The Never Changing Face of Immutability

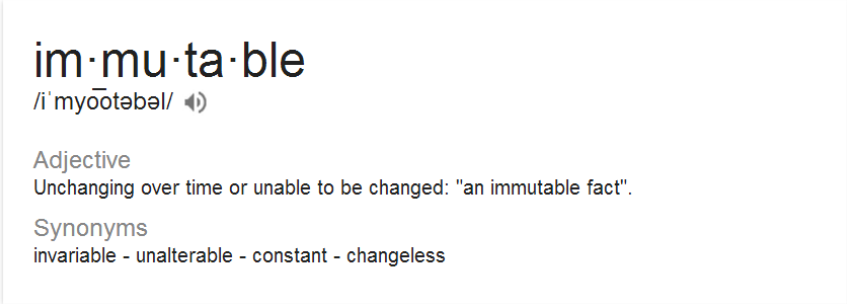
Chris Howe-Jones

15th December 2015

Warning!!

- There will be a Lisp!
- There will be Entomology!
- There will be History!

The Never Changing Face of Immutability



Who am I?

Name: `Chris Howe-Jones`
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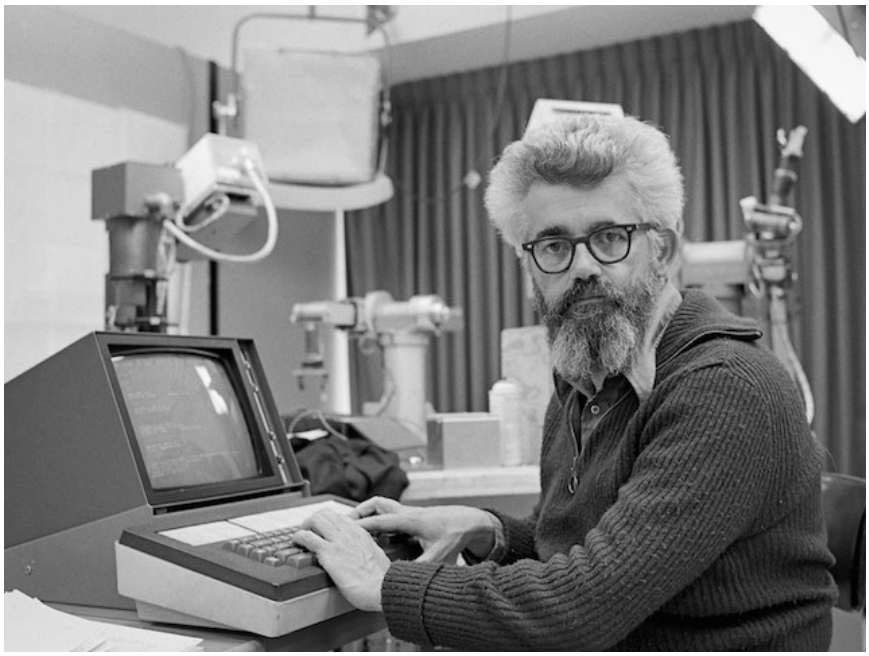
Blog: `chrishowejones.wordpress.com`

Credentials

- 28 years of pushing data around
- Procedural/OOP/FP
- Architecture & Design
- RAD/Agile/Lean
- CTO

History Lesson

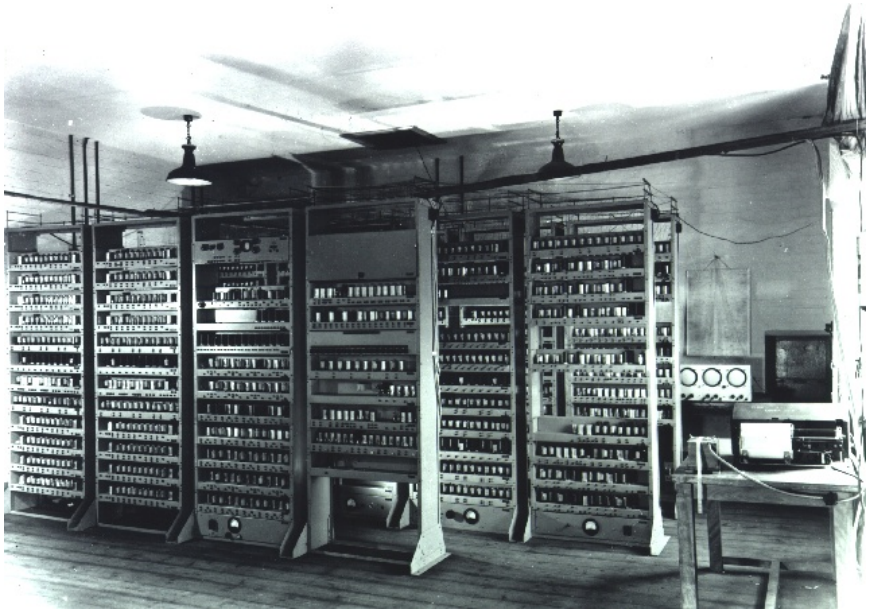


Once upon a time..

Book Keeping

- List of entries in a ledger
- No 'crossing out'!

Dawn of Computing

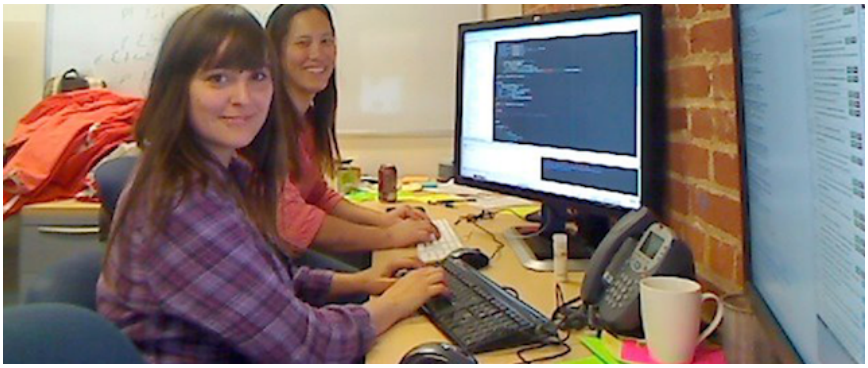


- Math
- Transient storage

60's-90's

- Spot the expense?
- Memory
- Tape
- Disk

21st Century



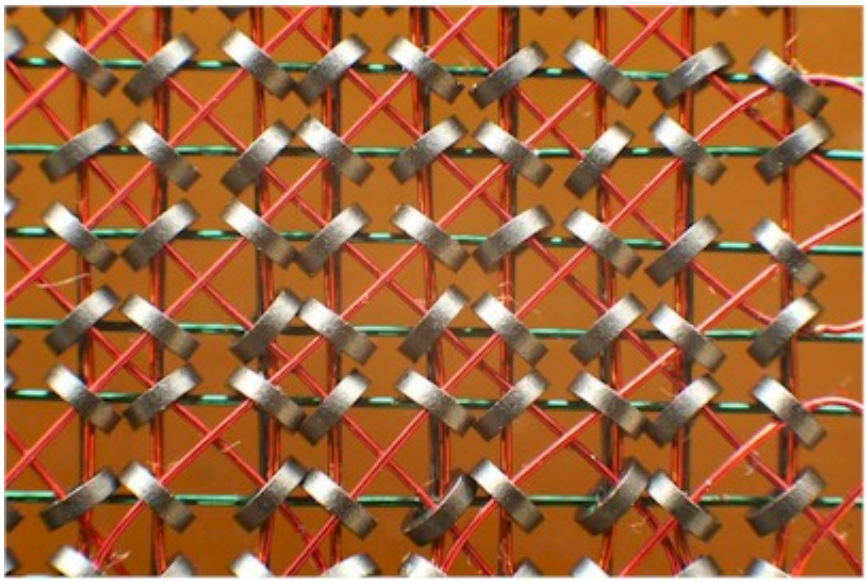
Spot the expense?

- Developers

Cheap resources: SSD/Disk, Memory, CPU

And..

In place computing



- Update data in place
- Reuse expensive real estate

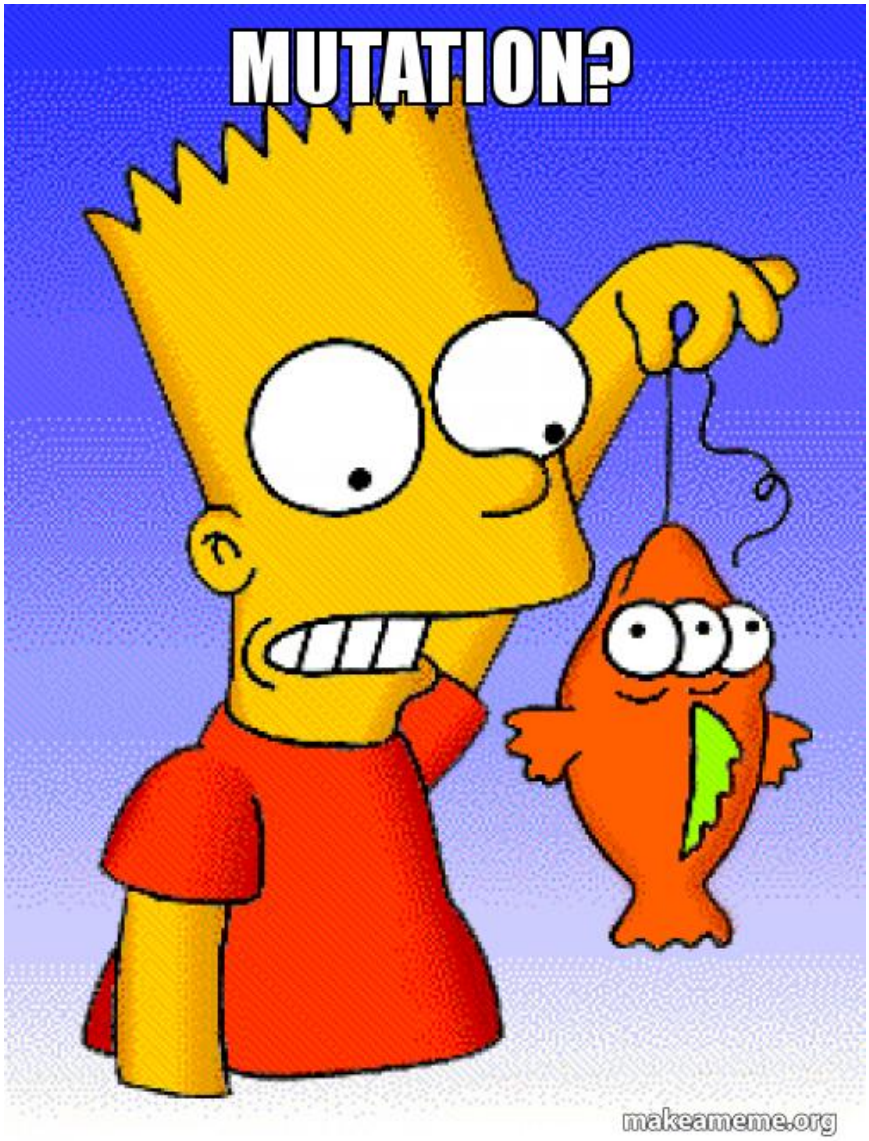
RDBMS

- Data updated
- Values overwritten
- Reuse memory and disk

Result?

In place oriented programming (PLOP) relies on...

Mutation



Which leads to..

complect

transitive verb

Definition of COMPLECT

Popularity: Bottom 20% of words

obsolete
: INTERTWINE, EMBRACE; *especially* : to plait together : INTERWEAVE

Complect

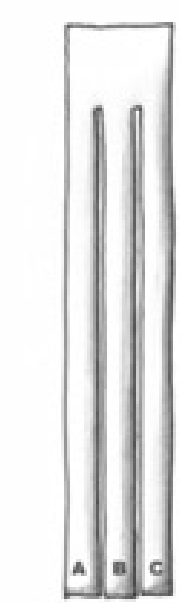


fig. 1

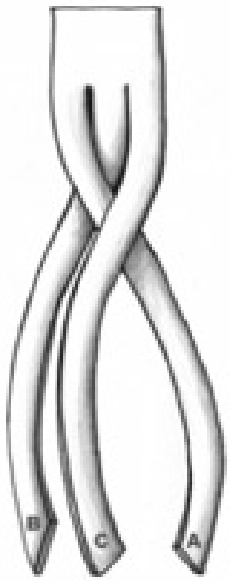


fig. 2

fig. 3

fig. 4

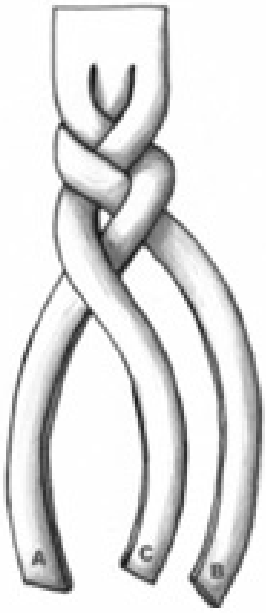


fig. 5

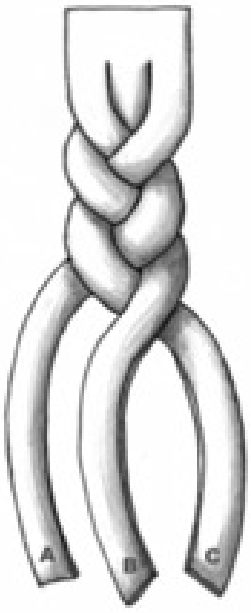


fig. 6

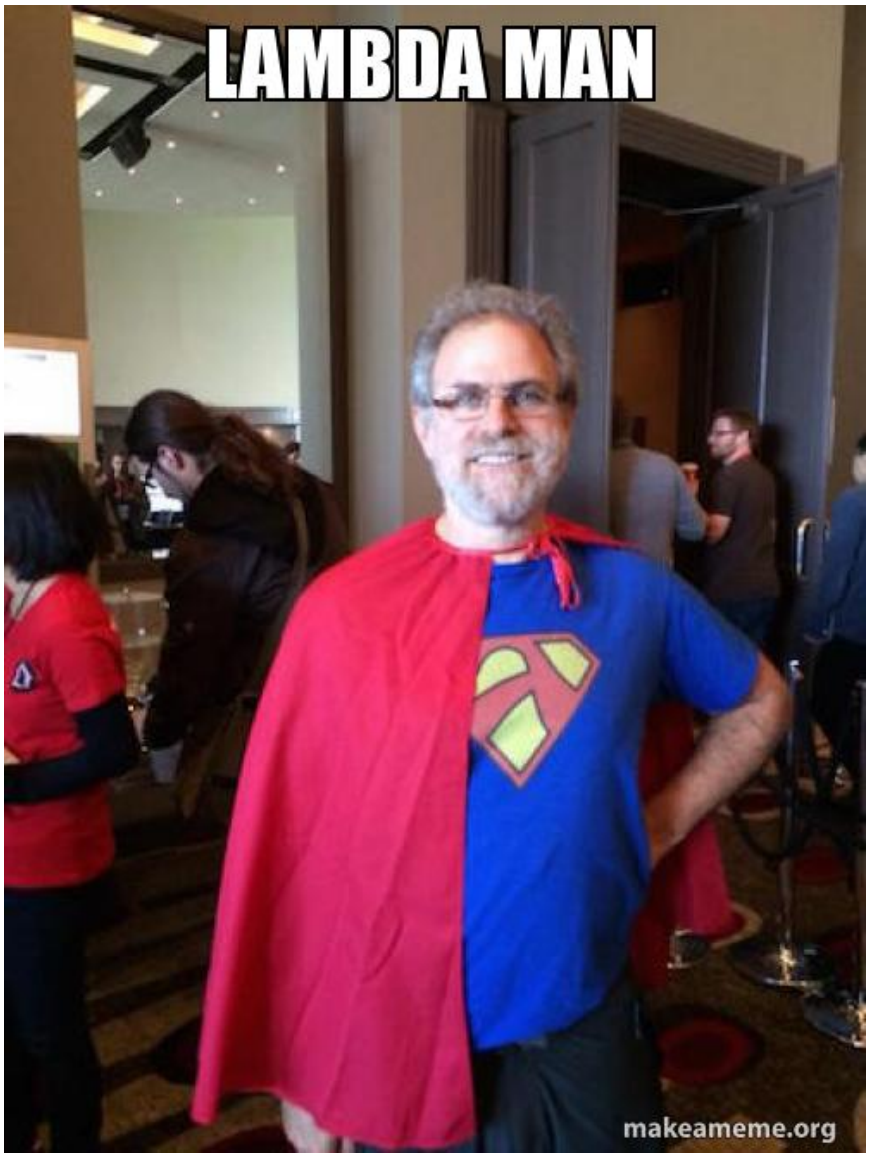
- Complecting Identity & Value
- Especially RDBMS, OOP
- Pessimistic concurrency strategies

What's changed?

`./historical_cost_graph5.gif`

- Computing capacity has increased by a million fold!

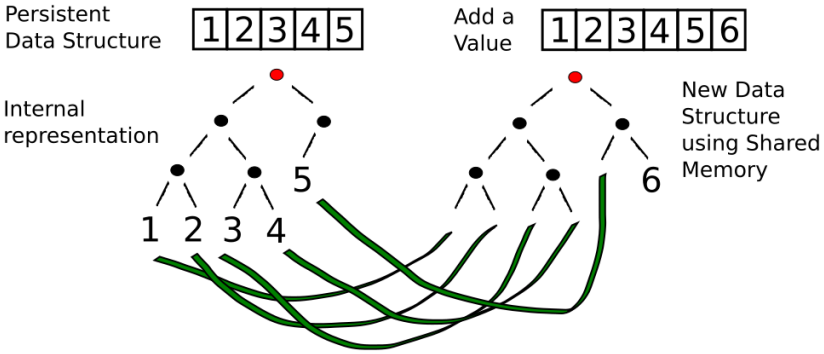
Immutability (and values) to the rescue!



Values

- Values are generic
- Values are easy to fabricate
- Drives reuse
- Values aggregate to values
- Distributable

Isn't copying values inefficient?



- Structural sharing
- For example in Clojure:
  - persistent bit-partitioned vector trie
  - 32 node tries
  - Wide shallow trees

What does it look like?

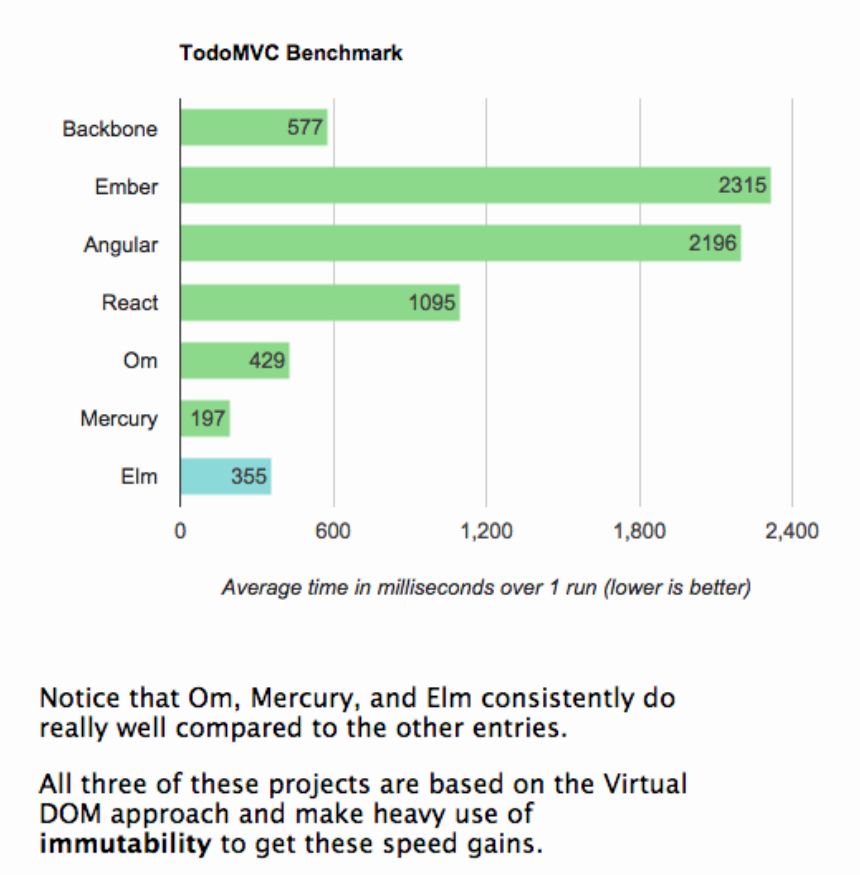
- Immutable by default
- Explicit state change
- Database as a value

ClojureScript on the client

```
(def initial-state
  {:event {:event/name "" :event/speaker ""} :server-state nil})

(defn- event-form
  [ui-channel {:keys [event/name event/speaker] :as event}]
  [:table.table
   [:tr
    [:td [:label "Event name:"]]
    [:td [:input {:type :text
                  :placeholder "Event name..."
                  :defaultValue event/name
                  :on-change (send-value! ui-channel m/->ChangeEventName)}]]]
   [:tr
    [:td [:label "Speaker:"]]
    [:td [:input {:type :text
                  :placeholder "Speaker..."
                  :defaultValue event/speaker
                  :on-change (send-value! ui-channel m/->ChangeEventSpeaker)}]]]
   [:tr
    [:td
     [:button.btn.btn-success
      {:on-click (send! ui-channel (m/->CreateEvent))}
      "Go"]]]])
```

```
(defrecord ChangeEventName [name])

(defrecord ChangeEventSpeaker [speaker])

(defrecord CreateEvent [event])

(defrecord CreateEventResults [body])

(extend-protocol Message
  m/ChangeEventName
  (process-message [{:keys [name]} app]
    (assoc-in app [:event :event/name] name)))
;; redacted for clarity ...

(extend-protocol EventSource
  m/CreateEvent
  (watch-channels [_ {:keys [event]
                      :as app}]
    #{(rest/create-event event)}))

(extend-protocol Message
  m/CreateEventResults
  (process-message [response app]
    (assoc app :server-state (-> response :body))))
```

Efficiency

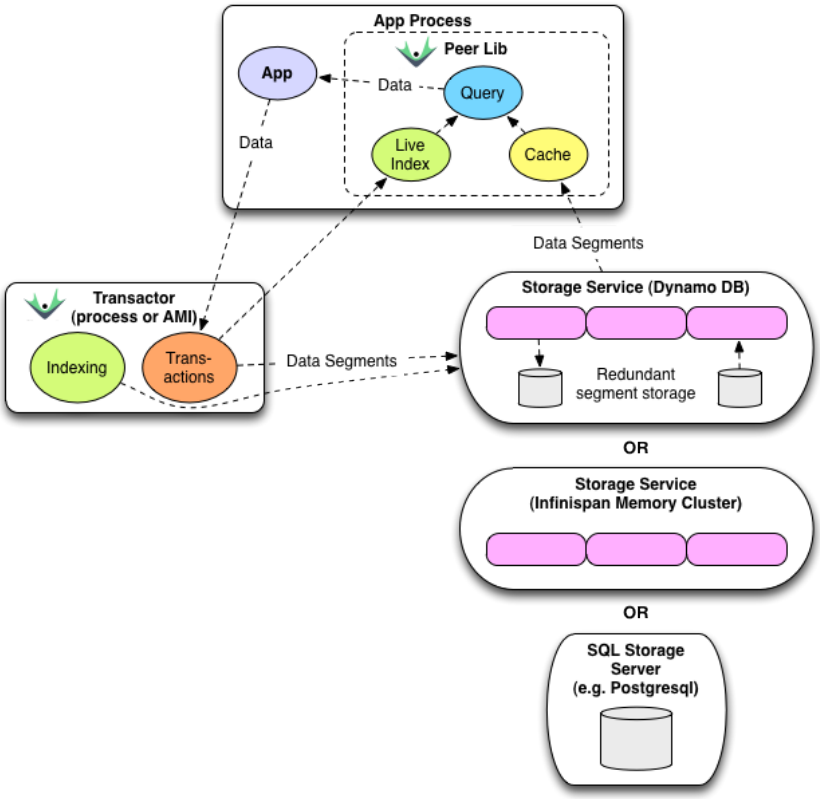


Clojure on the server

```
(defn- handle-query
  [db-conn]
  (fn [{req-body :body-params}]
    {:body (case (:type req-body)
             :get-events (data/get-events db-conn)
             :create-event (data/create-entity db-conn (:txn-data req-body)))}))


(defn app [dbconn]
  (-> (routes
       (GET "/" [] home-page)
```

```
 (POST "/q" []
       (handle-query dbconn))
 (resources "/"))
(wrap-restful-format :formats [:edn :transit-json])
(rmd/wrap-defaults (-> rmd/site-defaults
                       (assoc-in [:security :anti-forgery] false)))))
```

Datomic for Data



- App get's its own query, comms, memory- Each App is a peer

Database as a value

Entity	Attribute	Value	Time
Fiona	likes	Ruby	01/06/2015
Dave	likes	Haskell	25/09/2015
Fiona	likes	Clojure	15/12/2015

- Effectively DB is local
- Datalog query language

```
[:find ?e :where [?e :likes ‘‘Clojure’’]]
```

Schema

```
 ;;event
 {
  :db/id                 #db/id[:db.part/db]
  :db/ident              :event/name
  :db/cardinality        :db.cardinality/one
  :db/valueType          :db.type/string
  :db/unique             :db.unique/identity
  :db.install/_attribute :db.part/db
  }
 {
  :db/id                 #db/id[:db.part/db]
  :db/ident              :event/description
  :db/cardinality        :db.cardinality/one
  :db/valueType          :db.type/string
  :db.install/_attribute :db.part/db
  }
 {
  :db/id                 #db/id[:db.part/db]
  :db/ident              :event/location
  :db/cardinality        :db.cardinality/one
  :db/valueType          :db.type/ref
  :db.install/_attribute :db.part/db
  }
...
```

```
;;location
 {
  :db/id                 #db/id[:db.part/db]
  :db/ident              :location/postCode
  :db/cardinality        :db.cardinality/one
  :db/valueType          :db.type/string
  :db.install/_attribute :db.part/db
  }
 {
  :db/id                 #db/id[:db.part/db]
  :db/ident              :location/description
  :db/cardinality        :db.cardinality/one
  :db/valueType          :db.type/string
  :db.install/_attribute :db.part/db
  }
...
```

Persistence

```
(defn create-entity
  "Takes transaction data and returns the resolved tempid"
  [conn tx-data]
  (let [had-id (contains? tx-data ":db/id")
        data-with-id (if had-id
                       tx-data
                       (assoc tx-data :db/id #db/id[:db.part/user -1000001]))
        tx @(d/transact conn [data-with-id])]
    (if had-id (tx-data ":db/id")
        (d/resolve-tempid (d/db conn) (:tempids tx)
                          (d/tempid :db.part/user -1000001)))))

(defn get-events [db]
  (d/pull-many db [:*]
               (->> (d/q '{:find [?event-id]
                           :where [[?event-id :event/name]]}
                         db)
                    (map first))))
```

Conclusion?

- Immutability simplifies
- State as function call stack
- Mostly pure functions
  - Easier to test & reason about
- Time as first class concept
- Easier to distribute

Resources

- Rich Hickey talks -
  - 'The Value of Values'
  - 'The Language of the System'
  - 'Simple Made Easy'
  - 'Clojure, Made Simple'
  - 'The Database as a Value'
  - 'The Language of Systems'
- Moseley and Marks - Out of the Tar Pit

- Kris Jenkins
  - 'ClojureScript - Architecting for Scale' (Clojure eXchange 2015)