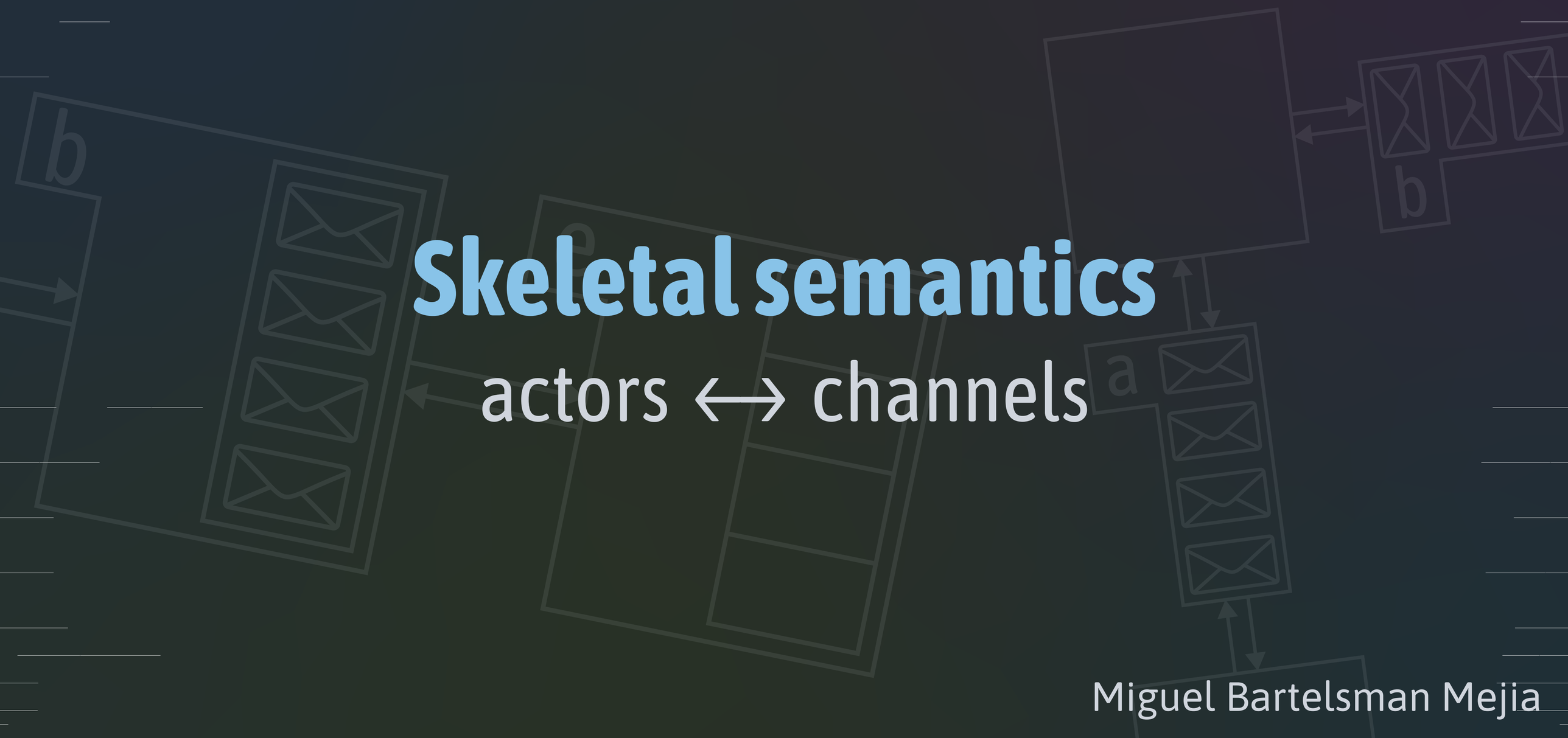
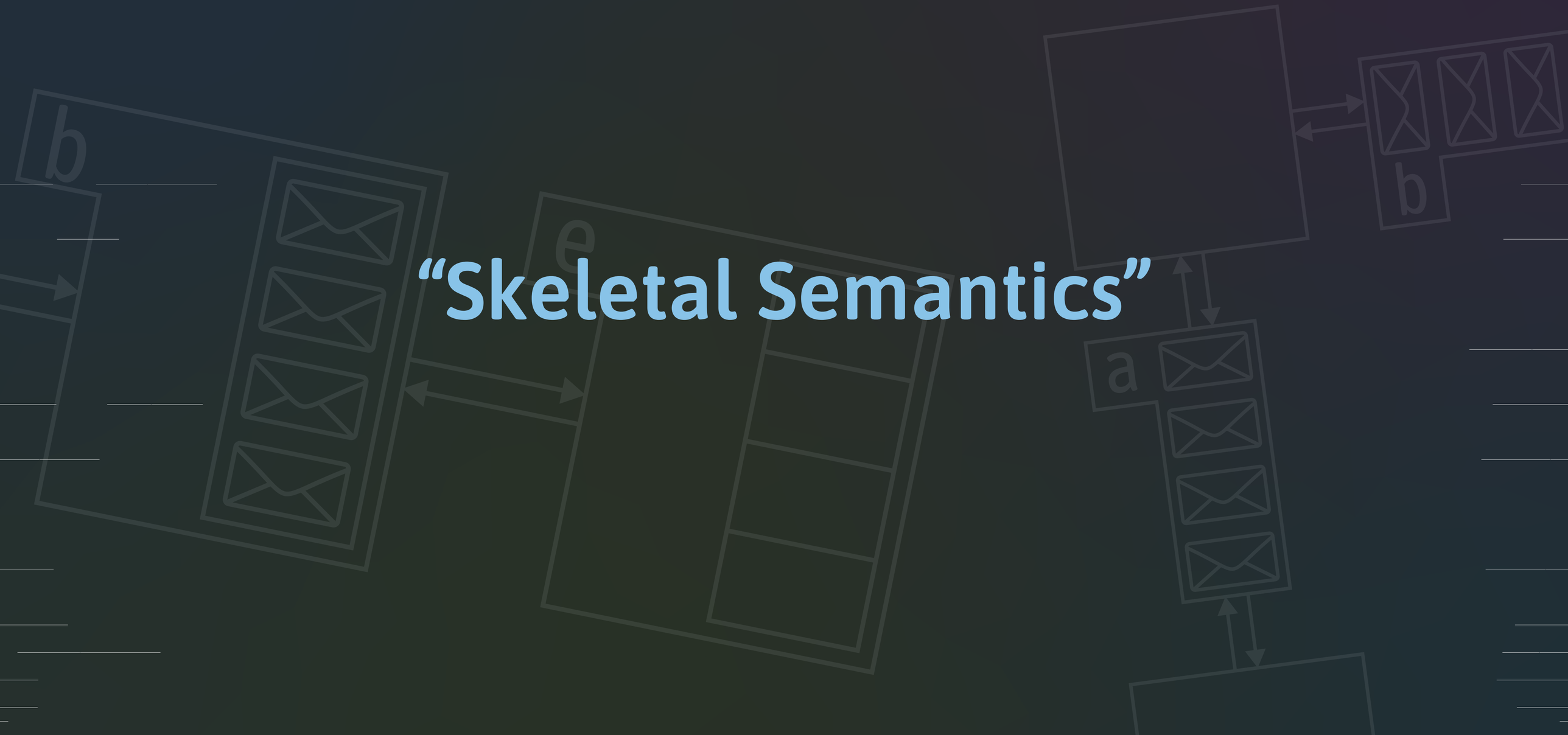


Skeletal semantics

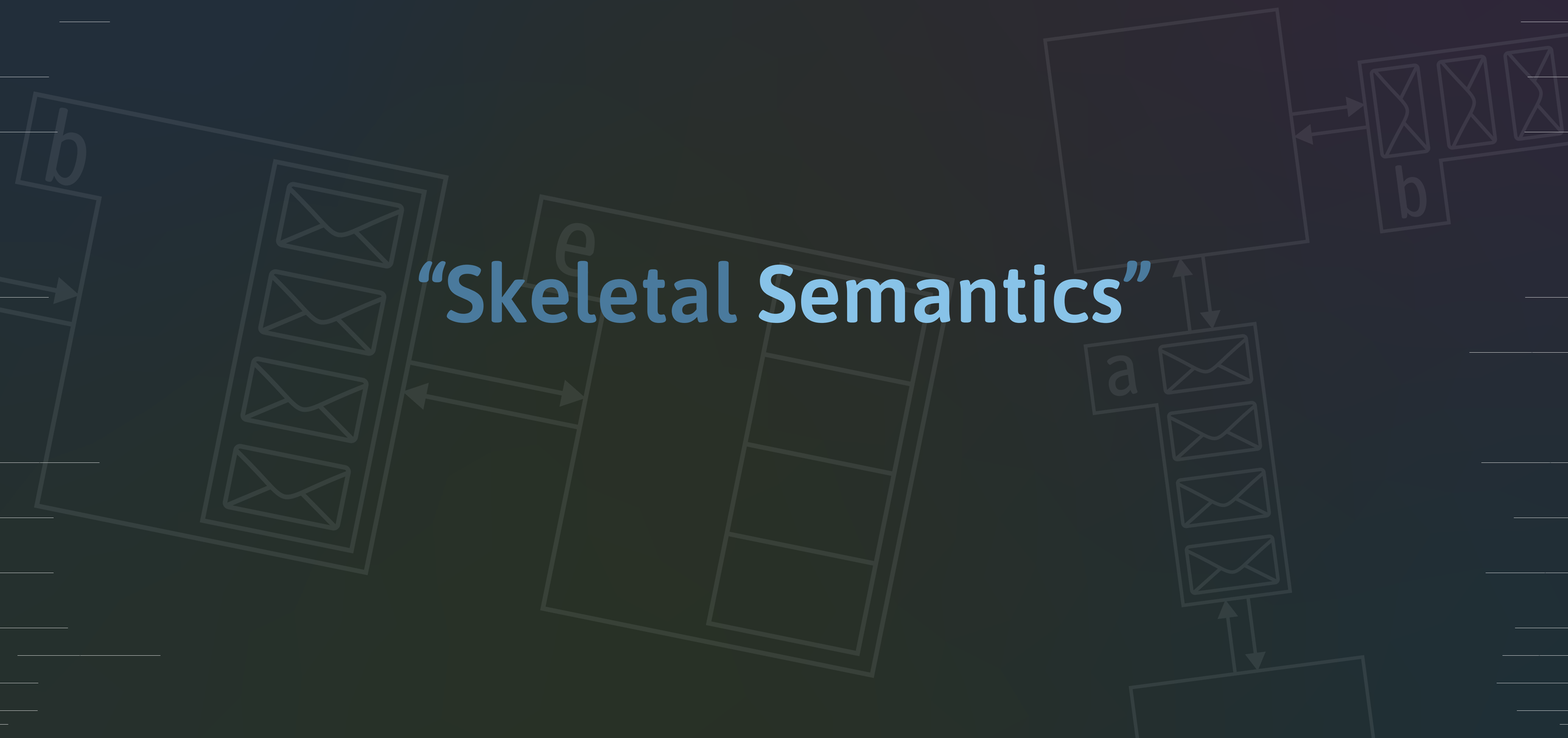
actors ↔ channels

Miguel Bartelsman Mejia

“Skeletal Semantics”



“Skeletal Semantics”



Skeletal **Semantics**

$$\frac{t_1 \to \mathit{true} \qquad t_2 \to v_2}{\mathit{if}\ (t_1)\ \mathit{then}\ (t_2)\ \mathit{else}\ (t_3) \to v_2}$$

$$\frac{t_1 \to \mathit{false} \qquad t_3 \to v_3}{\mathit{if}\ (t_1)\ \mathit{then}\ (t_2)\ \mathit{else}\ (t_3) \to v_3}$$

Skeletal **Semantics**

Premises

$$\frac{t_1 \to \mathit{true} \qquad t_2 \to v_2}{\mathit{if}\ (t_1)\ \mathit{then}\ (t_2)\ \mathit{else}\ (t_3) \to v_2}$$

$$\frac{t_1 \to \mathit{false} \qquad t_3 \to v_3}{\mathit{if}\ (t_1)\ \mathit{then}\ (t_2)\ \mathit{else}\ (t_3) \to v_3}$$

Conclusions

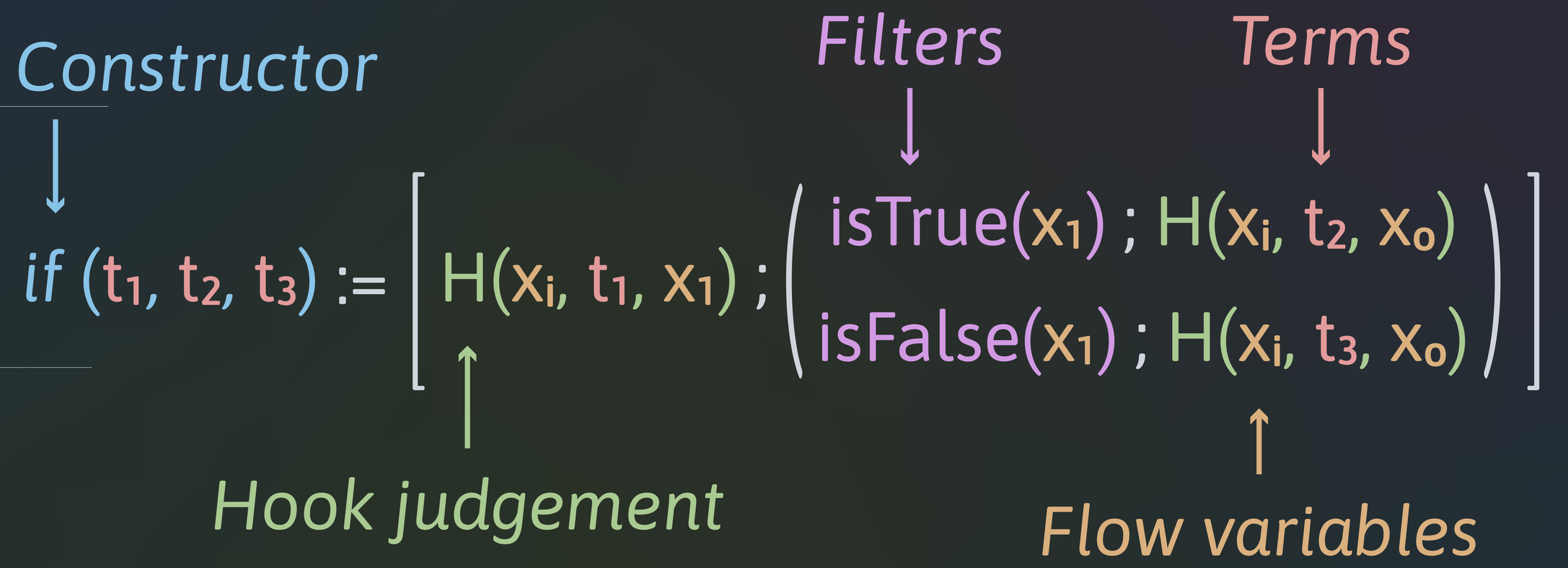
Evaluation relation

“Skeletal Semantics”

Skeletal *Semantics*

$$\mathit{if}\ (t_1, t_2, t_3) := \left[H(x_i, t_1, x_1) \ ; \left(\begin{array}{l} \mathsf{isTrue}(x_1) \ ; H(x_i, t_2, x_o) \\ \mathsf{isFalse}(x_1) \ ; H(x_i, t_3, x_o) \end{array} \right) \right]$$

Skeletal *Semantics*



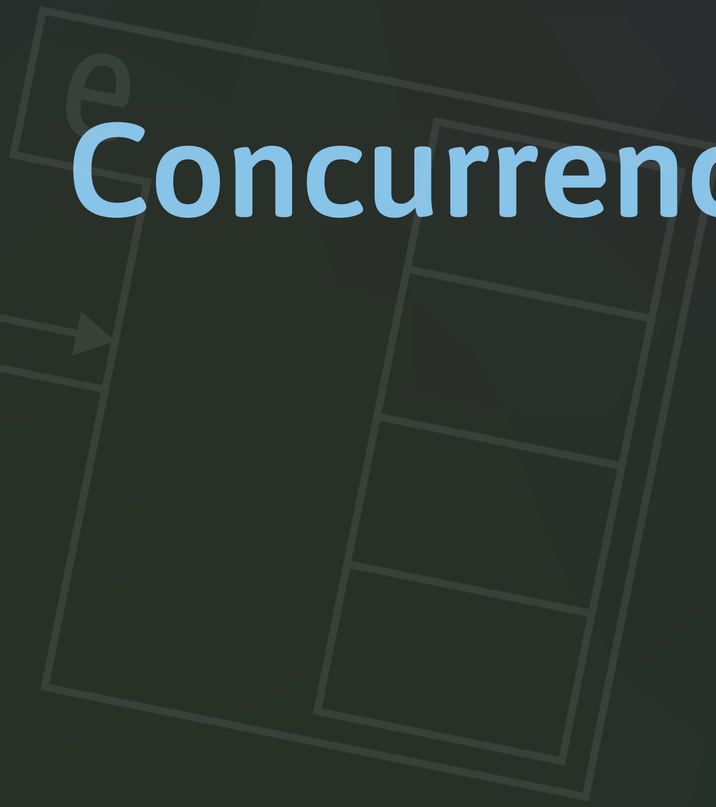
Skel and Necro

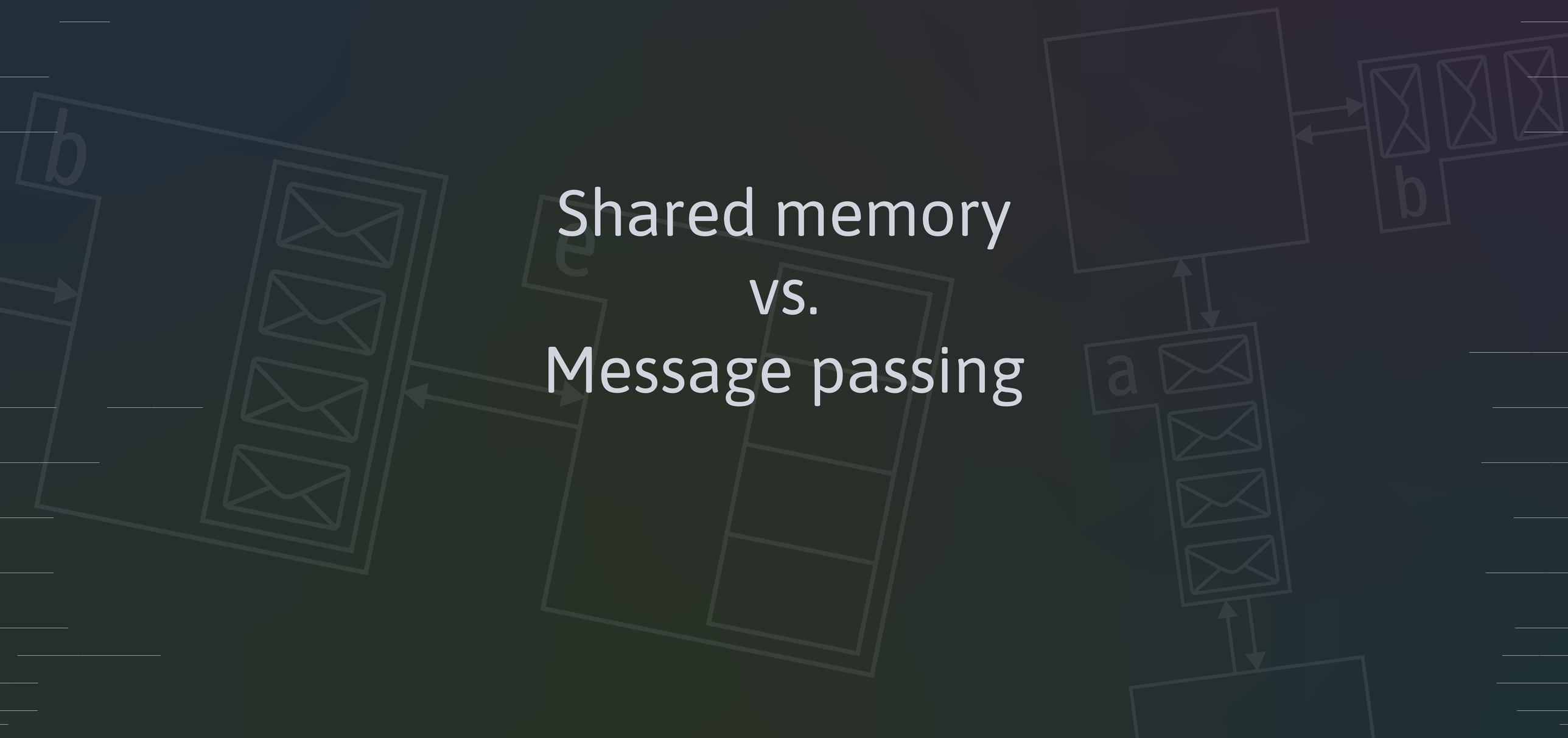
```
val eval_if (xi, t) =
  let If (t1, t2, t3) = t in
  let x1 = eval (xi, t1) in
  branch
    let x1 = isTrue (x1) in eval (x1, t2)
  or
    let x1 = isFalse (x1) in eval (x1, t3)
  end
```

Skel and Necro

```
(* ... *)
let eval_if =
  function (xi, t) →
  begin match expr with
  | If (t1, t2, t3) →
    let* x1 = apply1 eval (xi, t1) in
    M.branch [
      (function () →
        let* x1 = apply1 isTrue x1 in
        apply1 eval (x1, t2)
      end) ;
      (function () →
        let* x1 = apply1 isFalse x1 in
        apply1 eval (x1, t3)
      end)
    ]
  | _ → M.fail ""
  end
(* ... *)
```

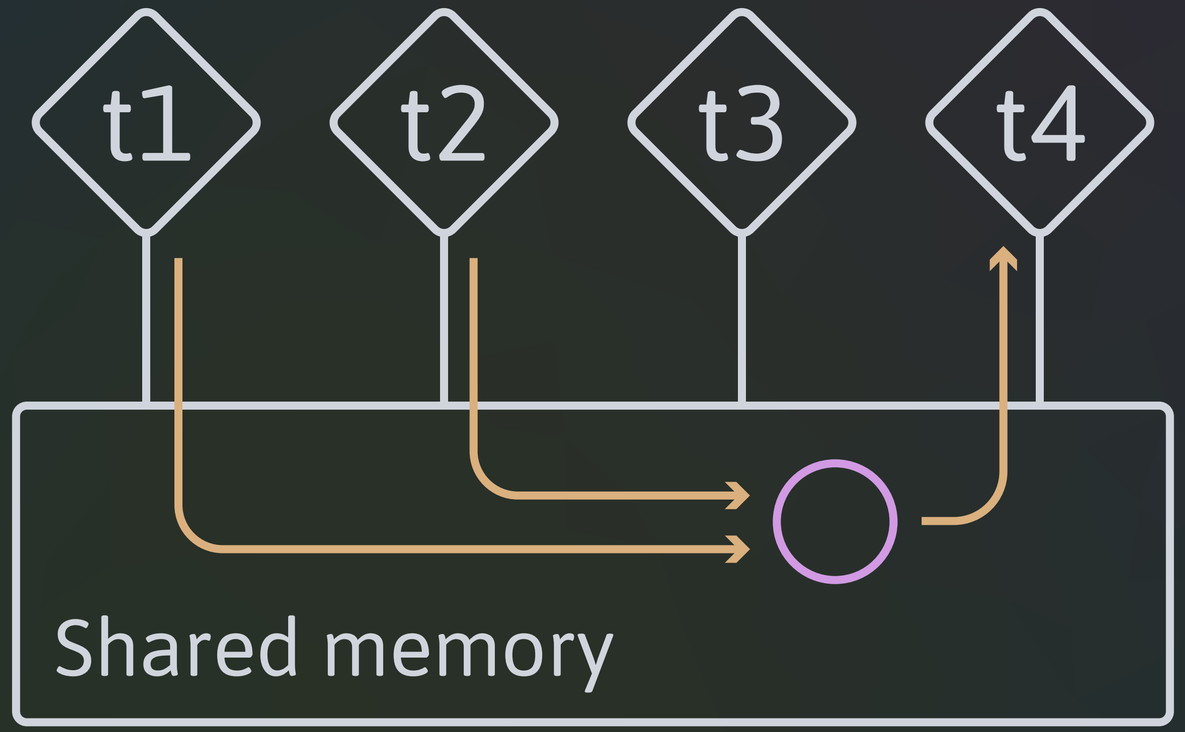
Concurrency



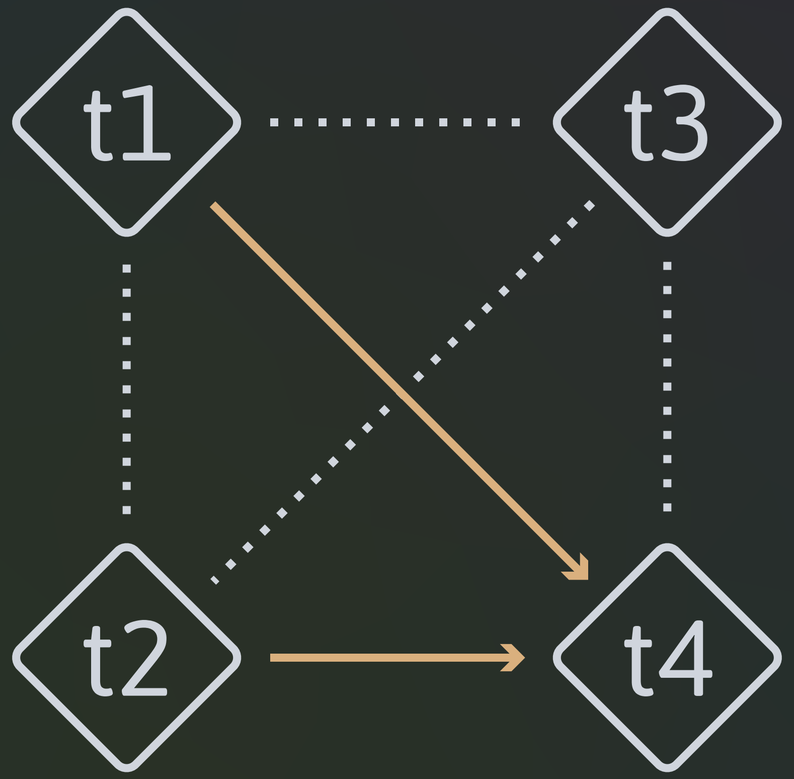


Shared memory
vs.
Message passing

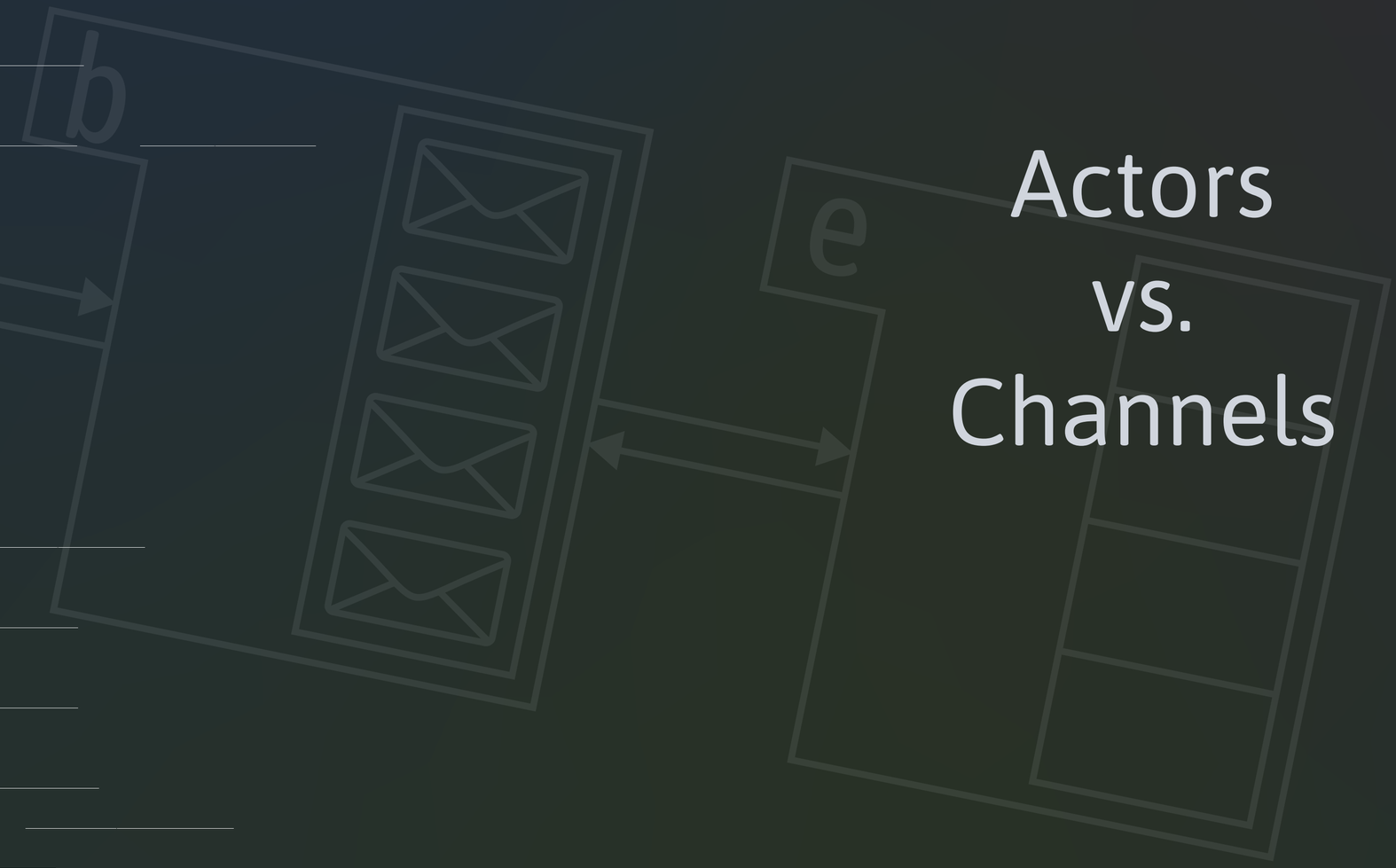
Shared memory



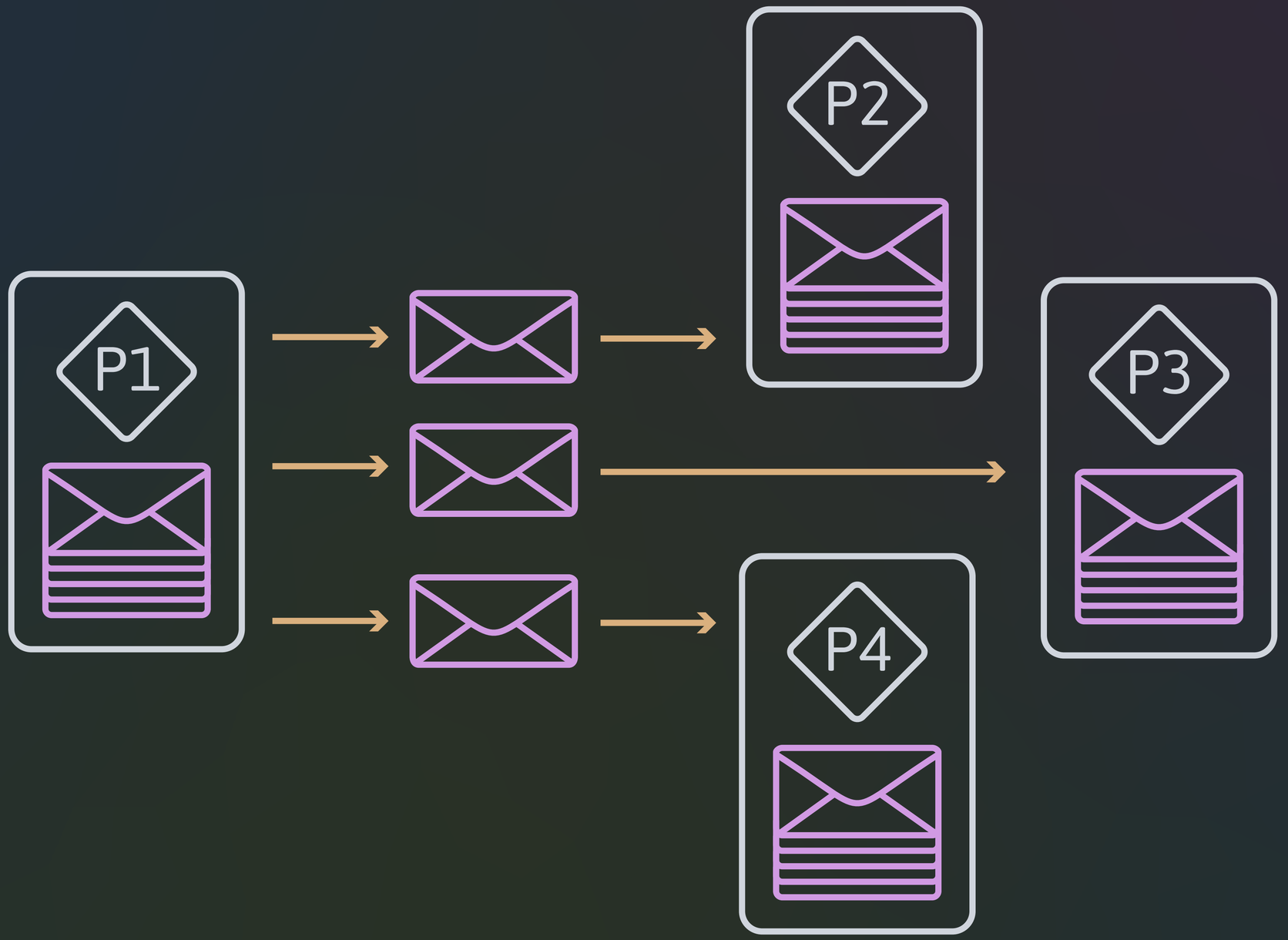
Message passing



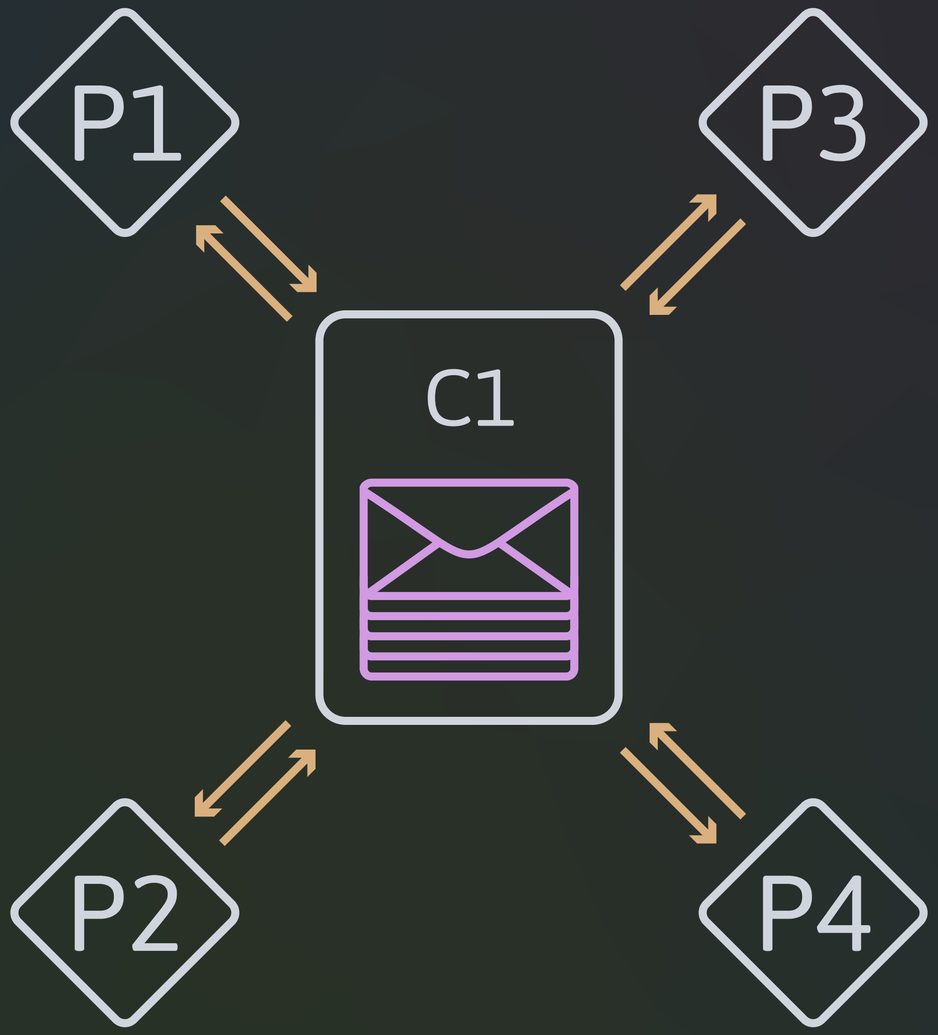
Actors
vs.
Channels



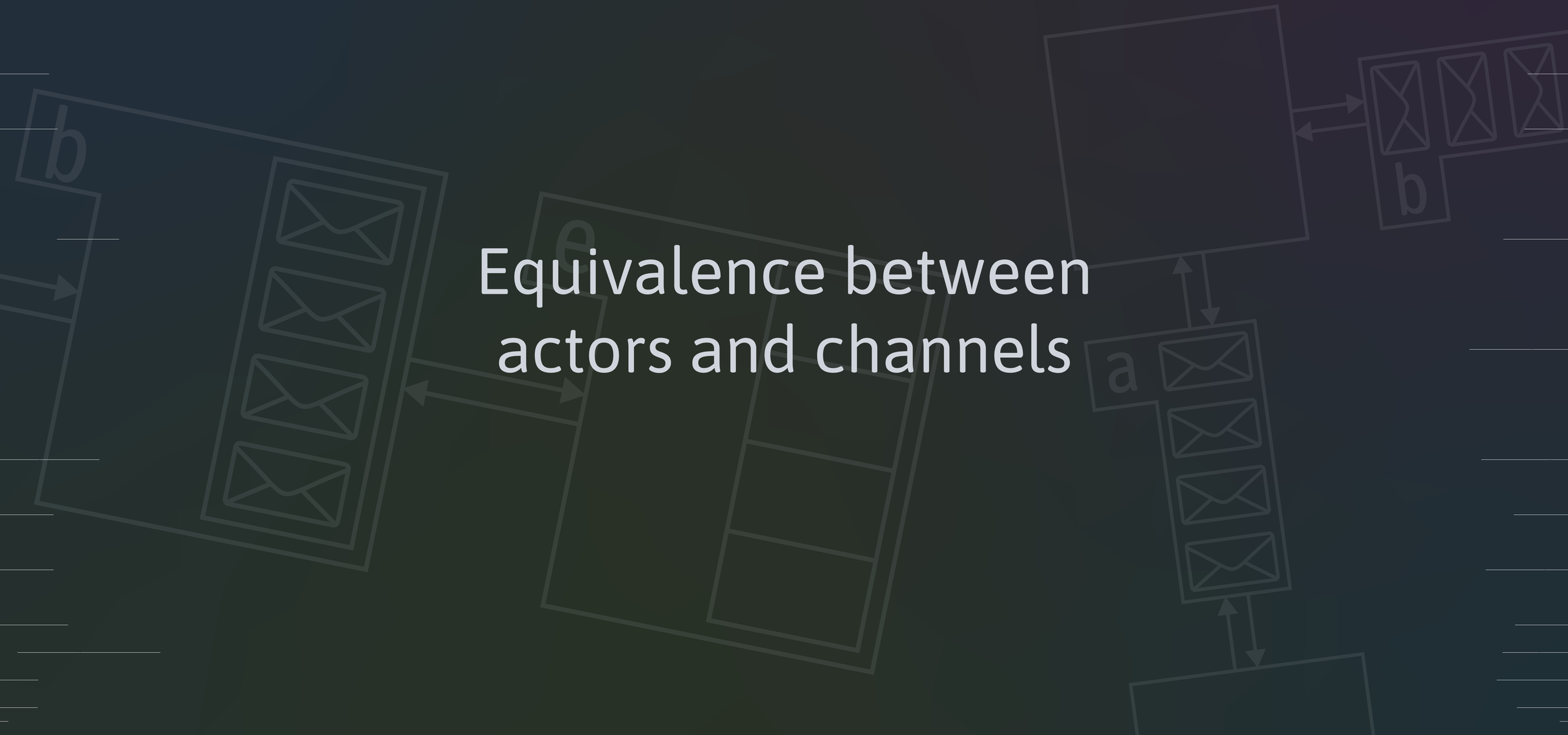
Actors



Channels

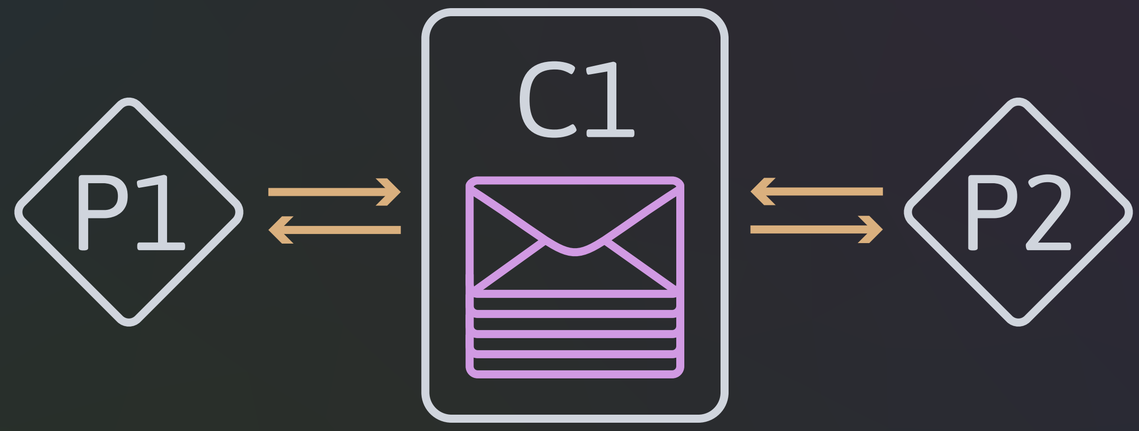


Equivalence between actors and channels

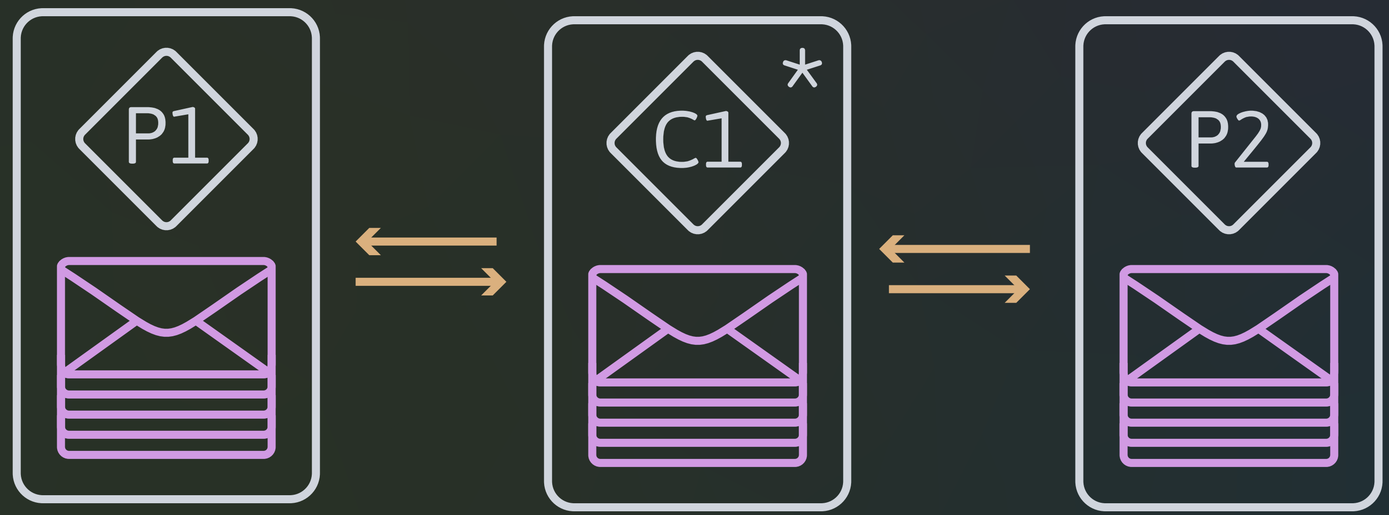


Channels to actors

Channels

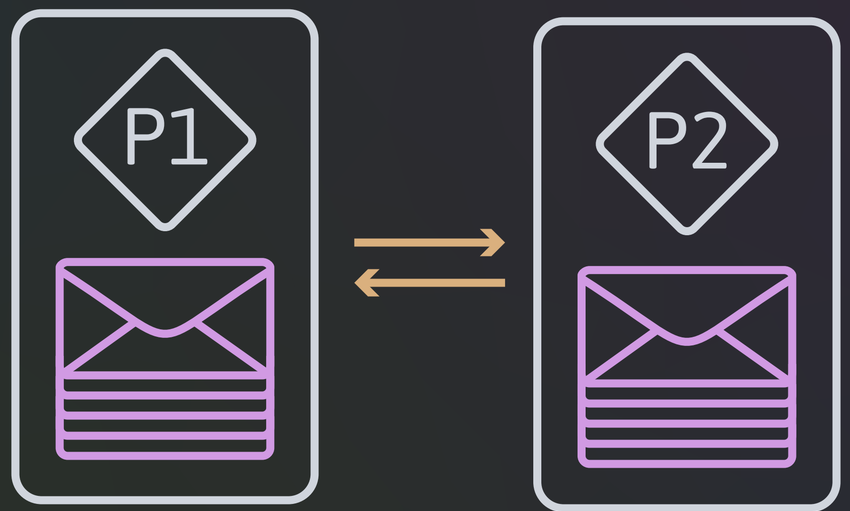


Actors



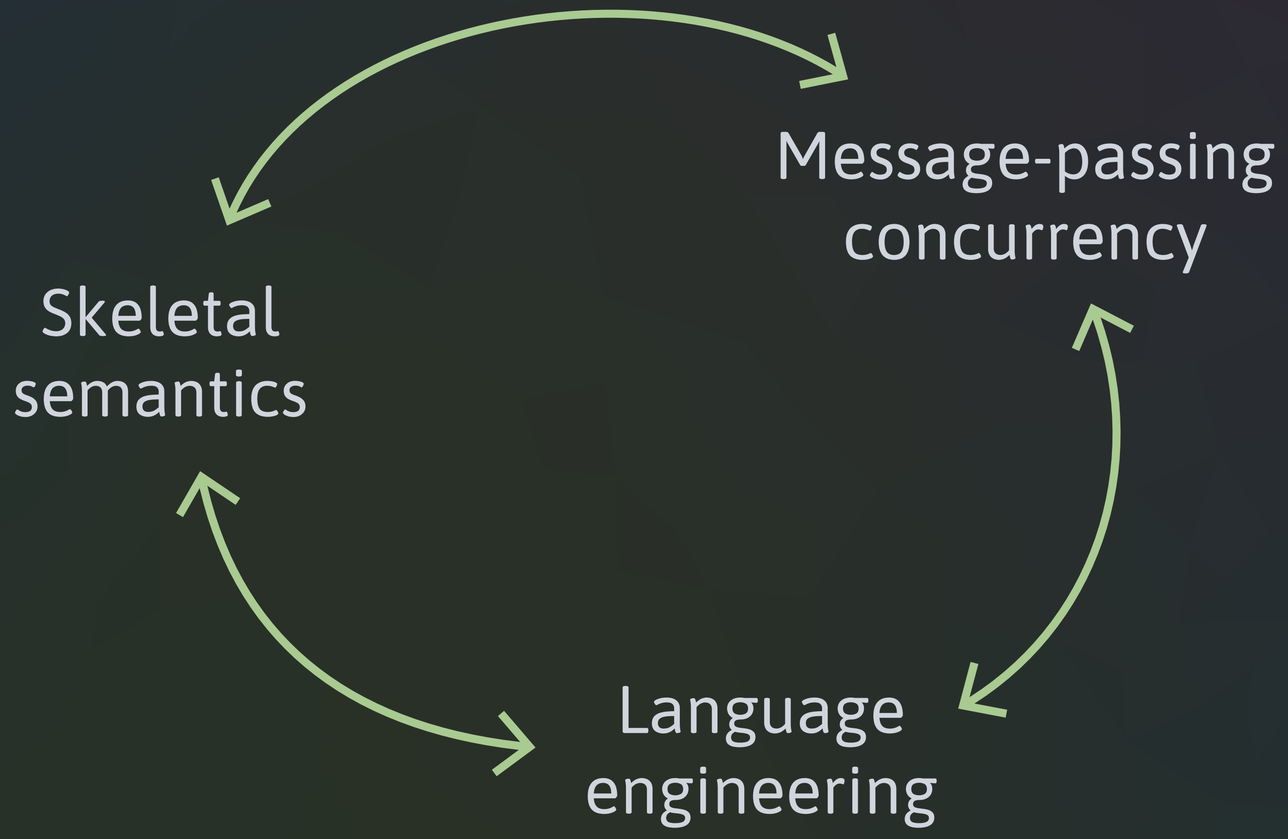
Actors to channels

Actors

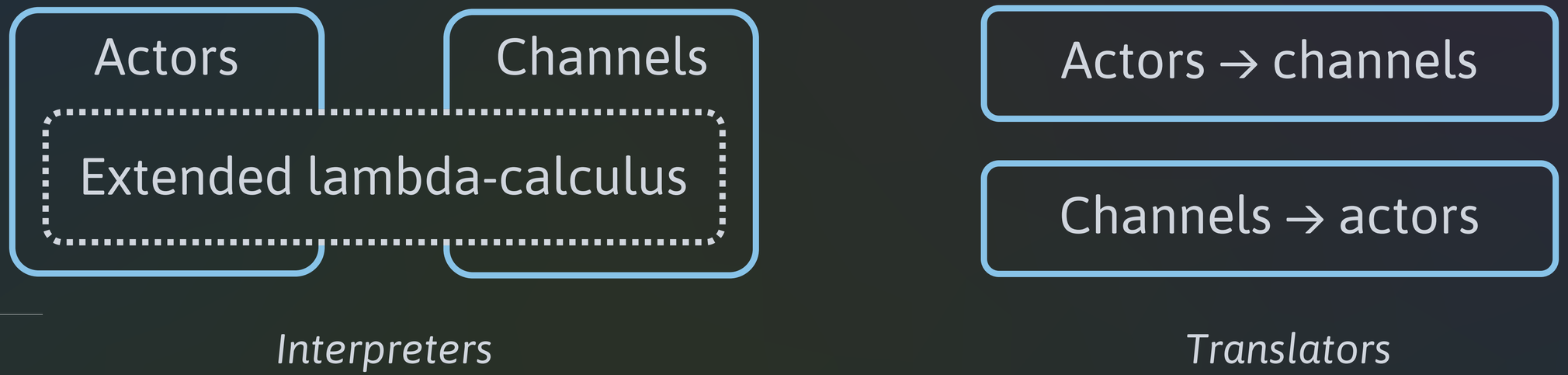


The project

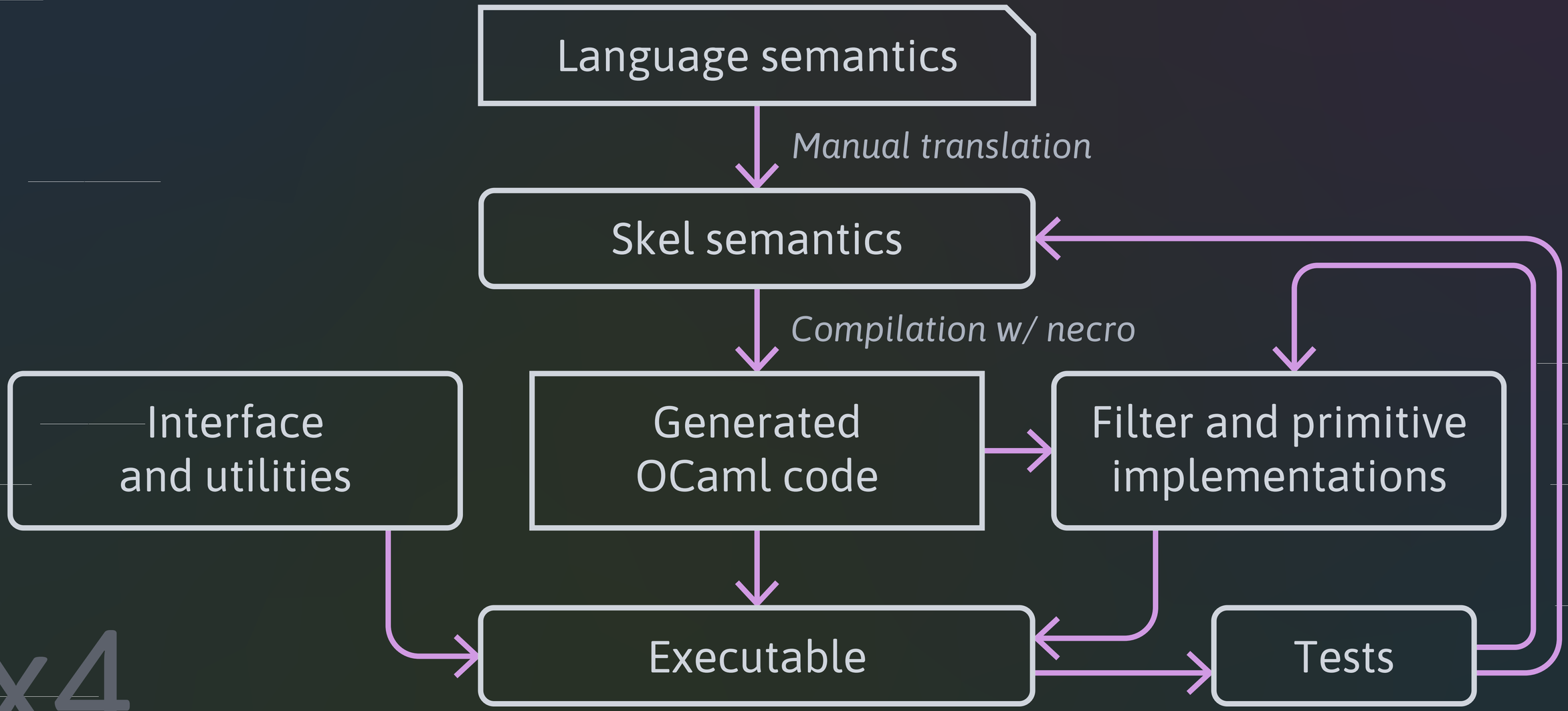
Goals


Message-passing
concurrency
Skeletal
semantics
Language
engineering

Deliverables

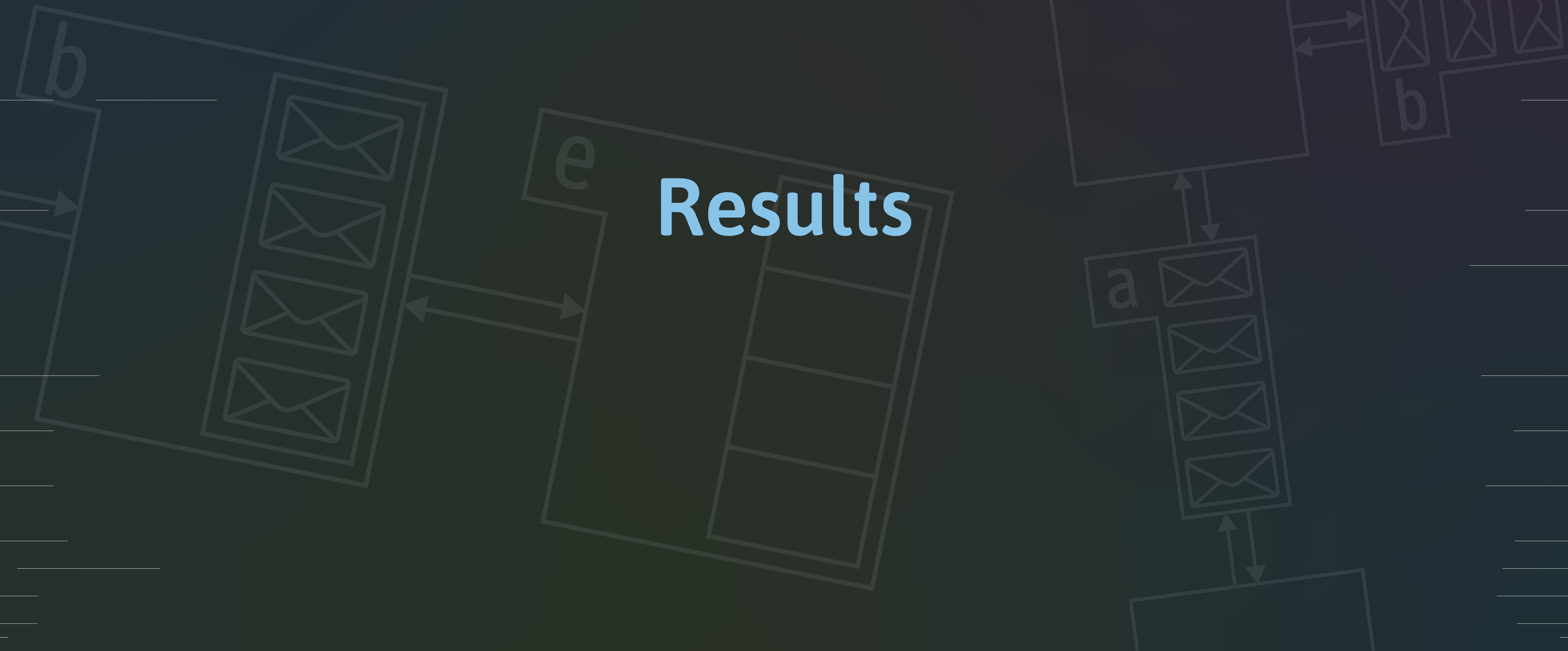


Workflow


Language semantics
Manual translation
Skel semantics
Compilation w/ necro
Interface and utilities
Generated OCaml code
Filter and primitive implementations
Executable
Tests

x4

Results

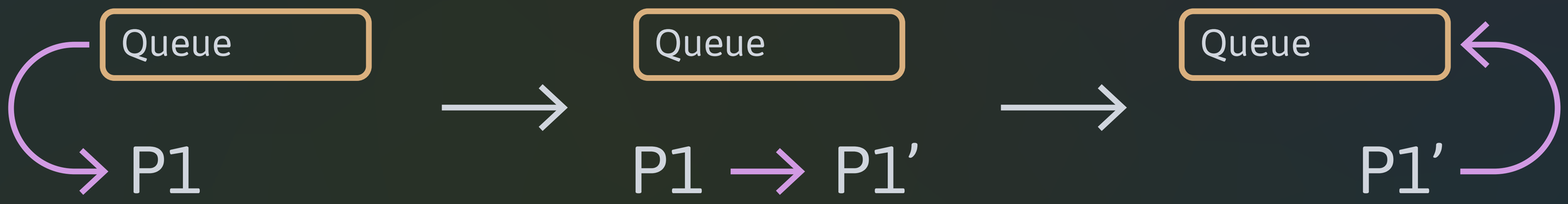


Results

$$P1 \parallel P2 \equiv P2 \parallel P1$$

$$(P1 \parallel P2) \parallel P3 \equiv P1 \parallel (P2 \parallel P3)$$

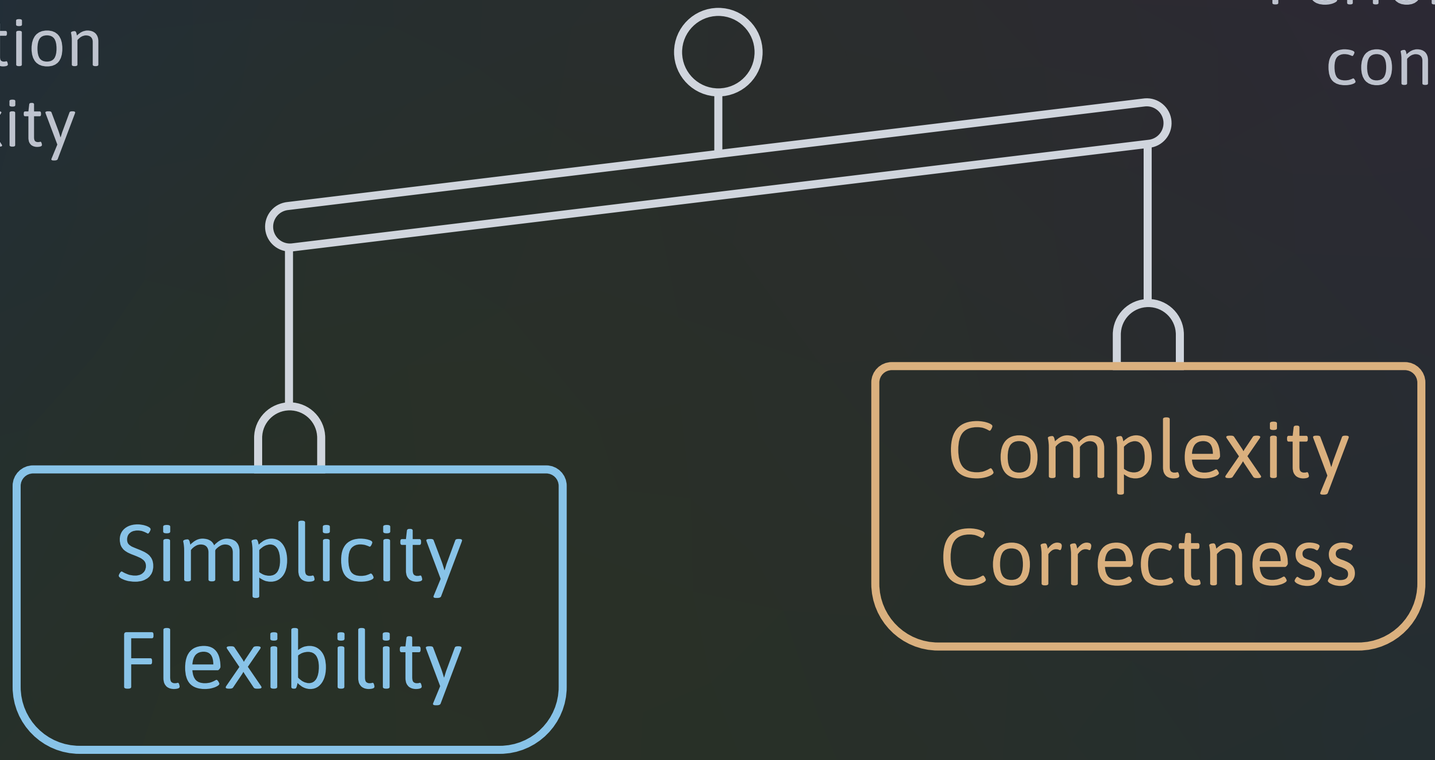
$$\frac{P1 \rightarrow P1'}{P1 \parallel P2 \rightarrow P1' \parallel P2}$$



Results

Specification complexity

Performance concerns

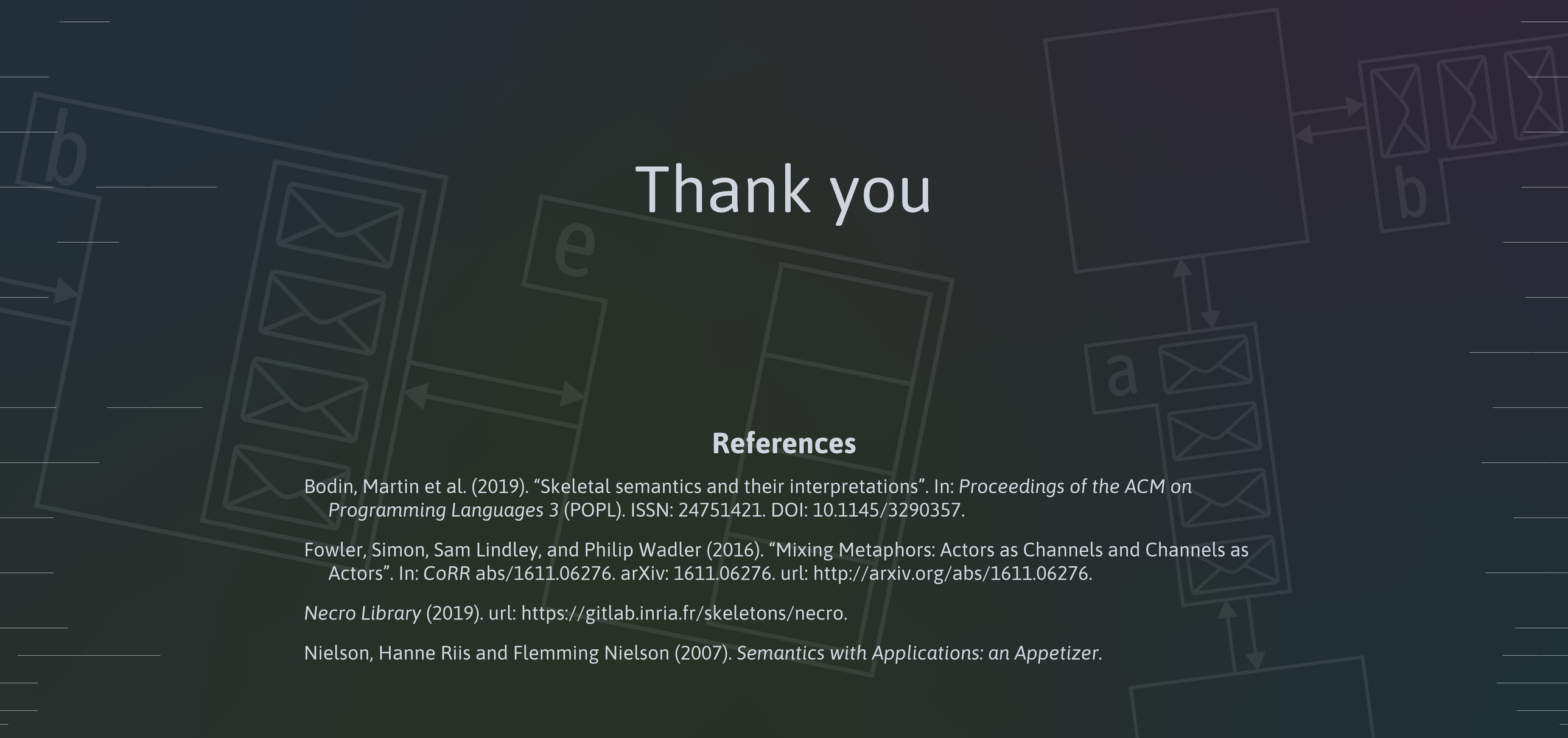


Target platform

Host langauge

Architecture requirements

Thank you



References

Bodin, Martin et al. (2019). “Skeletal semantics and their interpretations”. In: *Proceedings of the ACM on Programming Languages 3* (POPL). ISSN: 24751421. DOI: 10.1145/3290357.

Fowler, Simon, Sam Lindley, and Philip Wadler (2016). “Mixing Metaphors: Actors as Channels and Channels as Actors”. In: *CoRR* abs/1611.06276. arXiv: 1611.06276. url: http://arxiv.org/abs/1611.06276.

Necro Library (2019). url: https://gitlab.inria.fr/skeletons/necro.

Nielson, Hanne Riis and Flemming Nielson (2007). *Semantics with Applications: an Appetizer.*