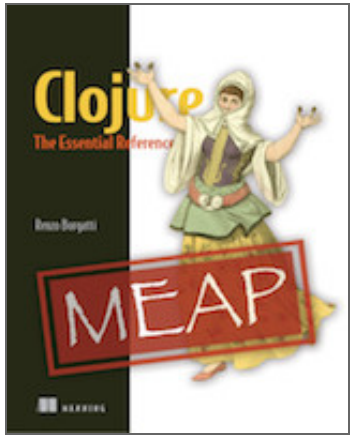
What's next? (IMHO)

- GraalVM
- Formal Verification/STM solvers
- Deep Learning/AI
- What's the killer app?

~ Fin ~

- Questions?

...oh, the book!



- **Clojure: The Essential Reference** by Manning
- 800+ pages, 1500+ man/hours, 3 years effort.
- Writing last chapter!
- **Get 42% discount** with “ssborgatti”
- Thanks!
- Renzo (@reborg)