# Monads are Burritos

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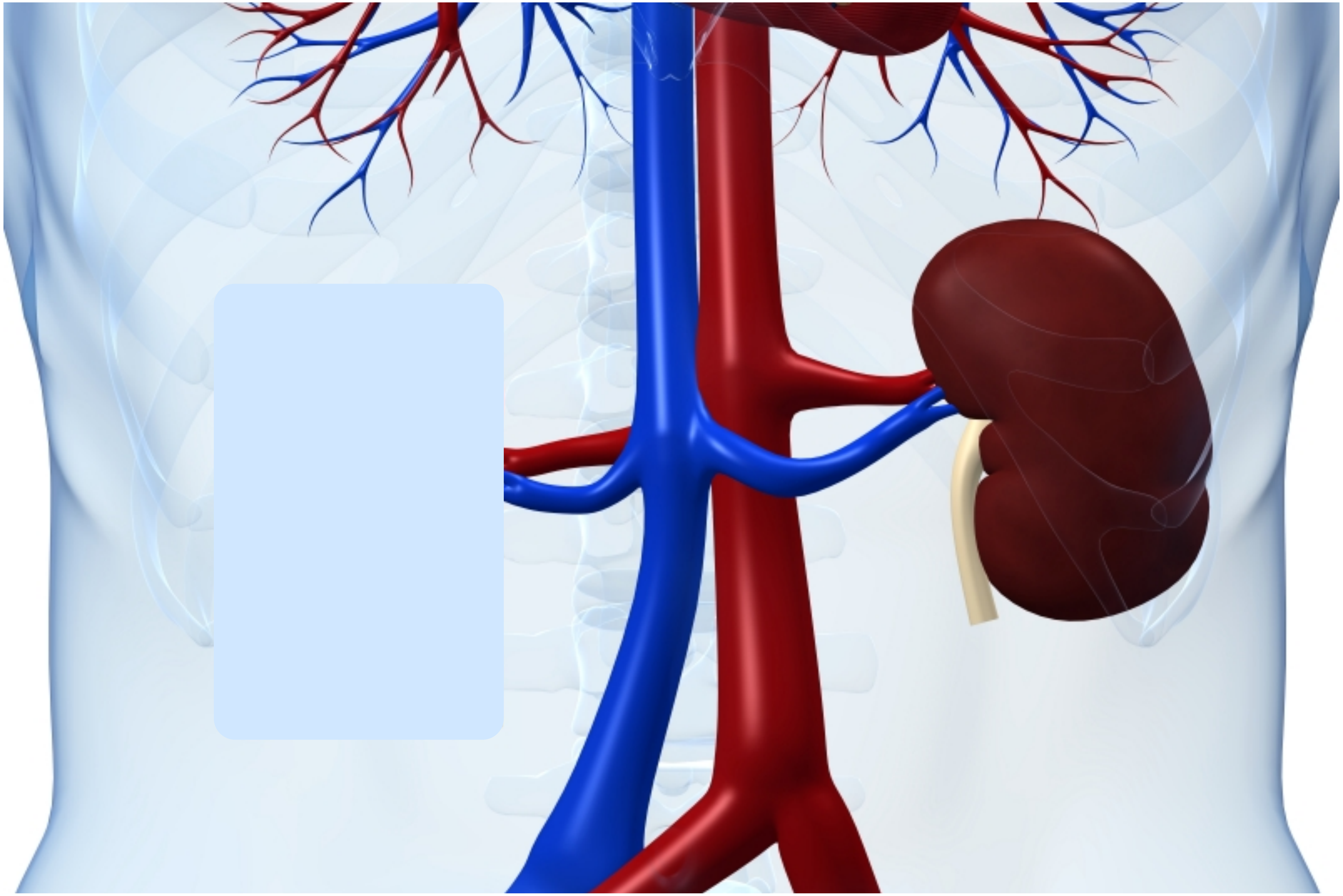
*There is no Burrito: we all must find our own.*

*The Promised Land is a journey, just as it was for objects, recursion, etc*

Our Master of Ceremonies
is
http://demetrimartin.com

A cerebral comic with
jokes such as:

*What is the smartest thing anyone
has said that starts with "Dude"* ?



*“Dude, we removed a kidney and you’re going to be fine.”*

*“Dude, these are isotopes!”* -- excellent but we can top that

## Haskell

- pure functional
- strong, static typing
- modular, and not OO
- lazy evaluation

## *Iterative, location-based programming is a scourge*

```
tuple a b = do {
                x <- a ;
                y <- b ;
                return (x,y)
            }
```

*This was presented as pseudo-code of iterative programming, but it is in fact valid Haskell.*

## Functions in mathematics

$$\mathbf{f : N \rightarrow R}$$

$$f(x) = |\sqrt{x}|$$

$$f(100) = 10$$

$$f(3.14) = ?$$

$$f(-2) = ?$$

Reviewing the notion of **domain** and **range** for math functions

## Type Signatures in Haskell

**f : N -> R** in math

in Haskell:

**f :: a -> b**  (eg String -> Integer)

**g :: a -> a -> b** (eg String String -> Integer)

**h :: a -> (a -> b) -> b** (eg String f -> Integer)

## Maybe type

```
data Maybe a = Nothing | Just a

Just “Lambda Lounge” :: Maybe String

Just 10 :: Maybe Integer
```

*Maybe is a wrapper type. ‘a’ here is a type variable*

## Monad:

1. Type constructor **m** (eg Maybe)

2. injection function: a -> **m** a

3. chain function:

   **m** a -> (a -> **m** b) -> **m** b

Due to variance within this structure, there are many instances of monads in Haskell.

For a monad **m**, in Haskell:

1. injector is **return** = a -> **m** a

2. chain is called bind. Symbol is **>>=**

   **m** a -> (a -> **m** b) -> **m** b

| **Monad** | **use** | **support** |
|---|---|---|
| Maybe | short-circuit | n/a |
| Logger | state | runLogger |
| IO | impure IO | putStrLn |
| STM | concurrency | atomically |

record “any” =
Logger ( (), [“any”] )

ezRegex “abc” =
Logger ( “abc”, [] )

return ( ‘.’ ++ “abc” ) =
Logger ( “.abc”, [] )

*The logger example inspired by Real World Haskell.*

record “any” =
Logger ( (), [“any”] )

( (), [“any”] )

( “abc”, [] )

---

( “abc”, [“any”] )

globToRegex “abc” =
Logger ( “abc”, [] )

return ( ‘.’ ++ “abc” ) =
Logger ( “.abc”, [] )

record “any” =
Logger ( (), [“any”] )

```
   ( (), [“any”] )
   ( “abc”, [] )
  ------------------
  ( “abc”, [“any”] )
   ( “.abc”, [] )
  ------------------
 ( “.abc” , [“any”])
```

globToRegex “abc” =
Logger ( “abc”, [] )

return ( ‘.’ ++ “abc” ) =
Logger ( “.abc”, [] )

## Wrap up that burrito

- **Monads are a combination of structure and variance**
- **Myth: monads are hard (see Maybe)**
- **Myth: monads are only used for IO**
- **Myth: monads are only in Haskell (OCaml, C++, etc)**

## Wrap up that burrito

Dude, a monad ***is a burrito***,
if a burrito is a functor-like object
with a generic type, a sense of
encapsulation, and the ability to
combine large computations out of
smaller ones.

## Syntactic sugar (bonus section)

```
tuple :: (m x) -> (m y) -> (m (x,y))

tuple a b = a >>= \x ->
            b >>= \y ->
            return (x,y)
```

*This behaviour of this code (and next slides) changes depending on which monadic values are passed in.*

## Syntactic sugar

```
tuple a b = do {
                 x <- a ;
                 b >>= \y ->
                 return (x,y)
              }
```

*Machine translatable from previous slide*

## Syntactic sugar

```
tuple a b = do {
              x <- a ;
              b >>= \y ->
              return (x,y)
            }
```

*Read right to left: ‘a’ is a monad; the highlight is a function with parameter ‘x’. The inner type is removed from ‘a’ and fed into this function.*

## Syntactic sugar

```
tuple a b = do {
                x <- a ;
                y <- b ;
                return (x,y)
             }
```

*Now, the same is done with monad ‘b’ and the value ‘y’.*

## Syntactic sugar

```
tuple a b = do {
                  x <- a ;
                  y <- b ;
                  return (x,y)
               }
```

*Dude*, a monad is a *programmable* semi-colon !

*This was presented speciously as the ‘scourge’ of iterative programming, but it is in fact sugared Haskell syntax for monads.*

My sincere thanks to everyone at the Lambda Lounge for the chance to learn and explore monads. I would never have learned as much without the group.

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