Concurrency In The Erlang VM

Erlang is often referred to as the "*concurrency oriented programming language*".

How did it get this name? How can a language created in the 80s for the telecom industry help us now?

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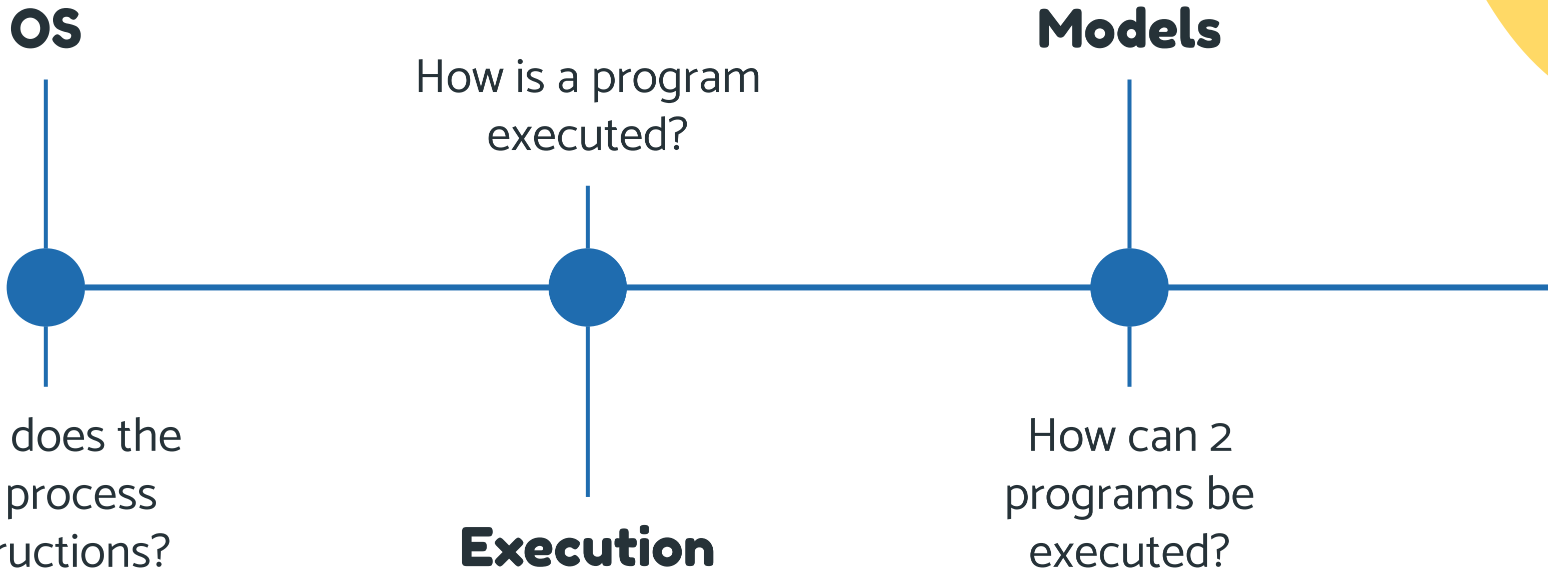
The Plan


OS
How does the OS process instructions?
How is a program executed?
Execution
Models
How can 2 programs be executed?

The Plan

Demo

Getting our hands dirty with Elixir.

So much more to learn! So little time to do it.

Extended Topics

Coronavirus will end.... maybe?

whoami

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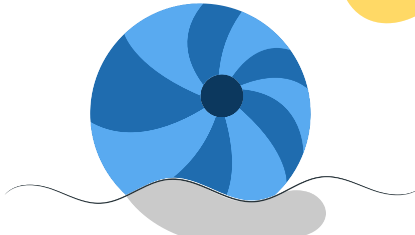
How does the OS process instructions?

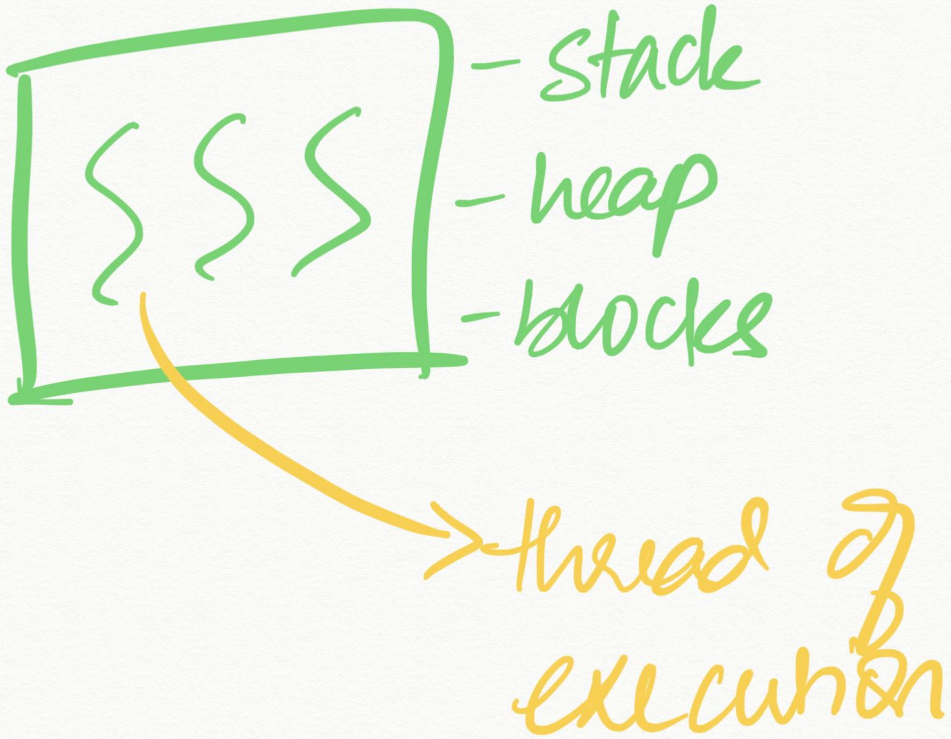
1. Obviously uses the **CPU**.
2. The CPU executes processes.
3. Processes are isolated blocks of execution. It occupies memory, it has a stack and heap, it is able to context switch.
4. **Threads** are “lightweight” processes.

1. The CPU does not process multiple processes at a time. It processes small bits of multiple processes sequentially, switching over so fast that it “looks” like it is processing in parallel.
2. **Context switching** is expensive!

1. **Moore’s law**: The number of transistors on an affordable CPU would double every two years.
2. Unfortunately we’ve hit a bump in the road, we’ve reached the upper limit of the Moore’s law.
3. Now it makes sense to scale horizontally, instead of vertically. Hence “cores”.
4. This happened when we realized going much higher than 4GHz is very difficult and futile. *Speed of light actually became a constraint.*



An OS Process



Execution

Sequential

Start executing process B, only after process A is complete.

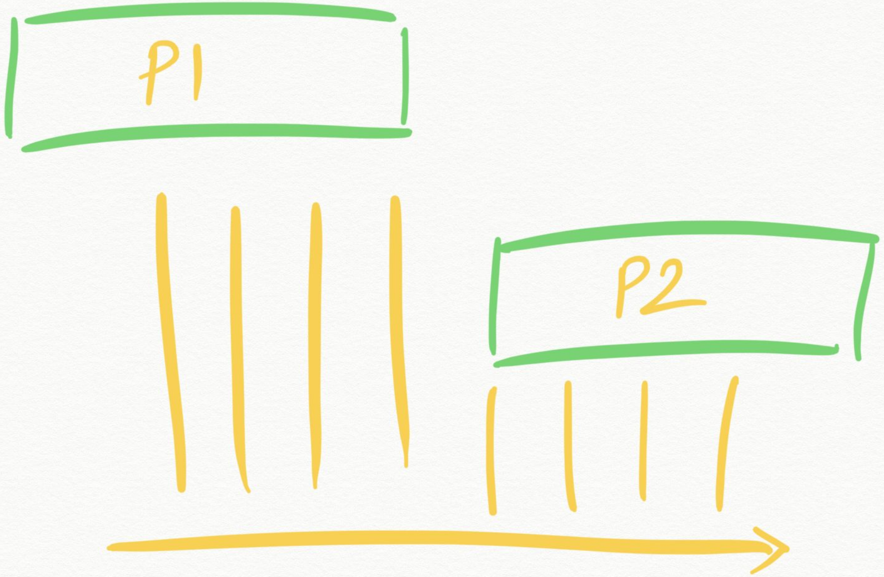
Concurrency

Break up process A and B, switch between them really fast.

Parallelism

Execute both process A and process B at the same time.

Sequential Processing



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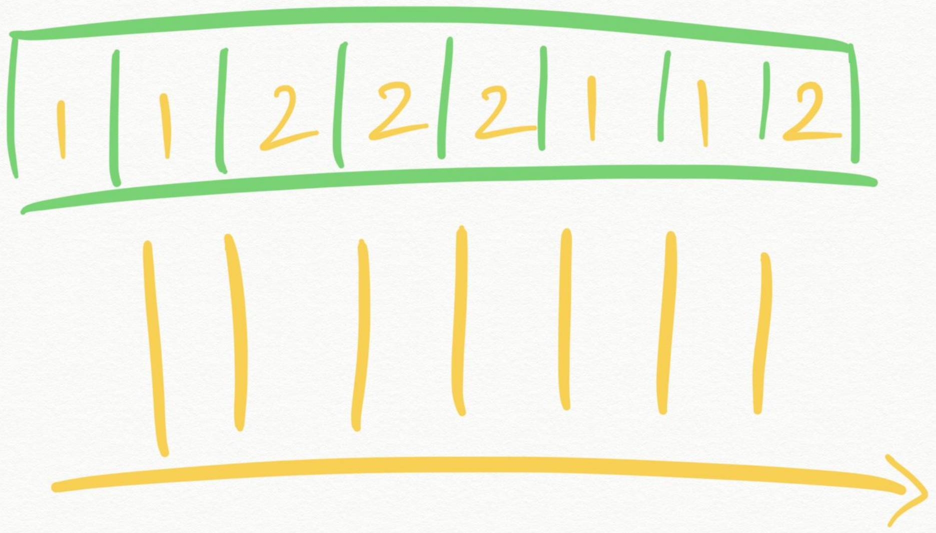
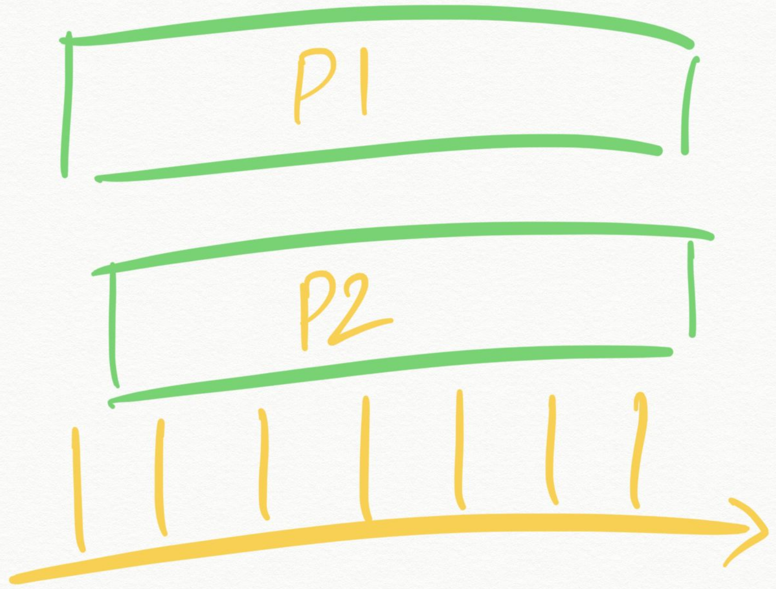
Concurrency



Parallelism



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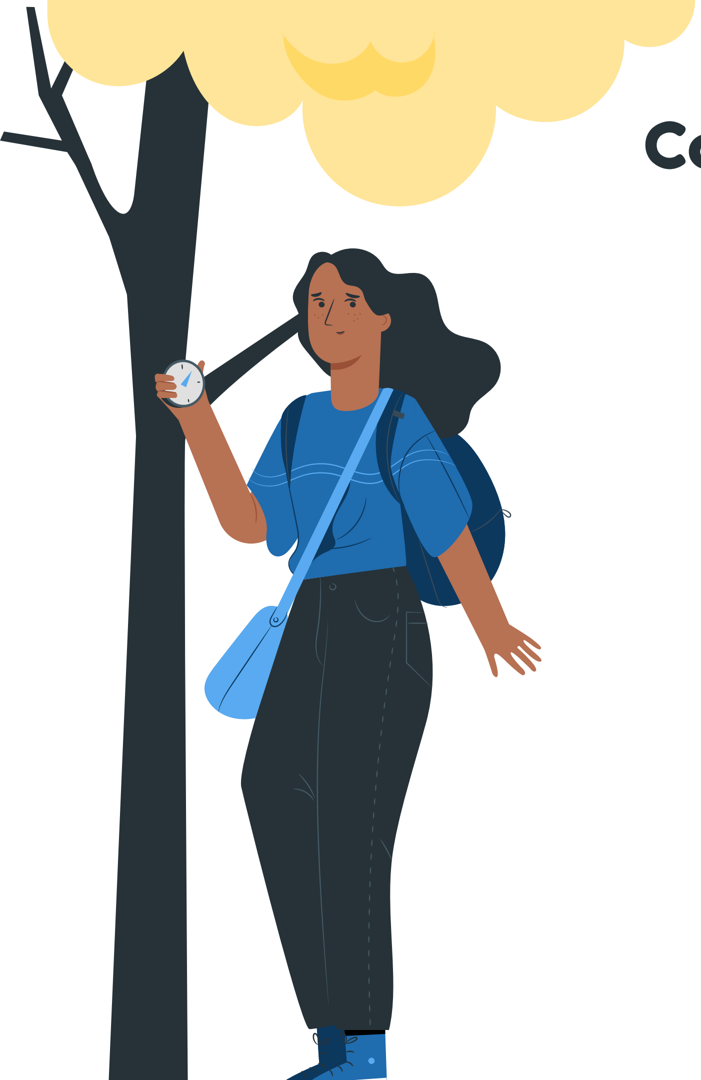

Concurrency Models

SM

Shared Memory model used by Java and C#.

Actor

Actor model used by Erlang and Rust.

CSP

Communicating Sequential Process model used by Go.

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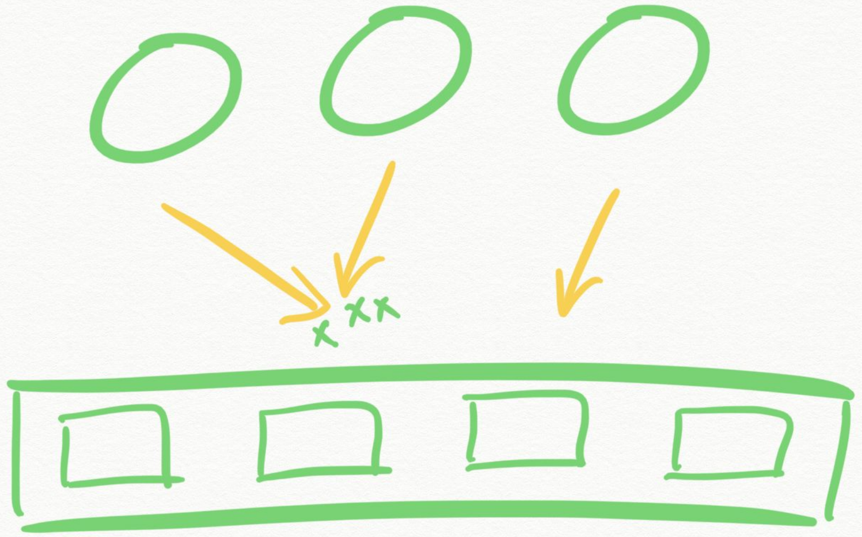
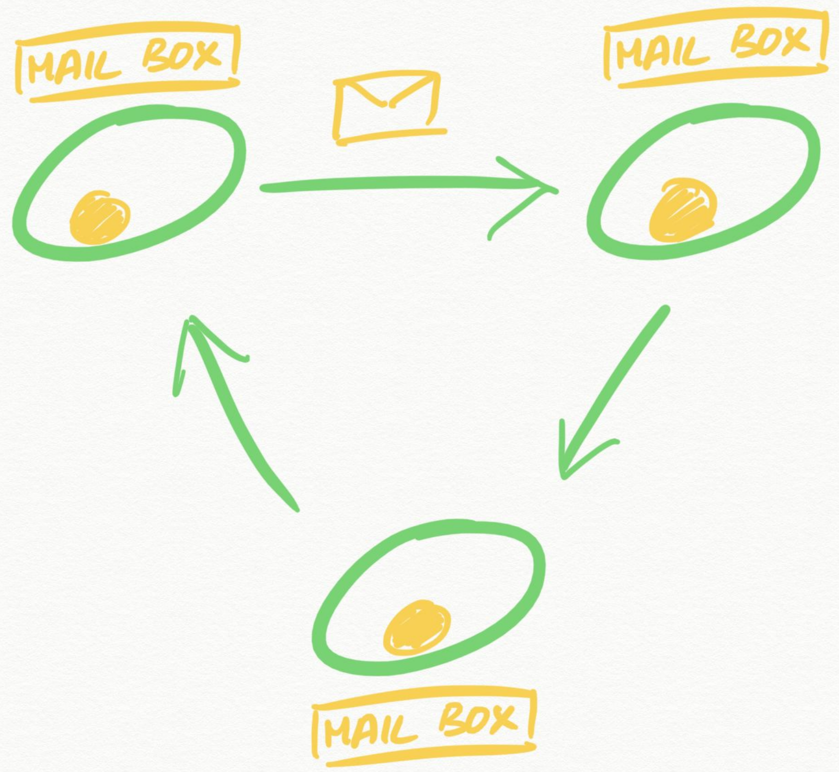
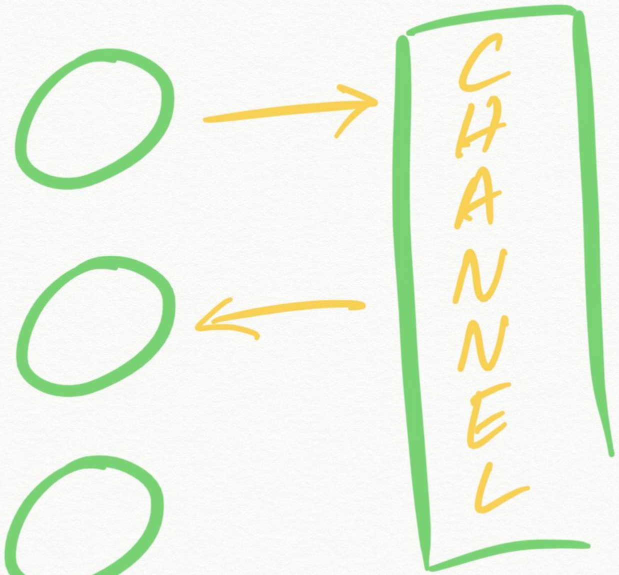
Shared Memory



Actors



Communicating Sequential Processing



Actor Model

Create

Create more actors (these are not child processes).

Send

Send messages to other actors.

Actor Model

Designate

Designate what to do with the next message. It basically means defining how this state will look like for the next message it receives. Or, more clearly, it's how actors *mutate state*.

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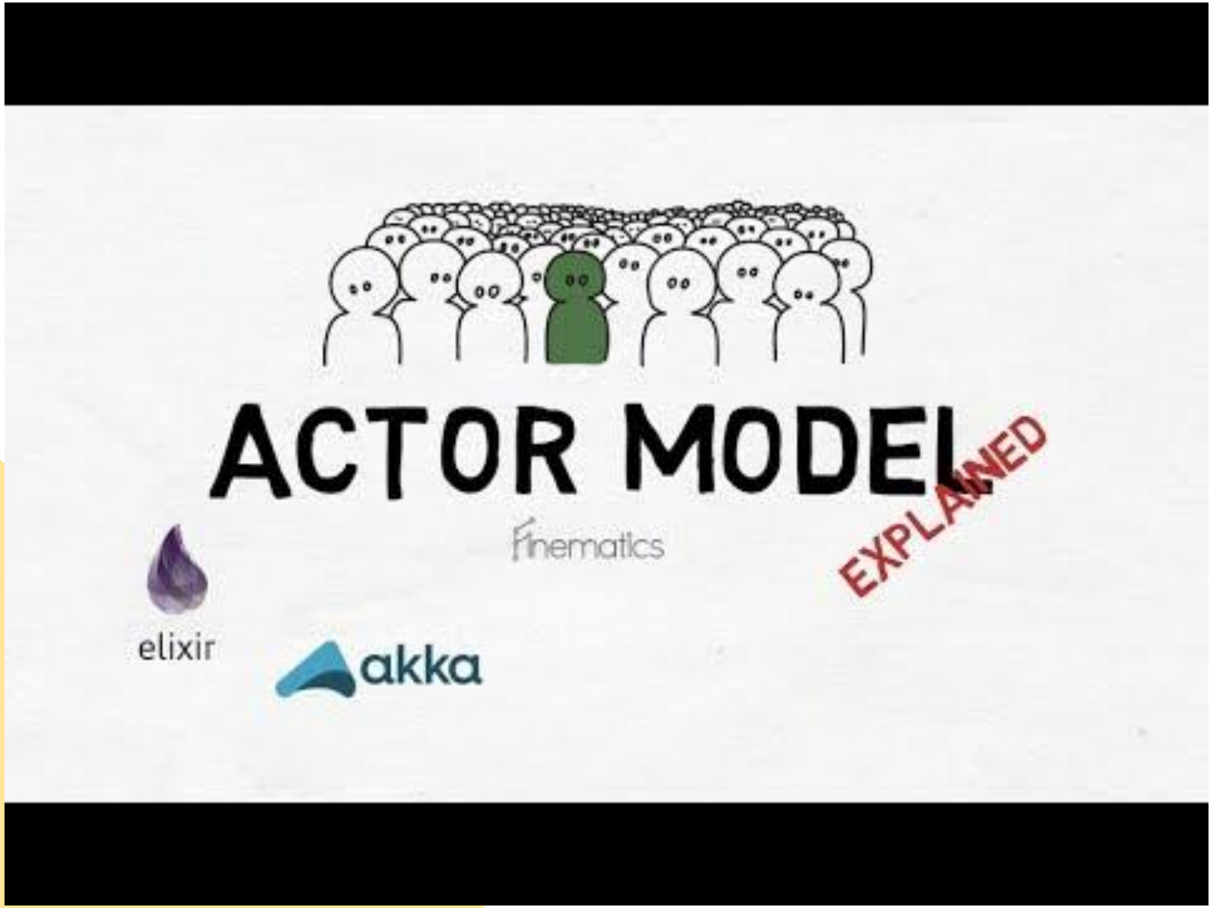
The Actor Model in 5 Min

Because a picture is worth a 1000 words, and a video so much more.



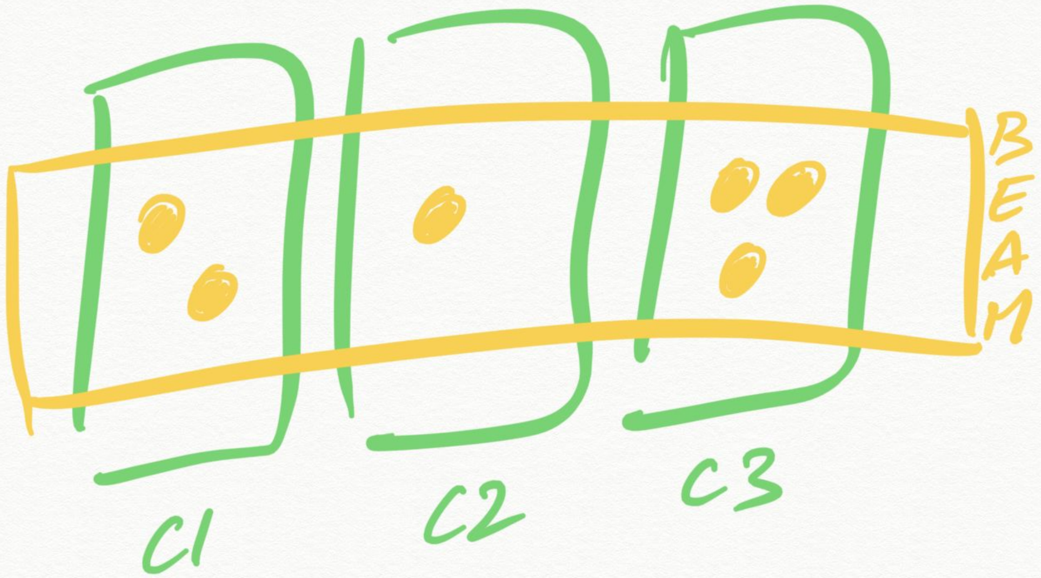
So.. Erlang?

Erlang is so great at concurrency because of BEAM.

Beam me up Scotty....? No!

BEAM is the Erlang VM. It schedules lightweight Erlang processes. Erlang processes, not OS processes.

BEAM



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01

BEAM

Lightweight Erlang threads and scheduling.

02

Actor Model

Message passing and isolated processes.

03

Distributed

Scale horizontally and make use of all cores.

04

Fault Tolerance

Failure at one node does not affect other nodes.

Also...

No GIL

Global Interpreter Lock

Immutability

Not mutable?

Compiled

Hence the VM!

Supervisor

Just like a real life supervisor.

GenServer

Used to keep state, execute code asynchronously.

...

I wish I knew this one to make this slide balanced.

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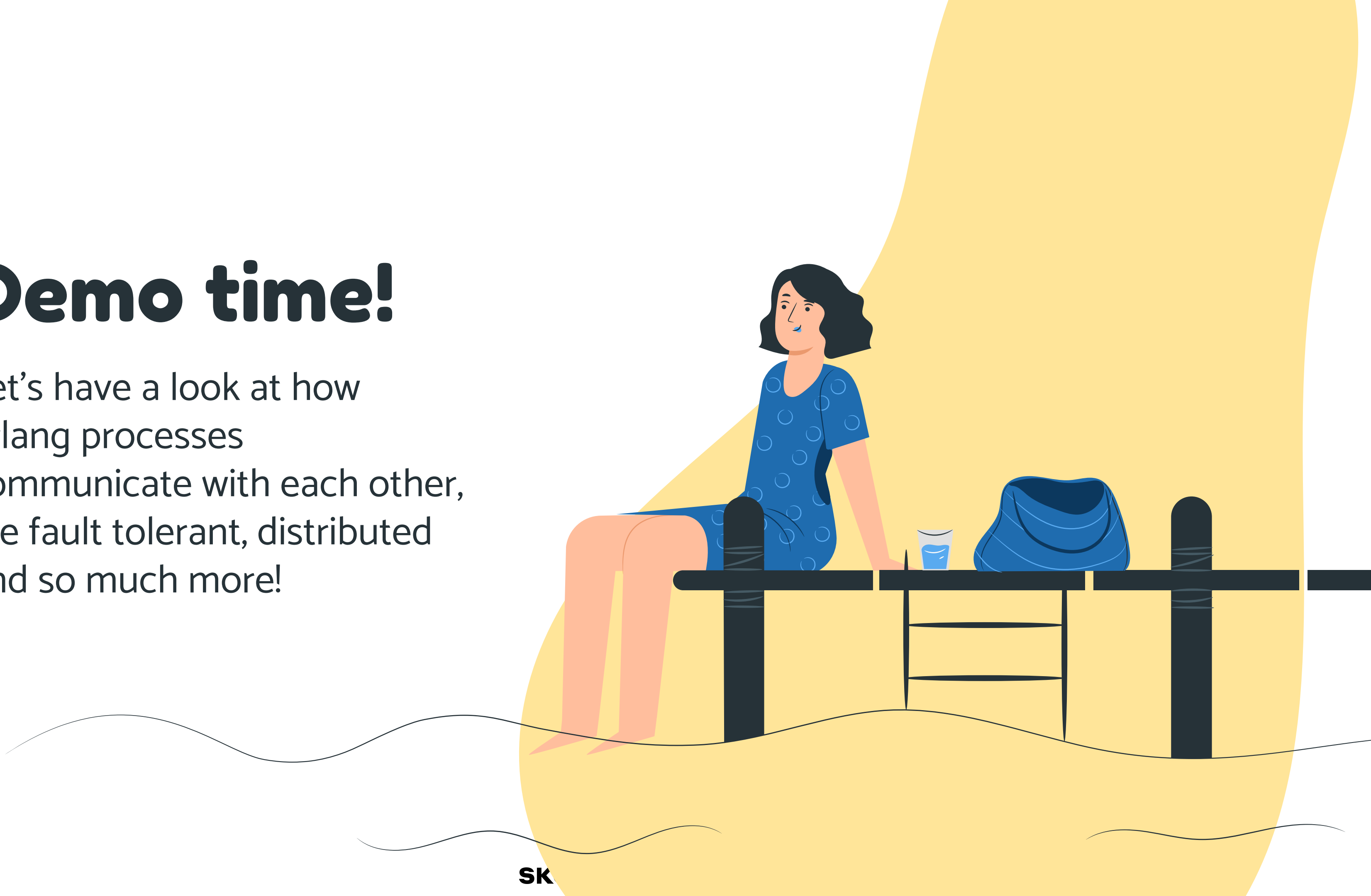
Demo time!

Let's have a look at how Erlang processes communicate with each other, are fault tolerant, distributed and so much more!



Resources

- https://www.knowthen.com/elixir-and-phoenix-for-beginners
- https://stackoverflow.com/questions/2708033/technically-why-are-processes-in-erlang-more-efficient-than-os-threads
- http://dockyard.com/blog/2020/05/28/scaling-up-with-elixir
- http://ablogaboutcode.com/2012/02/06/the-ruby-global-interpreter-lock
- https://tsh.io/blog/simple-guide-concurrency-node-js/
- https://www.poeticoding.com/spawning-processes-in-elixir-a-gentle-introduction-to-concurrency/
- https://www.poeticoding.com/hey-process-there-is-a-message-for-you/
- https://www.brianstorti.com/the-actor-model/
- http://blog.plataformatec.com.br/2018/04/elixir-processes-and-this-thing-called-otp/

- Zen of Erlang
- Gary from Android Authority: Process and Threads
- Concurrency in a Go Coffee Shop
- Hewitt, Meijer and Szyperski: The Actor Model

Thanks!

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