Ocsigen

Reactive client-server Web applications

with Js_of_ocaml and Eliom

Vincent Balat — Hugo Heuzard

OUPS meetup — 9 december 2014

The project

created in 2004, more than 200 000 l.o.c., LGPL

People:

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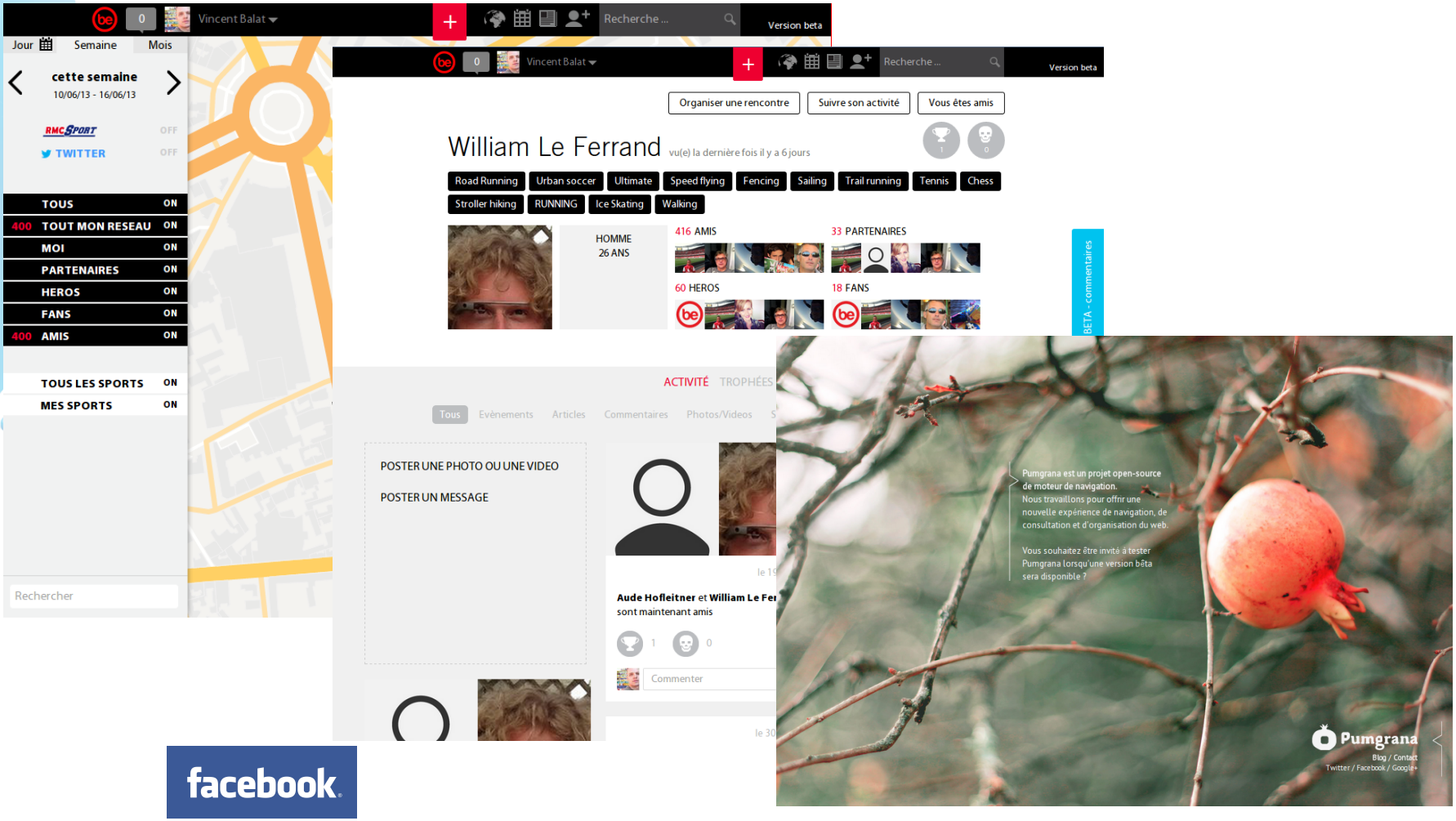
Users



Some companies and open source projects:

BeSport, NYU CGSB Genomics Core, Pumgrana, Facebook, Cumulus, Life.tl, Ashima Arts, Metaweb/Freebase, Hypios, Ocamlcore, Ocamlpro, Nleyten...

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Some of our projects

ocsigen eliom

More information

Write client/server Web applications in very few lines of OCaml code!

ocsigen js_of_ocaml

More information

An OCaml to Javascript compiler.

ocsigen lwt

More information

A cooperative threading library for OCaml.

ocsigen server

More information

A full-featured and extensible Web server.

> And many other projects ...

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Recap of last episode

Running OCaml programs in a Browser (Ocsigen Js_of_ocaml)

Recap of last episode

1. Running OCaml programs in a Browser
2. Interact with the DOM and JS libraries

   (Syntax `value##method(a, b)`, etc.)

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6. Client-server applications: sections

Syntax:

```
{server{ ...
}}
{client{ ...
}}
{shared{ ...
}}
```

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7. Client-server communication: server values in client code, RPCs

```
%v
```

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7. Client-server communication: server values in client code, RPCs
8. Client values: defining client values from server side

```
let cv = {{ f x }} in
```

This talk

A demo of some features of Eliom, presented as a tutorial.
With some upcoming features:

- Eliom base app
- Reactive DOM
- Client-server reactive programming
- Client-server cache of data
- Notifications

The application: a very basic forum
`http://ocsigen.org/tuto/manual/tutoreact`

Eliom Base App

High level libraries for Eliom:

- User management (registration, activation links, lost password, change password, upload picture, grousp of users …)
- Notifications to users (new messages, etc)
- Tips for new users
- Dates and time zones
- …

Status: beta, not fully documented

+ a template for quickly building applications with users:

```
eliom-distillery -name tutoreact -template eba.pgocaml
```

Database interaction

I will not show the following functions:

```
module Db : sig
  val get_messages : unit -> int list Lwt.t
  val get_message : int -> string Lwt.t
  val add_message : string -> int Lwt.t
end
```

implemented on server side.

Use the DB you prefer. PGOCaml is a good choice.

Display messages

```
let display_messages userid_o =
  lwt messages = Db.get_messages () in
  lwt l = Lwt_list.map_s
    (fun id -> lwt msg = Db.get_message id in
               Lwt.return (li [pcdata msg]))
    messages
  in
  Lwt.return (ul l)
```

Adding new messages

Add an input in the page:

```
let inp = Raw.input ~a:[a_input_type `Text] () in
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Make function `Db.add_message` accessible from client side:

→ *server functions (RPC)*

```
let add_message_rpc =
  server_function Json.t<string> Db.add_message
```

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Make function `Db.add_message` accessible from client side:

→ *server functions (RPC)*

```
let add_message_rpc =
  server_function Json.t<string>
    (Eba_session.connected_rpc
       (fun userid value -> Db.add_message value))
```

`Eba_session.connected_rpc` wraps a function of type `'a -> 'b Lwt.t`
into a function of type `int64 -> 'a -> 'b Lwt.t`,
where the `int64` is the user id,
and fails if user is not connected.

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Make function `Db.add_message` accessible from client side:

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let add_message_rpc =
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    (Eba_session.connected_rpc
       (fun userid value -> Db.add_message value))
```

Bind the input: → *example of client value, Js_of_ocaml syntax*

```
let _ = {unit{
    let open Lwt_js_events in
    let inp = To_dom.of_input %inp in
        async (fun () -> changes inp (fun _ _ ->
          let value = Js.to_string (inp##value) in
          inp##value <- Js.string "";
          %add_message_rpc value))                    }}
in
```

Client server cache

We recommend to store the values used by the client program in a local database. New module `Eliom_cscache` implements this in a way that is compatible with client-server (and reactive) programming.
On server side, the cache is implemented "with scope request", avoiding to retrieving several times the same data from the DB during a request.

```
let cache = E_cscache.create ()
```

To retrieve some data, call `Eliom_cscache.find cache get_data key` from client or server side.

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```
let cache = E_cscache.create ()
```

To retrieve some data, call `Eliom_cscache.find cache get_data key` from client or server side.

Function `get_cache` must be implemented on both sides:

```
let get_data = Db.get_message
let get_data_rpc =
  server_function Json.t<int>
    (Eba_session.Opt.connected_rpc
        (fun userid_o id -> get_data id))
{client{
  let get_data id = %get_data_rpc id
}}
```

Reactive DOM

Reactive programming (using module React, by Daniel Bünzli)

```
let x, set_x = React.S.create 1
let pr_x = React.S.map print_int x
let () = List.iter set_x [2; 2; 3]
```

Reactive DOM

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Reactive DOM (before Eliom 4.1)

```
R.ul (React.S.map f rl)
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Reactive DOM

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Reactive DOM (before Eliom 4.1)

```
R.ul (React.S.map f rl)
```

Incremental changes (using module ReactiveData, by Hugo Heuzard)

```
R.ul (ReactiveData.RList.map f rd)
...
ReactiveData.RList.cons a (snd rd)
```

Reactive programming makes the update of an interface much easier.

Client-server reactive DOM

New modules SharedReactiveData and SharedReact, to make possible to generate reactive pages from server (or client) sides.

```
{shared{
let display_message id =
  lwt msg = E_cscache.find %cache get_data id in
  Lwt.return (li [pcdata msg])
}}
let display_messages () =
  lwt messages = Db.get_messages () in
  let rmessages = SharedReactiveData.RList.make messages in
  lwt content = SharedReactiveData.RList.Lwt.map_p
      {shared{ display_message }}
      (fst rmessages)
  in
  Lwt.return (R.ul content)
}}
```

Notify clients of changes

Define a notification module for each type of data:

```
module Msg_notif = Eba_notif.Make(struct
  type key = ... (* The type of the data identifiers *)
  type notification = ... (* The type of notifications *)
end)
```

Notify clients of changes

Define a notification module for each type of data:

```
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  type key = ... (* The type of the data identifiers *)
  type notification = ... (* The type of notifications *)
end)
```

Reacting to notifications:

```
React.E.map (handle_notif %rmessages) %(Msg_notif.client_ev ())
```

Where `handle_notif` is defined by:

```
  let handle_notif rmessages (_, msgid) =
    SharedReactiveData.RList.cons msgid (snd rmessages)
```

Notify clients of changes

Define a notification module for each type of data:

```
module Msg_notif = Eba_notif.Make(struct
  type key = ... (* The type of the data identifiers *)
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Reacting to notifications:

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Where `handle_notif` is defined by:

```
  let handle_notif rmessages (_, msgid) =
    SharedReactiveData.RList.cons msgid (snd rmessages)
```

To declare that I'm a client listening on data `i`:

```
Msg_notif.listen i;
```

To notify clients listening on data `i`:

```
Msg_notif.notify i (fun userid -> Lwt.return (Some id));
```

In this example, `i` is `()`, type `key` is `unit`, and type `notification` is `int`.

Full code

```
{shared{
  open Eliom_content.Html5
  open Eliom_content.Html5.D
  open E_csreact
}}
module Msg_notif = Eba_notif.Make(struct
  type key = unit
  type notification = int
end)

let add_message_rpc =
  server_function
    Json.t<string>
    (Eba_session.connected_rpc
       (fun userid value ->
          lwt id = Db.add_message value in
          Msg_notif.notify () (fun userid -> Lwt.return (Some id));
          Lwt.return ())
       )

let get_data = Db.get_message

let get_data_rpc =
  server_function Json.t<int>
    (Eba_session.Opt.connected_rpc (fun userid_o id -> get_data id))
{client{
   let get_data id = %get_data_rpc id
}}

let cache : (int, string) E_cscache.t = E_cscache.create ()
{shared{
let display_message id =
  lwt msg = E_cscache.find %cache get_data id in
  Lwt.return (li [pcdata msg])
 }}
{client{
   let handle_notif_message_list rmessages (_, msgid) =
     SharedReactiveData.RList.cons msgid (snd rmessages)
 }}
let display_messages () =
  Msg_notif.listen ();
  lwt messages = Db.get_messages () in
  let rmessages = SharedReactiveData.RList.make messages in
  ignore {unit{
    ignore (React.E.map (handle_notif_message_list %rmessages)
            %(Msg_notif.client_ev ()));
  }};
  lwt content = SharedReactiveData.RList.Lwt.map_p
      {shared{display_message}}
      (fst rmessages)
  in
  Lwt.return (R.ul content)

let display userid_o =
  lwt messages = display_messages () in
  let l = match userid_o with
    | None -> []
    | _ ->
      let inp = Raw.input ~a:[a_input_type `Text] () in
      let _ = {unit{
        let open Lwt_js_events in
        let inp = To_dom.of_input %inp in
        async (fun () -> changes inp (fun _ ->
          let value = Js.to_string (inp##value) in
          inp##value <- Js.string "";
          %add_message_rpc value
        ))
      }}
      in
      [inp]
  in
  Lwt.return (messages::l)
```

→ 75 lines of code

Conclusion

Client-server reactive programming

- Pages generated either from client or server side (same code)
  (good for indexing by search engines, etc.)
- Very fast page changes (using client-server cache)
- No need to program the updates of the page at all!
- Very concise

Eliom base app

- Send customized notifications to client easily
- Template for applications with users (quick MVP)
- …

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Conclusion

Experience:

Rewriting a Web app. from “traditional” Eliom to Client-server reactive Eliom.

Lines of code: 10053 $\rightarrow$ 4521

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Status:

Modules `Eliom_csreact` and `Eliom_cscache` are still experimental (but usable).

If you want to try: Eliom’s Github repository, `sharedreact` branch.

Conclusion

Ocsigen is dedicated not only to this kind of programs:

- Client only (using Js_of_ocaml and Eliom)
- Server only (Web site)
- HTML5 mobile apps with Phonegap
- Static Web site (using Server)
- Embedded Web server (using Server, Eliom, etc) (soon)
- …