Pipe Dreams

pipes |> macros |> beautiful_code

(Mar7), 2014

- Why pipes?
- pipe_matching
- pipe_with
- Wrapping up

Why pipes?

José Valim

Why did you add Pipes to Elixir?

I stole them from F#.

Why pipes?

José Valim

Do you see them as an important part of the language?

It is puzzling. I haven't given much thought to it

Why pipes?

José Valim

Do you see them as an important part of the language?

It is puzzling. I haven't given much thought to it when I added to the language but many came to find it an essential tool to help thinking functionally!

Why pipes?

...

However, developers quickly embraced the operator, because it embodies one of the main ideas in function programming, which is the transformation of data, via multiple steps (functions).

Why pipes?

Dave Thomas

Programming Elixir
Functional |> Concurrent |> Pragmatic |> Fun

Why pipes?

Chris McCord (Phoenix creator)

“Pipes and macros are why I am here”

Why pipes?

Joe Armstrong

Actually, the Elixir version is easier to read:

```
:io_lib.format("~p", [x])
|> :lists.flatten
|> :erlang.list_to_binary
```

Just like the good ol' Unix pipe operator.

Why pipes?

Functional Programming

```
back(back(forward(step)))
```

Why pipes?

Why pipes?

Functional Programming

```
forward(step)
```

Why pipes?

Functional Programming

```
step |> forward
```

Why pipes?

Functional Programming

```
back(back(forward(step)))
```

Why pipes?

Functional Programming

```
step |> forward |> back |> back
```

Why pipes?

Why pipes?

```
def request(conn) do
  conn |>
  enforce_ssl |>
  map_params |>
  route |>
  respond
end
```

- Why pipes?
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- pipe_with
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pipe_matching

Problem: Unreliable tasks

```
works |> works |> breaks |> works
```

pipe_matching

```elixir
defmodule RussianRoulette do
  def click(acc) do
    IO.puts "click..."
    {:ok, "click"}
  end

  def bang(acc) do
    IO.puts "BANG."
    {:error, "bang"}
  end
end

{:ok, ""} |> click |> click |> bang |> click
```

pipe_matching

```
mix run examples/return_codes.exs
click...
click...
BANG.
click...
```

pipe_matching

(Mar7), 2014

pipe_matching

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pipe_matching

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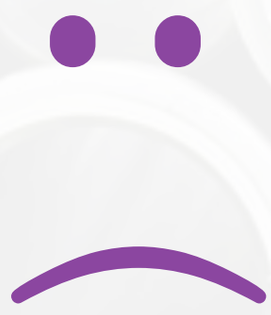
`pipe_matching`

- Corrupt your functions
- Wrap your functions
- Corrupt your compositions



pipe_matching

- Change the |> operator

pipe_matching

Macros

pipe_with

```
(defmacro unless [test body]
   (list 'if (list 'not test) body))
```

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Paste Previous ⇧⌘V

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pipe_matching

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pipe_matching {:ok, _},
{:ok, ""} |> click |> click |> bang |> click
```

pipe_matching

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pipe_matching

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end

pipe_matching {:ok, _},
{:ok, ""} |> click |> click |> bang |> click
```

`pipe_matching`

- Preserve syntax
- Prevent execution

- Must be a macro

What is a macro?

- Executes at compile time
- Potentially changing the syntax tree
- Especially useful as code templates

pipe_matching

```
defmodule Pipe do
  defmacro __using__(_) do
    quote do
      import Pipe
    end
  end

  defmacro...
  defmacro...

end
```

pipe_matching

```
defmacro pipe_matching(expr, pipes) do
  quote do
    pipe_while( &(match? unquote(expr), &1),
                unquote pipes)
  end
end
```

pipe_matching

Level I

```
defmacro pipe_matching(expr, pipes) do
  quote do
    pipe_while( &(match? unquote(expr), &1),
                unquote pipes)
  end
end
```

pipe_matching

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defmacro pipe_matching(expr, pipes) do
  quote do
    pipe_while( &(match? unquote(expr), &1),
                unquote pipes)
  end
end
```

Level 2

pipe_matching

```
defmacro pipe_while(test, pipes) do
  Enum.reduce Macro.unpipe(pipes), &(reduce_if &1, &2, test)
end

defp reduce_if( x, acc, test ) do
  quote do
    ac = unquote acc
    case unquote(test).(ac) do
      true -> unquote(Macro.pipe((quote do: ac), x))
      false -> ac
    end
  end
end
```

pipe_matching

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defmacro pipe_while(test, pipes) do
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pipe_matching

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pipe_matching

```
mix run examples/return_codes.exs
click...
click...
BANG.
```

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`pipe_with`

Problem: Non-uniform exceptions

```
works |> works |> breaks |> works
```

pipe_with

Problem: Non-uniform exceptions

```
works |> works |> breaks |> works
```

Throws or {:error, ...}

pipe_with

```elixir
defmodule Roulette do
  def start, do: :ok
  def click(acc) do
    IO.puts "oh yayz iz a liv #{inspect acc}"
  end

  def bang(_acc) do
    IO.puts "oh noz iz ded"
    raise "shotz"
  end
end

Roulette.start |>
Roulette.click |>
Roulette.click |>
Roulette.bang |>
Roulette.click
```

pipe_with

```
defmodule Roulette do
  def start, do: :ok
  def click(acc) do
    IO.puts "oh yayz iz a liv #{inspect acc}"
  end

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    raise "shotz"
  end
end

Roulette.start |>
Roulette.click |>
Roulette.click |>
Roulette.bang |>
Roulette.click
```

pipe_with

```
defmodule ExceptionWrapper do
  def wrap({:error, e, acc}, _), do: {:error, e, acc}
  def wrap(acc, f) do
    f.(acc)
  rescue
    x in [RuntimeError] ->
      {:error, x, acc}
  end
end
```

pipe_with

```
use Pipe
game = pipe_with &ExceptionWrapper.wrap/2,
           Roulette.start |>
           Roulette.click |>
           Roulette.click |>
           Roulette.bang |>
           Roulette.click
```

pipe_with

Problem: Changing Semantics

```
matrix |> operator |> operator
```

pipe_with

```
list = [1, 2, 3]

list |>
Kernel.+(1) |>
Kernel.*(2)

matrix = [[1, 2], [2, 3], [0, 1]]
matrix |>
Kernel.+(1) |>
Kernel.*(2)
```

pipe_with

```
x    |>    f1    |>    f2
```

pipe_with

```
x    |> g(f1)   |> g(f2)
```

pipe_with

```
defmacro pipe_with(fun, pipes) do
  Enum.reduce Macro.unpipe(pipes), &(reduce_with &1, &2, fun)
end

defp reduce_with( segment, acc, outer ) do
  quote do
    inner = fn(x) ->
      unquote Macro.pipe((quote do: x), segment)
    end

    unquote(outer).(unquote(acc), inner)
  end
end
```

pipe_with

```
defmacro pipe_with(fun, pipes) do
  Enum.reduce Macro.unpipe(pipes), &(reduce_with &1, &2, fun)
end

defp reduce_with( segment, acc, outer ) do
  quote do
    inner = fn(x) ->
      unquote Macro.pipe((quote do: x), segment)
    end

    unquote(outer).(unquote(acc), inner)
  end
end
```

pipe_with

```
defmacro pipe_with(fun, pipes) do
  Enum.reduce Macro.unpipe(pipes), &(reduce_with &1, &2, fun)
end

defp reduce_with( segment, acc, outer ) do
  quote do
    inner = fn(x) ->
      unquote Macro.pipe((quote do: x), segment)
    end

    unquote(outer).(unquote(acc), inner)
  end
end
```

pipe_with

```elixir
defmodule Matrix do
  def merge_list(x, f), do: Enum.map(x, f)
  def merge_lists(x, f), do: Enum.map(x, &Matrix.merge_list(&1, f))
end

use Pipe
list = [1, 2, 3]
pipe_with &Matrix.merge_list/2,
          list |> Kernel.+(1) |> Kernel.*(2)

matrix = [[1, 2], [2, 3], [0, 1]]
pipe_with &Matrix.merge_lists/2,
          matrix |> Kernel.+(1) |> Kernel.*(2)
```

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Programming is Thinking

Pipes Help Us Think

Macros make the Pipes Better

Resources

- Programming Elixir
  - http://pragprog.com/book/elixir/programming-elixir
- elixir-pipes
  - https://github.com/batate/elixir-pipes
- Joe Armstrong on pipes
  - http://joearms.github.io/2013/05/31/a-week-with-elixir.html

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