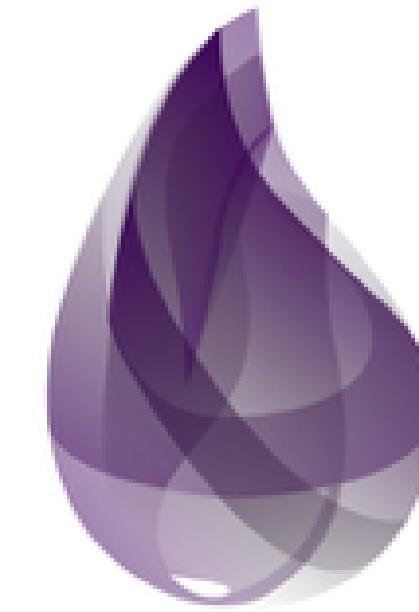


3.1.2021 / 6pm if [www.HAU4.de](http://www.HAU4.de)

# Elixir

Presented by @Dawei Ma



elixir

# My programming language learning path

- C/C++
- Java/Scala (SpringBoot/Play2/Vert.x/RxJava)
- Swift/Objective-C (RxSwift)
- Python (Django/Flask/Tornado)
- Elixir/Erlang (Phoenix)
- Golang
- Javascript (Vue/Angular)
- PHP (Laravel)
- CommonLisp (Learning)
- Rust (Will Learn)

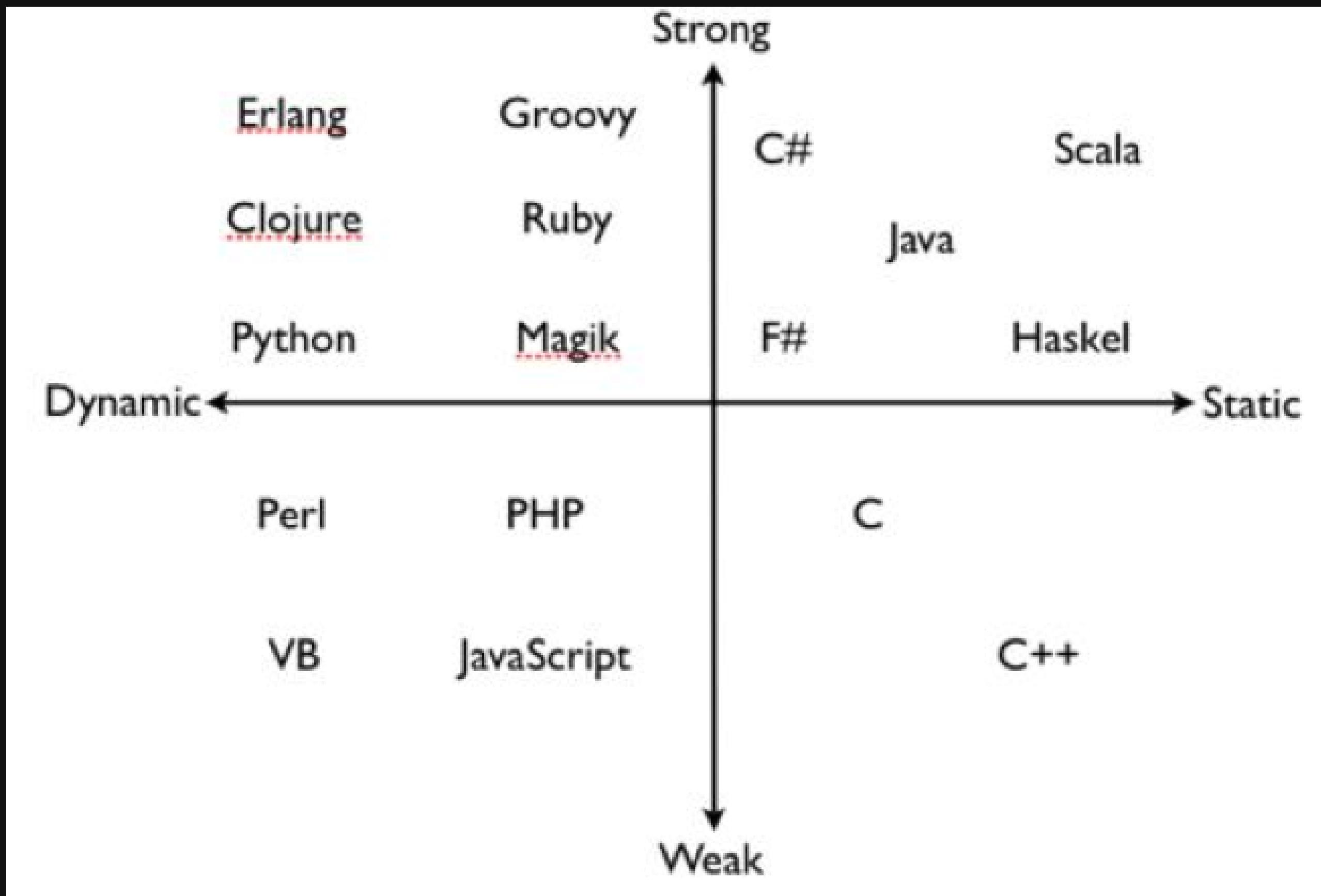
# Rules for learning a language

- Must solve a problem
- Problem not addressed by current stack
- “Fast” is not a purpose
- Should be the best solution

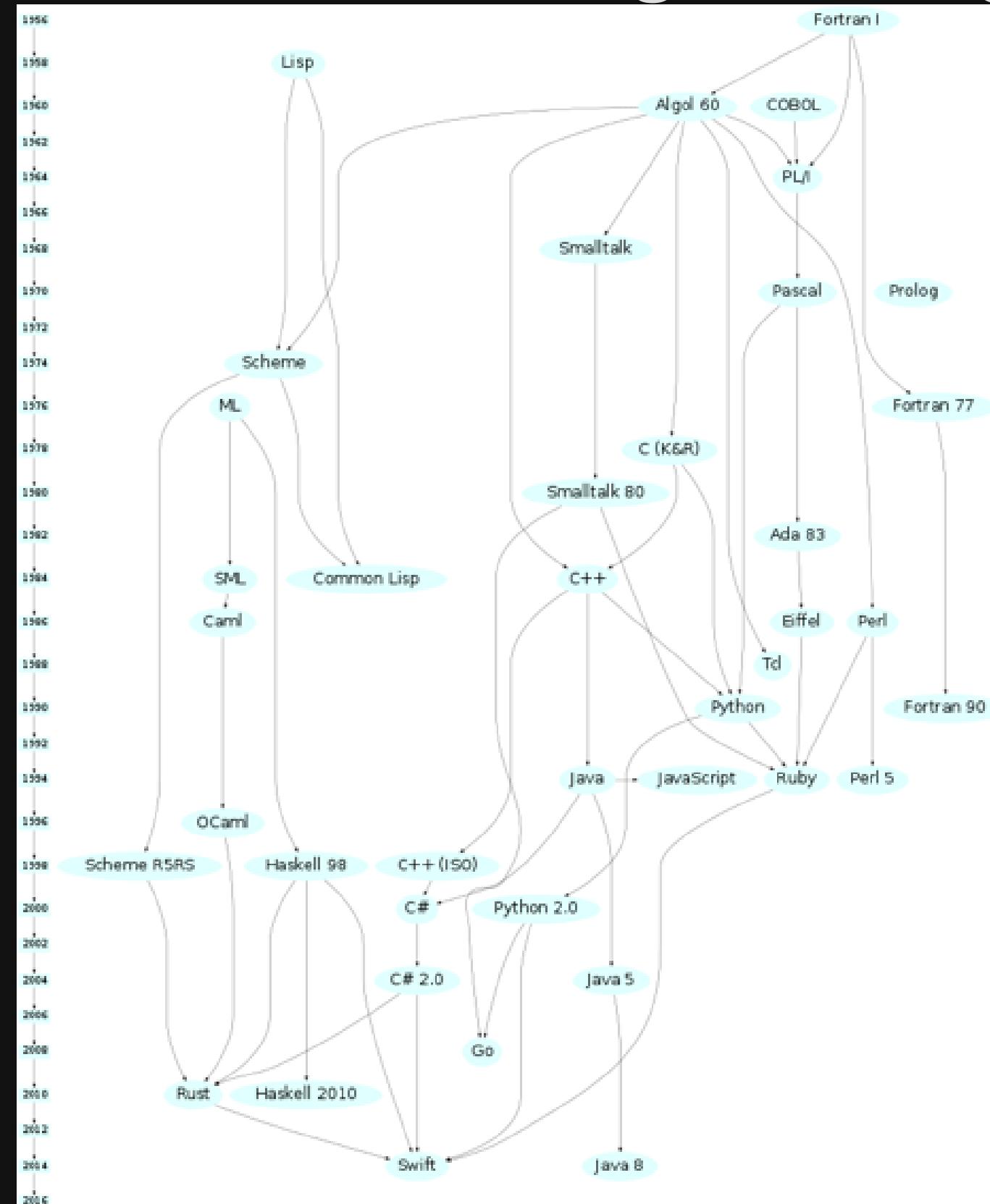




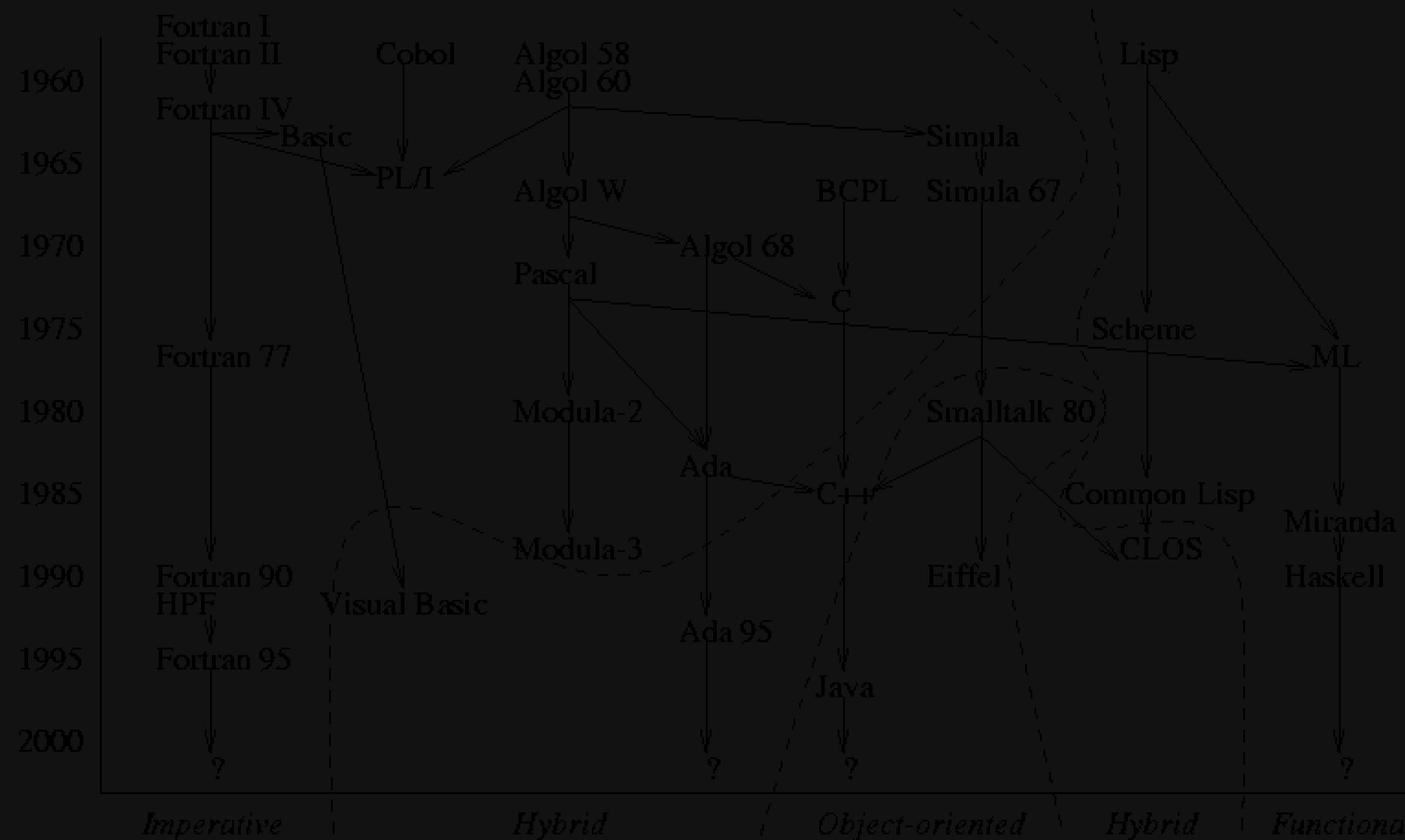
# Type System



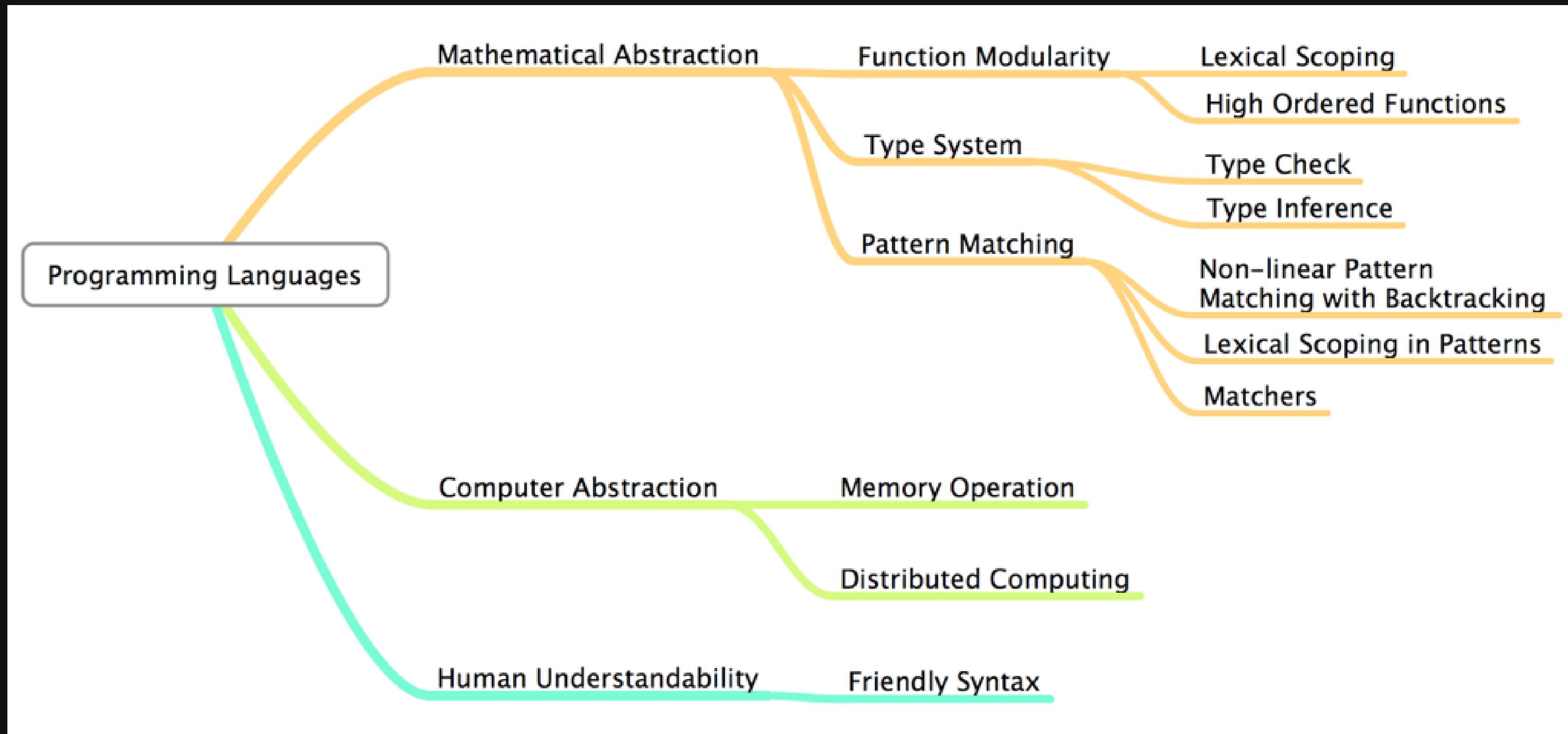
# Evolution of Programming Languages

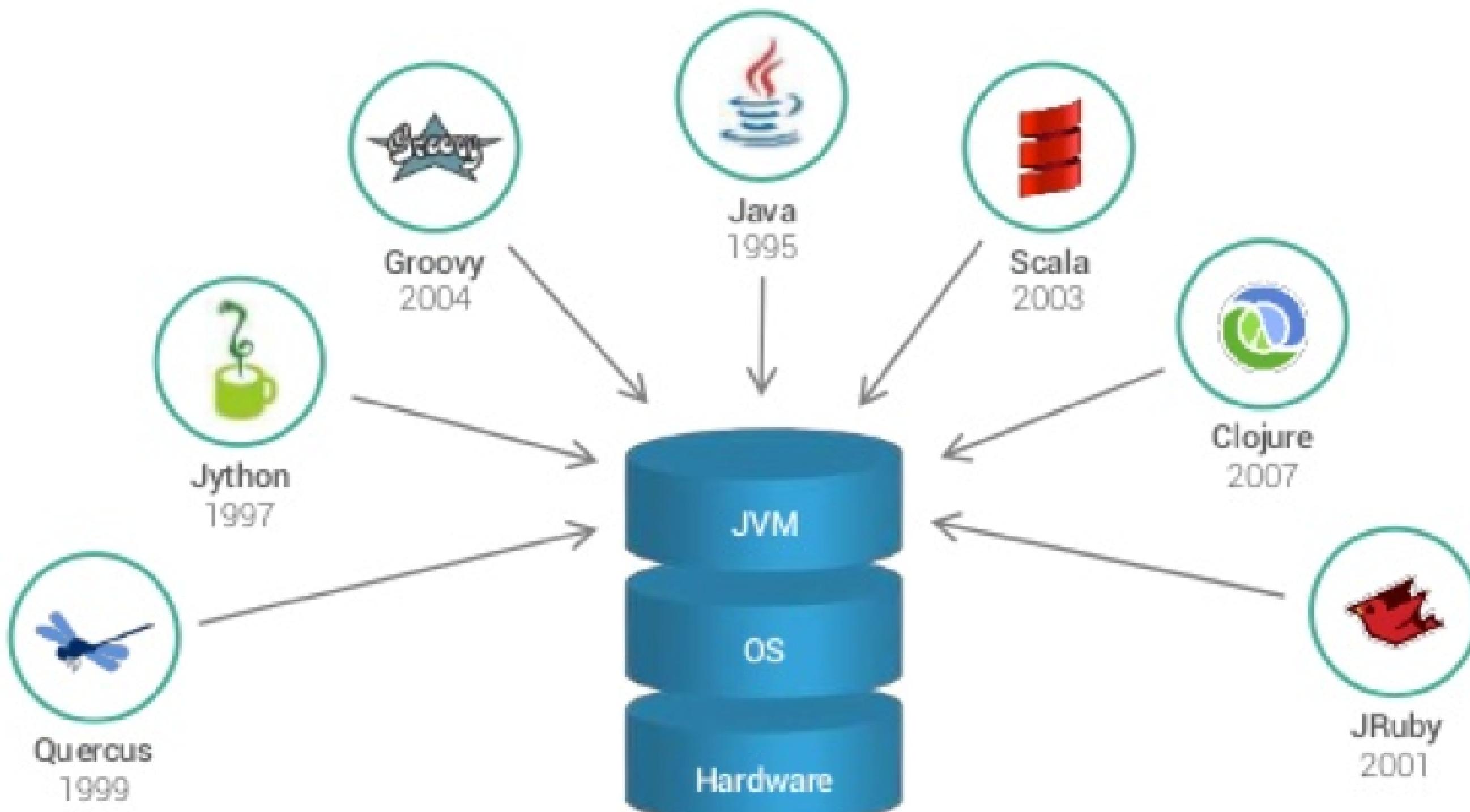


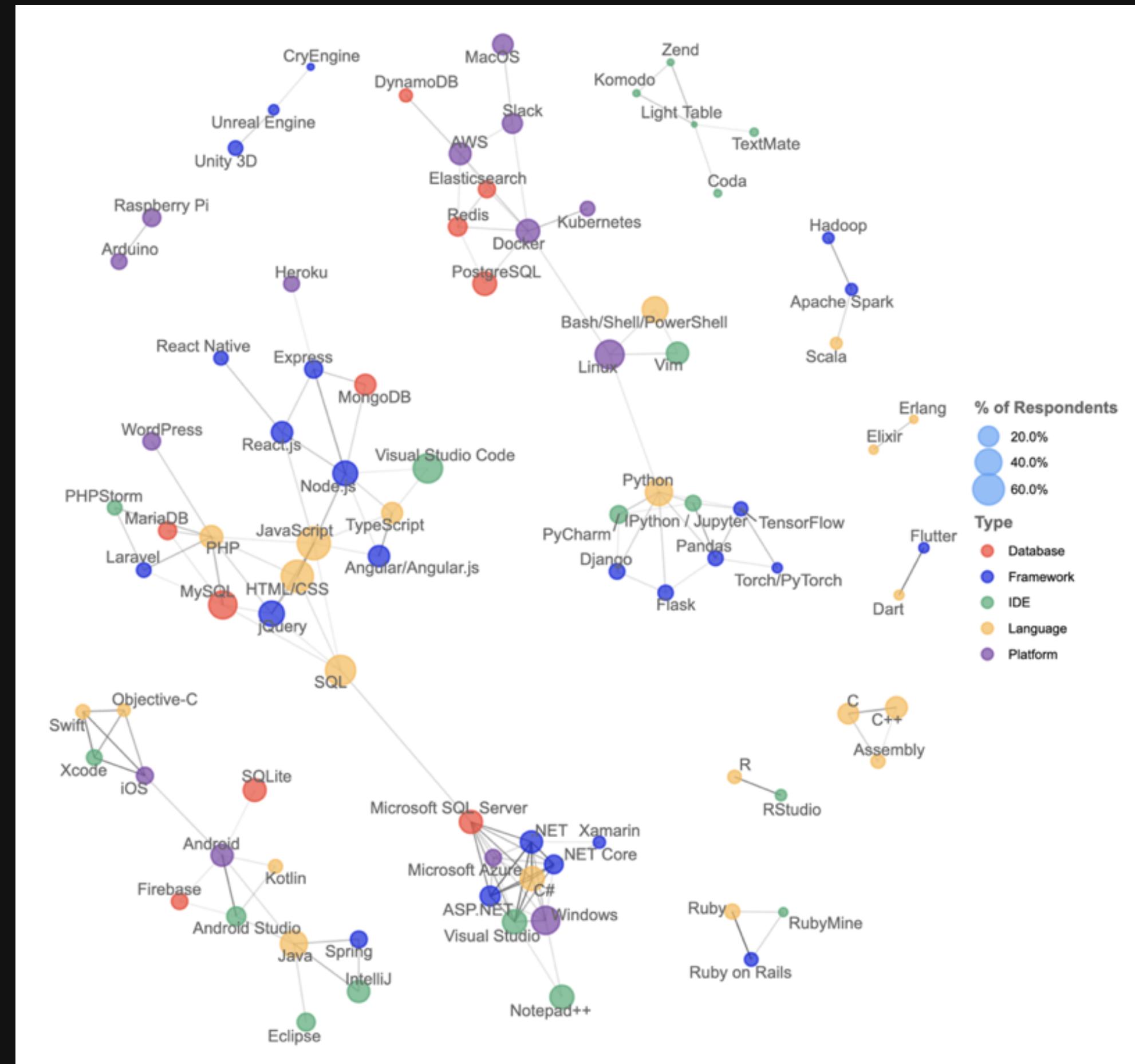
# Classify



# Evaluate programming languages





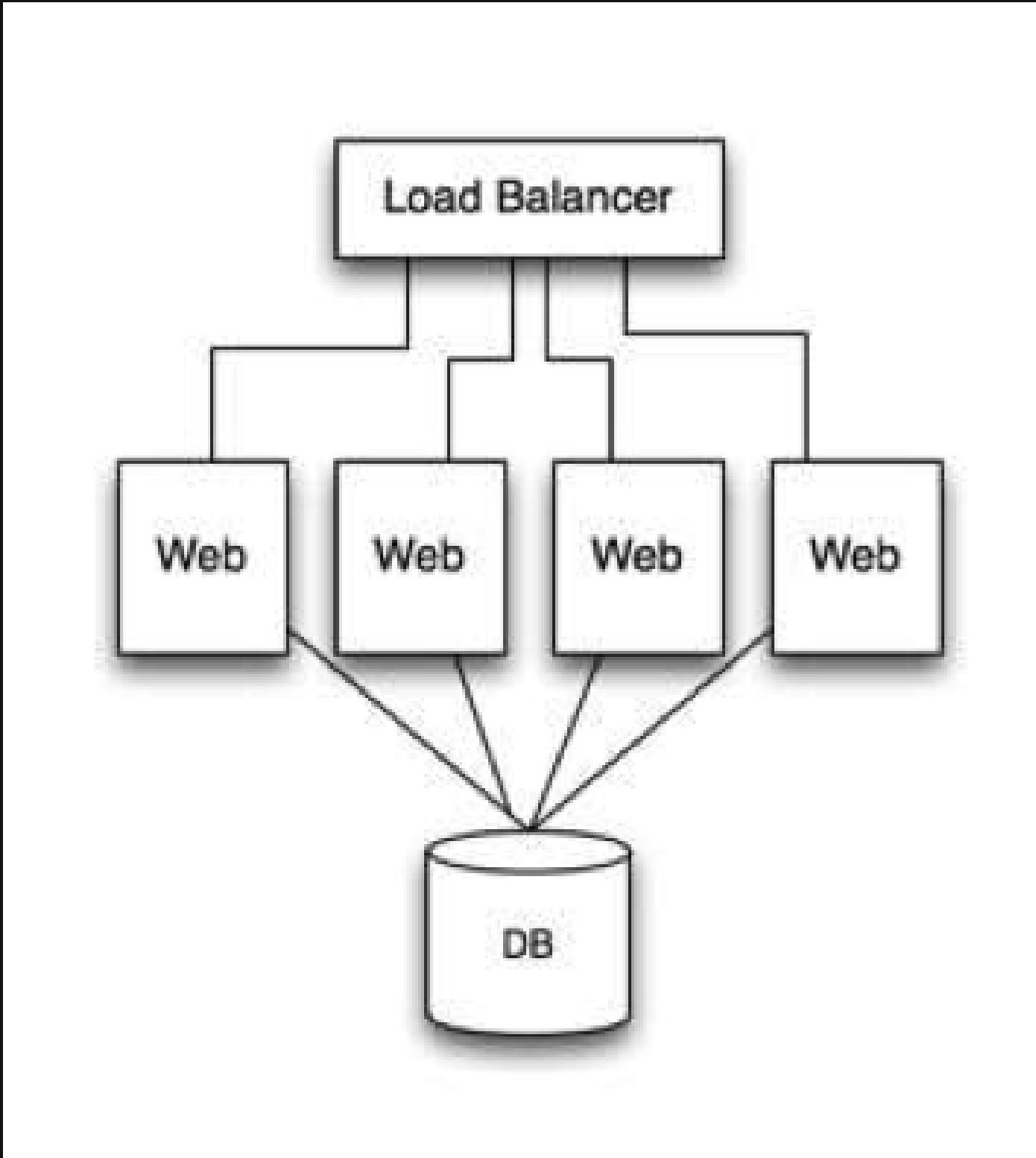


## WHAT'S THE BIG DEAL WITH ELIXIR?

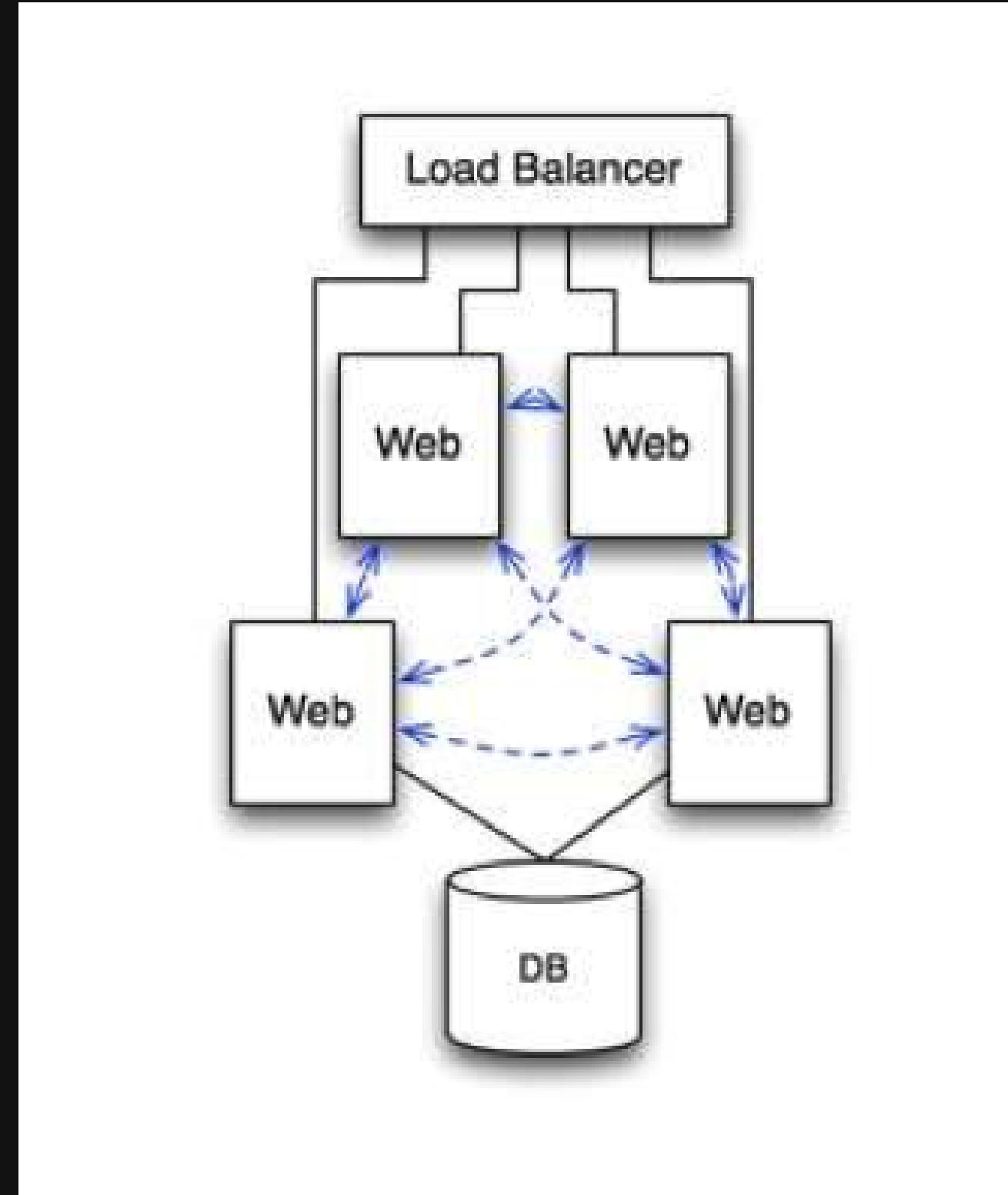
- Ruby-like focus on developer productivity
- Embedded database
- Compiles down to code to run on the BEAM Virtual Machine
- BEAM/OTP is what Erlang runs on
- Erlang/BEAM is the best existing language for concurrency, consistency and fault tolerance, hot code swapping
- Erlang does not focus on developer productivity
- Problem in Ruby is concurrency model



# Standard Web App



# OTP



# What's the big deal?

- Facebook paid \$22 billion for WhatsApp
- WhatsApp had \$10 million in revenue
- What was the big deal?
  - Erlang/OTP
  - 2 million users / server
  - No central relay point
  - Scales horizontally
  - Deploys w/o disconnect

# Other languages

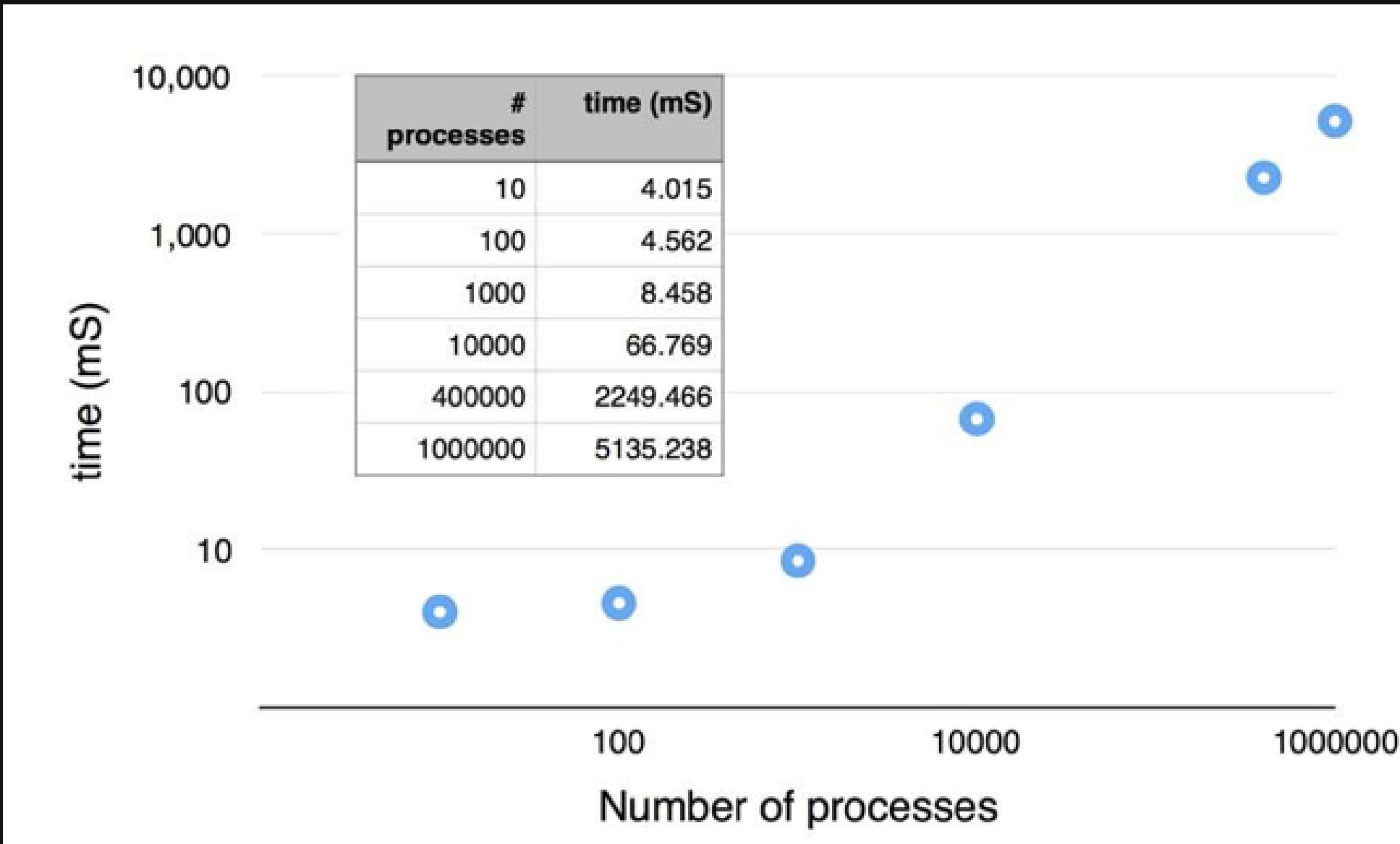
- Boot up
- Memory is shared
  - Where leaks come from
  - Changing shared memory requires a mutex lock
- Garbage collector periodically runs
  - Pause entire stack
- Requests run in threads in the same process
  - Threads are cooperatively scheduled
  - Deployment means shutting down current code, starting new code

# Erlang/Elixir/OTP

- No memory is shared
- Data structures are immutable
- Each Erlang process (basically a light thread) has its own HEAP
  - Reclaimed on completion
- Code can be hot deployed
  - New code runs next time it's accessed (existing code keeps running)
- Processes are prescheduled

# Sound familiar?

- Difference is size of the allocations
  - An Erlang process is 0.5 kb
  - A Go goroutine is 2 kb (version 1.4)
  - A Java thread is 1024 kb on 64 bit VM
  - PHP request varies by how much is loaded
  - Laravel averages 7-12mb / request



Programming Elixir, Chapter 15 Laptop w/ 4 cores and 4gb of RAM counting concurrently 1,000,000 processes =

- 0.48 gb in Elixir
- 1.91 gb in Golang (go routines)
- 977 gb in Java (threads)

# Immutable Data

- There's no passing pointers
- Add something to a list, get a new list
- Everything is “message passing”
  - Avoids mutex locks
  - Enables per-process garbage collection
  - Makes calling a function locally, in another process or on another machine transparent

# 3 Databases Built In

- ETS – Erlang Term Storage
  - In memory table storage for a node
- DETS – Disk-based Erlang Term Storage
  - Disk table storage for a node

# 3 Databases Built In

- Mnesia - #awesome
  - A relational/object hybrid data model that is suitable for telecommunications applications.
  - A DBMS query language, Query List Comprehension (QLC) as an add-on library.
  - Persistence. Tables can be coherently kept on disc and in the main memory.
  - Replication. Tables can be replicated at several nodes.
  - Atomic transactions. A series of table manipulation operations can be grouped into a single atomic transaction.
  - Location transparency. Programs can be written without knowledge of the actual data location.
  - Extremely fast real-time data searches.
  - Schema manipulation routines. The DBMS can be reconfigured at runtime without stopping the system.

# Loops?

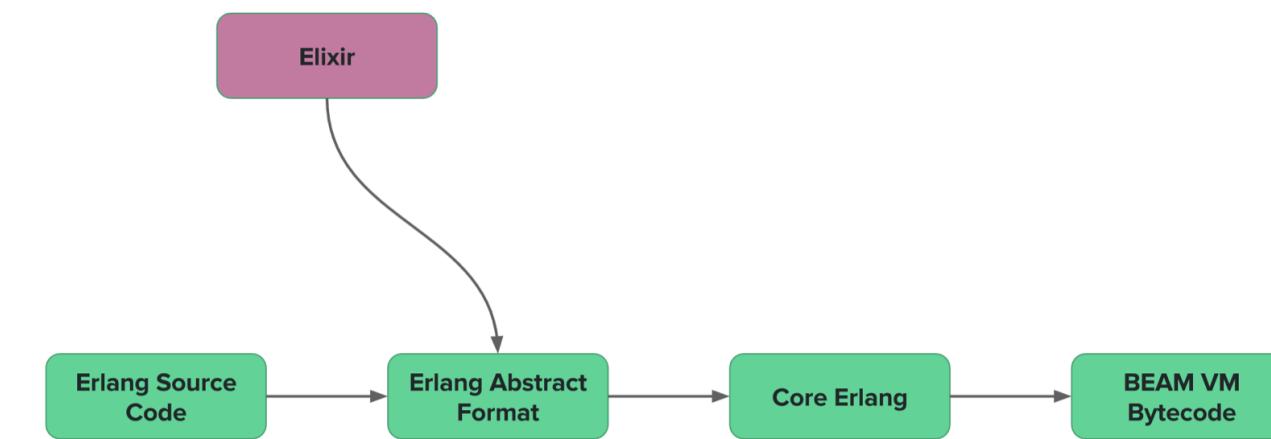
How do you have a for loop with an immutable increment?

Recursion. Lots of recursion.

“If Java is the right one to run anywhere, then Erlang is the right one to run forever.”  
- Joe Armstrong

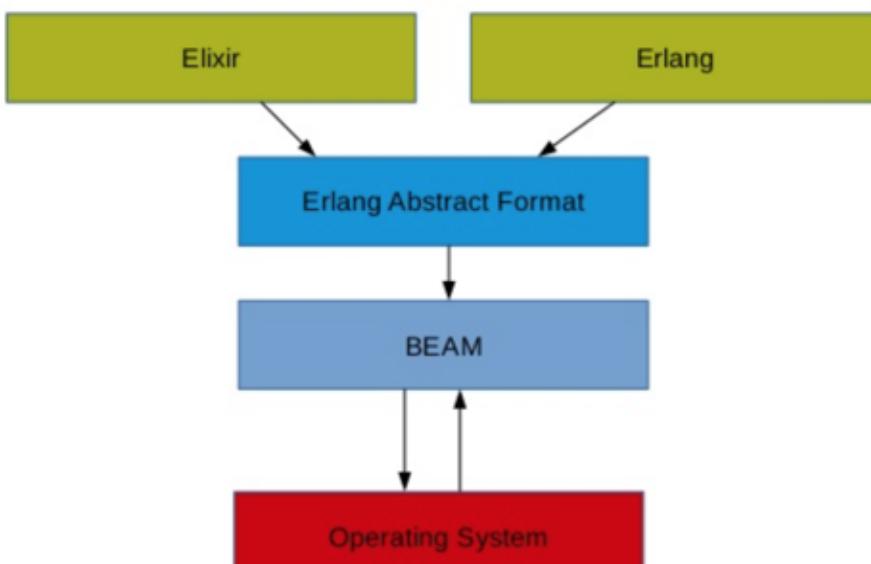


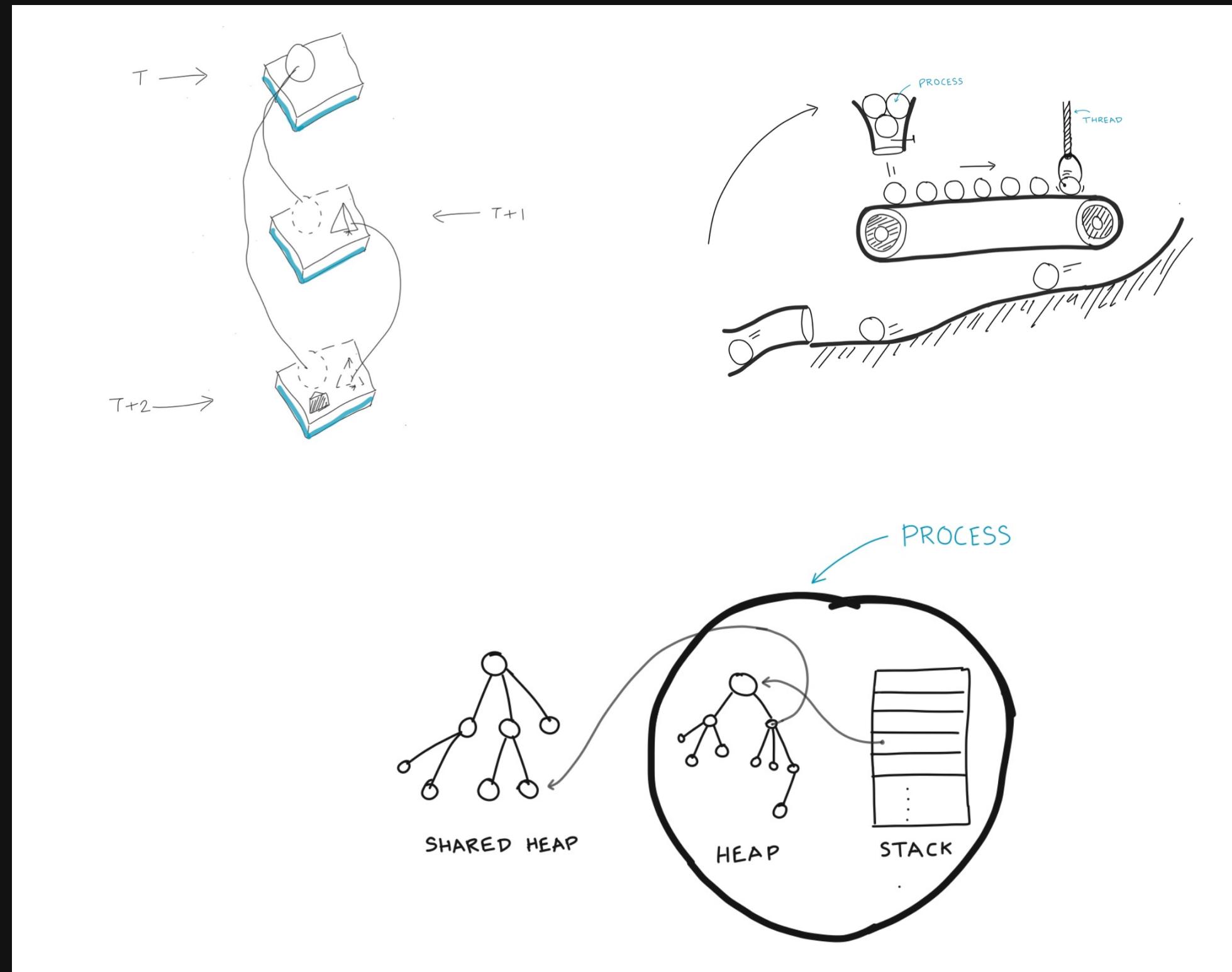
elixir



# elixir on beam

## What Is Elixir?





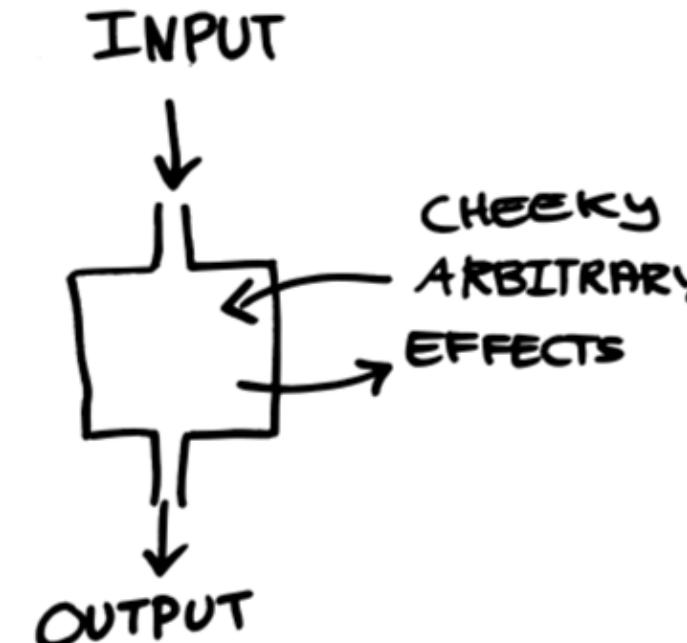
# why functional?

- Predictable
- Easier to test
- Immutable data
- Easier concurrency
- Simpler (yes, really)

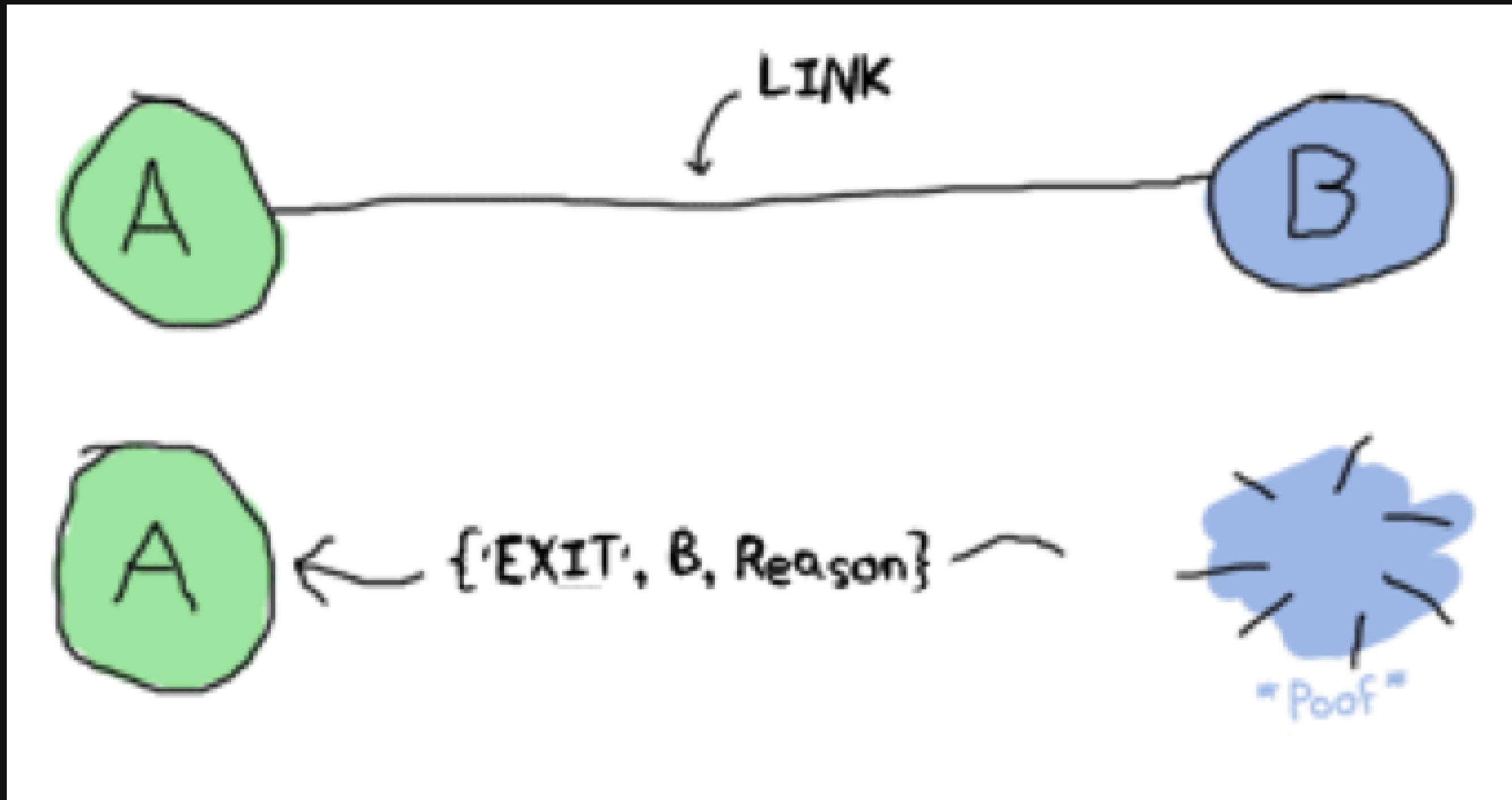
Functions



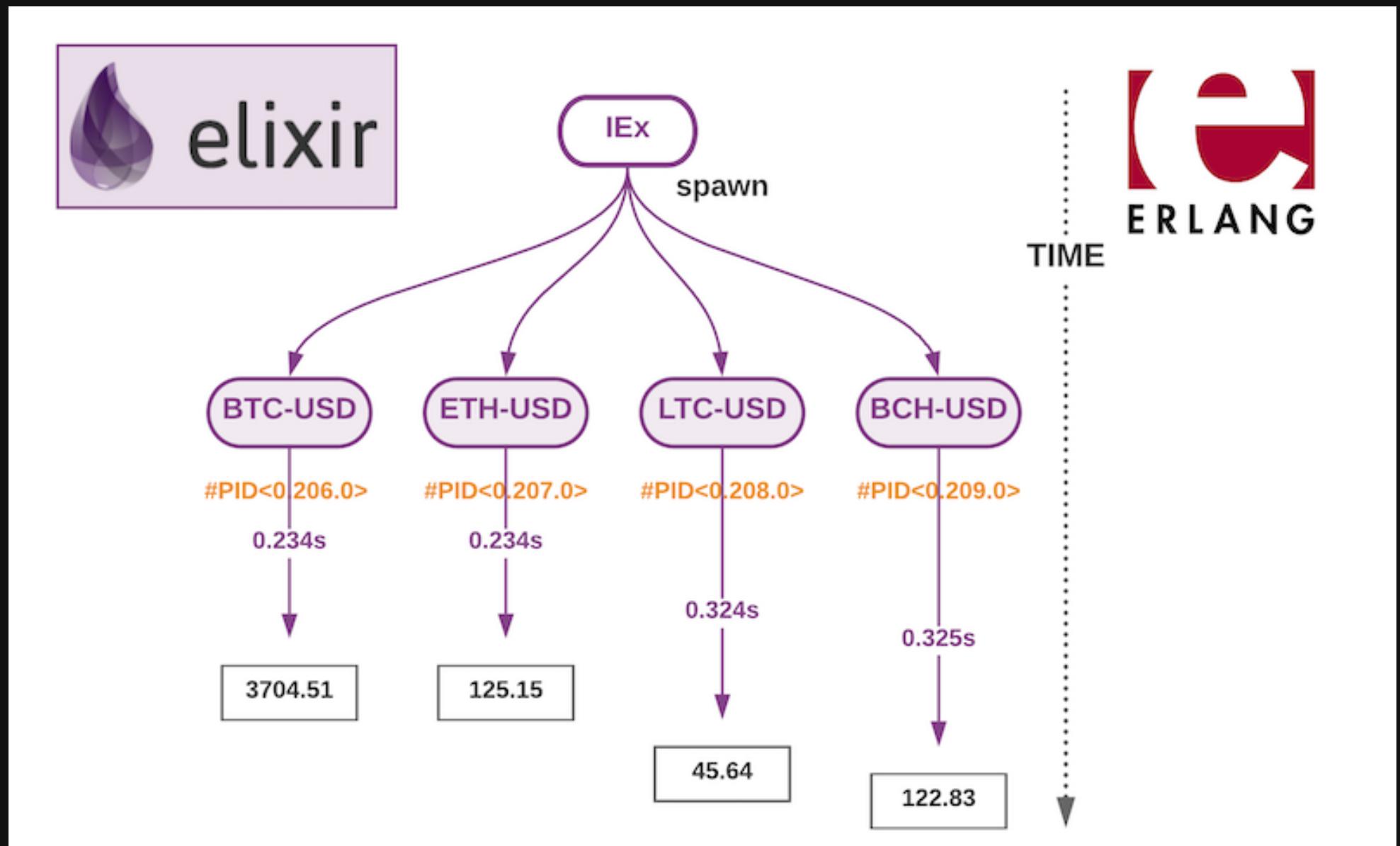
Procedures

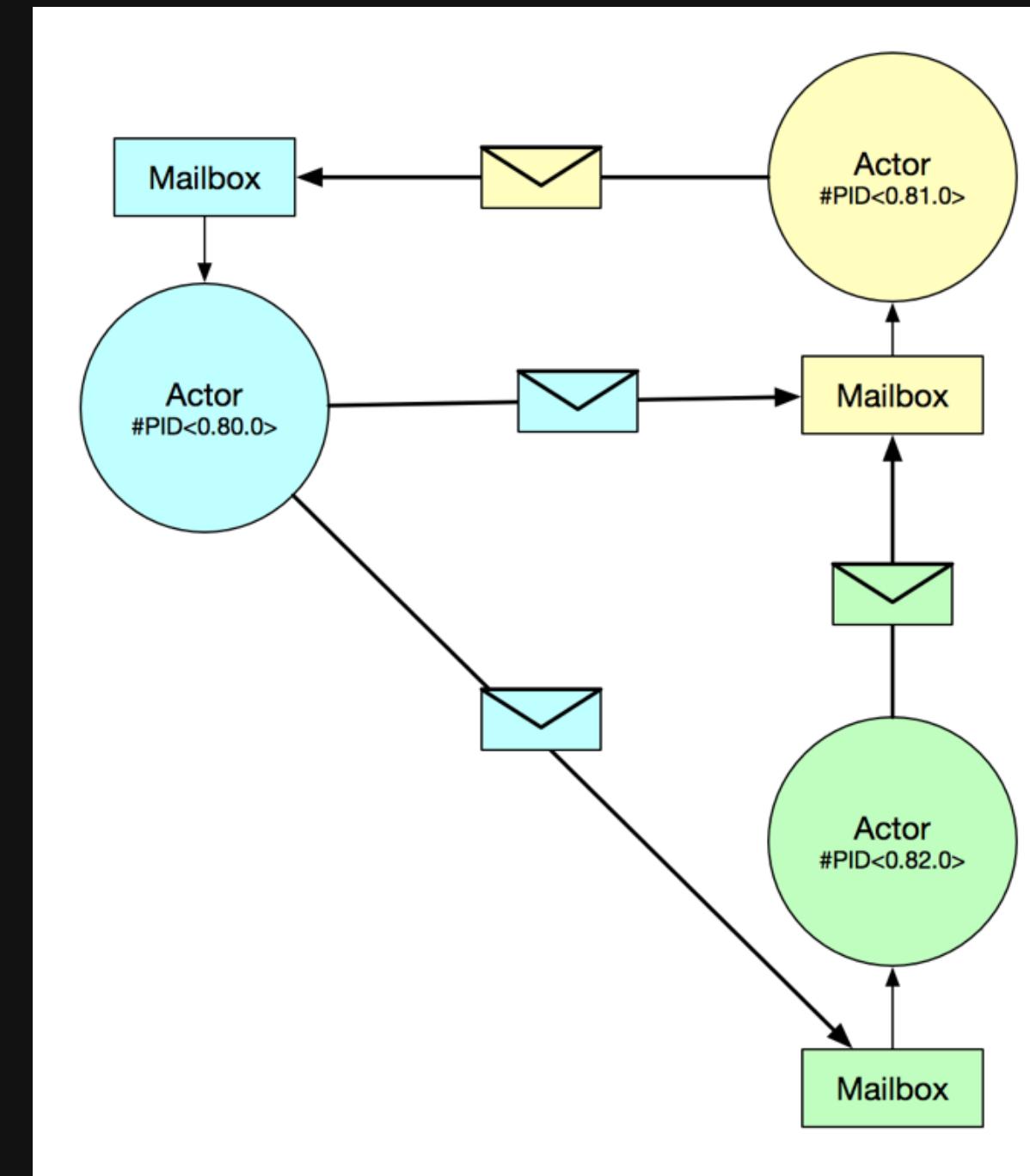


# Let it crash



# Let it crash





# OVERVIEW OF ERLANG

Everything in Erlang is process.

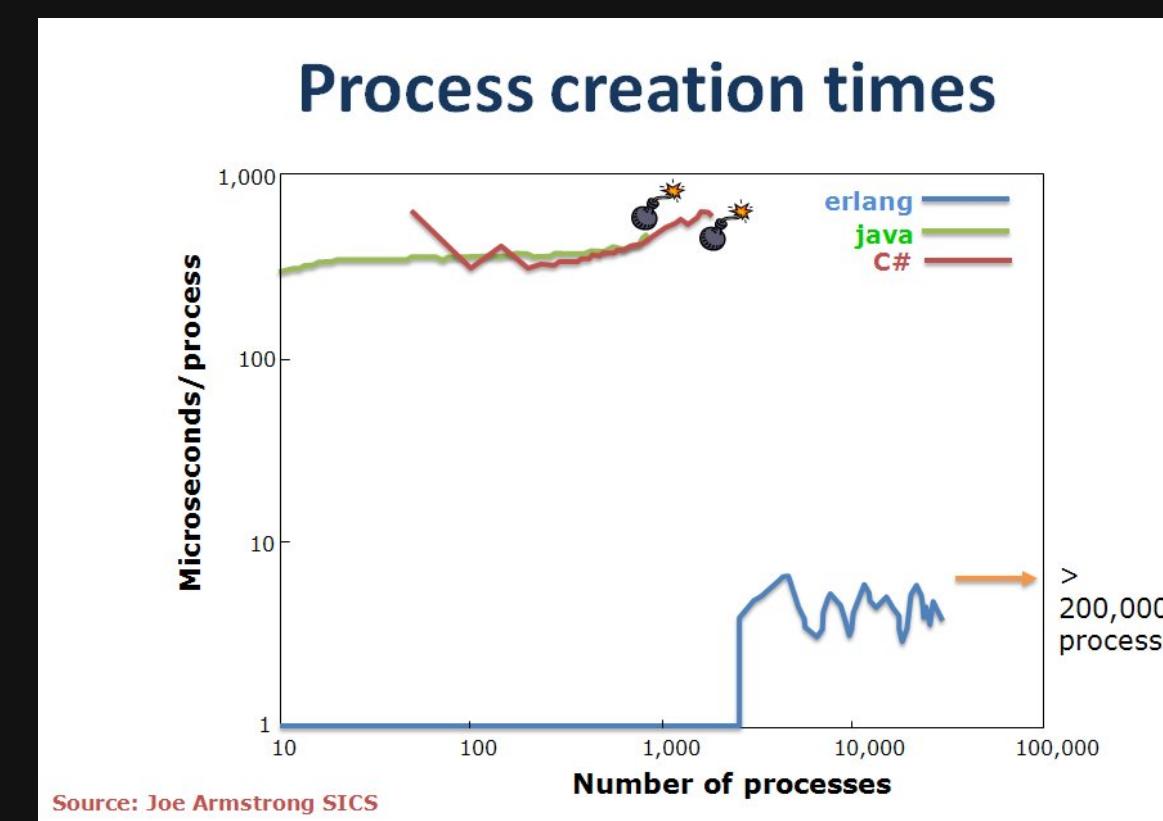
Processes are strongly isolated.

Process creation and destruction is light weight process.

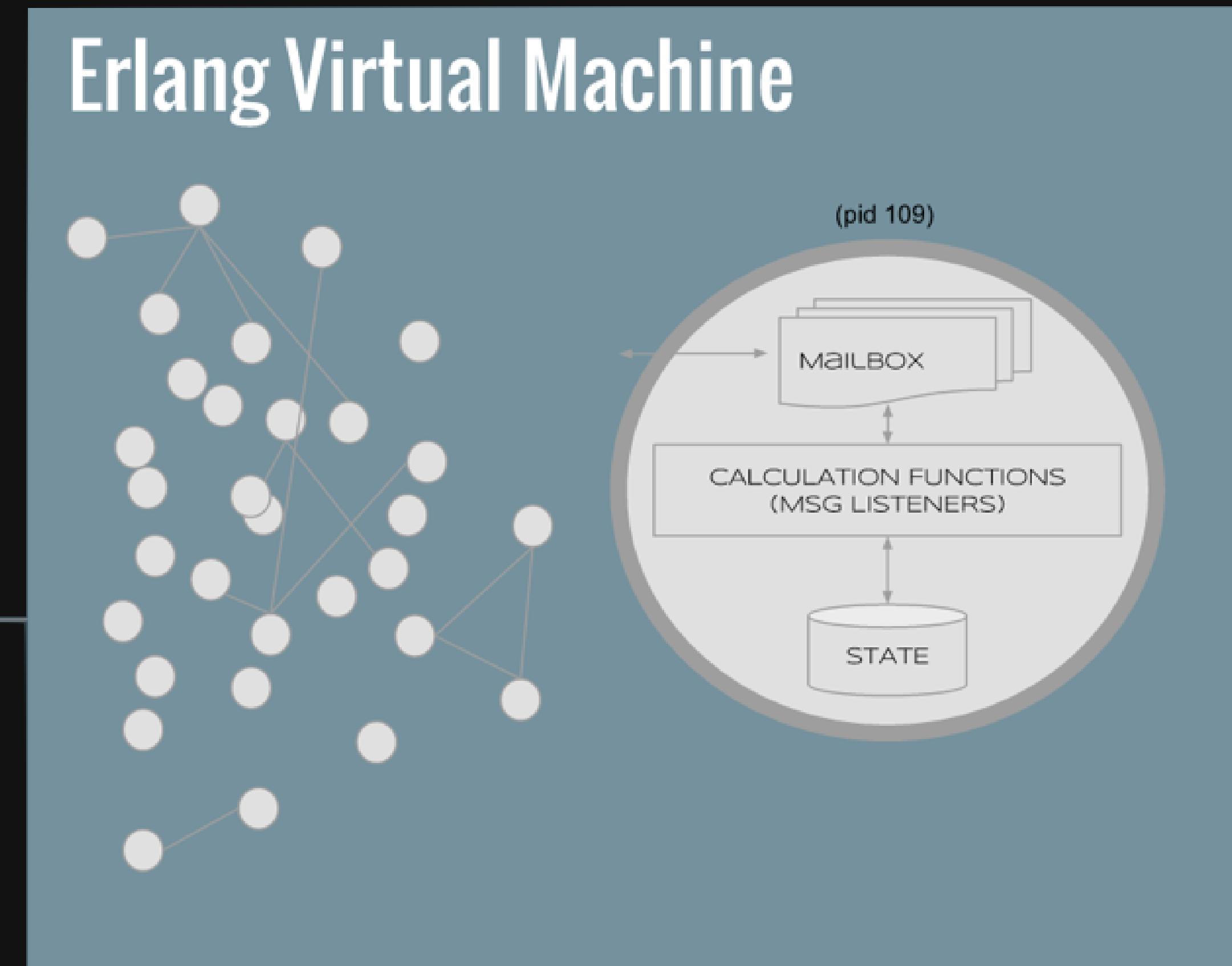
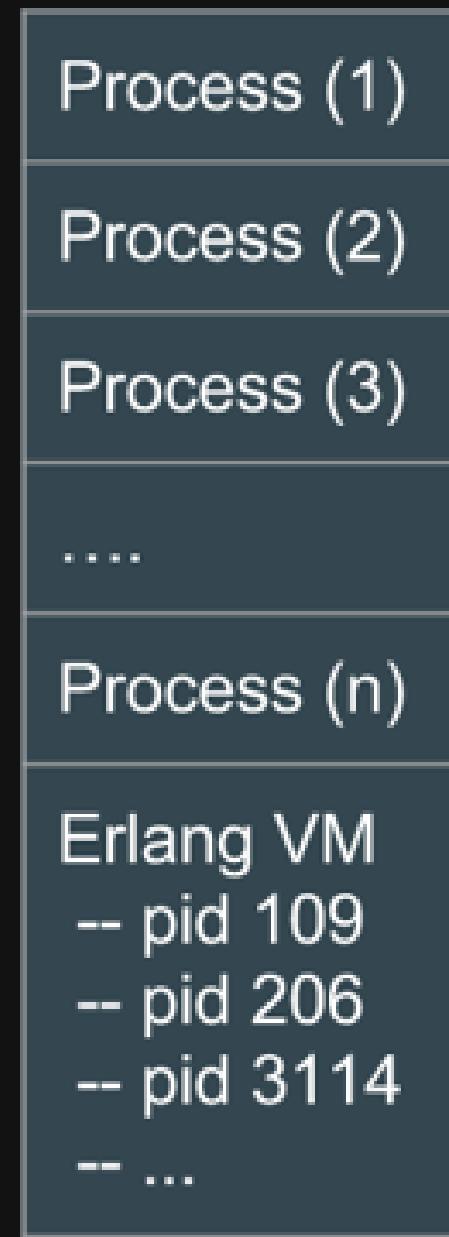
Message Passing is the only way processes can interact.

Processes are identified by Pids.

Processes share no resources.



# OS



# Pattern Matching Functions

```
defmodule Factorial do
  def of(0), do: 1
  def of(n), do: n * of(n-1)
end

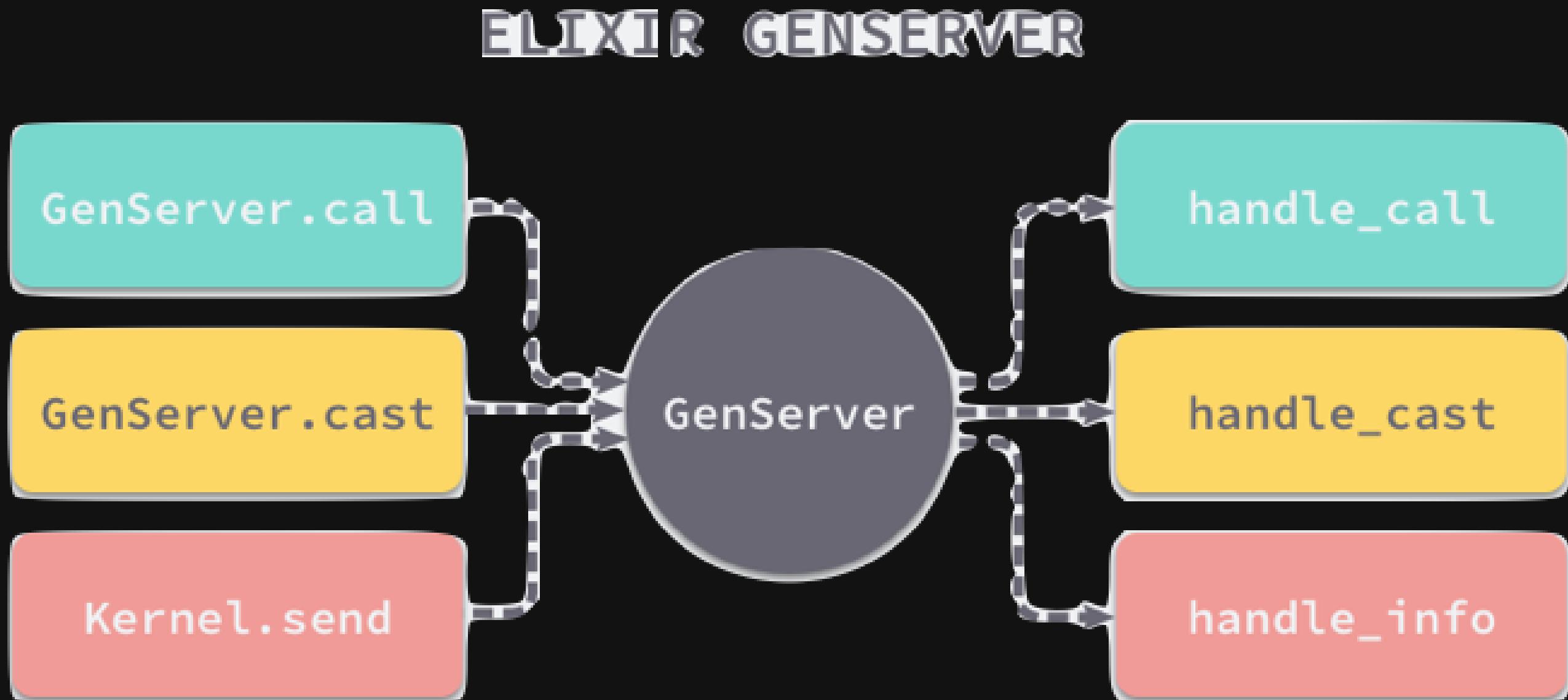
defmodule PrintStuff do
  def print({:error, stuff}) do
    IO.puts "ERROR! #{stuff}"
  end
  def print({:ok, stuff}), do: IO.puts stuff
end

PrintStuff.print({:ok, "Hello"})
```

# Parallel Map

```
defmodule Paraller do
  def pmap(collection, fun) do
    me = self
    collection
    |> Enum.map(fn (elem) ->
      spawn_link fn -> (send me, { self, fun.(elem) }) end
      end)
    |> Enum.map(fn (pid) ->
      receive do { ^pid, result } -> result end
      end)
    end
  end
```

OTP



```
defmodule Stack do
  use GenServer

  def init(stack) do
    {:ok, stack}
  end

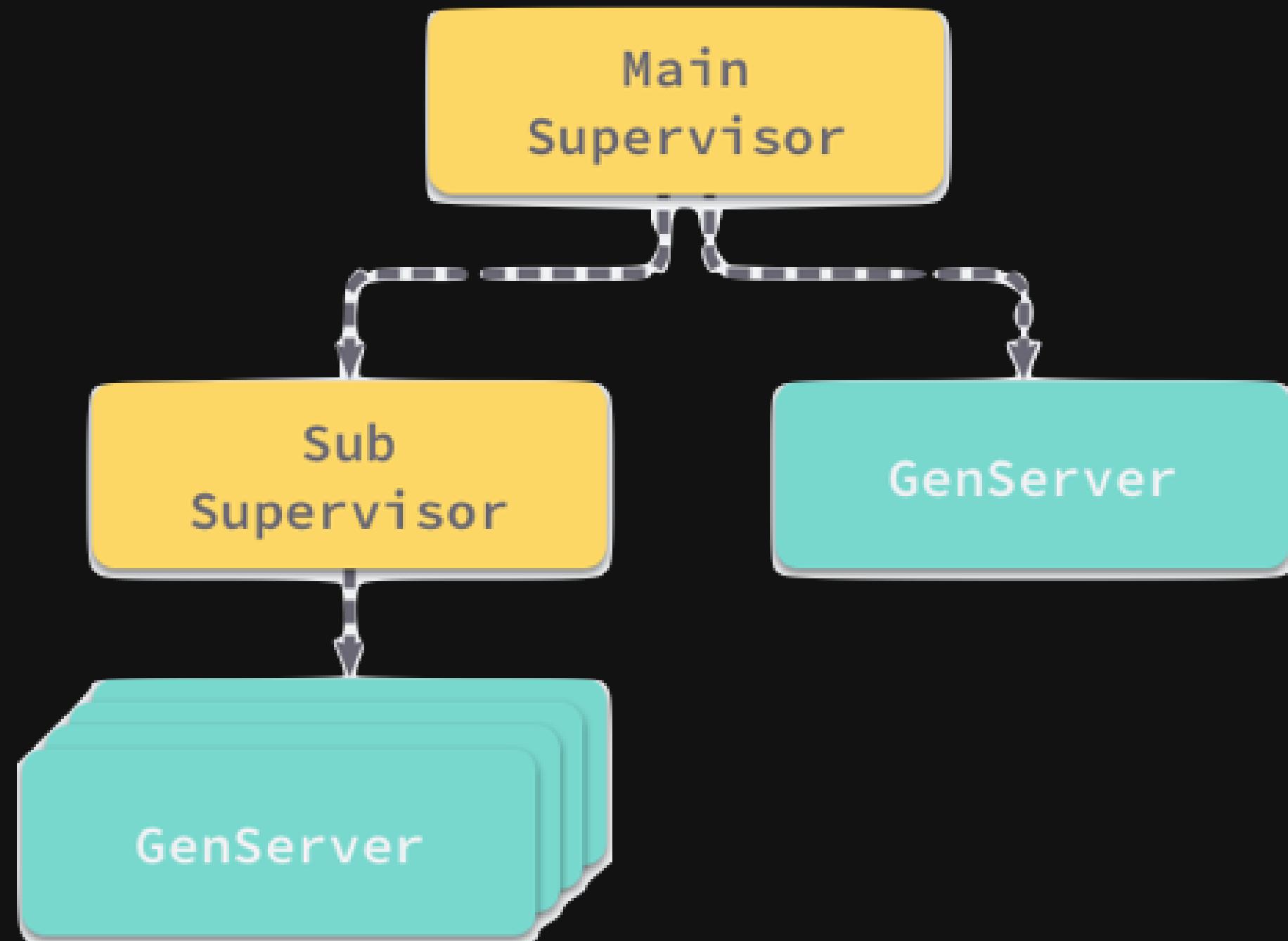
  def handle_call(:pop, _from, [head | tail]) do
    {:reply, head, tail}
  end

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

{:ok, pid} = GenServer.start_link(Stack, [:hello])

GenServer.call(pid, :pop)          #=> :hello
GenServer.cast(pid, {:push, :world}) #=> :ok
GenServer.call(pid, :pop)          #=> :world
```

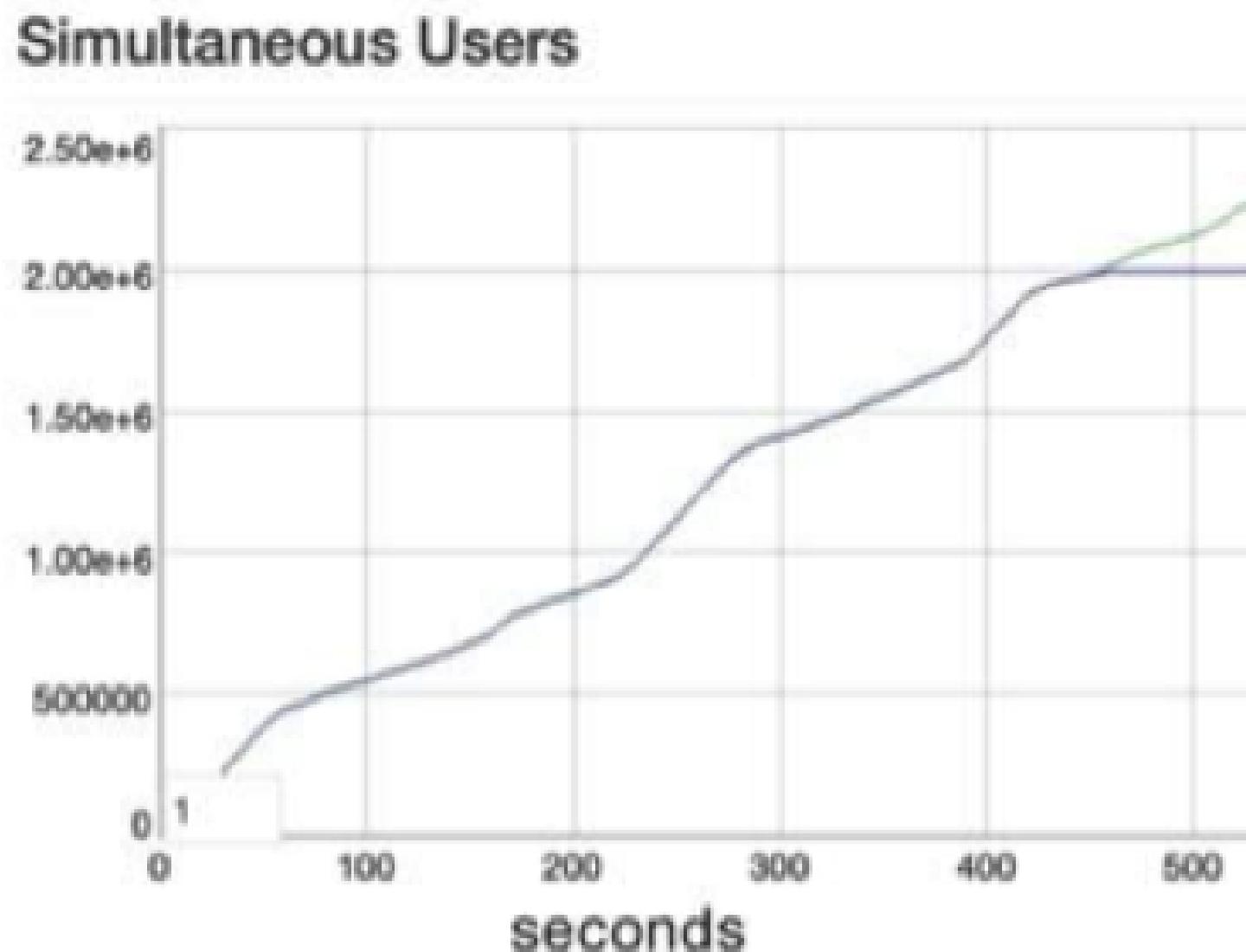
## ELIXIR PROCESS TREE



# Phoenix Framework

# The Road to 2 Million Websocket Connections in Phoenix

By Gary Rennie · 10 months ago · v1.0.0



Phoenix LiveView

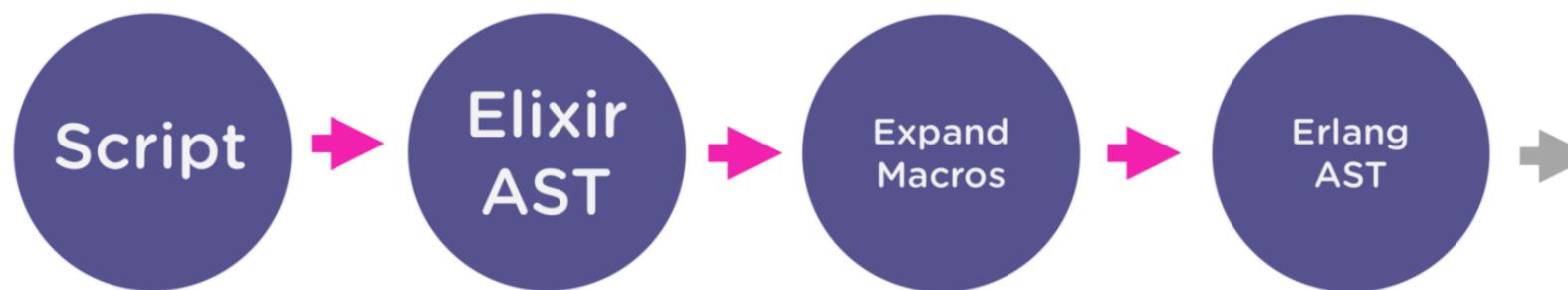
real-time user experiences with server-rendered HTML

No JavaScript!

# Macros – Metaprogramming

```
defmodule MyMacros do
  defmacro nice_print({:+, _meta, [lhs, rhs]}) do
    quote do
      IO.puts """
        #{unquote(lhs)}
        +
        #{unquote(rhs)}
        --
        #{unquote(lhs+rhs)}
      """
    end
  end
end
```

```
iex(1)> require MyMacros
[MyMacros]
iex(2)> MyMacros.nice_print 2 + 3
  2
+
  3
--
  5
```



```
iex> quote do: 1 + 2
{:+, [context: Elixir, import: Kernel], [1, 2]}
```

# Erlang is Full Stack

**Table 1.1 Comparison of technologies used in two real-life web servers**

Technical requirement	Server A	Server B
HTTP server	Nginx and Phusion Passenger	Erlang
Request processing	Ruby on Rails	Erlang
Long-running requests	Go	Erlang
Server-wide state	Redis	Erlang
Persistable data	Redis and MongoDB	Erlang
Background jobs	Cron, Bash scripts, and Ruby	Erlang
Service crash recovery	Upstart	Erlang

Q&A

THANKS!