# Thinking Functionally

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# What is Functional Programming?

- More sophisticated type systems, e.g. Haskell
- No side effects: function outputs depend only on inputs
  - No shared state
  - Concurrency
- Pattern matching

# Benefits

- Easier to test
- Easier to deal with faults in production
- All state is in function parameters, so logs are good
- Message passing

# Functional vs Object Oriented: Types

- OO connects behavior with types, i.e. object methods
- Functional programming uses types for safety
- Modern functional programming languages use type inference to reduce programmer overhead
- "If it will compile, it's correct

# Erlang types

- Pattern matching at runtime
- “Let it crash”
- Supervisors retrying
- Hot code updates

# Type checking

- Optional type checking
- Typespecs
- Dialyzer
- Tagged tuples
  - {:ok, value} vs {:error, reason}

# Elixir types

- Structs are simply wrappers on Maps

- ```
  defmodule User do
    defstruct name: "John", age: 27
  end
  ```

- ```
  iex> %User{}
  %User{age: 27, name: "John"}
  iex> %User{name: "Meg"}
  %User{age: 27, name: "Meg"}
  ```

- ```
  iex> is_map(john)
  true
  iex> john.__struct__
  User
  ```
  ```

# Immutable Data

- It's a good thing
- Erlang does not allow mutating variables
  - Actually re-binding
- Elixir allows it, but it goes against the core of the language
- If you are mutating variables, you are probably doing something wrong
- "Help Doctor, my variables are not varying!"

# Functional vs Object Oriented: Nouns vs Verbs

- OO: No unbound methods
- FP: Standard algorithms with “meta-programming", lambda functions
- Lambda functions, Ruby "blocks" becoming popular
- Execution in the Kingdom of Nouns: http://steve-yegge.blogspot.tw/2006/03/execution-in-kingdom-of-nouns.html

# Functional vs Object Oriented: Polymorphism

- OO: Inheritance
- FP: Protocols

# Protocols

- defprotocol Blank do
    @doc "Returns true if data is considered blank/empty”
    def blank?(data)
    end

end

# Protocols

- defimpl Blank, for: Integer do
  def blank?(_), do: false
  end
- defimpl Blank, for: List do
  def blank?([]), do: true
  def blank?(_),  do: false
  end
- defimpl Blank, for: Map do
  # Keep in mind we could not pattern match on %{} because
  # it matches on all maps. We can however check if the size
  # is zero (and size is a fast operation).
  def blank?(map), do: map_size(map) == 0
  end

# Protocols

- defimpl Blank, for: Atom do
  def blank?(false), do: true
  def blank?(nil), do: true
  def blank?( _ ), do: false
  end
- defimpl Blank, for: User do
  def blank?(_), do: false
  end

# Protocols: JSON

- iex> IO.puts Poison.Encoder.encode([1, 2, 3], [])
  "[1,2,3]"
- defimpl Poison.Encoder, for: Person do
  def encode(%{name: name, age: age}, options) do
  Poison.Encoder.BitString.encode("#{name} (#{age})",
  options)
  end
  end

# Higher Order Programming

- Using functions to “specialize” common algorithms
- Recursion is nice, but generally not the right solution
- Standard algorithms make intent clearer
- Fewer bugs

# Higher Order Programming: List Comprehensions

- iex> IO.puts Poison.Encoder.encode([1, 2, 3], [])
  "[1,2,3]"
- defimpl Poison.Encoder, for: Person do
  def encode(%{name: name, age: age}, options) do
  Poison.Encoder.BitString.encode("#{name} (#{age})",
  options)
  end
  end

# Higher Order Programming: Map

- iex> Enum.map([1, 2, 3], fn x -> x 2 end)
  [2, 4, 6]
- iex> Enum.map(%{1 => 2, 3 => 4}, fn {k, v} -> k v end)
  [2, 12]

# Higher Order Programming: Fizz Buzz

- defmodule FizzBuzz do
  def fizzbuzz_check(n) do
    case {rem(n, 3), rem(n, 5)} do
      {0, 0} -> "FizzBuzz"
      {0, _} -> "Fizz"
      {_, 0} -> "Buzz"
      {_, _} -> n
    end
  end

  def fizbuzz do
    IO.inspect Enum.map(1..100, fizzbuzz_check/1)
  end
end

# Higher Order Programming: Fold / Reduce

- iex> List.foldl([1, 2, 3], 0, fn (x, acc) -> x + acc end)
  6

# Higher Order Programming: Streams

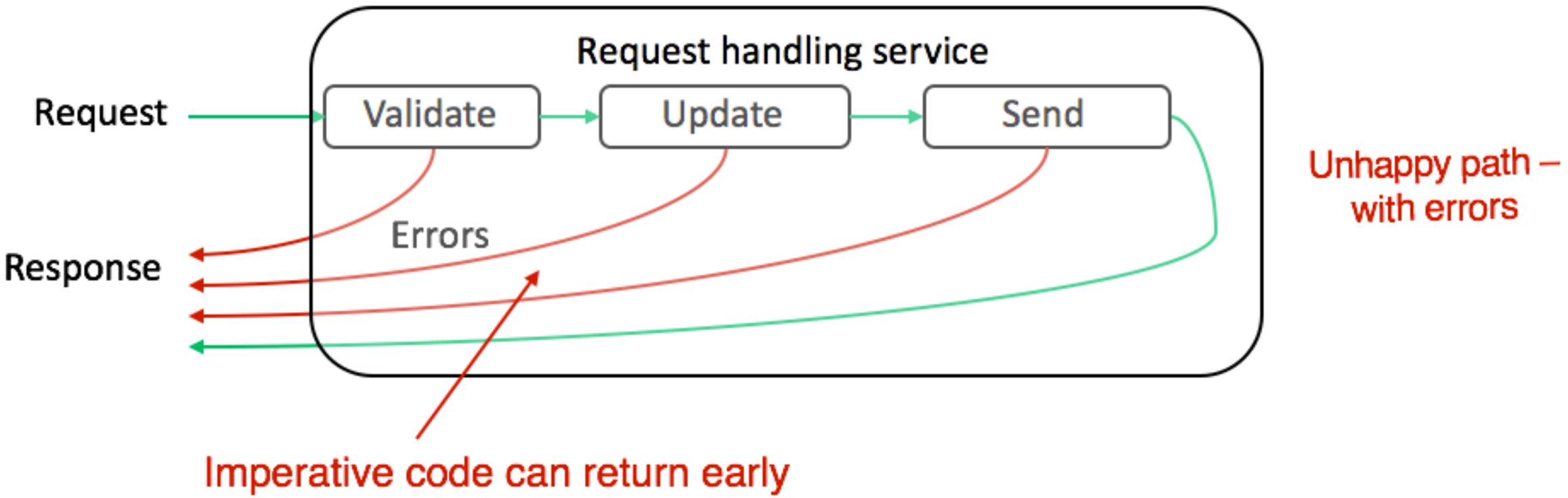
- nums = Stream.iterate(1, &(&1 + 1))
  fizz = Stream.cycle ["", "", "Fizz"]
  buzz = Stream.cycle ["", "", "", "", "Buzz"]

```
fizzbuzz = Stream.zip(fizz, buzz)
|> Stream.zip(nums)
|> Stream.map(fn
    {{"",             ""},  number} -> number
    {{fizzword, buzzword}, _number} -> fizzword <> buzzword
end)
fizzbuzz |> Stream.take(30) |> Enum.join("\n") |> IO.puts
```

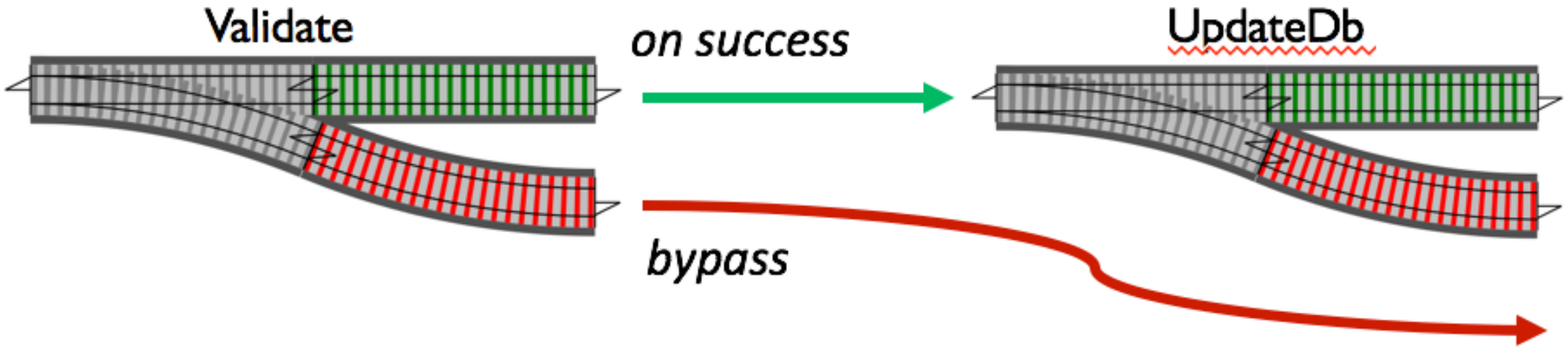
# Phoenix Request Processing

- Handling a request is just a series of transformations
- Take a request as input, transform it into a response
- Plug framework

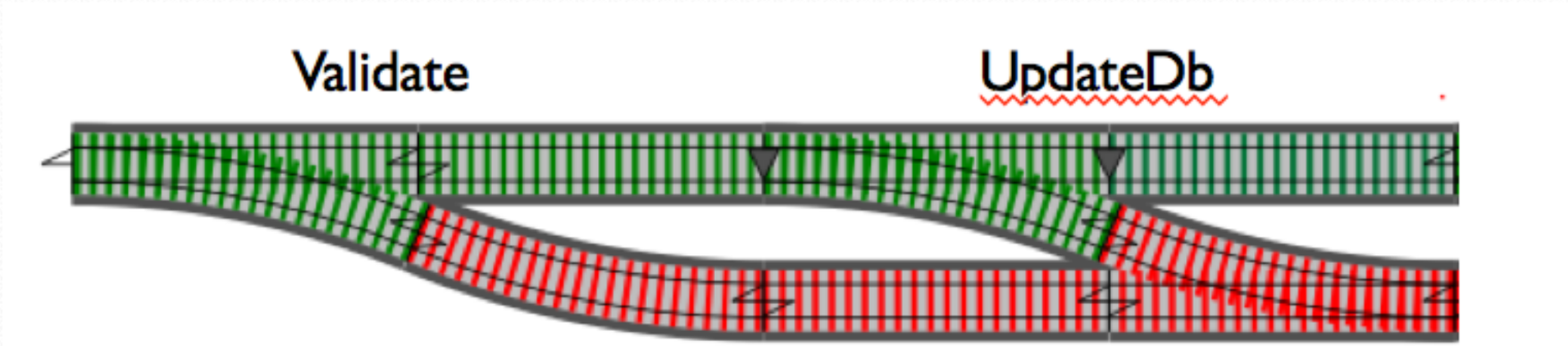
# Railway Oriented Programming



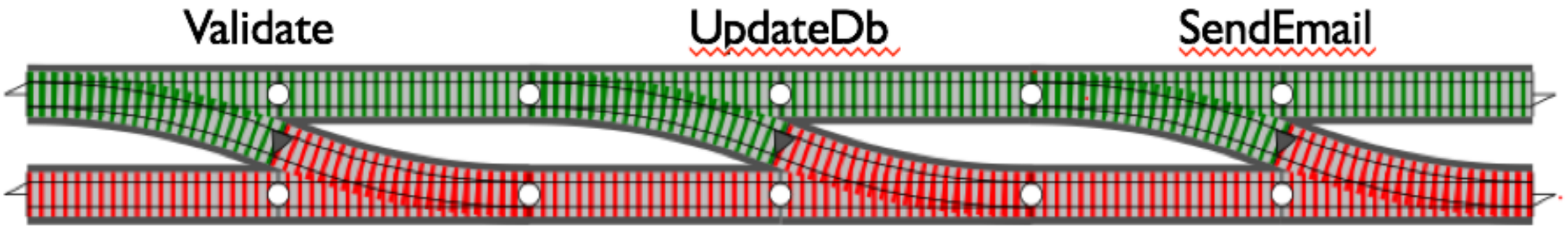
# Railway Oriented Programming



# Railway Oriented Programming



# Railway Oriented Programming




- http://zohaib.me/railway-programming-pattern-in-elixir/

# Heresy

- Small functions instead of testing
- Relational model is primary, not ORM
- Erlang is a *truly* object oriented language, unlike these pretenders

# Questions?