ReactiveML
une extension d'OCaml pour la programmation de systèmes réactifs synchrones

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Balançoire

```
let balancoire centre rayon alpha_init vitesse =
  let alpha = ref alpha_init in
  while true do
    alpha := !alpha +. vitesse;
    dessine centre rayon !alpha;
  done


let main =
  Thread.create (balancoire c1 r pi) vitesse;
  Thread.create (balancoire c2 r 0.) vitesse
```

Balançoire

```
let balancoire centre rayon alpha_init vitesse =
  let alpha = ref alpha_init in
  while true do
    alpha := !alpha +. vitesse;
    dessine centre rayon !alpha;
    Thread.yield ()
  done

let main =
  Thread.create (balancoire c1 r pi) vitesse;
  Thread.create (balancoire c2 r 0.) vitesse
```

Balançoire

```
let process balancoire centre rayon alpha_init vitesse =
  let alpha = ref alpha_init in
  while true do
    alpha := !alpha +. vitesse;
    dessine centre rayon !alpha;
    pause
  done

let process main =
     run (balancoire c1 r pi vitesse)
  || run (balancoire c2 r 0. vitesse)
```

ReactiveML

Langage pour la programmation de systèmes interactifs

- extension d'un langage généraliste (OCaml)
- basé sur le modèle synchrone
- suppression de la contrainte temps-réel

Motivations

- Descriptions de systèmes non bornés statiquement
- Programmation d'interfaces graphiques, jeux, simulateurs
- Intérêts : déterminisme, compositionnalité, sûreté

$\Rightarrow$ alternative à la programmation événementielle ou par threads

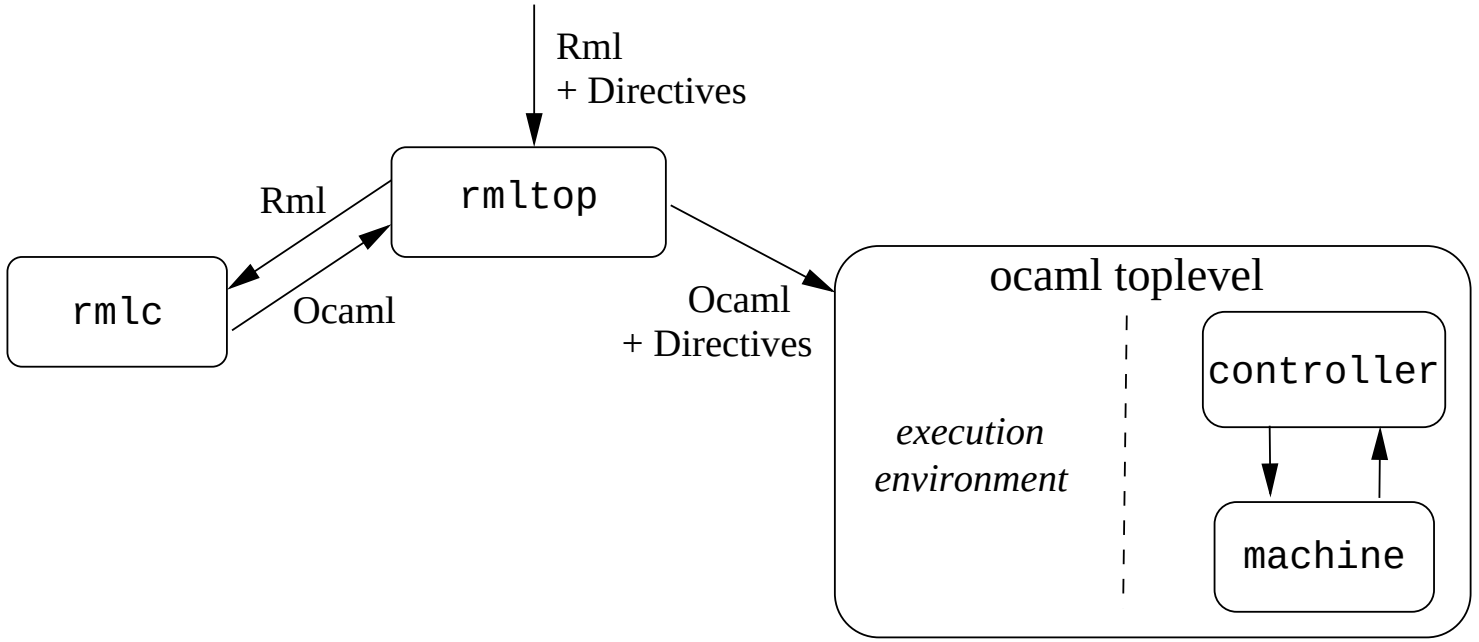
Plan

1. Présentation du langage
2. Implantation de `rmltop`
3. Vers de la reconfiguration dynamique
4. Conclusion et discussion

Démo

Implantation

Implantation

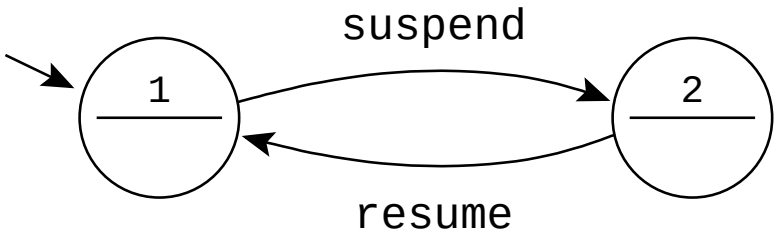


- Le contrôleur est implémenté en ReactiveML.

Contrôleur

```
let process sampled =
  loop Rmltop_reactive_machine.rml_react(get_to_run()); pause end

let process step_by_step =
  loop
    await step(n) in
    do
      for i = 1 to n do
        Rmltop_reactive_machine.rml_react(get_to_run()); pause
      done
    until suspend done
  end
```

Contrôleur




```
let process machine_controller =
  loop
    do run sampled until suspend done;
    do run step_by_step until resume done
  end
```

Reconfiguration dynamique

Langage pour étudier la reconfiguration dynamique

- Des combinateurs pour manipuler (individuellement) des processus en cours d'exécution
  - tuer
  - suspendre/reprendre
  - ajouter des branches parallèles supplémentaires
  - ...
- Facilement programmable en ReactiveML
  - utilisation de l'ordre supérieur et du polymorphisme

killable

```
signal kill
val kill : (int, int list) event


let process killable p =
  let id = gen_id () in print_endline ("["^(string_of_int id)^"]");
  do run p
  until kill(ids) when List.mem id ids done
val killable : unit process -> unit process
```

Création dynamique : rappel

```
let rec process extend to_add =
  await to_add(p) in
  run p || run (extend to_add)
val extend : ('a, 'b process) event -> unit process

signal to_add
  default process ()
  gather (fun p q -> process (run p || run q))
val add_to_me : (unit process, unit process) event
```

Création dynamique avec état

```
let rec process extend to_add state =
  await to_add(p) in
  run (p state) || run (extend to_add state)
val extend : ('a , ('b -> 'c process)) event -> 'b -> unit process

signal to_add
  default (fun s -> process ())
  gather (fun p q s -> process (run (p s) || run (q s)))
val to_add : (('_state -> unit process) , ('_state -> unit process)) event
```

extensible

```
signal add
val add : ((int * (state -> unit process)),
           (int * (state -> unit process)) list) event

let process extensible p_init state =
  let id = gen_id () in print_endline ("{"^(string_of_int id)^"}");
  signal add_to_me
    default (fun s -> process ())
    gather (fun p q s -> process (run (p s) || run (q s))) in
  run (p_init state) || run (extend add_to_me state)
  || loop
       await add(ids) in
       List.iter (fun (x,p) -> if x = id then emit add_to_me p) ids
     end
val extensible : (state -> 'a process) -> state -> unit process
```

Bibliothèque pour le toplevel

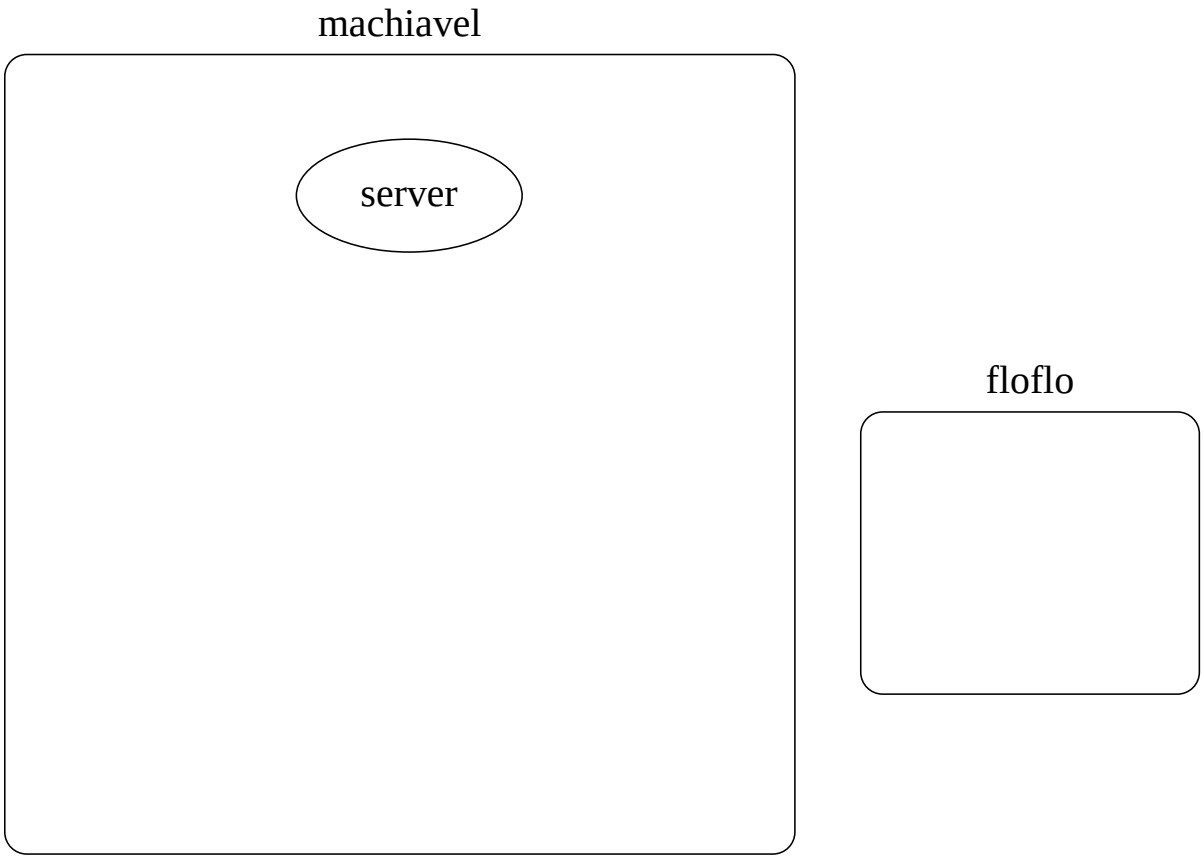
```
type ident

val kill: (int , ident list) event
val killable: 'a process -> 'a option process

val sr: (int , ident list) event
val suspendable: 'a process -> 'a process

val extensible:
  ('a, (int * ('state -> unit process)) list) event ->
  ('state -> unit process) -> 'state -> unit process

val ps: unit -> unit
```

Conclusion et discussion

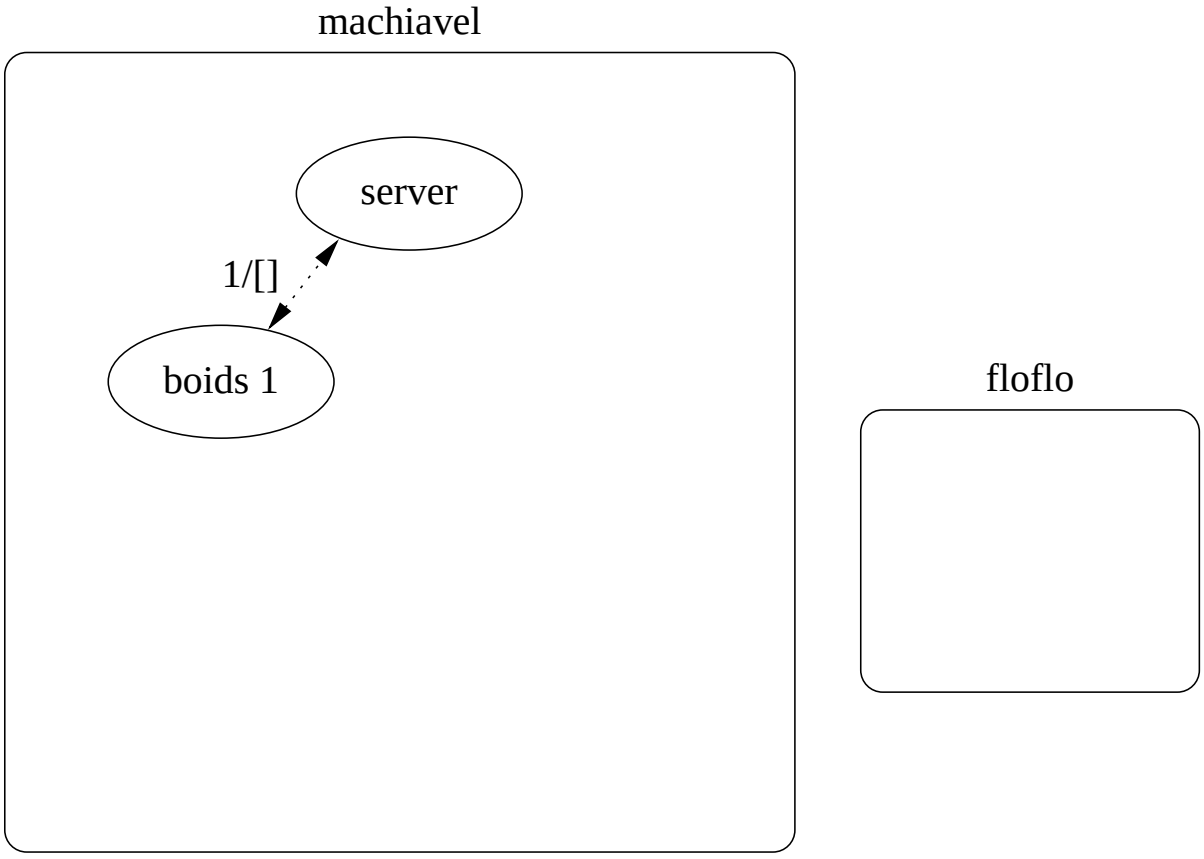
Discussion

- Collaboration entre ReactiveML et JoCaml
- Exemple des boids

Boids



Boids



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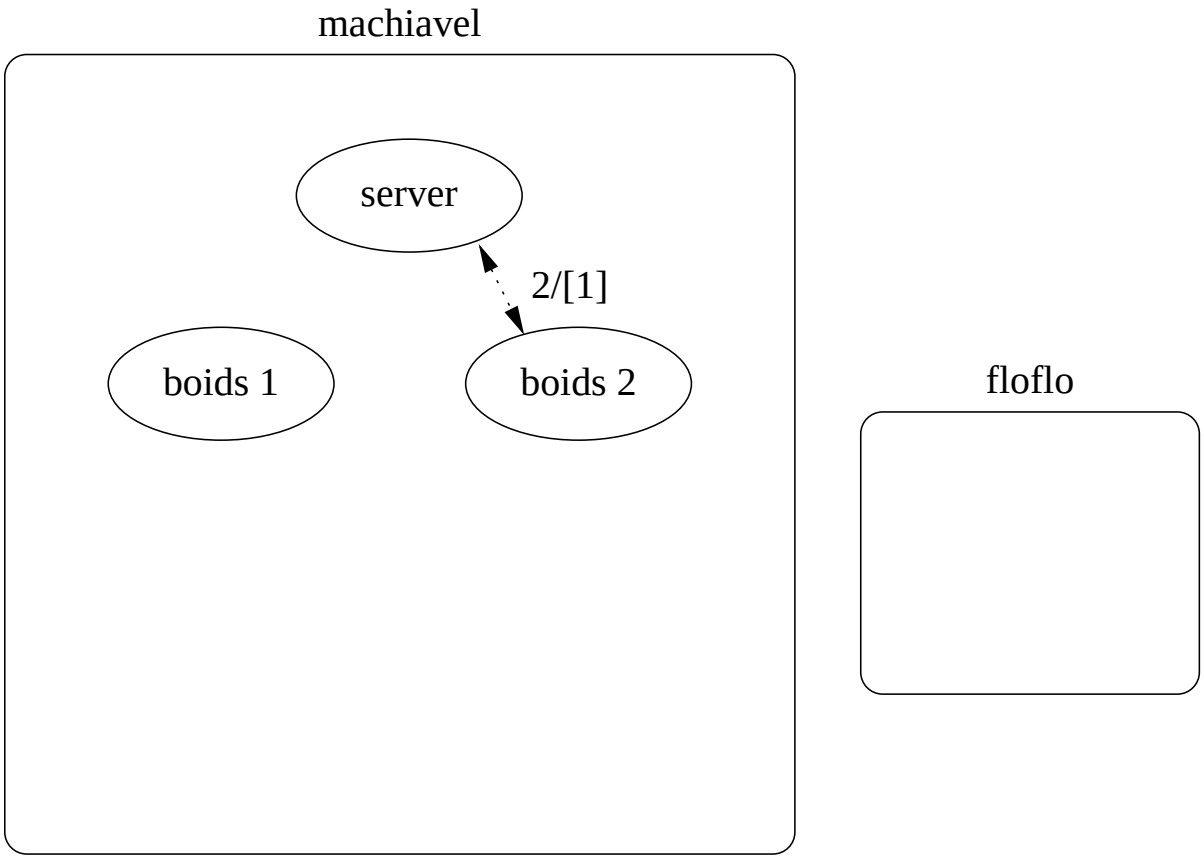

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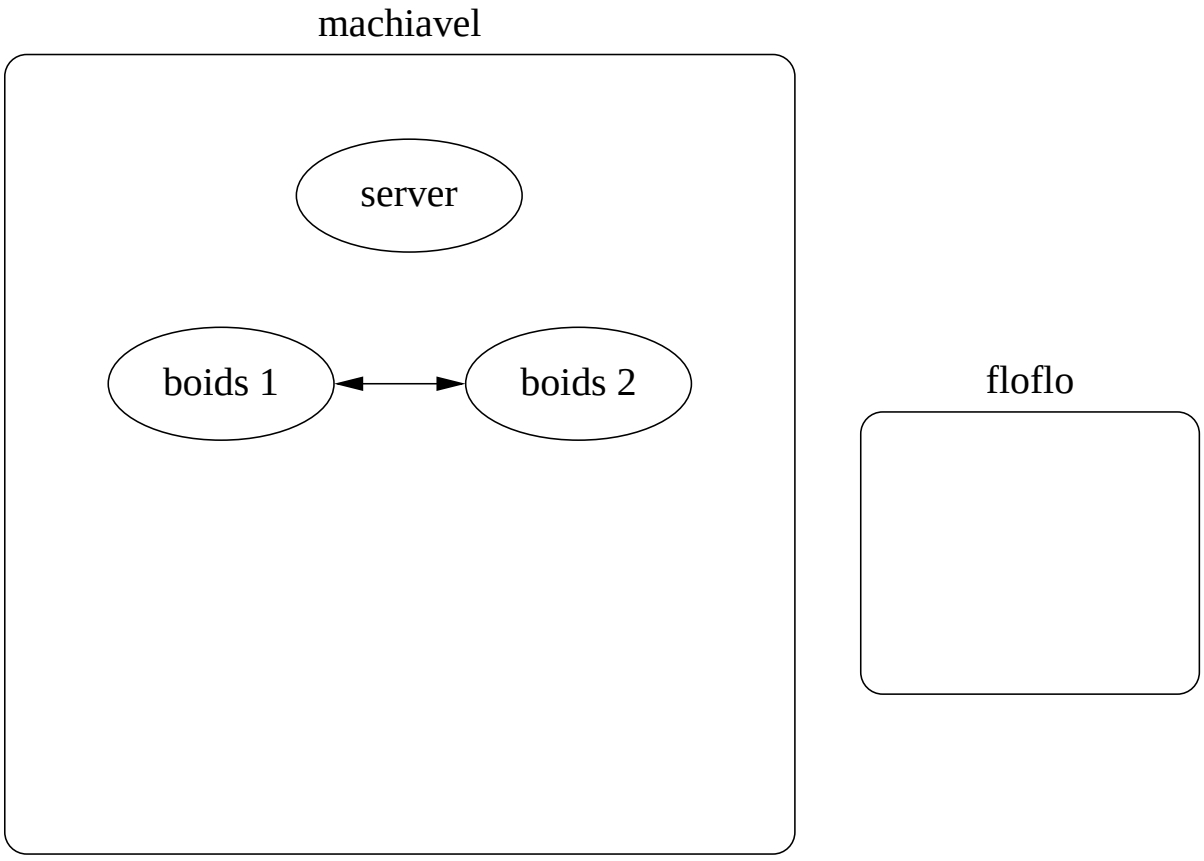

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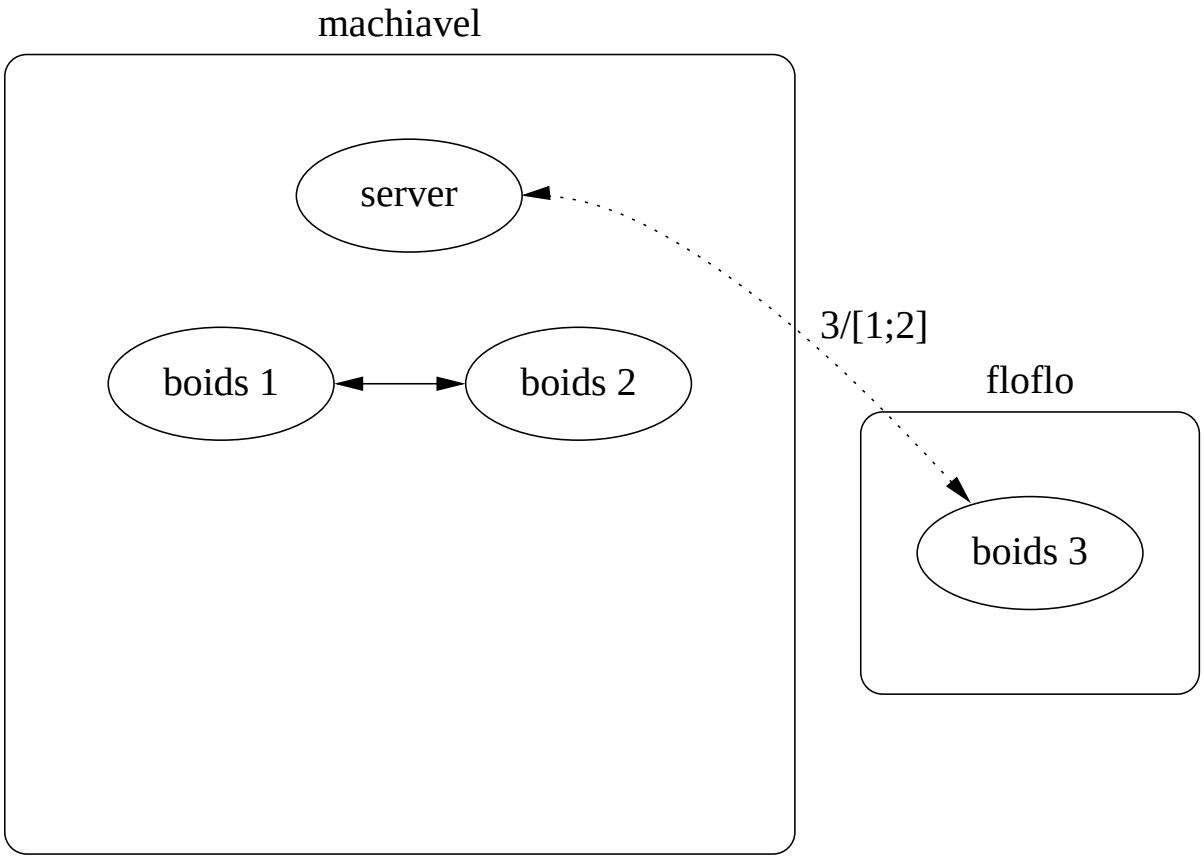

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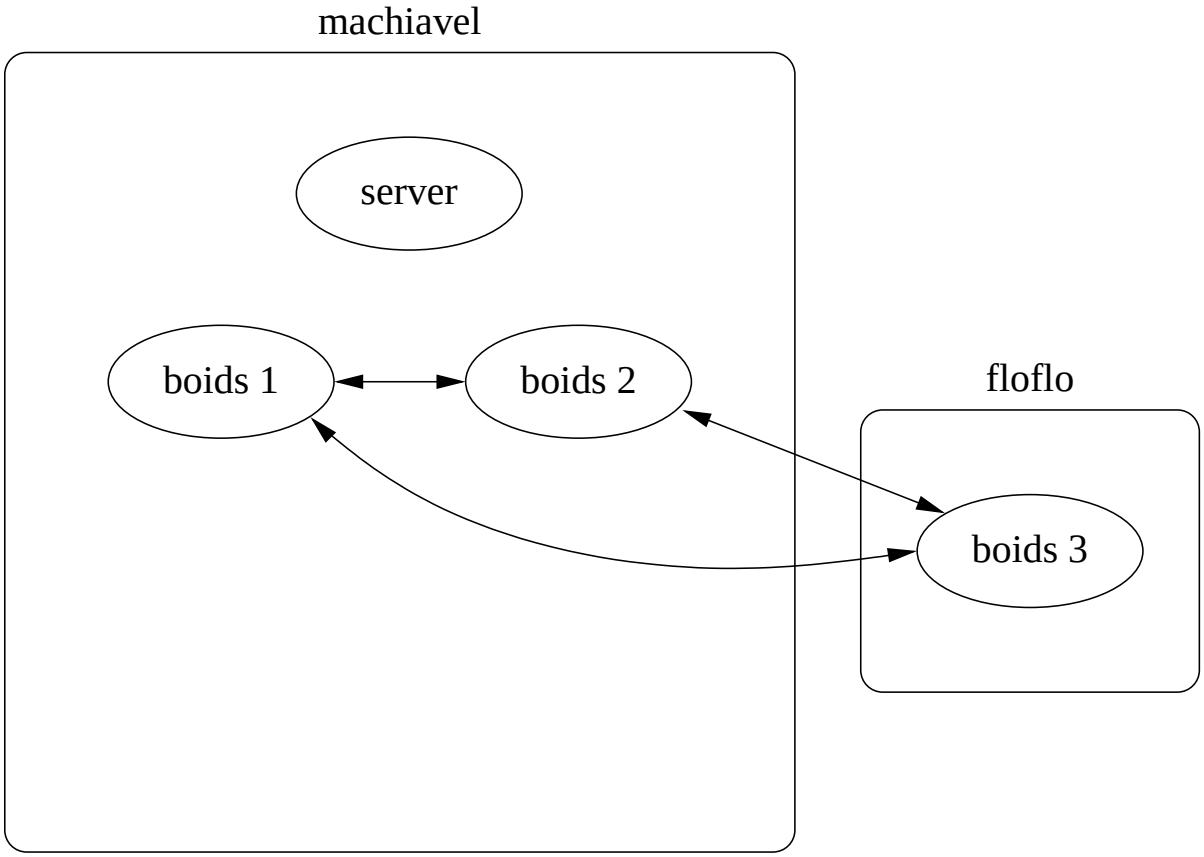

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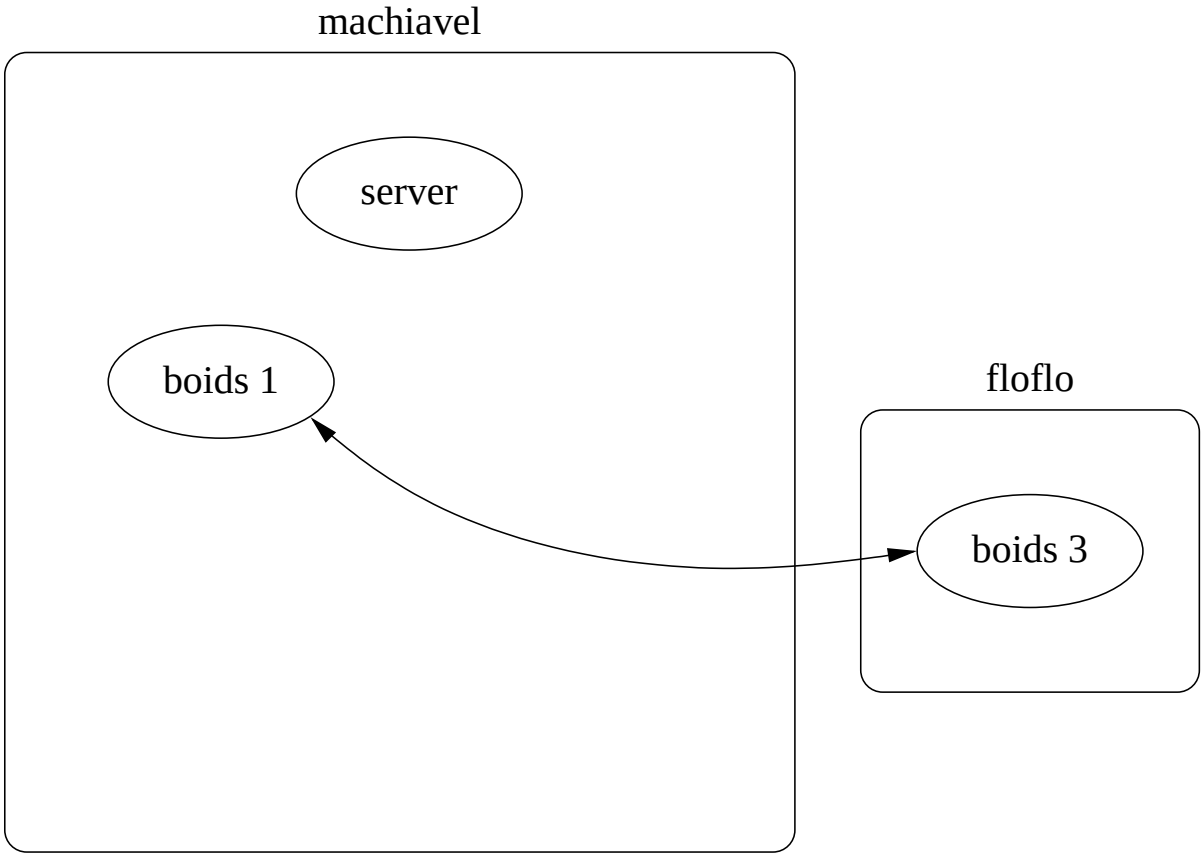

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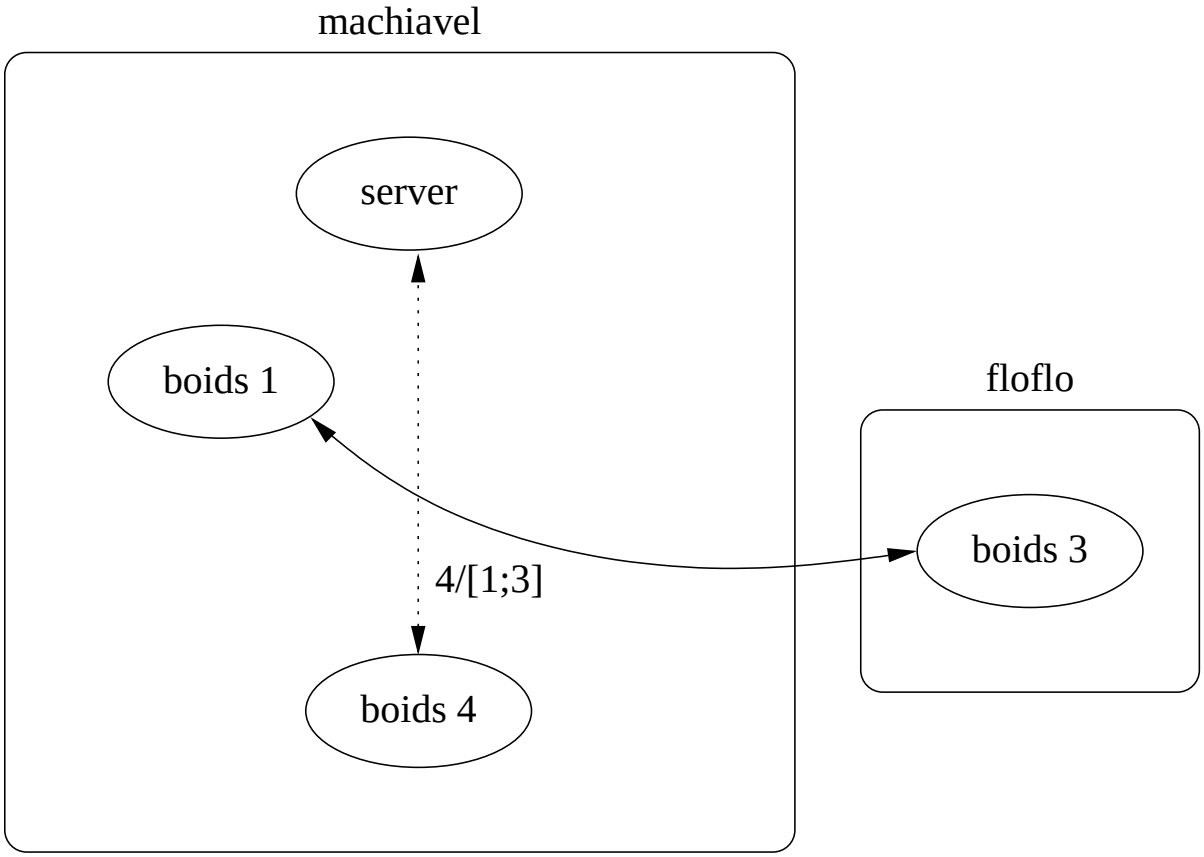
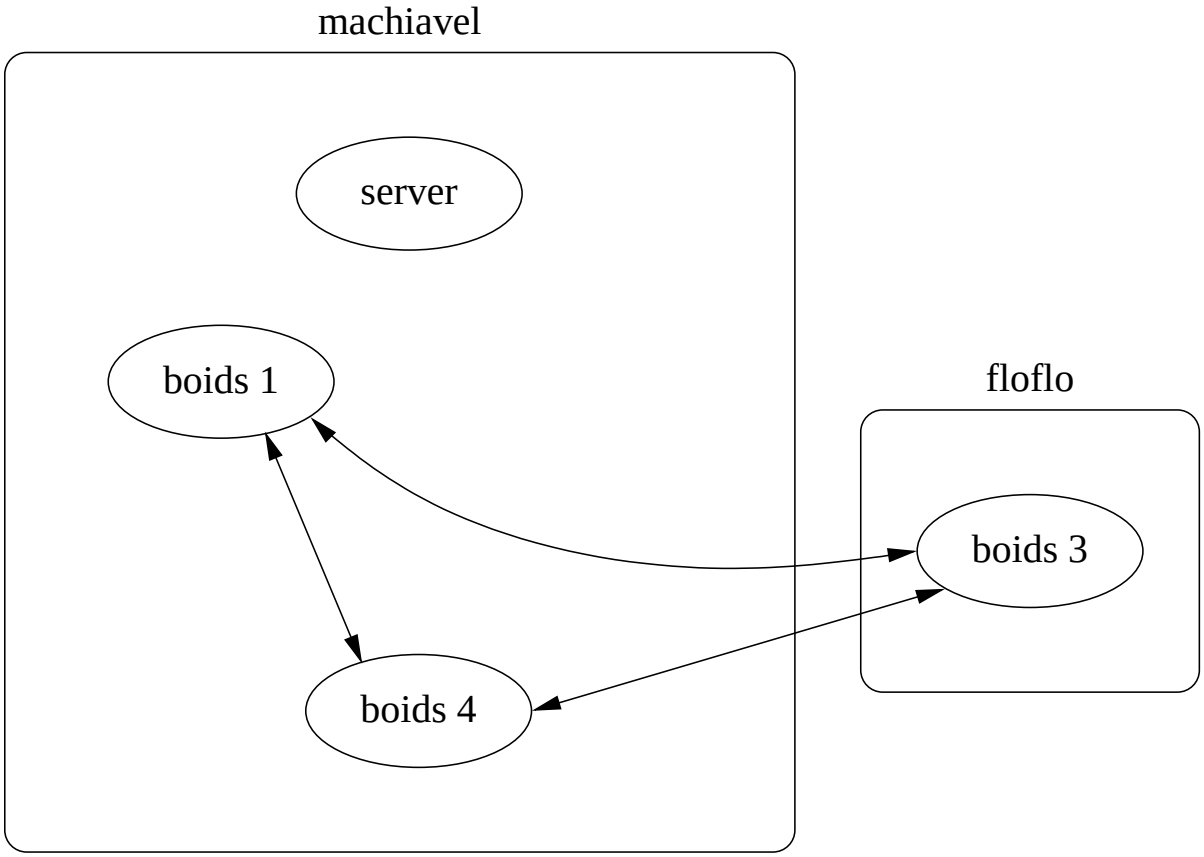


Boids



Implémentations disponibles

http://rml.lri.fr
http://jocaml.inria.fr

Communication asynchrone

```
let new_cell () =
  def state (_) & set(x) = state(Some x) & reply () to set
   or state (Some x) & get() = state(None) & reply x to get in
  spawn (state None);
  (set, get)
val new_cell : ('a -> unit process, unit -> 'a process)

let set_step, get_step = new_cell()
let process generate_step =
  loop let n = run (get_step ()) in emit step n ; pause end
```