Server-side web-development

with Duct & Integrant

Integrant What?

"Integrant is a Clojure (and ClojureScript) micro-framework for building applications with data-driven architecture."

- A way to define “lifecycles” for component
- “init” and “halt” functions
- Like Stuart Sierra’s Component, but:
  - Multimethods instead of Protocols
  - Leverages “derive” relationships
  - Built-in easy EDN config

Duct What?

"Duct is a highly modular framework for building server-side applications in Clojure using data-driven architecture."

- A “framework” that gives you:
  - A project template
  - Common functionality
  - A small amount of structure
  - A set of premade modules
  - “Reloaded” workflow
- Based on Integrant

What to Build?

- Server-side REST API
- Hacker News style site
- Using Duct’s defaults

We will use HTTPie to interact our API
https://httpie.org/

What to Build?

Stories

- Get list of stories

  GET /

- Submit new story

  POST /stories

- Upvote a story

  POST /stories/<*id*>/votes

Comments

- Get list of comments for story

  GET /stories/<*id*>/comments

- Add new comment to story

  POST /stories/<*id*>/comments

- Upvote a comment

  POST /stories/<*id*>/comments/<*id*>/votes

Getting Started

```
lein new duct duct-talk +api +sqlite +ataraxy +example
```

- +api Add API middleware and handler
- +sqlite Add SQLite dependency and component
- +ataraxy Add Duct's Ataraxy request router
- +example Add an example handler

Using the REPL

```
cd duct-talk
lein duct setup
lein repl
```

```
user=> (dev)
dev=> (go)
```

To reload after making changes:

```
dev=> (reset)
```

```
http localhost:3000/example
```

```
HTTP/1.1 200 OK
Content-Length: 18
Content-Type: application/json;
charset=utf-8
Date: Tue, 03 Sep 2019 13:19:35 GMT
Server: Jetty(9.2.21.v20170120)

{
    "example": "data"
}
```

Duct Configuration

Duct template sets up configuration with multiple profiles

- Base configuration: core config and modules

  resources/duct_talk/config.edn
- Dev configuration: development profile

  dev/resources/dev.edn
- Local configuration: local profile, not comitted to git

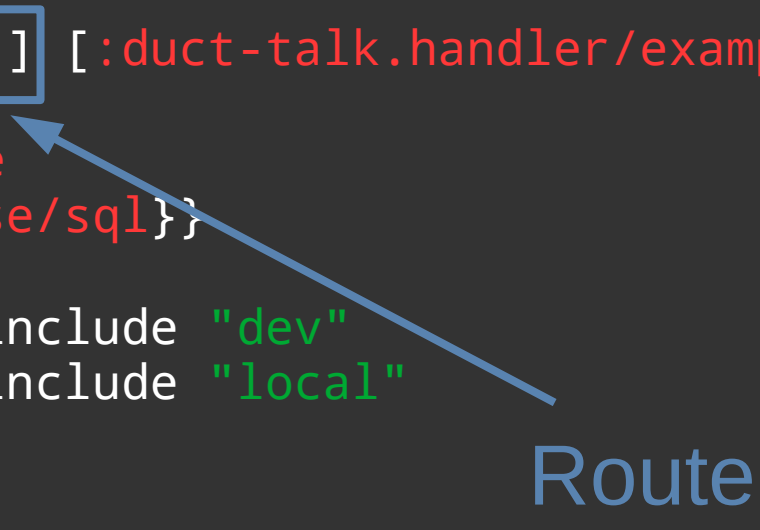
  dev/resources/local.edn

Base Configuration

```
{:duct.profile/base
 {:duct.core/project-ns duct-talk

  :duct.router/ataraxy
  {:routes {[:get "/example"] [:duct-talk.handler/example]}}

  :duct-talk.handler/example
  {:db #ig/ref :duct.database/sql}}

 :duct.profile/dev   #duct/include "dev"
 :duct.profile/local #duct/include "local"
 :duct.profile/prod  {}

 :duct.module/logging {}
 :duct.module.web/api {}
 :duct.module/sql {}}
```

Base Configuration

```
{:duct.profile/base
 {:duct.core/project-ns duct-talk

  :duct.router/ataraxy
  {:routes {[:get "/example"] [:duct-talk.handler/example]}}

  :duct-talk.handler/example
  {:db #ig/ref :duct.database/sql}}

 :duct.profile/dev   #duct/include "dev"
 :duct.profile/local #duct/include "local"
 :duct.profile/prod  {}

 :duct.module/logging {}
 :duct.module.web/api {}
 :duct.module/sql {}}
```



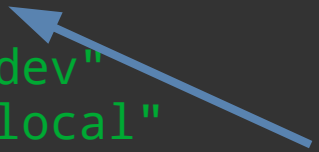
Base Configuration

```
{:duct.profile/base
 {:duct.core/project-ns duct-talk

  :duct.router/ataraxy
  {:routes {[:get "/example"] [:duct-talk.handler/example]}}

  :duct-talk.handler/example
  {:db #ig/ref :duct.database/sql}}

  :duct.profile/dev   #duct/include "dev"
  :duct.profile/local #duct/include "local"
  :duct.profile/prod  {}

  :duct.module/logging {}
  :duct.module.web/api {}
  :duct.module/sql {}}
```

Handler Component

Base Configuration

```
{:duct.profile/base
 {:duct.core/project-ns duct-talk

  :duct.router/ataraxy
  {:routes {[:get "/example"] [:duct-talk.handler/example]}}

  :duct-talk.handler/example
  {:db #ig/ref :duct.database/sql}}

 :duct.profile/dev   #duct/include "dev"
 :duct.profile/local #duct/include "local"
 :duct.profile/prod  {}

 :duct.module/logging {}
 :duct.module.web/api {}
 :duct.module/sql {}}
```



Dependency on Database component

Dev Configuration

```
{:duct.database/sql
 {:connection-uri "jdbc:sqlite:db/dev.sqlite"}}
```

Handler Component

```
(ns duct-talk.handler.example
  (:require [ataraxy.core :as ataraxy]
            [ataraxy.response :as response]
            [integrant.core :as ig]))

(defmethod ig/init-key :duct-talk.handler/example
  [_ options]
  (fn [{[_] :ataraxy/result}]
    [::response/ok {:example "data"}]))
```

Add Routes for Stories

```
{:duct.profile/base
 {:duct.core/project-ns duct-talk}

 :duct.profile/dev   #duct/include "dev"
 :duct.profile/local #duct/include "local"
 :duct.profile/prod  {}

 :duct.module/ataraxy
 {"/" {:get [:stories/index]
       "stories" {:post [:stories/submit]
                  [:post "/" ^int story-d "/votes"] [:stories/upvote story-id]}}}

 :duct.module/logging {}
 :duct.module.web/api {}
 :duct.module/sql {}}
```

Add Handler Components for Stories

```
{:duct.profile/base
 {:duct.core/project-ns duct-talk
  :duct-talk.handler.stories/index
  {:db #ig/ref :duct.database/sql}

  :duct-talk.handler.stories/submit
  {:db #ig/ref :duct.database/sql}

  :duct-talk.handler.stories/upvote
  {:db #ig/ref :duct.database/sql}}


 :duct.profile/dev   #duct/include "dev"
 :duct.profile/local #duct/include "local"
 :duct.profile/prod  {}

...
```

Add Handler Logic

```clojure
(ns duct-talk.handler.stories
  (:require [ataraxy.core :as ataraxy]
            [ataraxy.response :as response]
            [integrant.core :as ig]))

(defmethod ig/init-key ::index
  [_ options]
  (fn [{[_] :ataraxy/result}]
    [::response/ok []]))

(defmethod ig/init-key ::submit
  [_ options]
  (fn [{[_] :ataraxy/result}]
    [::response/ok "submitted"]))

(defmethod ig/init-key ::upvote
  [_ options]
  (fn [{[_] :ataraxy/result}]
    [::response/ok "voted"]))
```

Demo

Reload changes:

dev=> (reset)

http GET localhost:3000/

HTTP/1.1 200 OK
Content-Length: 2
Content-Type: application/json;
charset=utf-8
Date: Tue, 03 Sep 2019 15:57:12 GMT
Server: Jetty(9.2.21.v20170120)

[ ]

http GET localhost:3000/stories

{
    "error": "method-not-allowed"
}

http POST localhost:3000/stories

submitted

http POST localhost:3000/stories/1

voted

Add Database Migrations

```
{:duct.profile/base
 {:duct.core/project-ns duct-talk
  :duct-talk.handler.stories/index
  {:db #ig/ref :duct.database/sql}

  :duct-talk.handler.stories/submit
  {:db #ig/ref :duct.database/sql}

  :duct-talk.handler.stories/upvote
  {:db #ig/ref :duct.database/sql}

  [:duct.migrator.ragtime/sql :migrations/init-stories]
  {:up   [#duct/resource "migrations/init-stories.up.sql"]
   :down [#duct/resource "migrations/init-stories.down.sql"]}

  :duct.migrator/ragtime
  {:migrations [#ig/ref :migrations/init-stories]}}

...
```

Migration SQL

resources/migrations/init-stories.up.sql

```
CREATE TABLE stories (
  id INTEGER PRIMARY KEY,
  title TEXT NOT NULL,
  url TEXT NOT NULL,
  votes INTEGER DEFAULT 0
);
```

resources/migrations/init-stories.down.sql

```
DROP TABLE stories;
```

Boundaries

"Boundaries not only allow you to control how data enters and exits your application; boundaries are also useful for testing."

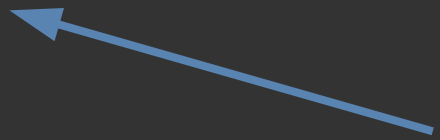
- Protocol
- Interface to an external service
- Should be split by purpose
- Should hide implementation details

Stories Boundary

```clojure
(ns duct-talk.boundaries.stories
  (:require [duct.database.sql]
            [hugsql.core :as hugsql]))

(hugsql/def-db-fns "duct_talk/boundaries/stories.sql")

(defprotocol Stories
  (index [db])
  (create! [db title url])
  (upvote! [db id]))

(extend-protocol Stories
  duct.database.sql.Boundary
  (index [{db :spec}]
    (list-stories db))

  (create! [{db :spec} title link]
    (create-story! db {:title title
                       :link link}))

  (upvote! [{db :spec} id]
    (upvote-story! db {:id id})))
```

Stories Boundary

```clojure
(ns duct-talk.boundaries.stories
  (:require [duct.database.sql]
            [hugsql.core :as hugsql]))

(hugsql/def-db-fns "duct_talk/boundaries/stories.sql")

(defprotocol Stories
  (index [db])
  (create! [db title url])
  (upvote! [db id]))

(extend-protocol Stories
  duct.database.sql.Boundary
  (index [{db :spec}]
    (list-stories db))

  (create! [{db :spec} title link]
    (create-story! db {:title title
                       :link link}))

  (upvote! [{db :spec} id]
    (upvote-story! db {:id id})))
```

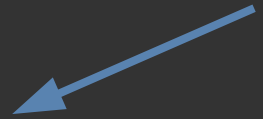


Boundary Protocol

Stories Boundary

```clojure
(ns duct-talk.boundaries.stories
  (:require [duct.database.sql]
            [hugsql.core :as hugsql]))

(hugsql/def-db-fns "duct_talk/boundaries/stories.sql")

(defprotocol Stories
  (index [db])
  (create! [db title url])
  (upvote! [db id]))
```

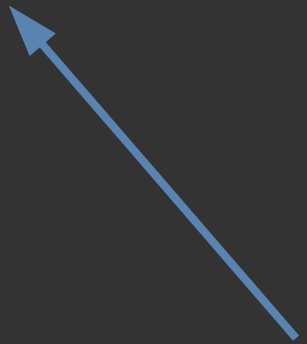
```clojure
(extend-protocol Stories
  duct.database.sql.Boundary
  (index [{db :spec}]
    (list-stories db))

  (create! [{db :spec} title link]
    (create-story! db {:title title
                       :link link}))

  (upvote! [{db :spec} id]
    (upvote-story! db {:id id})))
```



Boundary
Implementation for SQL

Stories Boundary

```clojure
(ns duct-talk.boundaries.stories
  (:require [duct.database.sql]
            [hugsql.core :as hugsql]))

(hugsql/def-db-fns "duct_talk/boundaries/stories.sql")

(defprotocol Stories
  (index [db])
  (create! [db title url])
  (upvote! [db id]))

(extend-protocol Stories
  duct.database.sql.Boundary
  (index [{db :spec}]
    (list-stories db))

  (create! [{db :spec} title link]
    (create-story! db {:title title
                       :link link}))

  (upvote! [{db :spec} id]
    (upvote-story! db {:id id})))
```



SQL file of queries, using HugSQL

SQL Queries for Stories

`duct_talk/boundaries/stories.sql`

```
-- :name list-stories :?
-- :doc Retrieve list of all stories
select id, title, url, votes from stories;

-- :name create-story! :!
-- :doc Create a new story submission
insert into stories (title, url) values (:title, :link);

-- :name upvote-story! :!
-- :doc Increment the vote count for a story
update stories set votes = votes + 1 where id = :id;
```

Update Handler Logic

```clojure
(ns duct-talk.handler.stories
  (:require [ataraxy.core :as ataraxy]
            [ataraxy.response :as response]
            [integrant.core :as ig]
            [duct-talk.boundaries.stories :as stories]))

(defmethod ig/init-key ::index
  [_ {:keys [db]}]
  (fn [_]
    [::response/ok (stories/index db)]))

(defmethod ig/init-key ::submit
  [_ {:keys [db]}]
  (fn [{{:keys [title link]} :body-params}]
    (stories/create! db title link)
    [::response/ok "submitted"]))

(defmethod ig/init-key ::upvote
  [_ {:keys [db]}]
  (fn [{{id :story-id} :route-params}]
    (stories/upvote! db id)
    [::response/ok "voted"]))
```

Demo

```
http GET localhost:3000/

[ ]

http POST localhost:3000/stories "title=New Story" link=https://google.com

submitted

http GET localhost:3000/

[
    {
        "id": 1,
        "title": "New Story",
        "url": "https://google.com",
        "votes": 0
    }
]
```

Add Database Migrations

```
...

  :duct-talk.handler.stories/upvote
  {:db #ig/ref :duct.database/sql}

  [:duct.migrator.ragtime/sql :migrations/init-stories]
  {:up   [#duct/resource "migrations/init-stories.up.sql"]
   :down [#duct/resource "migrations/init-stories.down.sql"]}

  [:duct.migrator.ragtime/sql :migrations/init-comments]
  {:up   [#duct/resource "migrations/init-comments.up.sql"]
   :down [#duct/resource "migrations/init-comments.down.sql"]}

  :duct.migrator/ragtime
  {:migrations [#ig/ref :migrations/init-stories
                #ig/ref :migrations/init-comments]}}

...
```

Migration SQL

resources/migrations/init-comments.up.sql

```
CREATE TABLE comments (
  id INTEGER PRIMARY KEY,
  story_id INTEGER NOT NULL,
  comment TEXT NOT NULL,
  votes INTEGER DEFAULT 0,
  FOREIGN KEY (story_id) REFERENCES stories(id)
);
```

resources/migrations/init-comments.down.sql

```
DROP TABLE comments;
```

Add Components for Comments

```
...

  :duct-talk.handler.stories/index
  {:db #ig/ref :duct.database/sql}

  :duct-talk.handler.stories/submit
  {:db #ig/ref :duct.database/sql}

  :duct-talk.handler.stories/upvote
  {:db #ig/ref :duct.database/sql}}

  :duct-talk.handler.comments/list
  {:db #ig/ref :duct.database/sql}

  :duct-talk.handler.comments/submit
  {:db #ig/ref :duct.database/sql}

  :duct-talk.handler.comments/upvote
  {:db #ig/ref :duct.database/sql}

...
```

Handler Logic for Comments

```
(ns duct-talk.handler.comments
  (:require [ataraxy.core :as ataraxy]
            [ataraxy.response :as response]
            [integrant.core :as ig]
            [duct-talk.boundaries.comments :as comments]))

(defmethod ig/init-key ::list
  [_ {:keys [db]}]
  (fn [{{id :story-id} :route-params}]
    [::response/ok (comments/get-list db id)]))

(defmethod ig/init-key ::submit
  [_ {:keys [db]}]
  (fn [{{id :story-id} :route-params
        {text :comment} :body-params}]
    (comments/create! db id text)
    [::response/ok "submitted"]))

(defmethod ig/init-key ::upvote
  [_ {:keys [db]}]
  (fn [{{id :story-id} :route-params}]
    (comments/upvote! db id)
    [::response/ok "voted"]))
```

Add Routes for Comments

```
...

 :duct.module/ataraxy
 {"/" {:get [:stories/index]
       "stories" {:post [:stories/submit]
                  ["/" ^int story-id] {[:post "/votes"] [:stories/upvote story-id]
                                       "/comments" {:get [:comments/list story-id]
                                                    :post [:comments/submit story-id]
                                                    [:post "/" ^int comment-id "/votes"]
                                                    [:comments/upvote comment-id]}}}}}

 :duct.module/logging {}
 :duct.module.web/api {}
 :duct.module/sql {}}
```

Comments Boundary

```clojure
(ns duct-talk.boundaries.comments
  (:require [duct.database.sql]
            [hugsql.core :as hugsql]))

(hugsql/def-db-fns "duct_talk/boundaries/comments.sql")

(defprotocol Comments
  (get-list [db story-id])
  (create! [db story-id text])
  (upvote! [db id]))

(extend-protocol Comments
  duct.database.sql.Boundary
  (get-list [{db :spec} story-id]
    (list-comments db {:story-id story-id}))

  (create! [{db :spec} story-id text]
    (add-comment! db {:story-id story-id
                      :comment text}))

  (upvote! [{db :spec} id]
    (upvote-comment! db {:id id})))
```

SQL Queries for Comments

`duct_talk/boundaries/comments.sql`

```
-- :name list-comments :?
-- :doc Retrieve list of comments for a story
select id, comment, votes from comments where story_id = :story-id;

-- :name add-comment! :! :1
-- :doc Add a new comment to a story
insert into comments (story_id, comment) values (:story-id, :comment);

-- :name upvote-comment! :!
-- :doc Increment the vote count for a comment
update comments set votes = votes + 1 where id = :id;
```

Demo

http POST localhost:3000/stories/1/comments "comment: This is a comment”

submitted

http POST localhost:3000/stories/1/comments/1/vote

voted

http GET localhost:3000/stories/1/comments


```
[
    {
        "comment": "this is a comment",
        "id": 1,
        "votes": 1
    }
]
```

Questions?

Any Questions?

https://github.com/danielytics