Erlang SOLUTIONS

inaka

ERLANG & ELIXIR

FACTORY LITE

Buenos Aires 2017

ABSTRACT TYPES & OTHER YERBAS

OPAQUE TYPES & OTHER YERBAS

HELLO!

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Erlang SOLUTIONS

ERLANG IS...

- Functional
- Concurrent
- Distributed
- Fault-Tolerant

THIS TALK IS ABOUT...

- **Types**
- Modules
- Functions
- Specs

BUT WHY TYPES?

WHAT IS SOFTWARE?

SOFTWARE AS MODELING

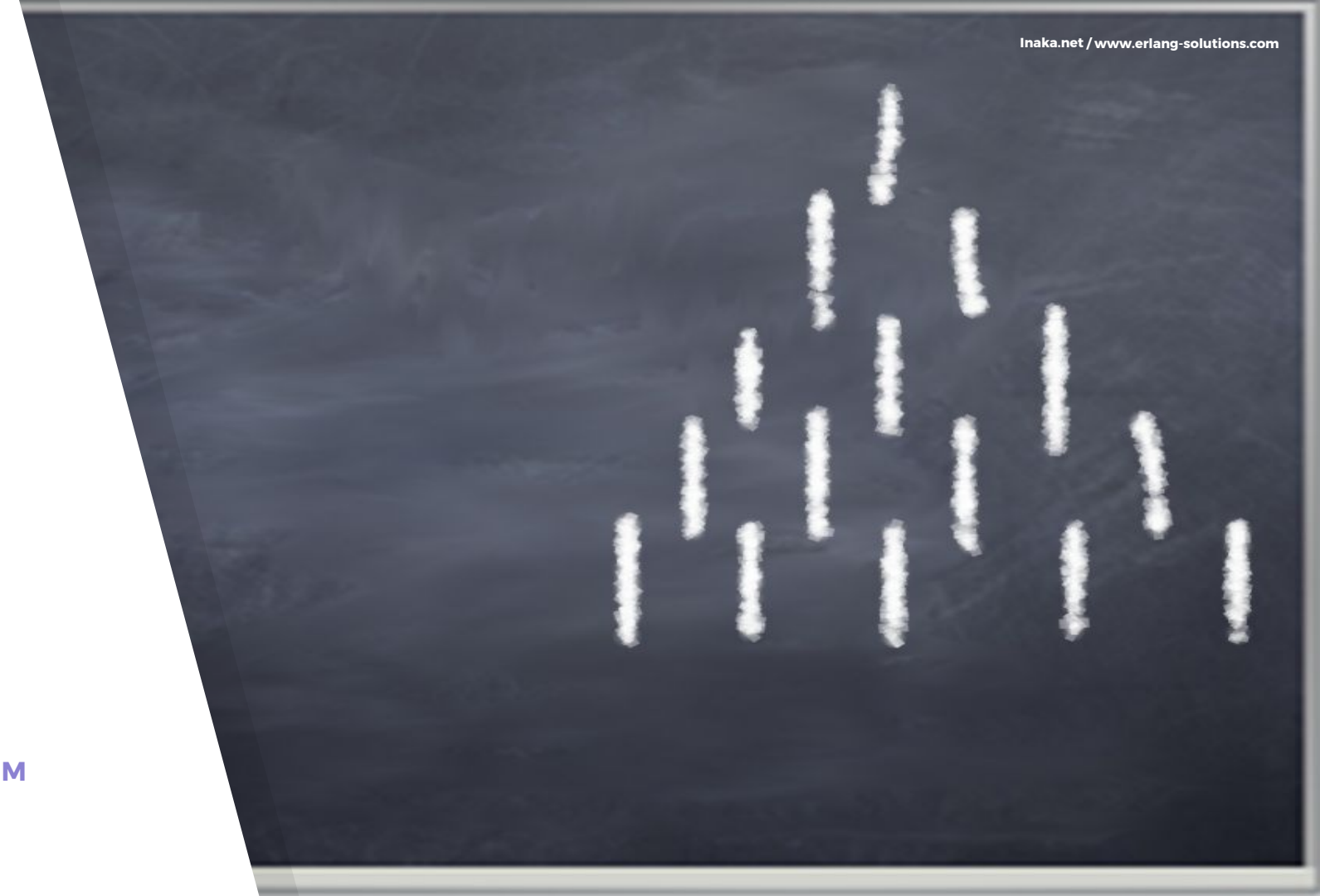
ENTITIES AS OBJECTS

ENTITIES AS INSTANCES

WHAT ABOUT ERLANG?

MANY OPTIONS

- Basic Types
  - Lists, Tuples, Numbers
  - Tagged Tuples
  - Records
  - Maps
- Opaque Types



A SAMPLE SYSTEM: NIM

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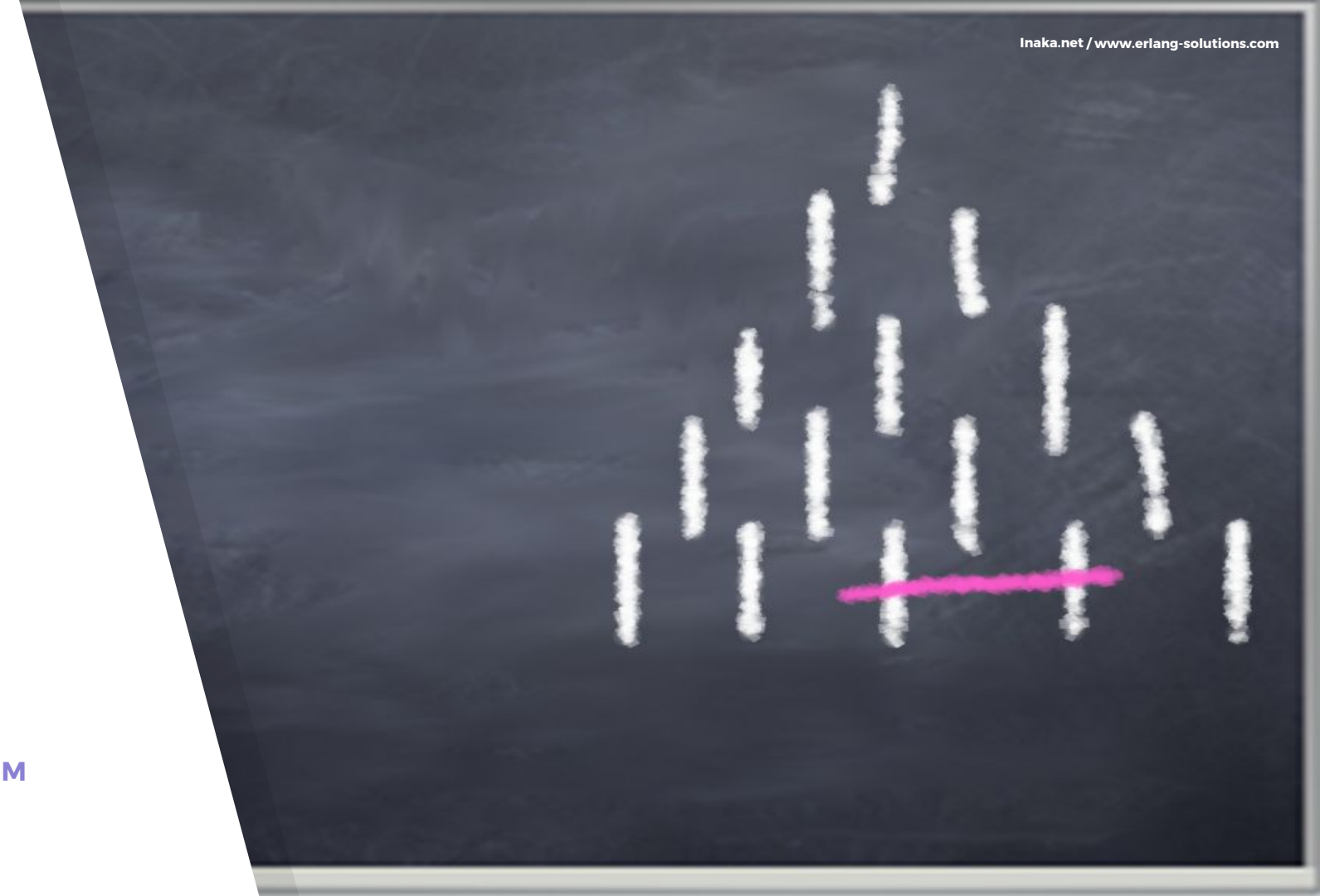

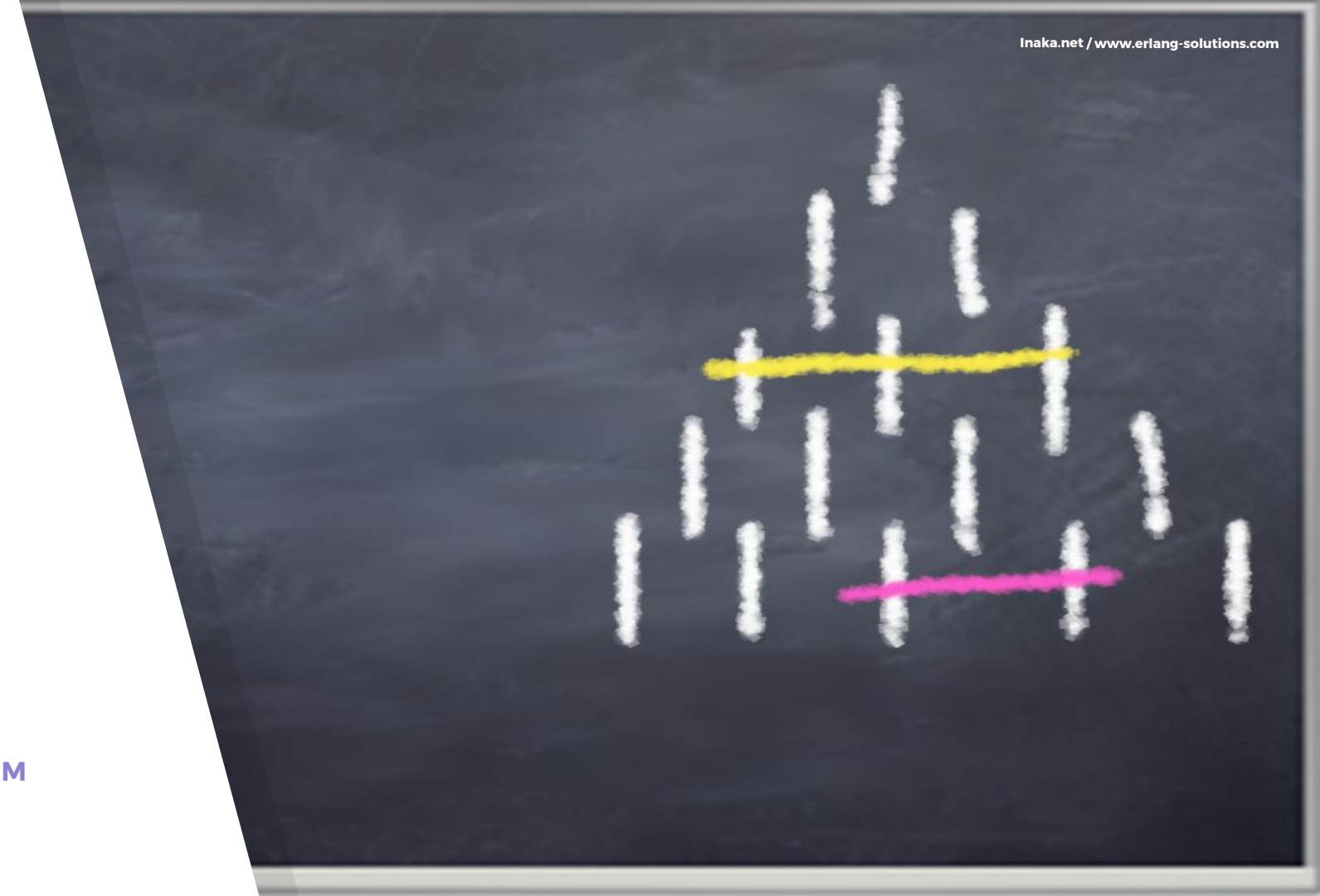

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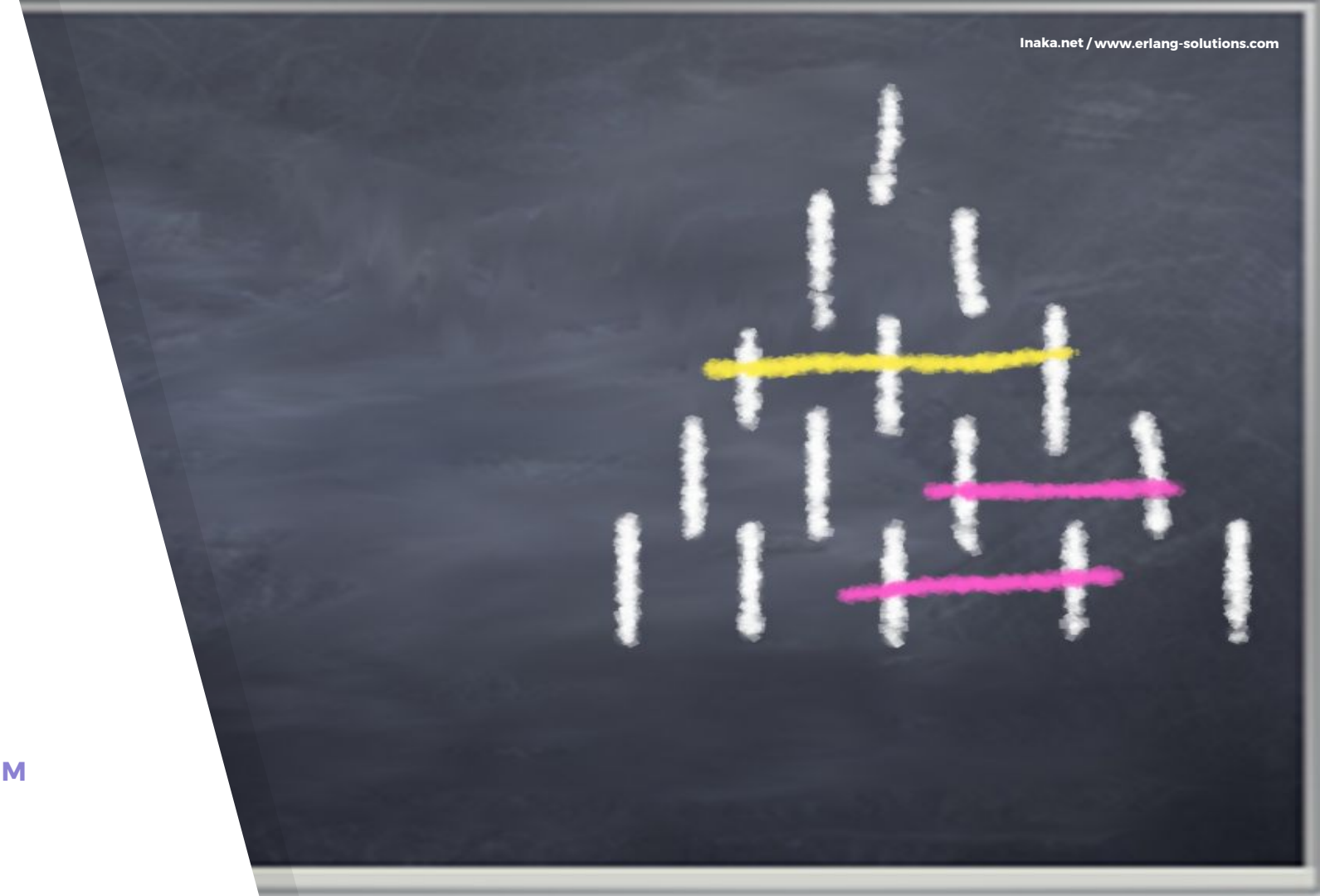

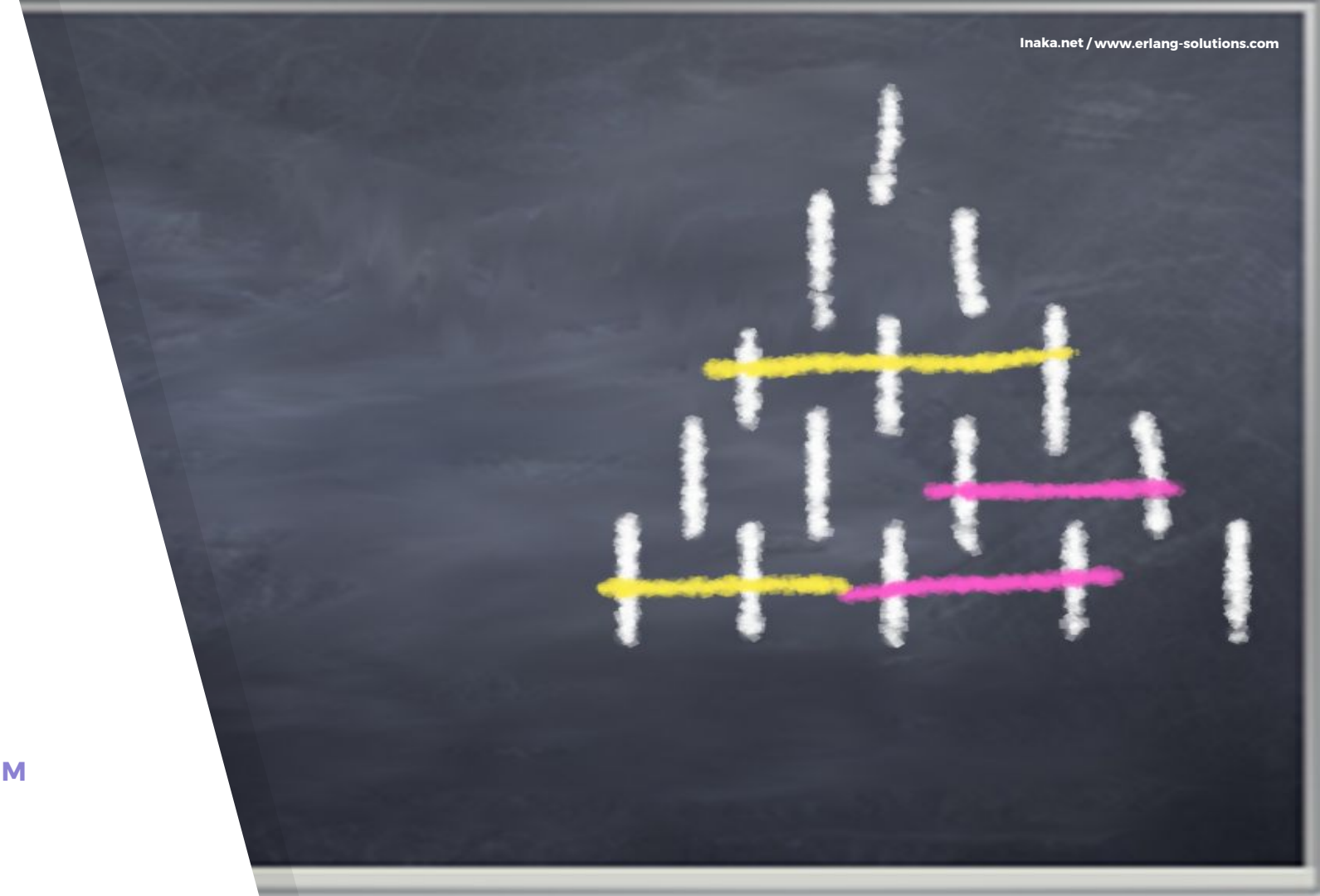

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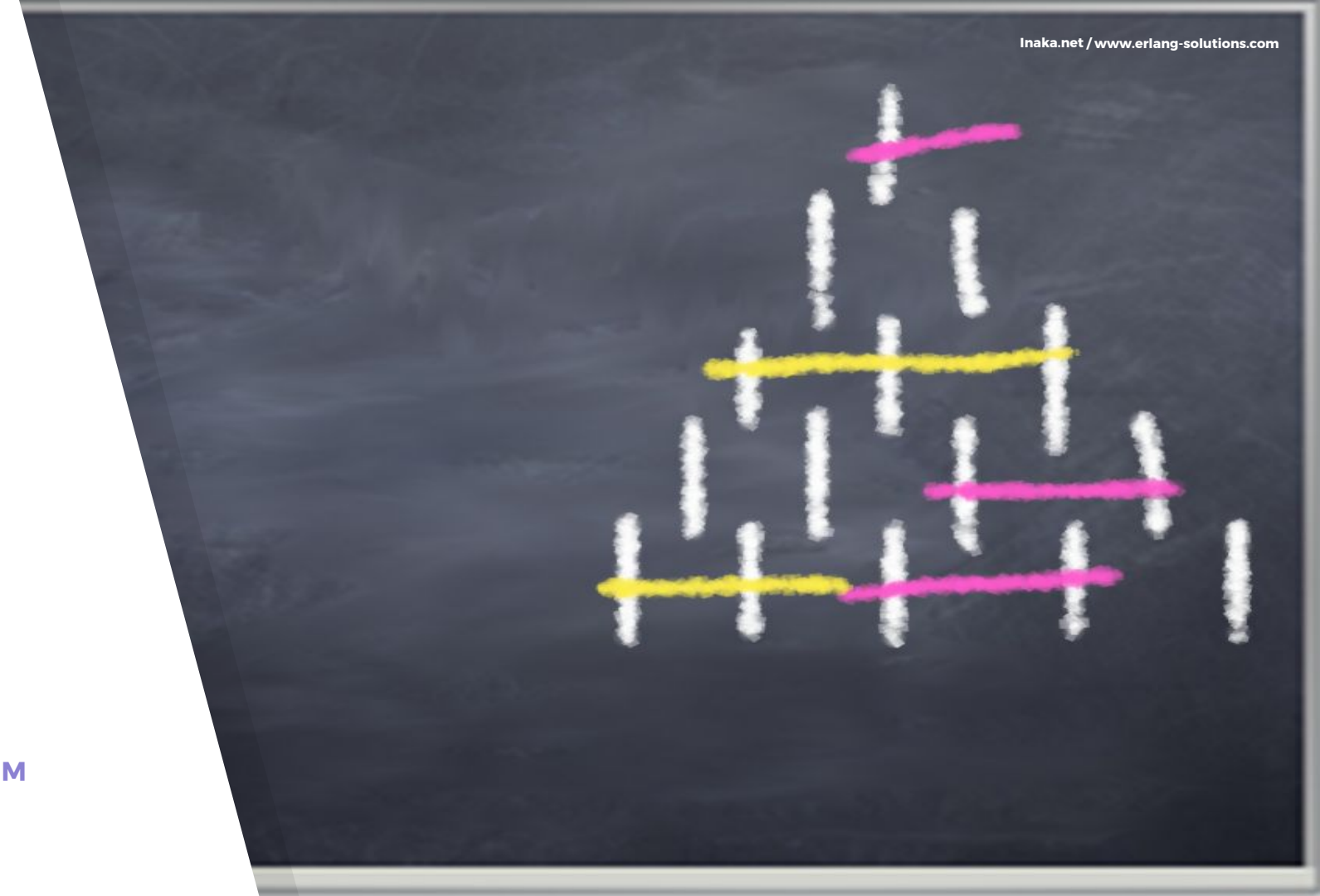

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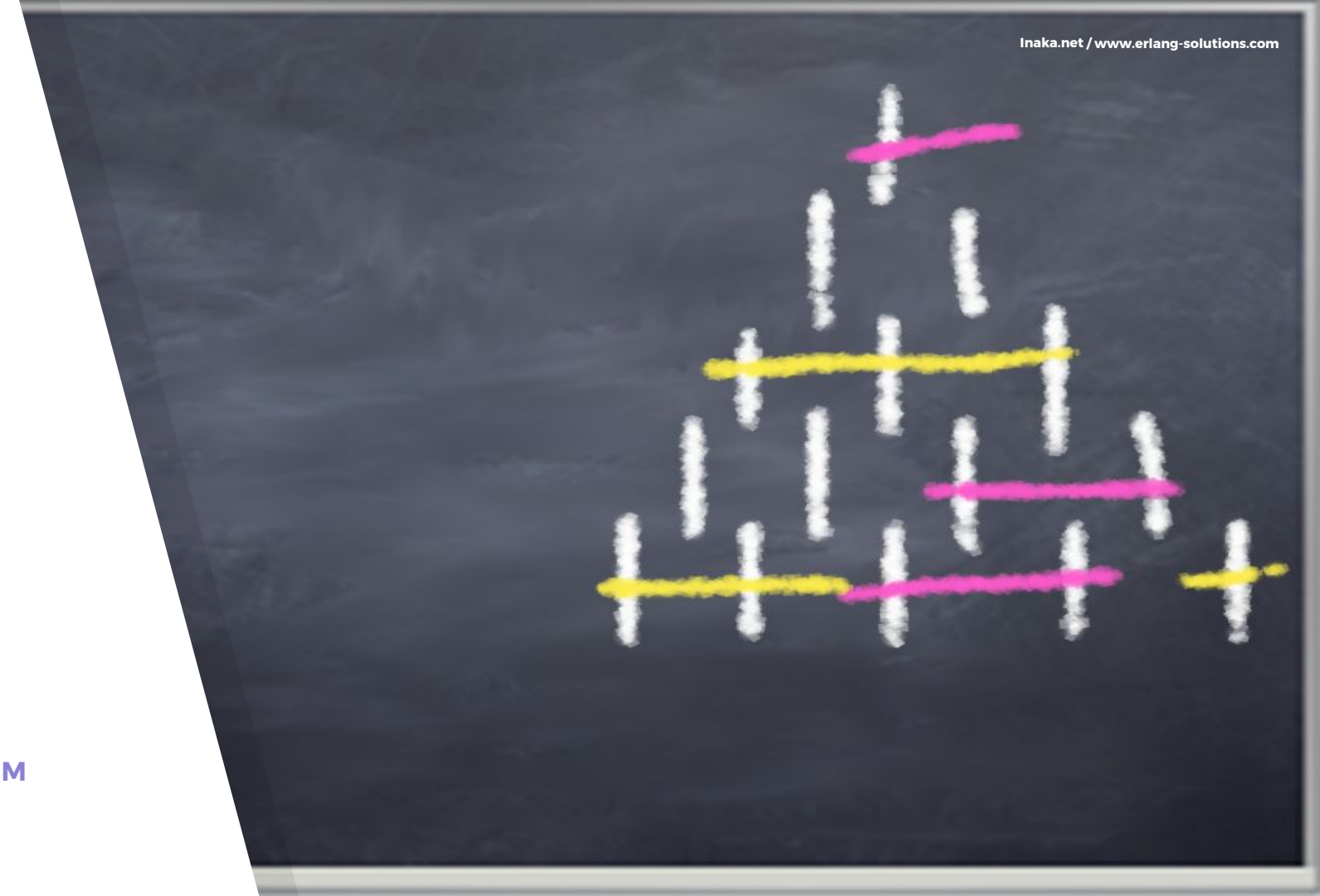

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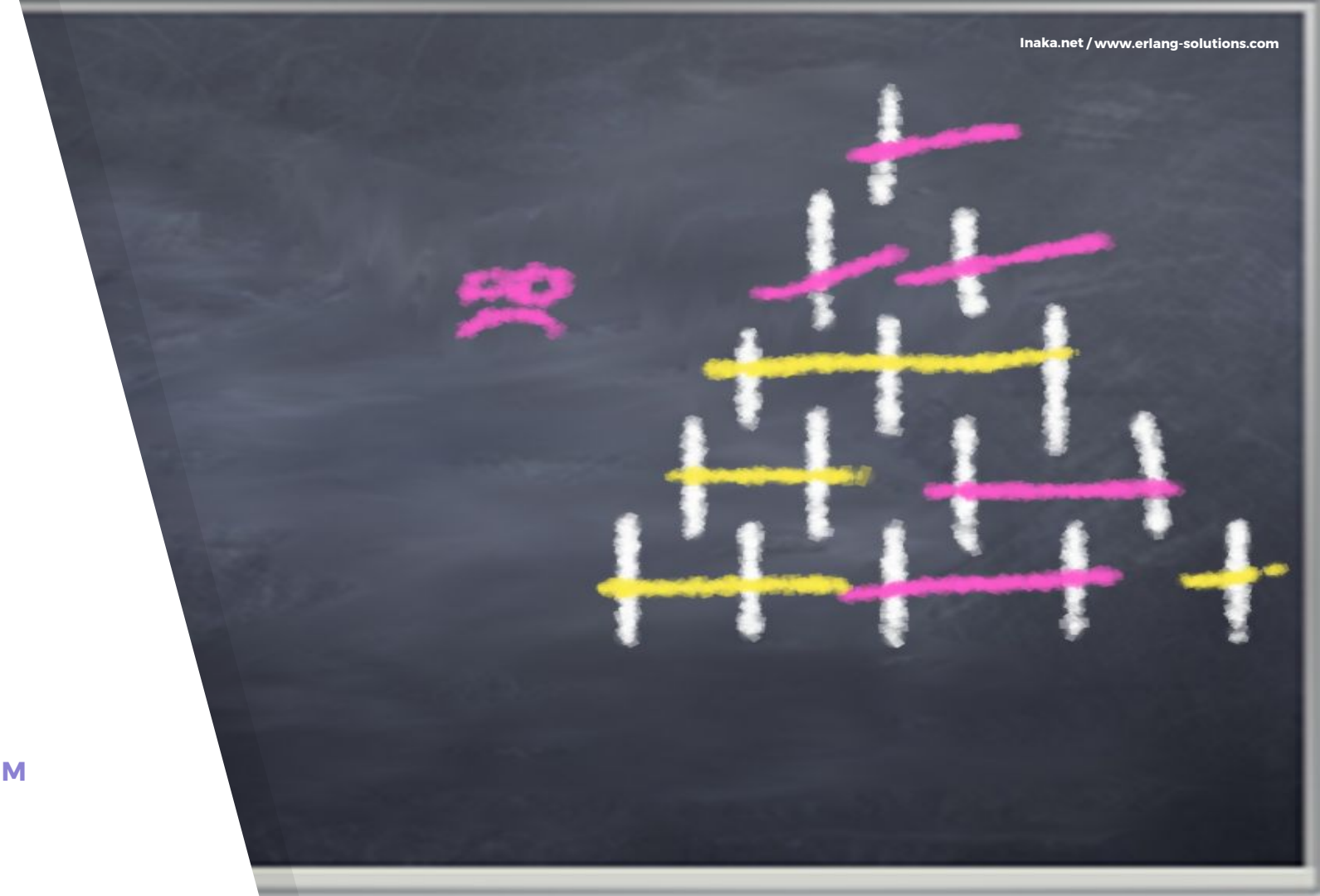

A SAMPLE SYSTEM: NIM

RECOGNIZING ENTITIES

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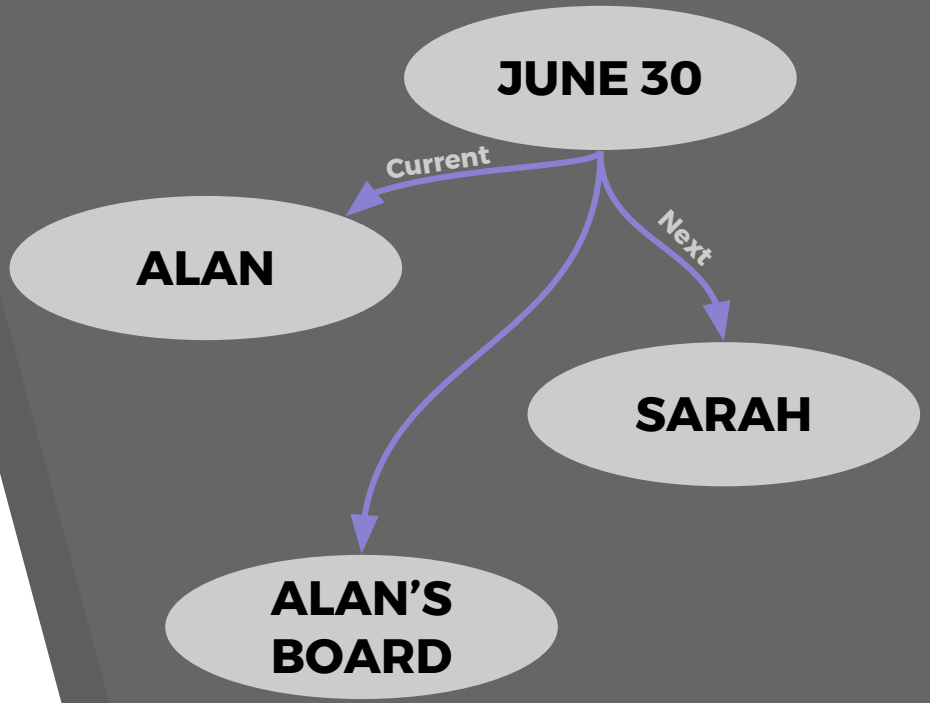

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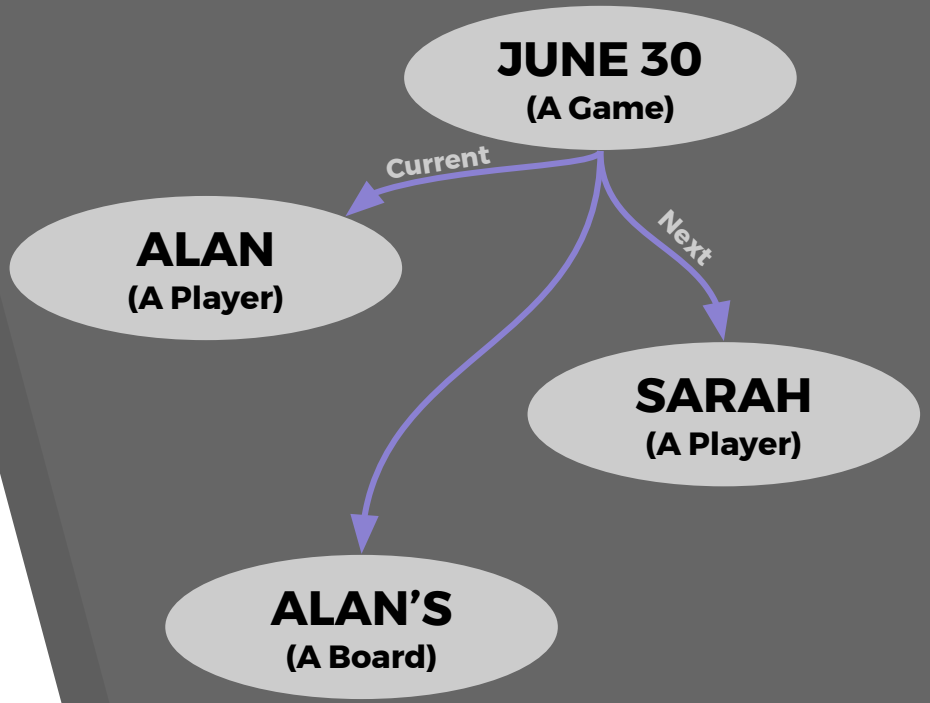
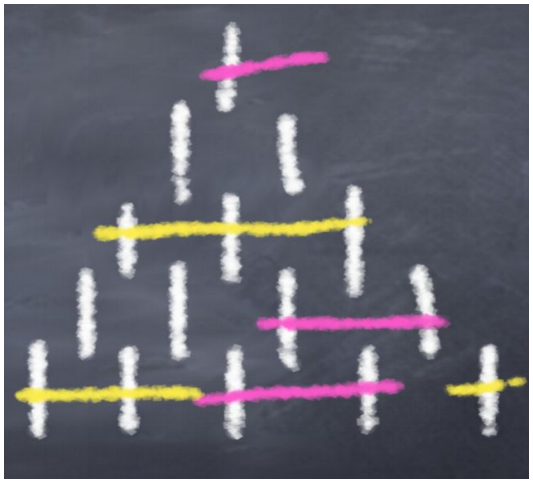
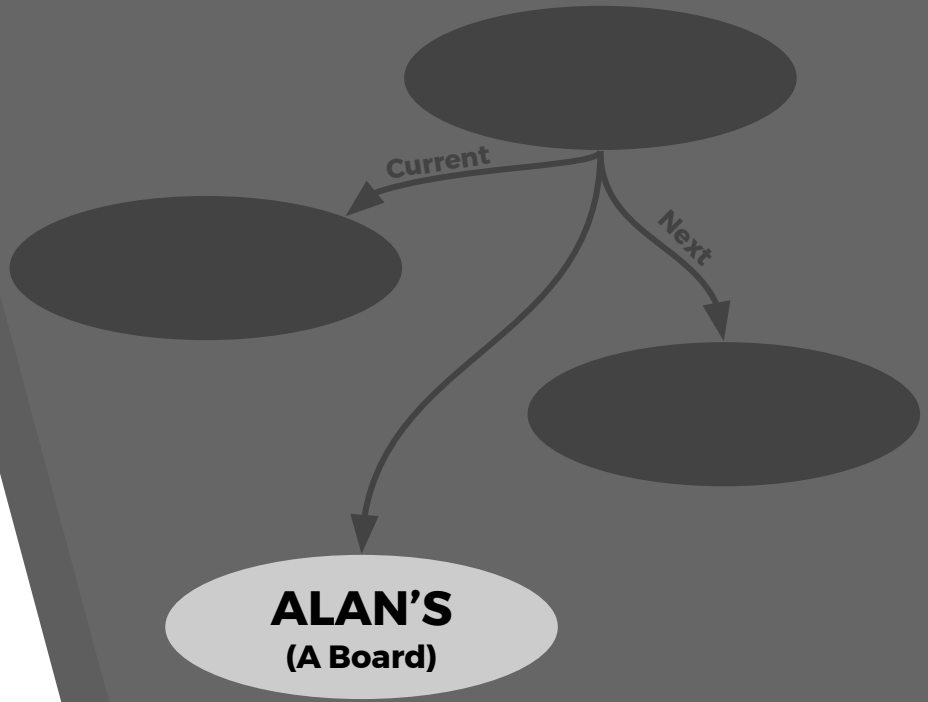


A BOARD

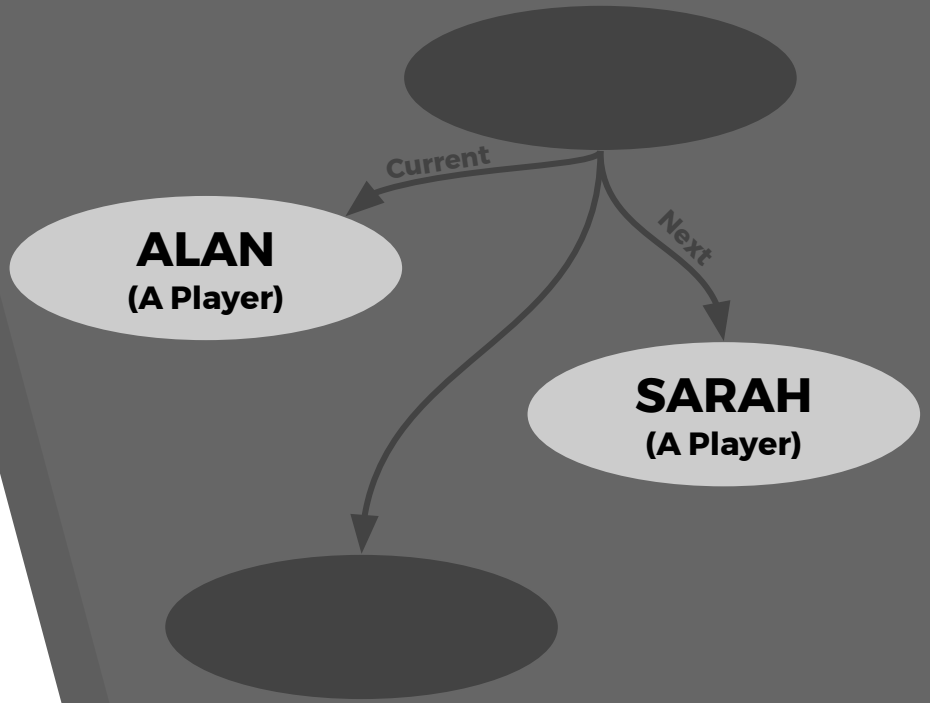
- Rows
  - With **Sticks**
    - Some **Crossed Out**
    - Some Still **Available**





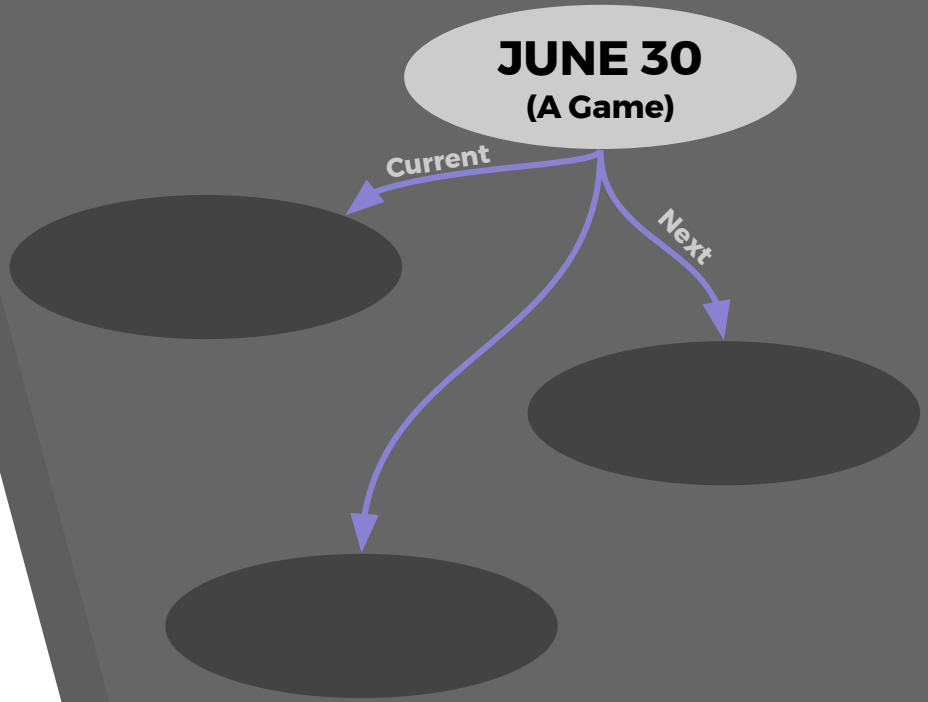
A PLAYER

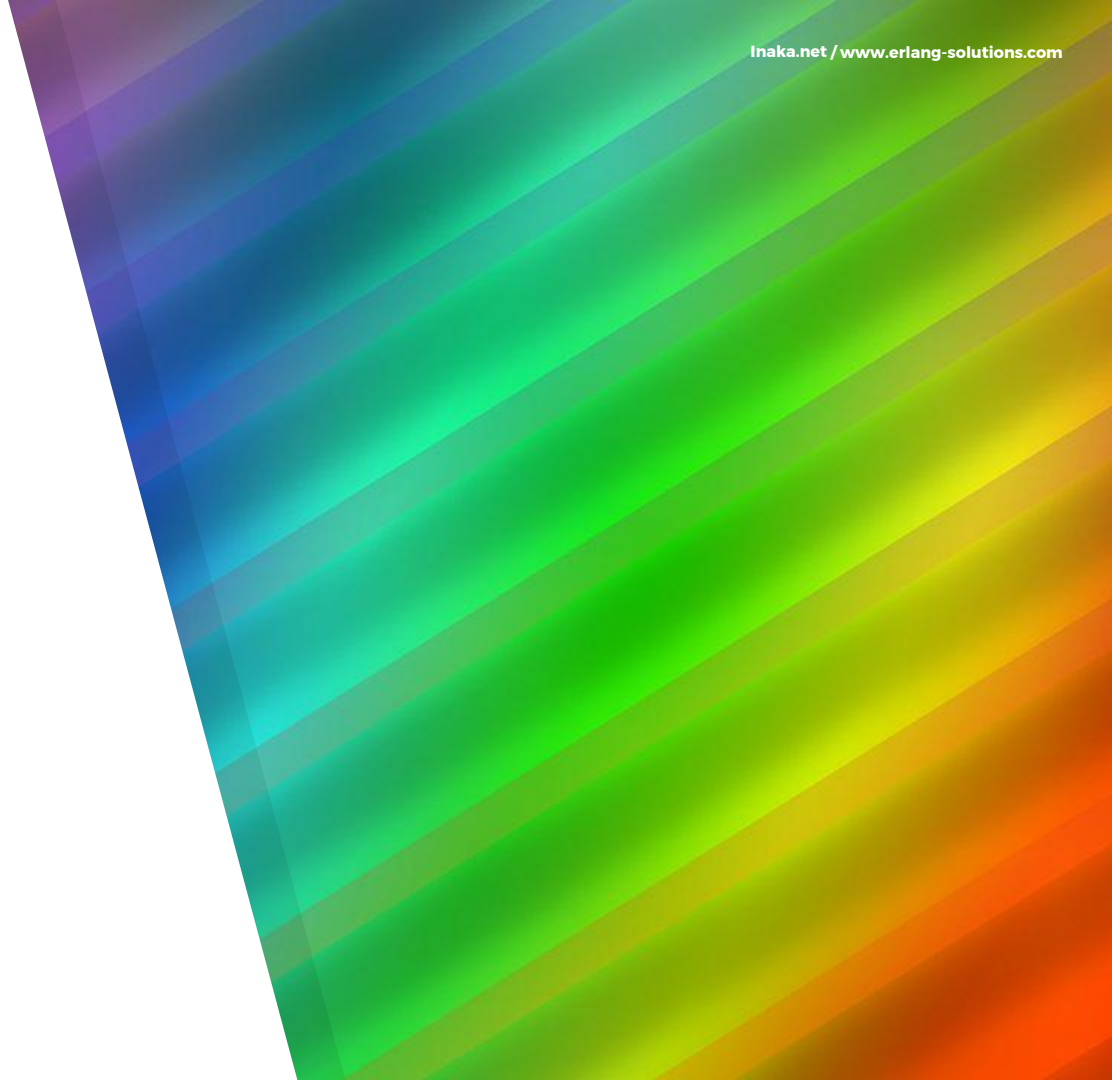
- Name



A GAME

- Two **Players**
  - **Current**
  - **Next**
- A **Board**





BASIC TYPES

BASIC TYPES

- Players as **Strings**
- Board as a **5-Tuple**
  - Rows as **Lists of 0 | 1**
- Game as a **3-Tuple**

```
CurrentPlayer = "Alan",
NextPlayer = "Sarah",
Board =
  { [1]
  , [1, 1]
  , [1, 1, 1]
  , [1, 1, 1, 1]
  , [1, 1, 1, 1, 1]
  },
Game =
  { CurrentPlayer
  , NextPlayer
  , Board
  }.
```

BASIC TYPES

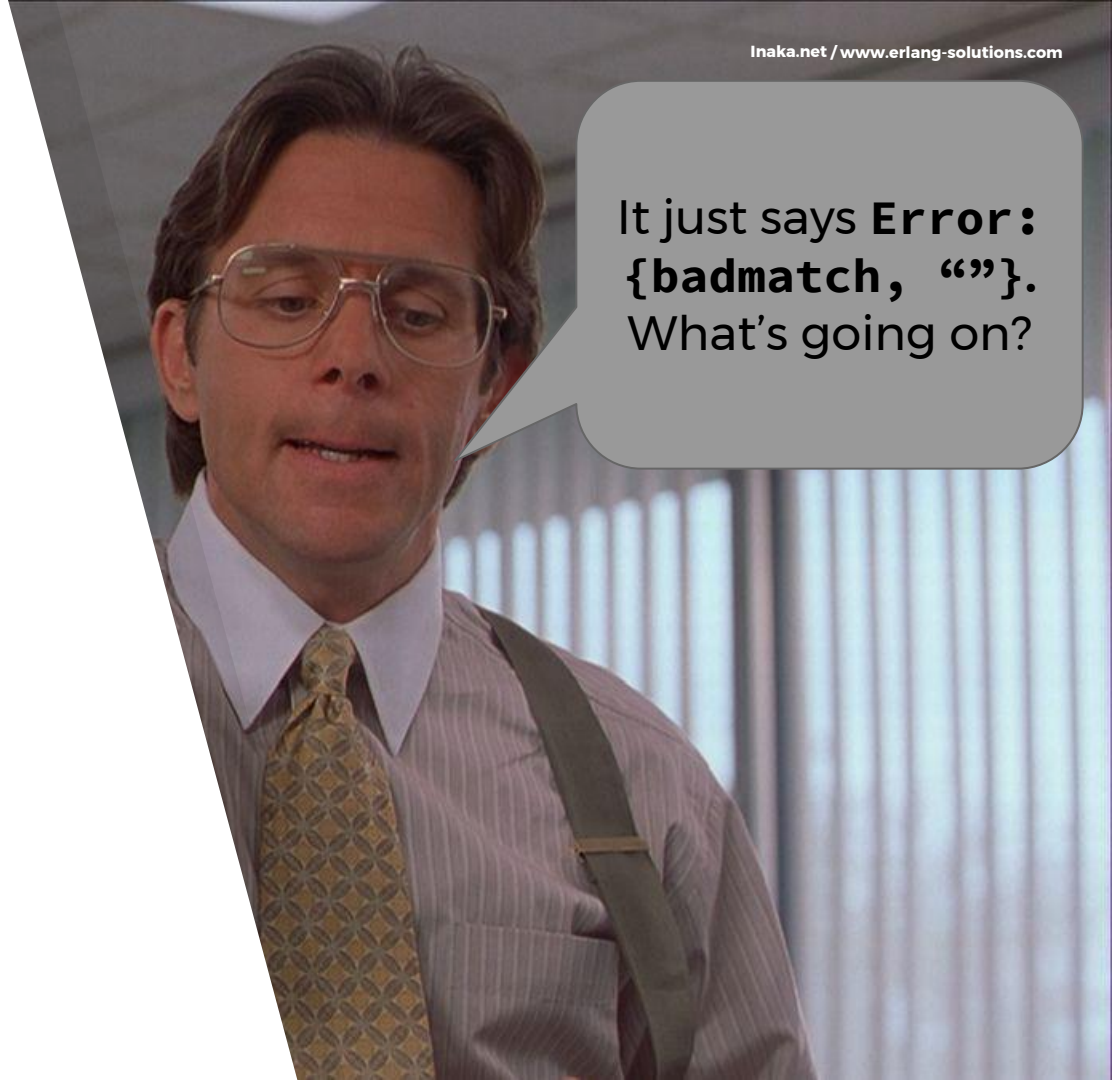
- Functions use
  - Pattern-Matching
  - BIFs

```
cross(RowN, Pos, Len, Game) ->
  {Current, Next, Board} =
    Game,
  Row = element(RowN, Board),

  %% changes 1s by 0s in a row
  NewRow =
    cross(Pos, Len, Row),

  NewBoard =
    setelement(
      RowN, Board, NewRow),

  {Next, Current, NewBoard}.
```

PROBLEMS

PROBLEM #1:
Low Maintainability

PROBLEM #2:
Hard to Debug



PROBLEM #3:
No Encapsulation

PROBLEM #4:
No Documentation

DOCUMENTATION WITHOUT TYPES

```
-spec cross(RowN, Pos, Len, Game) -> Game when
  RowN    :: 1..5,
  Pos     :: 1..5,
  Len     :: 1..5,
  Game    :: {Player, Player, Board},
  Player  :: string(),
  Board   :: {Row, Row, Row, Row, Row},
  Row     :: [Stick, ...],
  Stick   :: 0 | 1.
```

DOCUMENTATION WITH TYPES

```
-type row_num() :: 1..5.
-type pos()     :: 1..5.
-type len()     :: 1..5.
-type game()    :: {player(), player(), board()}.
-type player()  :: string().
-type board()   :: {row(), row(), row(), row(), row()}.
-type row()     :: [stick(), ...].
-type stick()   :: 0 | 1.

-spec cross(row_num(), pos(), len(), game()) -> game().
```

SHARING TYPES

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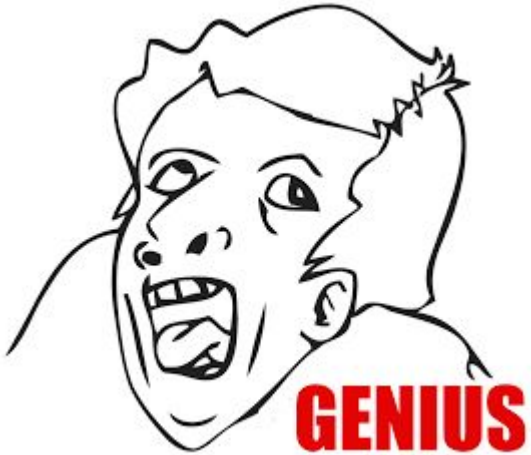
SHARING TYPES

- Copy & Paste



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SHARING TYPES

- Copy & Paste
- Header Files

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SHARING TYPES

- Copy & Paste
- Header Files
- Export Types

SOURCE MODULE

```
-type row_num() :: 1..5.
-type pos()     :: 1..5.
-type len()     :: 1..5.
-type game()    :: {player(), player(), board()}.
-type player()  :: string().
-type board()   :: {row(), row(), row(), row(), row()}.
-type row()     :: [stick(), ...].
-type stick()   :: 0 | 1.

-export_type([row_num/0, pos/0, len/0, game/0, player/0,
              board/0, row/0, stick/0]).
```

OTHER MODULES

```
-spec cross( source_mod:row_num()
           , source_mod:pos()
           , source_mod:len()
           , source_mod:game()
           ) -> source_mod:game().
```

Who is source_mod?

“

The module where you define your shared types should only include the **Opaque Data Type** implementation.

- **Brujo**

NIM MODULE

```
-spec start(
    nim_player:name(), nim_player:name()) -> nim_game:t().
start(P1, P2) ->
  nim_game:new(nim_player:new(P1), nim_player:new(P2),
               nim_board:new()).

-spec cross(
    nim_board:row_num(), nim_board:pos(),
    nim_board:len(), nim_game:t()) -> nim_game:t().
cross(RowN, Pos, Len, Game) ->
  nim_game:cross(RowN, Pos, Len, Game).
```

NIM_GAME MODULE

```
-opaque t() ::
    {nim_player:t(), nim_player:t(), nim_board:t()}.
-export_type([t/0]).

-export([new/3, cross/4]).

-spec new(
    nim_player:t(), nim_player:t(), nim_board:t()) -> t().
new(Current, Next, Board) ->
  {Current, Next, Board}.
```

NIM_GAME MODULE

```
-spec cross( nim_board:row_num()
           , nim_board:pos()
           , nim_board:len()
           , t()
           ) -> t().
cross(RowN, Pos, Len, Game) ->
  {Current, Next, Board} = Game,
  NewBoard = nim_board:cross(RowN, Pos, Len, Board),
  {Next, Current, NewBoard}.
```

NIM_BOARD MODULE

```
-opaque t() :: { nim_row:t()
               , nim_row:t()
               , nim_row:t()
               , nim_row:t()
               , nim_row:t()
               }.
-export_type([t/0]).
```

NIM_BOARD MODULE

```
-spec new() -> t().
new() ->
  { nim_row:new(1)
  , nim_row:new(2)
  , nim_row:new(3)
  , nim_row:new(4)
  , nim_row:new(5)
  }.
```

NIM_BOARD MODULE

```
-spec cross(row_num(), pos(), len(), t()) -> t().
cross(RowN, Pos, Len, Board) ->
  Row = element(RowN, Board),
  NewRow = nim_row:cross(Pos, Len, Row),
  setelement(RowN, Board, NewRow).
```

ADT IMPLEMENTATION

- Module Name is Type Name
- Opaque Type t/0
  - Exported
- Constructor: new/X
- Accessors with t() in the spec

```
-module(my_adt).

-opaque t() :: …type def….
-export_type([t/0]).

-export([new/X]).
-export([other_funs/Y, …]).

-spec new(…) -> t().
new(Arguments) -> …instance….

-spec other_fun(… t() …) ->
    other_thing() | t().
```


WHY?

PROBLEMS

PROBLEMS

1. ~~Low Maintainability~~
2. ~~Hard to Debug~~
3. ~~No Encapsulation~~
4. ~~No Documentation~~

EXTRA BENEFITS

- Makes **dialyzer** happy
- Makes **edoc** happy
- More **organized** code bases
- You can...
  - Switch **implementations**
  - Apply **common interfaces**
    - Sumo **behaviors**
    - Elixir **protocols**
  - Implement OOP **Heuristics**
    - Ask **Hernán** about them!

THE KEY CONCEPT

- nim_player:t() =/= string()
- nim_row:t() =/= [1 | 0]
- nim_board:t() =/= {[1|0], …}
- nim_game:t() =/= {string(), …}

You have BETTER MODELS

You've built

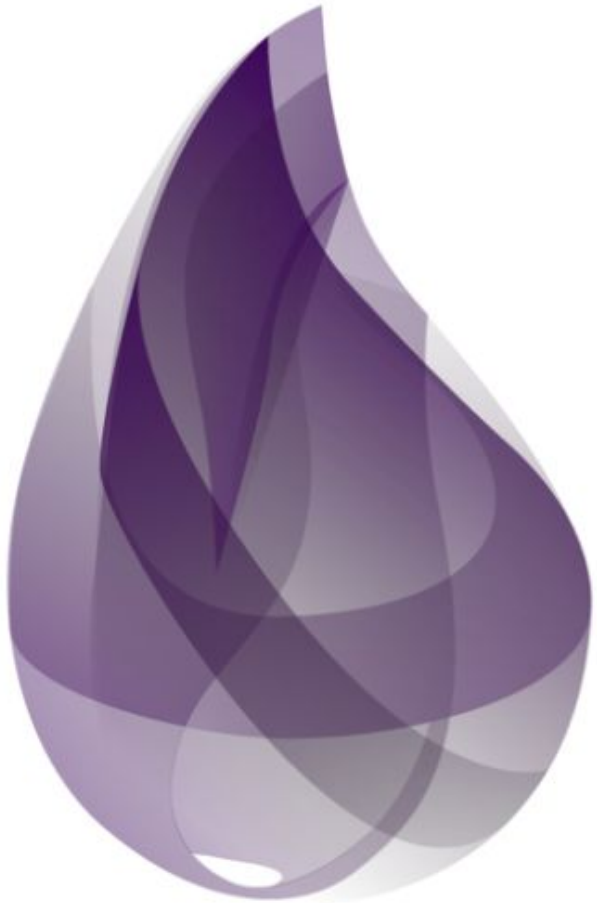
A BETTER SOFTWARE!

DOWNSIDES

- More **code**
  - More **modules**
  - More **functions**
- **Performance** concerns?
  - **Benchmark** your code
  - `-compile({inline,…`
- Less **“smart”** code
  - **Pattern Matching**
  - **List Comprehensions**

IN ELIXIR

- You can define types with:
  - **defstruct**
  - `@type t :: %__MODULE__{…}`
- Then you can use your types like **`MyADT.t`**
- And you can implement **protocols**



FURTHER READING

- [Heuristics for OOP]
  (by Hernán Wilkinson)
- [Heuristics for Erlang]
  (by Brujo Benavides)
- [Erlang and Code Style]
  (by Jesper L. Andersen)
- [Everything]
  (by erlang-questions / Slack / etc.)

THANK YOU

Any questions?

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