

# State Monad

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# Today

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- ❖ Concepts
- ❖ Demos

*State Monad is a (relatively) simple **design pattern** in functional programming.*

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# Pure Functional Programming

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$$S \Rightarrow A$$

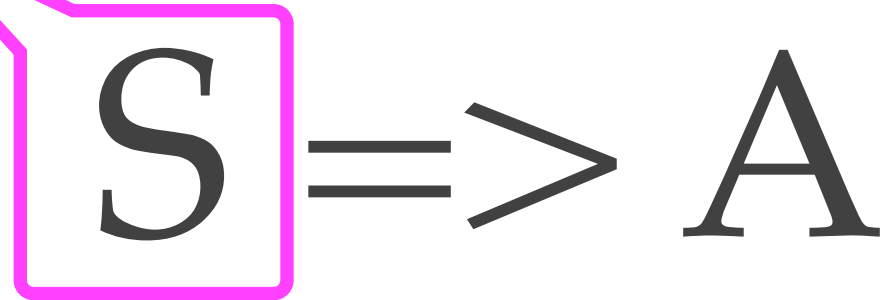
- ❖ Calculate an answer (A) out of the source (S)
- ❖ Scientific computation, IO...
- ❖ Scala Example: Append an element to a list produces a new list

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# Pure Functional Programming

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Immutable



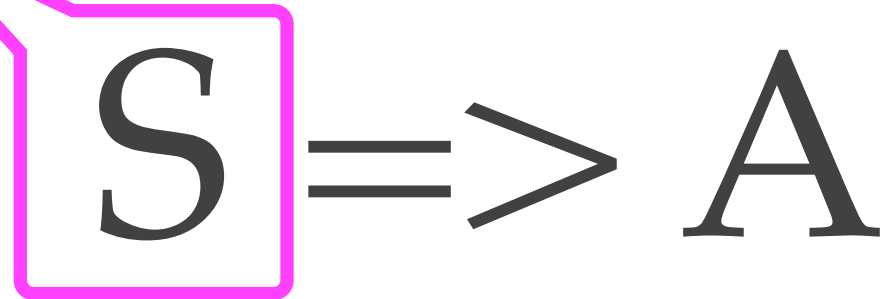
- ❖ Calculate an answer (A) out of the source (S)
- ❖ Scientific computation, IO...
- ❖ Scala Example: Append an element to a list produces a new list

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But, the real world often has to deal with changes

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Immutability breaks!

  $S = > A$

- ❖ Database
- ❖ Google
- ❖ Scala example: Generating a random data

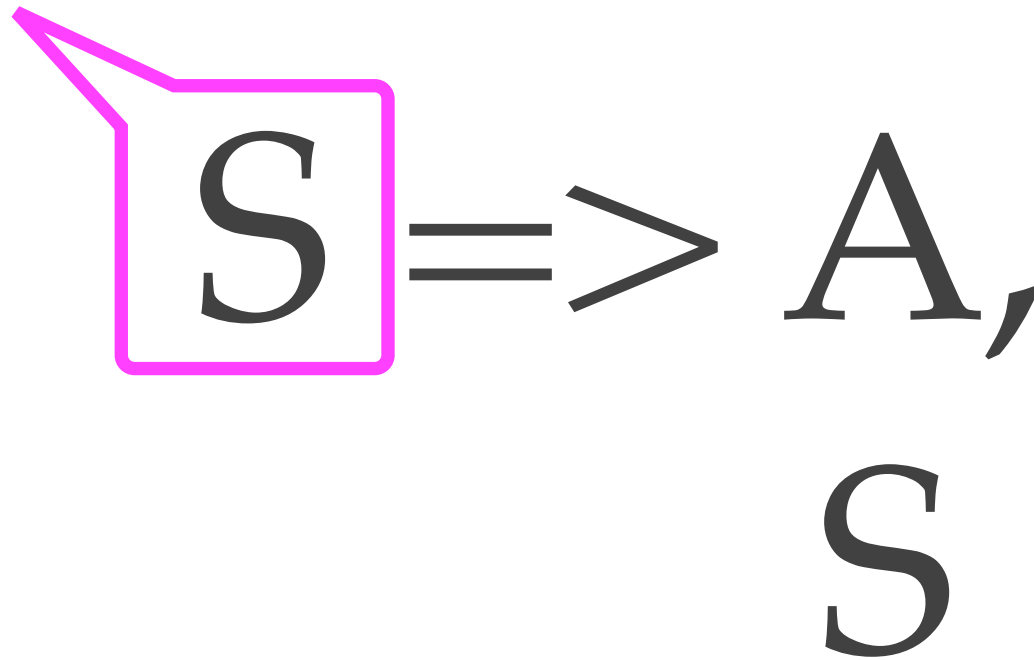
**DEMO**

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# Back to pure functional programming

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Immutable



A diagram illustrating the state monad. It features a magenta-outlined square containing the letter 'S'. To the right of this square is a double-lined arrow pointing to the right, followed by the letter 'A' and a comma. Below the 'A' is a large 'S'. This visualizes the mapping from a stateful computation (S) to a pure value (A), with the state (S) being passed along.

$$S \Rightarrow A,$$

S

*And, this is what characterizes a so-called state monad.*

# A state monad wraps $S \Rightarrow S, A$

```
trait State[S,A]{  
  def transition (initial:S):(S,A)  
}  
  
object State{  
  def apply[S,A](f:S => (S,A)):State[S,A] =  
    new State[S,A] {  
      def transition(initial:S): (S,A) = f(initial)  
    }  
}
```

*So, a state monad does not compute;  
it wraps.*





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Combinators can then be added on top of this structure.  
To practice in your exercises.

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```
trait State[S,A]{  
  def transition (initial:S):(S,A)
```

```
//combinators
```

```
def map[B] (f: A=>B):State[S,B] = ???  
def flatMap[B] (f: A => State[S,B]):State[S,B] = ???  
}
```

- ❖ map, map2, flatMap
- ❖ Useful, in cases like: derive a random Int list generator from a random Int generator
- ❖ Again, a monad does not compute; it wraps