Elixir

Peeking into *Elixir's*

Processes, OTP & Supervisors

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benjamintanweihao@gmail.com

/benjamintanweihao

/bentanweihao

What will we learn today?

Elixir & Erlang

In less than 5 minutes

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Processes 101

The Basic Concurrency Primitive

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OTP

Framework and much more

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Supervisors

Fault Tolerance & Recovery

Ohai, Elixir!

Elixir is a functional, meta-programming aware language built on top of the Erlang VM.

Elixir & Erlang

In less than 5 minutes

Ohai, Erlang!

Erlang is a general-purpose concurrent, garbage-collected programming language and runtime system. The sequential subset of Erlang is a functional language, with eager evaluation, single assignment, and dynamic typing. It was designed by Ericsson to support distributed, fault-tolerant, soft-real-time, non-stop applications. It supports hot swapping, so that code can be changed without stopping a system.

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Why Elixir ?

- Free lunch is over
- Hyper-threading & Multicore
- Faster software means using all cores!
- Concurrency -> Coordination
- Functional

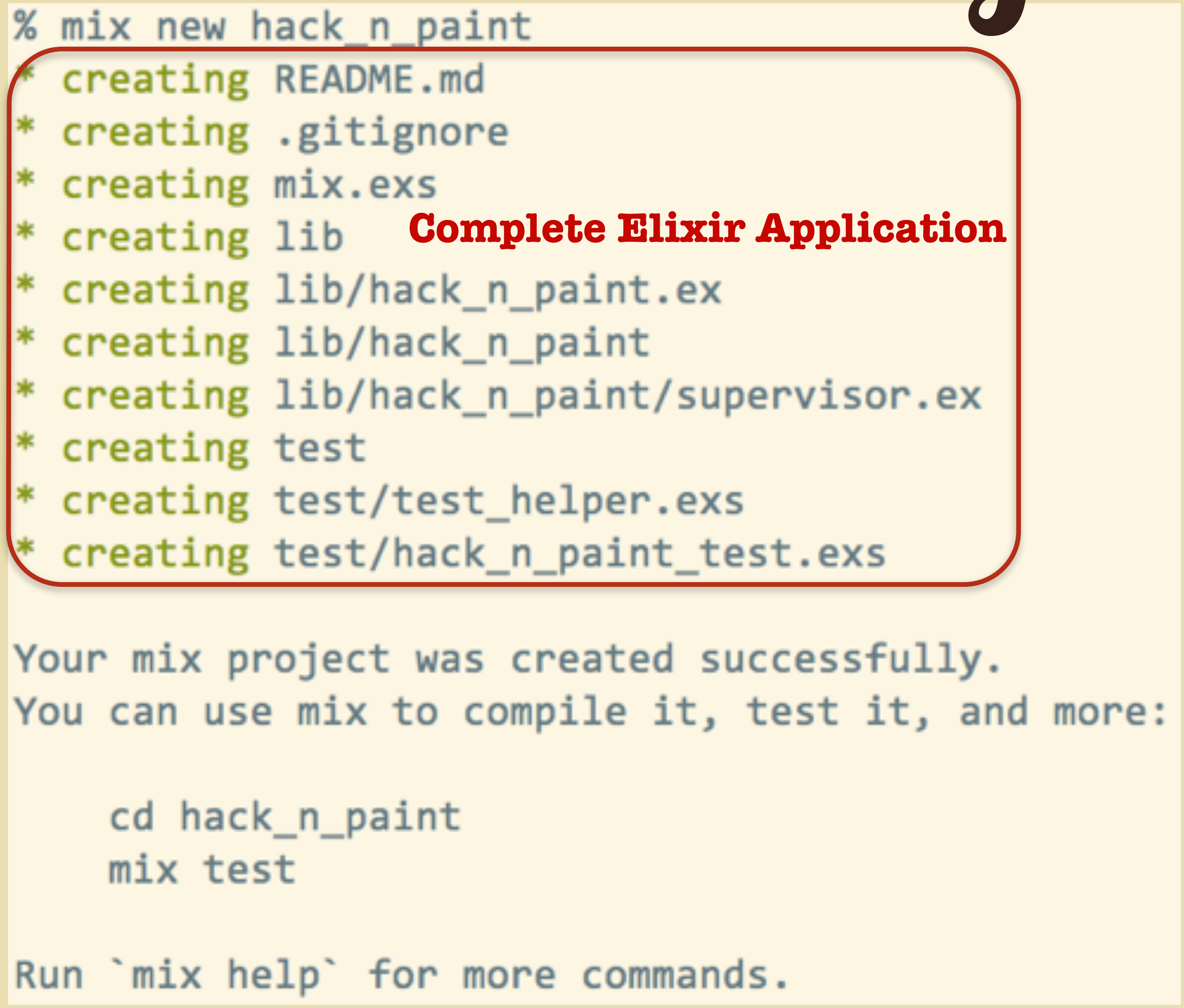
Design Goals of Elixir

1. Productivity

2. Extensibility

3. Compatibility

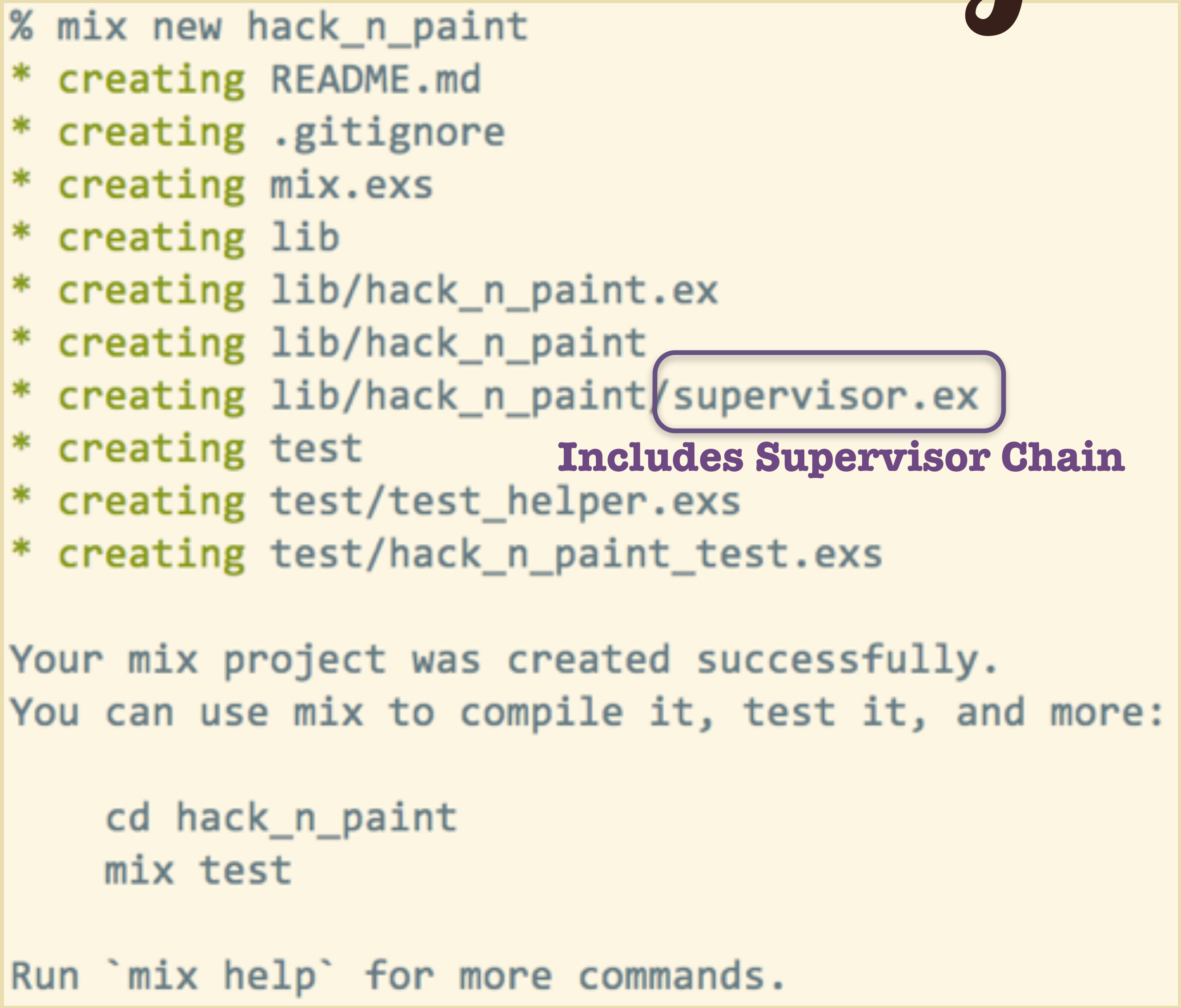
Productivity



```
% mix new hack_n_paint
* creating README.md
* creating .gitignore
* creating mix.exs
* creating lib
* creating lib/hack_n_paint.ex
* creating lib/hack_n_paint
* creating lib/hack_n_paint/supervisor.ex
* creating test
* creating test/test_helper.exs
* creating test/hack_n_paint_test.exs

Your mix project was created successfully.
You can use mix to compile it, test it, and more:

    cd hack_n_paint
    mix test

Run `mix help` for more commands.
```

Complete Elixir Application

Productivity



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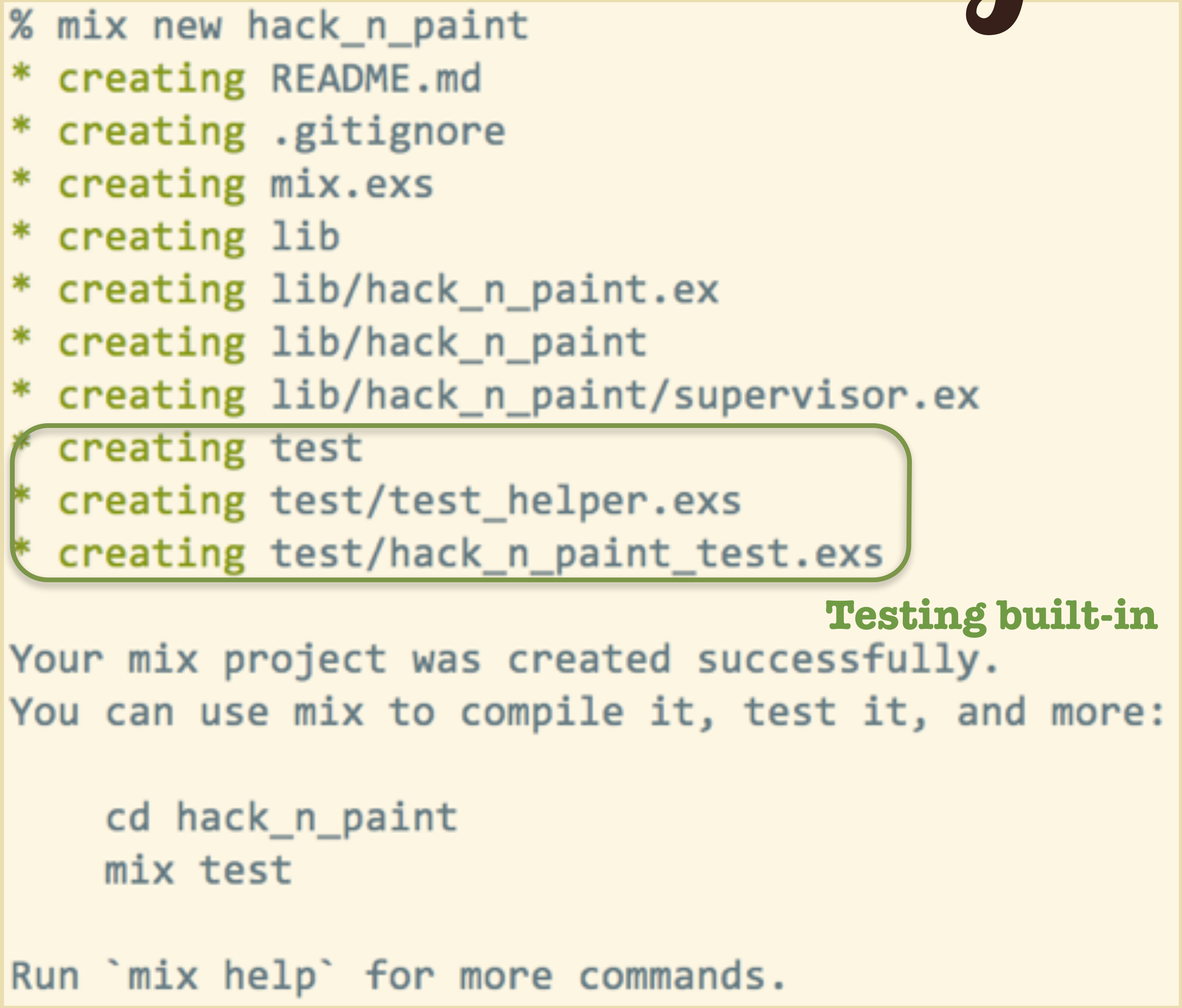
Includes Supervisor Chain

Productivity



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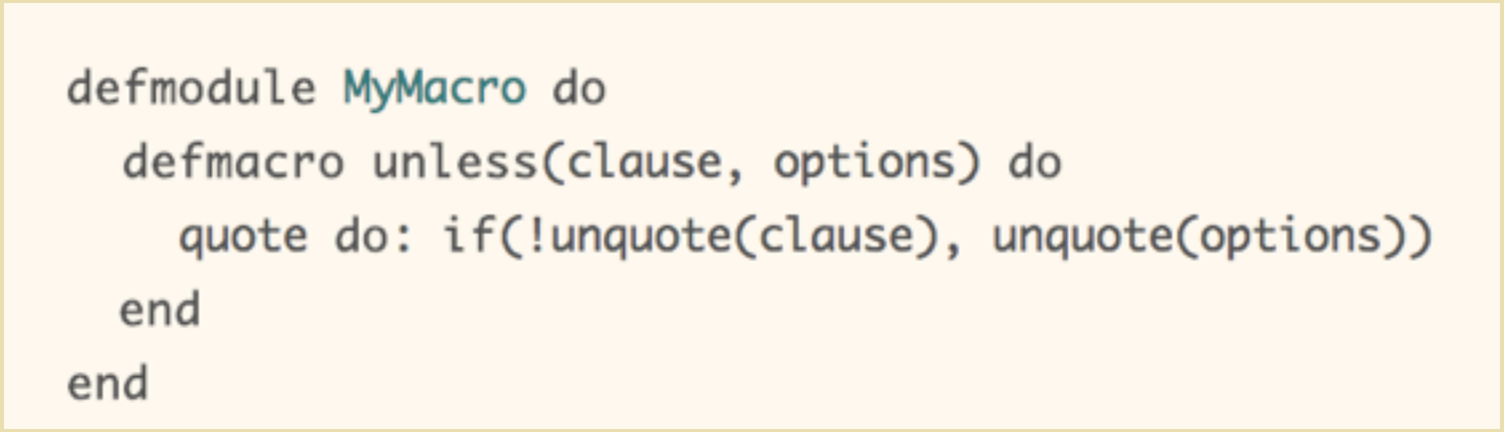
Testing built-in

Extensibility

Macros & Meta-programming

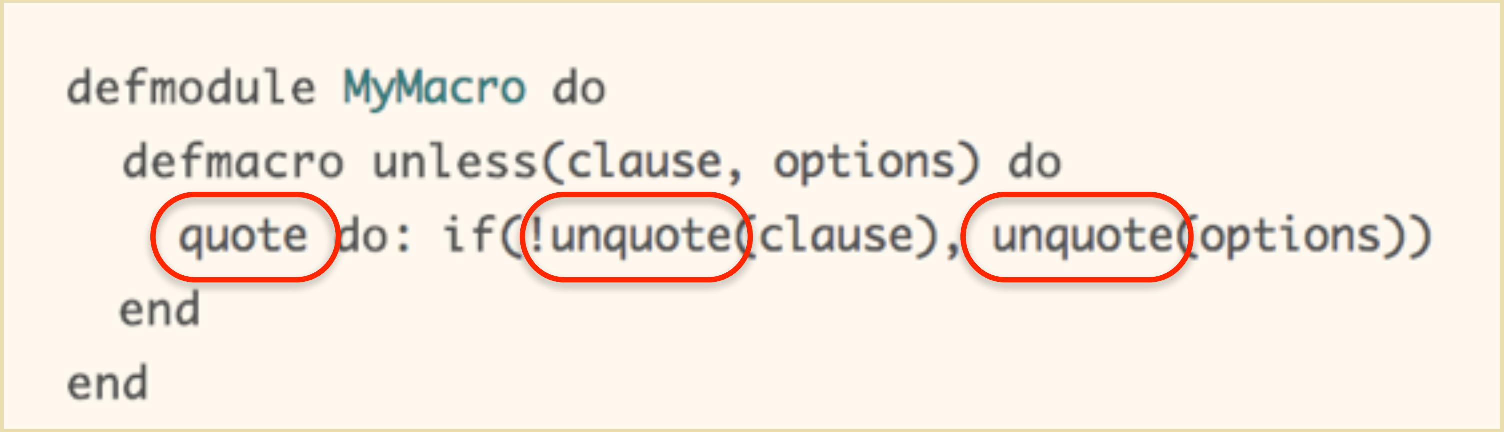


```
defmodule MyMacro do
  defmacro unless(clause, options) do
    quote do: if(!unquote(clause), unquote(options))
  end
end
```

Implementing **unless** using **if**

Extensibility

Macros & Meta-programming



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Implementing **unless** using **if**

Compatibility

Elixir can call *Erlang* code, without any conversion cost at all.

Compatibility

Elixir can use Erlang libraries!

The Actor Concurrency Model

- Actor = Process

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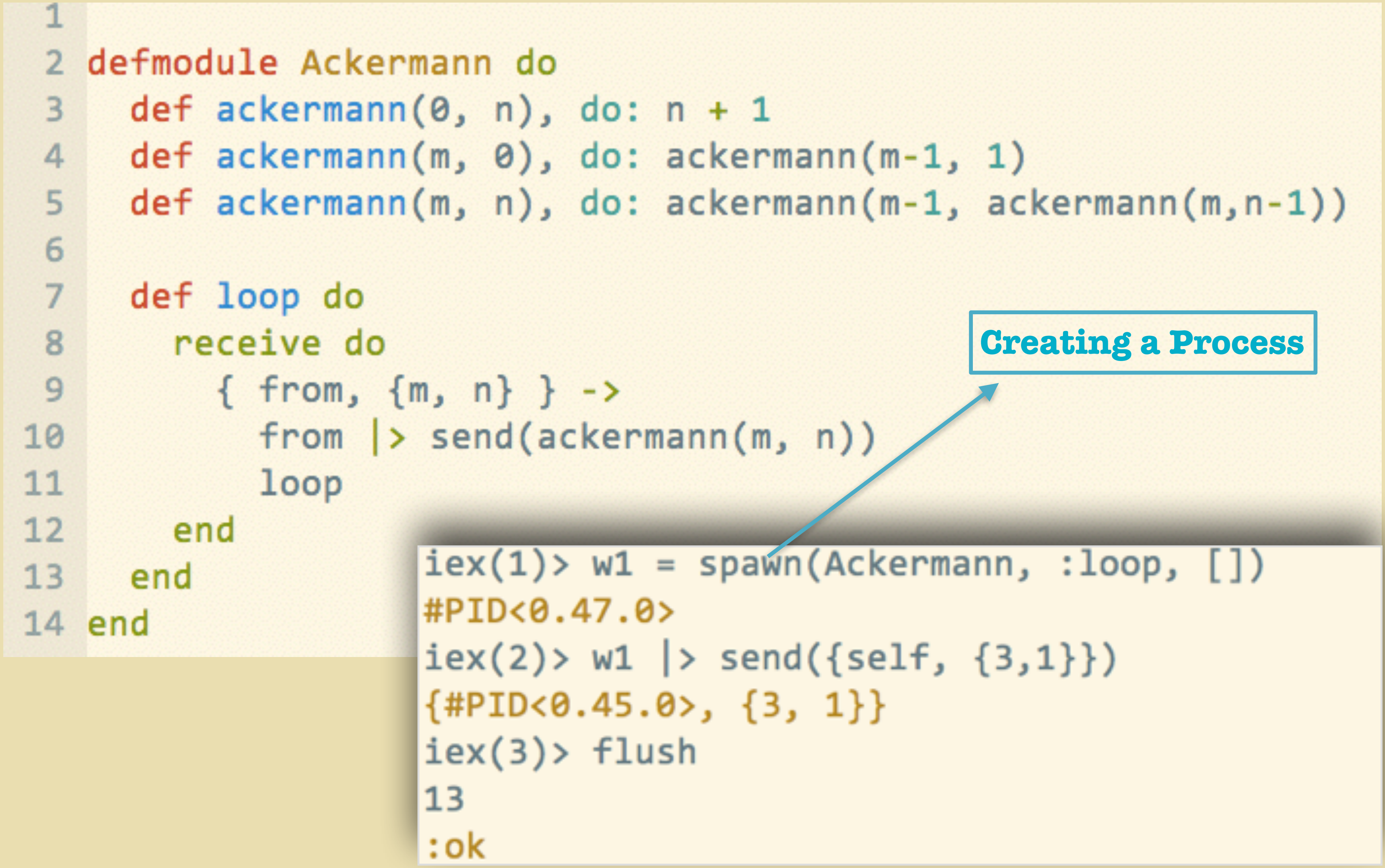
Shared-nothing Async Message-passing

Processes 101

The Basic Concurrency Primitive

Creating Processes & Sending Messages in Elixir



```

defmodule Ackermann do
  def ackermann(0, n), do: n + 1
  def ackermann(m, 0), do: ackermann(m-1, 1)
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  def loop do
    receive do
      { from, {m, n} } ->
        from |> send(ackermann(m, n))
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    end
  end
end
```
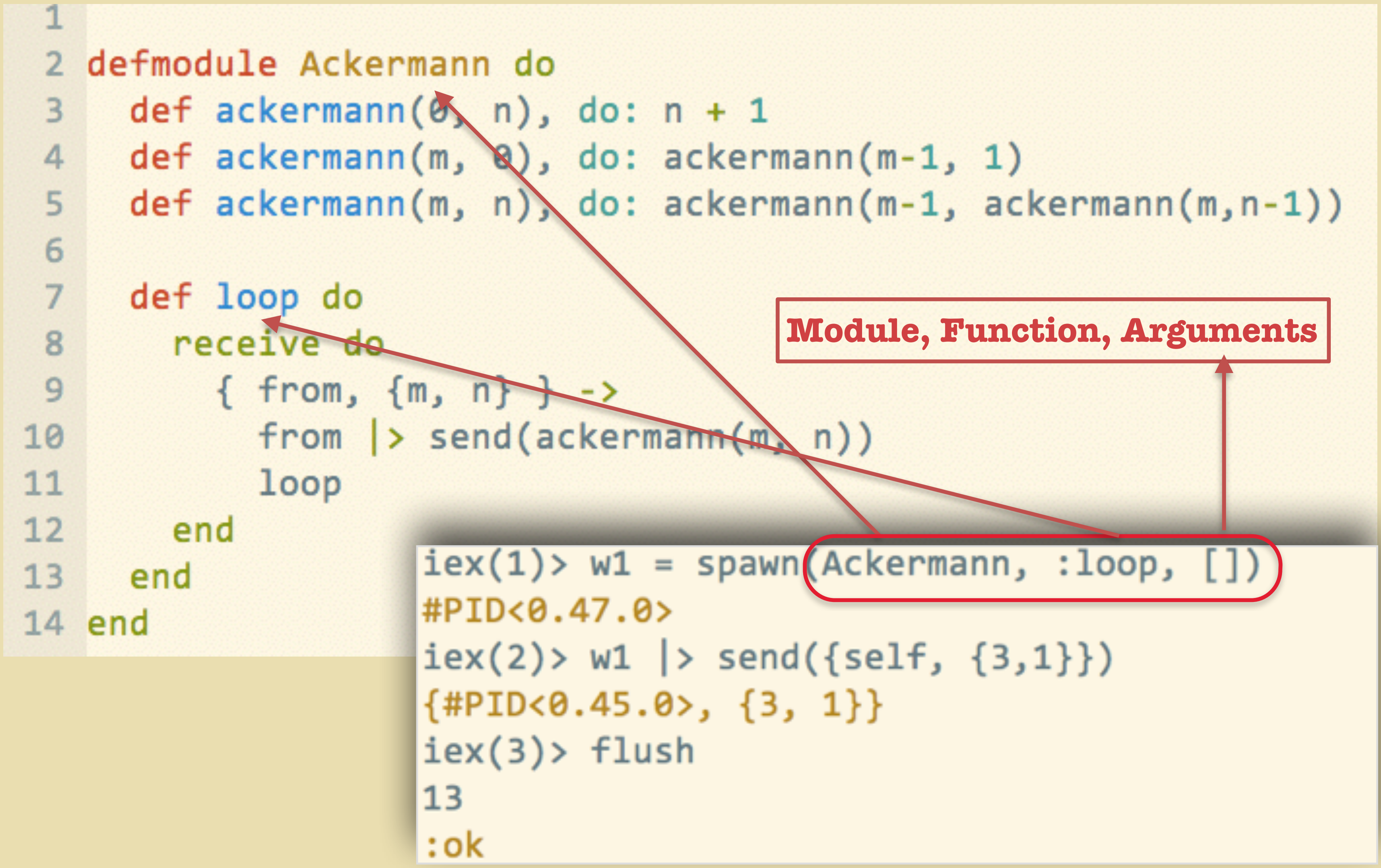

Creating a Process

```
iex(1)> w1 = spawn(Ackermann, :loop, [])
#PID<0.47.0>
iex(2)> w1 |> send({self, {3,1}})
{#PID<0.45.0>, {3, 1}}
iex(3)> flush
13
:ok
```

Creating Processes & Sending Messages in Elixir



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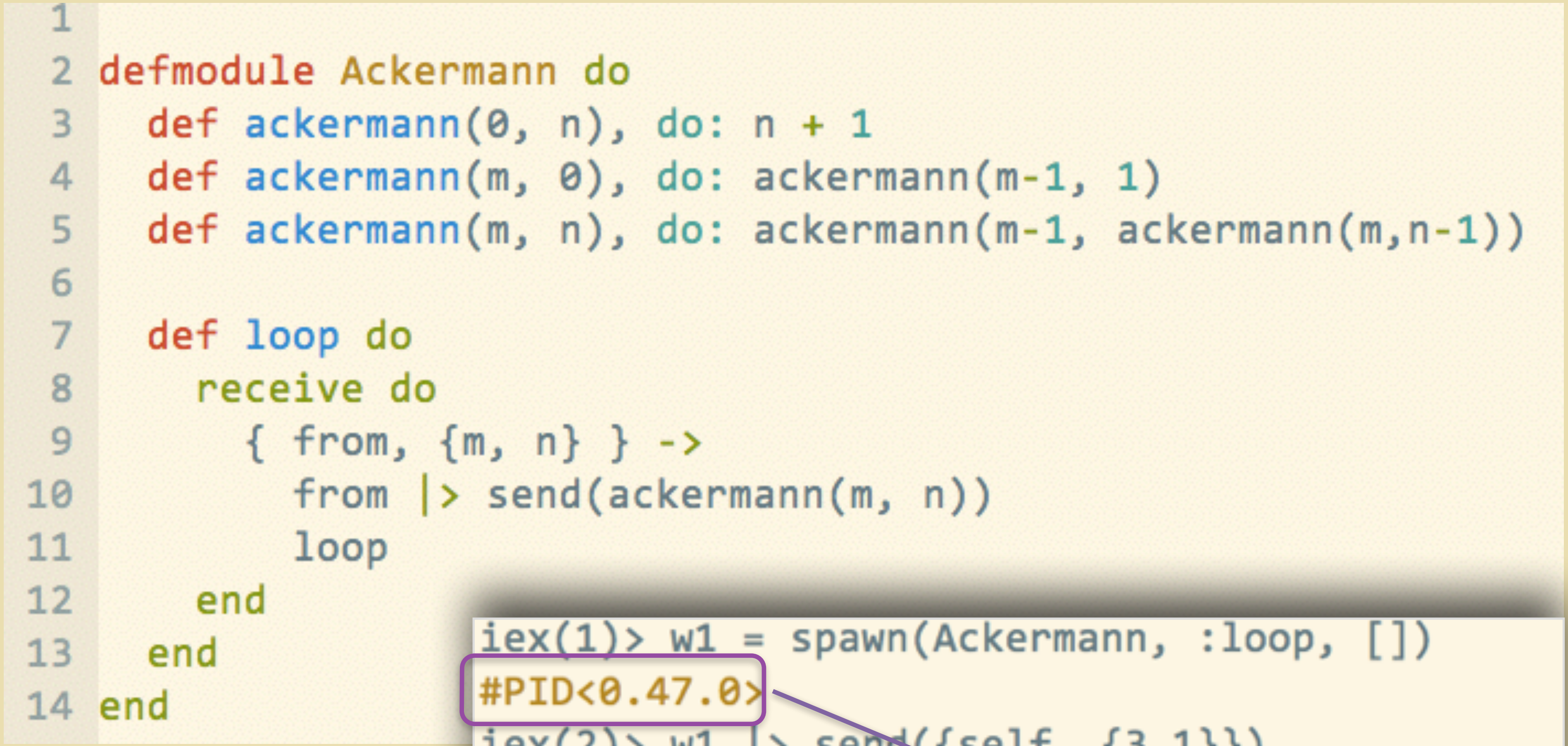

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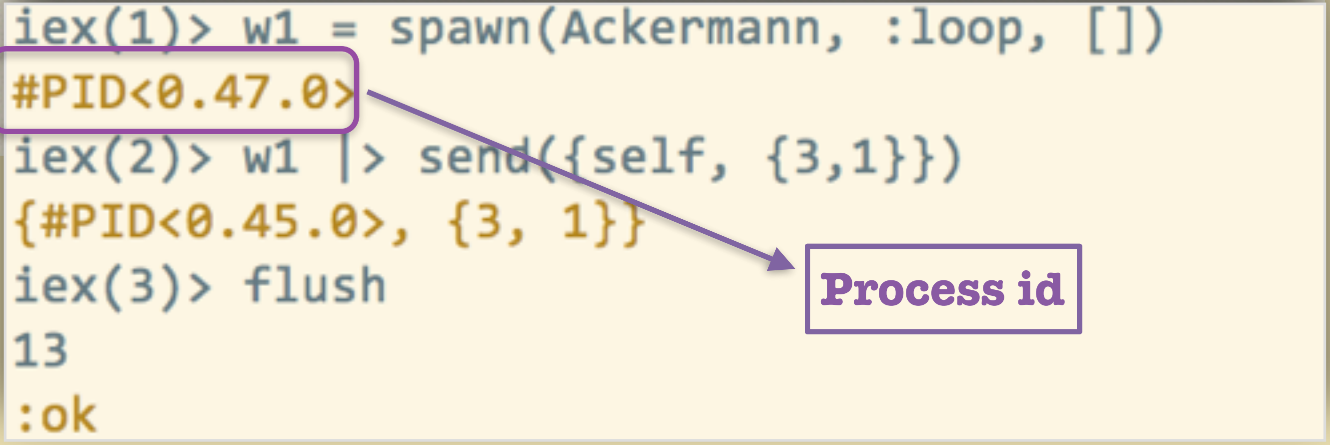

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Process id

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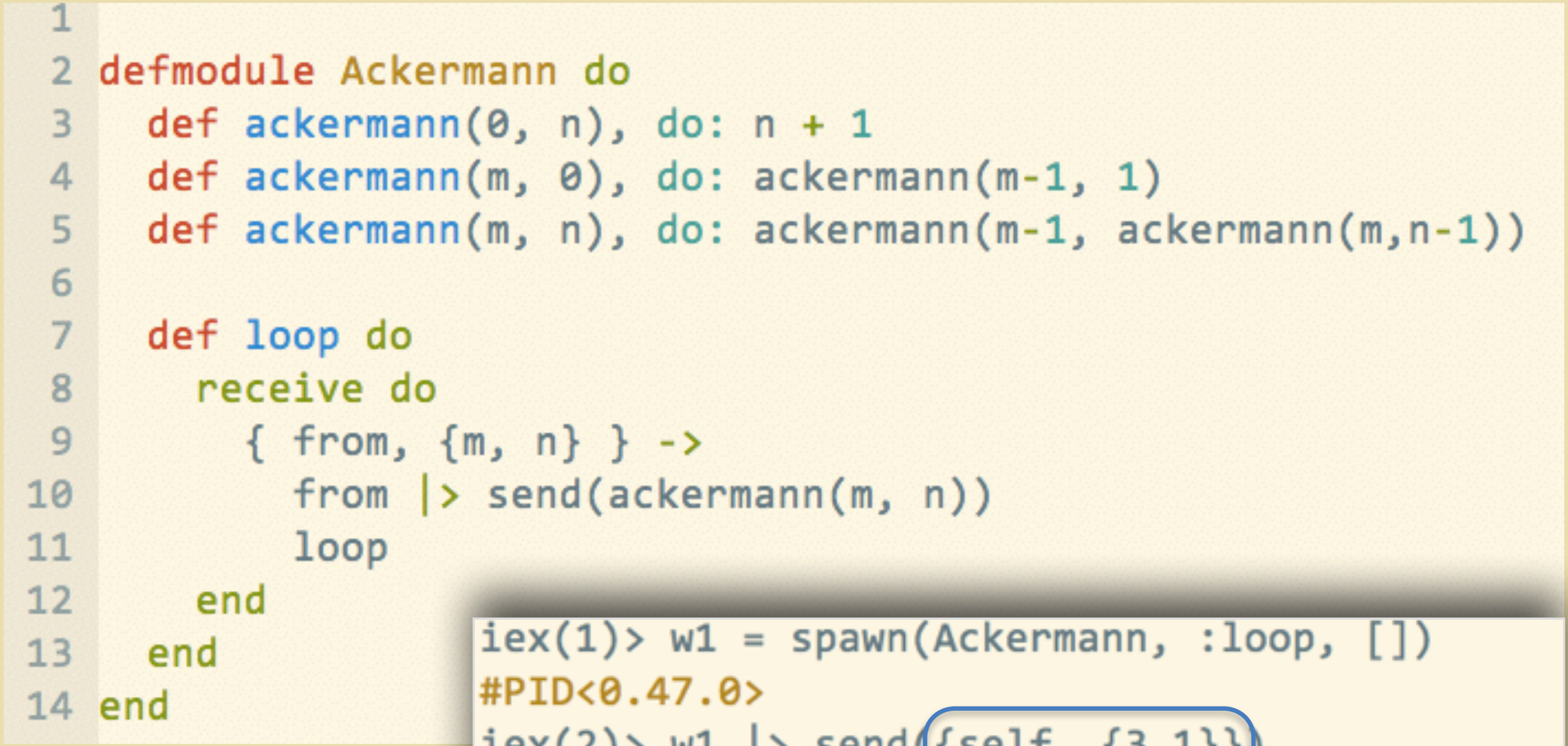

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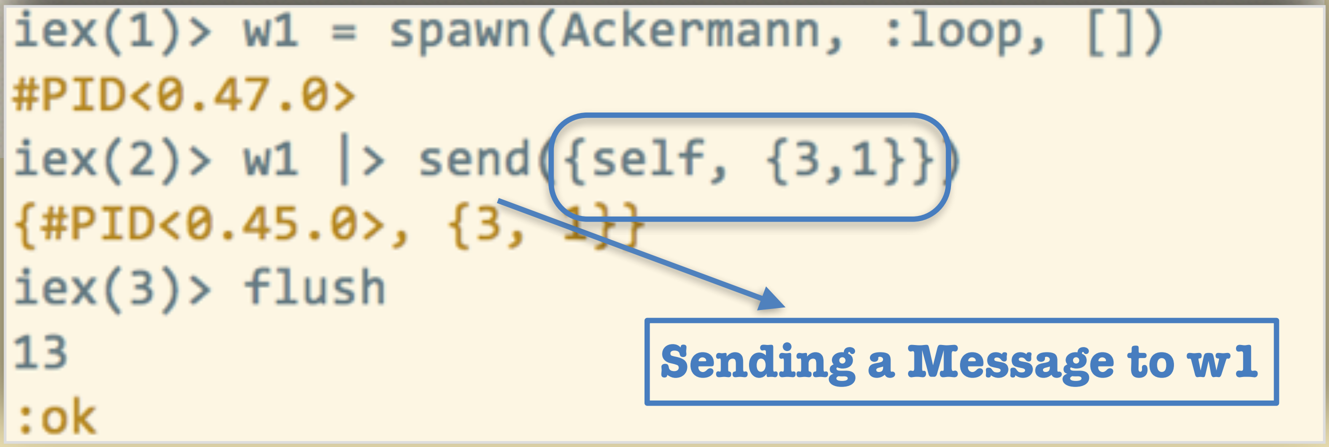

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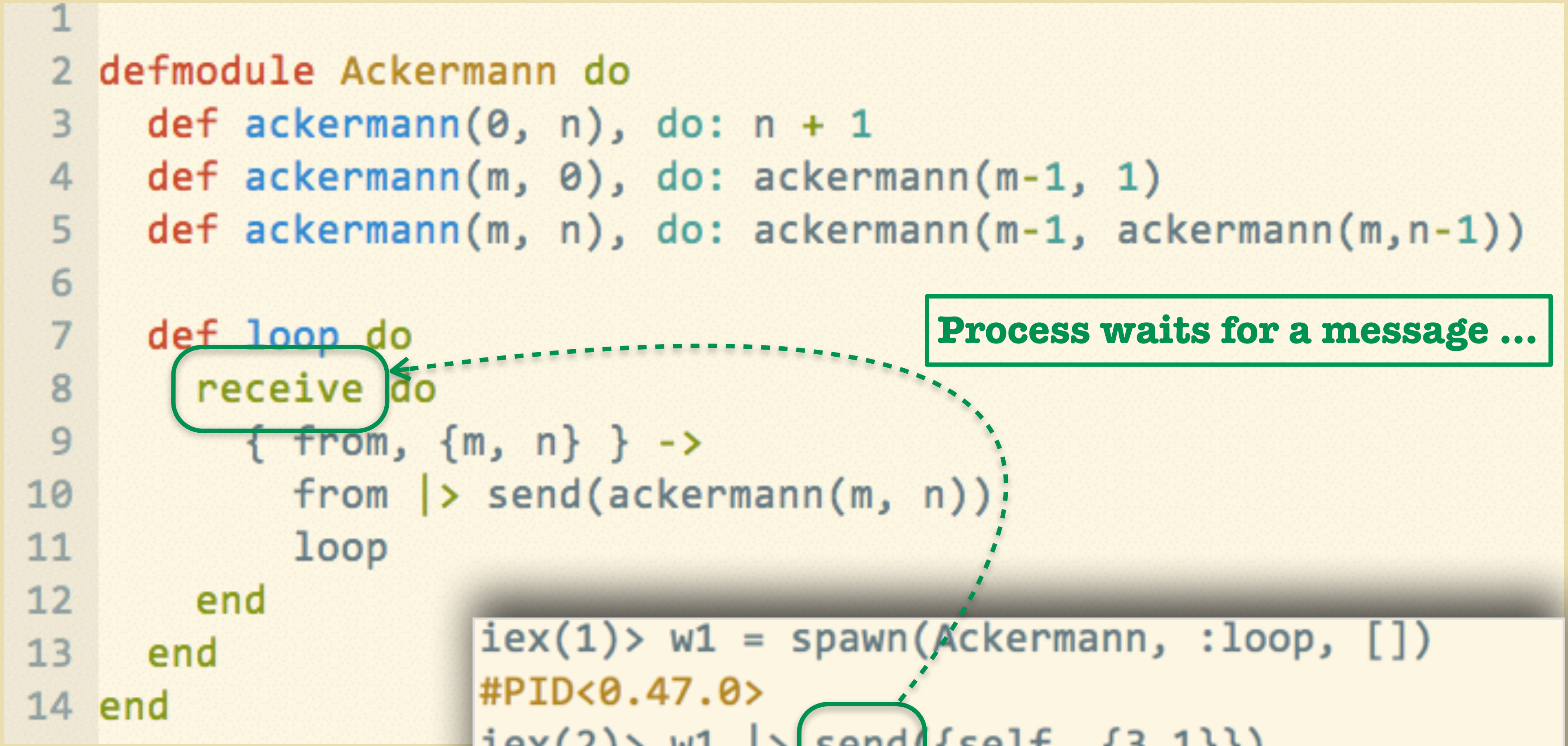

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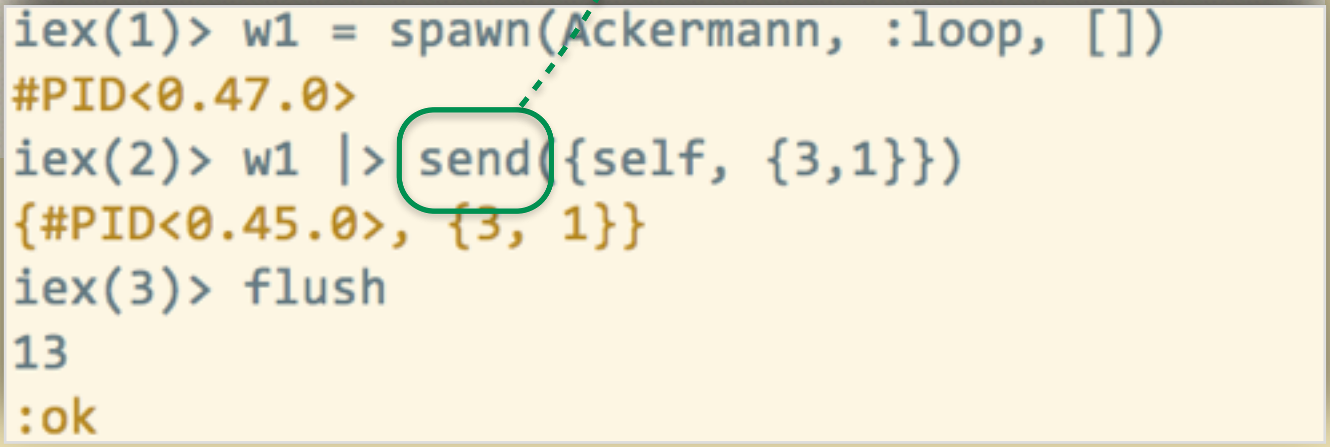
```

Process waits for a message ...



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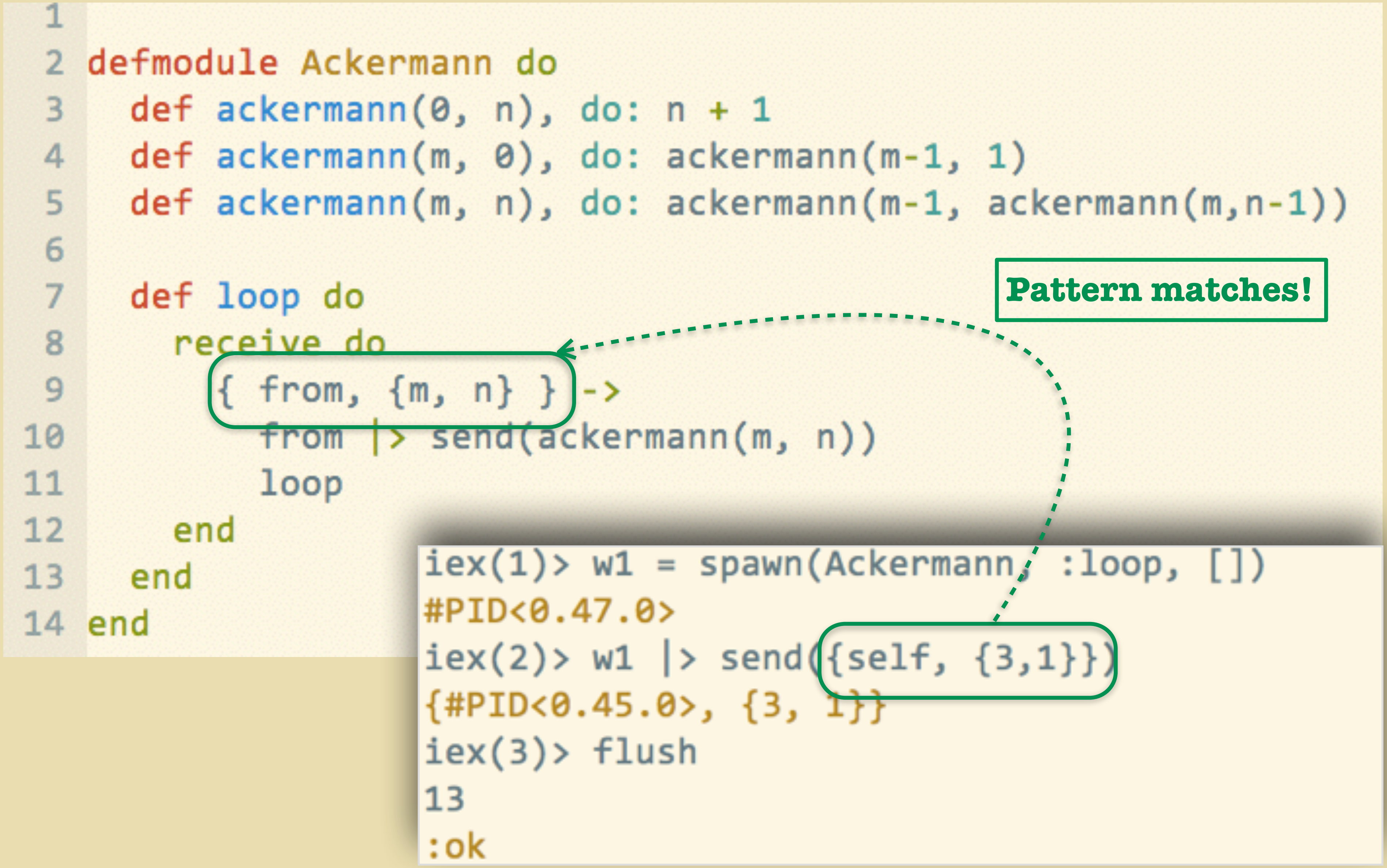

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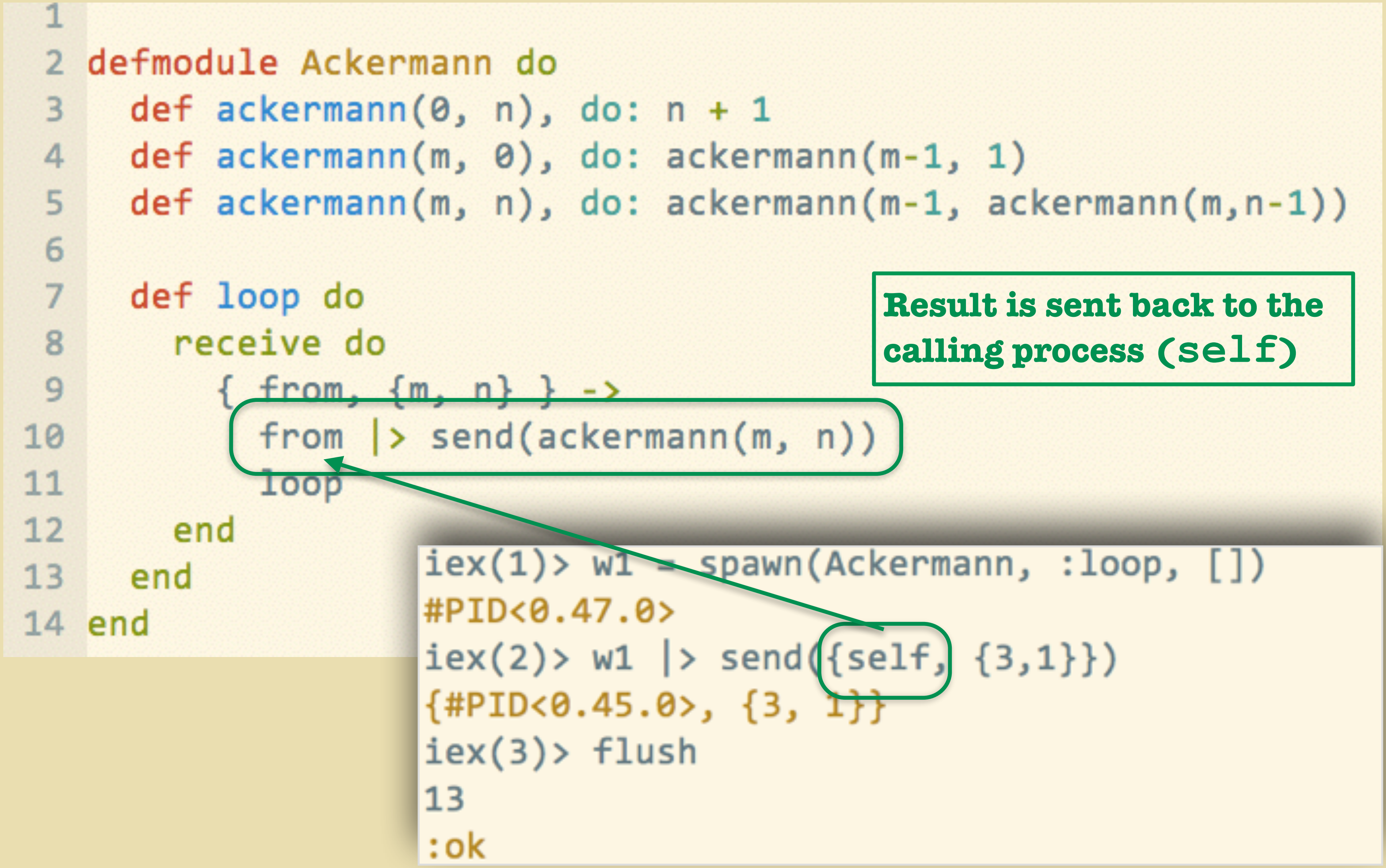

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```

Result is sent back to the calling process (`self`)

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Creating Processes & Sending Messages in Elixir

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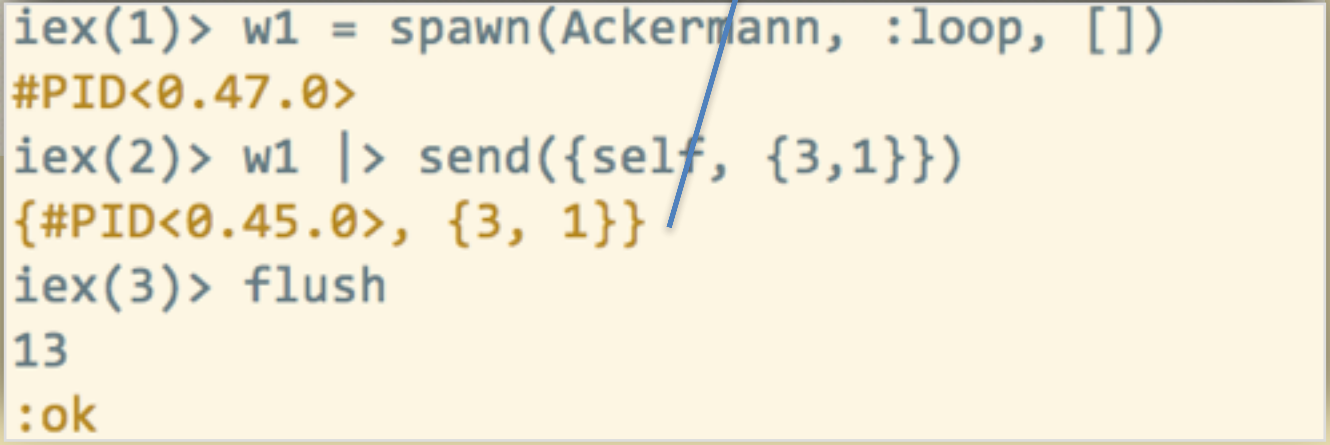

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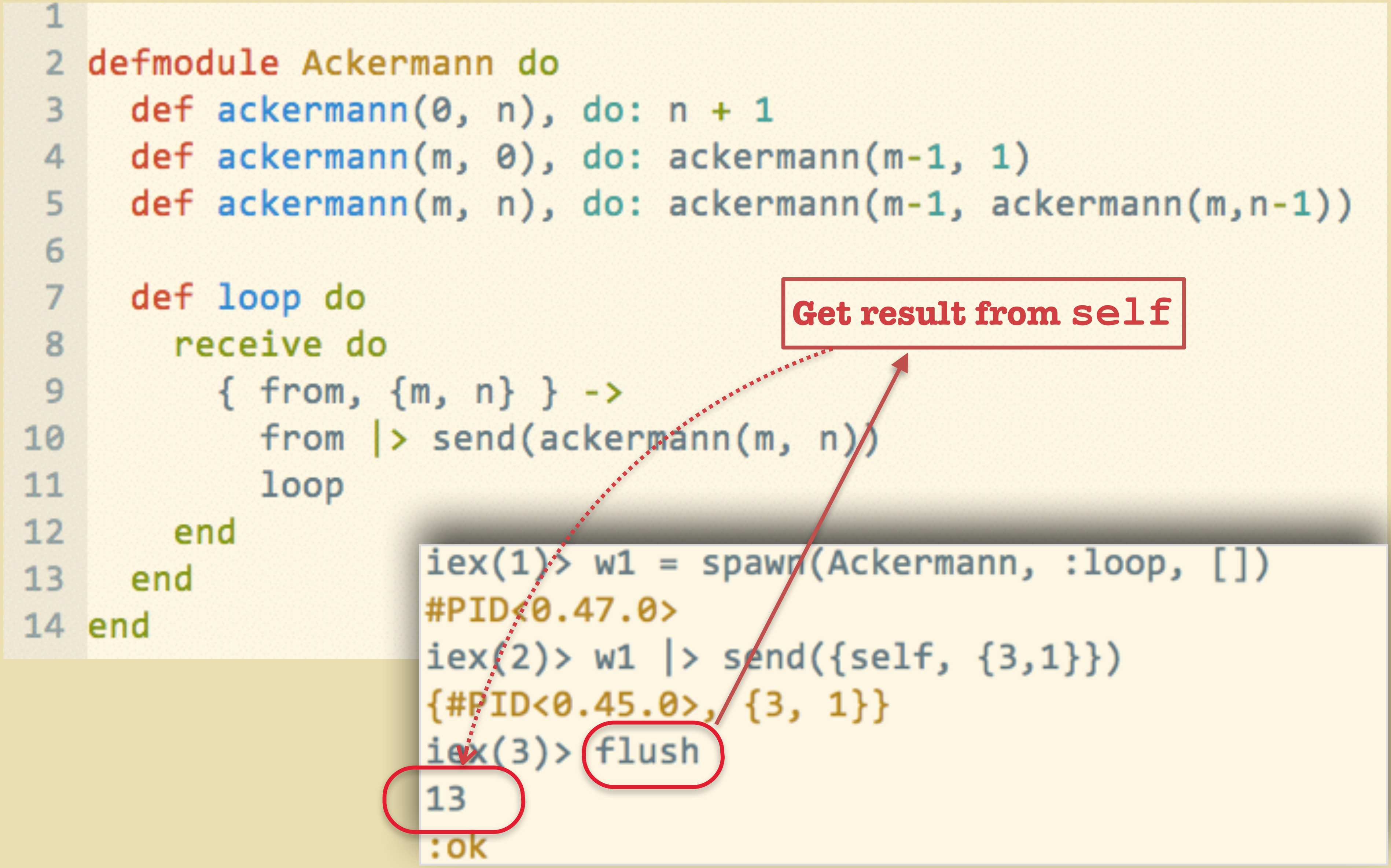
Returns immediately

Creating Processes & Sending Messages in Elixir



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Get result from `self`

OTP

Framework and much more

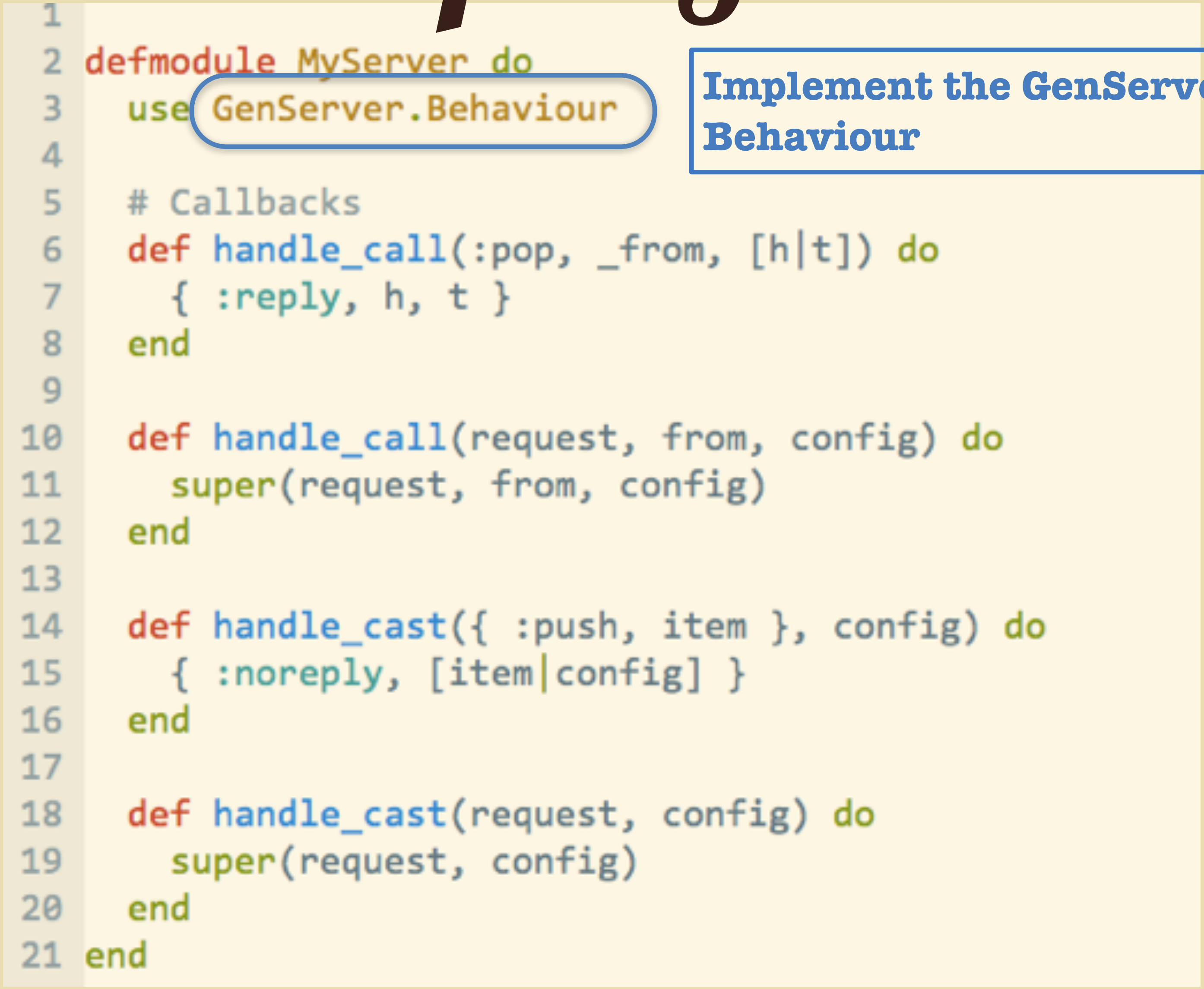
What is OTP?

- Comes with Elixir/Erlang
- Framework to build applications that are fault-tolerant, scalable, distributed
- Databases + Profilers + Debuggers

OTP Behaviours

- GenServer
- Supervisor
- Application

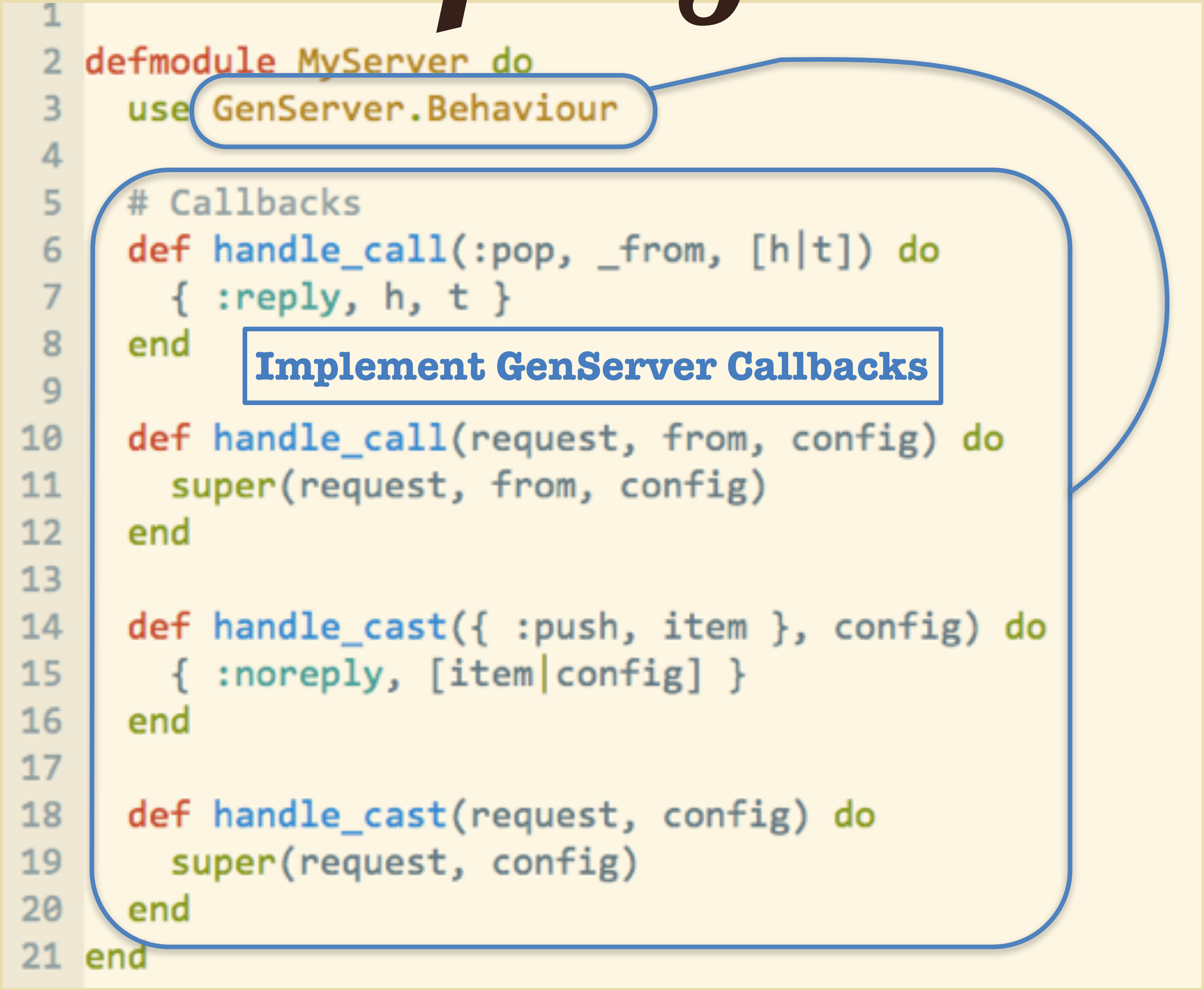
An Example GenServer



```
defmodule MyServer do
  use GenServer.Behaviour

  # Callbacks
  def handle_call(:pop, _from, [h|t]) do
    { :reply, h, t }
  end

  def handle_call(request, from, config) do
    super(request, from, config)
  end

  def handle_cast({ :push, item }, config) do
    { :noreply, [item|config] }
  end

  def handle_cast(request, config) do
    super(request, config)
  end
end
```

Implement the GenServer Behaviour

An Example GenServer



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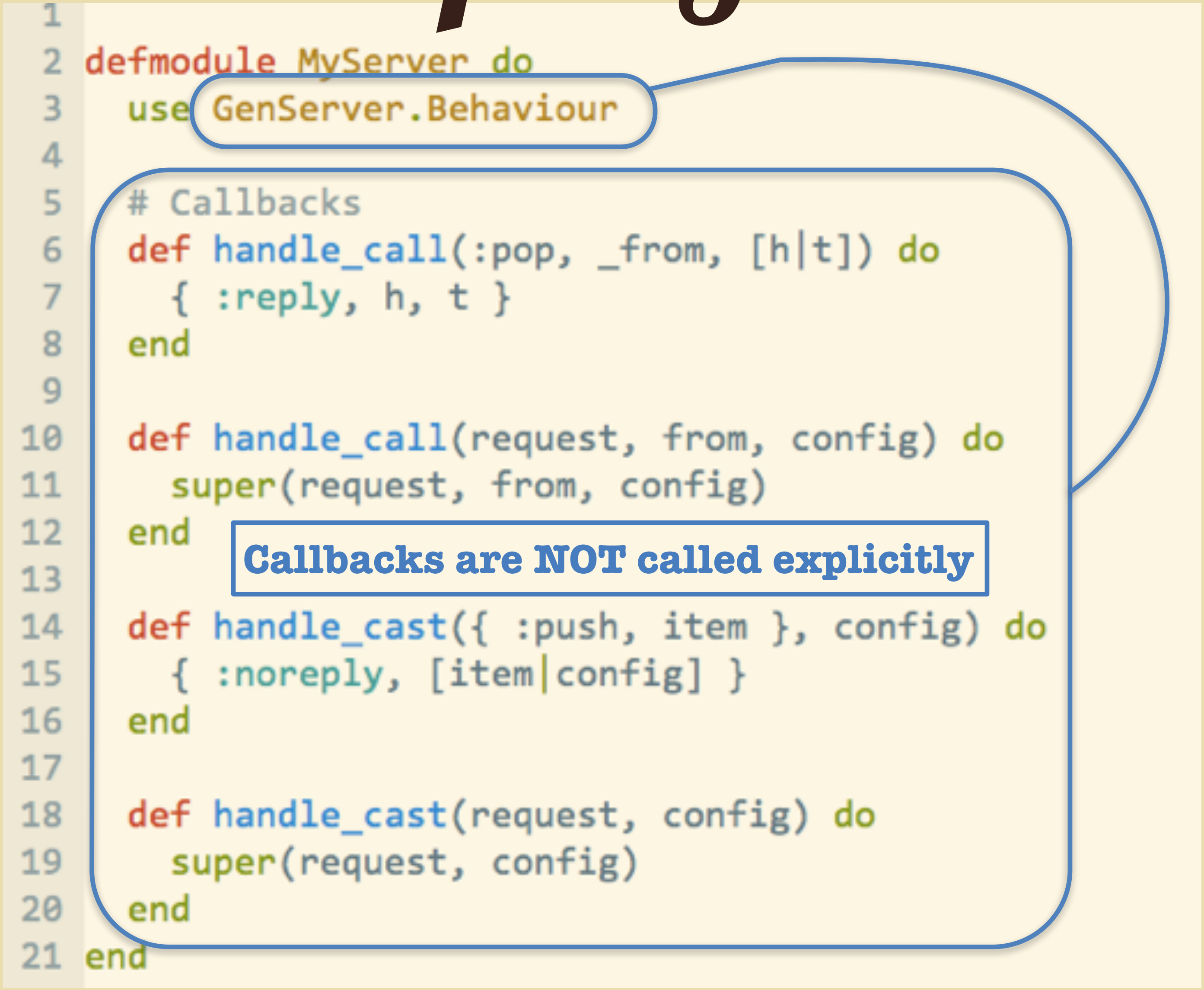

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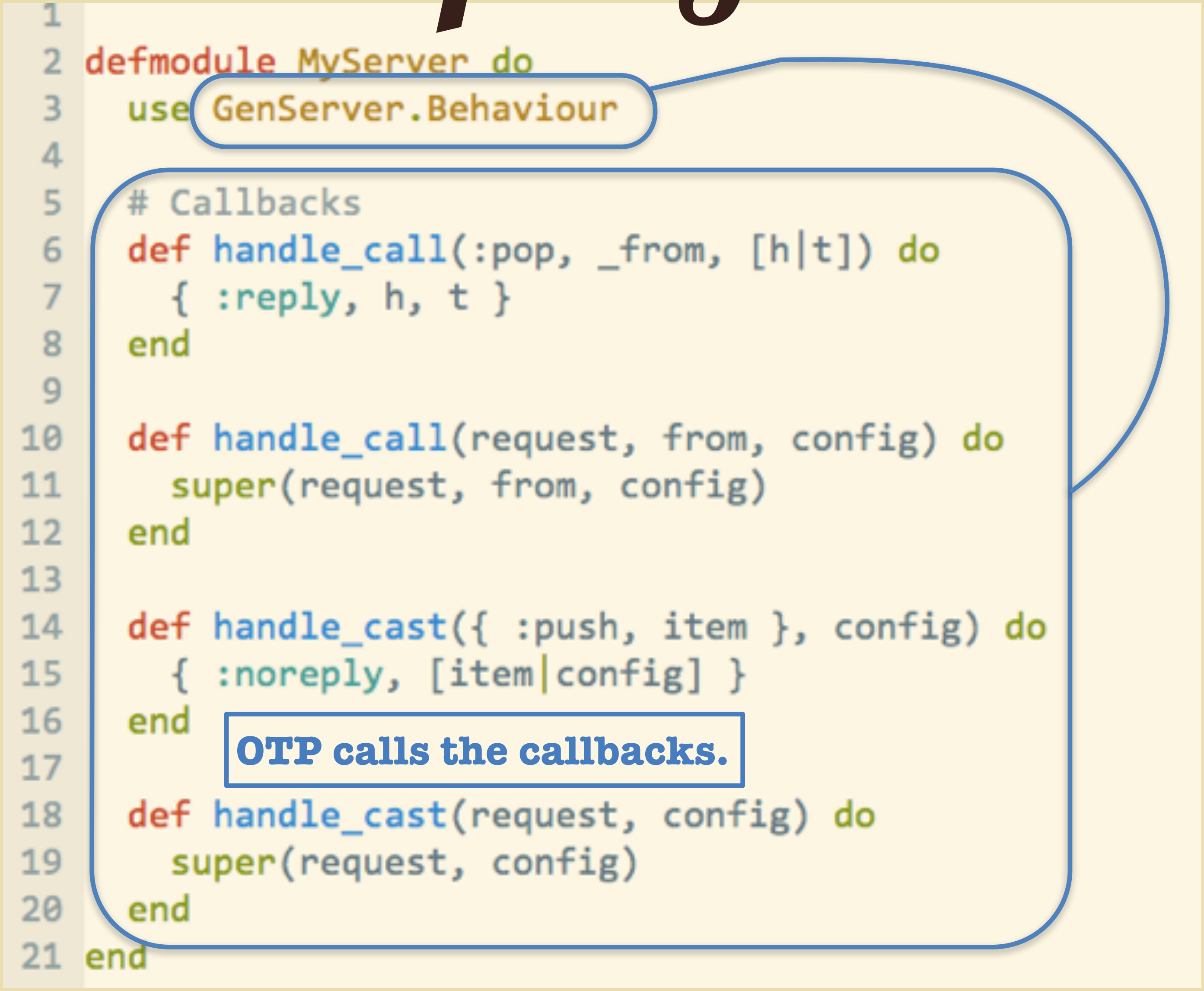
  end

  def handle_cast({ :push, item }, config) do
    { :noreply, [item|config] }
  end

  def handle_cast(request, config) do
    super(request, config)
  end
end
```

Callbacks are NOT called explicitly

An Example GenServer



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  end

  def handle_cast({ :push, item }, config) do
    { :noreply, [item|config] }
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  def handle_cast(request, config) do
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end
```
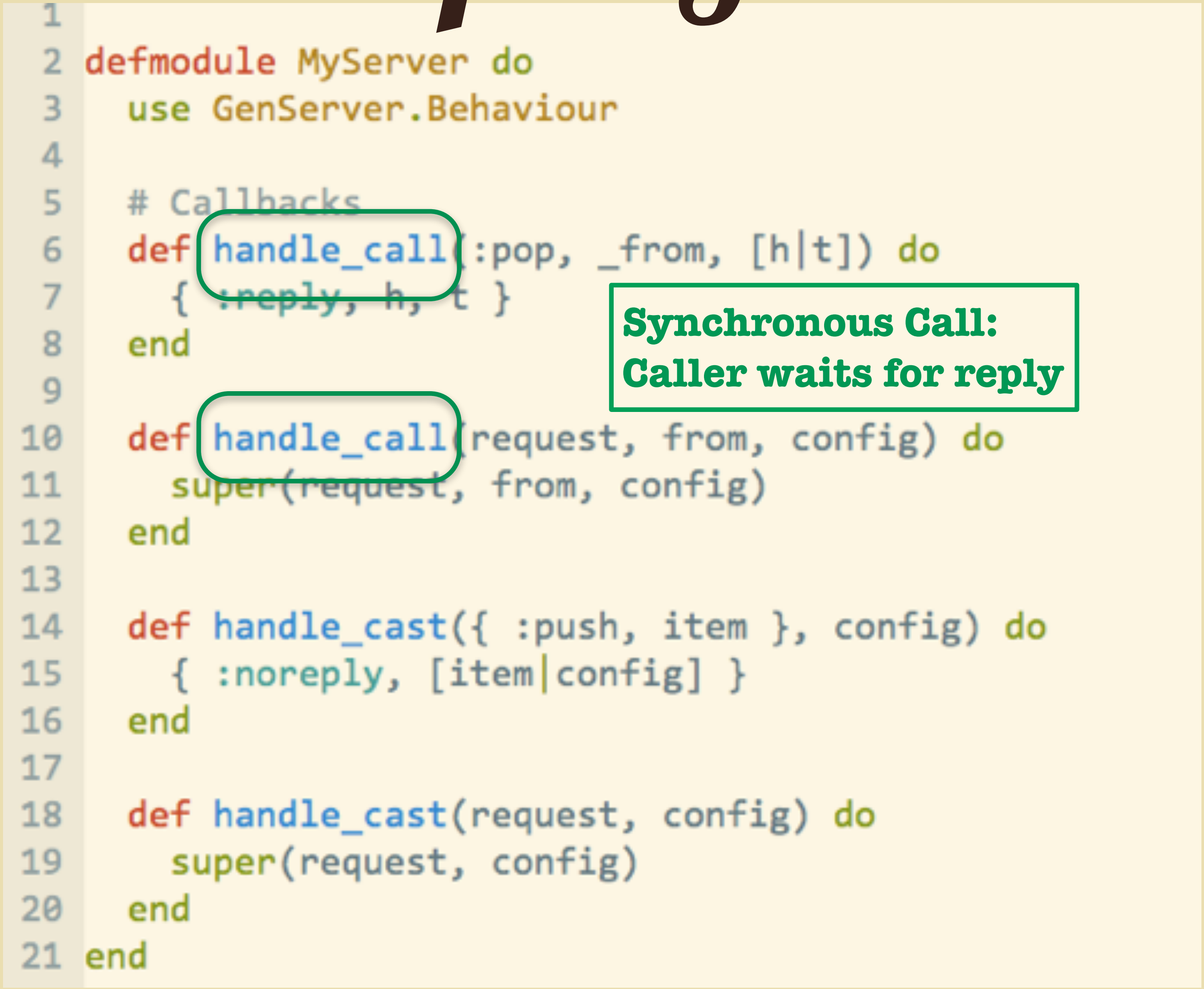

OTP calls the callbacks.

An Example GenServer



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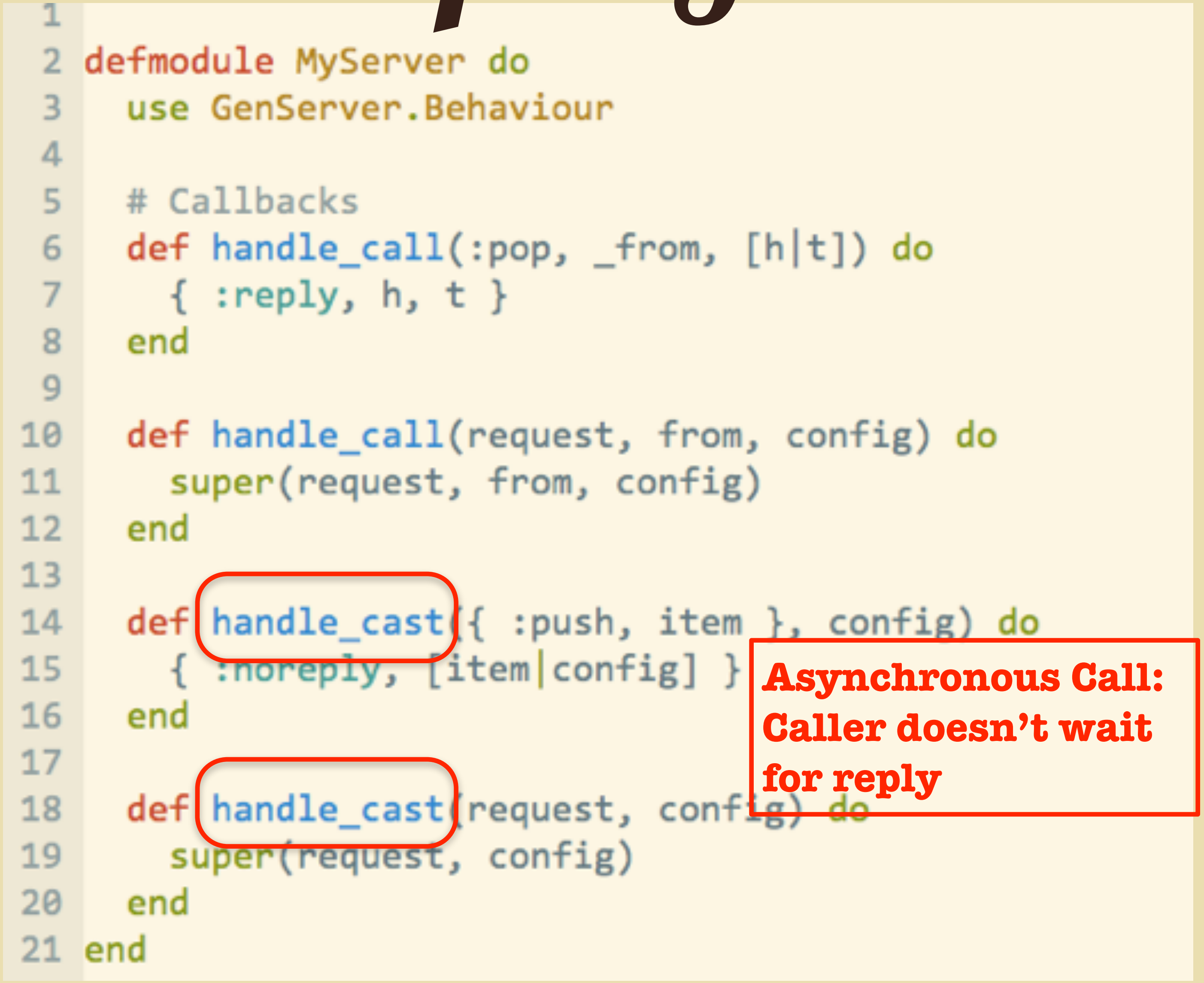
```

**Synchronous Call:
Caller waits for reply**

An Example GenServer



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  end
end
```
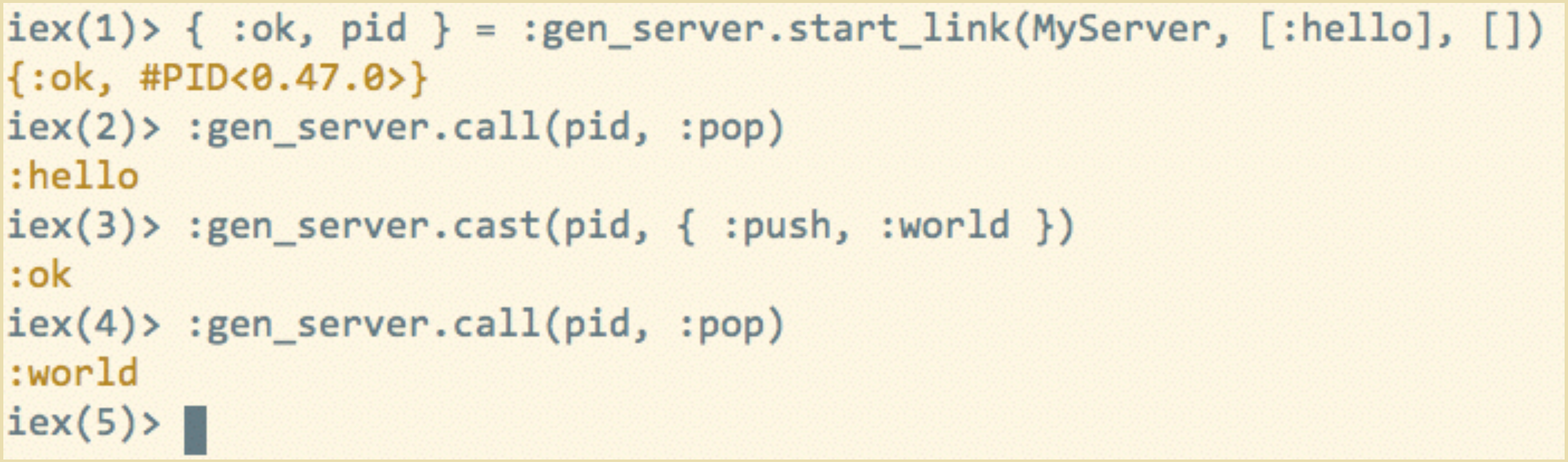

Asynchronous Call: Caller doesn't wait for reply

An Example GenServer Demo

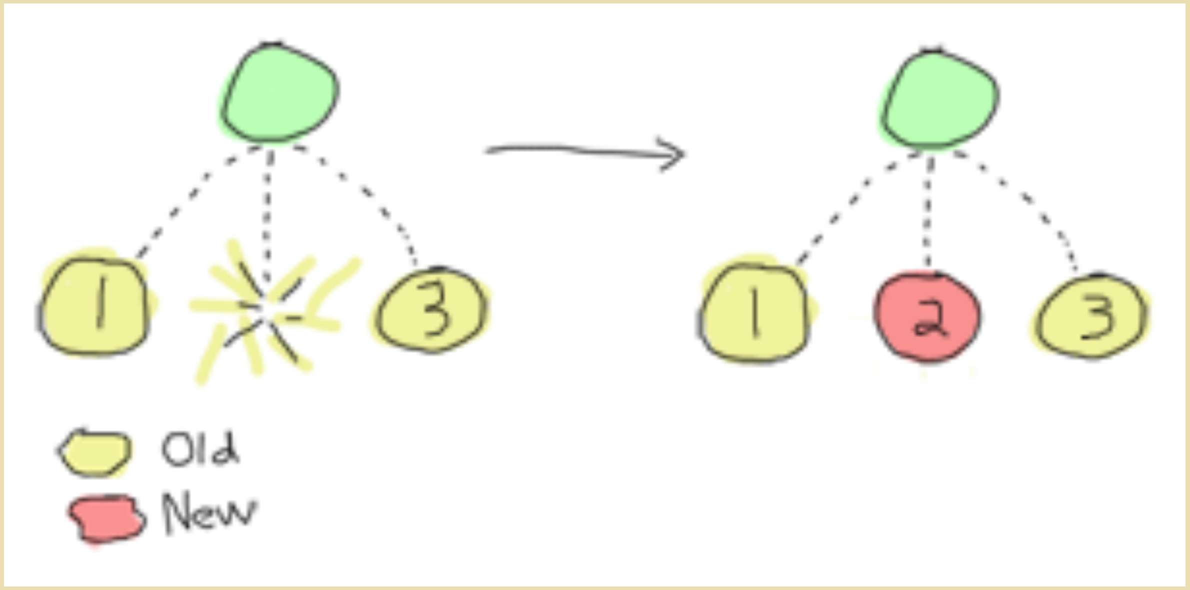


```
iex(1)> { :ok, pid } = :gen_server.start_link(MyServer, [:hello], [])
{:ok, #PID<0.47.0>}
iex(2)> :gen_server.call(pid, :pop)
:hello
iex(3)> :gen_server.cast(pid, { :push, :world })
:ok
iex(4)> :gen_server.call(pid, :pop)
:world
iex(5)>
```

Supervisors

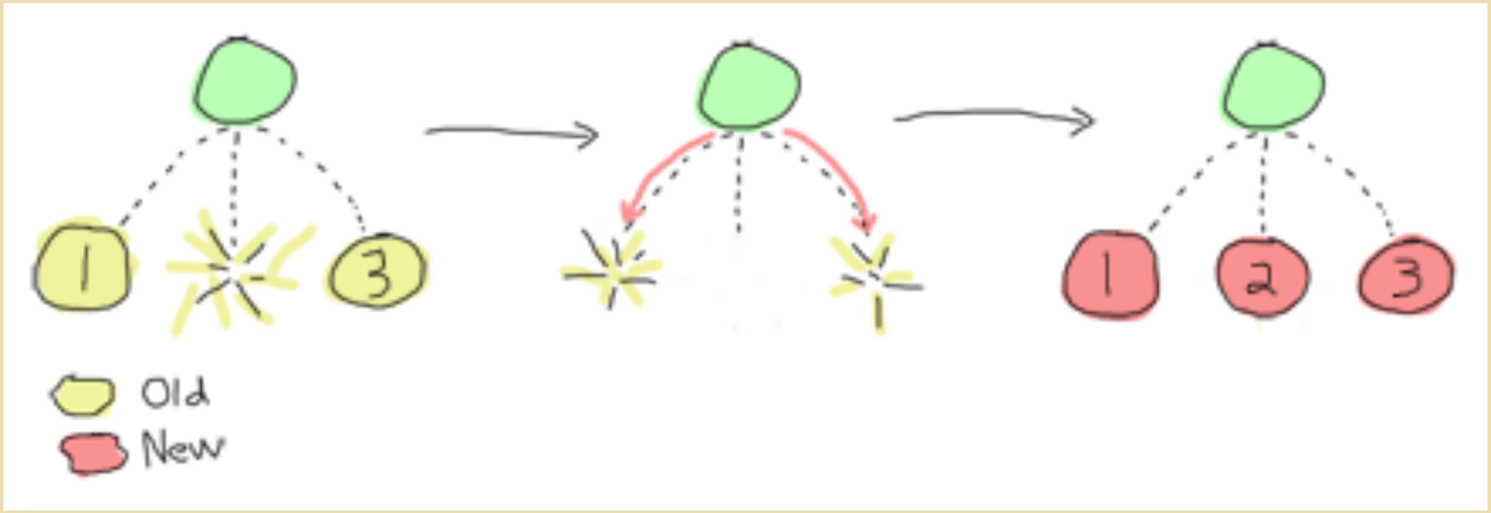
Fault Tolerance & Recovery

Supervisors for Fault Tolerance and Recovery



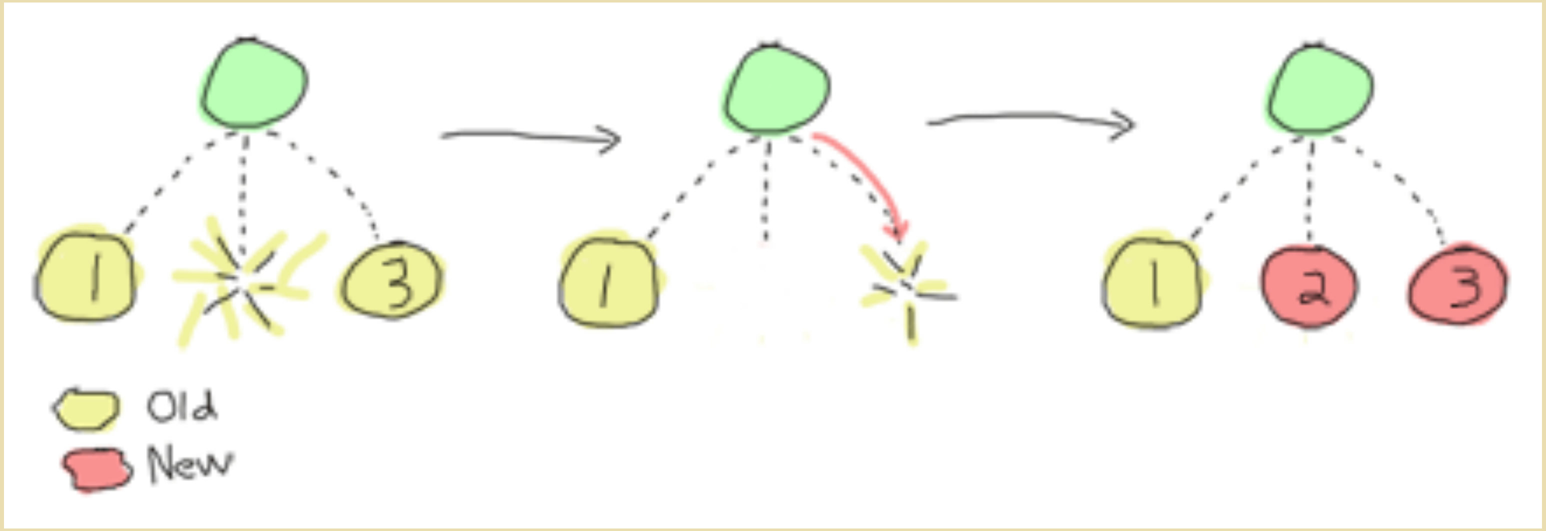
one_for_one restart strategy

Supervisors for Fault Tolerance and Recovery



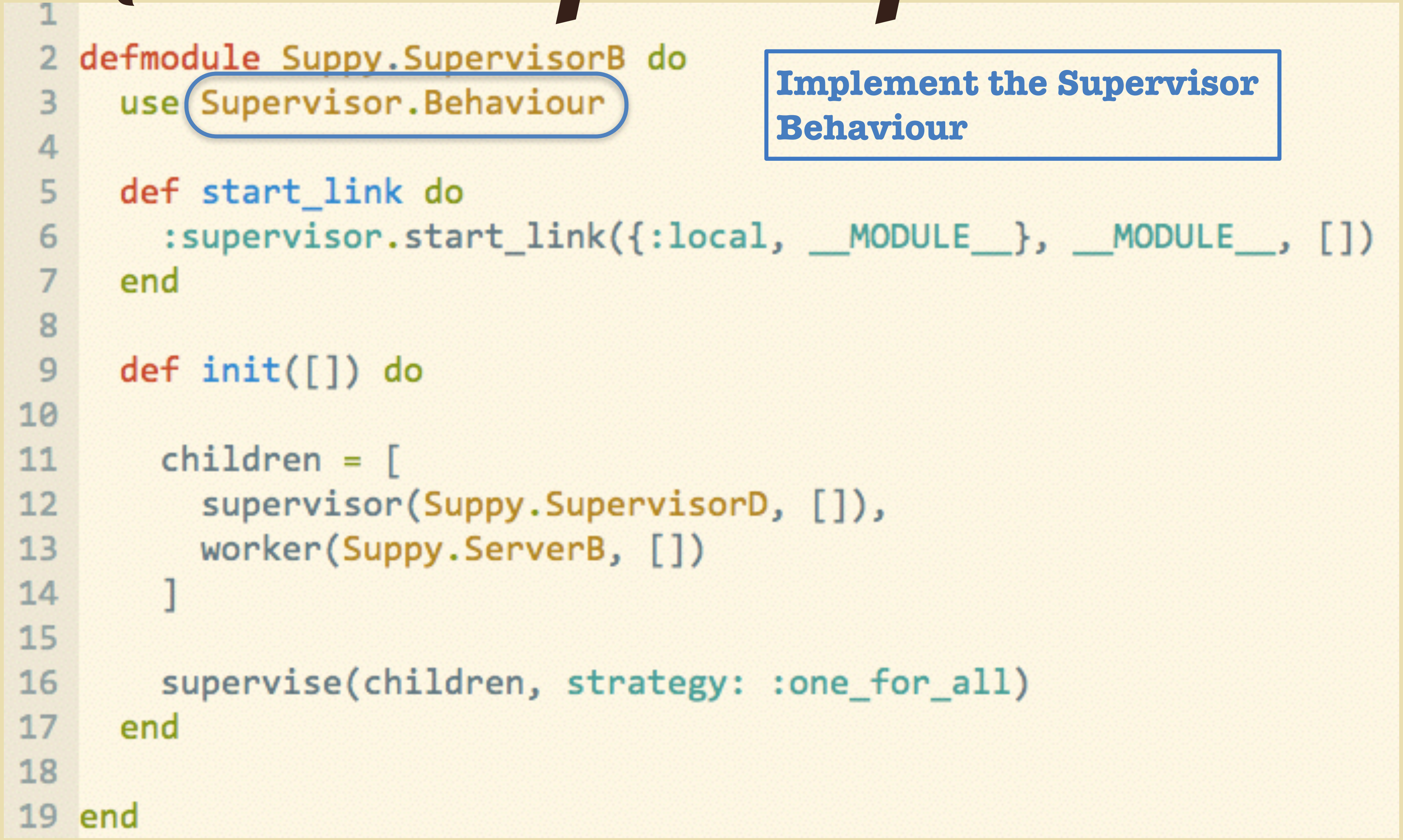
rest_for_all restart strategy

Supervisors for Fault Tolerance and Recovery



rest_for_one restart strategy

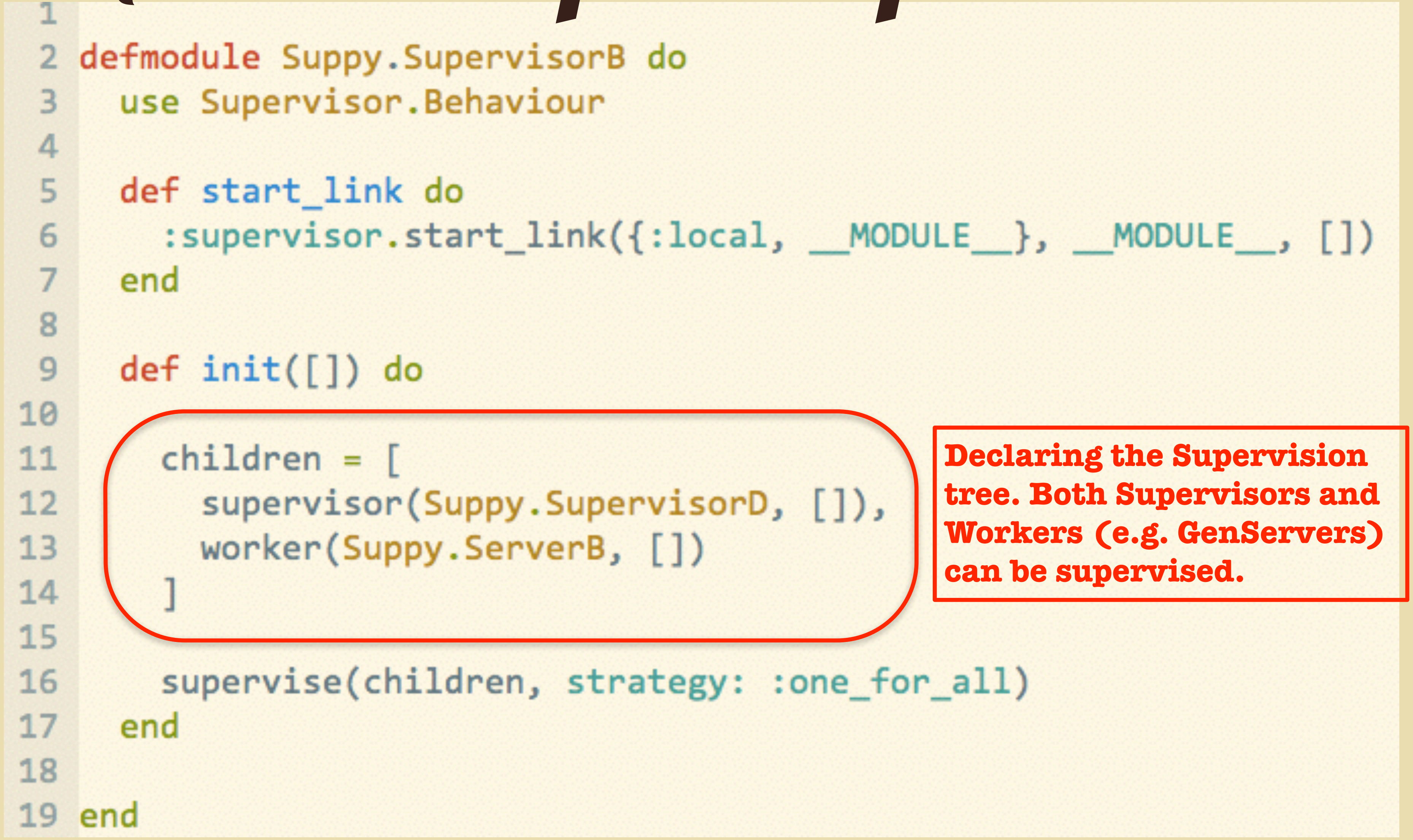
An Example Supervisor



```
defmodule Suppy.SupervisorB do
  use Supervisor.Behaviour

  def start_link do
    :supervisor.start_link({:local, __MODULE__}, __MODULE__, [])
  end

  def init([]) do

    children = [
      supervisor(Suppy.SupervisorD, []),
      worker(Suppy.ServerB, [])
    ]

    supervise(children, strategy: :one_for_all)
  end

end
```

Implement the Supervisor Behaviour

An Example Supervisor



```elixir

defmodule Suppy.SupervisorB do
  use Supervisor.Behaviour

  def start_link do
    :supervisor.start_link({:local, __MODULE__}, __MODULE__, [])
  end

  def init([]) do

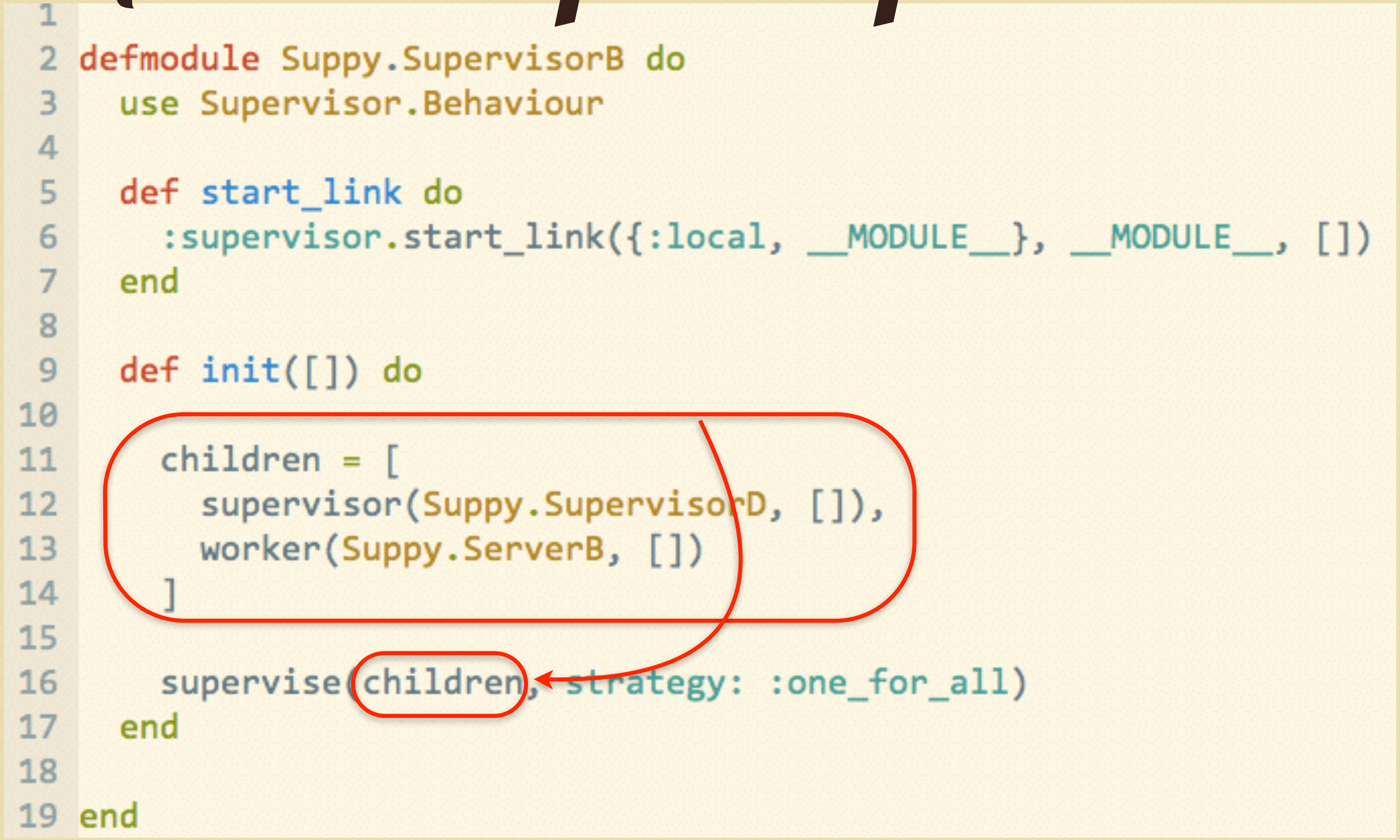
    children = [
      supervisor(Suppy.SupervisorD, []),
      worker(Suppy.ServerB, [])
    ]

    supervise(children, strategy: :one_for_all)
  end

end
```

Declaring the Supervision tree. Both Supervisors and Workers (e.g. GenServers) can be supervised.

An Example Supervisor



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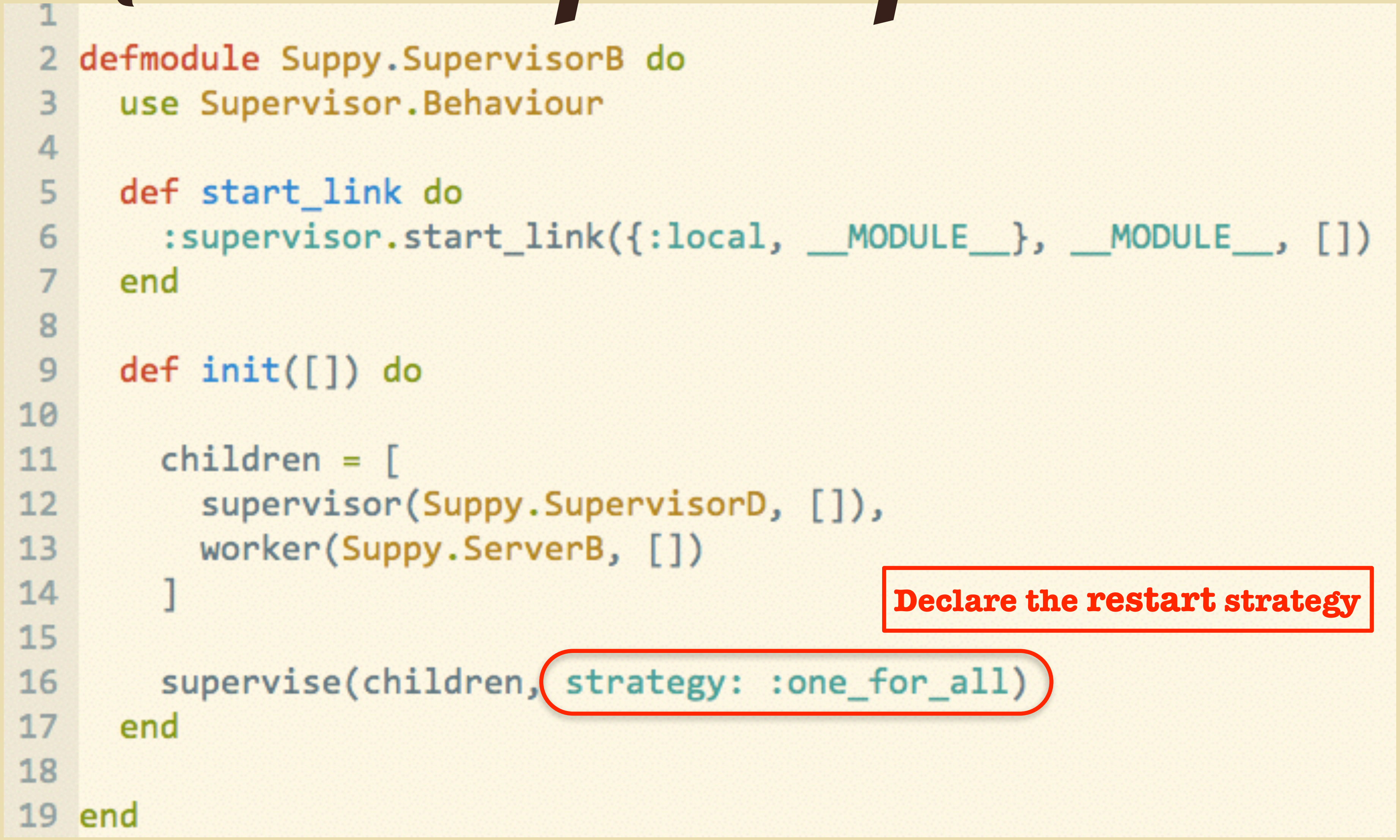
An Example Supervisor



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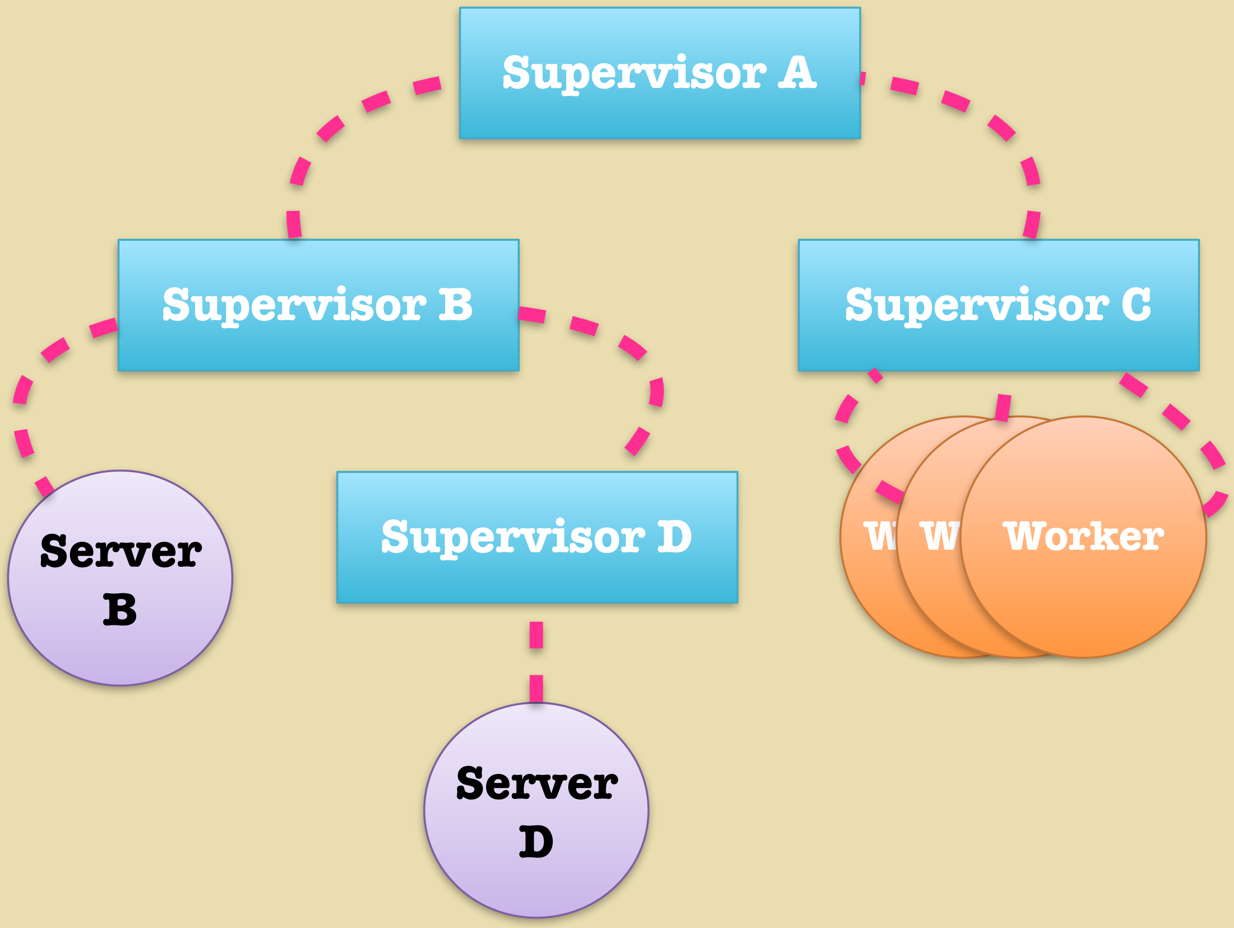
end
```

Declare the restart strategy

Supervisor Demo



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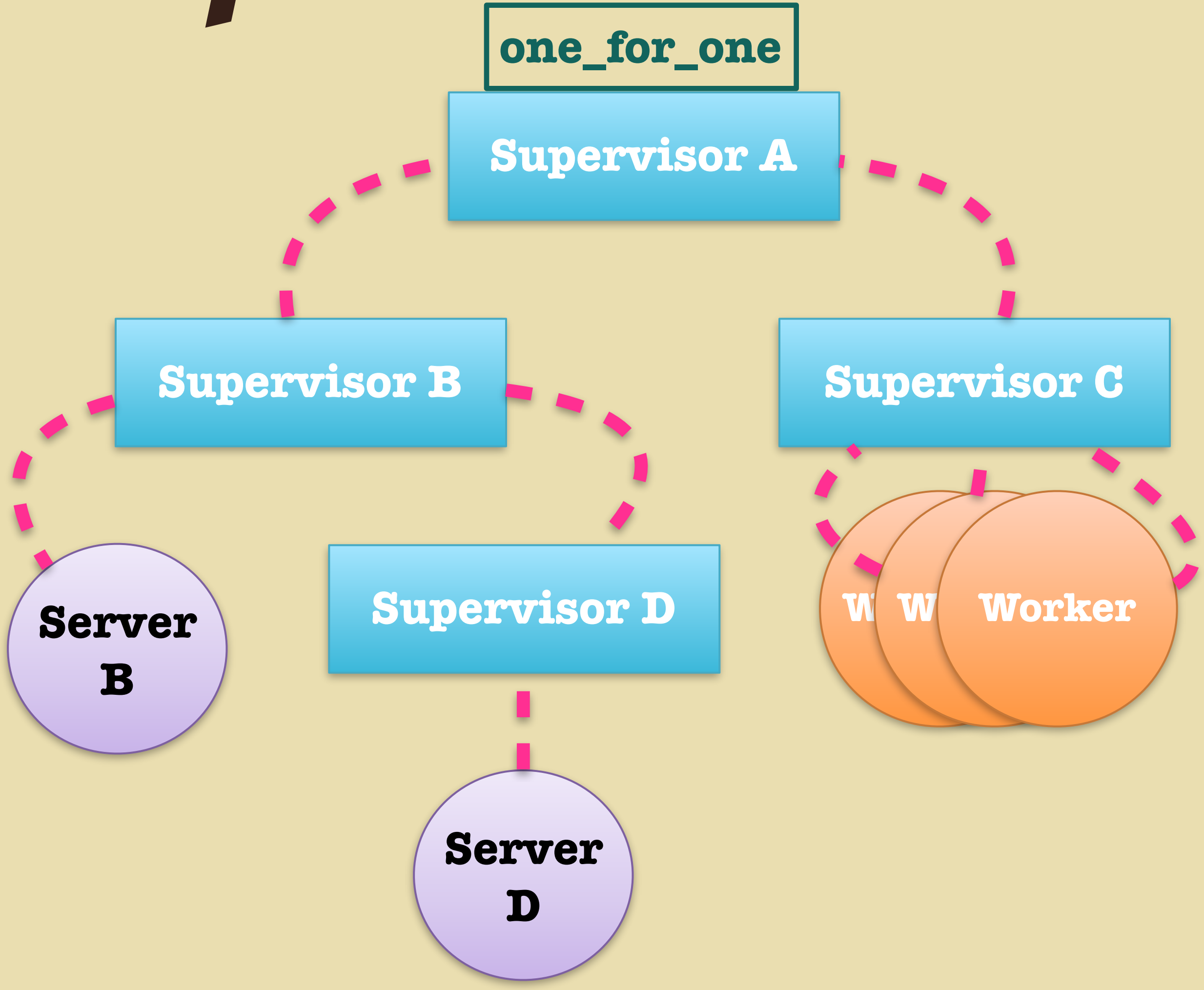
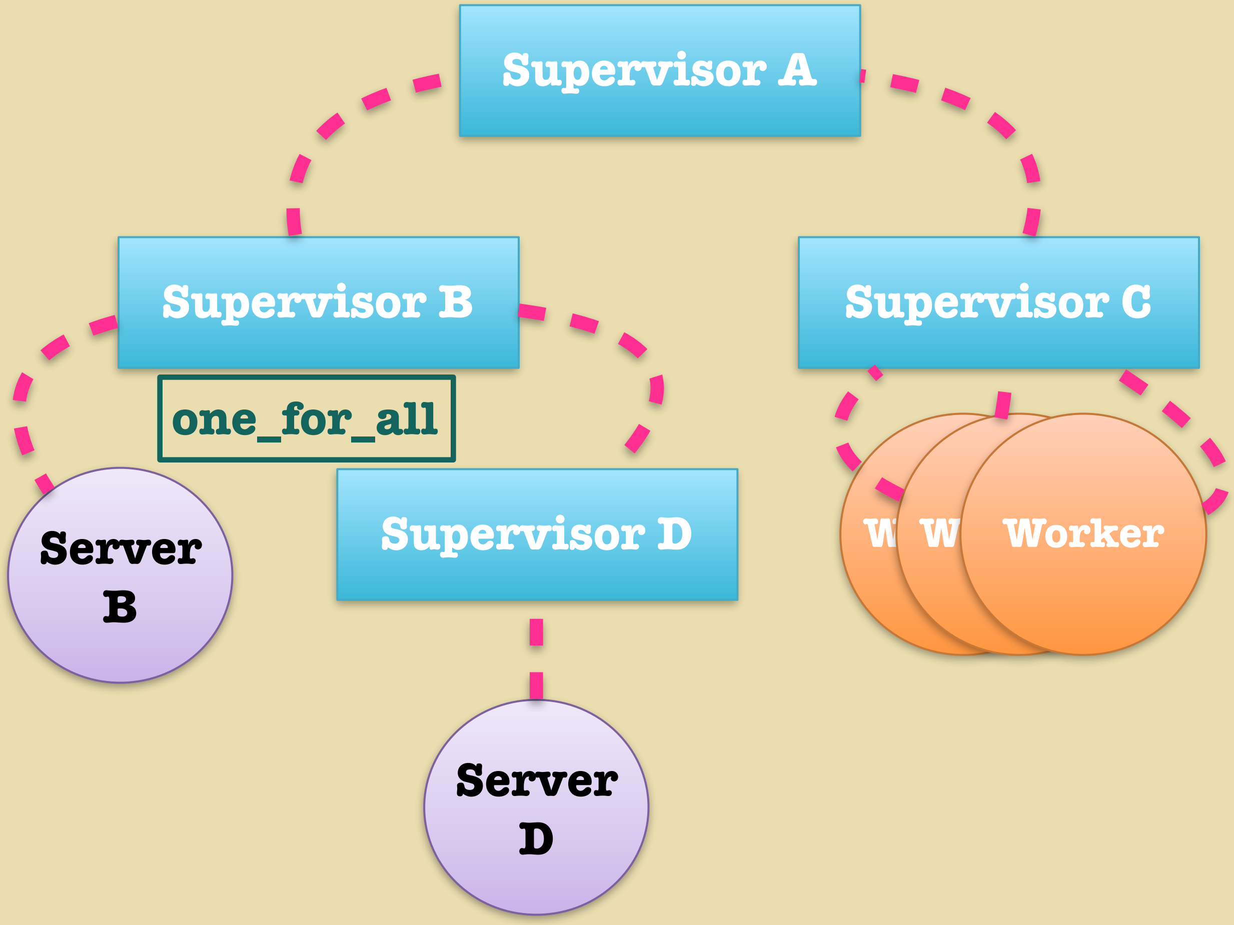
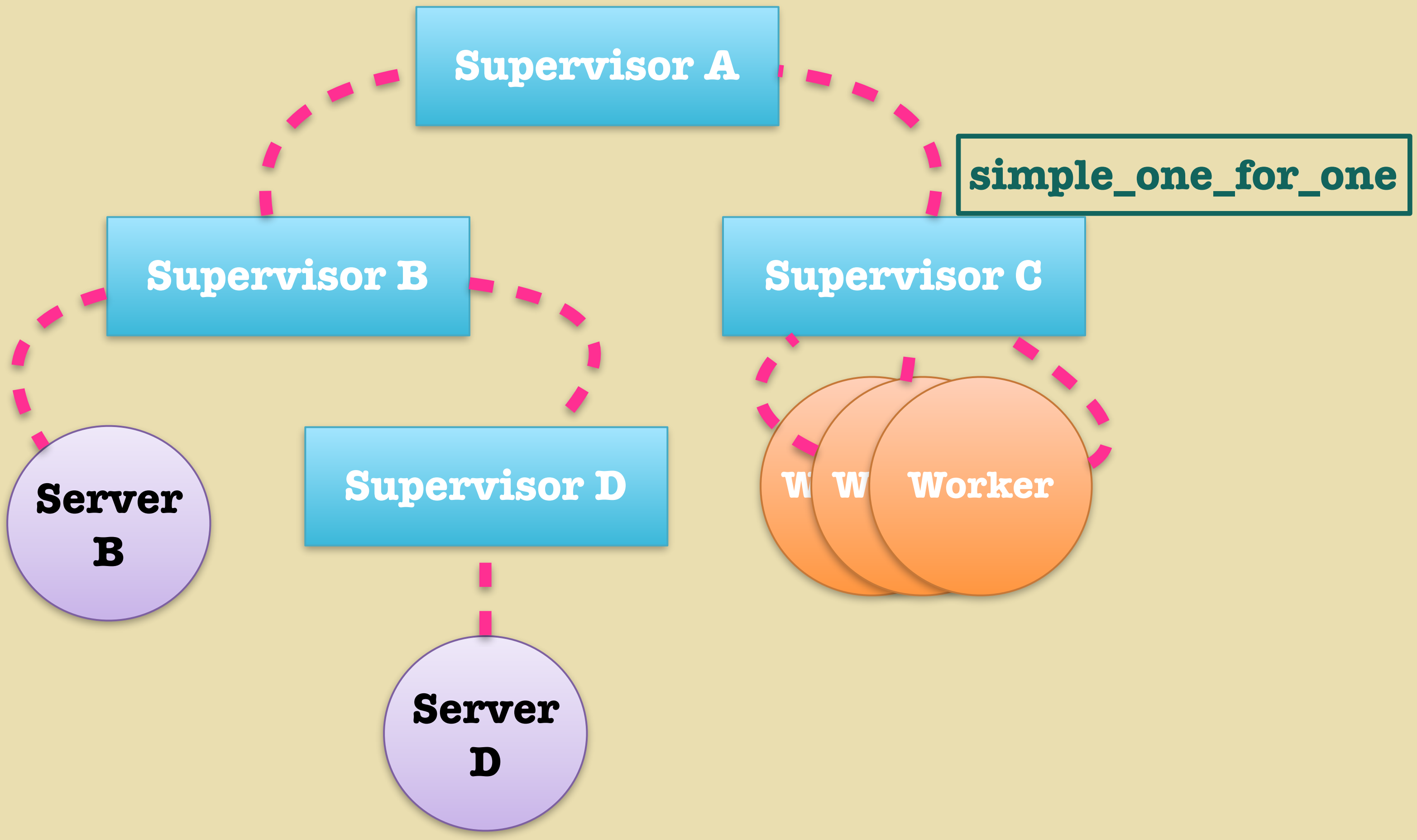


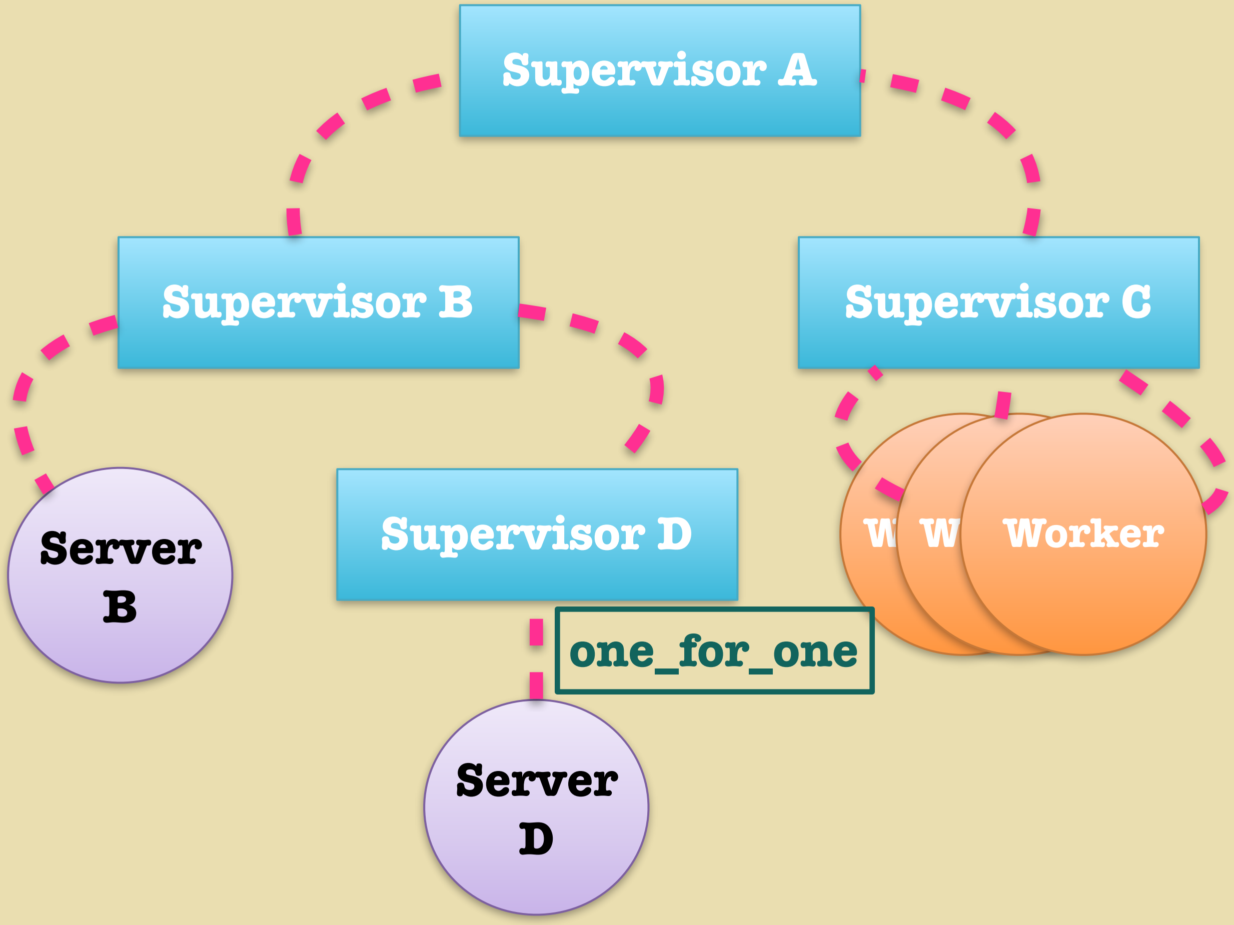
Supervisor Demo



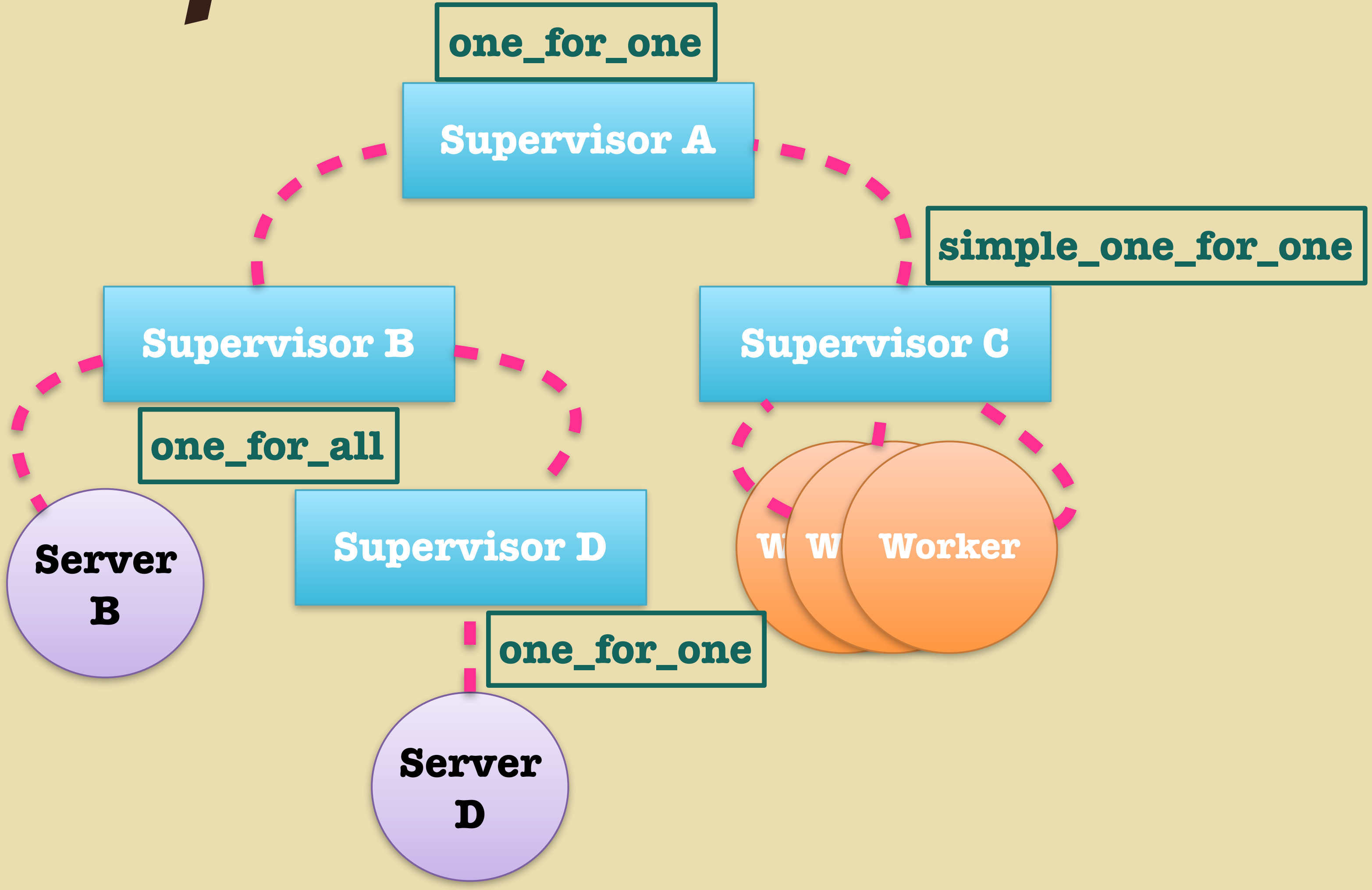
Supervisor Demo



Supervisor Demo



Supervisor Demo



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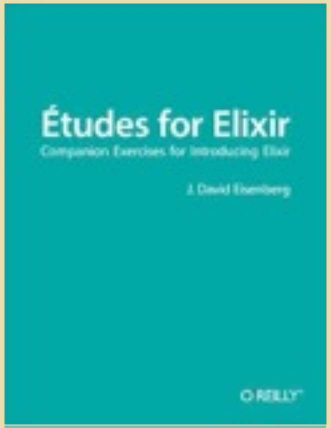
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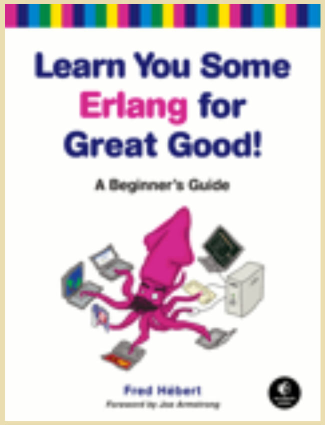
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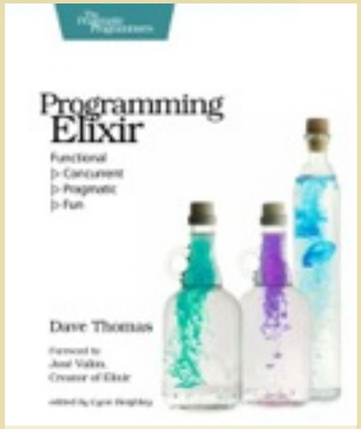
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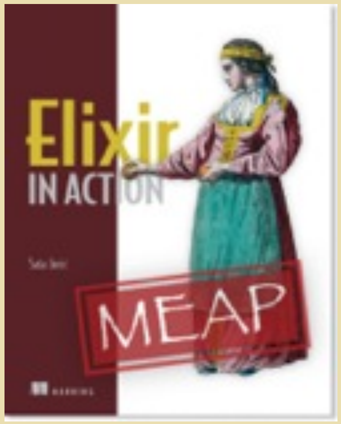
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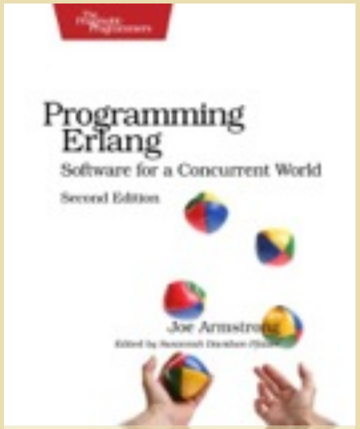
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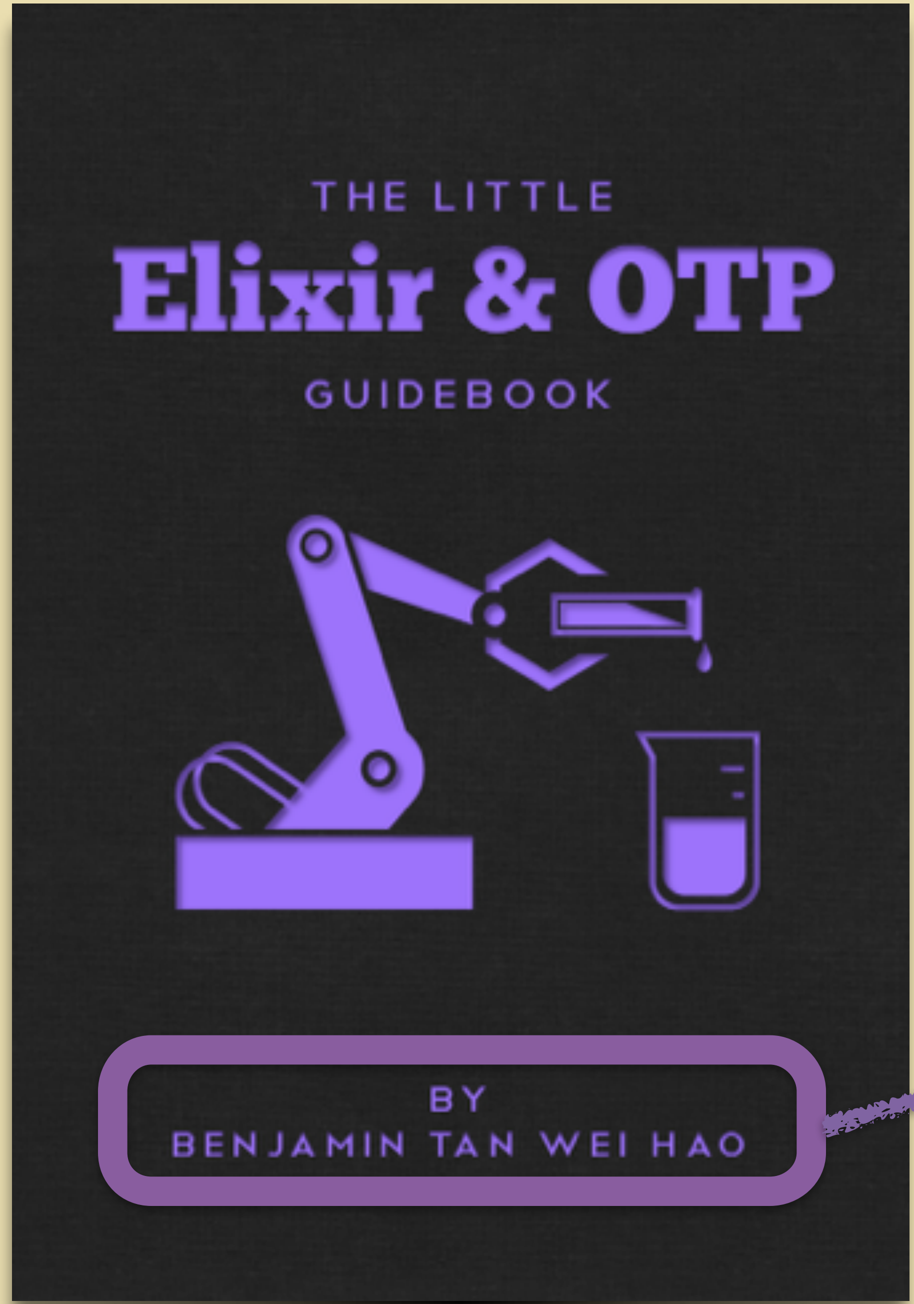

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