

**Definition** (Monad (computer science)). A monad

$$\langle M, \text{return}, \text{join}, \text{fmap}, \text{bind}, \text{fish}, \text{lift} \rangle$$

is a set of operations with the following signature:

$$\text{return} : A \rightarrow MA$$

$$\text{join} : MMA \rightarrow MA$$

$$\text{fmap} : (A \rightarrow B) \rightarrow (MA \rightarrow MB)$$

$$\text{lift} : (A \rightarrow B) \rightarrow (A \rightarrow MB)$$

$$\text{bind} : MA \rightarrow (A \rightarrow MB) \rightarrow MB$$

$$\text{fish} : (A \rightarrow MB) \rightarrow (B \rightarrow MC) \rightarrow (A \rightarrow MC)$$

*return* is also known as “return”

These maps satisfy the equivalent axioms of unitality and associativity:

- ▷ *return* is a left identity for *bind*:

...

- ▷ *return* is a right identity for *bind*:

...

- ▷ *bind* is associative

...