Actor Model

#SCBCN14

sponsored by

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thanks!

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Questions!

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about you

about me

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1) problem solver, Garbage Collector, mostly scala, java 8, agile for tech teams

2) kayaker

3) under construction

4) all things JVM

The Pragmatic Programmers

Seven Concurrency Models in Seven Weeks

When Threads Unravel

Paul Butcher

Series editor: *Bruce Tate*
Development editor: *Jacquelyn Carter*

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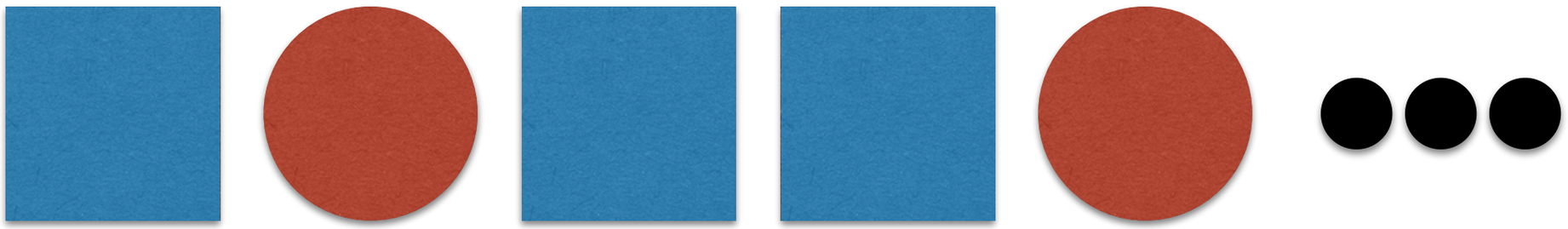
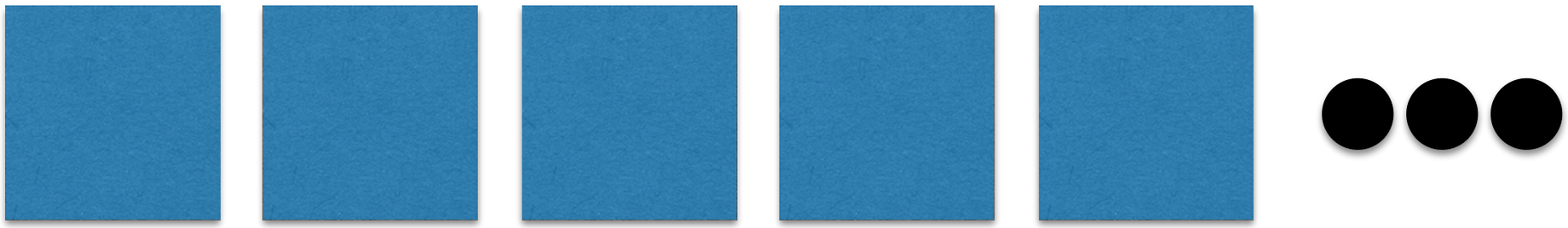
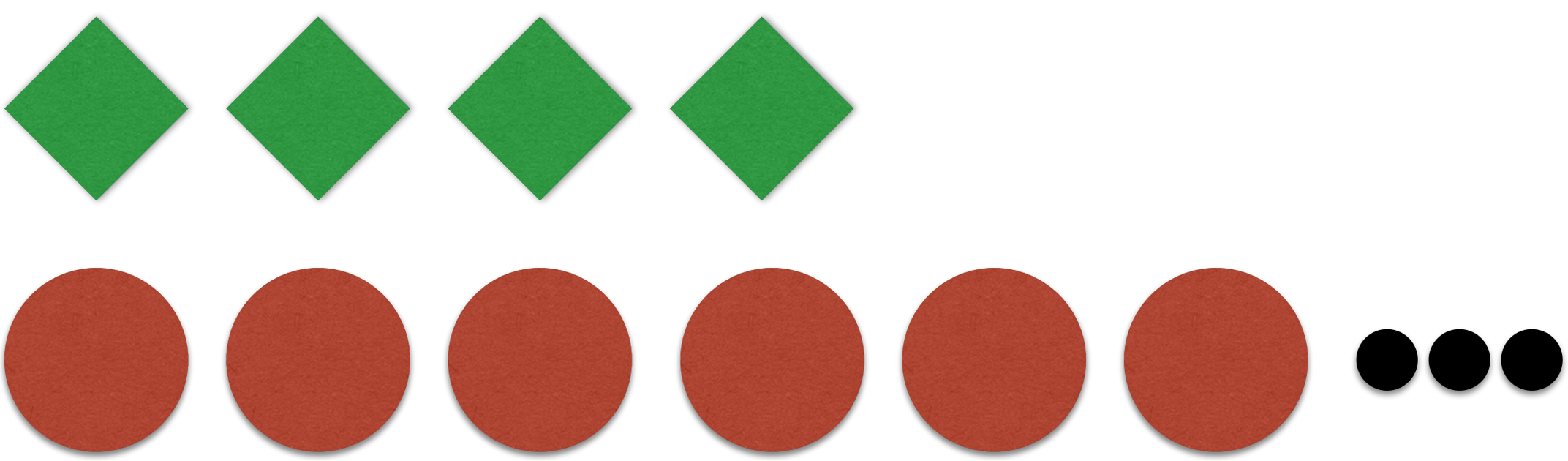
Concurrency

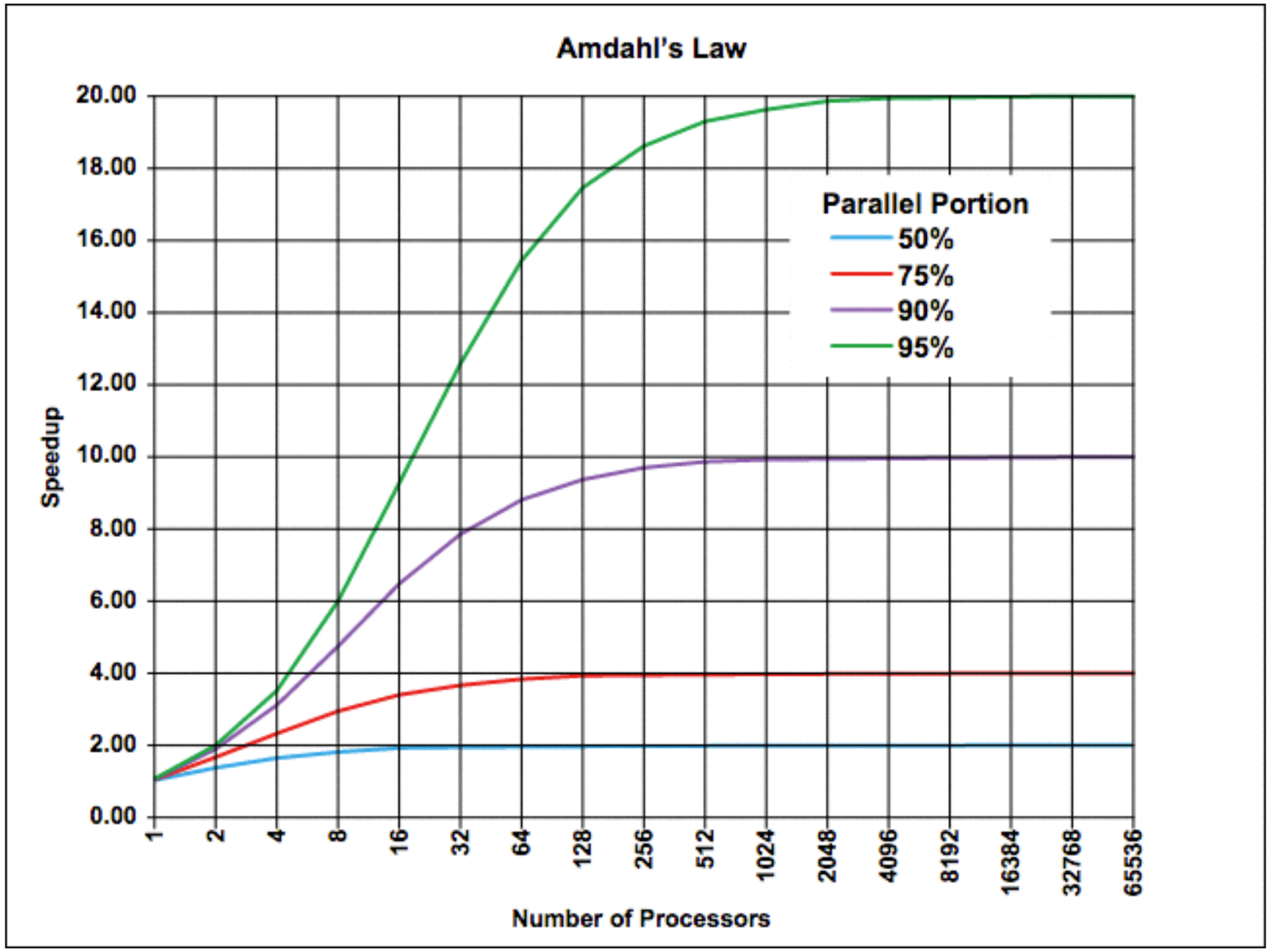


Parallelism





The Problem


Amdahl's Law
Speedup
Number of Processors
Parallel Portion
50%
75%
90%
95%
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
1
2
4
8
16
32
64
128
256
512
1024
2048
4096
8192
16384
32768
65536

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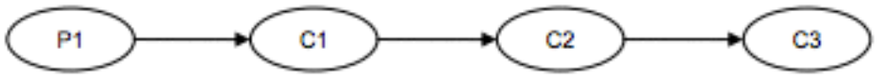
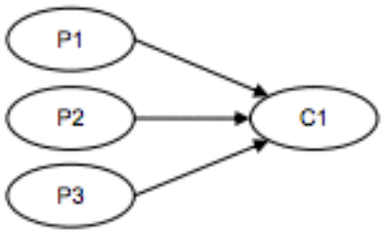
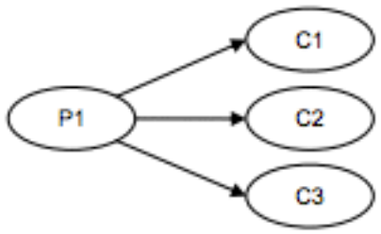
Unicast: 1P – 1C



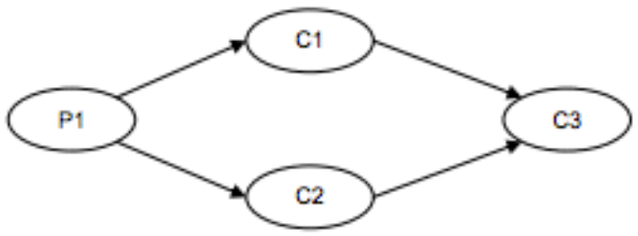
Three Step Pipeline: 1P – 3C



Sequencer: 3P – 1C



Multicast: 1P – 3C



Diamond: 1P – 3C

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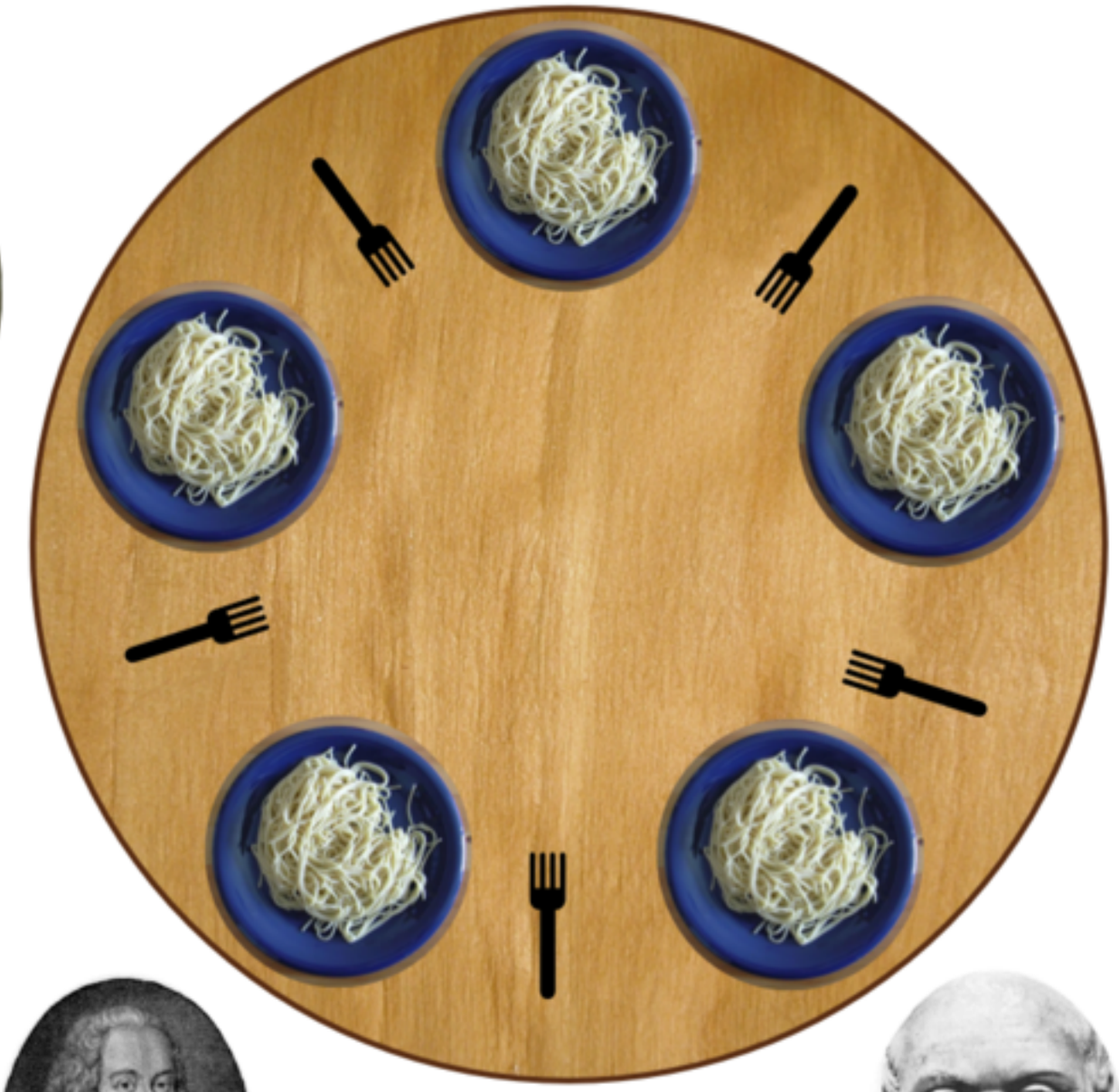
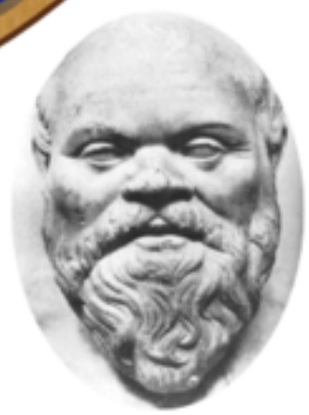
- CPU-bound or IO bound
- Latency or Thoughput
- memory footprint





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Threads and Locks

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Threads and Locks

- low level
- debugging
- ThreadPool

Threads and Locks

- threads are heavy
- locks expensive
- low level
- no recovery
- locking granularity
- visibility

Threads and Locks

Mutual Exclusion
Lock Ordering
Memory Model

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HD

Event Loop

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Event Loop

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filmax

SEDA

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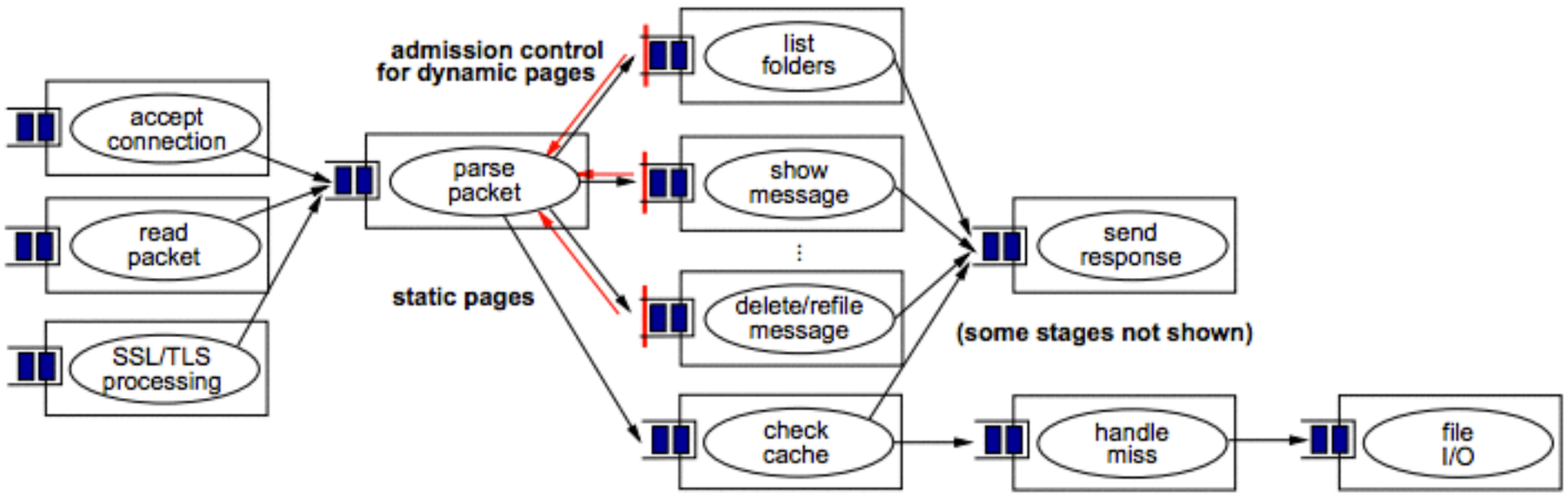
SEDA



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Disruptor

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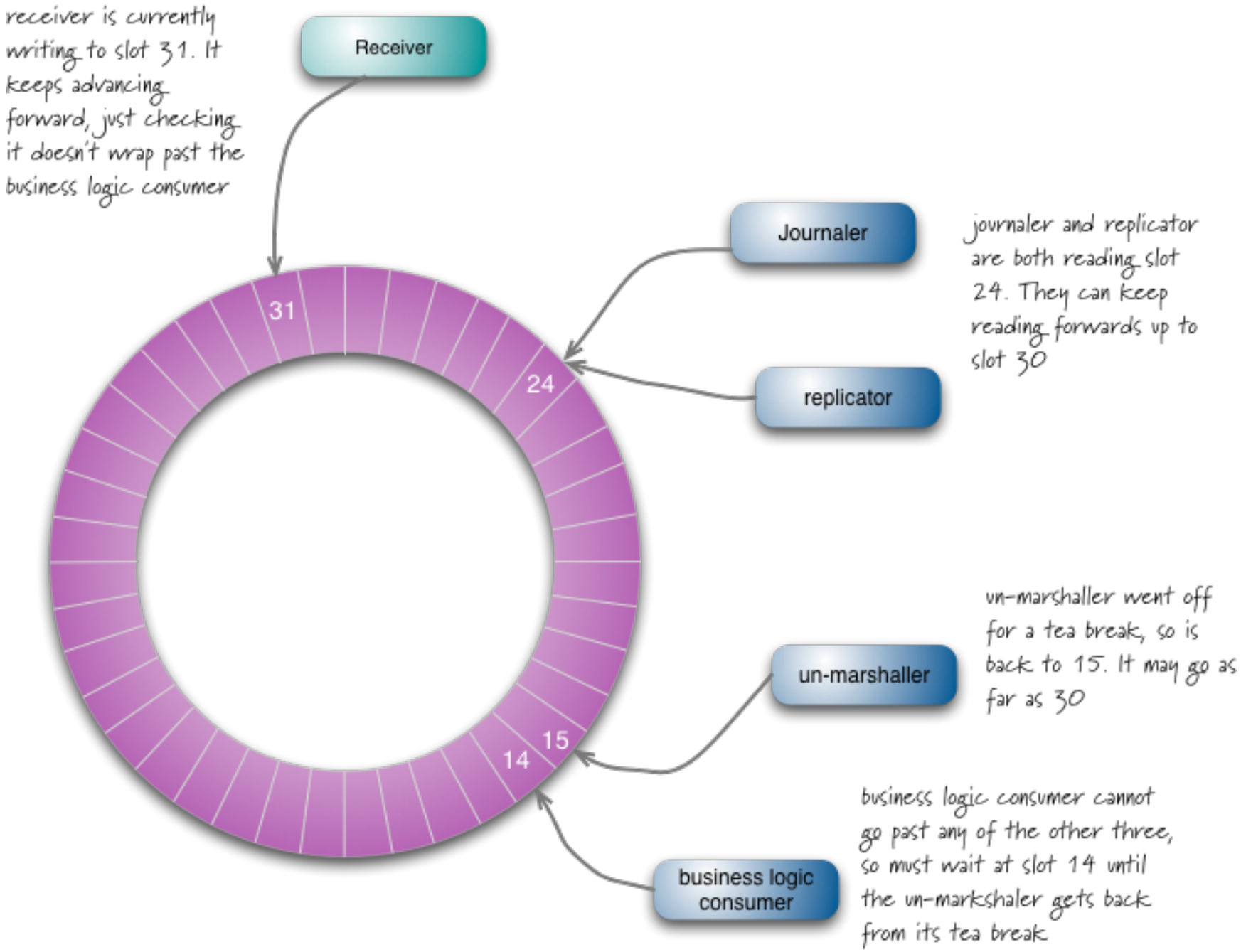
Disruptor



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ANCING ELK
1974

Functional Programming

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Functional Programming

Referential Transparency
Immutability

Persistent Datastructures

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Concurrency models

- Shared state
  - Threads and locks
  - Disruptor
  - FP
- Message passing
  - SEDA
  - Actors

WARNING!!! Very incomplete list!!!

Actor Model

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Actor Model

- OOP was always about passing messages
  - State encapsulation
- Actors run concurrently
- Actors *DO* send messages

What is ?

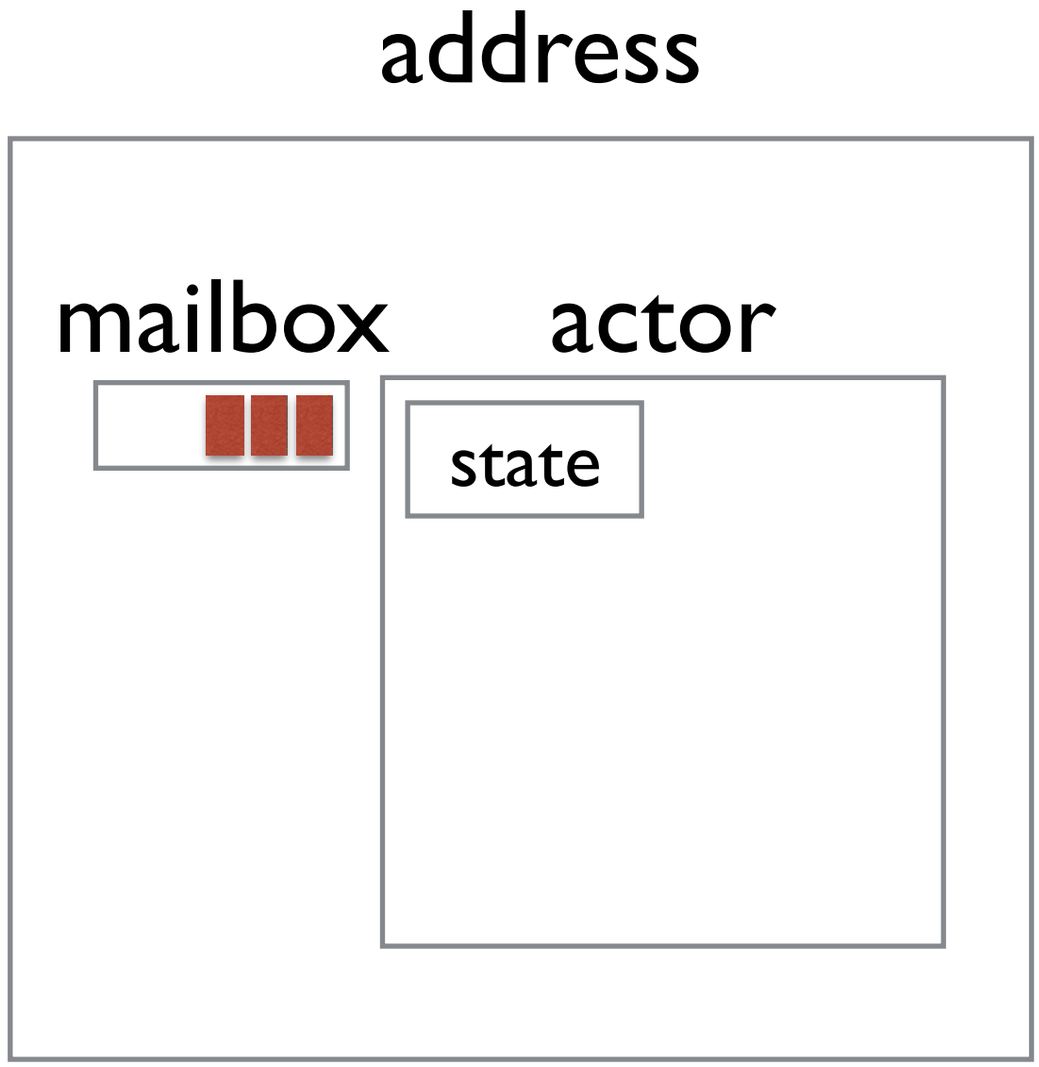
- fundamental unit of computation
- process
- store
- communicate

Axioms

- An Actor […], in response to a message it receives, can concurrently:
  - send messages to addresses of Actors that it has
  - create new Actors
  - designate how to handle the next message it receives

Higher abstraction

- everything runs on a ‘system’
- forget about locks, queues,
- programmer doesn’t know anything about where it’s running. It can be adapted at environment.


address
mailbox
actor
state

This is you now
(Only picture without actors)

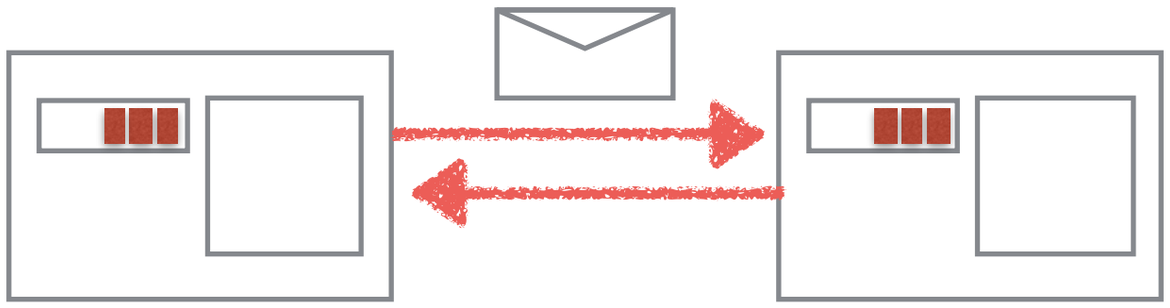
Actors/hello_actors/hello_actors.exs

```
def loop do
  receive do
    {:greet, name} -> IO.puts("Hello #{name}")
    {:praise, name} -> IO.puts("#{name}, you're amazing")
    {:celebrate, name, age} -> IO.puts("Here's to another #{age} years, #{name}")
  end
  loop
end
```

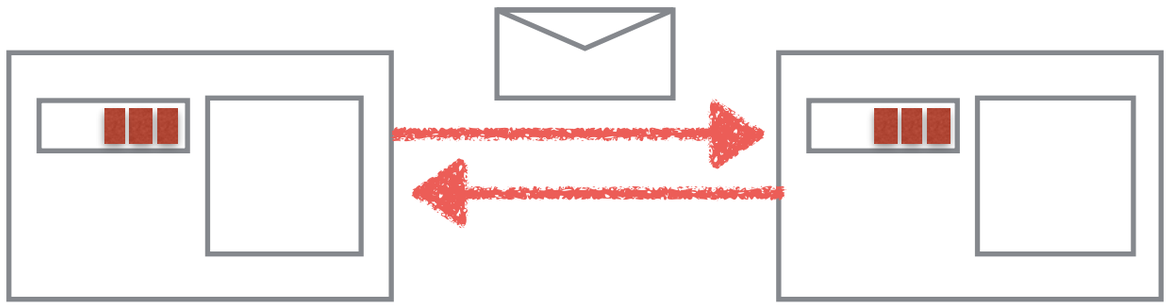
source: 7 concurrency models in 7 weeks

fire and forget

invoke

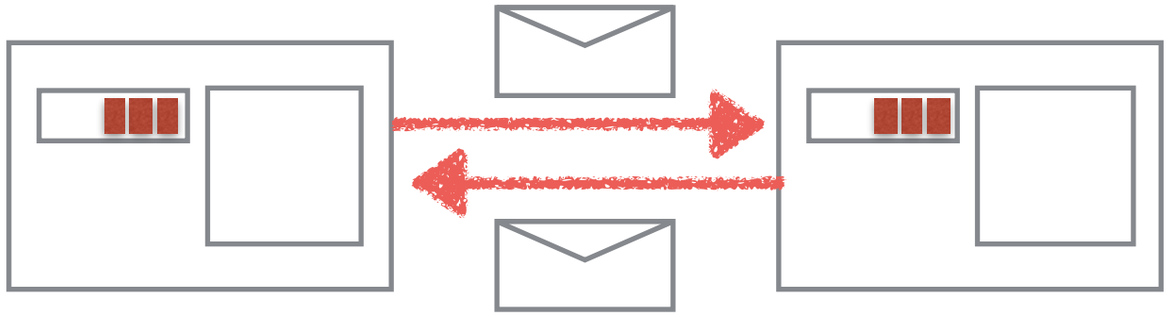


ask



- actors
- futures (for timeouts)
- receiving actor *must* reply

ff & ff



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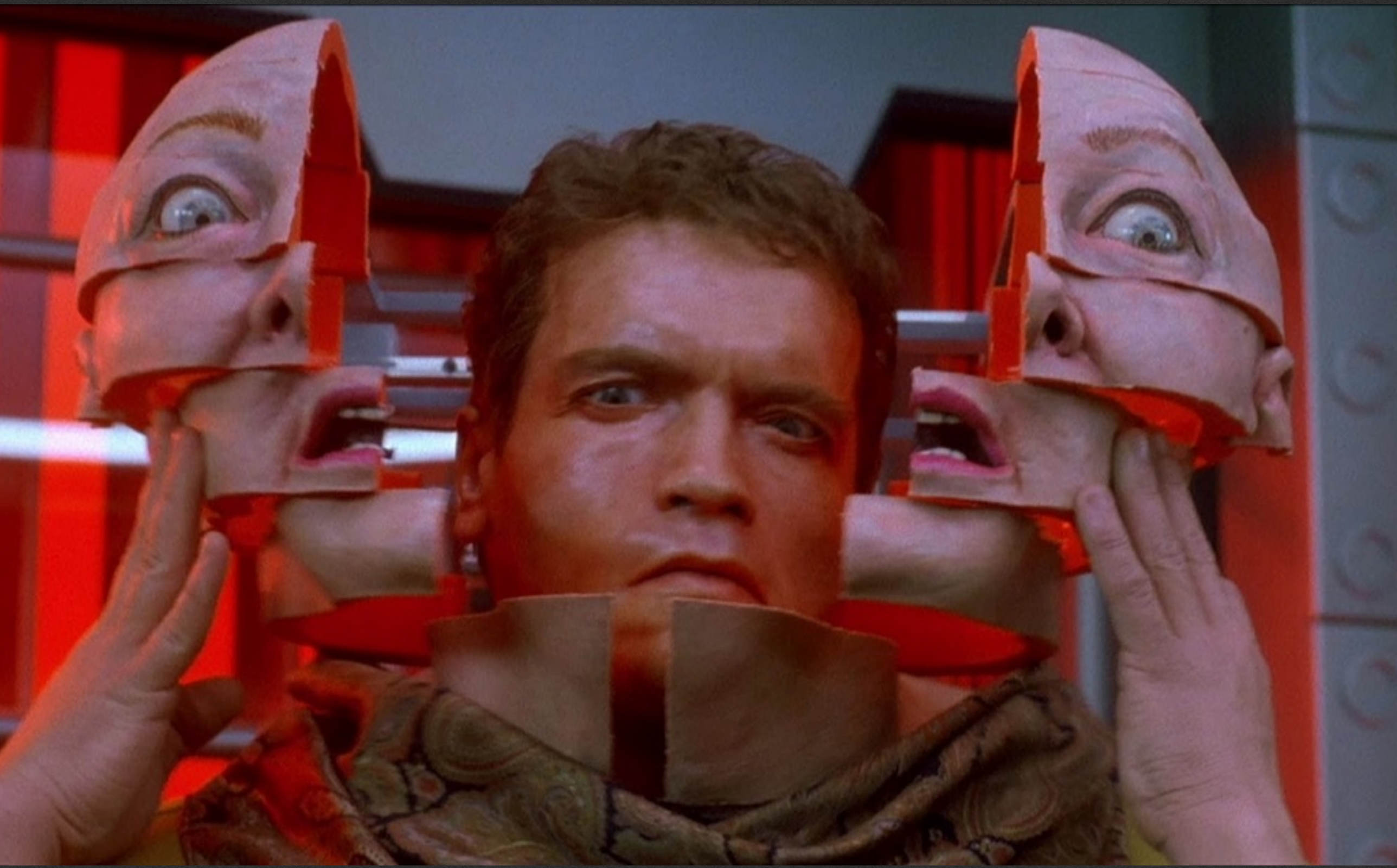
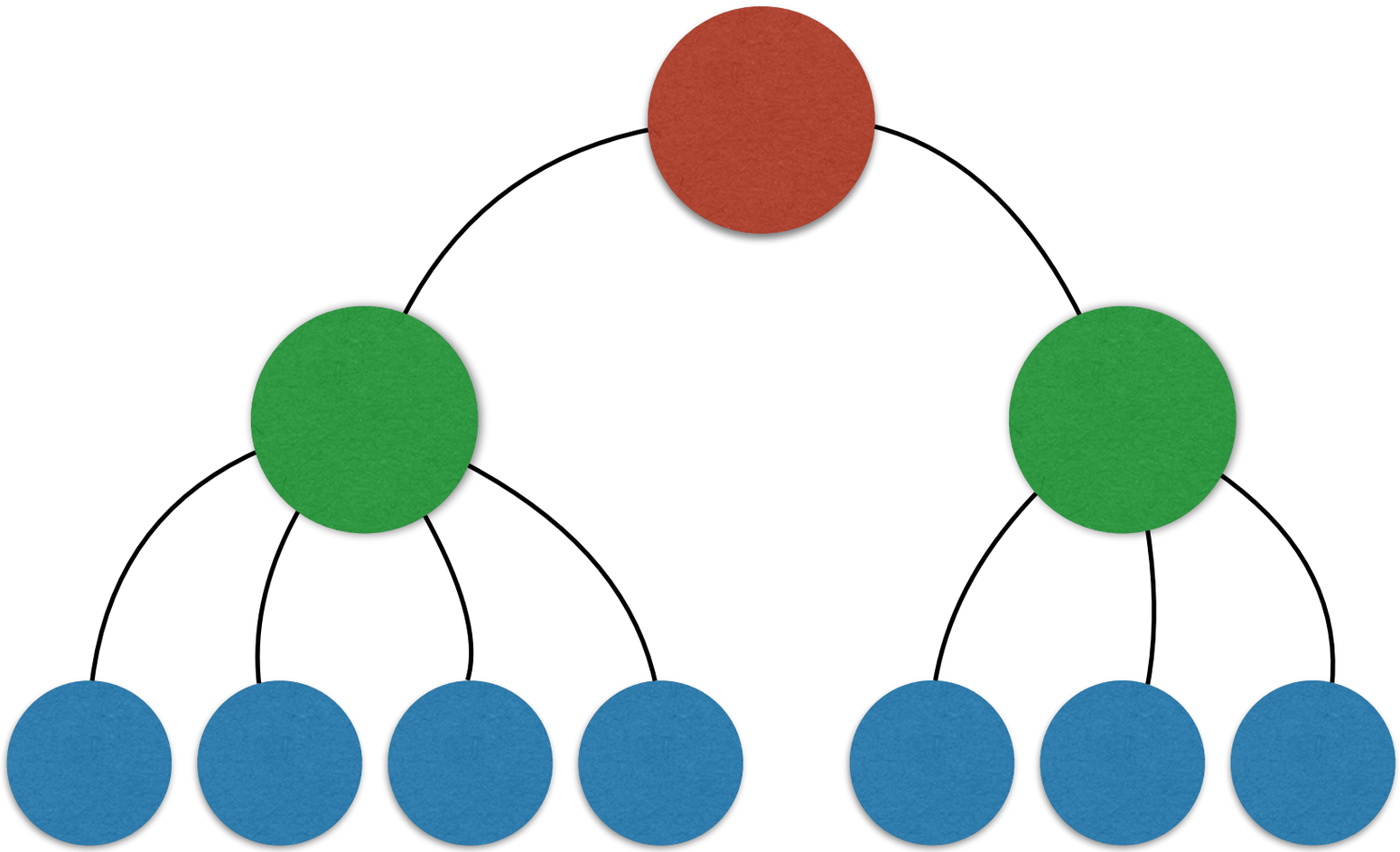


Actors/counter/counter2.ex

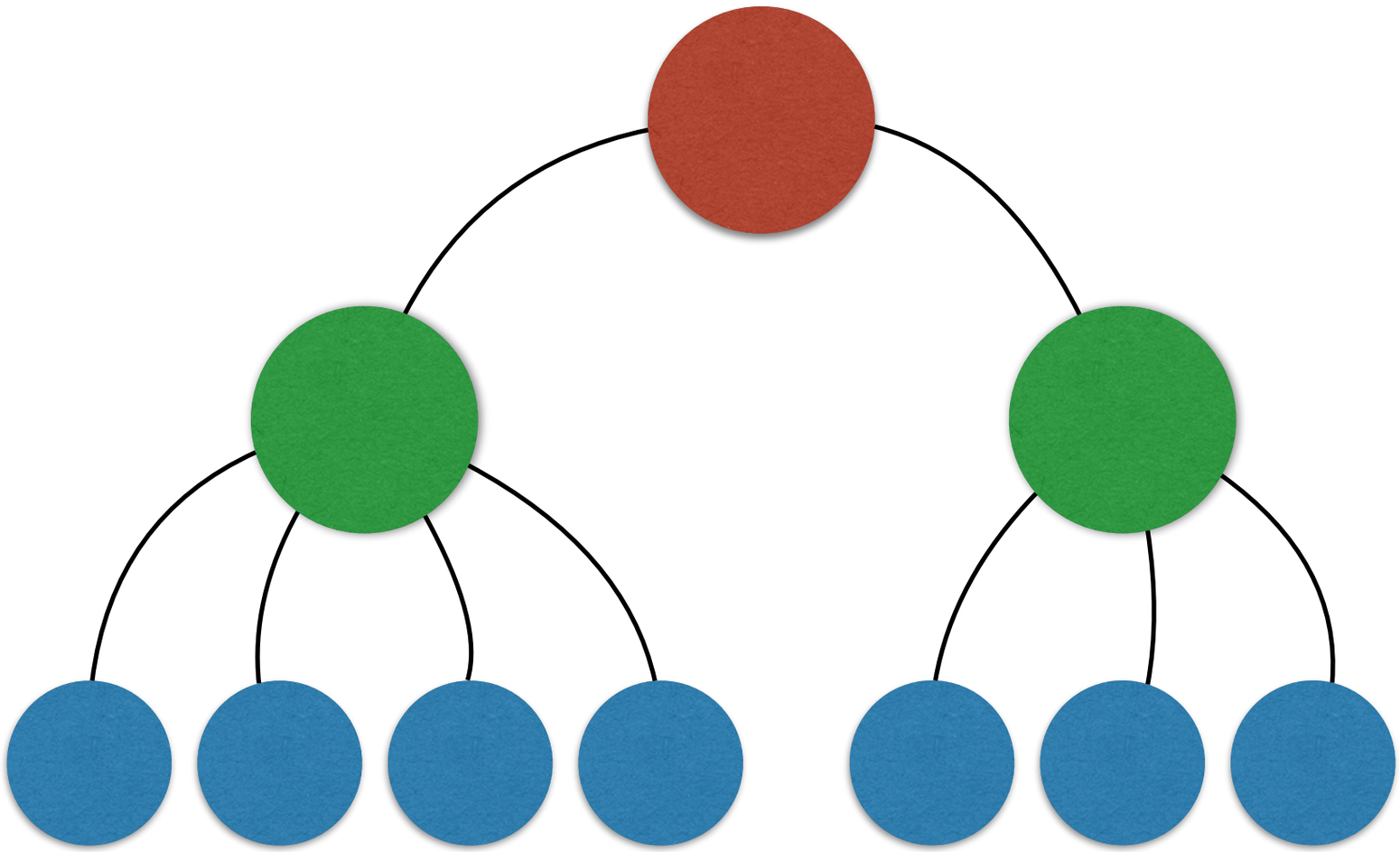
```
defmodule Counter do
  def start(count) do
    spawn(__MODULE__, :loop, [count])
  end
  def next(counter) do
    ref = make_ref()
    send(counter, {:next, self(), ref})
    receive do
      {:ok, ^ref, count} -> count
    end
  end
  def loop(count) do
    receive do
      {:next, sender, ref} ->
        send(sender, {:ok, ref, count})
        loop(count + 1)
    end
  end
end
```

source: 7 concurrency models in 7 weeks

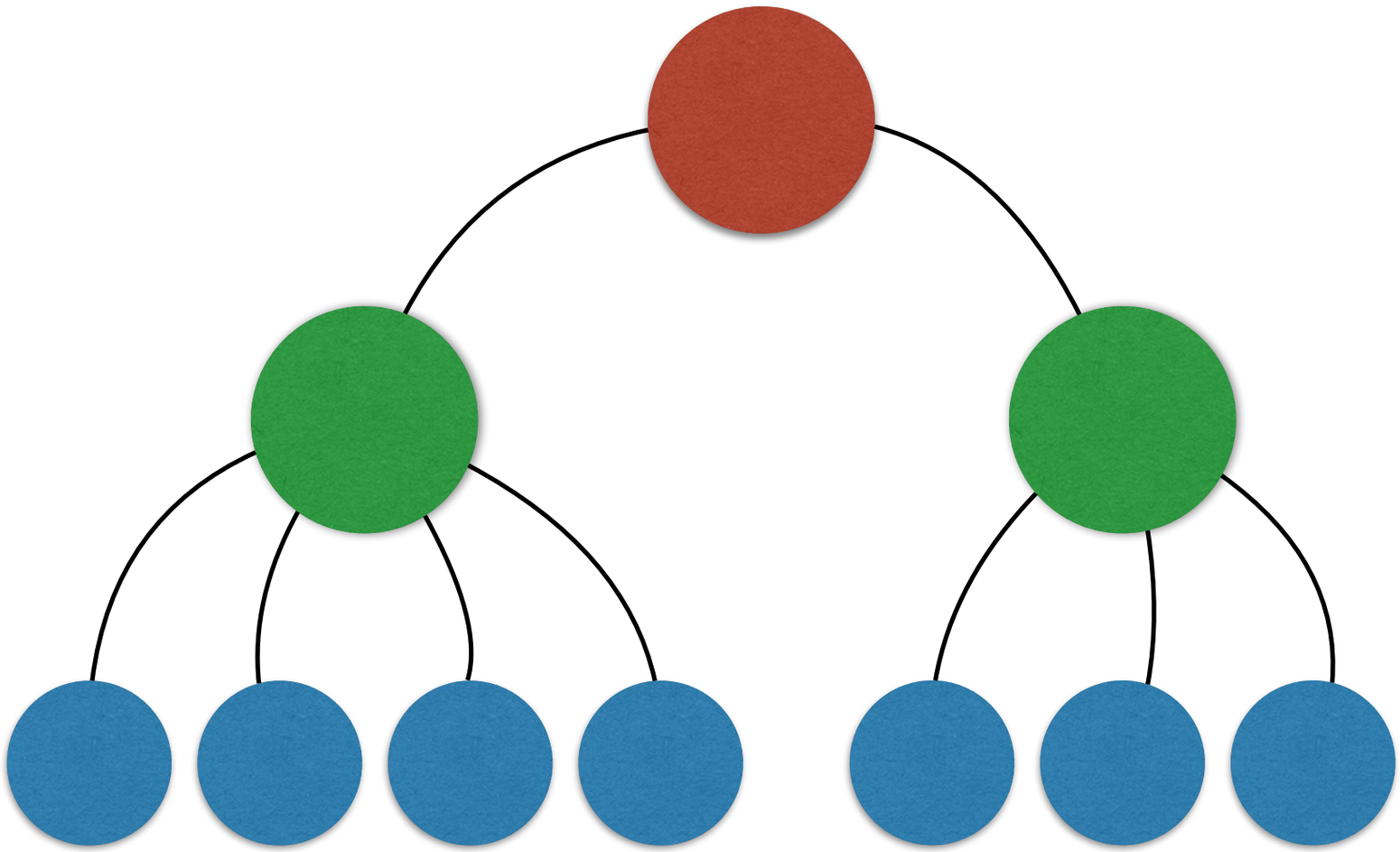
Supervision



One for One



One for One

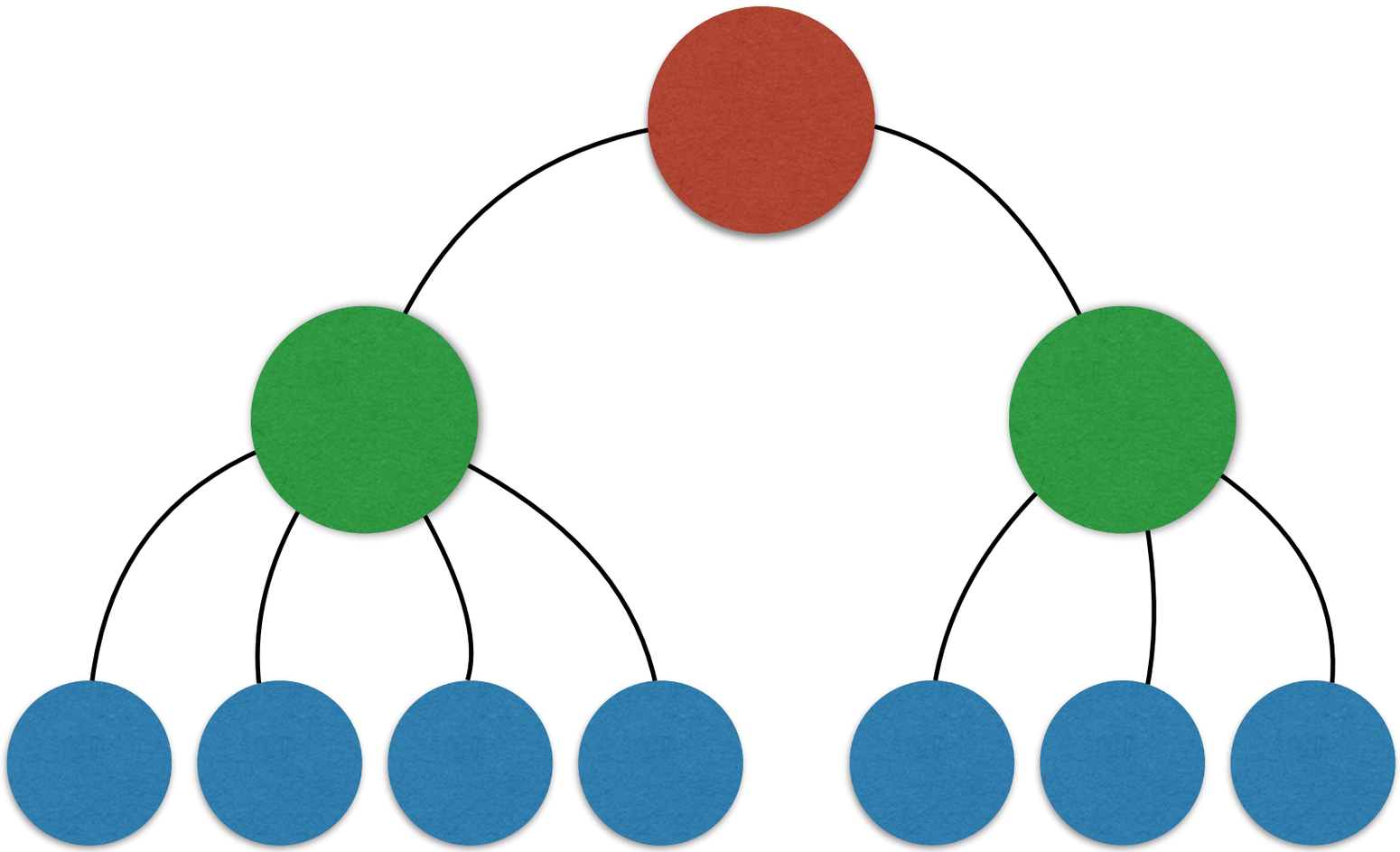


One for One

```
4.
5.  override val supervisorStrategy =
6.    OneForOneStrategy(maxNrOfRetries = 10, withinTimeRange = 1 minute) {
7.      case _: ArithmeticException       => Resume
8.      case _: NullPointerException      => Restart
9.      case _: IllegalArgumentException => Stop
10.     case _: Exception                 => Escalate
11.   }
```

source: akka.io (old version)

All for One



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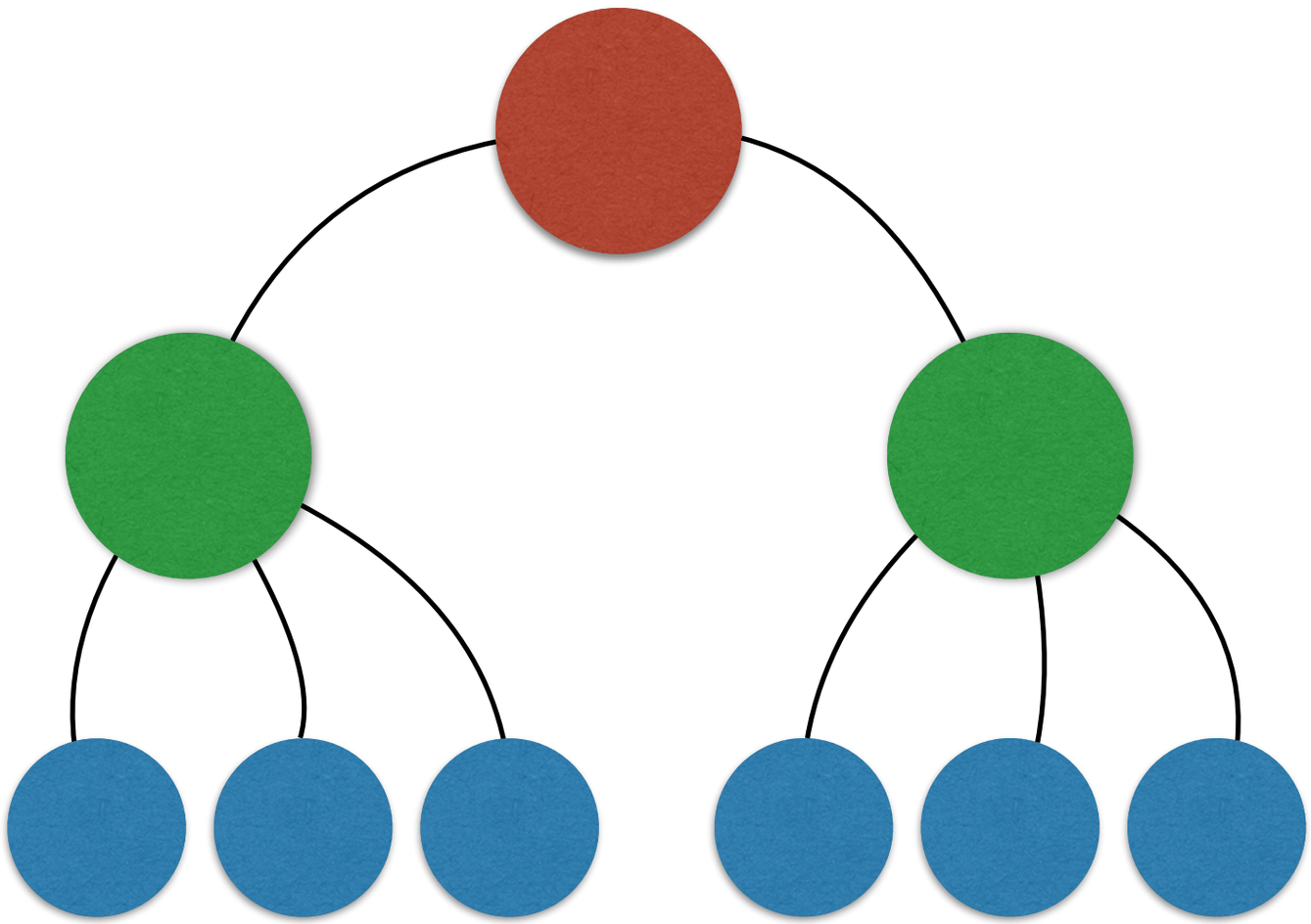
All for One



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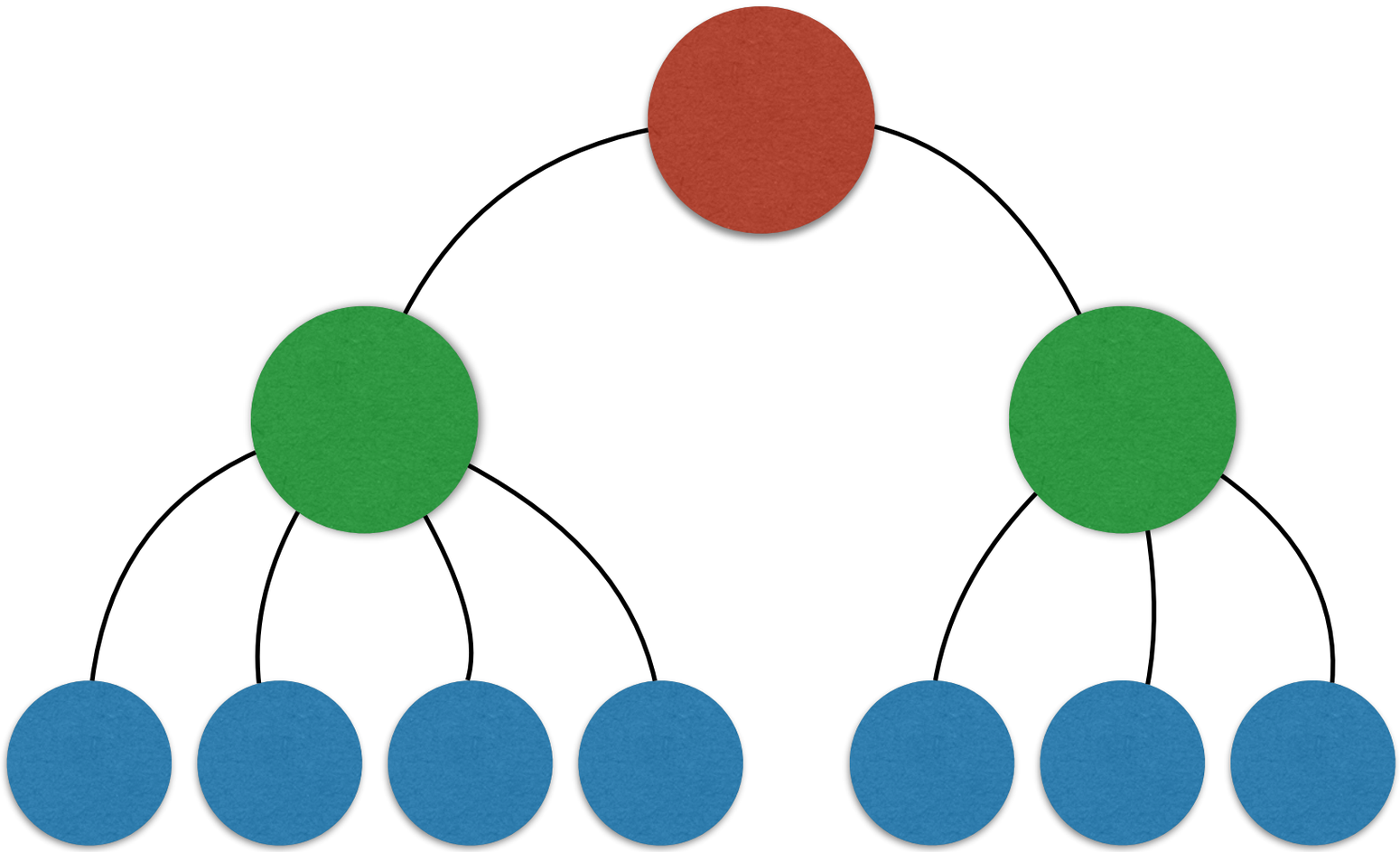
All for One



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Delivery

at-most-once

Tuning

Dispatcher *
PinnedDispatcher
BalancingDispatcher
CallingThreadDispatcher

Tuning

Dispatcher *

- one MB per actor
- many actors bound to a ThreadPool
- Bulkheading

Tuning

PinnedDispatcher

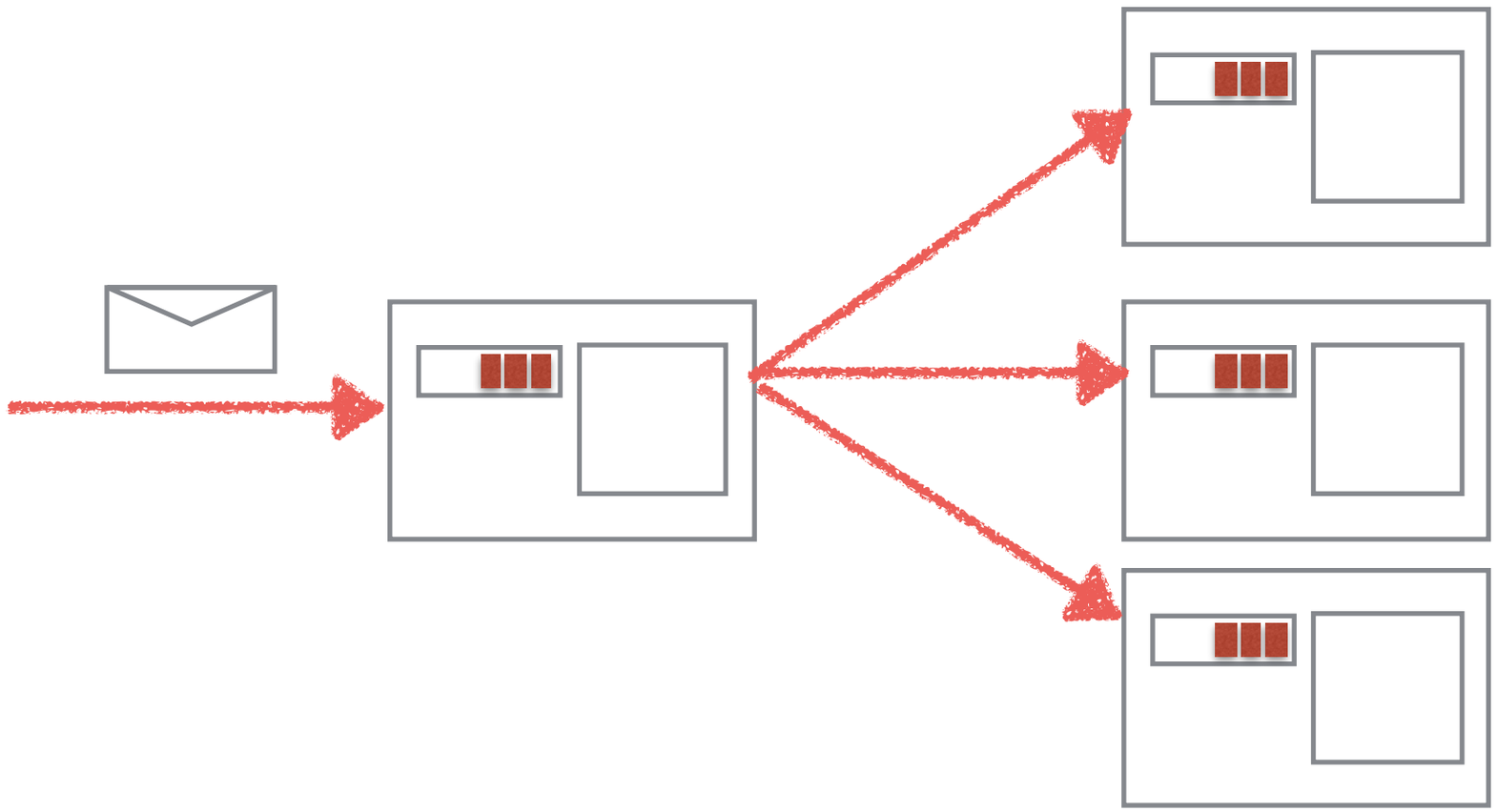
- one MB per actor
- dedicated Thread per actor
- Bulkheading

Tuning

BalancingDispatcher

- one MB - many actors
- ThreadPool
- work-sharing

Patterns



Patterns

- tailchopping
- balancing
- work pulling
- receptionist
- routing
- message forwarding
- …

Conclusions

- I/O bound vs CPU bound
- YMMV
- know your tools
- actors
  - distributed
  - at-most-once
  - supervision

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URGER

Questions?

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thanks!

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References

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