OHA!

ОНЕЈ!

Implementing A Worker Pool Application in 4 acts

or: How I finally grokked OTP

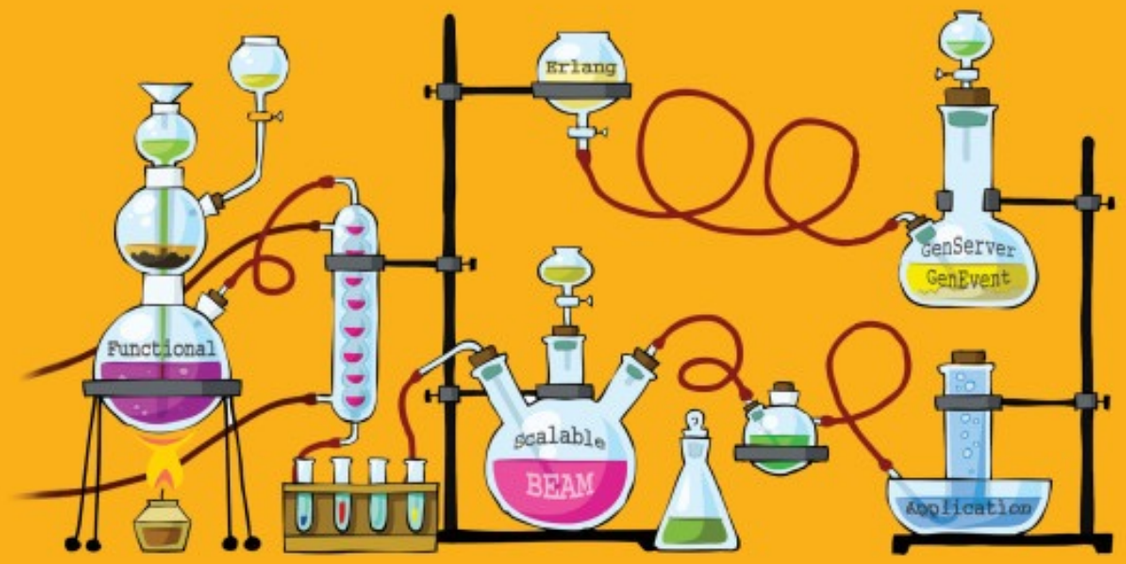
9th June 2017

Benjamin Tan Wei Hao
@bentanweihao

Erlang User Conference 2017

Erlang USER CONFERENCE

THE LITTLE Elixir & OTP GUIDEBOOK



Benjamin Tan Wei Hao

MANNING

13 hours!

WHAT IS A WORKER POOL?

WHY BUILD A WORKER POOL?

Poolboy

< 400 lines!

is a **lightweight**, **generic** pooling library for Erlang with a focus on **simplicity**, **performance**, and **rock-solid** disaster recovery.

Terminology

① Check-out

② Check-in

Terminology

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② Check-in

Creating a Process:

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"Chuck Norris can instantiate an abstract class.”
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Checking Out & In a Process:

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iex(1)> pid = Pooly.checkout("ChuckNorris")
#PID<0.180.0>

iex(2)> ChuckFetcher.fetch(pid)
"Chuck Norris can unit test entire applications with a single assert."

iex(3)> Pooly.checkin("ChuckNorris", pid)
:ok
```

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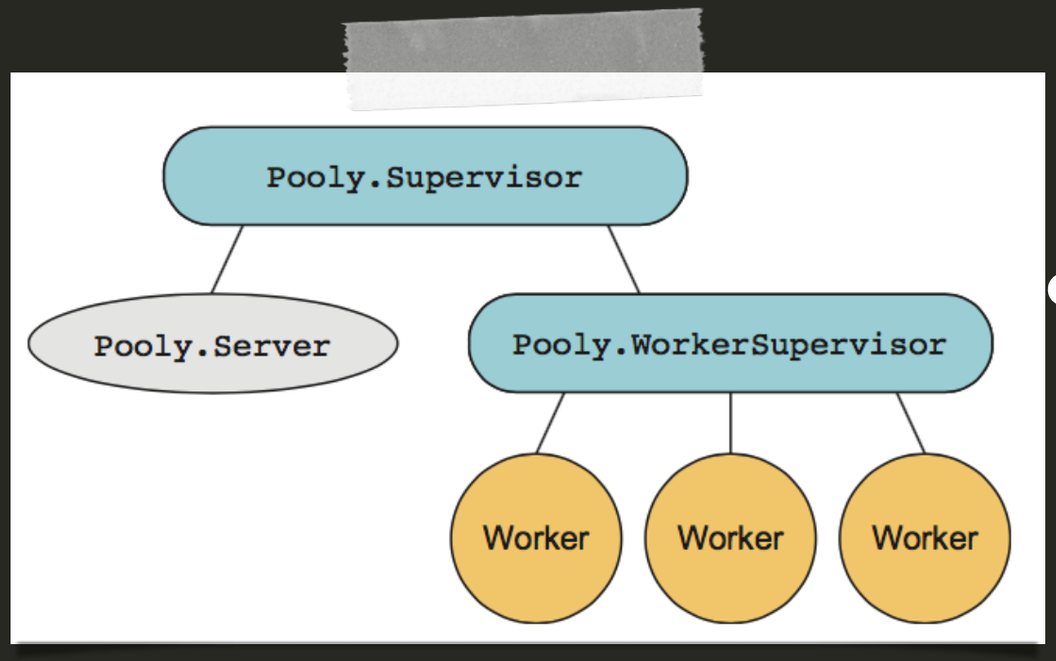
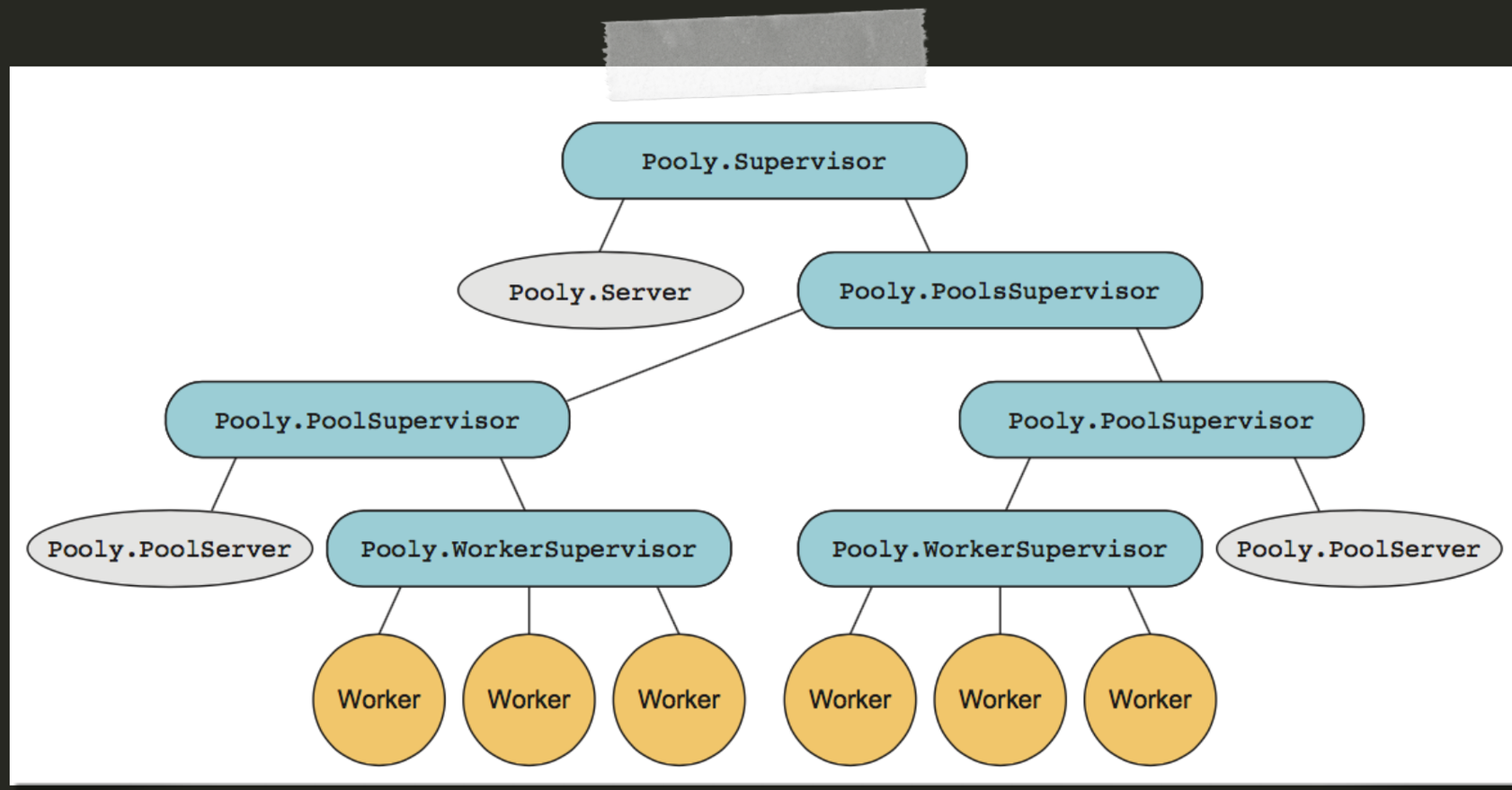


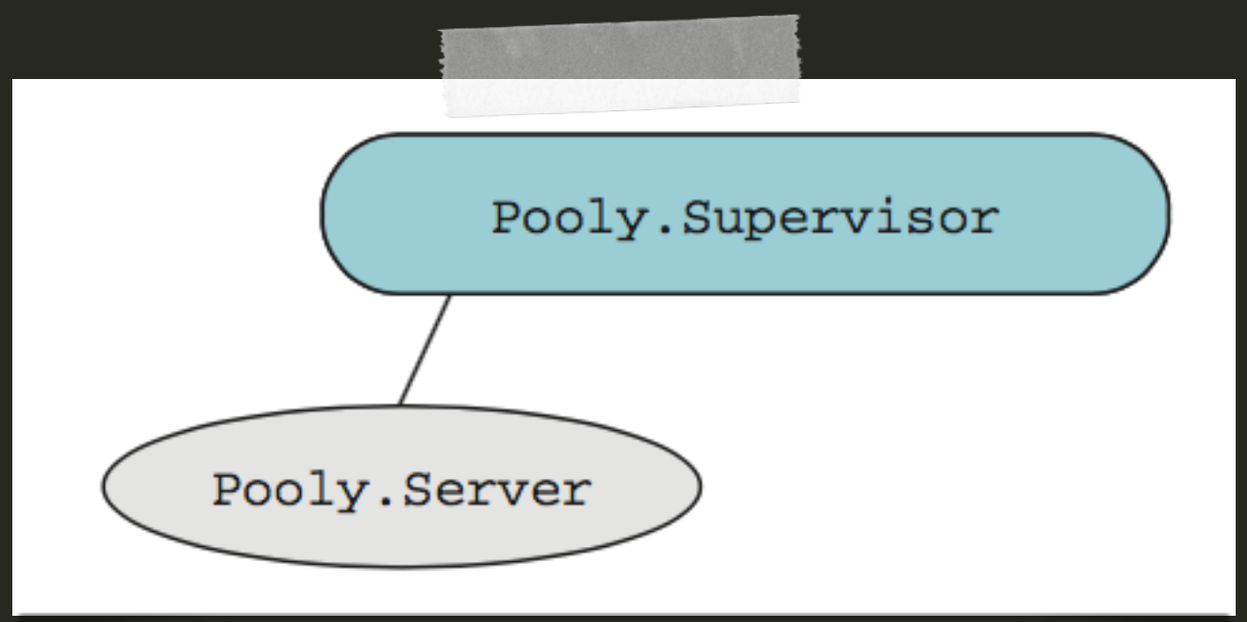
VERSION 1 & 2

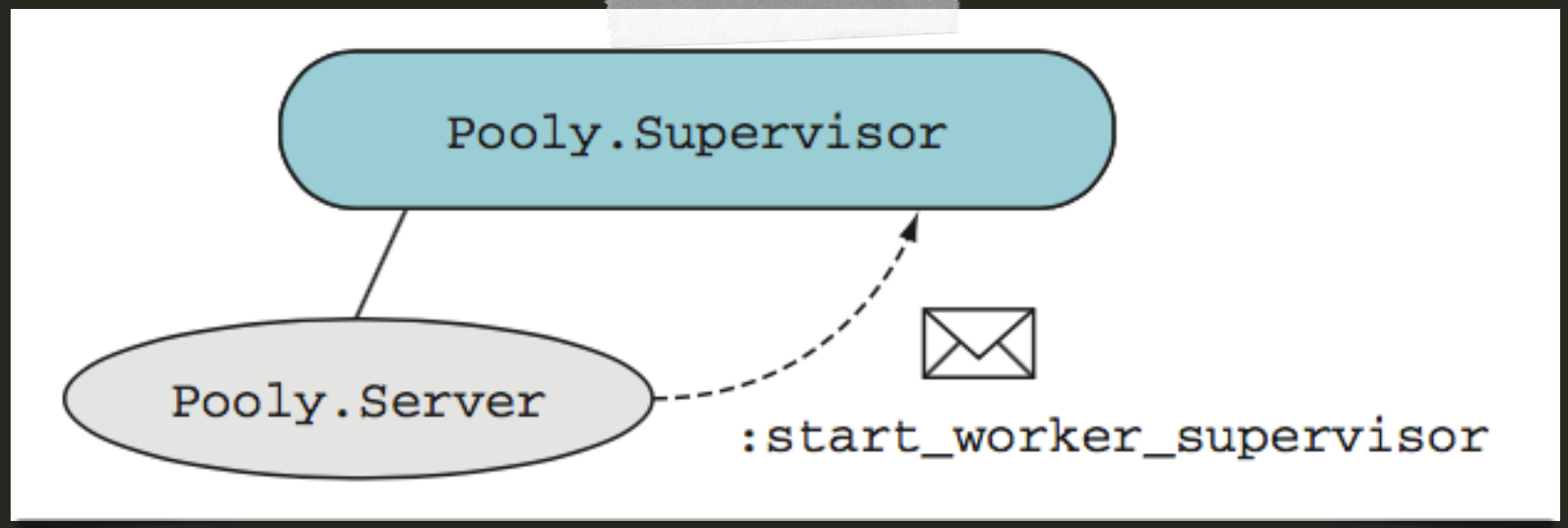
VERSION 3 & 4



VERSION 1

TYPE OF POOL	Single	Multiple
CREATION OF WORKERS	Fixed	Dynamic
CONSUMER RECOVERY	No	Yes
WORKER RECOVERY	No	Yes
QUEUEING FOR BUSY WORKERS	No	Yes


Pooly.Supervisor
Pooly.Server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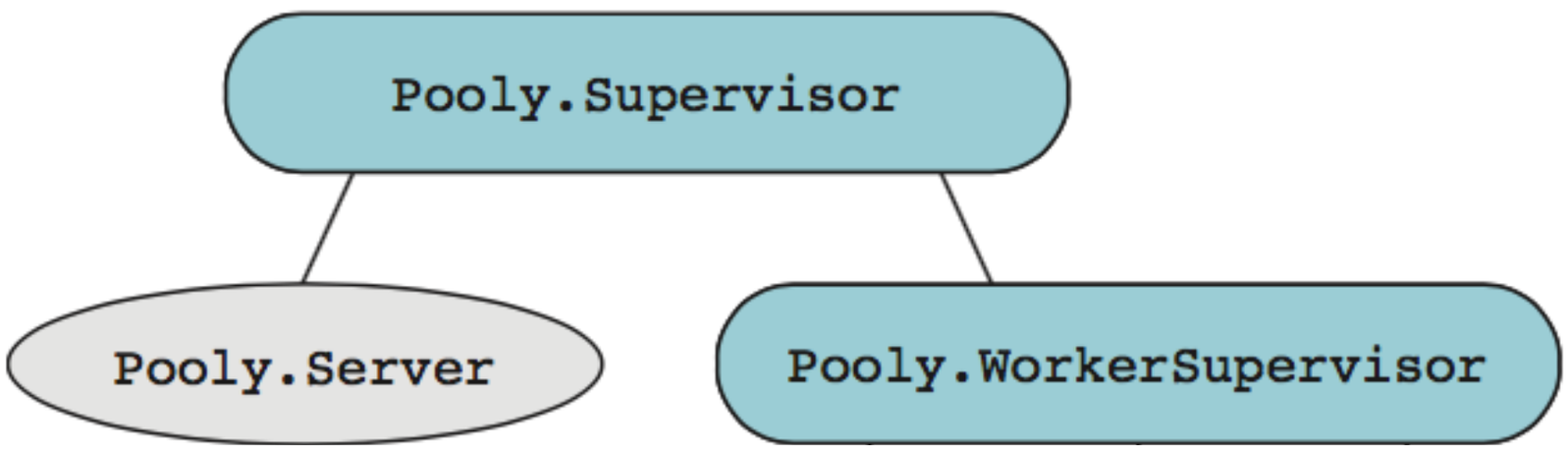
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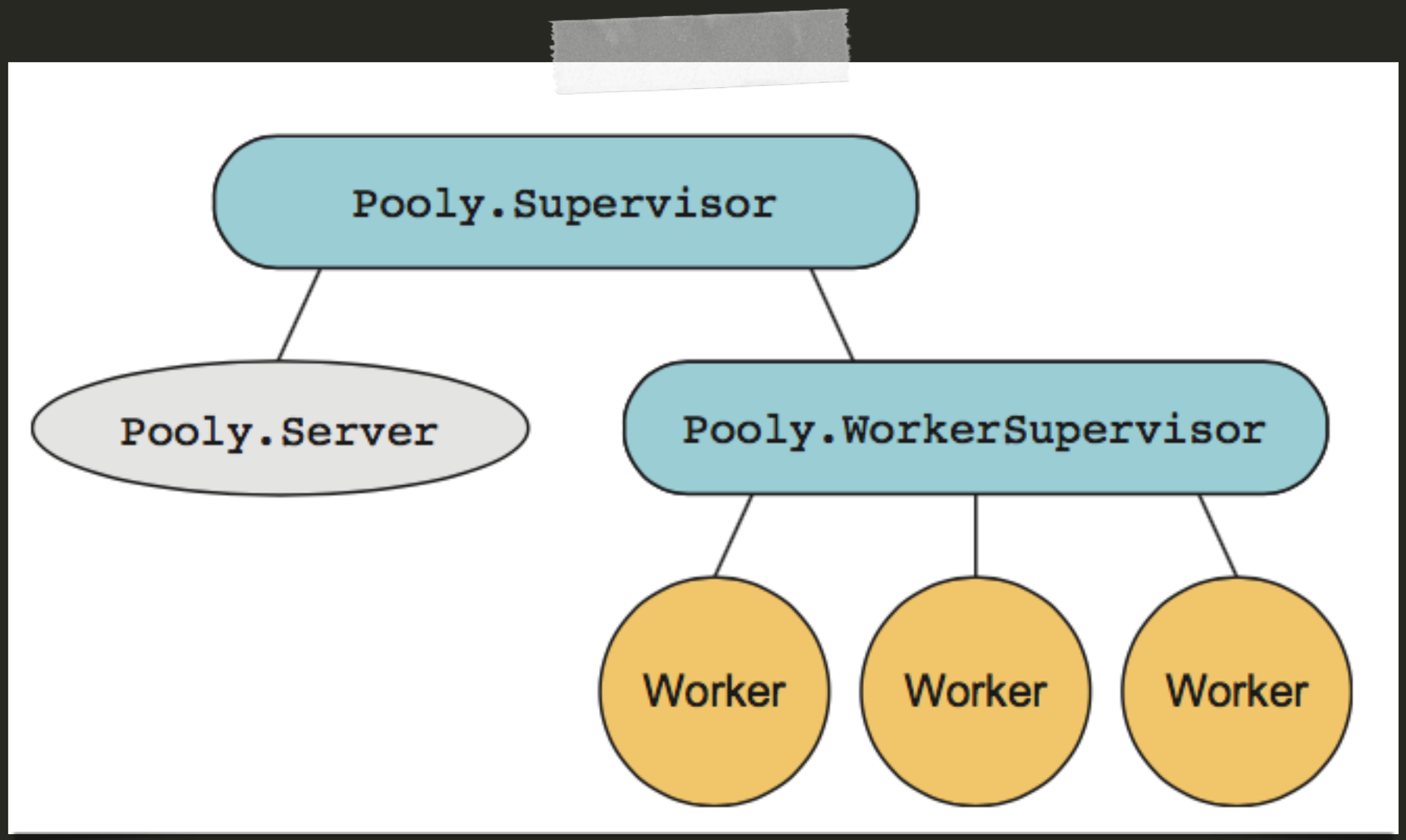
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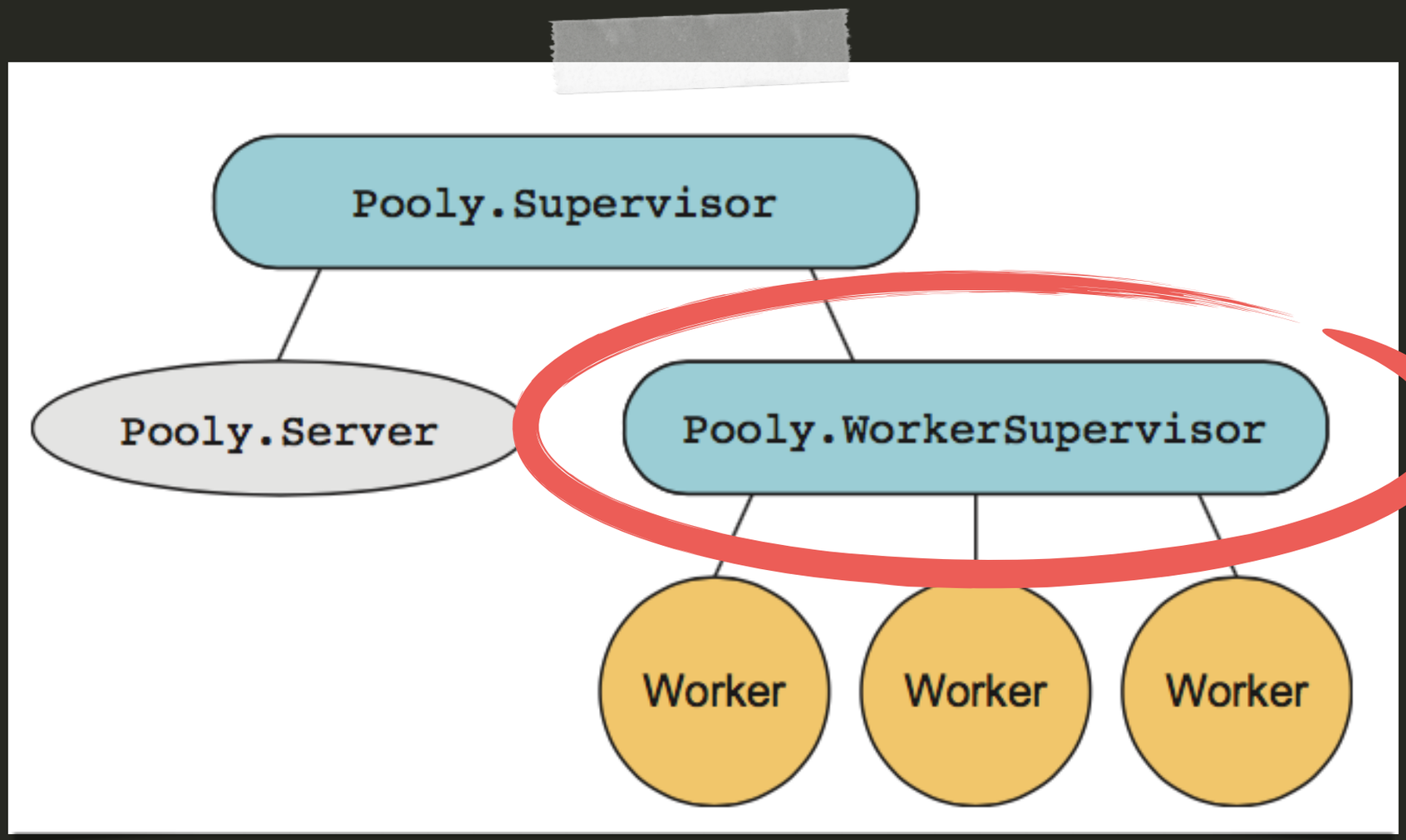
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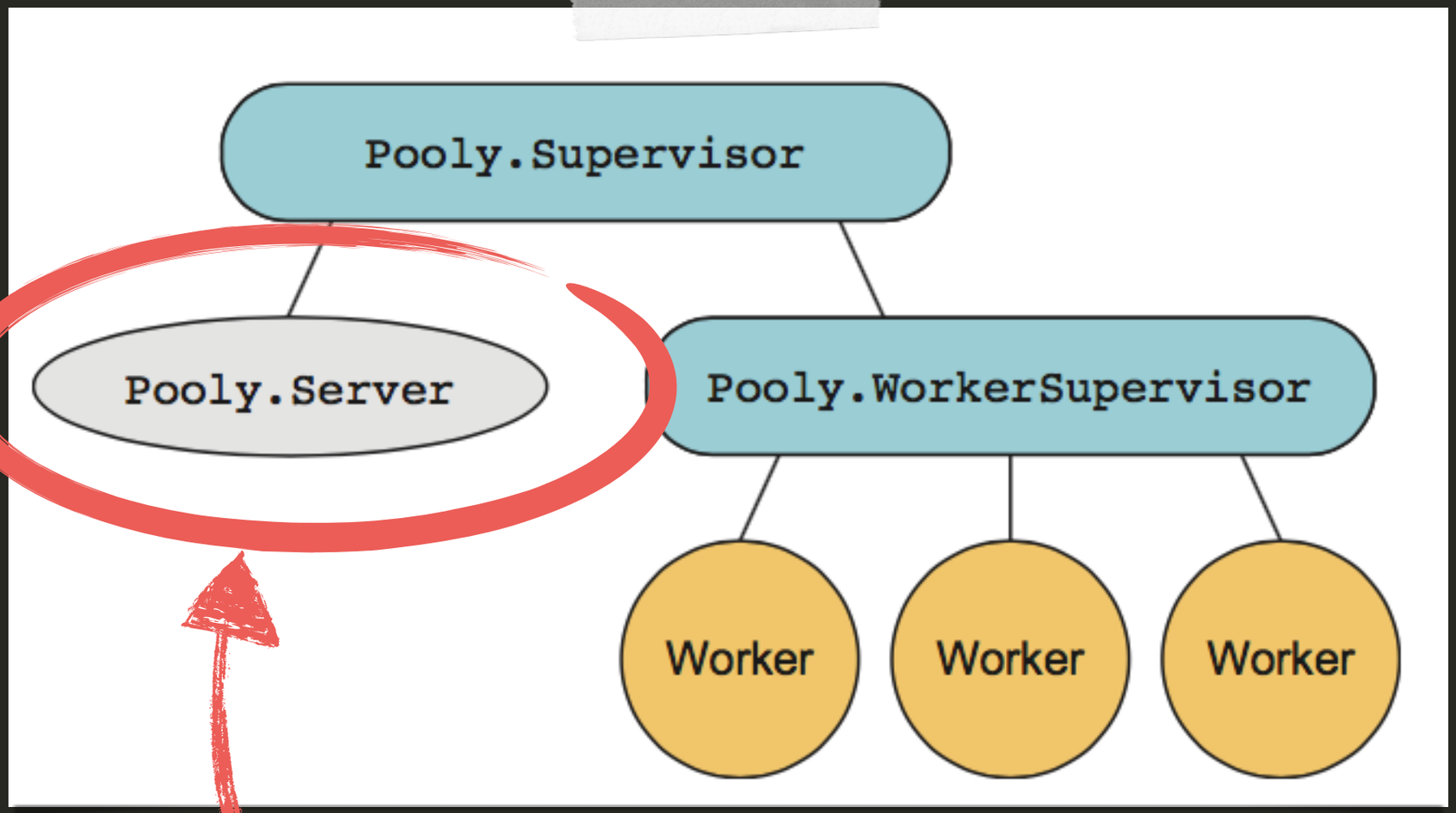


REALLY NEEDED?

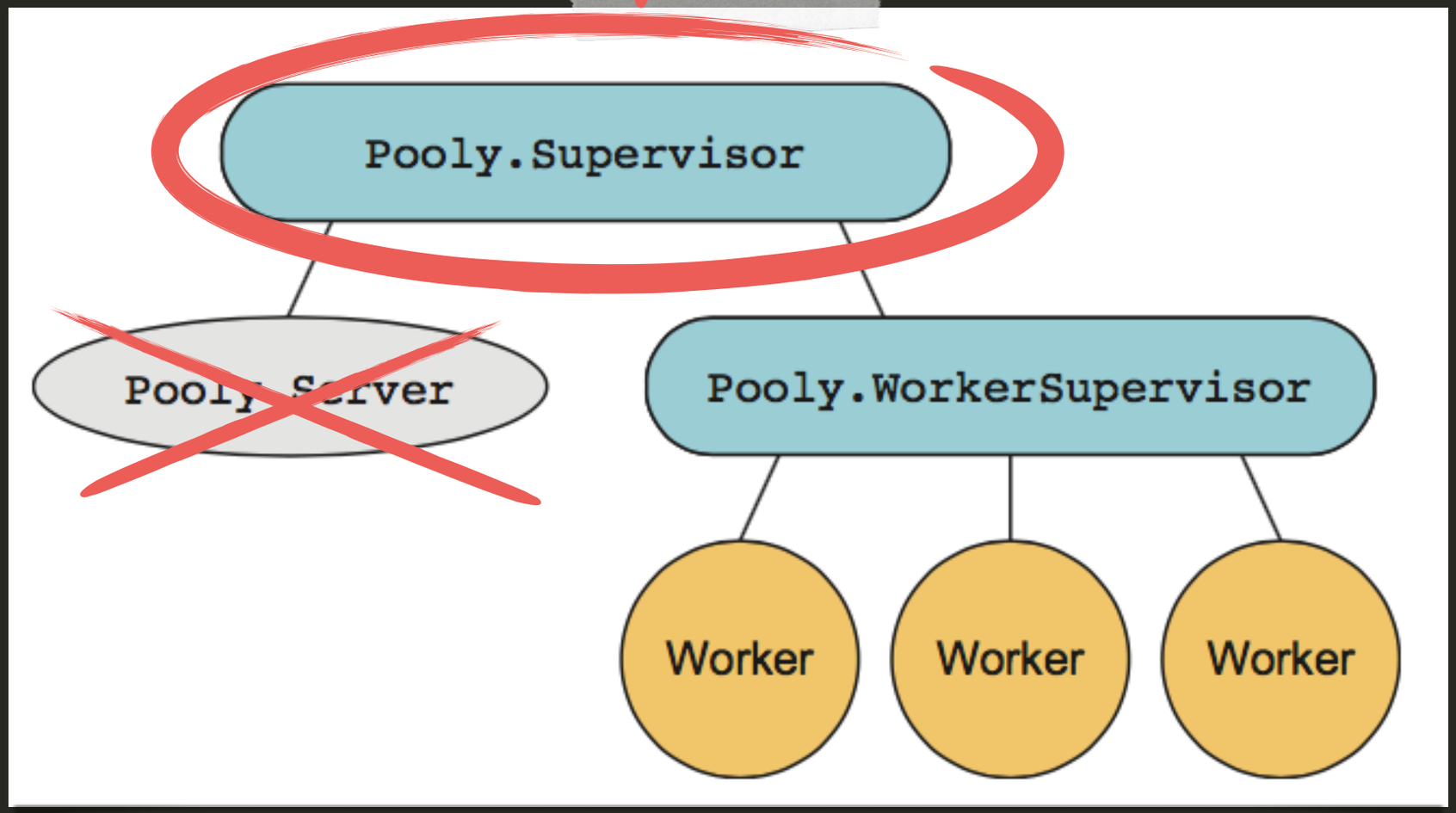
```
-module(supervisor).

-behaviour(gen_server).

-export([start_link/2, start_link/3,
    start_child/2, restart_child/2,
    delete_child/2, terminate_child/2,
    which_children/1, count_children/1,
    check_childspecs/1, get_childspec/2]).

-export([init/1, handle_call/3, handle_cast/2, handle_info/2,
    terminate/2, code_change/3, format_status/2]).
-export([try_again_restart/2]).
```

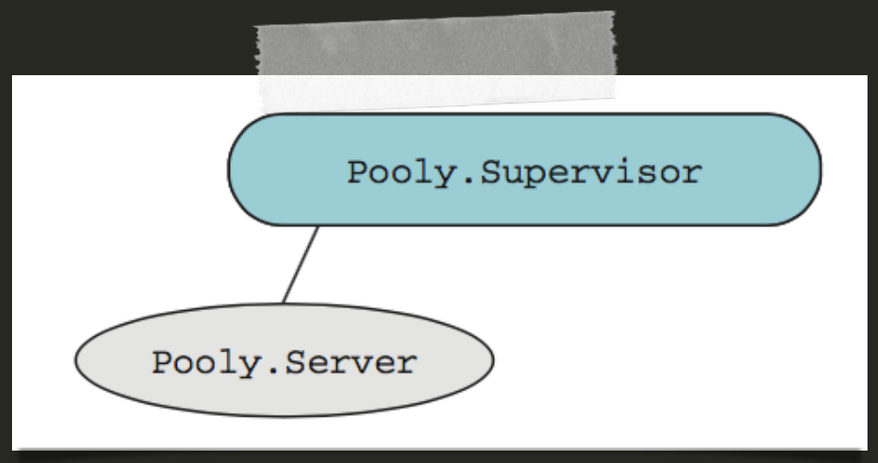
LOGIC GOES HERE?



IF DEBUGGING IS THE PROCESS
OF REMOVING BUGS FROM THE CODE

THE PROGRAMMING MUST BE THE
PROCESS OF PUTTING THEM IN

WHAT GOES INTO THE SERVER STATE?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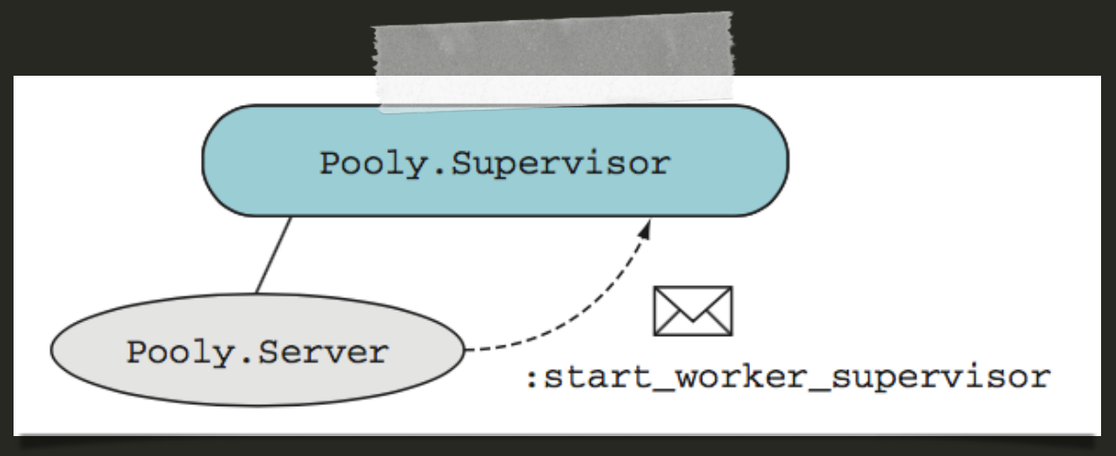
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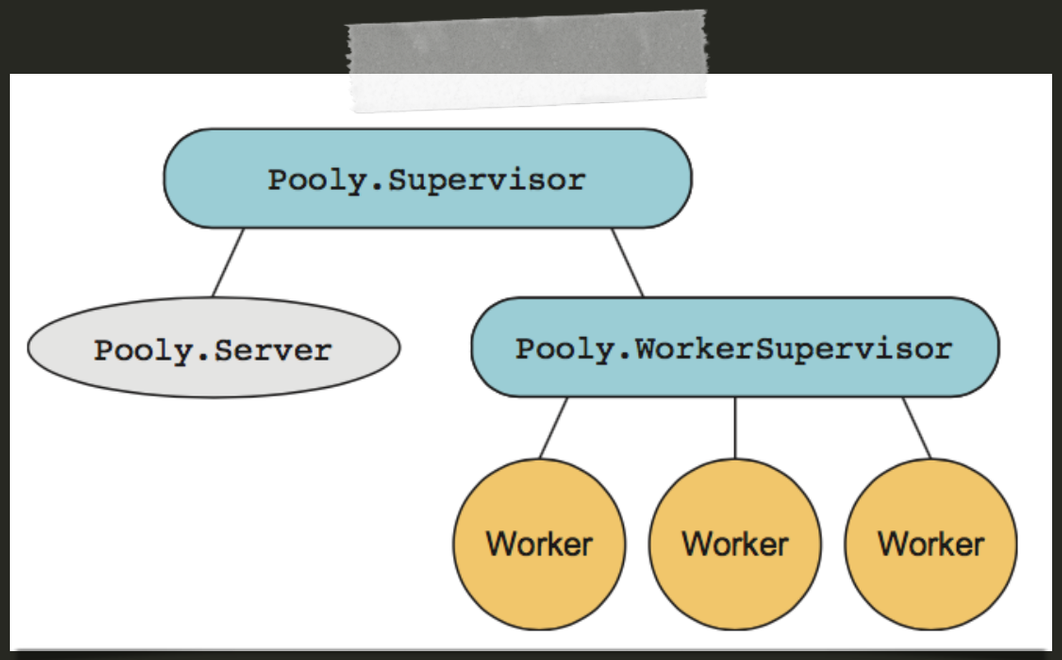
Pooly.Supervisor
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Worker
Worker
Worker

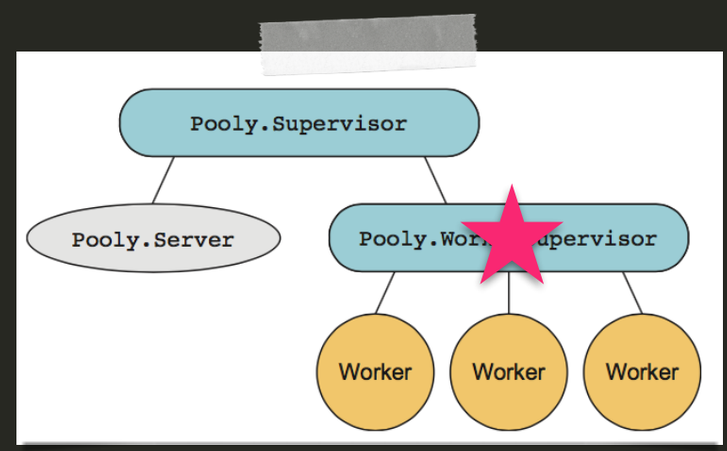
```elixir
defmodule Pooly.WorkerSupervisor do
  use Supervisor

  def start_link({_,_,_} = mfa) do
    Supervisor.start_link(__MODULE__, mfa)
  end

  def init({m,f,a}) do
    worker_opts = [restart:  :permanent,
                   shutdown: 5000,
                   function: f]

    children = [worker(m, a, worker_opts)]
    opts     = [strategy:     :simple_one_for_one,
                max_restarts: 5,
                max_seconds:  5]

    supervise(children, opts)
  end
end
```



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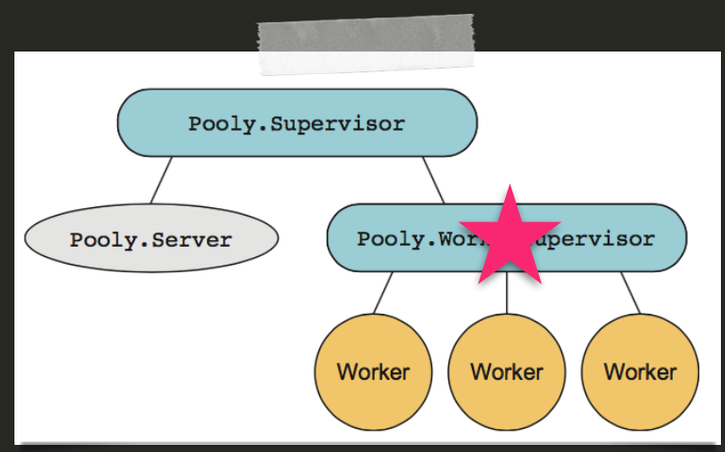

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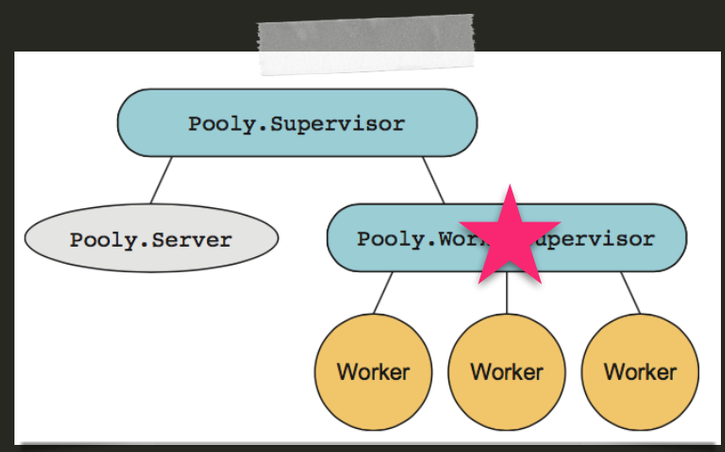

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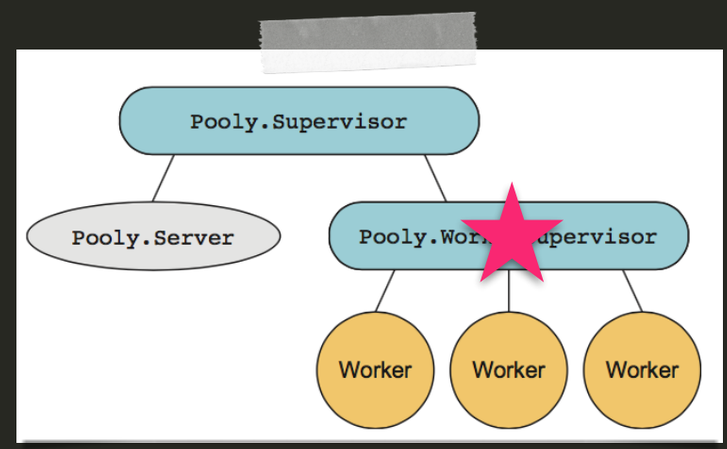
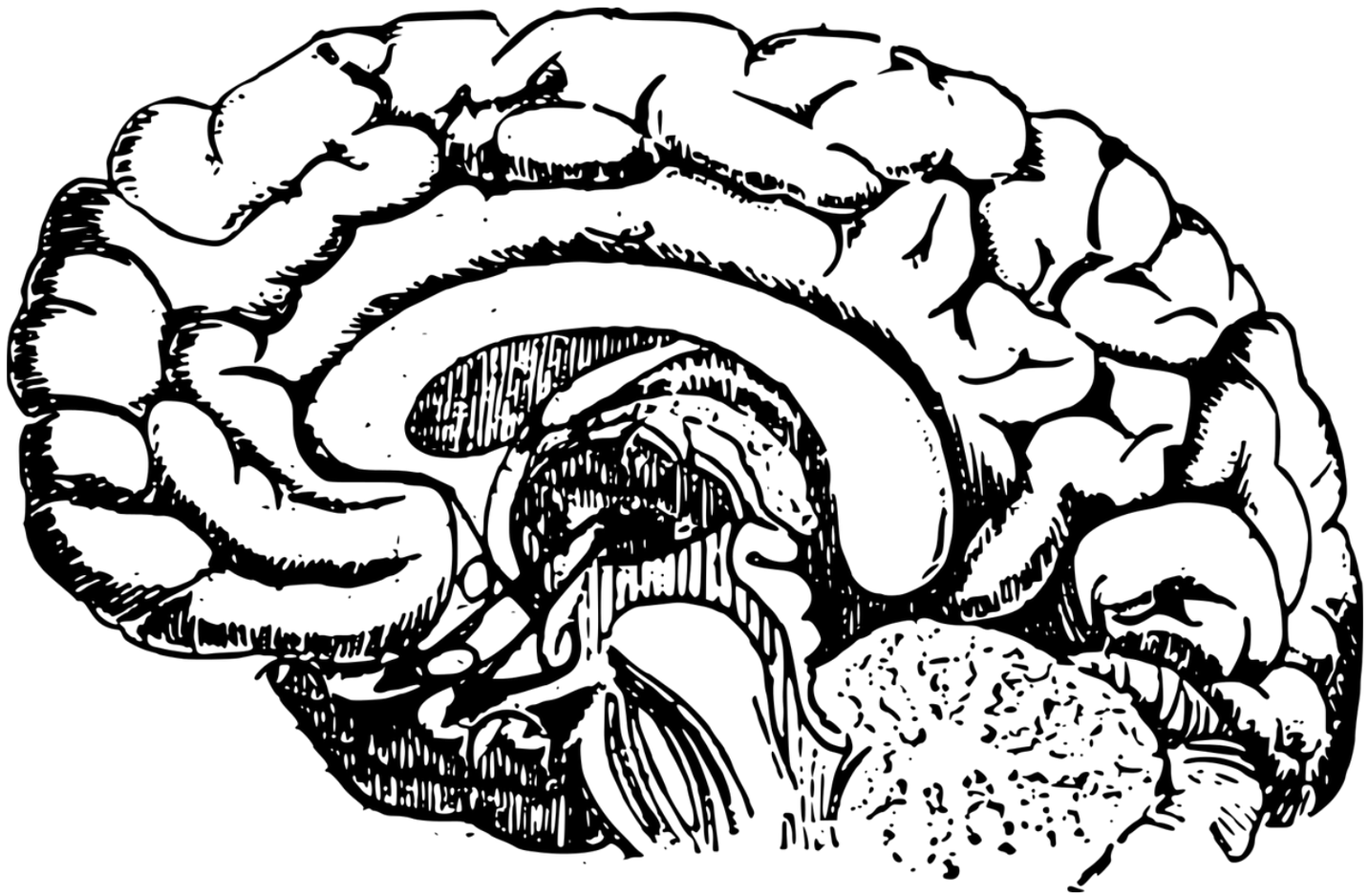


The Pool Server:



OF THE OPERATION

```elixir
defmodule Pooly.Server do
  use GenServer
  import Supervisor.Spec

  defmodule State do
    defstruct sup: nil, size: nil, mfa: nil
  end

  def start_link(sup, pool_config) do
    GenServer.start_link(__MODULE__, [sup, pool_config],
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  end

  def init([sup, pool_config]) when is_pid(sup) do
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  def init([{:mfa, mfa}|rest], state) do: init(rest, %{state | mfa: mfa})
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  def init([_|rest], state), do: init(rest, state)
  def init([], state) do
    send(self, :start_worker_supervisor)
    {:ok, state}
  end
end
```

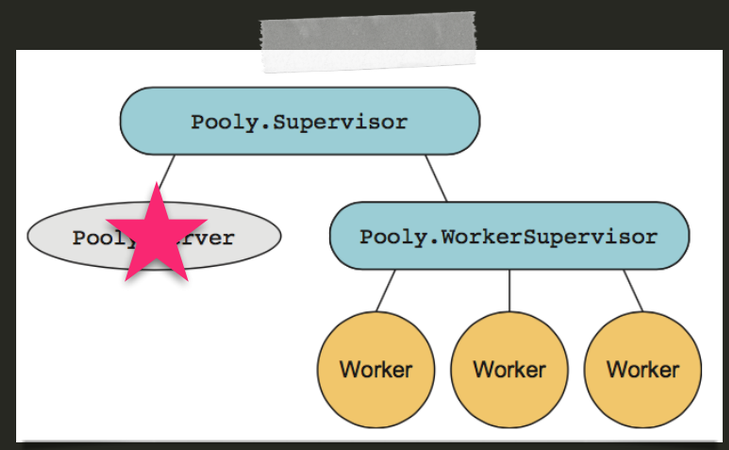

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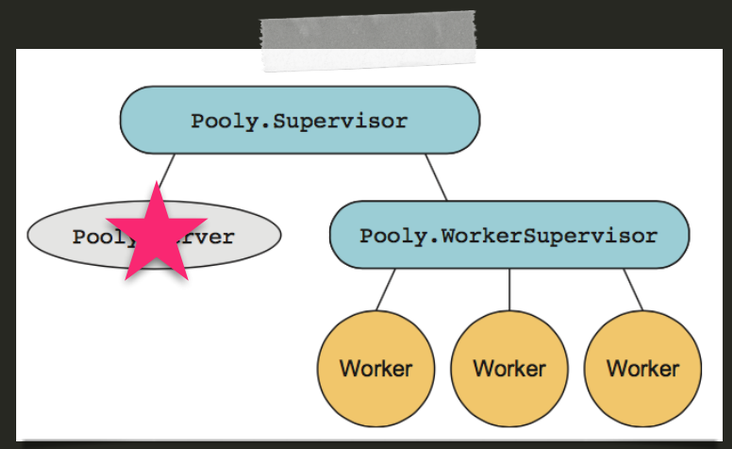

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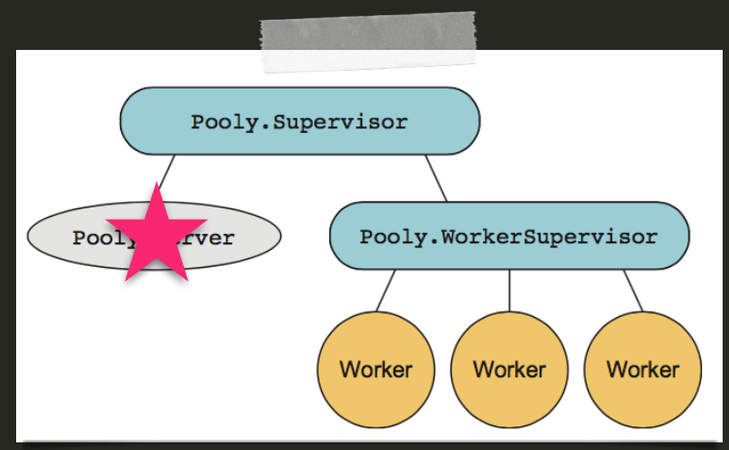

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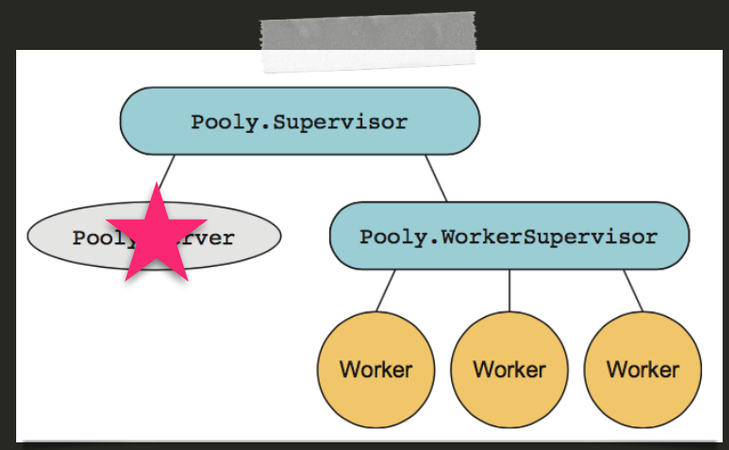

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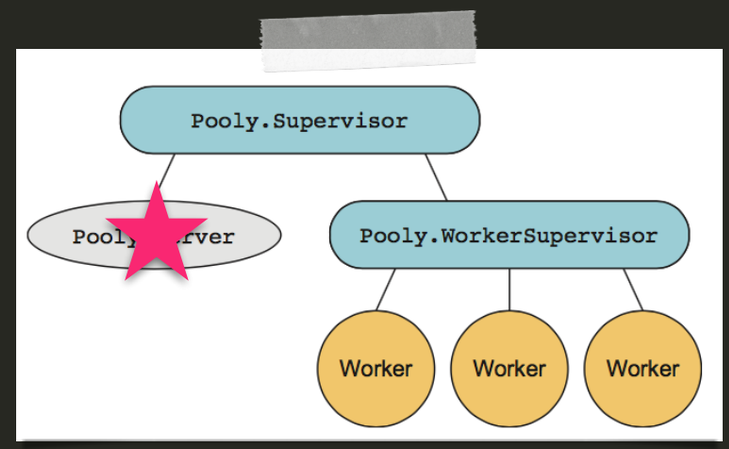

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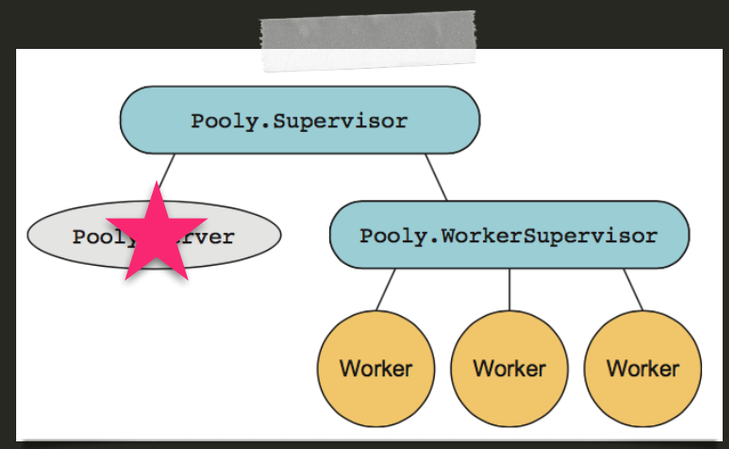

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  defstruct State do
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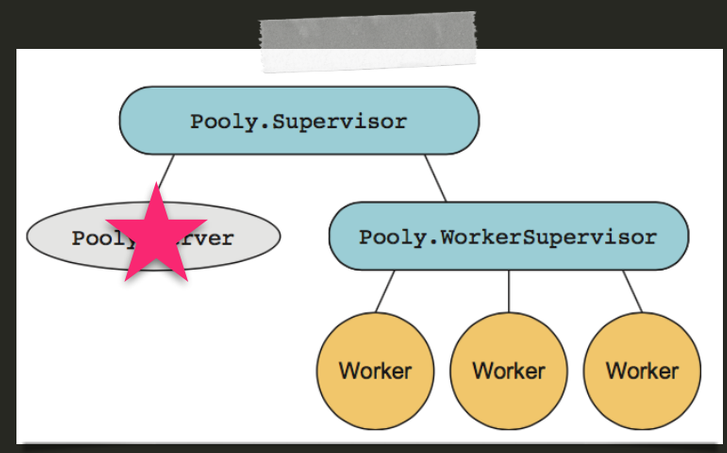
  end

  def handle_info(:start_worker_supervisor, state) do
    %{sup: sup, mfa: mfa, size: size} = state
    {:ok, worker_sup} = Supervisor.start_child(sup, supervisor_spec(mfa))
    workers = prepopulate(size, worker_sup)
    {:noreply, %{state | worker_sup: worker_sup, workers: workers}}
  end

  defp prepopulate(size, sup) when size > 1 do
    1..size |> Enum.map(fn _ -> new_worker(sup) end)
  end
  defp prepopulate(_size, _sup), do: []

  defp new_worker(sup) do
    {:ok, worker} = Supervisor.start_child(sup, [[]])
    worker
  end

  defp supervisor_spec(mfa) do
    supervisor(Pooly.WorkerSupervisor, [mfa],
               [restart: :temporary])
  end
end
```



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    {:ok, worker_sup} = Supervisor.start_child(sup, supervisor_spec(mfa))
    workers = prepopulate(size, worker_sup)
    {:noreply, %{state | worker_sup: worker_sup, workers: workers}}
  end

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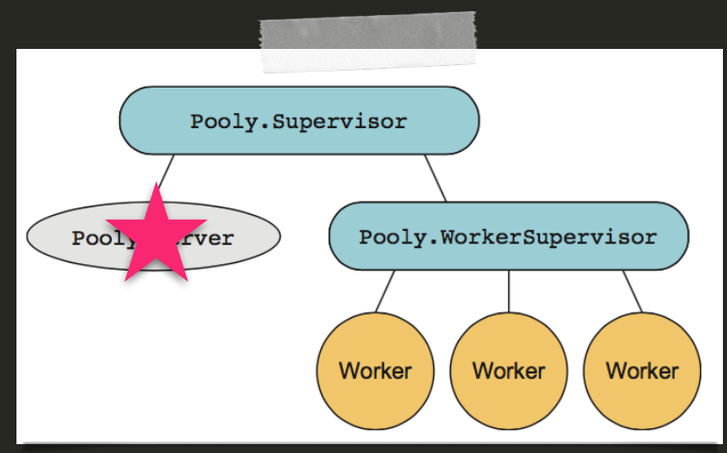

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    workers = prepopulate(size, worker_sup)
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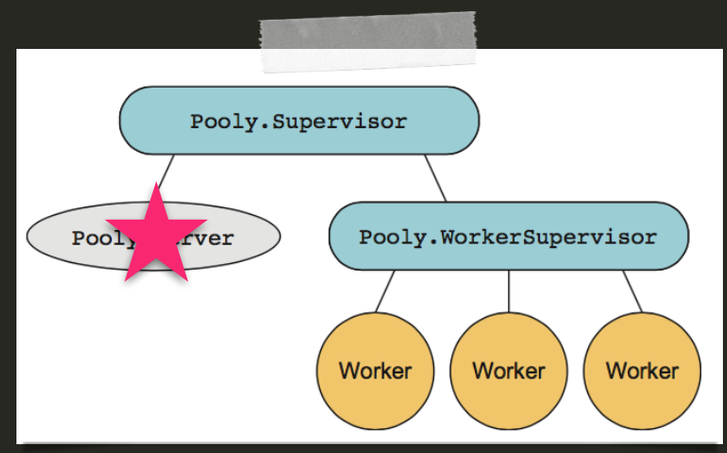

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    sup: nil, worker_sup: nil, size: nil, workers: nil, mfa: nil
  end

  def handle_info(:start_worker_supervisor, state) do
    %{sup: sup, mfa: mfa, size: size} = state
    {:ok, worker_sup} = Supervisor.start_child(sup, supervisor_spec(mfa))
    workers = prepopulate(size, worker_sup)
    {:noreply, %{state | worker_sup: worker_sup, workers: workers}}
  end

  defp prepopulate(size, sup) when size > 1 do
    1..size |> Enum.map(fn _ -> new_worker(sup) end)
  end
  defp prepopulate(_size, _sup), do: []

  defp new_worker(sup) do
    {:ok, worker} = Supervisor.start_child(sup, [[]])
    worker
  end

  defp supervisor_spec(mfa) do
    supervisor(Pooly.WorkerSupervisor, [mfa],
               [restart: :temporary])
  end
end
```
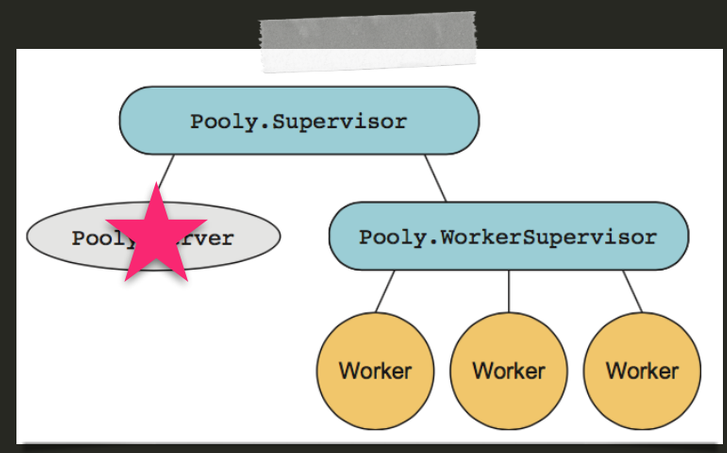
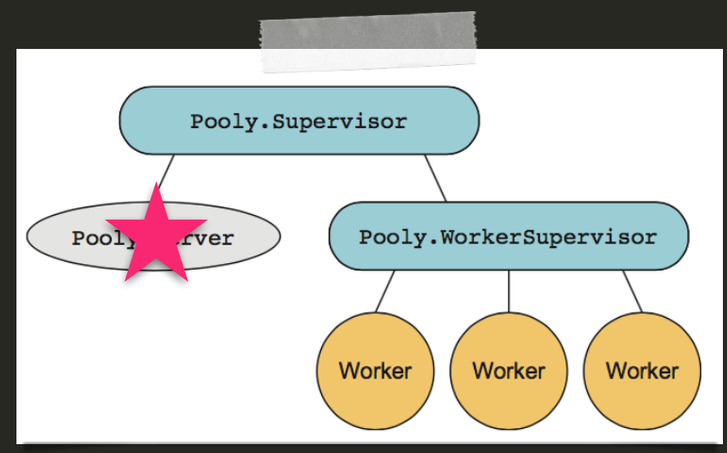
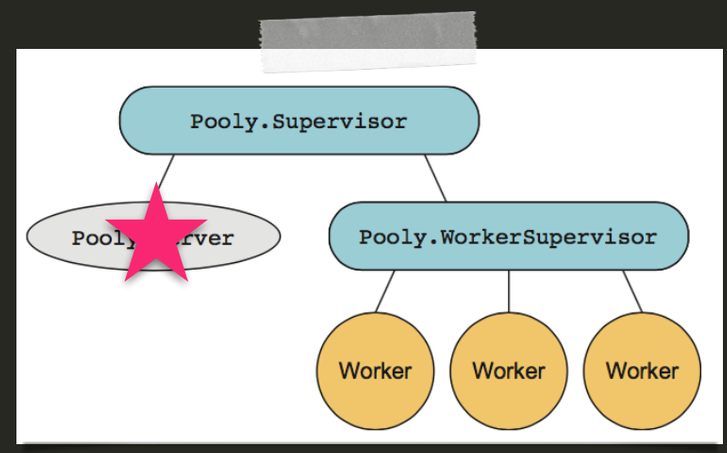



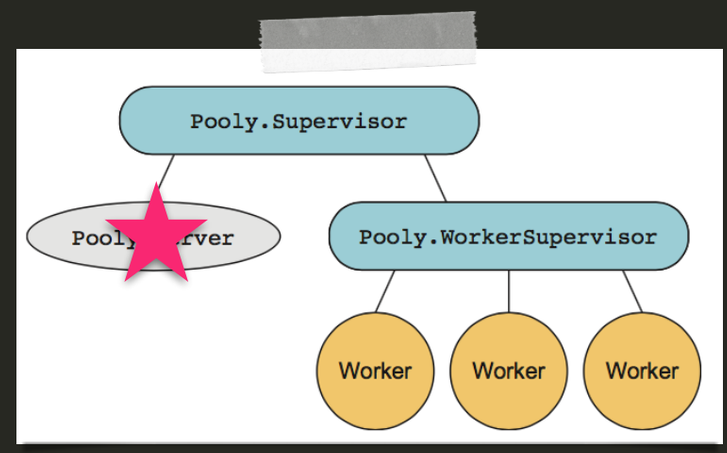
```elixir
defmodule Pooly.Server do
  defstruct State do
    sup: nil, worker_sup: nil, size: nil, workers: nil, mfa: nil
  end

  def handle_info(:start_worker_supervisor, state) do
    %{sup: sup, mfa: mfa, size: size} = state
    {:ok, worker_sup} = Supervisor.start_child(sup, supervisor_spec(mfa))
    workers = prepopulate(size, worker_sup)
    {:noreply, %{state | worker_sup: worker_sup, workers: workers}}
  end

  defp prepopulate(size, sup) when size > 1 do
    1..size |> Enum.map(fn _ -> new_worker(sup) end)
  end
  defp prepopulate(_size, _sup), do: []

  defp new_worker(sup) do
    {:ok, worker} = Supervisor.start_child(sup, [[]])
    worker
  end

  defp supervisor_spec(mfa) do
    supervisor(Pooly.WorkerSupervisor, [mfa],
               [restart: :temporary])
  end
end
```



```elixir
defmodule Pooly.Server do
  defstruct State do
    sup: nil, worker_sup: nil, size: nil, workers: nil, mfa: nil
  end

  def handle_info(:start_worker_supervisor, state) do
    %{sup: sup, mfa: mfa, size: size} = state
    {:ok, worker_sup} = Supervisor.start_child(sup, supervisor_spec(mfa))
    workers = prepopulate(size, worker_sup)
    {:noreply, %{state | worker_sup: worker_sup, workers: workers}}
  end

  defp prepopulate(size, sup) when size > 1 do
    1..size |> Enum.map(fn _ -> new_worker(sup) end)
  end
  defp prepopulate(_size, _sup), do: []

  defp new_worker(sup) do
    {:ok, worker} = Supervisor.start_child(sup, [[]])
    worker
  end

  defp supervisor_spec(mfa) do
    supervisor(Pooly.WorkerSupervisor, [mfa],
               [restart: :temporary])
  end
end
```

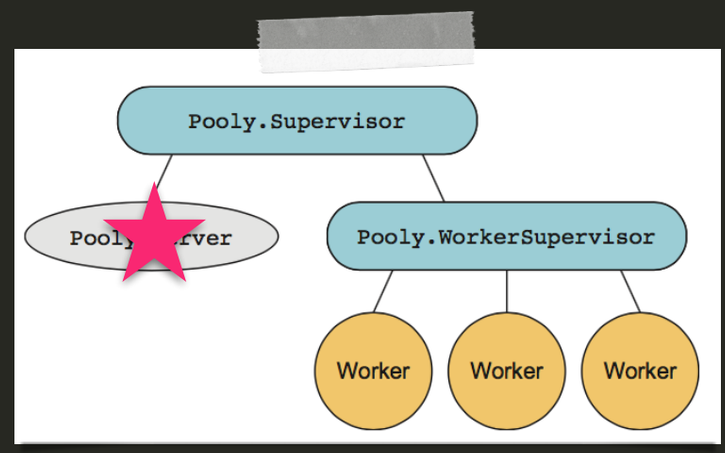


```elixir
defmodule Pooly.Server do
  defstruct State do
    sup: nil, worker_sup: nil, size: nil, workers: nil, mfa: nil
  end

  def handle_info(:start_worker_supervisor, state) do
    %{sup: sup, mfa: mfa, size: size} = state
    {:ok, worker_sup} = Supervisor.start_child(sup, supervisor_spec(mfa))
    workers = prepopulate(size, worker_sup)
    {:noreply, %{state | worker_sup: worker_sup, workers: workers}}
  end

  defp prepopulate(size, sup) when size > 1 do
    1..size |> Enum.map(fn _ -> new_worker(sup) end)
  end
  defp prepopulate(_size, _sup), do: []

  defp new_worker(sup) do
    {:ok, worker} = Supervisor.start_child(sup, [[]])
    worker
  end

  defp supervisor_spec(mfa) do
    supervisor(Pooly.WorkerSupervisor, [mfa],
               [restart: :temporary])
  end
end
```



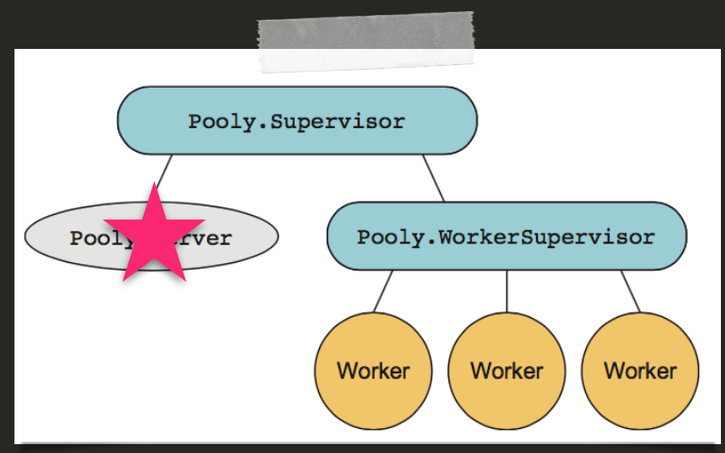
WORKER CHECK-OUT

```
defmodule Pooly.Server do

  def handle_call(:checkout, {from_pid, _ref}, state) do
    %{workers: workers, monitors: monitors} = state
    case workers do
      [worker|rest] ->
        ref = Process.monitor(from_pid)
        true = :ets.insert(monitors, {worker, ref})
        {:reply, worker, %{state | workers: rest}}

      [] ->
        {:reply, :noproc, state}
    end
  end

end
```



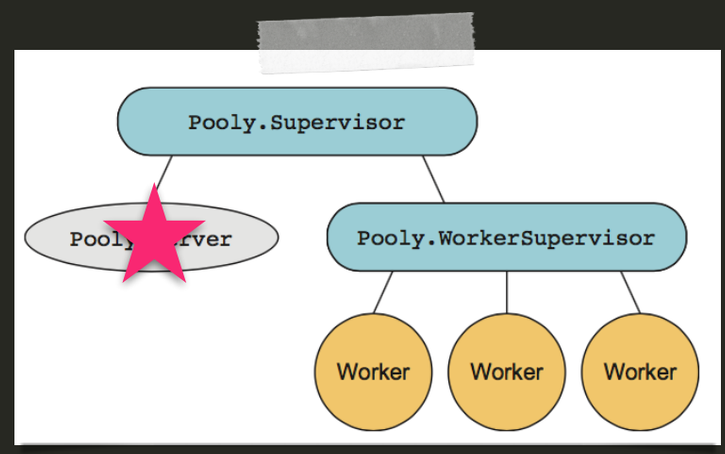
WORKER CHECK-OUT

```
defmodule Pooly.Server do

  def handle_call(:checkout, {from_pid, _ref}, state) do
    %{workers: workers, monitors: monitors} = state
    case workers do
      [worker|rest] ->
        ref = Process.monitor(from_pid)
        true = :ets.insert(monitors, {worker, ref})
        {:reply, worker, %{state | workers: rest}}

      [] ->
        {:reply, :noproc, state}
    end
  end

end
```



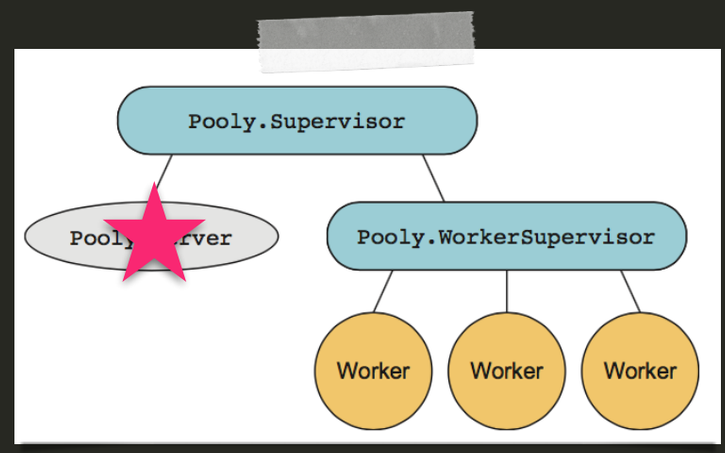
WORKER CHECK-OUT

```elixir
defmodule Pooly.Server do

  def handle_call(:checkout, {from_pid, _ref}, state) do
    %{workers: workers, monitors: monitors} = state
    case workers do
      [worker|rest] ->
        ref = Process.monitor(from_pid)
        true = :ets.insert(monitors, {worker, ref})
        {:reply, worker, %{state | workers: rest}}

      [] ->
        {:reply, :noproc, state}
    end
  end

end
```



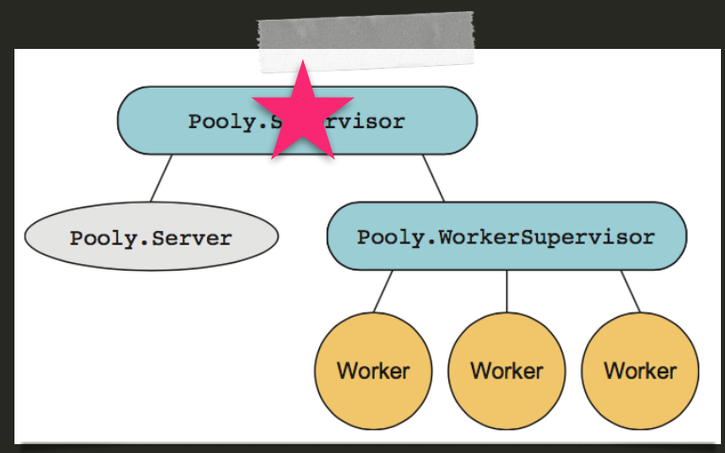
WORKER CHECK-IN

```
defmodule Pooly.Server do

  def handle_cast({:checkin, worker}, state) do
    %{workers: workers, monitors: monitors} = state
    case :ets.lookup(monitors, worker) do
      [{pid, ref}] ->
        true = Process.demonitor(ref)
        true = :ets.delete(monitors, pid)
        {:noreply, %{state | workers: [pid|workers]}}
      [] ->
        {:noreply, state}
    end
  end

end
```



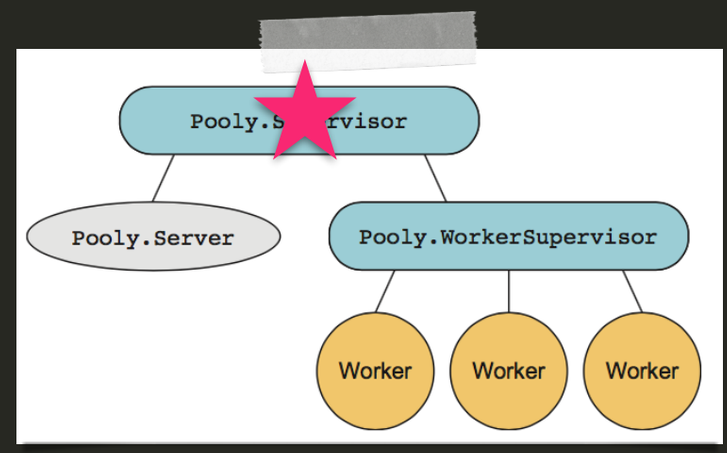
TOP-LEVEL SUPERVISOR

```
defmodule Pooly.Supervisor do
  use Supervisor

  def start_link(pool_config) do
    Supervisor.start_link(__MODULE__, pool_config)
  end

  def init(pool_config) do
    children = [
      worker(Pooly.Server, [self, pool_config])
    ]

    opts = [strategy: :one_for_all]

    supervise(children, opts)
  end
end
```



TOP-LEVEL SUPERVISOR

```elixir
defmodule Pooly.Supervisor do
  use Supervisor

  def start_link(pool_config) do
    Supervisor.start_link(__MODULE__, pool_config)
  end

  def init(pool_config) do
    children = [
      worker(Pooly.Server, [self, pool_config])
    ]

    opts = [strategy: :one_for_all]

    supervise(children, opts)
  end
end
```



VERSION 1

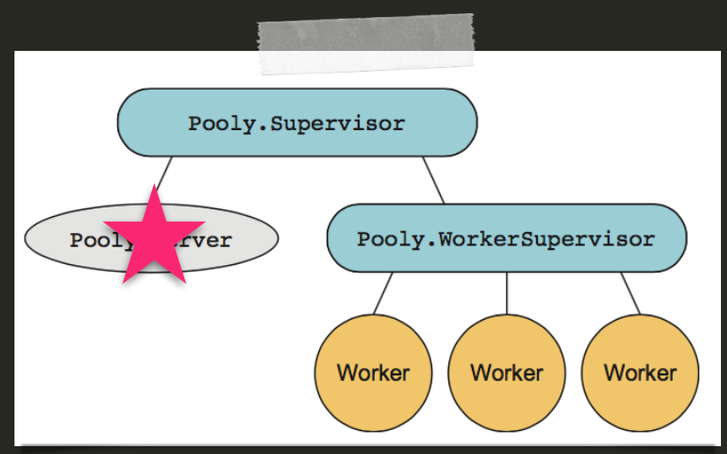
TYPE OF POOL	Single	Multiple
CREATION OF WORKERS	Fixed	Dynamic
CONSUMER RECOVERY	No	Yes
WORKER RECOVERY	No	Yes
QUEUEING FOR BUSY WORKERS	No	Yes

VERSION 2

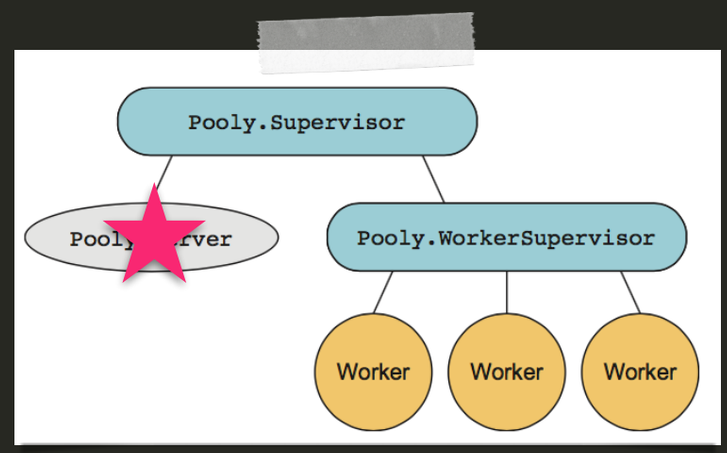
TYPE OF POOL	Single	Multiple
CREATION OF WORKERS	Fixed	Dynamic
CONSUMER RECOVERY	No	Yes
WORKER RECOVERY	No	Yes
QUEUEING FOR BUSY WORKERS	No	Yes

WHAT HAPPENS WHEN CONSUMER PROCESS DIES?

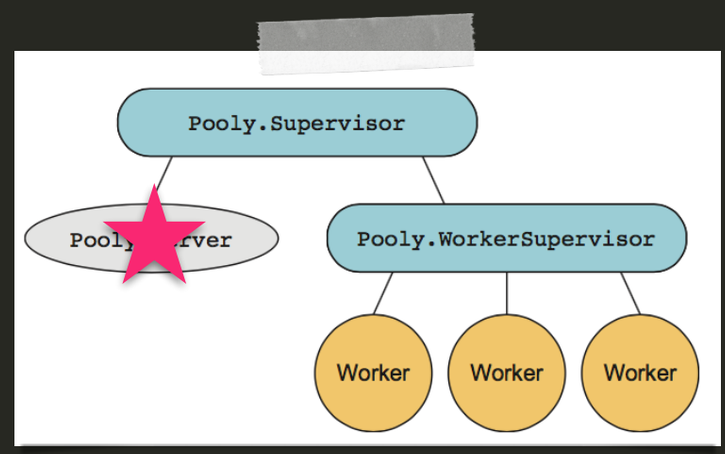
```elixir
defmodule Pooly.Server do
  def handle_info({:DOWN, ref, _, _, _}, state) do
    %{monitors: monitors, workers: workers} = state
    case :ets.match(monitors, {:"$1", ref}) do
      [[pid]] ->
        true = :ets.delete(monitors, pid)
        new_state = %{state | workers: [pid|workers]}
        {:noreply, new_state}
      [[]] ->
        {:noreply, state}
    end
  end
end
```



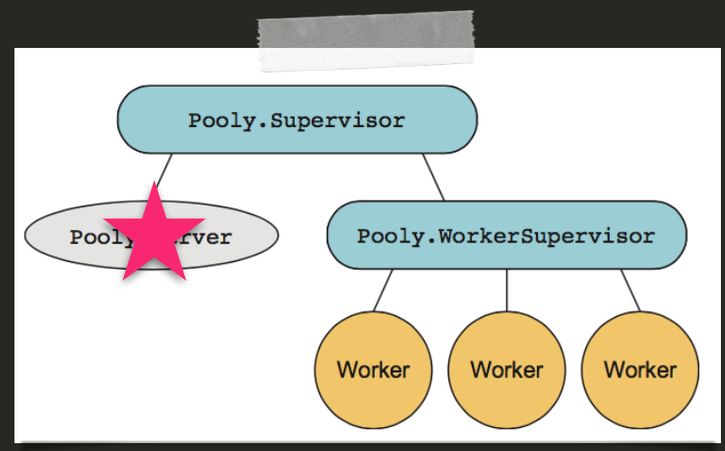
```elixir
defmodule Pooly.Server do
  def handle_info({:DOWN, ref, _, _, _}, state) do
    %{monitors: monitors, workers: workers} = state
    case :ets.match(monitors, {:"$1", ref}) do
      [[pid]] ->
        true = :ets.delete(monitors, pid)
        new_state = %{state | workers: [pid|workers]}
        {:noreply, new_state}
      [[]] ->
        {:noreply, state}
    end
  end
end
```



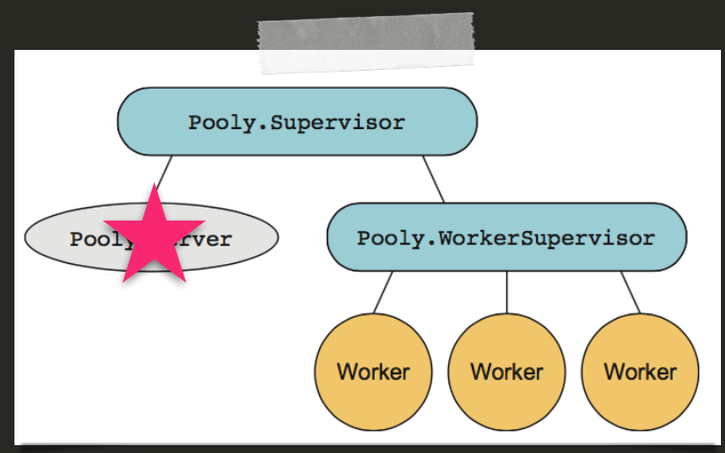
```elixir
defmodule Pooly.Server do
  def handle_info({:DOWN, ref, _, _, _}, state) do
    %{monitors: monitors, workers: workers} = state
    case :ets.match(monitors, {:"$1", ref}) do
      [[pid]] ->
        true = :ets.delete(monitors, pid)
        new_state = %{state | workers: [pid|workers]}
        {:noreply, new_state}
      [[]] ->
        {:noreply, state}
    end
  end
end
```



```elixir
defmodule Pooly.Server do
  def handle_info({:DOWN, ref, _, _, _}, state) do
    %{monitors: monitors, workers: workers} = state
    case :ets.match(monitors, {:"$1", ref}) do
      [[pid]] ->
        true = :ets.delete(monitors, pid)
        new_state = %{state | workers: [pid|workers]}
        {:noreply, new_state}

      [[]] ->
        {:noreply, state}
    end
  end
end
```

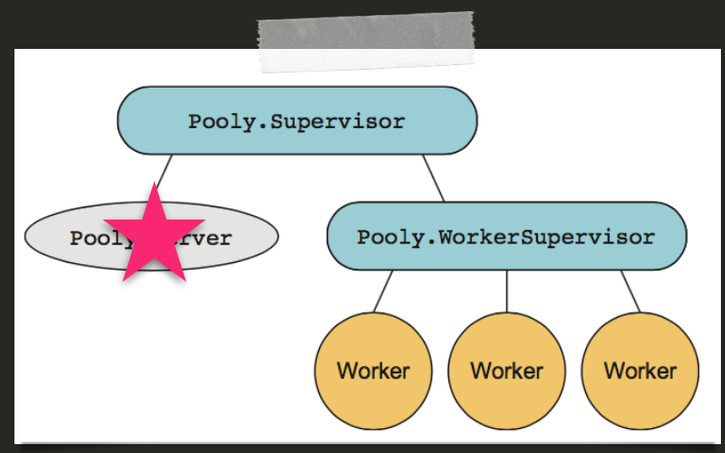


```elixir
defmodule Pooly.Server do
  def handle_info({:DOWN, ref, _, _, _}, state) do
    %{monitors: monitors, workers: workers} = state
    case :ets.match(monitors, {:"$1", ref}) do
      [[pid]] ->
        true = :ets.delete(monitors, pid)
        new_state = %{state | workers: [pid|workers]}
        {:noreply, new_state}
      [[]] ->
        {:noreply, state}
    end
  end
end
```

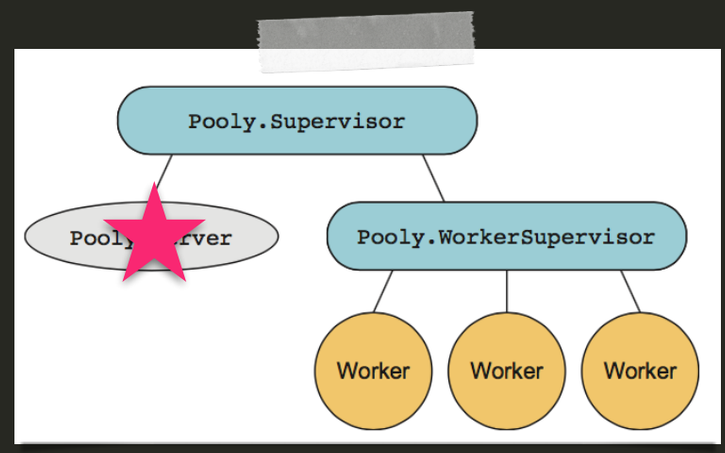


WHAT HAPPENS WHEN WORKER PROCESS DIES?

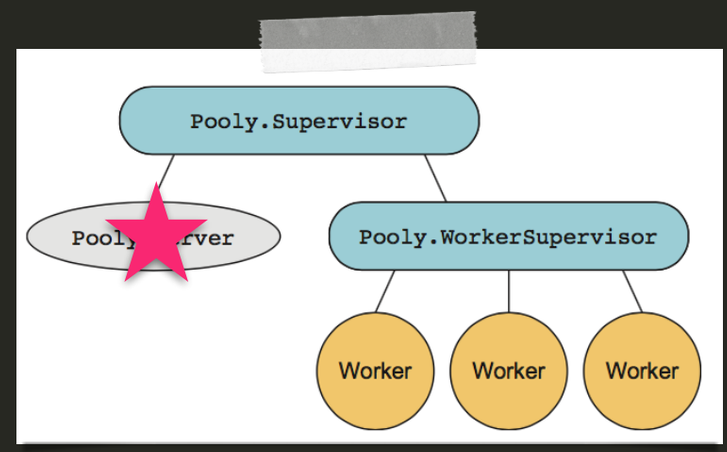
```elixir
defmodule Pooly.Server do
  def init([sup, pool_config]) when is_pid(sup) do
    Process.flag(:trap_exit, true)
    monitors = :ets.new(:monitors, [:private])
    init(pool_config, %State{sup: sup, monitors: monitors})
  end
end
```



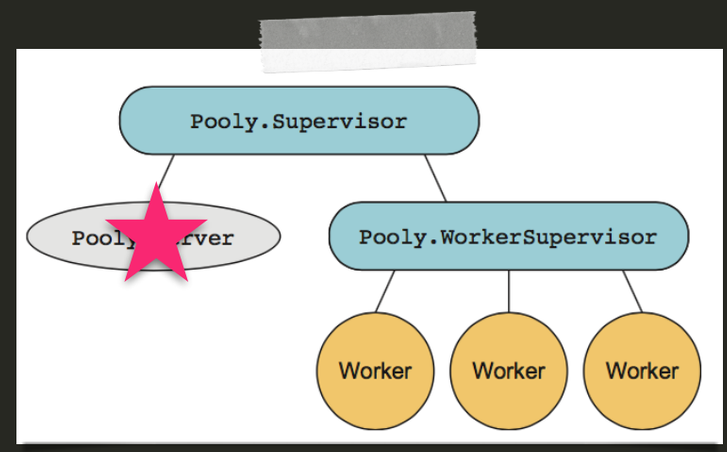
```elixir
defmodule Pooly.Server do
  def init([sup, pool_config]) when is_pid(sup) do
    Process.flag(:trap_exit, true)
    monitors = :ets.new(:monitors, [:private])
    init(pool_config, %State{sup: sup, monitors: monitors})
  end
end
```



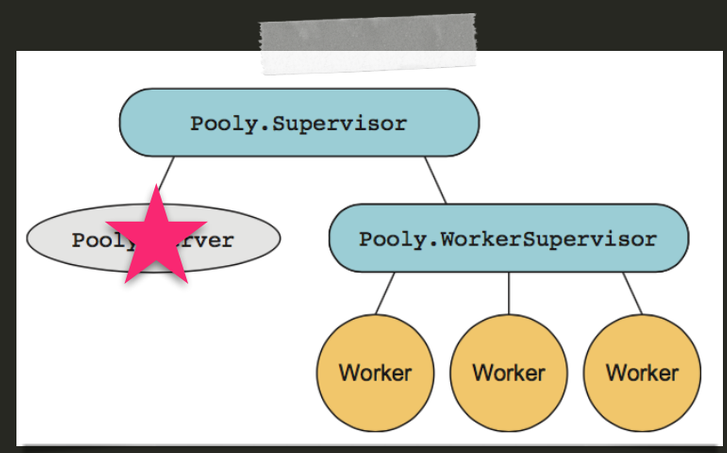
```elixir
def handle_info({:EXIT, pid, _reason}, state) do
  %{monitors: monitors,
    workers: workers,
    worker_sup: worker_sup} = state

  case :ets.lookup(monitors, pid) do
    [{pid, ref}] ->
      true = Process.demonitor(ref)
      true = :ets.delete(monitors, pid)
      new_state = %{state | workers: [new_worker(worker_sup)|workers]}
      {:noreply, new_state}

    [] ->
      {:noreply, state}
  end
end
```



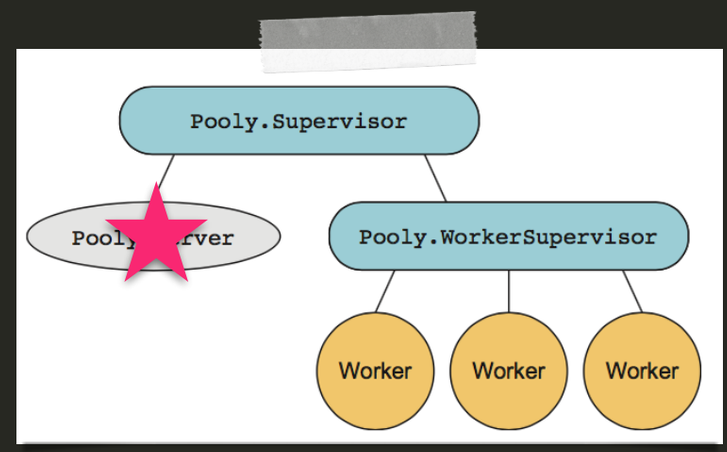
```elixir
def handle_info({:EXIT, pid, _reason}, state) do
  %{monitors: monitors,
    workers: workers,
    worker_sup: worker_sup} = state

  case :ets.lookup(monitors, pid) do
    [{pid, ref}] ->
      true = Process.demonitor(ref)
      true = :ets.delete(monitors, pid)
      new_state = %{state | workers: [new_worker(worker_sup)|workers]}
      {:noreply, new_state}

    [] ->
      {:noreply, state}
  end
end
```



```elixir
def handle_info({:EXIT, pid, _reason}, state) do
  %{monitors: monitors,
    workers: workers,
    worker_sup: worker_sup} = state

  case :ets.lookup(monitors, pid) do
    [{pid, ref}] ->
      true = Process.demonitor(ref)
      true = :ets.delete(monitors, pid)
      new_state = %{state | workers: [new_worker(worker_sup)|workers]}
      {:noreply, new_state}

    [] ->
      {:noreply, state}
  end
end
```



```elixir
def handle_info({:EXIT, pid, _reason}, state) do
  %{monitors: monitors,
    workers: workers,
    worker_sup: worker_sup} = state

  case :ets.lookup(monitors, pid) do
    [{pid, ref}] ->
      true = Process.demonitor(ref)
      true = :ets.delete(monitors, pid)
      new_state = %{state | workers: [new_worker(worker_sup)|workers]}
      {:noreply, new_state}

    [] ->
      {:noreply, state}
  end
end
```




ERROR
RECOVERY
FTW!!!
4GIFs.com

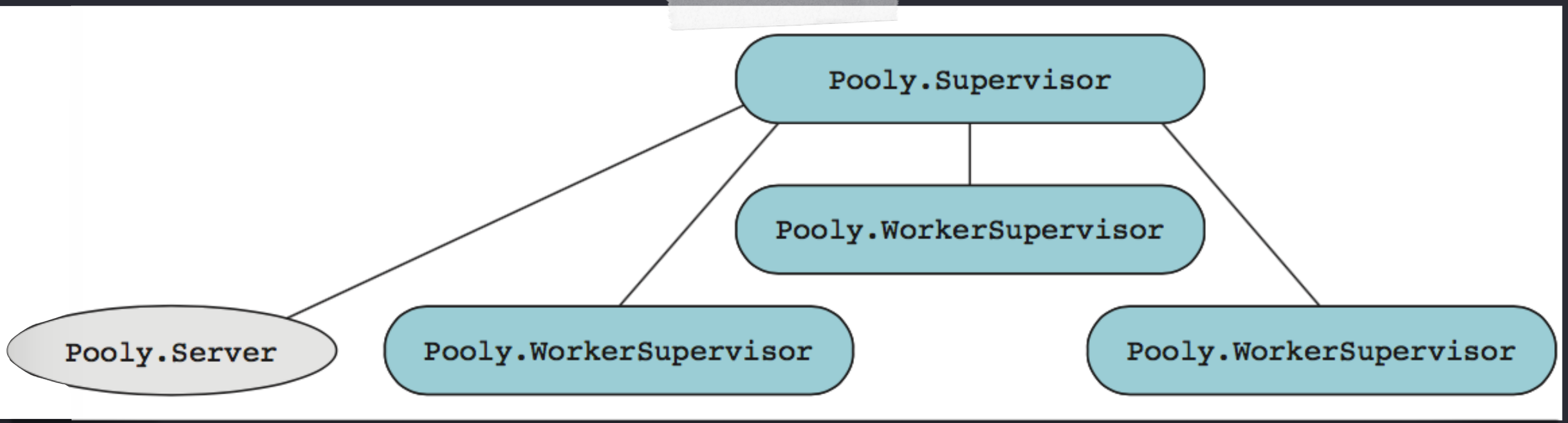
VERSION 2

TYPE OF POOL	Single	Multiple
CREATION OF WORKERS	Fixed	Dynamic
CONSUMER RECOVERY	No	Yes
WORKER RECOVERY	No	Yes
QUEUEING FOR BUSY WORKERS	No	Yes

VERSION 3

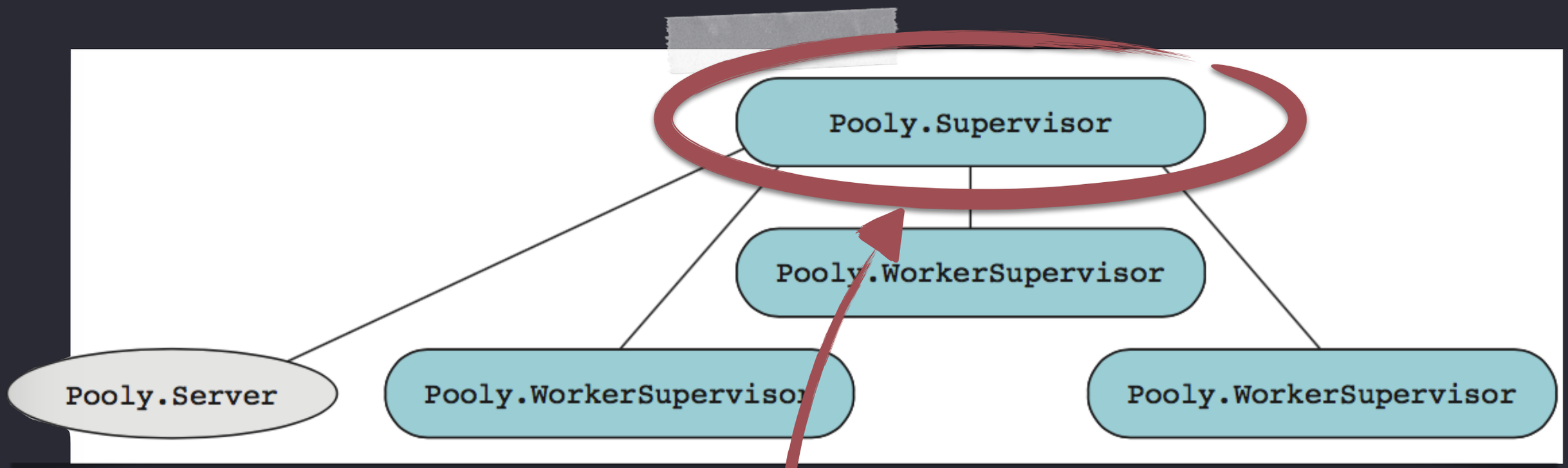
TYPE OF POOL	Single	Multiple
CREATION OF WORKERS	Fixed	Dynamic
CONSUMER RECOVERY	No	Yes
WORKER RECOVERY	No	Yes
QUEUEING FOR BUSY WORKERS	No	Yes

ATTEMPT #1



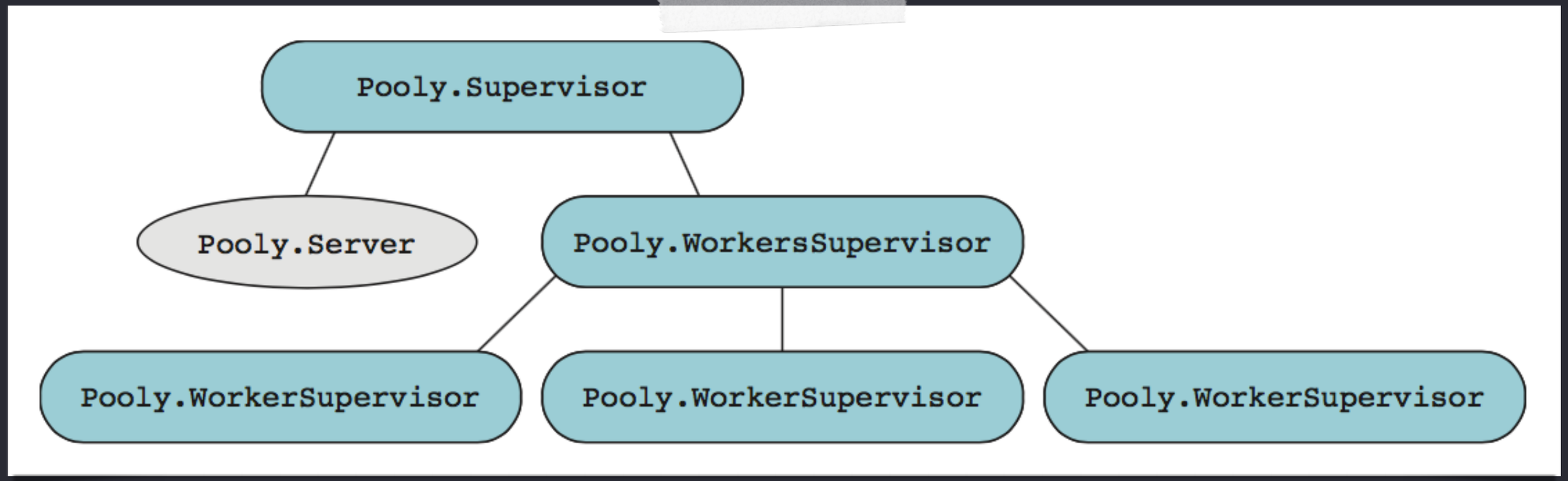
WHAT'S WRONG WITH THIS?

ATTEMPT #1



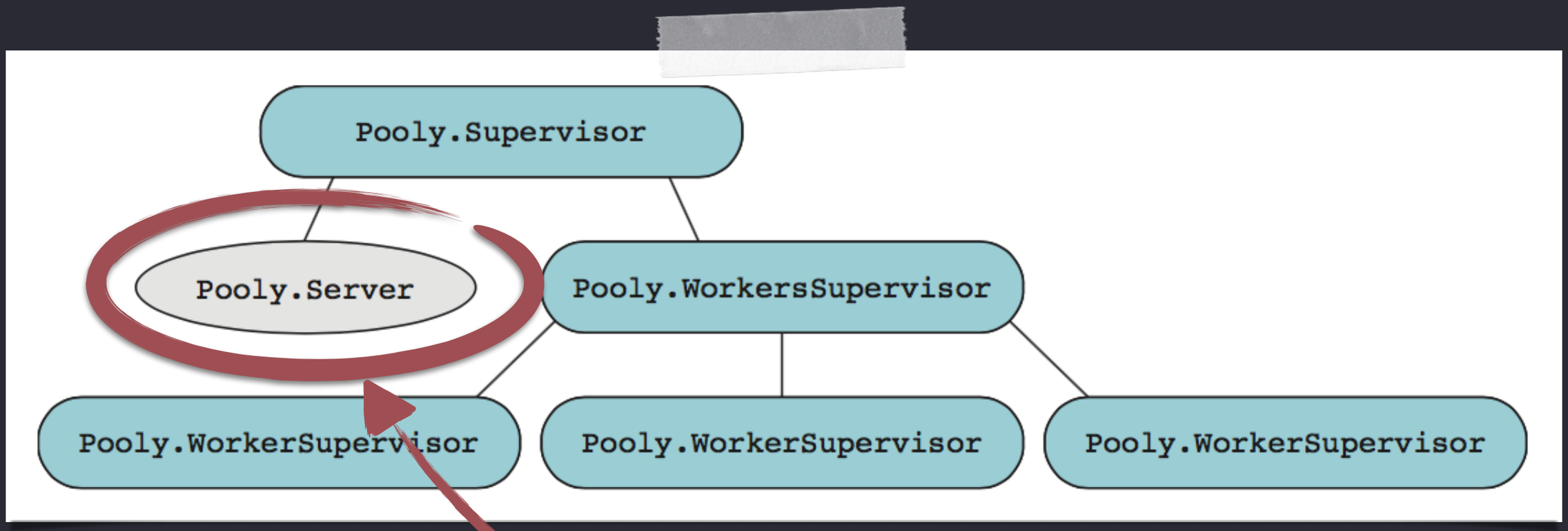
THIS.

ATTEMPT #2



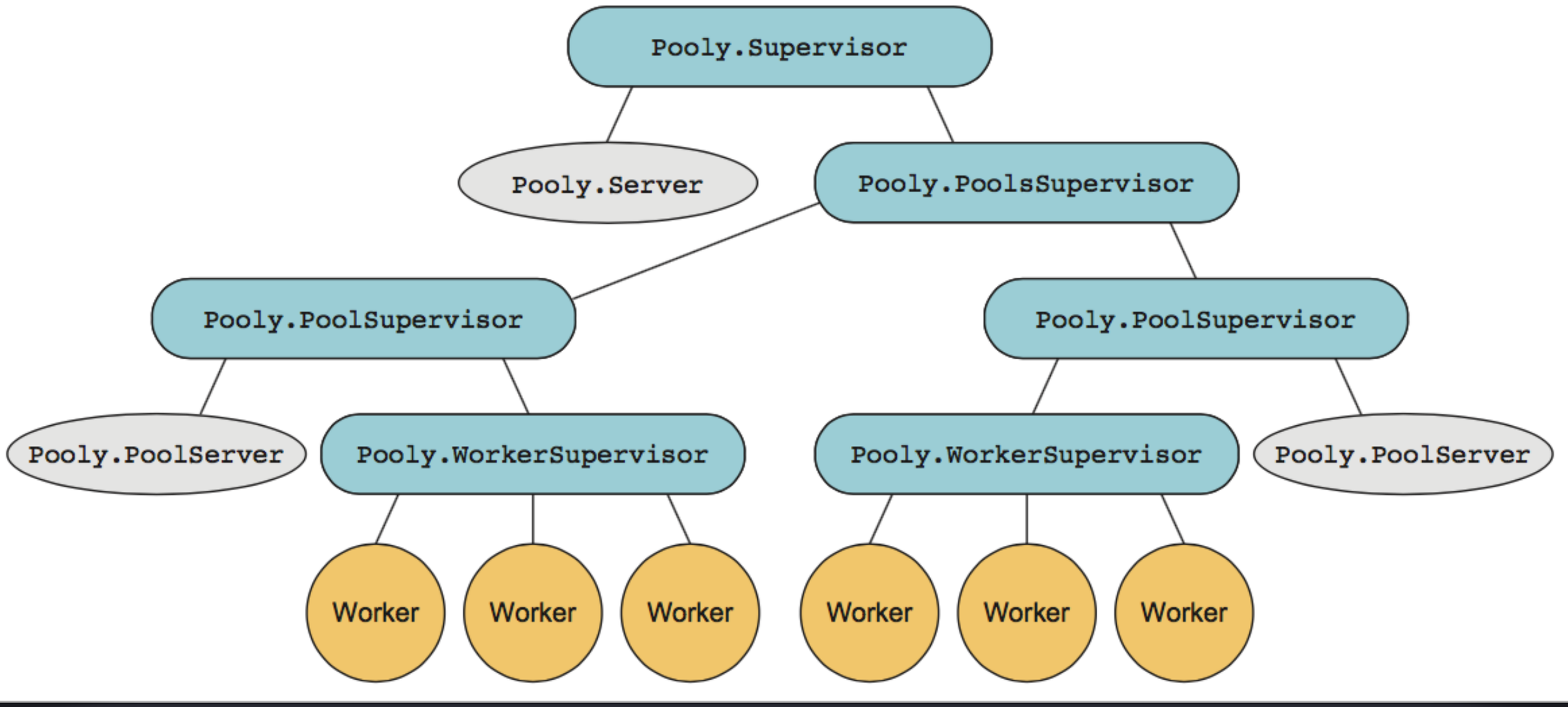
WHAT'S WRONG WITH THIS?

ATTEMPT #2



THIS.

ATTEMPT #3

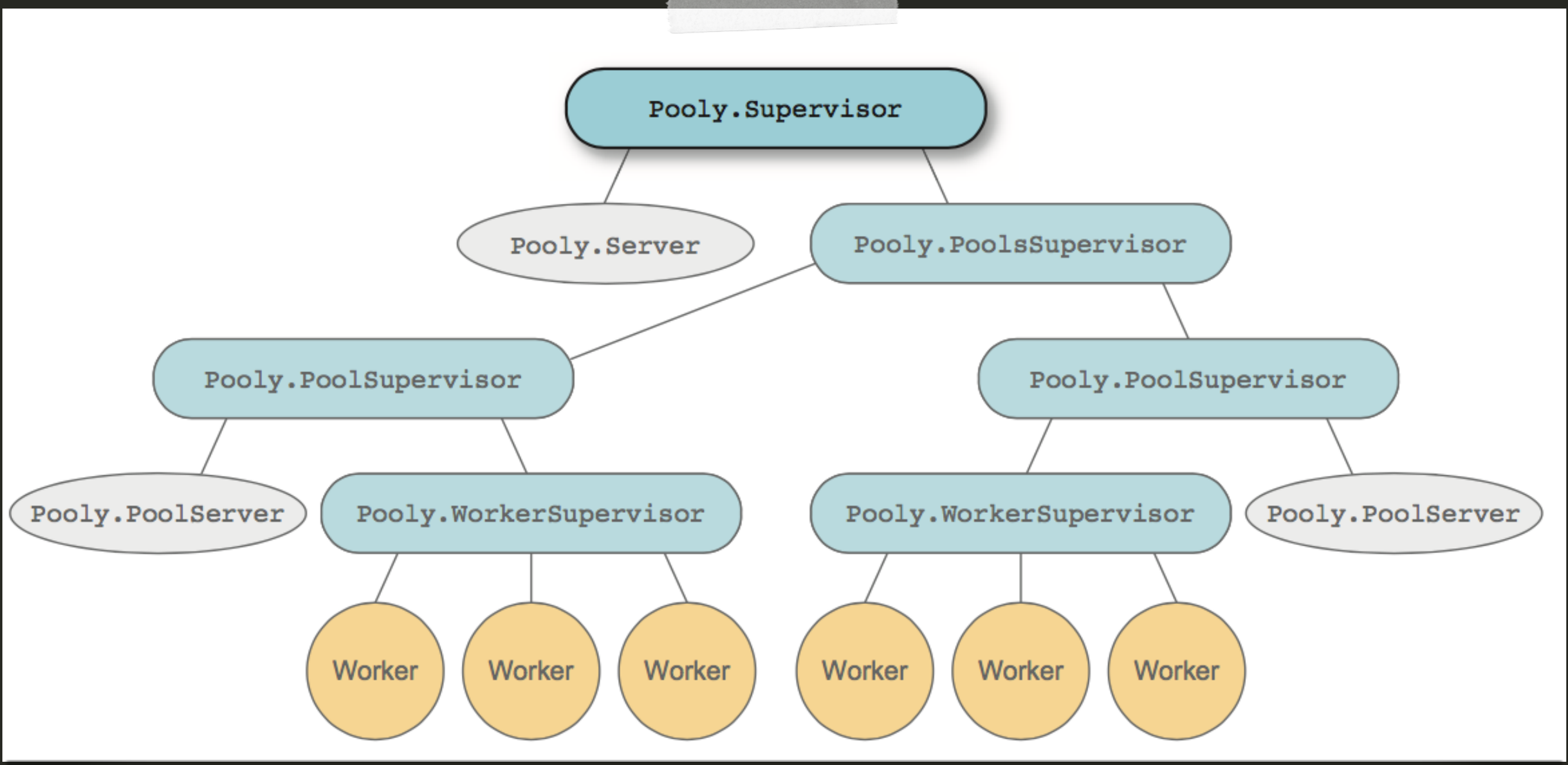

Pooly.Supervisor
Pooly.Server
Pooly.PoolsSupervisor
Pooly.PoolSupervisor
Pooly.PoolSupervisor
Pooly.PoolServer
Pooly.WorkerSupervisor
Pooly.WorkerSupervisor
Pooly.PoolServer
Worker
Worker
Worker
Worker
Worker
Worker

EACH POOL

GETS A NAME

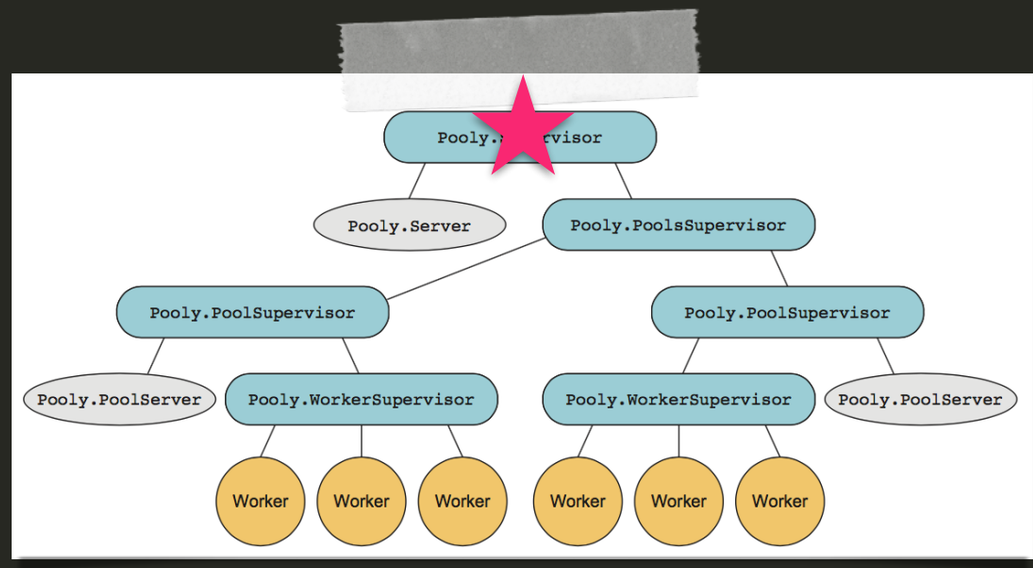
```elixir
defmodule Pooly do
  use Application

  def start(_type, _args) do
    pools_config =
      [
        [name: "Pool1",
          mfa: {SampleWorker, :start_link, []}, size: 2],
        [name: "Pool2",
          mfa: {SampleWorker, :start_link, []}, size: 3],
        [name: "Pool3",
          mfa: {SampleWorker, :start_link, []}, size: 4],
      ]

    start_pools(pools_config)
  end
end
```

ADDING THE TOP MOST TOP LEVEL SUPERVISOR



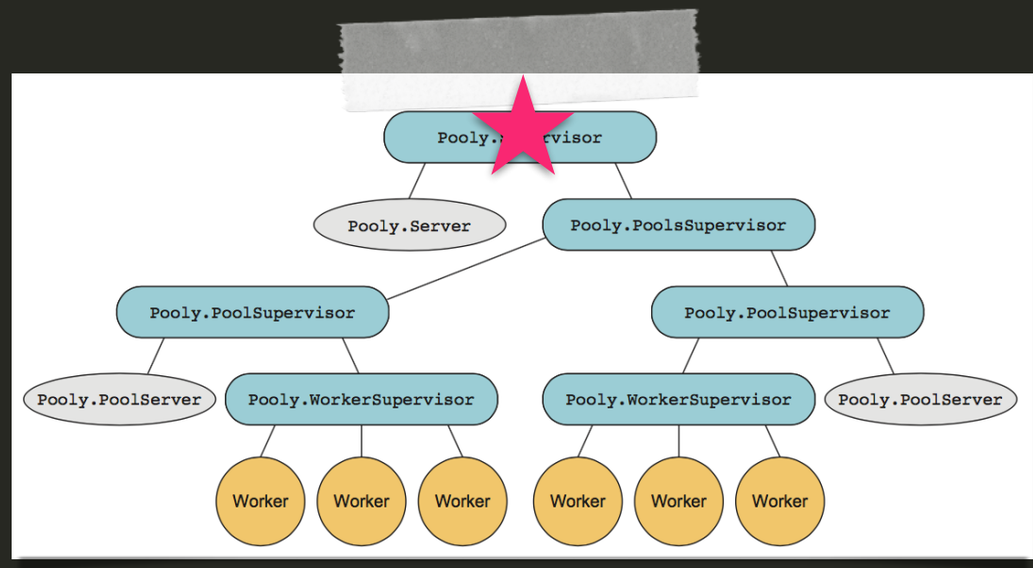
ADDING THE TOP LEVEL SUPERVISOR

```elixir
defmodule Pooly.Supervisor do
  use Supervisor

  def start_link(pools_config) do
    Supervisor.start_link(__MODULE__, pools_config, name: __MODULE__)
  end

  def init(pools_config) do
    children = [
      supervisor(Pooly.PoolsSupervisor, []),
      worker(Pooly.Server, [pools_config])
    ]
    opts = [strategy: :one_for_all]
    supervise(children, opts)
  end
end
```



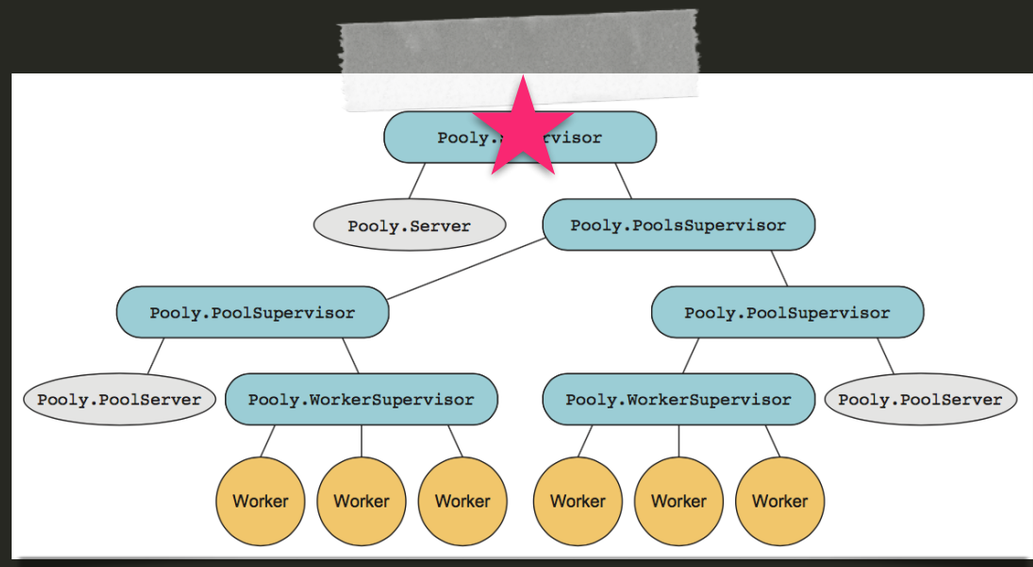
ADDING THE TOP LEVEL SUPERVISOR

```elixir
defmodule Pooly.Supervisor do
  use Supervisor

  def start_link(pools_config) do
    Supervisor.start_link(__MODULE__, pools_config, name: __MODULE__)
  end

  def init(pools_config) do
    children = [
      supervisor(Pooly.PoolsSupervisor, []),
      worker(Pooly.Server, [pools_config])
    ]
    opts = [strategy: :one_for_all]
    supervise(children, opts)
  end
end
```



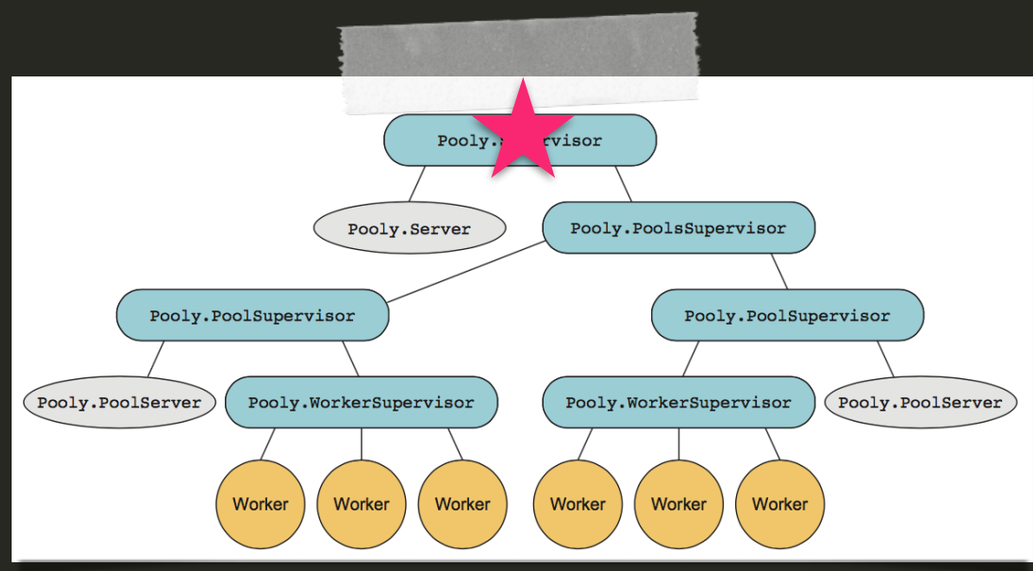
ADDING THE TOP LEVEL SUPERVISOR

```
defmodule Pooly.Supervisor do
  use Supervisor

  def start_link(pools_config) do
    Supervisor.start_link(__MODULE__, pools_config, name: __MODULE__)
  end

  def init(pools_config) do
    children = [
      supervisor(Pooly.PoolsSupervisor, []),
      worker(Pooly.Server, [pools_config])
    ]
    opts = [strategy: :one_for_all]
    supervise(children, opts)
  end
end
```

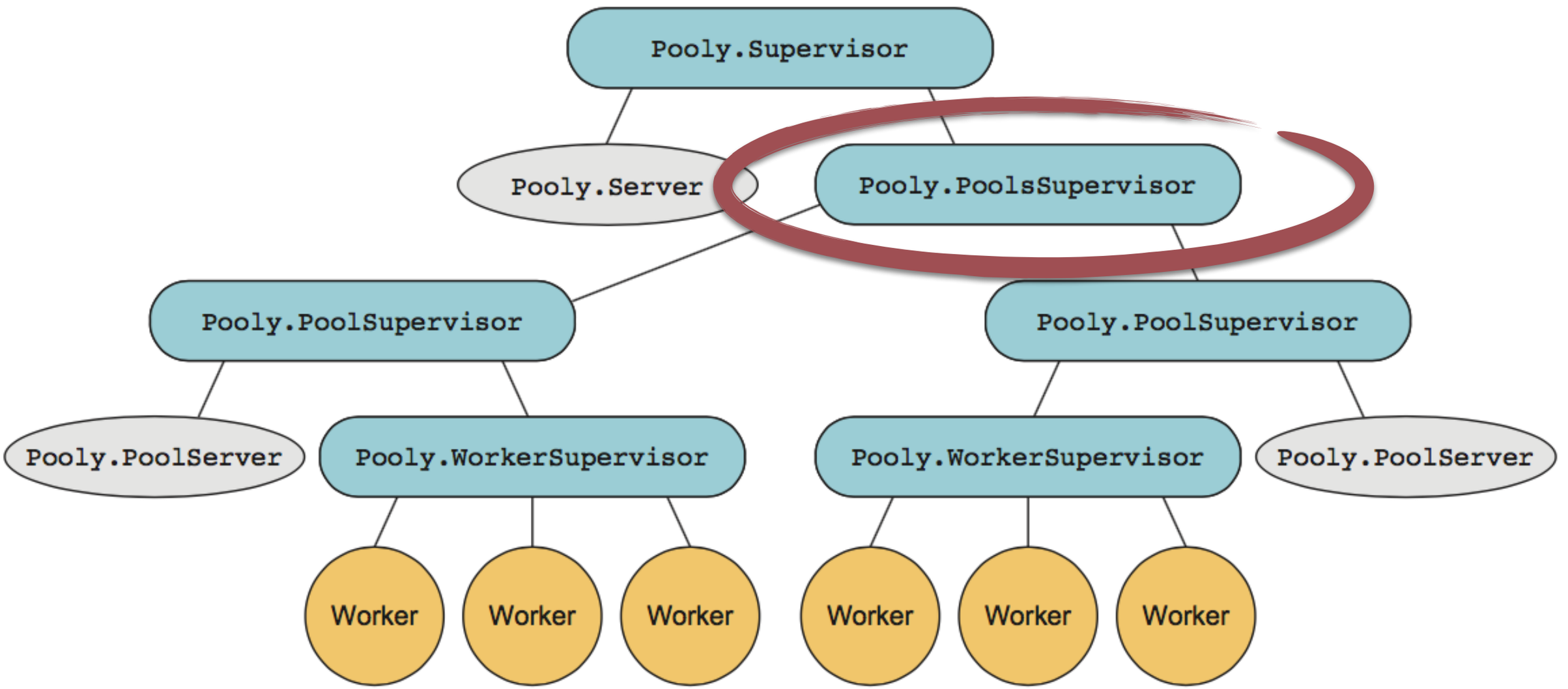


ADDING THE TOP LEVEL SUPERVISOR

```
defmodule Pooly.Supervisor do
  use Supervisor

  def start_link(pools_config) do
    Supervisor.start_link(__MODULE__, pools_config, name: __MODULE__)
  end

  def init(pools_config) do
    children = [
      supervisor(Pooly.PoolsSupervisor, []),
      worker(Pooly.Server, [pools_config])
    ]
    opts = [strategy: :one_for_all]
    supervise(children, opts)
  end
end
```

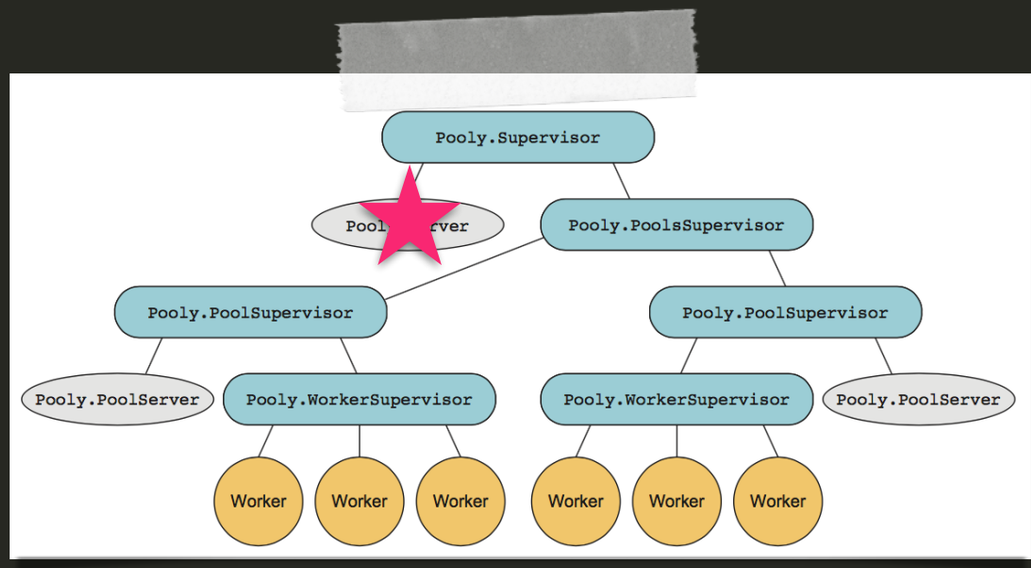


ADDING THE POOLS SUPERVISOR



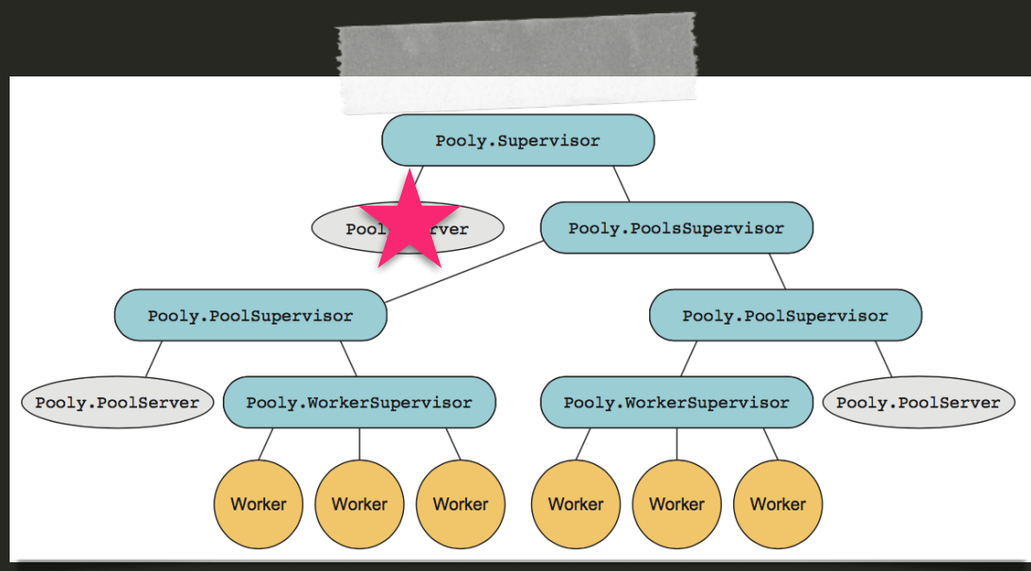
ADDING THE POOLS SUPERVISOR

```elixir
defmodule Pooly.PoolsSupervisor do
  use Supervisor

  def start_link do
    Supervisor.start_link(__MODULE__, [], name: __MODULE__)
  end

  def init(_) do
    opts = [strategy: :one_for_one]

    supervise([], opts)
  end
end
```



ADDING THE POOLS SUPERVISOR

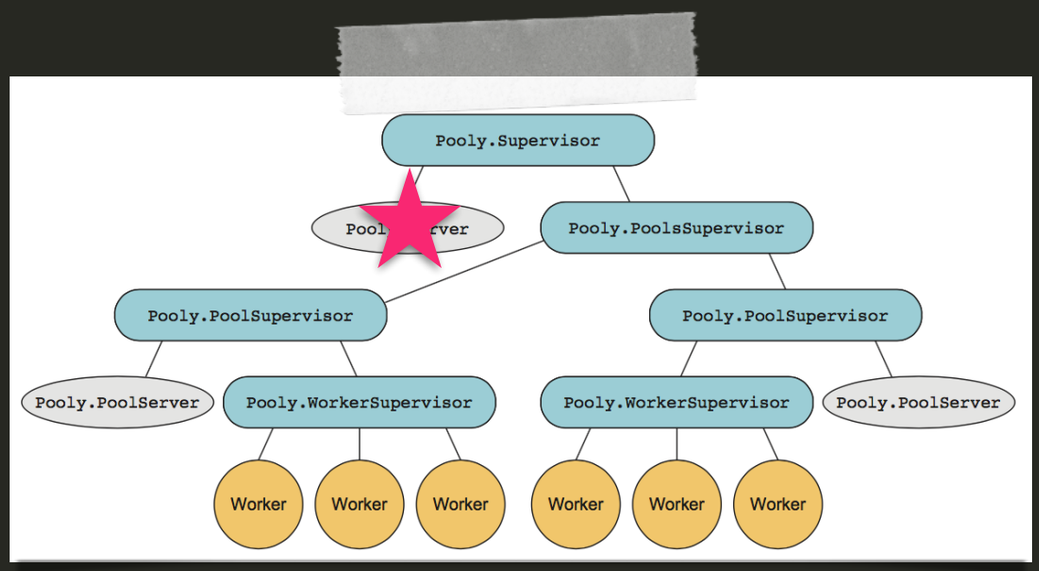
```elixir
defmodule Pooly.PoolsSupervisor do
  use Supervisor

  def start_link do
    Supervisor.start_link(__MODULE__, [], name: __MODULE__)
  end

  def init(_) do
    opts = [strategy: :one_for_one]

    supervise([], opts)
  end
end
```



ADDING THE POOLS SUPERVISOR

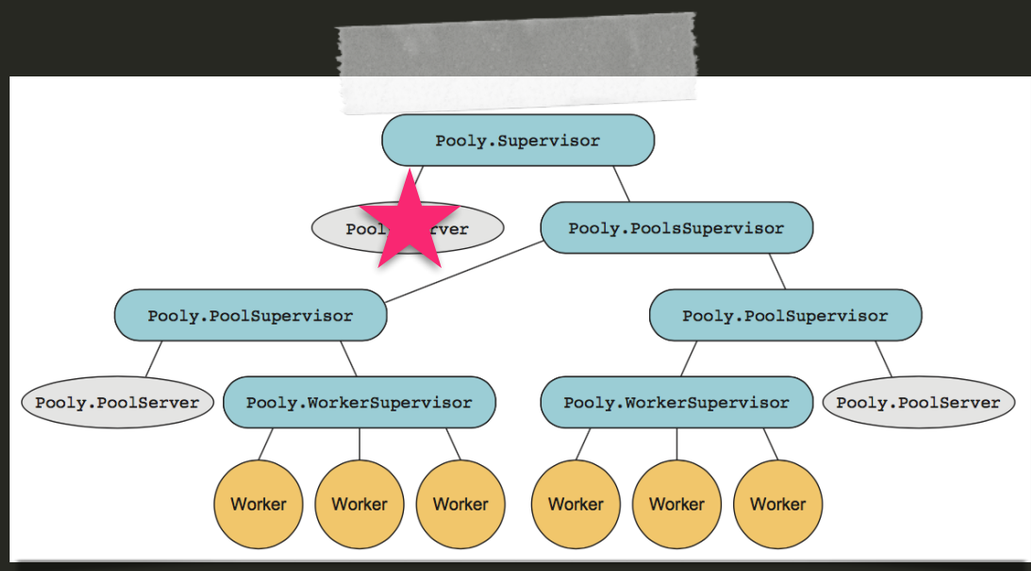
```elixir
defmodule Pooly.PoolsSupervisor do
  use Supervisor

  def start_link do
    Supervisor.start_link(__MODULE__, [], name: __MODULE__)
  end

  def init(_) do
    opts = [strategy: :one_for_one]

    supervise([], opts)
  end
end
```

Empty child spec!

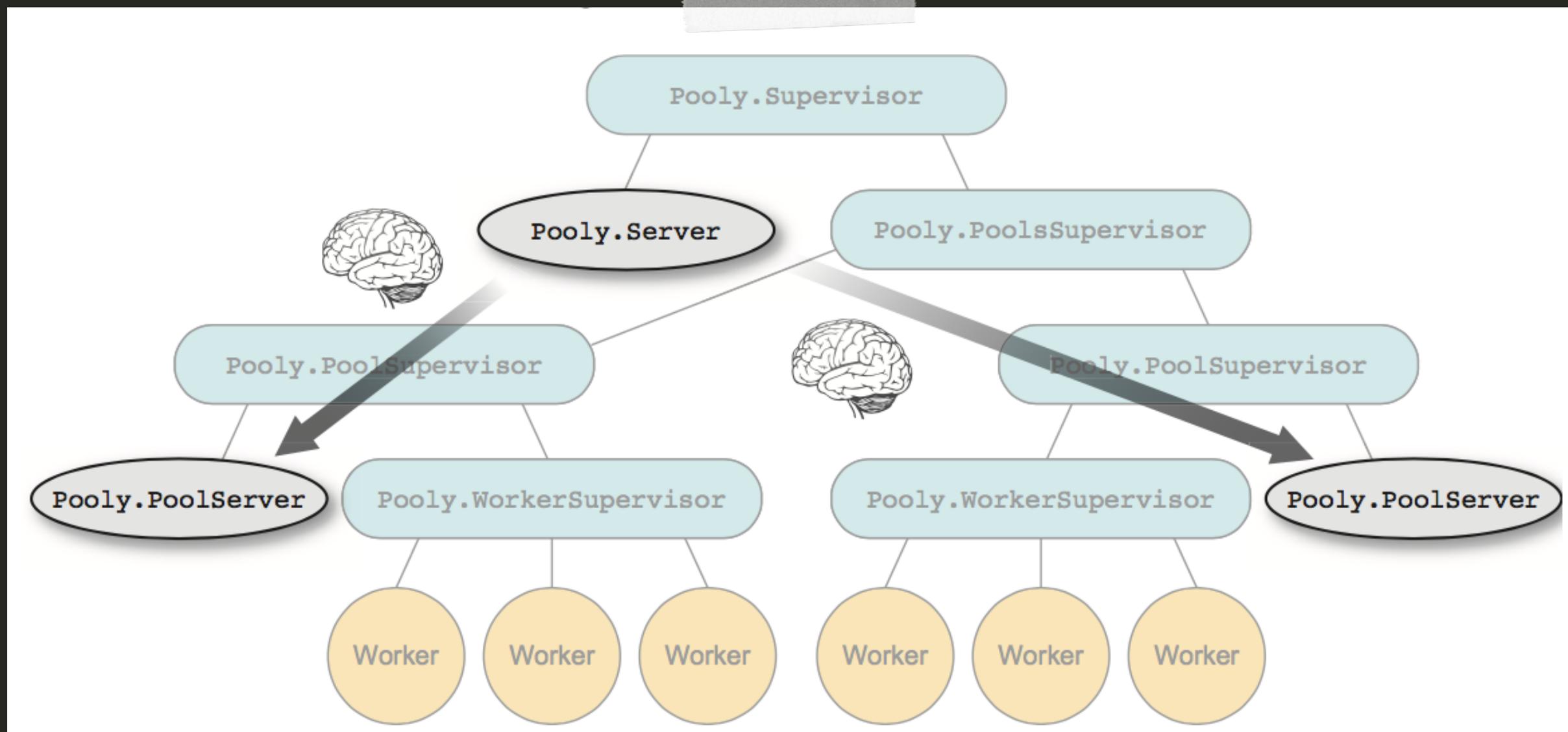


ADDING THE POOLS SUPERVISOR

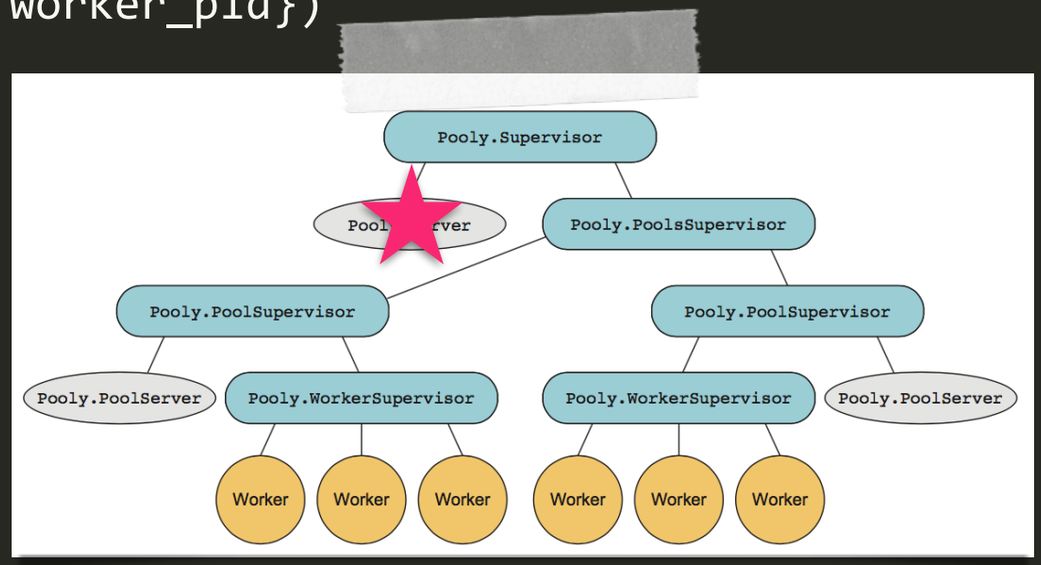
```elixir
defmodule Pooly.PoolsSupervisor do
  use Supervisor

  def start_link do
    Supervisor.start_link(__MODULE__, [], name: __MODULE__)
  end

  def init(_) do
    opts = [strategy: :one_for_one]

    supervise([], opts)
  end
end
```



MAKING Pooly.Server DUMBER



```elixir
defmodule Pooly.Server do
  use GenServer
  import Supervisor.Spec

  def start_link(pools_config) do
    GenServer.start_link(__MODULE__, pools_config, name: __MODULE__)
  end

  def checkout(pool_name) do
    GenServer.call(:"#{pool_name}Server", :checkout)
  end

  def checkin(pool_name, worker_pid) do
    GenServer.cast(:"#{pool_name}Server", {:checkin, worker_pid})
  end

  def init(pools_config) do
    pools_config |> Enum.each(fn(pool_config) ->
      send(self, {:start_pool, pool_config})
    end)

    {:ok, pools_config}
  end

  def handle_info({:start_pool, pool_config}, state) do
    {:ok, _pool_sup} = Supervisor.start_child(Pooly.PoolsSupervisor,
                                              supervisor_spec(pool_config))
    {:noreply, state}
  end

  defp supervisor_spec(pool_config) do
    opts = [id: :"#{pool_config[:name]}Supervisor"]
    supervisor(Pooly.PoolSupervisor, [pool_config], opts)
  end
end
```



```elixir
defmodule Pooly.Server do
  use GenServer
  import Supervisor.Spec

  def start_link(pools_config) do
    GenServer.start_link(__MODULE__, pools_config, name: __MODULE__)
  end

  def checkout(pool_name) do
    GenServer.call(:"#{pool_name}Server", :checkout)
  end

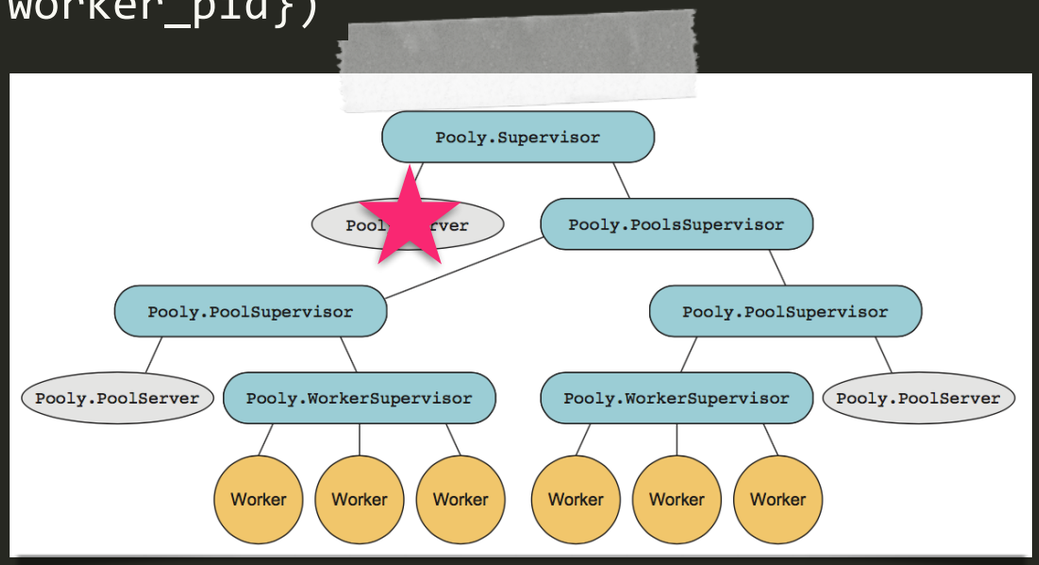
  def checkin(pool_name, worker_pid) do
    GenServer.cast(:"#{pool_name}Server", {:checkin, worker_pid})
  end

  def init(pools_config) do
    pools_config |> Enum.each(fn(pool_config) ->
      send(self, {:start_pool, pool_config})
    end)

    {:ok, pools_config}
  end

  def handle_info({:start_pool, pool_config}, state) do
    {:ok, _pool_sup} = Supervisor.start_child(Pooly.PoolsSupervisor,
                                              supervisor_spec(pool_config))
    {:noreply, state}
  end

  defp supervisor_spec(pool_config) do
    opts = [id: :"#{pool_config[:name]}Supervisor"]
    supervisor(Pooly.PoolSupervisor, [pool_config], opts)
  end
end
```



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  def start_link(pools_config) do
    GenServer.start_link(__MODULE__, pools_config, name: __MODULE__)
  end

  def checkout(pool_name) do
    GenServer.call(:"#{pool_name}Server", :checkout)
  end

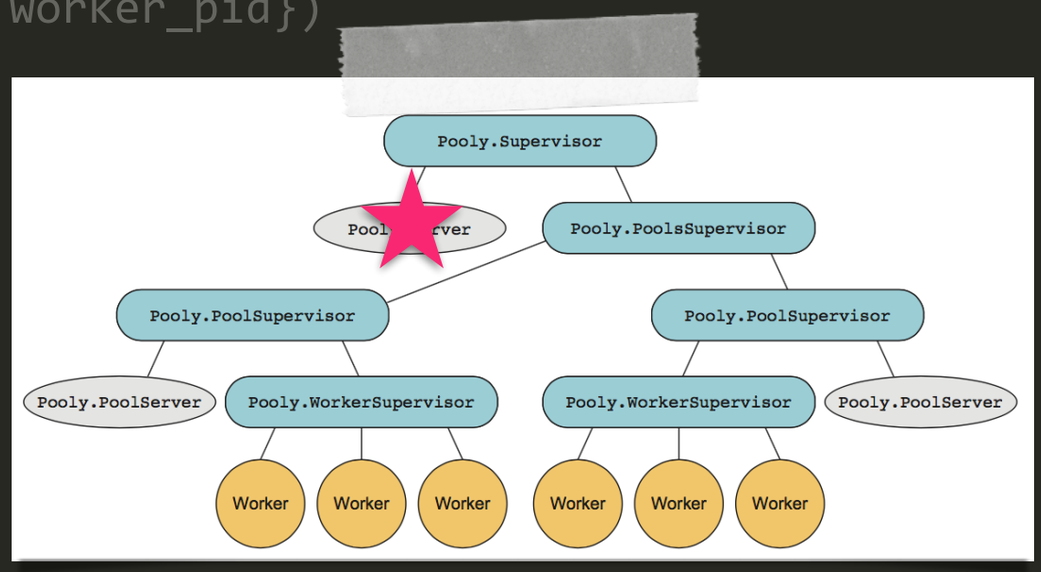
  def checkin(pool_name, worker_pid) do
    GenServer.cast(:"#{pool_name}Server", {:checkin, worker_pid})
  end

  def init(pools_config) do
    pools_config |> Enum.each(fn(pool_config) ->
      send(self, {:start_pool, pool_config})
    end)

    {:ok, pools_config}
  end

  def handle_info({:start_pool, pool_config}, state) do
    {:ok, _pool_sup} = Supervisor.start_child(Pooly.PoolsSupervisor,
                                              supervisor_spec(pool_config))
    {:noreply, state}
  end

  defp supervisor_spec(pool_config) do
    opts = [id: :"#{pool_config[:name]}Supervisor"]
    supervisor(Pooly.PoolSupervisor, [pool_config], opts)
  end
end
```



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  def start_link(pools_config) do
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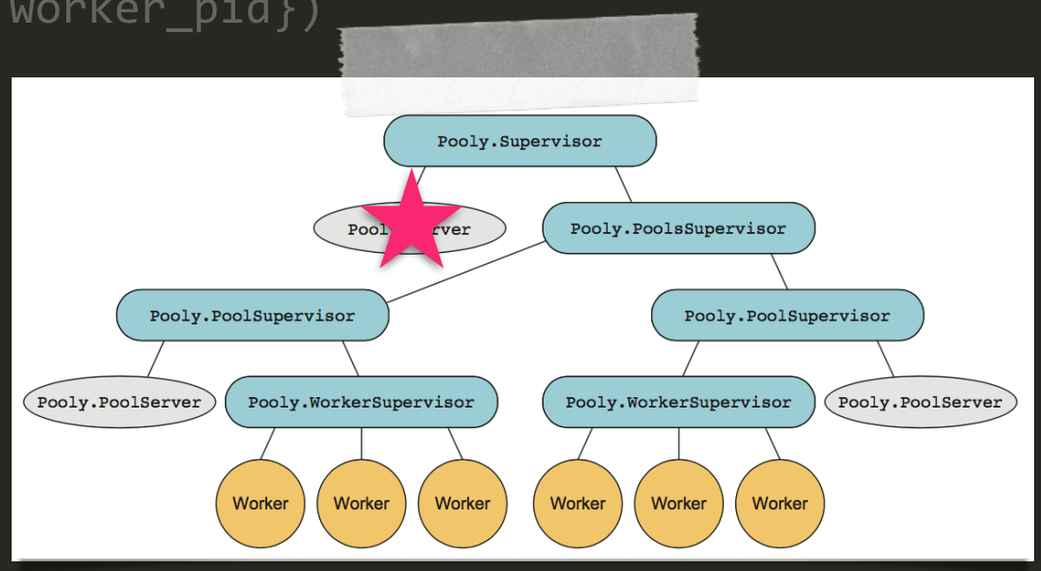
  end

  def init(pools_config) do
    pools_config |> Enum.each(fn(pool_config) ->
      send(self, {:start_pool, pool_config})
    end)

    {:ok, pools_config}
  end

  def handle_info({:start_pool, pool_config}, state) do
    {:ok, _pool_sup} = Supervisor.start_child(Pooly.PoolsSupervisor,
                                              supervisor_spec(pool_config))
    {:noreply, state}
  end

  defp supervisor_spec(pool_config) do
    opts = [id: :"#{pool_config[:name]}Supervisor"]
    supervisor(Pooly.PoolSupervisor, [pool_config], opts)
  end
end
```



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  def start_link(pools_config) do
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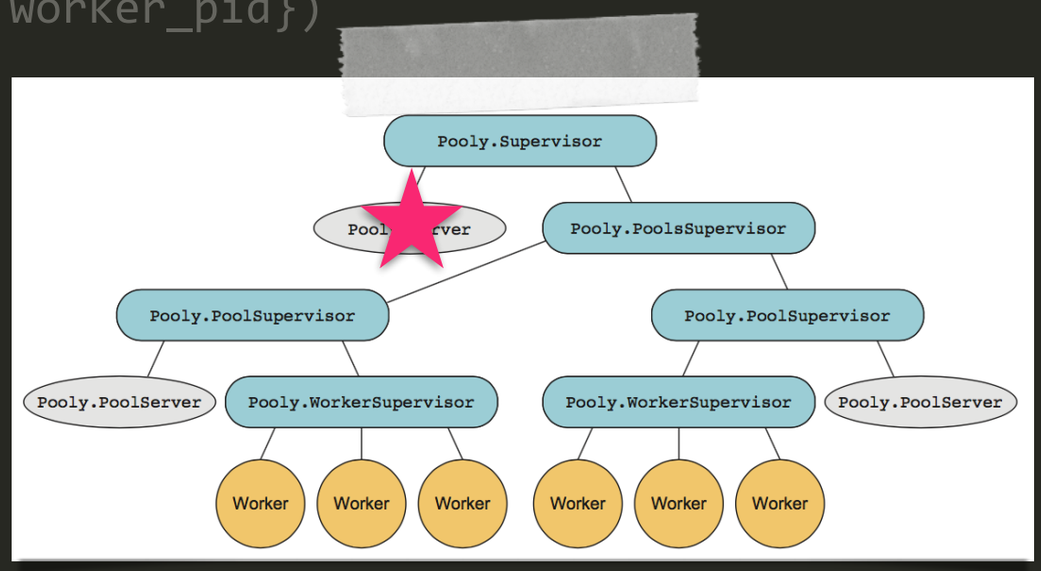
    GenServer.cast(:"#{pool_name}Server", {:checkin, worker_pid})
  end

  def init(pools_config) do
    pools_config |> Enum.each(fn(pool_config) ->
      send(self, {:start_pool, pool_config})
    end)

    {:ok, pools_config}
  end

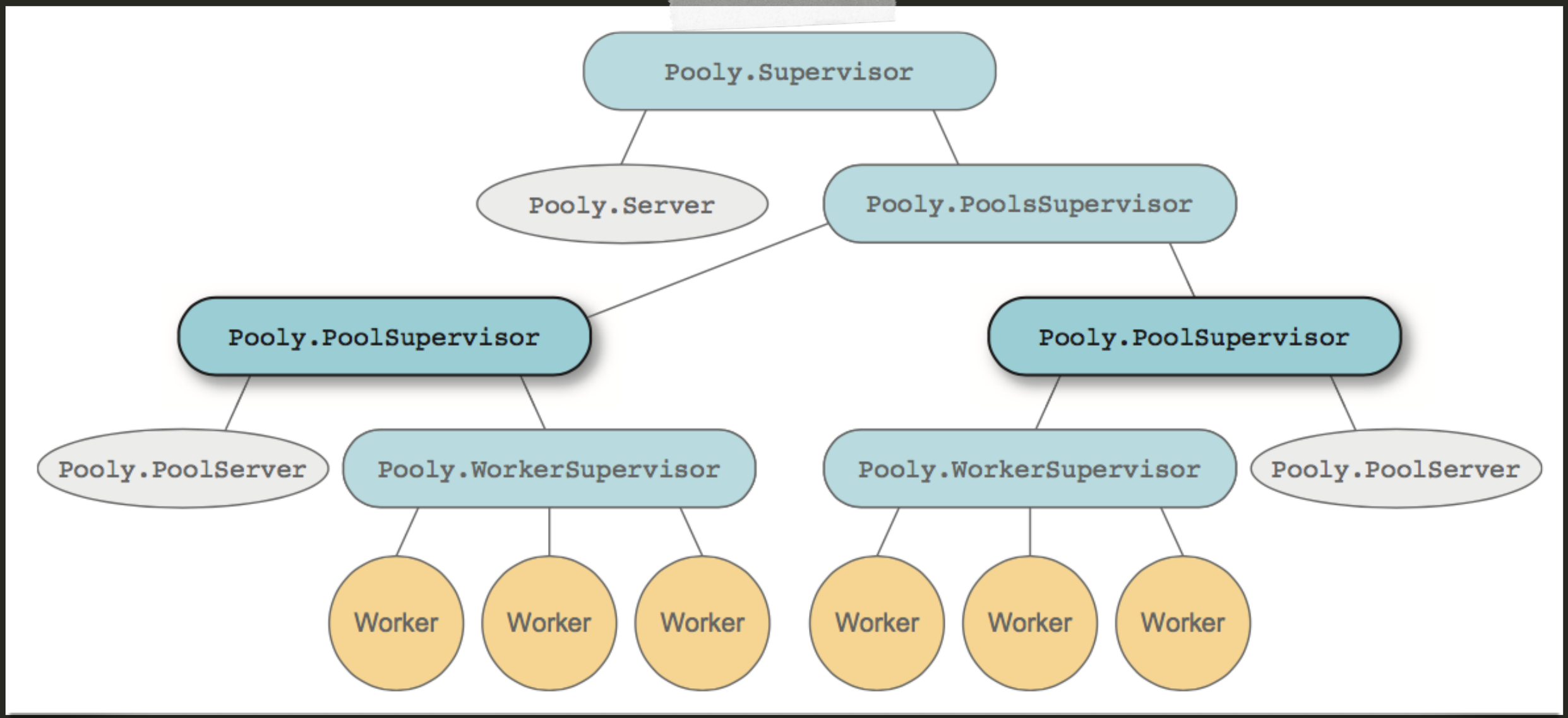
  def handle_info({:start_pool, pool_config}, state) do
    {:ok, _pool_sup} = Supervisor.start_child(Pooly.PoolsSupervisor,
                                              supervisor_spec(pool_config))
    {:noreply, state}
  end

  defp supervisor_spec(pool_config) do
    opts = [id: :"#{pool_config[:name]}Supervisor"]
    supervisor(Pooly.PoolSupervisor, [pool_config], opts)
  end
end
```



Unique spec ID!

ADDING THE POOL SUPERVISOR

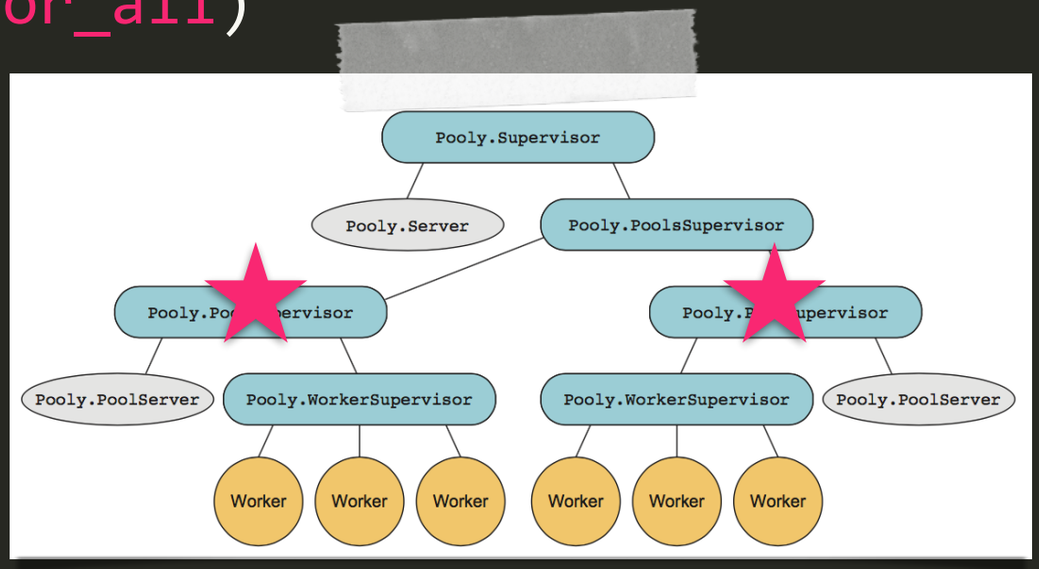


```elixir
defmodule Pooly.PoolSupervisor do
  use Supervisor

  def start_link(pool_config) do
    Supervisor.start_link(__MODULE__, pool_config,
                          name: :"#{pool_config[:name]}Supervisor")
  end

  def init(pool_config) do
    children = [
      worker(Pooly.PoolServer, [self, pool_config])
    ]

    supervise(children, strategy: :one_for_all)
  end
end
```



```elixir
defmodule Pooly.PoolSupervisor do
  use Supervisor

  def start_link(pool_config) do
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                          name: :"#{pool_config[:name]}Supervisor")
  end

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      worker(Pooly.PoolServer, [self, pool_config])
    ]

    supervise(children, strategy: :one_for_all)
  end
end
```
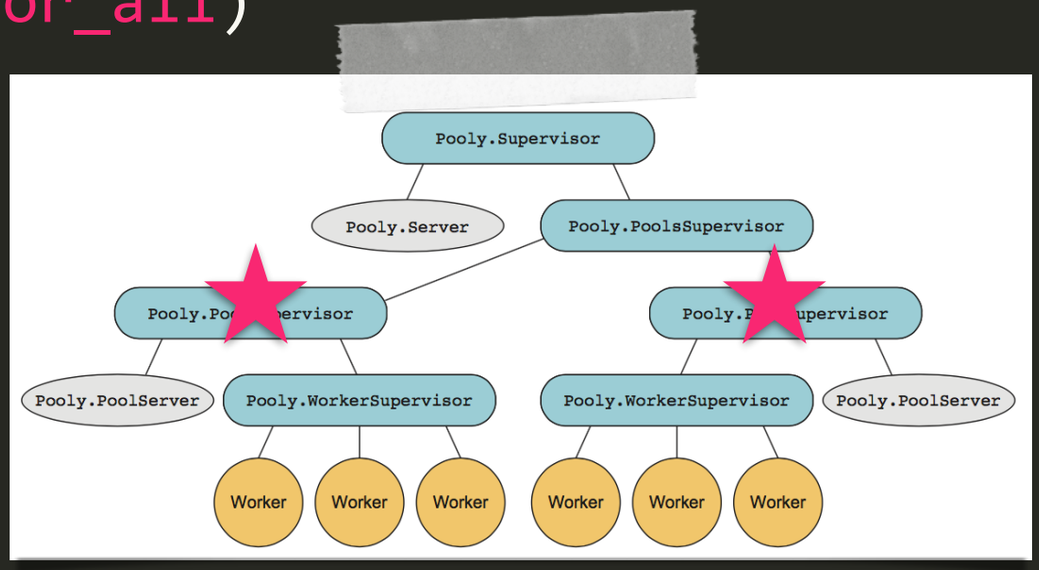
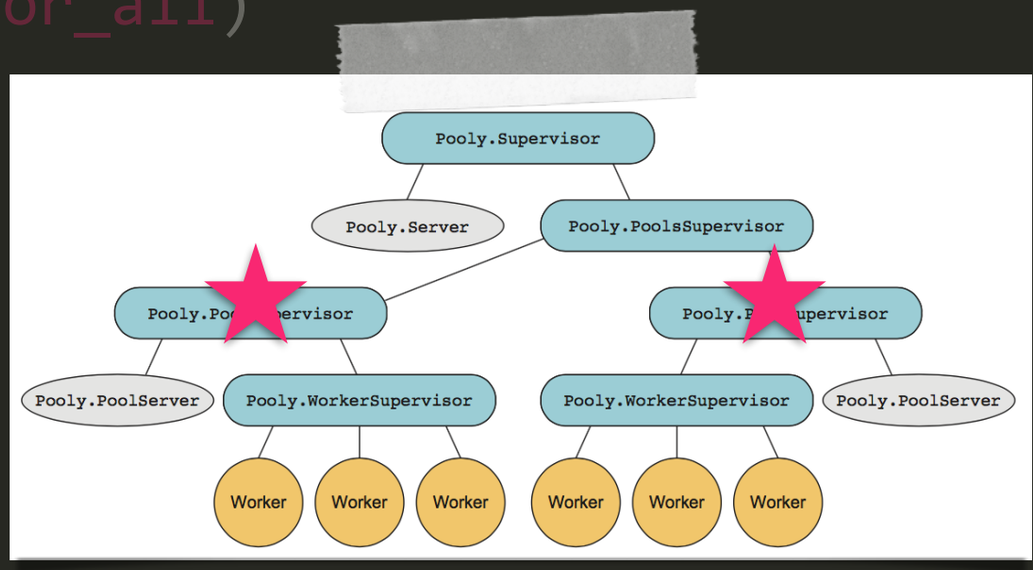
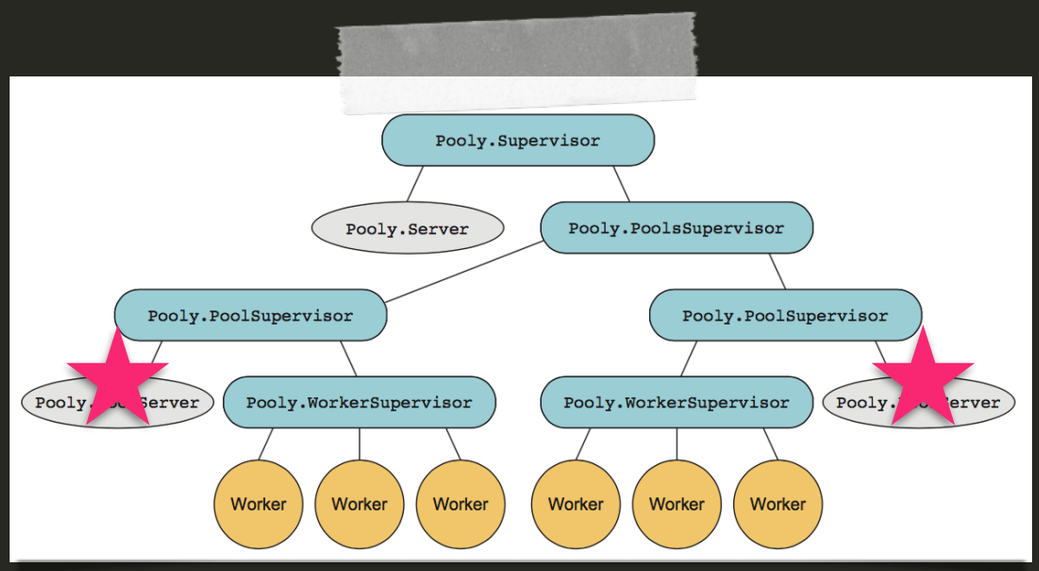



```elixir
defmodule Pooly.PoolSupervisor do
  use Supervisor

  def start_link(pool_config) do
    Supervisor.start_link(__MODULE__, pool_config,
                          name: :"#{pool_config[:name]}Supervisor")
  end

  def init(pool_config) do
    children = [
      worker(Pooly.PoolServer, [self, pool_config])
    ]

    supervise(children, strategy: :one_for_all)
  end
end
```



IMPLEMENTING THE POOL SERVER

```
defmodule Pooly.PoolServer do
  defmodule State do
    defstruct
      pool_sup: nil,
      worker_sup: nil,
      monitors: nil,
      size: nil,
      workers: nil,
      name: nil,
      mfa: nil
  end
end
```



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```
defmodule Pooly.PoolServer do
  defmodule State do
    defstruct
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      worker_sup: nil,
      monitors: nil,
      size: nil,
      workers: nil,
      name: nil,
      mfa: nil
  end
end
```
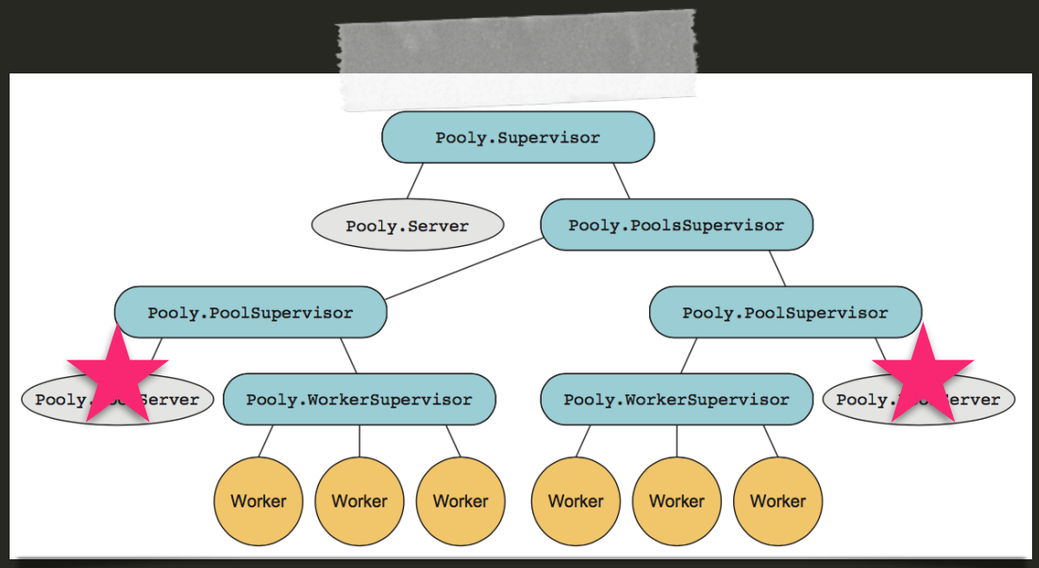
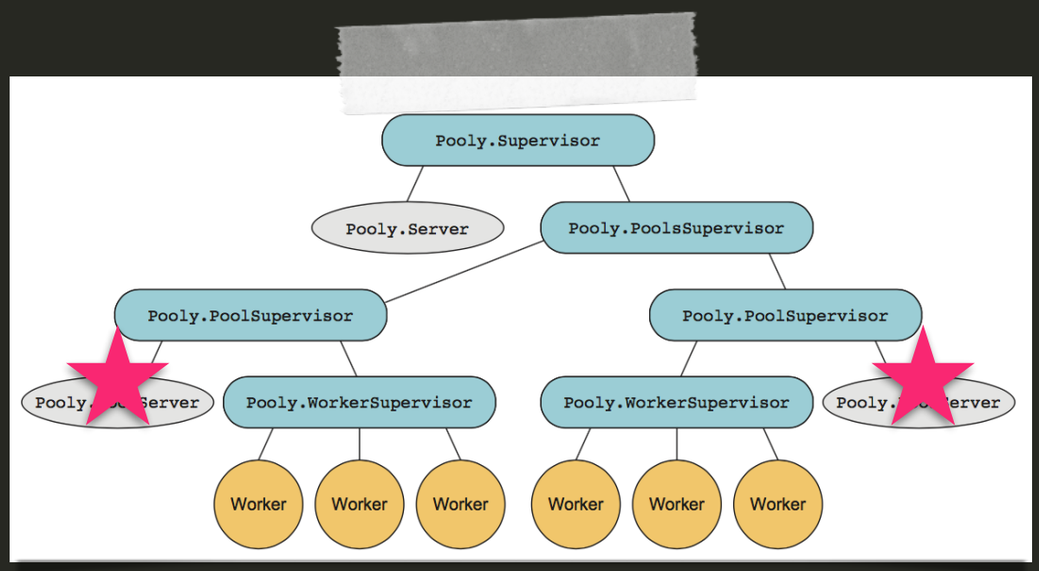
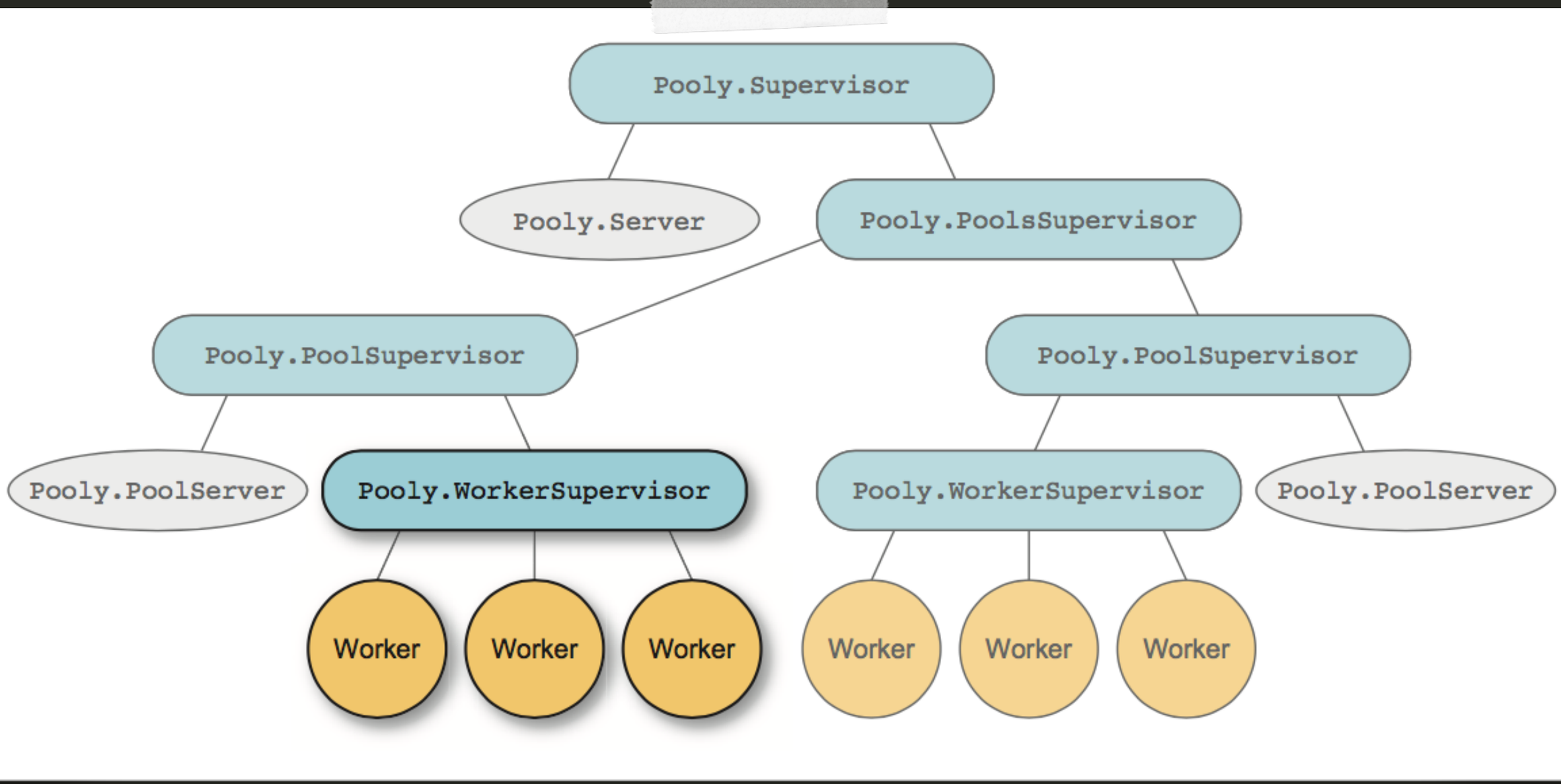



IMPLEMENTING THE POOL SERVER

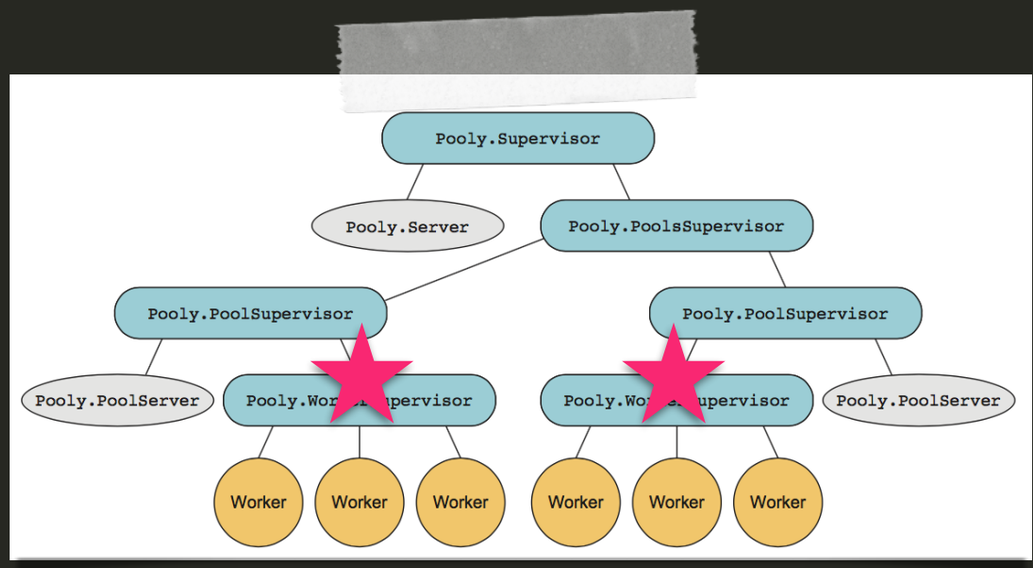
```
defmodule Pooly.PoolServer do
  defmodule State do
    defstruct
      pool_sup: nil,
      worker_sup: nil,
      monitors: nil,
      size: nil,
      workers: nil,
      name: nil,
      mfa: nil
  end
end
```



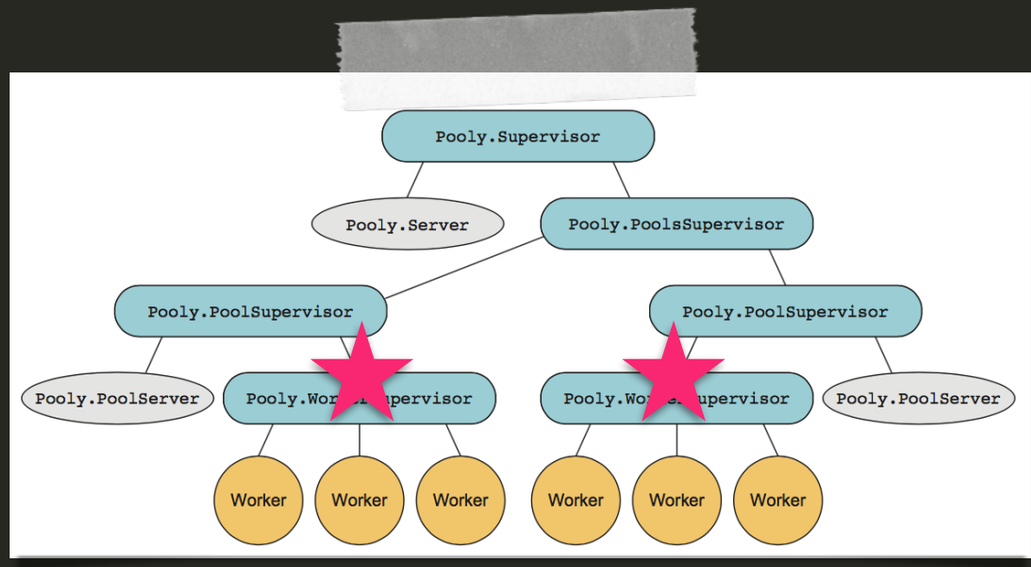
WORKER SUPERVISOR FOR THE POOL



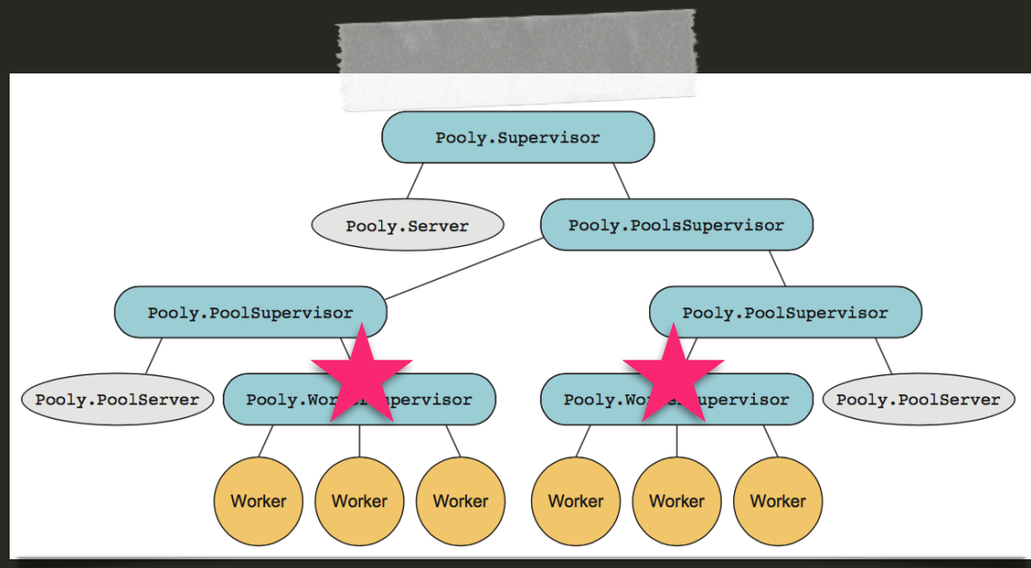
```elixir
defmodule Pooly.WorkerSupervisor do
  use Supervisor

  def start_link(pool_server, {_,_,_} = mfa) do
    Supervisor.start_link(__MODULE__, [pool_server, mfa])
  end

  def init([pool_server, {m,f,a}]) do
    Process.link(pool_server)
    worker_opts = [restart:  :temporary,
                   shutdown: 5000,
                   function: f]

    children = [worker(m, a, worker_opts)]
    opts     = [strategy:     :simple_one_for_one,
                max_restarts: 5,
                max_seconds:  5]
    supervise(children, opts)
  end
end
```



```elixir
defmodule Pooly.WorkerSupervisor do
  use Supervisor

  def start_link(pool_server, {_,_,_} = mfa) do
    Supervisor.start_link(__MODULE__, [pool_server, mfa])
  end

  def init([pool_server, {m,f,a}]) do
    Process.link(pool_server)
    worker_opts = [restart:  :temporary,
                   shutdown: 5000,
                   function: f]

    children = [worker(m, a, worker_opts)]
    opts     = [strategy:     :simple_one_for_one,
                max_restarts: 5,
                max_seconds:  5]
    supervise(children, opts)
  end
end
```



```elixir
defmodule Pooly.WorkerSupervisor do
  use Supervisor

  def start_link(pool_server, {_,_,_} = mfa) do
    Supervisor.start_link(__MODULE__, [pool_server, mfa])
  end

  def init([pool_server, {m,f,a}]) do
    Process.link(pool_server)
    worker_opts = [restart:  :temporary,
                   shutdown: 5000,
                   function: f]

    children = [worker(m, a, worker_opts)]
    opts     = [strategy:     :simple_one_for_one,
                max_restarts: 5,
                max_seconds:  5]
    supervise(children, opts)
  end
end
```

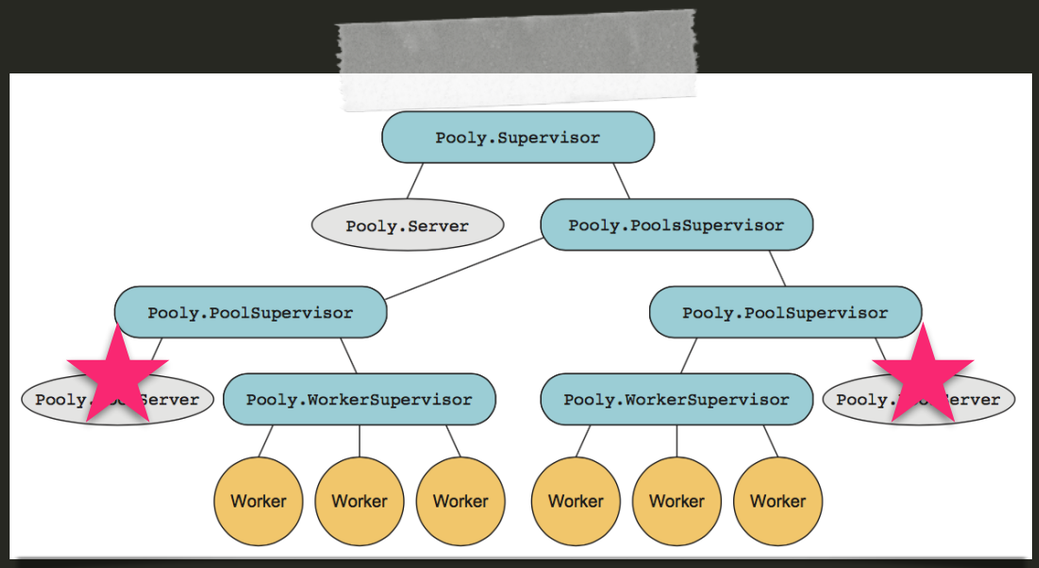


HANDLING A CRASH WHEN WORKER SUPERVISOR GOES DOWN.

```elixir
defmodule Pooly.PoolServer do

  def handle_info({:EXIT, worker_sup, reason}, state) do
    %{worker_sup: ^worker_sup} = state
    {:stop, reason, state}
  end

end
```



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defmodule Pooly.PoolServer do

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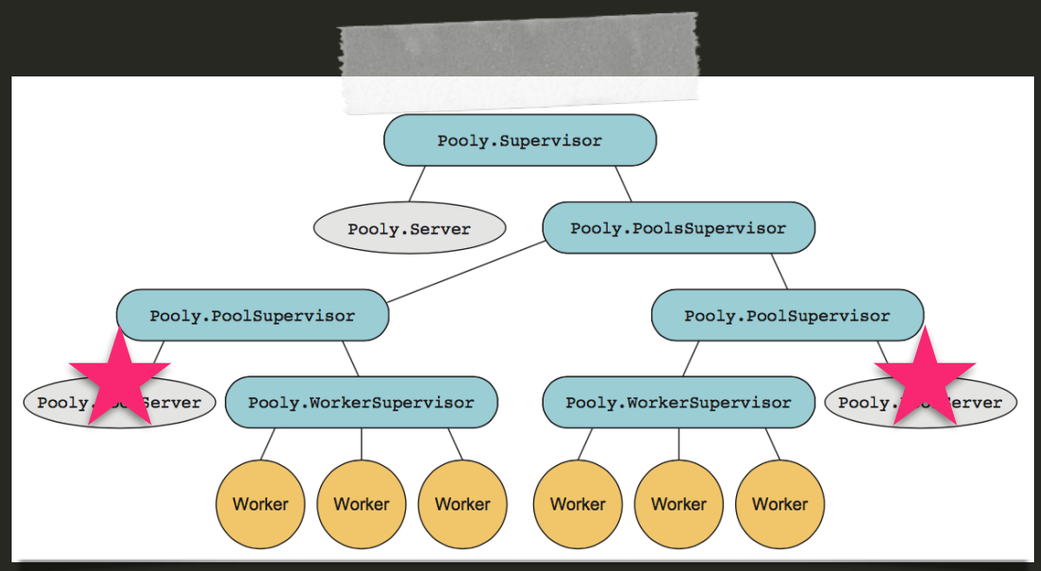
  end

end
```

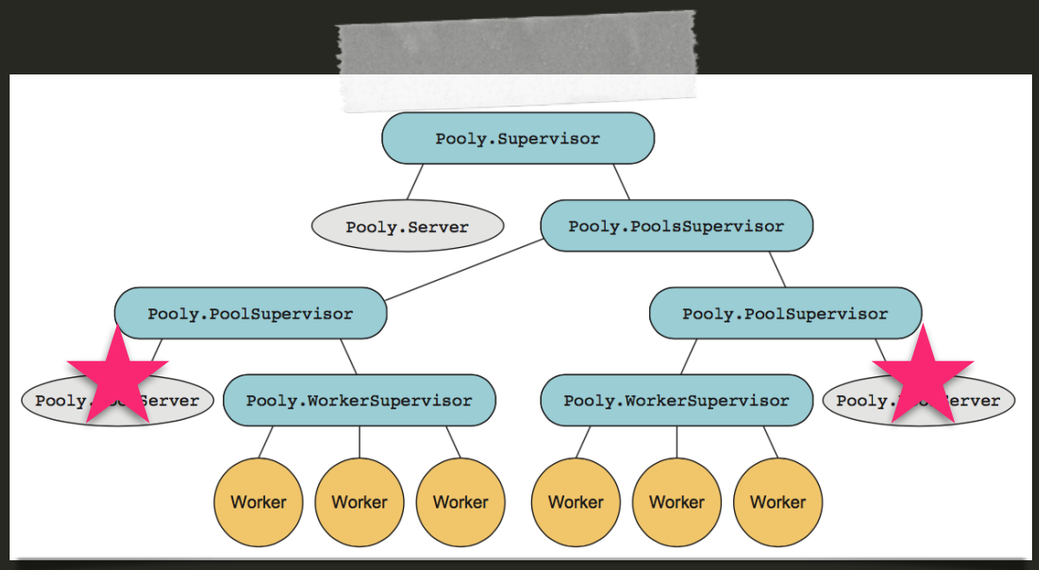


HANDLING A CRASH WHEN WORKER SUPERVISOR GOES DOWN.

```
defmodule Pooly.PoolServer do

  def handle_info({:EXIT, worker_sup, reason}, state) do
    %{worker_sup: ^worker_sup} = state
    {:stop, reason, state}
  end

end
```



VERSION 3

TYPE OF POOL	Single	Multiple
CREATION OF WORKERS	Fixed	Dynamic
CONSUMER RECOVERY	No	Yes
WORKER RECOVERY	No	Yes
QUEUEING FOR BUSY WORKERS	No	Yes

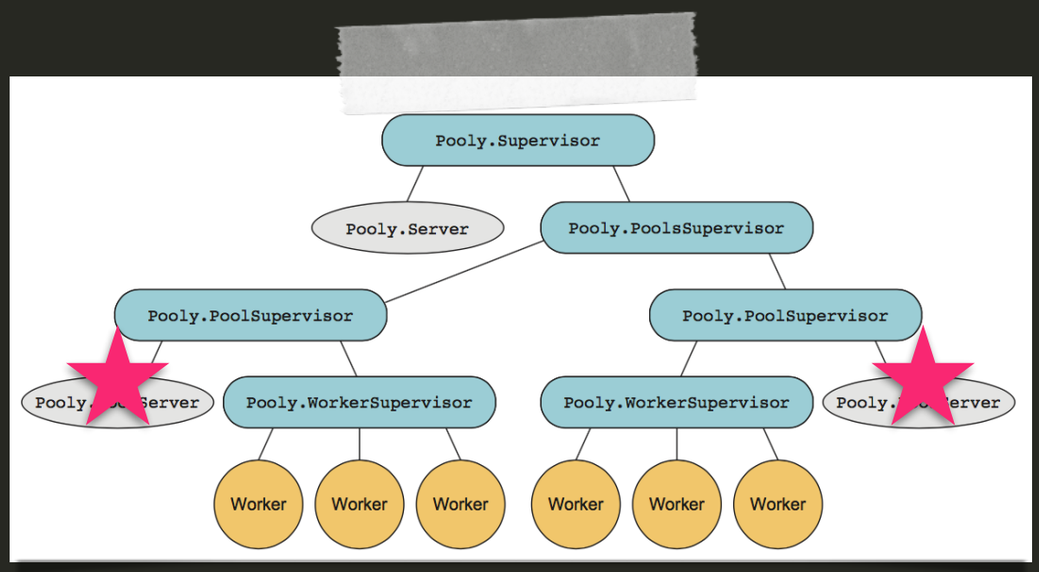
VERSION 4

TYPE OF POOL	Single	Multiple
CREATION OF WORKERS	Fixed	Dynamic
CONSUMER RECOVERY	No	Yes
WORKER RECOVERY	No	Yes
QUEUEING FOR BUSY WORKERS	No	Yes

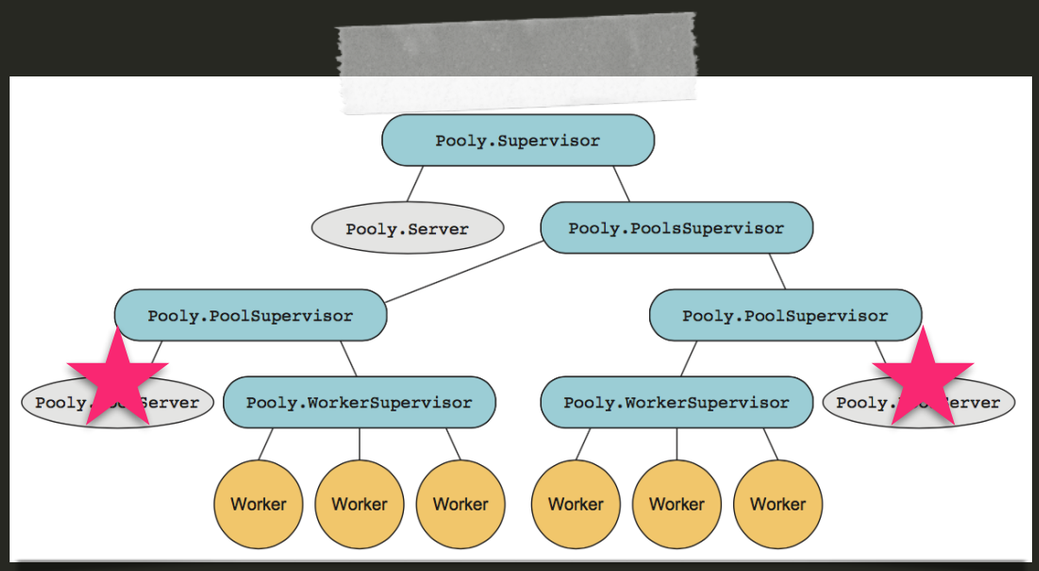
IMPLEMENTING OVERFLOW OVERFLOW OVERFLOW

```elixir
defmodule Pooly do
  def start(_type, _args) do
    pools_config =
      [
        [name: "ChuckNorris",
         mfa: {ChuckFetcher, :start_link, []},
         size: 2,
         max_overflow: 3
        ],
        [name: "StarWars",
         mfa: {SwapiFetcher, :start_link, []},
         size: 4,
         max_overflow: 3
        ]
      ]
    start_pools(pools_config)
  end
end
```

```elixir
defmodule Pooly.PoolServer do
  defmodule State do
    defstruct
      pool_sup: nil,
      worker_sup: nil,
      monitors: nil,
      size: nil,
      workers: nil,
      name: nil,
      mfa: nil,
      overflow: nil,
      max_overflow: nil
    end
  end
end
```

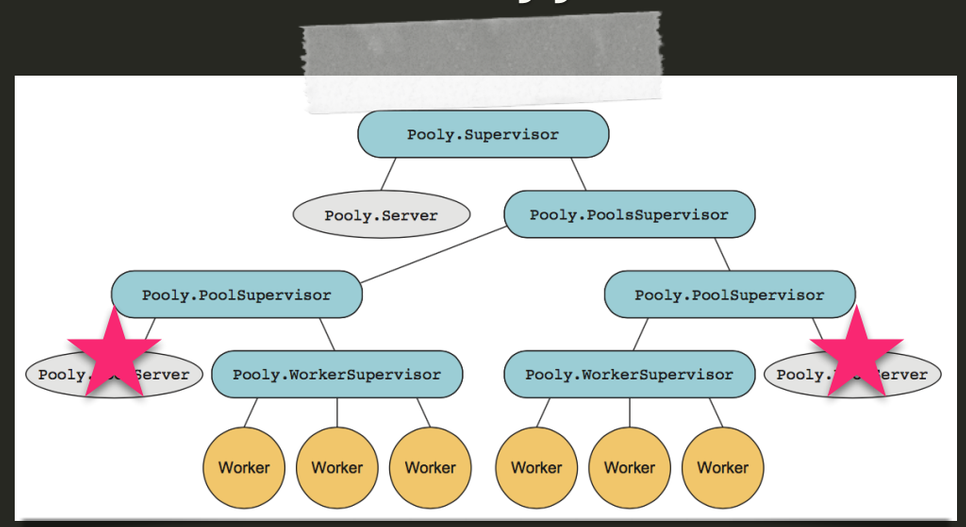


```elixir
defmodule Pooly.PoolServer do
  defmodule State do
    defstruct
      pool_sup: nil,
      worker_sup: nil,
      monitors: nil,
      size: nil,
      workers: nil,
      name: nil,
      mfa: nil,
      overflow: nil,
      max_overflow: nil
    end
  end
end
```



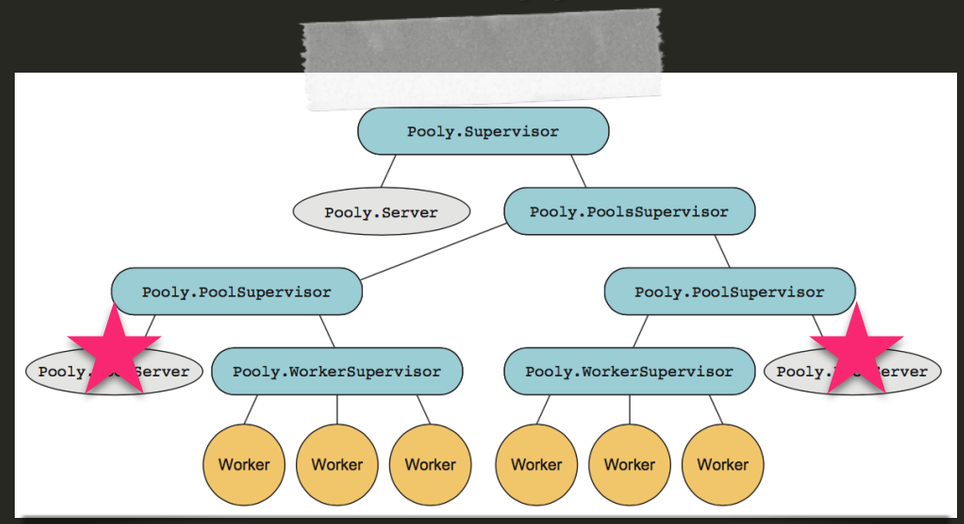
OVERFLOW: HANDLING WORKER CHECKOUTS

```
defmodule Pooly.PoolServer do
  def handle_call(:checkout, {from_pid, _ref} = from, state) do
    %{worker_sup:   worker_sup,
      workers:      workers,
      monitors:     monitors,
      overflow:     overflow,
      max_overflow: max_overflow} = state

    case workers do
      [worker|rest] ->
        # ...
        {:reply, worker, %{state | workers: rest}}
      [] when max_overflow > 0 and overflow < max_overflow ->
        {worker, ref} = new_worker(worker_sup, from_pid)
        true = :ets.insert(monitors, {worker, ref})
        {:reply, worker, %{state | overflow: overflow+1}}
      [] ->
        {:reply, :full, state};
    end
  end
end
```



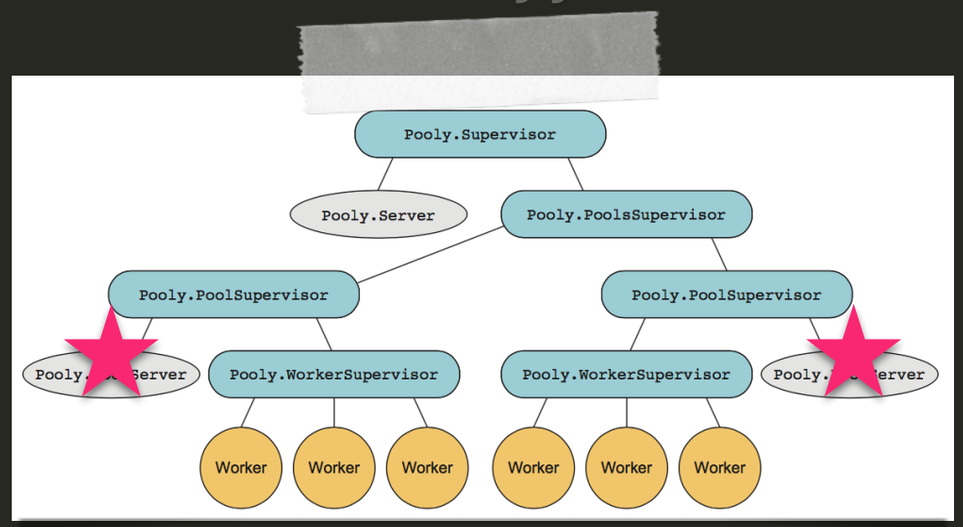
OVERFLOW: HANDLING WORKER CHECKOUTS

```
defmodule Pooly.PoolServer do
  def handle_call(:checkout, {from_pid, _ref} = from, state) do
    %{worker_sup:   worker_sup,
      workers:      workers,
      monitors:     monitors,
      overflow:     overflow,
      max_overflow: max_overflow} = state

    case workers do
      [worker|rest] ->
        # ...
        {:reply, worker, %{state | workers: rest}}
      [] when max_overflow > 0 and overflow < max_overflow ->
        {worker, ref} = new_worker(worker_sup, from_pid)
        true = :ets.insert(monitors, {worker, ref})
        {:reply, worker, %{state | overflow: overflow+1}}
      [] ->
        {:reply, :full, state};
    end
  end
end
```



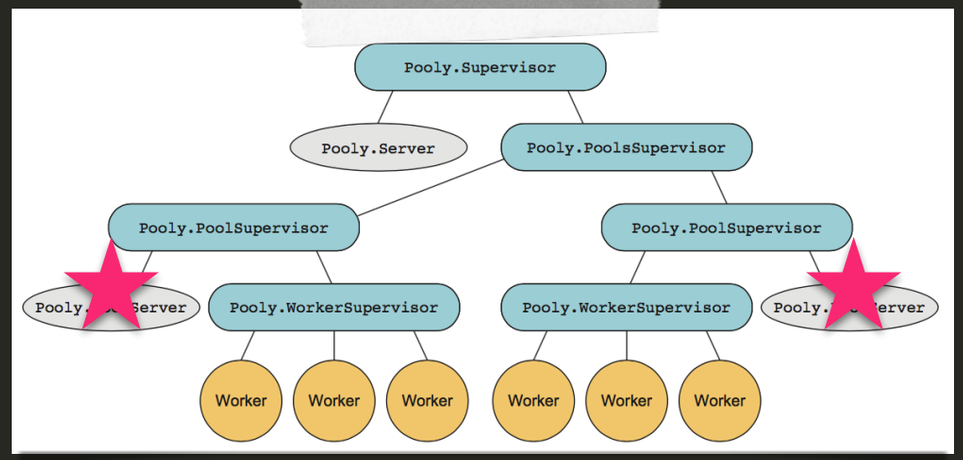
OVERFLOW: HANDLING WORKER CHECKOUTS

```
defmodule Pooly.PoolServer do
  def handle_call(:checkout, {from_pid, _ref} = from, state) do
    %{worker_sup:   worker_sup,
      workers:      workers,
      monitors:     monitors,
      overflow:     overflow,
      max_overflow: max_overflow} = state

    case workers do
      [worker|rest] ->
        # ...
        {:reply, worker, %{state | workers: rest}}
      [] when max_overflow > 0 and overflow < max_overflow ->
        {worker, ref} = new_worker(worker_sup, from_pid)
        true = :ets.insert(monitors, {worker, ref})
        {:reply, worker, %{state | overflow: overflow+1}}
      [] ->
        {:reply, :full, state};
    end
  end
end
```



OVERFLOW: HANDLING WORKER CHECKOUTS

```elixir
defmodule Pooly.PoolServer do
  def handle_call(:checkout, {from_pid, _ref} = from, state) do
    %{worker_sup:   worker_sup,
      workers:      workers,
      monitors:     monitors,
      overflow:     overflow,
      max_overflow: max_overflow} = state

    case workers do
      [worker|rest] ->
        # ...
        {:reply, worker, %{state | workers: rest}}
      [] when max_overflow > 0 and overflow < max_overflow ->
        {worker, ref} = new_worker(worker_sup, from_pid)
        true = :ets.insert(monitors, {worker, ref})
        {:reply, worker, %{state | overflow: overflow+1}}
      [] ->
        {:reply, :full, state};
    end
  end
end
```



OVERFLOW: HANDLING WORKER CHECKINS

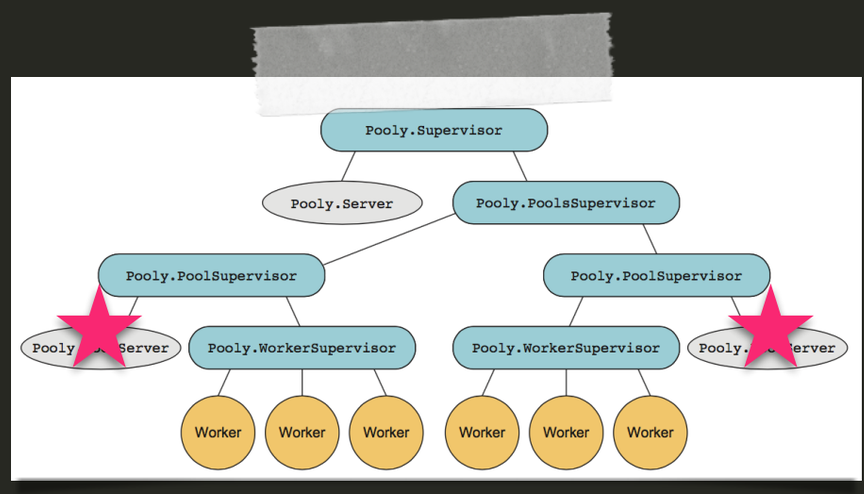
Previously:

```
{:noreply, %{state | workers: [pid|workers]}}
```

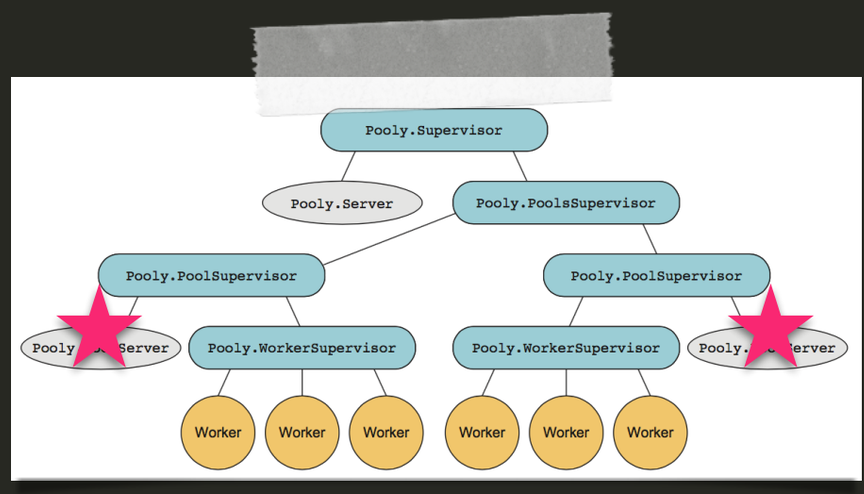
Now:

Worker dismissal: **UNLINK** + **TERMINATE CHILD**

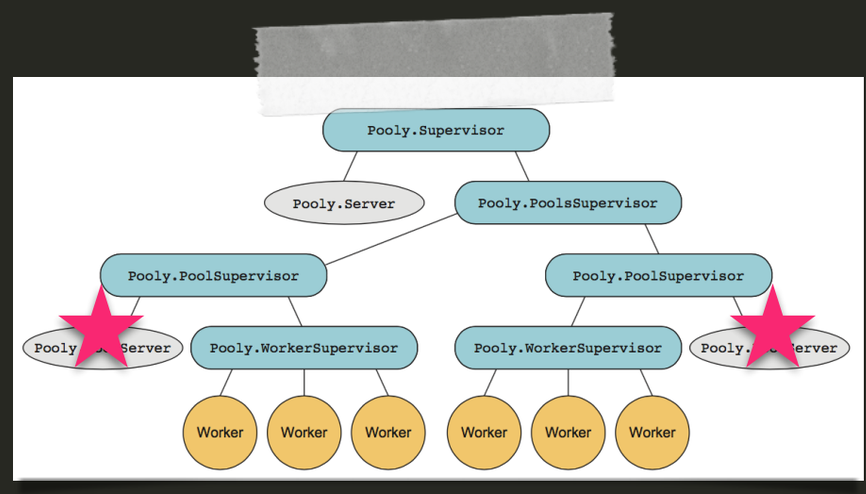
```elixir
defp handle_checkin(pid, state) do
  %{worker_sup:   worker_sup,
    workers:      workers,
    monitors:     monitors,
    waiting:      waiting,
    overflow:     overflow} = state

  if overflow > 0 do
    :ok = dismiss_worker(worker_sup, pid)
    %{state | waiting: empty, overflow: overflow-1}
  else
    %{state | waiting: empty,
              workers: [pid|workers], overflow: 0}
  end
end

defp dismiss_worker(sup, pid) do
  true = Process.unlink(pid)
  Supervisor.terminate_child(sup, pid)
end
```



```elixir
defp handle_checkin(pid, state) do
  %{worker_sup:   worker_sup,
    workers:      workers,
    monitors:     monitors,
    waiting:      waiting,
    overflow:     overflow} = state

  if overflow > 0 do
    :ok = dismiss_worker(worker_sup, pid)
    %{state | waiting: empty, overflow: overflow-1}
  else
    %{state | waiting: empty,
              workers: [pid|workers], overflow: 0}
  end
end

defp dismiss_worker(sup, pid) do
  true = Process.unlink(pid)
  Supervisor.terminate_child(sup, pid)
end
```



```elixir
defp handle_checkin(pid, state) do
  %{worker_sup:   worker_sup,
    workers:      workers,
    monitors:     monitors,
    waiting:      waiting,
    overflow:     overflow} = state

  if overflow > 0 do
    :ok = dismiss_worker(worker_sup, pid)
    %{state | waiting: empty, overflow: overflow-1}
  else
    %{state | waiting: empty,
              workers: [pid|workers], overflow: 0}
  end
end

defp dismiss_worker(sup, pid) do
  true = Process.unlink(pid)
  Supervisor.terminate_child(sup, pid)
end
```

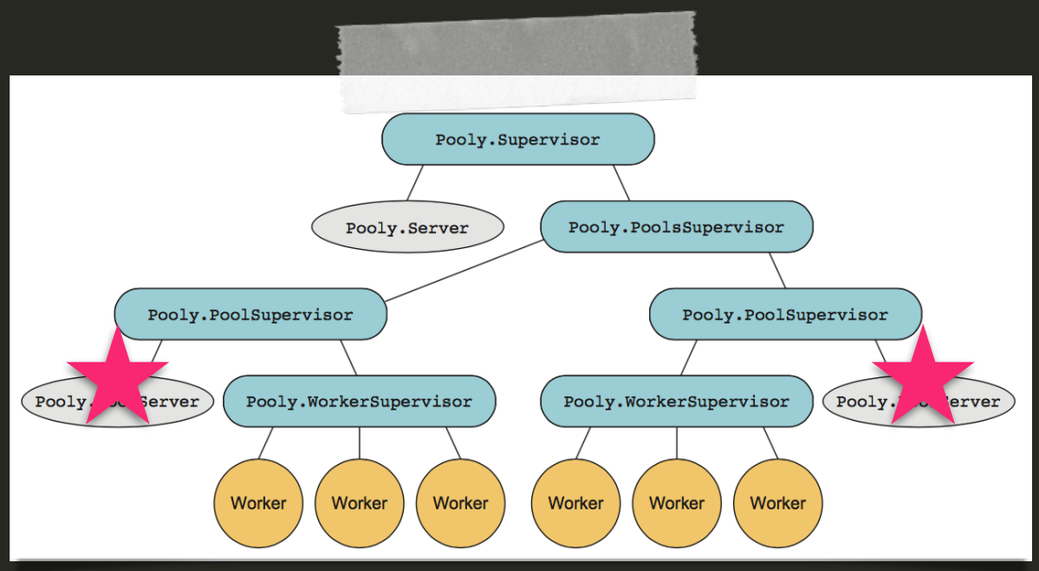


Handling Worker

HANDLING WORKER EXITS

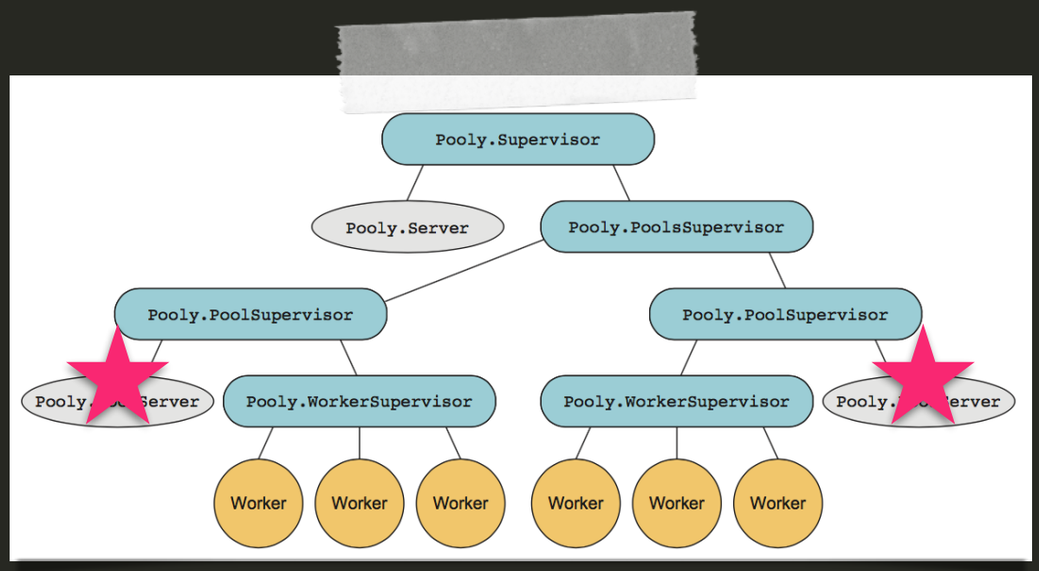
```
defmodule Pooly.PoolServer do

  defp handle_worker_exit(pid, state) do
    %{worker_sup: worker_sup,
      workers: workers,
      monitors: monitors,
      overflow: overflow} = state
    if overflow > 0 do
      %{state | overflow: overflow-1}
    else
      %{state | workers: [new_worker(worker_sup)|workers]}
    end
  end

end
```

```
defp handle_checkin(pid, state) do
  if overflow > 0 do
    :ok = dismiss_worker(worker_sup,
pid)
    %{state | waiting: empty,
              overflow: overflow-1}
  else
    %{state | waiting: empty,
              workers: [pid|workers],
              overflow: 0}
  end
end
```



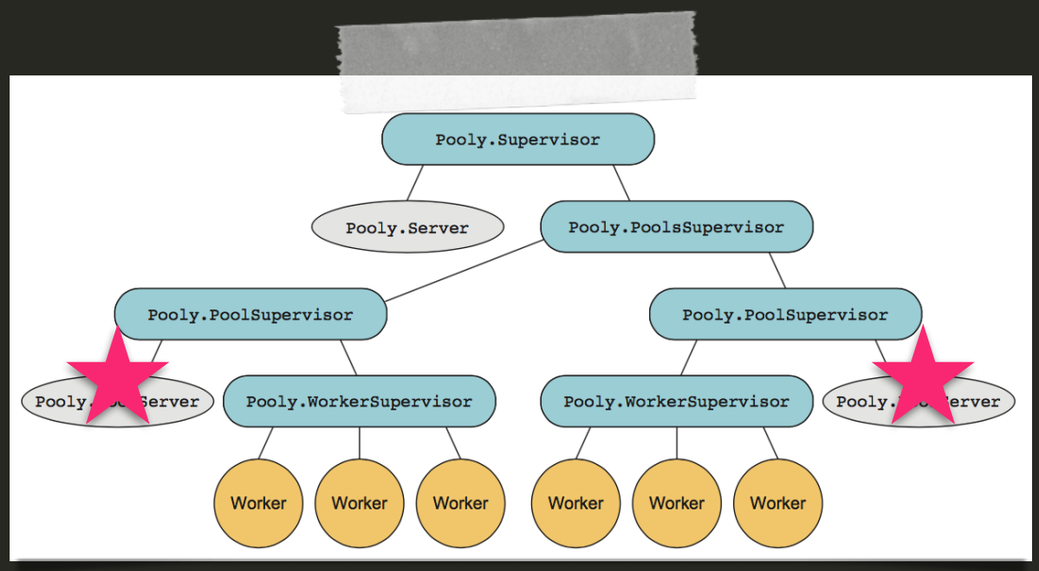
HANDLING WORKER EXITS

```
defmodule Pooly.PoolServer do

  defp handle_worker_exit(pid, state) do
    %{worker_sup: worker_sup,
      workers: workers,
      monitors: monitors,
      overflow: overflow} = state
    if overflow > 0 do
      %{state | overflow: overflow-1}
    else
      %{state | workers: [new_worker(worker_sup)|workers]}
    end
  end

end
```



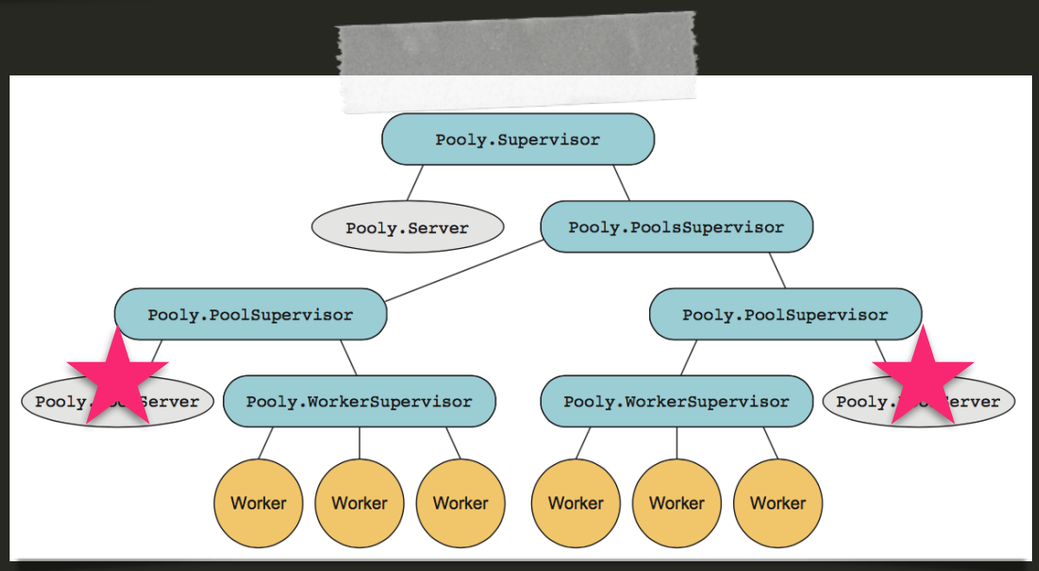
HANDLING WORKER EXITS

```
defmodule Pooly.PoolServer do

  defp handle_worker_exit(pid, state) do
    %{worker_sup: worker_sup,
      workers: workers,
      monitors: monitors,
      overflow: overflow} = state
    if overflow > 0 do
      %{state | overflow: overflow-1}
    else
      %{state | workers: [new_worker(worker_sup)|workers]}
    end
  end

end
```



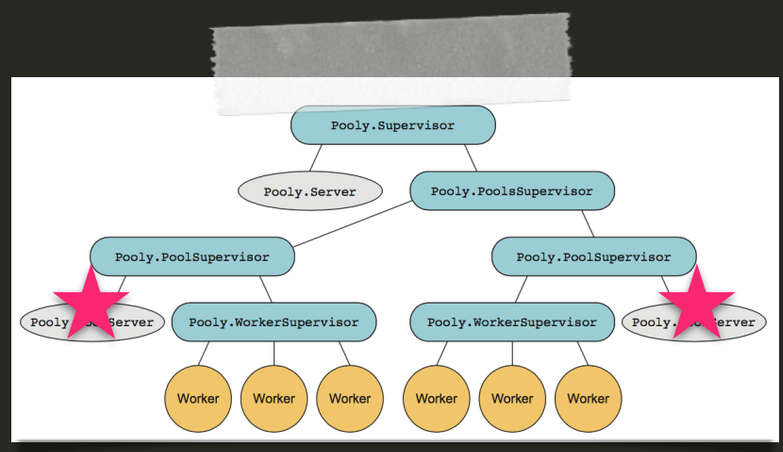
HANDLING WORKER EXITS

```
defmodule Pooly.PoolServer do

  def handle_info({:EXIT, pid, _reason}, state) do
    %{monitors: monitors,
      workers: workers,
      worker_sup: worker_sup} = state

    case :ets.lookup(monitors, pid) do
      [{pid, ref}] ->
        #
        new_state = handle_worker_exit(pid, state)
        {:noreply, new_state}
      _ ->
        {:noreply, state}
    end
  end

end
```

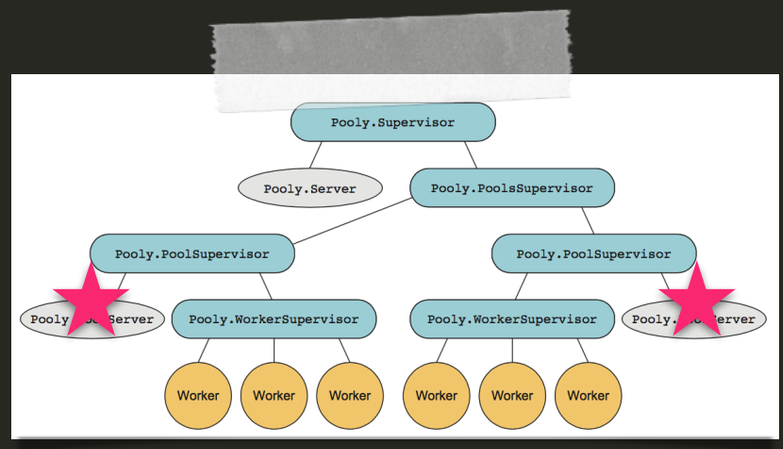


WHAT IF A CONSUMER PROCESS IS WILLING TO BLOCK?

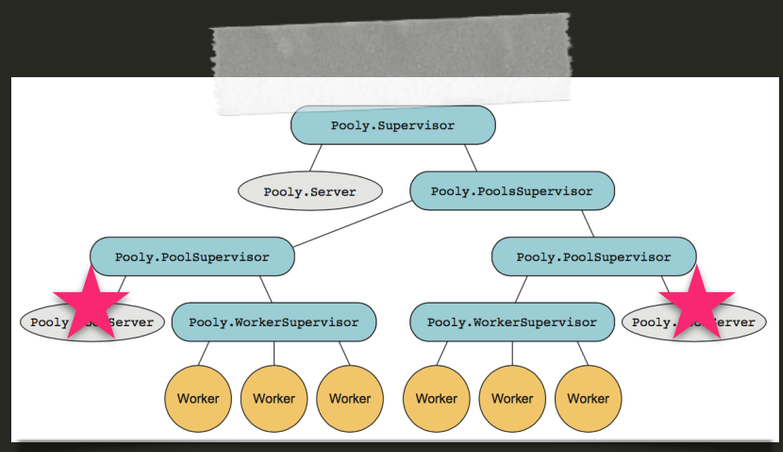
```elixir
defmodule Pooly.PoolServer do
  defmodule State do
    defstruct
    ...,
    waiting: nil,
    overflow: nil,
    max_overflow: nil
  end

  def init([pool_sup, pool_config]) when is_pid(pool_sup) do
    Process.flag(:trap_exit, true)
    monitors = :ets.new(:monitors, [:private])
    waiting  = :queue.new
    state    = %State{pool_sup: pool_sup,
                      monitors: monitors,
                      waiting: waiting,
                      overflow: 0}

    init(pool_config, state)
  end
end
```



```elixir
defmodule Pooly.PoolServer do
  defmodule State do
    defstruct
    ...,
    waiting: nil,
    overflow: nil,
    max_overflow: nil
  end

  def init([pool_sup, pool_config]) when is_pid(pool_sup) do
    Process.flag(:trap_exit, true)
    monitors = :ets.new(:monitors, [:private])
    waiting  = :queue.new
    state    = %State{pool_sup: pool_sup,
                      monitors: monitors,
                      waiting: waiting,
                      overflow: 0}

    init(pool_config, state)
  end
end
```

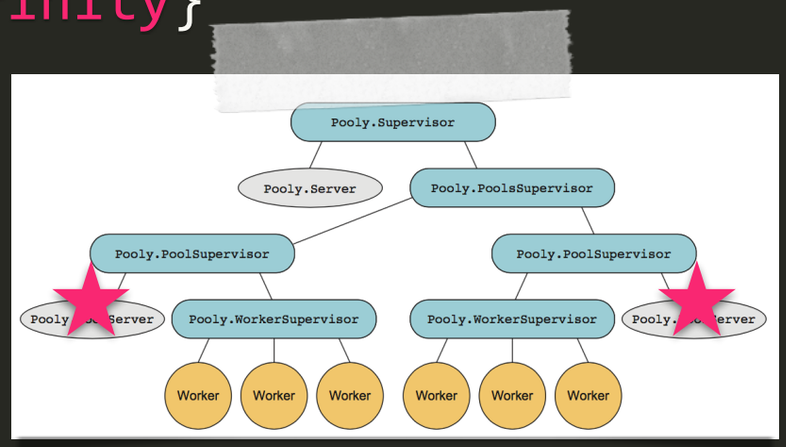


```elixir
defmodule Pooly.PoolServer do
  defmodule State do
    defstruct
    ...,
    waiting: nil,
    overflow: nil,
    max_overflow: nil
  end

  def init([pool_sup, pool_config]) when is_pid(pool_sup) do
    Process.flag(:trap_exit, true)
    monitors = :ets.new(:monitors, [:private])
    waiting  = :queue.new
    state    = %State{pool_sup: pool_sup,
                      monitors: monitors,
                      waiting: waiting,
                      overflow: 0}

    init(pool_config, state)
  end
end
```



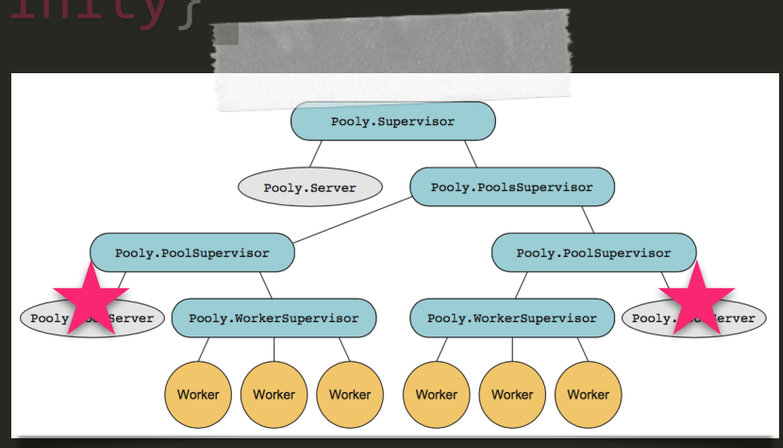
QUEUING: CHECKING OUT

```
def handle_call({:checkout, block}, {from_pid, _ref} = from, state) do
  %{worker_sup:   worker_sup,
    workers:      workers,
    monitors:     monitors,
    waiting:      waiting,
    overflow:     overflow,
    max_overflow: max_overflow} = state

  case workers do
    [worker|rest] ->
      # ...
    [] when max_overflow > 0 and overflow < max_overflow ->
      # …

    [] when block == true ->
      ref = Process.monitor(from_pid)
      waiting = :queue.in({from, ref}, waiting)
      {:noreply, %{state | waiting: waiting}, :infinity}

    [] ->
      {:reply, :full, state}
  end
end
```



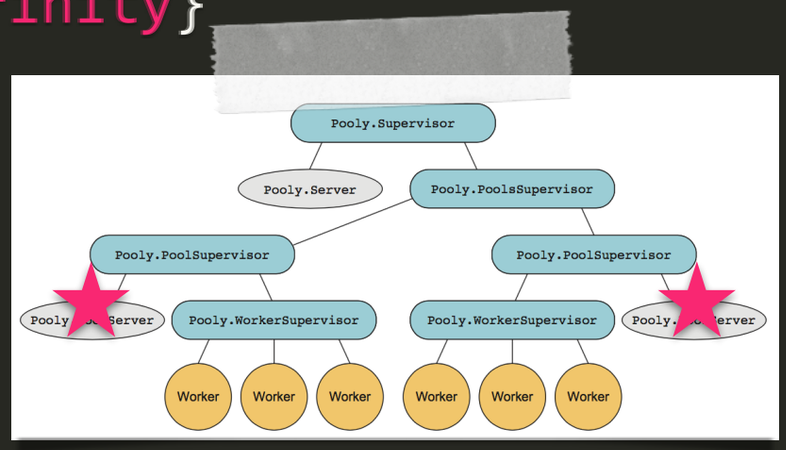
QUEUING: CHECKING OUT

```
def handle_call({:checkout, block}, {from_pid, _ref} = from, state) do
  %{worker_sup:   worker_sup,
    workers:      workers,
    monitors:     monitors,
    waiting:      waiting,
    overflow:     overflow,
    max_overflow: max_overflow} = state

  case workers do
    [worker|rest] ->
      # …

    [] when max_overflow > 0 and overflow < max_overflow ->
      # …

    [] when block == true ->
      ref = Process.monitor(from_pid)
      waiting = :queue.in({from, ref}, waiting)
      {:noreply, %{state | waiting: waiting}, :infinity}

    [] ->
      {:reply, :full, state}
  end
end
```



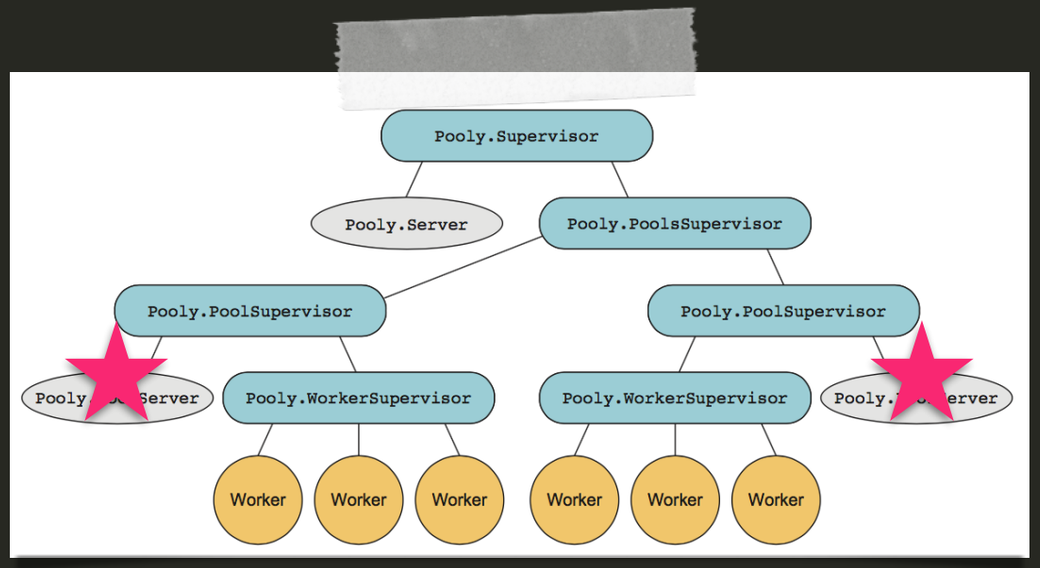
QUEUING: CHECKING OUT

```
def handle_call({:checkout, block}, {from_pid, _ref} = from, state) do
  %{worker_sup:   worker_sup,
    workers:      workers,
    monitors:     monitors,
    waiting:      waiting,
    overflow:     overflow,
    max_overflow: max_overflow} = state

  case workers do
    [worker|rest] ->
      # …

    [] when max_overflow > 0 and overflow < max_overflow ->
      # …

    [] when block == true ->
      ref = Process.monitor(from_pid)
      waiting = :queue.in({from, ref}, waiting)
      {:noreply, %{state | waiting: waiting}, :infinity}

    [] ->
      {:reply, :full, state}
  end
end
```



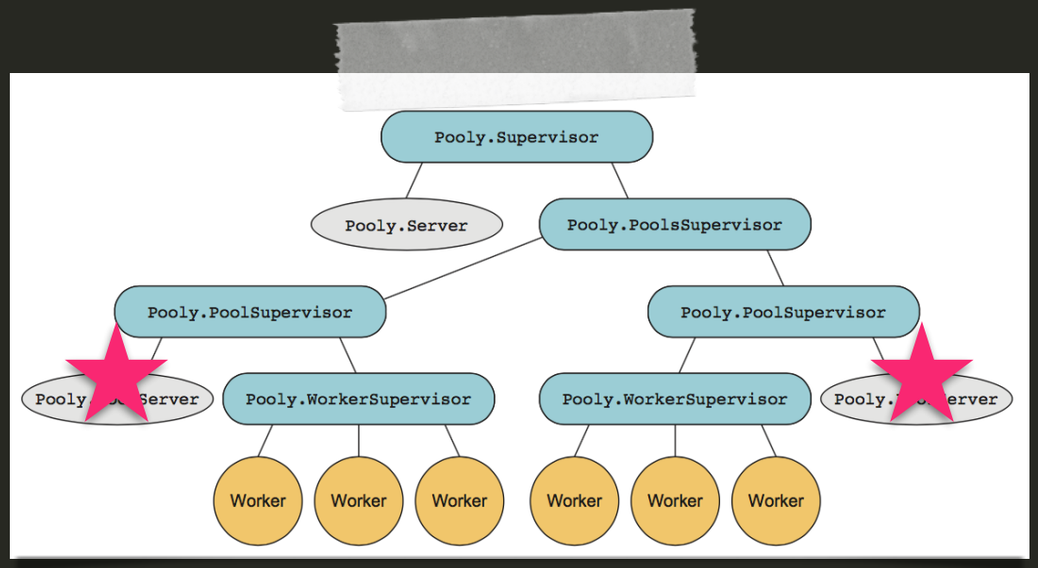
QUEUING: CHECKING IN

```
def handle_checkin(pid, state) do
  %{worker_sup:   worker_sup,
    workers:      workers,
    monitors:     monitors,
    waiting:      waiting,
    overflow:     overflow} = state

  case :queue.out(waiting) do
    {{:value, {from, ref}}, left} ->
      true = :ets.insert(monitors, {pid, ref})
      GenServer.reply(from, pid)
      %{state | waiting: left}

    {:empty, empty} when overflow > 0 ->
      :ok = dismiss_worker(worker_sup, pid)
      %{state | waiting: empty, overflow: overflow-1}

    {:empty, empty} ->
      %{state | waiting: empty, workers: [pid|workers], overflow: 0}
  end
end
```



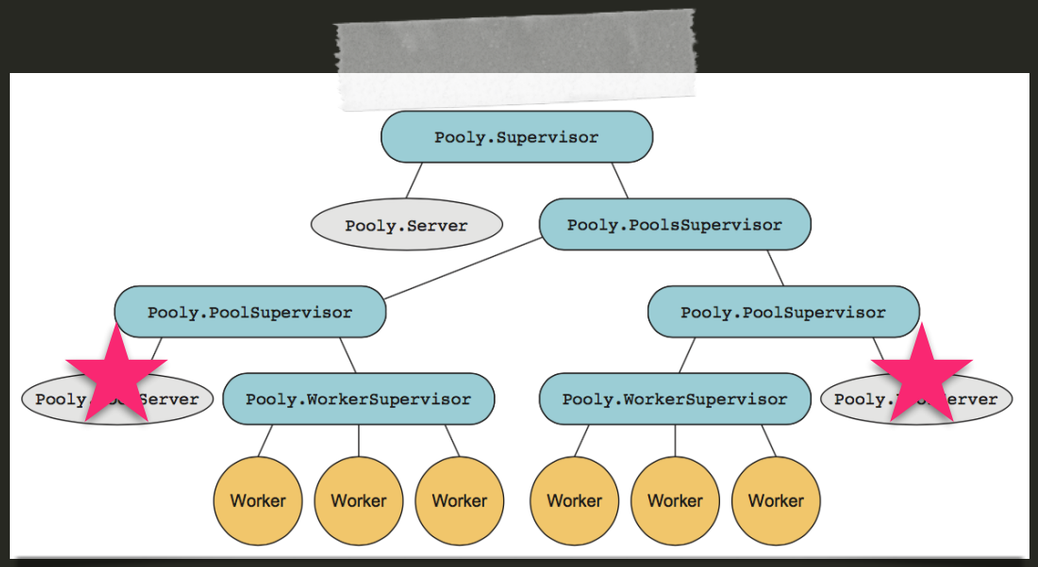
QUEUING: CHECKING IN

```elixir
def handle_checkin(pid, state) do
  %{worker_sup:   worker_sup,
    workers:      workers,
    monitors:     monitors,
    waiting:      waiting,
    overflow:     overflow} = state

  case :queue.out(waiting) do
    {{:value, {from, ref}}, left} ->
      true = :ets.insert(monitors, {pid, ref})
      GenServer.reply(from, pid)
      %{state | waiting: left}

    {:empty, empty} when overflow > 0 ->
      :ok = dismiss_worker(worker_sup, pid)
      %{state | waiting: empty, overflow: overflow-1}

    {:empty, empty} ->
      %{state | waiting: empty, workers: [pid|workers], overflow: 0}
  end
end
```



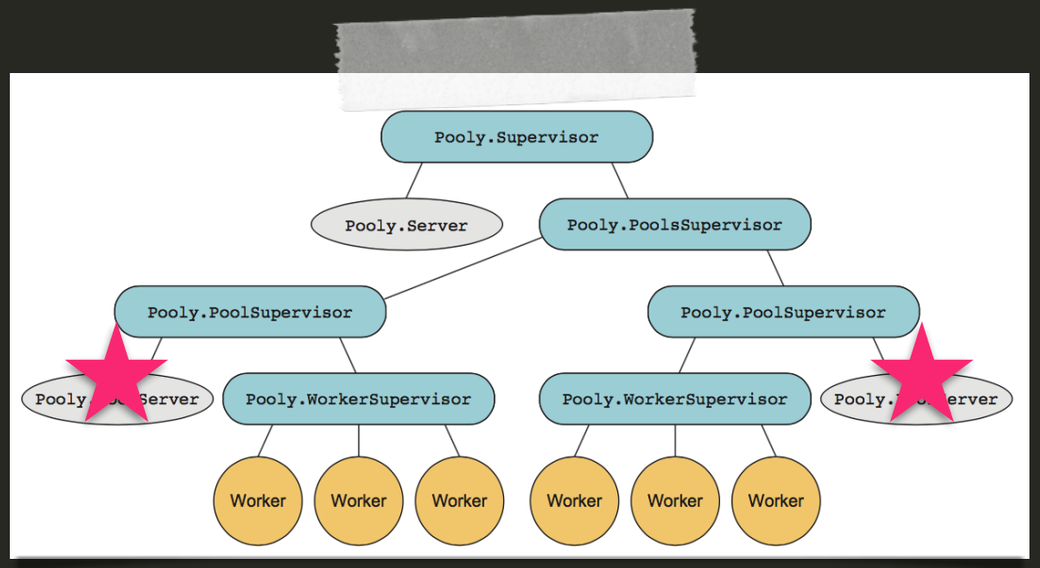
QUEUING: CHECKING IN

```
def handle_checkin(pid, state) do
  %{worker_sup:   worker_sup,
    workers:      workers,
    monitors:     monitors,
    waiting:      waiting,
    overflow:     overflow} = state

  case :queue.out(waiting) do
    {{:value, {from, ref}}, left} ->
      true = :ets.insert(monitors, {pid, ref})
      GenServer.reply(from, pid)
      %{state | waiting: left}

    {:empty, empty} when overflow > 0 ->
      :ok = dismiss_worker(worker_sup, pid)
      %{state | waiting: empty, overflow: overflow-1}

    {:empty, empty} ->
      %{state | waiting: empty, workers: [pid|workers], overflow: 0}
  end
end
```



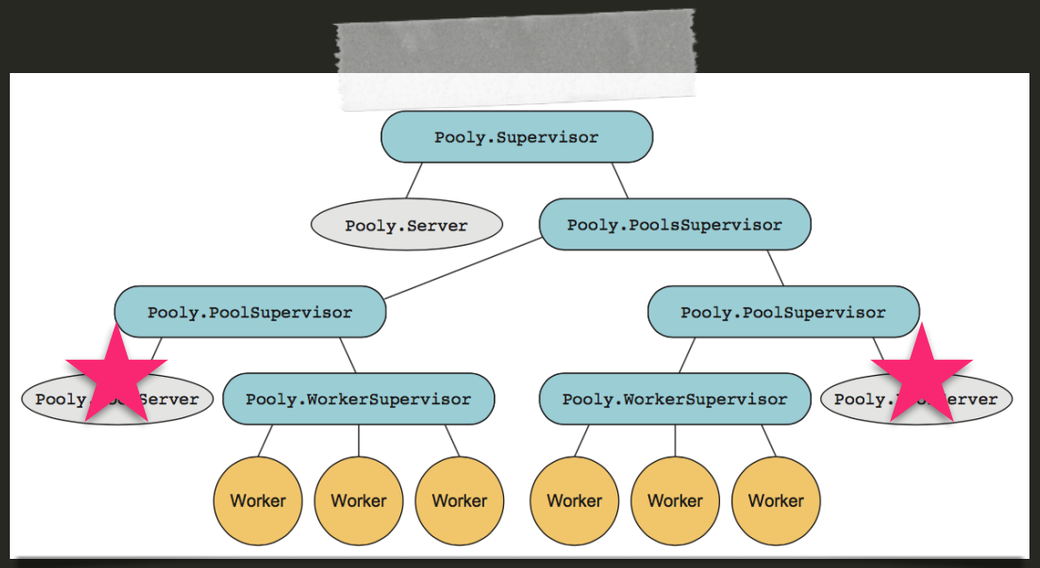
QUEUING: CHECKING IN

```
def handle_checkin(pid, state) do
  %{worker_sup:   worker_sup,
    workers:      workers,
    monitors:     monitors,
    waiting:      waiting,
    overflow:     overflow} = state

  case :queue.out(waiting) do
    {{:value, {from, ref}}, left} ->
      true = :ets.insert(monitors, {pid, ref})
      GenServer.reply(from, pid)
      %{state | waiting: left}

    {:empty, empty} when overflow > 0 ->
      :ok = dismiss_worker(worker_sup, pid)
      %{state | waiting: empty, overflow: overflow-1}

    {:empty, empty} ->
      %{state | waiting: empty, workers: [pid|workers], overflow: 0}
  end
end
```



QUEUING: CHECKING IN

```elixir
def handle_checkin(pid, state) do
  %{worker_sup:   worker_sup,
    workers:      workers,
    monitors:     monitors,
    waiting:      waiting,
    overflow:     overflow} = state

  case :queue.out(waiting) do
    {{:value, {from, ref}}, left} ->
      true = :ets.insert(monitors, {pid, ref})
      GenServer.reply(from, pid)
      %{state | waiting: left}

    {:empty, empty} when overflow > 0 ->
      :ok = dismiss_worker(worker_sup, pid)
      %{state | waiting: empty, overflow: overflow-1}

    {:empty, empty} ->
      %{state | waiting: empty, workers: [pid|workers], overflow: 0}
  end
end
```



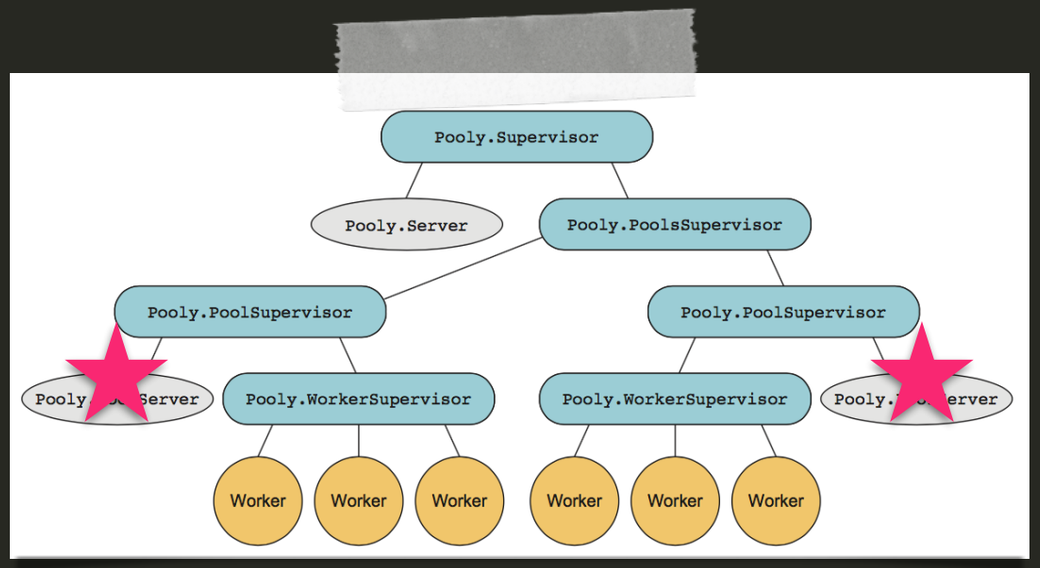
QUEUING: CHECKING IN

```elixir
def handle_checkin(pid, state) do
  %{worker_sup:   worker_sup,
    workers:      workers,
    monitors:     monitors,
    waiting:      waiting,
    overflow:     overflow} = state

  case :queue.out(waiting) do
    {{:value, {from, ref}}, left} ->
      true = :ets.insert(monitors, {pid, ref})
      GenServer.reply(from, pid)
      %{state | waiting: left}

    {:empty, empty} when overflow > 0 ->
      :ok = dismiss_worker(worker_sup, pid)
      %{state | waiting: empty, overflow: overflow-1}

    {:empty, empty} ->
      %{state | waiting: empty, workers: [pid|workers], overflow: 0}
  end
end
```



How Do You **ENSURE**

THAT EVERY

CHECK-OUT

IS FOLLOWED BY A

CHECK-IN?

TRANSACTIONS

```
def transaction(pool_name, fun, timeout) do
  worker = checkout(pool_name, true, timeout)
  try do
    fun.(worker)
  after
    checkin(pool_name, worker)
  end
end
```

TRANSACTIONS

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  worker = checkout(pool_name, true, timeout)
  try do
    fun.(worker)
  after
    checkin(pool_name, worker)
  end
end
```

TRANSACTIONS

```elixir
tasks = 1..5 |> Enum.map(fn(_) ->
  Task.async(fn ->
    Pooly.transaction("ChuckNorris", fn(worker_pid) ->
      ChuckFetcher.fetch(worker_pid)
    end, 5_000)
  end)
end)

tasks |> Enum.map(&Task.await(&1, 5_000))
```

TRANSACTIONS

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    end, 5_000)
  end)
end)

tasks |> Enum.map(&Task.await(&1, 5_000))
```

TRANSACTIONS

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    end, 5_000)
  end)
end)

tasks |> Enum.map(&Task.await(&1, 5_000))
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  end)
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```
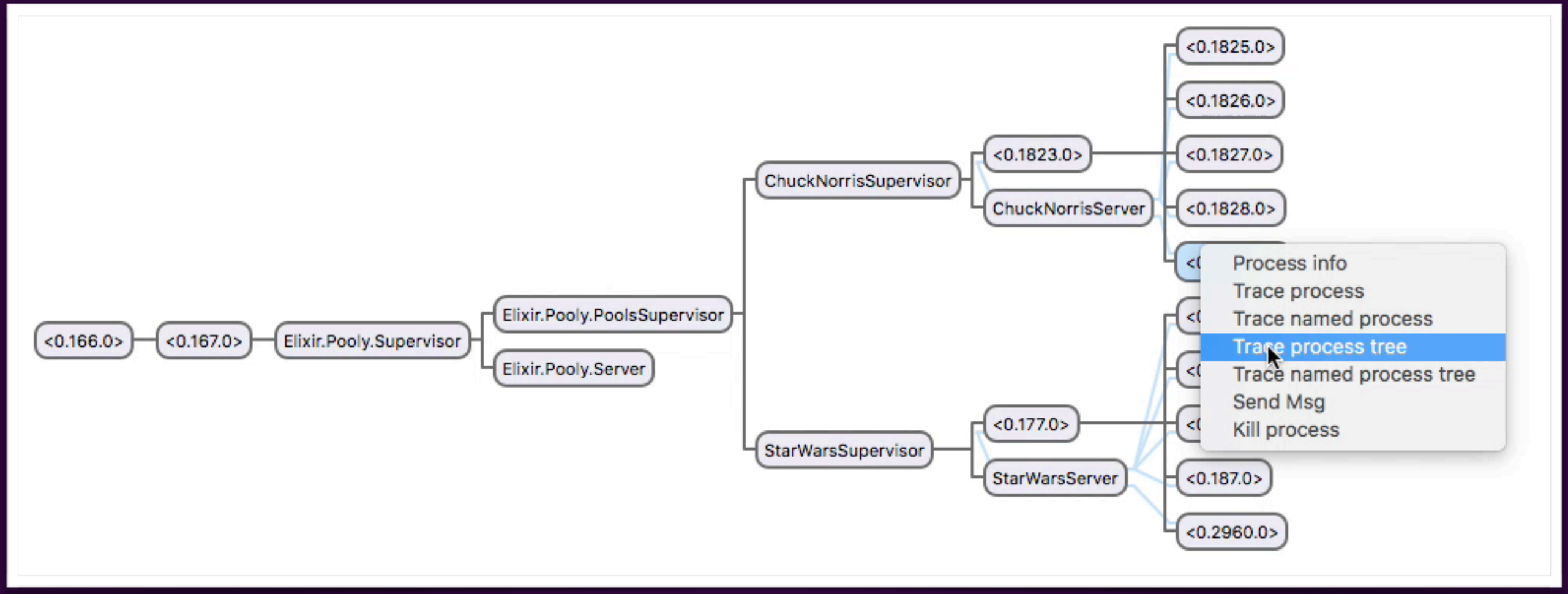
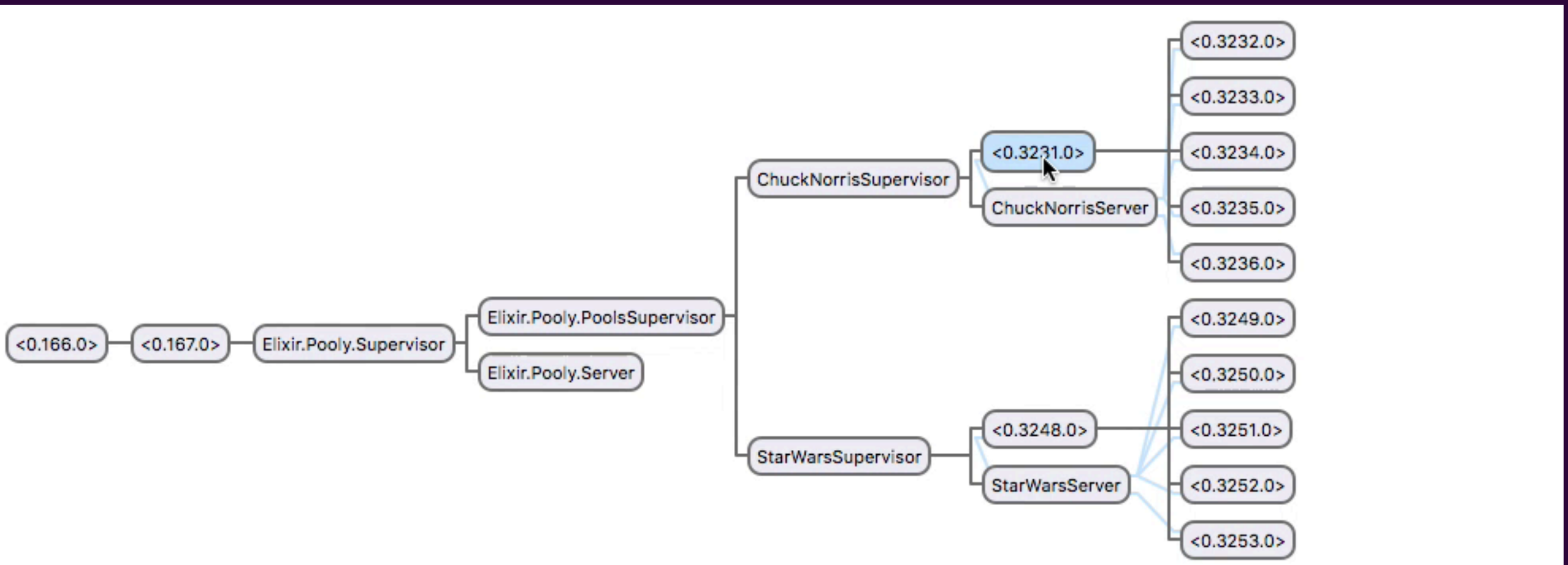

DEMO TIME!

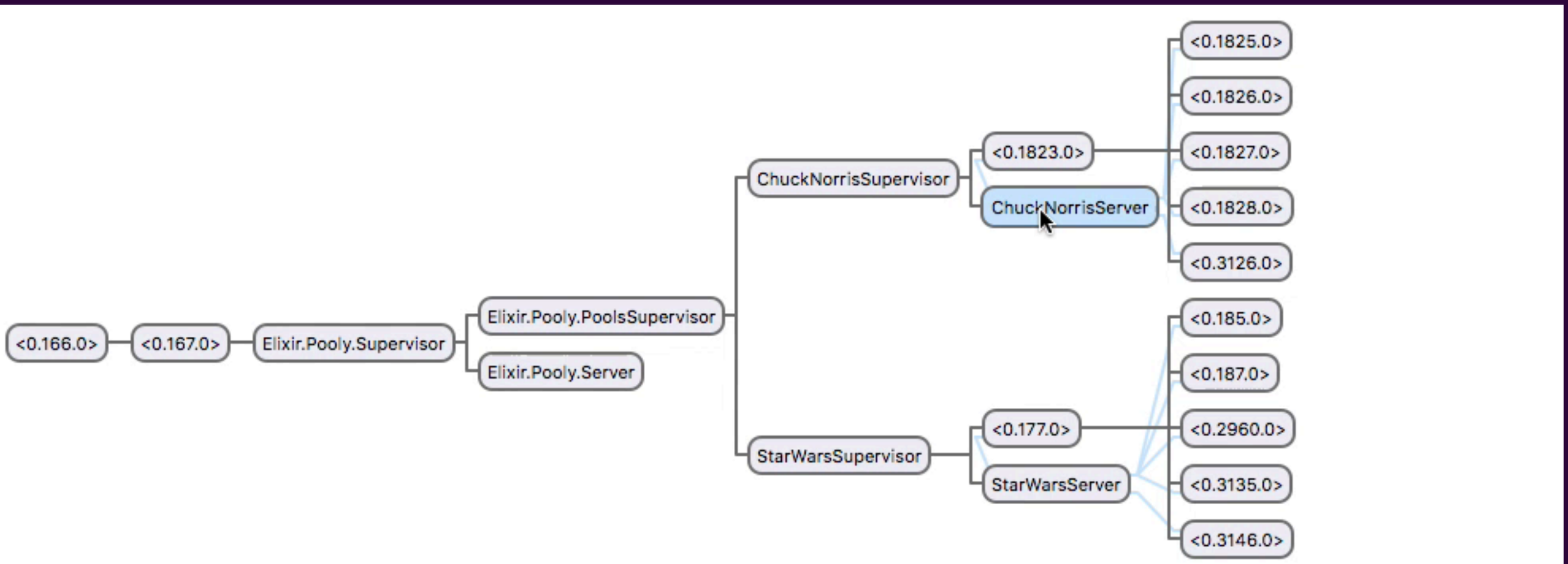
Demo: Killing Workers



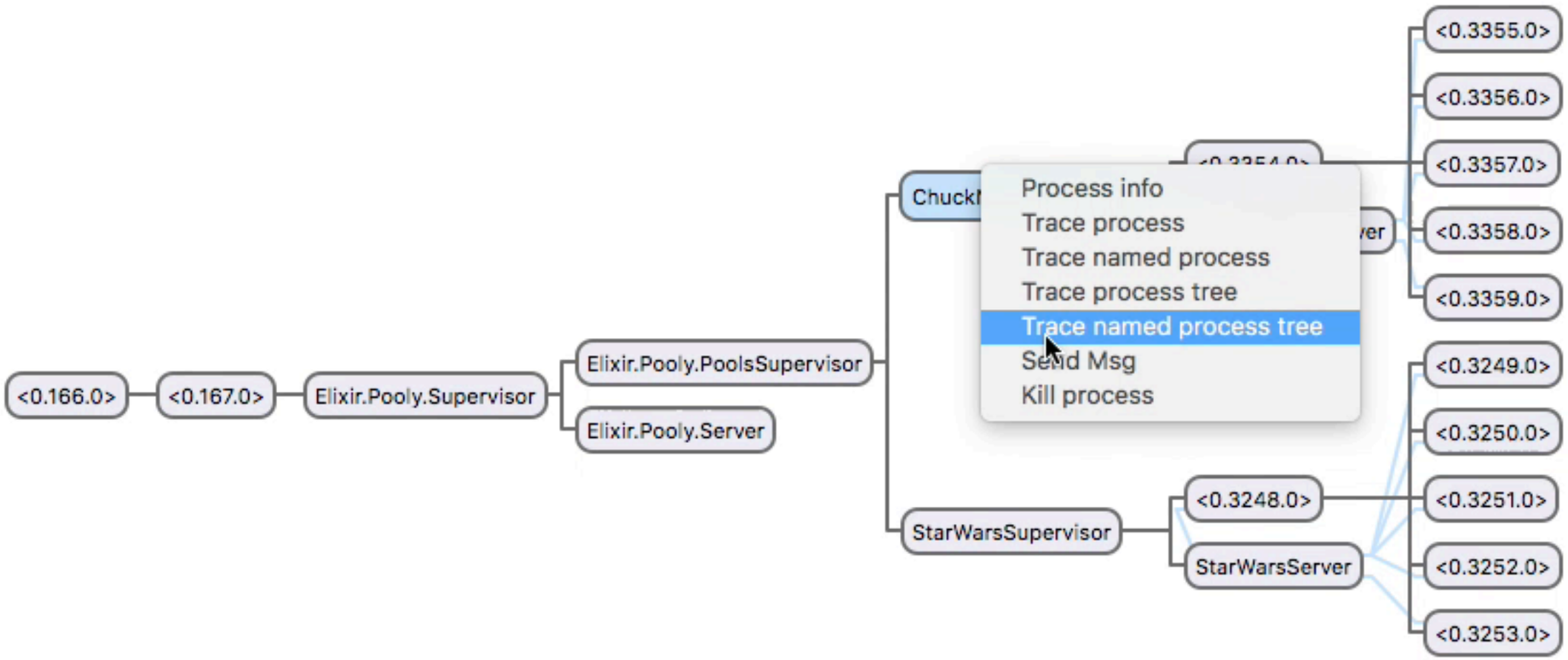
Demo: Killing Workers Supervisor



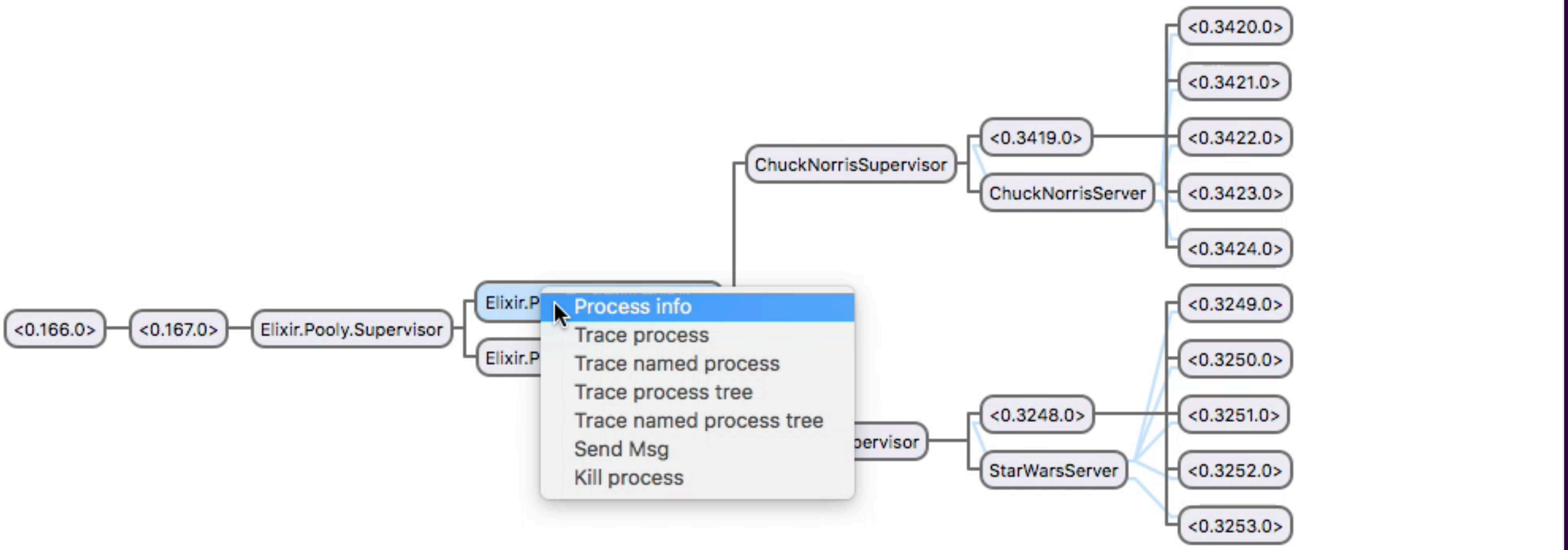
Demo: Killing Workers Supervisor



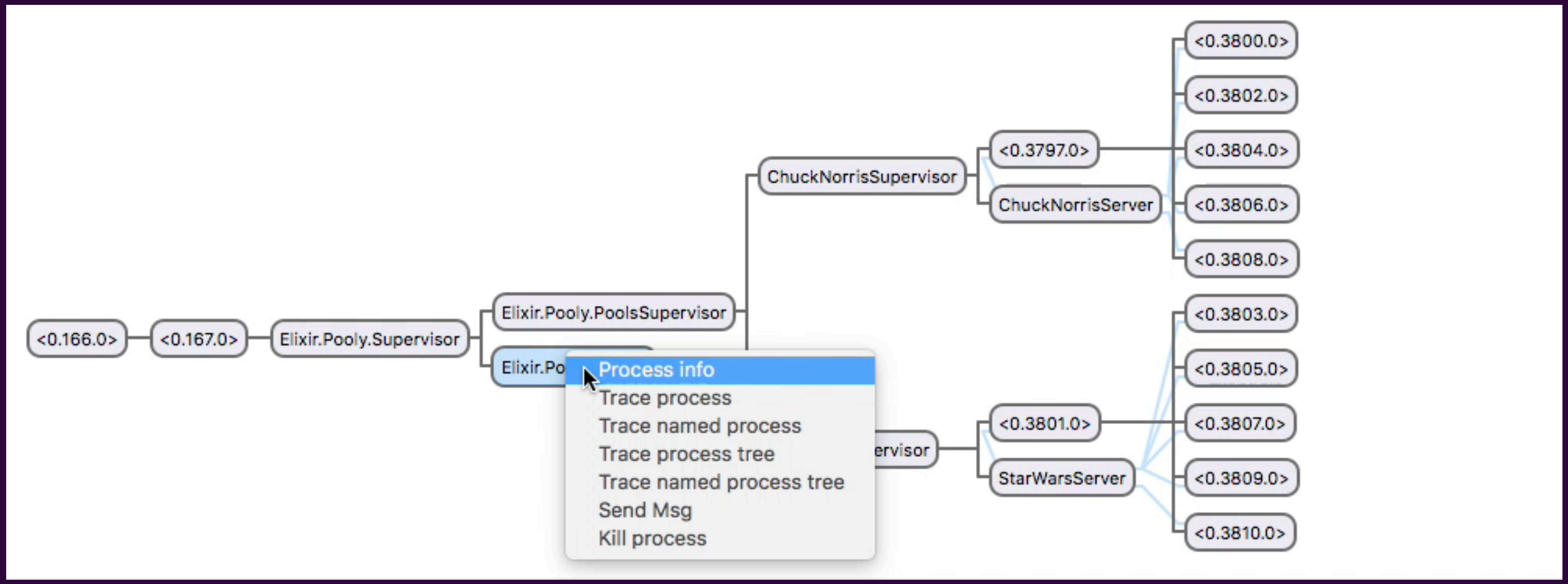
Demo: Killing Pool Supervisor



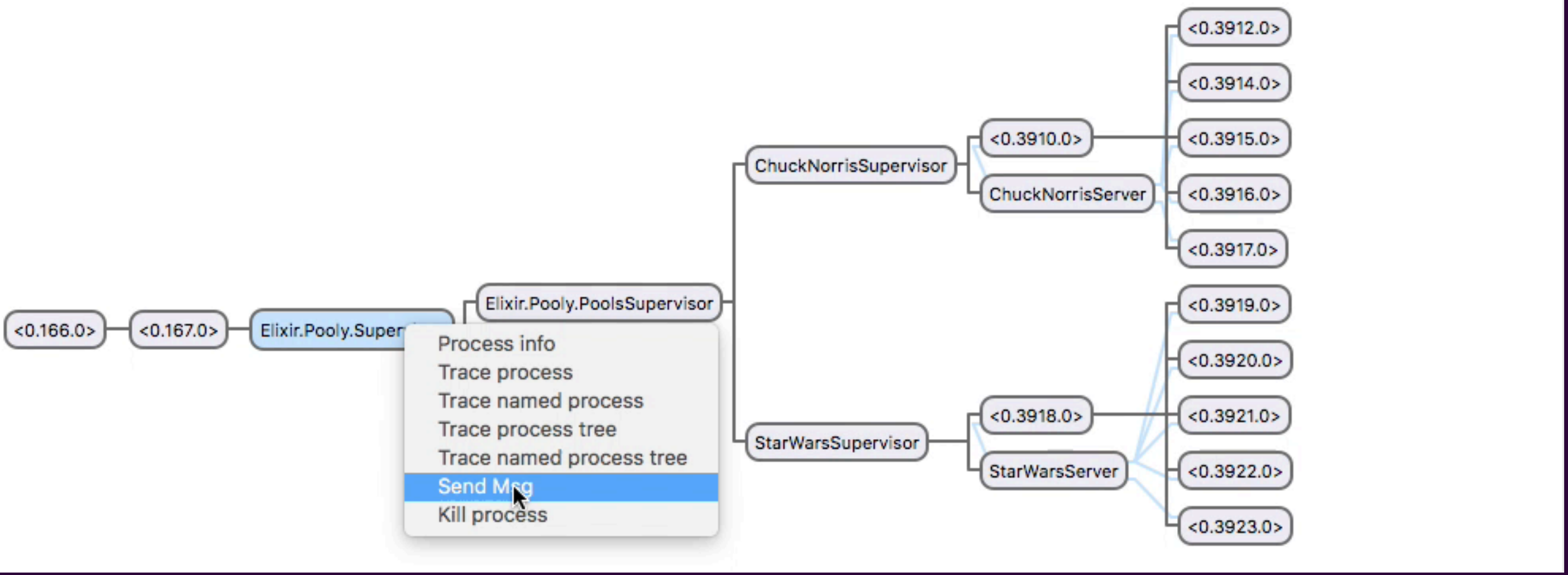
Demo: Killing Pools Supervisor



Demo: Killing Pools Server



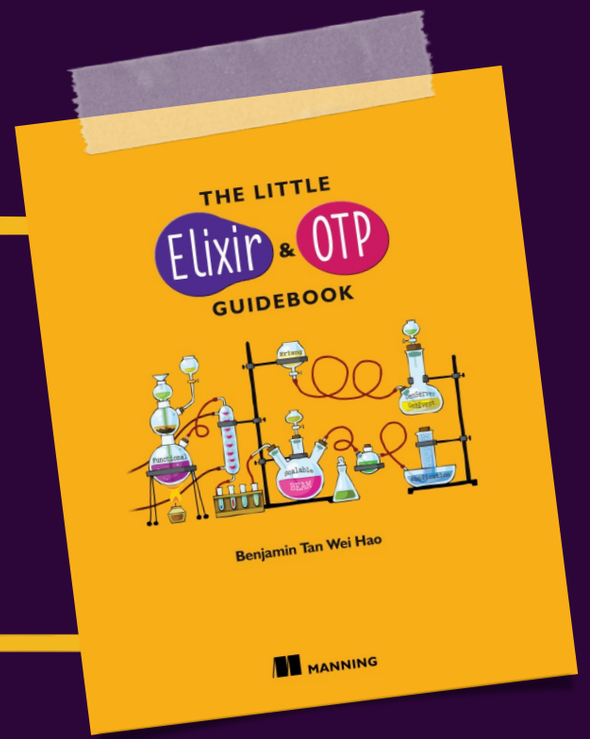
Demo: Killing The Top Level Supervisor




GREAT SUCCESS!

Resources

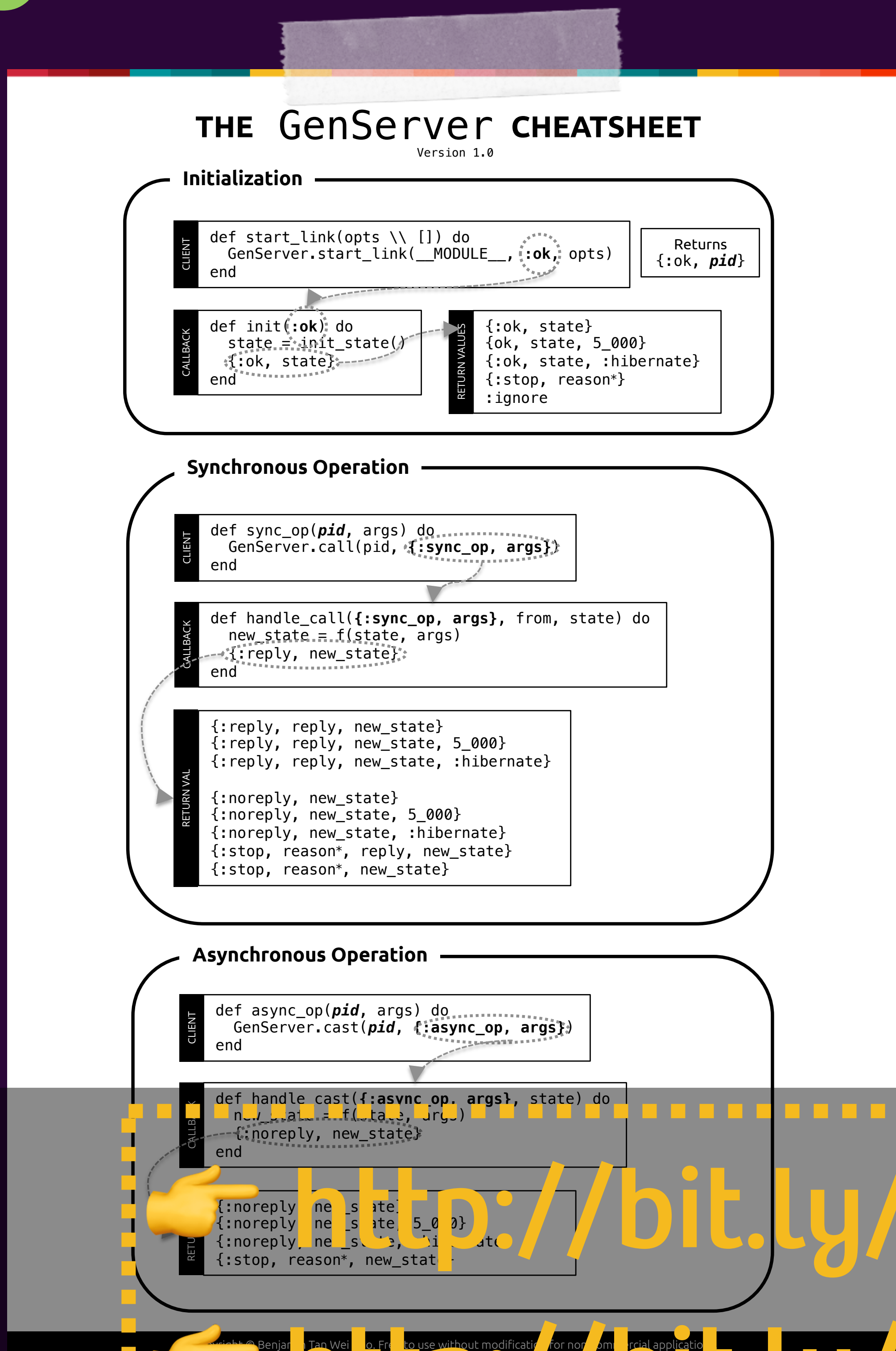
https://github.com/benjamintanweihao/the-little-elixir-otp-guidebook-code

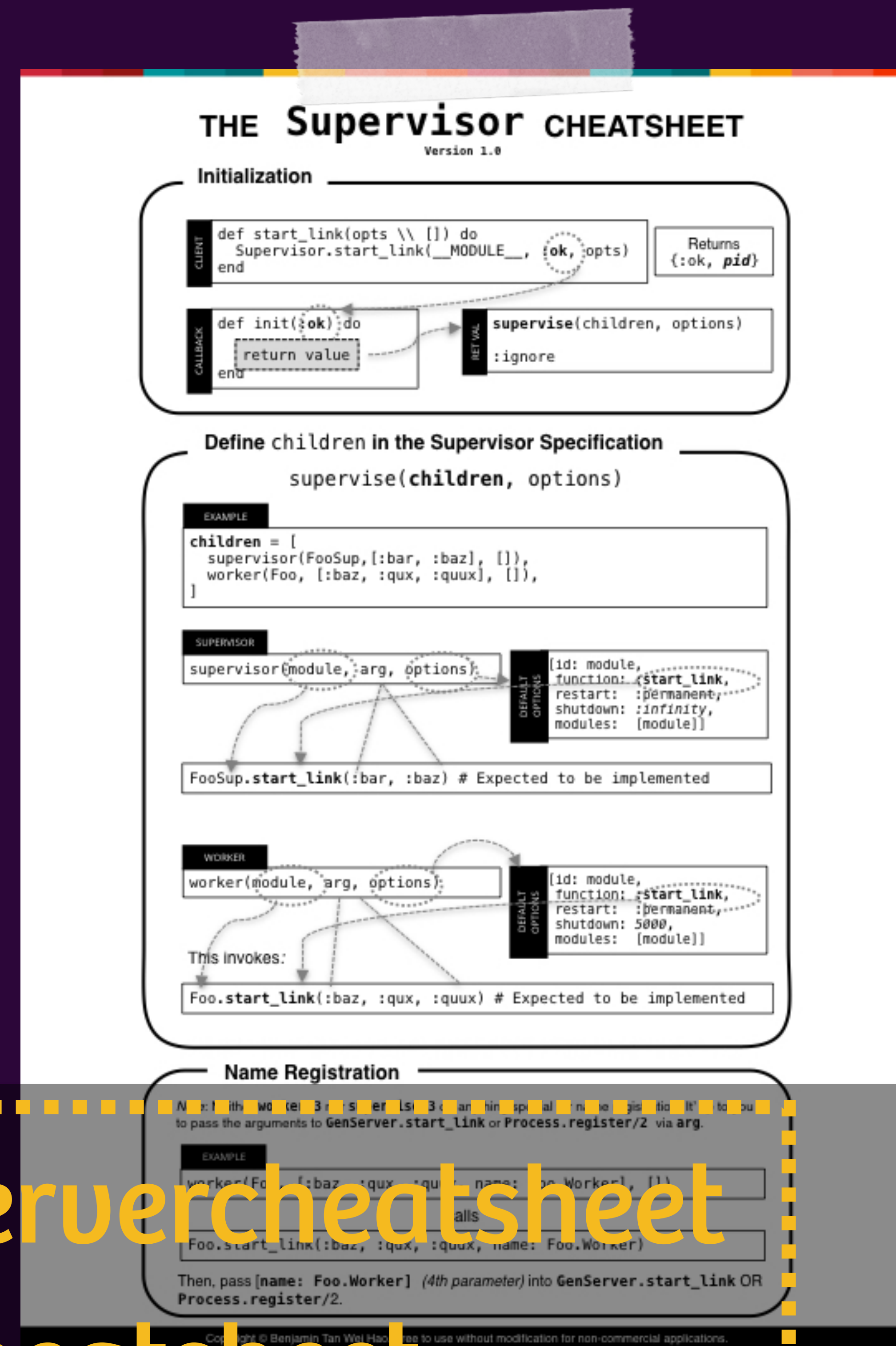


THE REAL THING™

https://github.com/devinus/poolboy

Resources



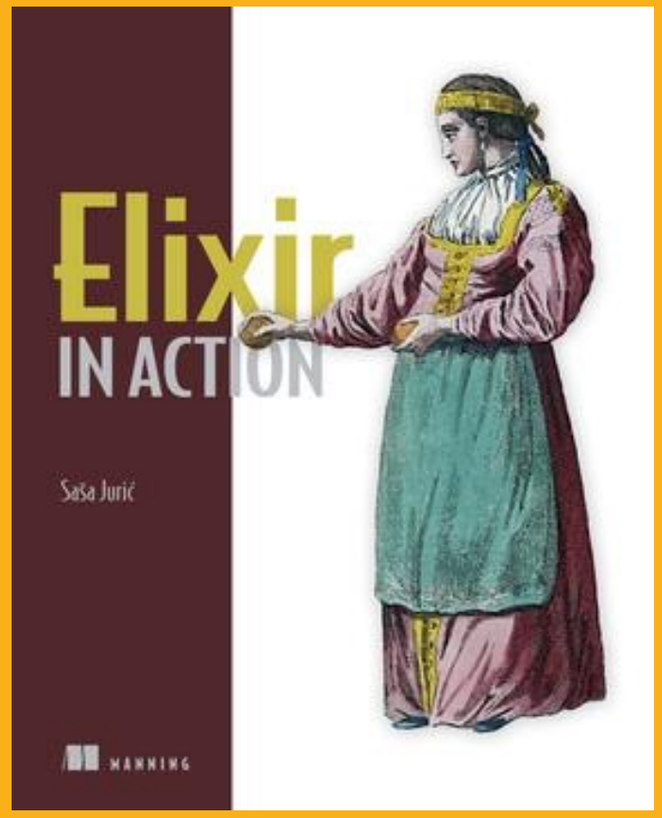


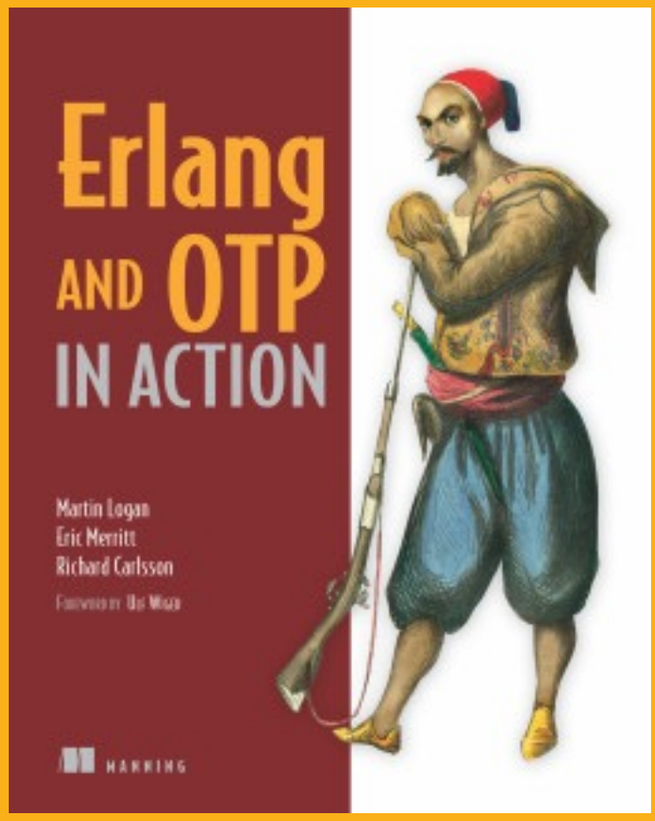
👉 http://bit.ly/genservercheatsheet

👉 http://bit.ly/supcheatsheet

ctweuc17

40% OFF!





KEEP

CALM

AND

LET IT

CRASH