React,
Functional Reactive
Programming for OCaml

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FRP
What & Why

Reactive

vs.

Transforma-tional

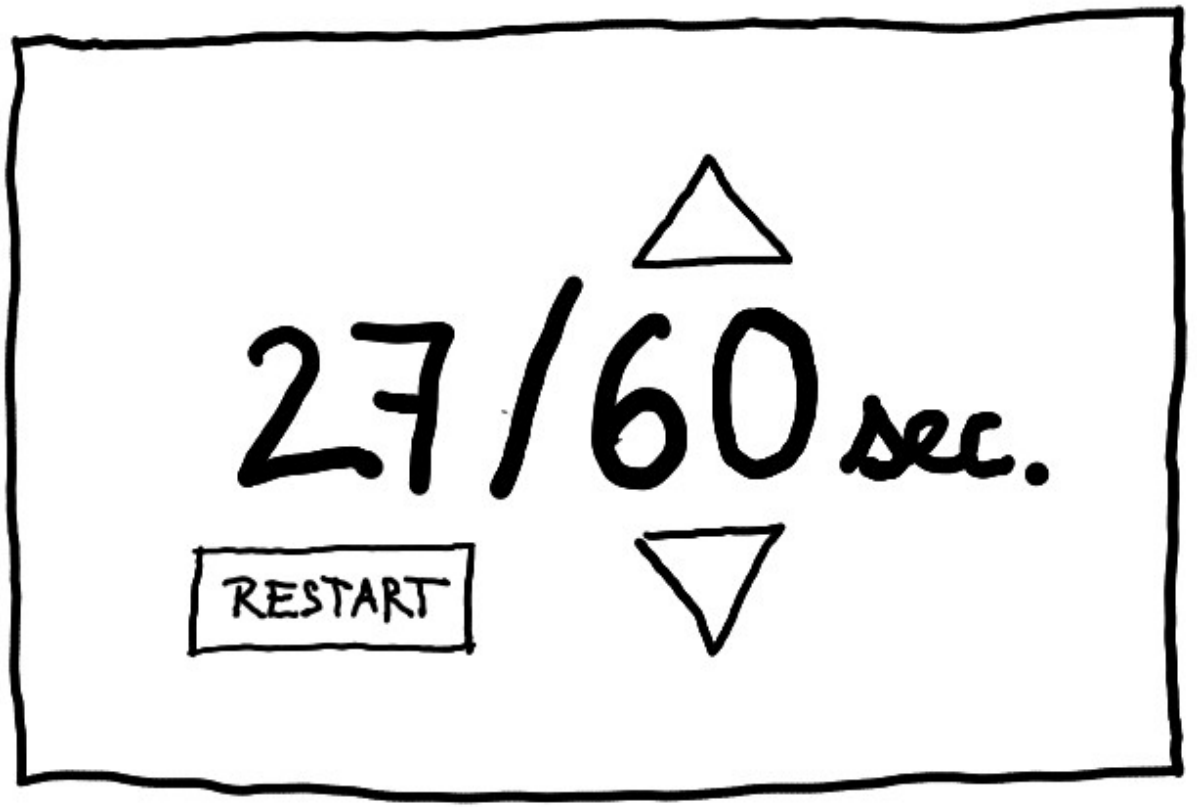
Functional

vs.

Imperative

Reactive with callbacks and side-effects

A counter example



Callback joy

```
let duration = ref 60
let elapsed = ref 0

let () =
  let on_trigger () =
    elapsed := min (!elapsed + 1) !duration;
    notify_elapsed_changed ()
  in
  Timer.each_second ~on_trigger

let duration_stepper =
  let on_change v =
    duration := v;
    elapsed := min !elapsed !duration;
    notify_duration_changed ();
    notify_elapsed_changed ();
  in
  Stepper.create ~value:!duration ~on_change

let restart_button =
  let on_click () = elapsed := 0; notify_elapsed_changed () in
  Button.create ~on_click
```

Functional

Functional Reactive Animation, ICFP'97

Conal Elliott & Paul Hudak

Signals
&
Events

```
type 'a signal = 'a S.t ≈ time -> 'a

type 'a event = 'a E.t ≈ time -> 'a option
```

Combinators !

```
val E.map : ('a -> 'b) -> 'a E.t -> 'b E.t

val S.map : ('a -> 'b) -> 'a S.t -> 'b S.t

val S.hold : 'a -> 'a E.t -> 'a S.t

...
```

FRP joy

```
let restart : unit E.t = RButton.create ()
let duration : int S.t = RStepper.create ~value:60
let secs : int S.t = RTimer.seconds ()

let elapsed : int S.t =
  let restart_t : int E.t = S.sample (fun _ t -> t) restart secs in
  let t0 : int S.t = S.hold (S.value secs) restart_t in
  S.l3 (fun d t t0 -> min d (t - t0)) duration secs t0
```

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React
FRP engine

Combinators

Create

primitives

Updates

Create primitives

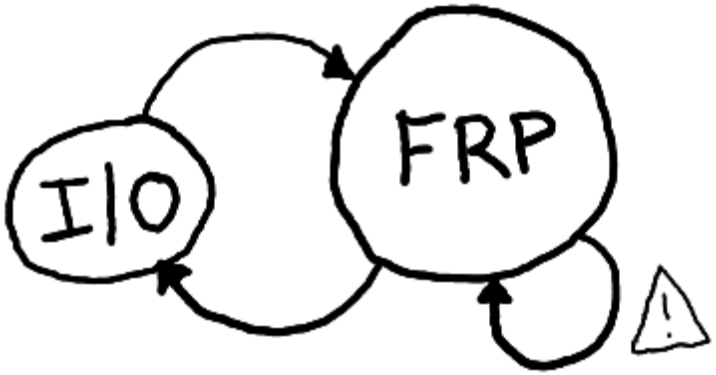
```
val E.create : unit -> 'a E.t * ('a -> unit)

val S.create : 'a -> 'a S.t * ('a -> unit)
```

Callbacks ▶ FRP

```
let value = 60
let s_val : int S.t, set = S.create value in
let s = Stepper.create ~value ~on_change:set
```

Program structure




```
(* create primitives *)
...

(* define derived signals & events *)
...

let () =
 while true do update_primitives () done
```

Try it !

http://erratique.ch/software/react

http://erratique.ch/talks/ocamlum-2010

OCaml & FRP

Froc

http://github.com/jaked/froc

Concurrent cell

http://ccell.forge.ocamlcore.org/

Other & FRP

Haskell

http://haskell.org/haskellwiki/Functional_Reactive_Programming

Javascript

http://flapjax-lang.org/

Scala

http://lamp.epfl.ch/~imaier/

Scheme

http://docs.plt-scheme.org/frtime/index.html

?

Leaks

Recursive values

Side-effects (eq.)

Runtime costs

Program struct.