



The Actor Model

Principles of Functional Programming

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What is an Actor?

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An Actor¹

- ▶ is an object with identity
- ▶ has a behavior
- ▶ only interacts using *asynchronous* message passing

¹Hewitt, Bishop, Steiger: *A Universal Modular Actor Formalism for Artificial Intelligence*, IJCAI 1973

The Actor Trait

```
type Receive = PartialFunction[Any, Unit]
```

```
trait Actor {  
  def receive: Receive  
  ...  
}
```

The Actor type describes the behavior of an Actor, its response to messages.

A Simple Actor

```
class Counter extends Actor {  
  var count = 0  
  def receive = {  
    case "incr" => count += 1  
  }  
}
```

This object does not exhibit stateful behavior.

Making it Stateful

Actors can send messages to addresses (`ActorRef`) they know:

```
class Counter extends Actor {  
  var count = 0  
  def receive = {  
    case "incr" => count += 1  
    case ("get", customer: ActorRef) => customer ! count  
  }  
}
```

How Messages are Sent

```
trait Actor {  
  implicit val self: ActorRef  
  def sender(): ActorRef  
  ...  
}
```

```
abstract class ActorRef {  
  def !(msg: Any)(implicit sender: ActorRef = Actor.noSender): Unit  
  def tell(msg: Any, sender: ActorRef) = this.!(msg)(sender)  
  ...  
}
```

Sending a message from one actor to the other picks up the sender's address implicitly.

Using the Sender

```
class Counter extends Actor {  
  var count = 0  
  def receive = {  
    case "incr" => count += 1  
    case "get"  => sender() ! count  
  }  
}
```


The Actor's Context

The Actor type describes the behavior, the execution is done by its ActorContext.

```
trait ActorContext {  
  def become(behavior: Receive, discardOld: Boolean = true): Unit  
  def unbecome(): Unit  
  ...  
}
```

```
trait Actor {  
  implicit val context: ActorContext  
  ...  
}
```

Changing an Actor's Behavior

```
class Counter extends Actor {  
  def counter(n: Int): Receive = {  
    case "incr" => context.become(counter(n + 1))  
    case "get"  => sender() ! n  
  }  
  def receive = counter(0)  
}
```

Changing an Actor's Behavior

```
class Counter extends Actor {  
  def counter(n: Int): Receive = {  
    case "incr" => context.become(counter(n + 1))  
    case "get"  => sender() ! n  
  }  
  def receive = counter(0)  
}
```

Functionally equivalent to previous version, with advantages

- ▶ state change is explicit
- ▶ state is scoped to current behavior

Similar to “asynchronous tail-recursion”.

Creating and Stopping Actors

```
trait ActorContext {  
  def actorOf(p: Props, name: String): ActorRef  
  def stop(a: ActorRef): Unit  
  ...  
}
```

Actors are created by actors.

“stop” is often applied to “self”.

An Actor Application

```
class Main extends Actor {  
  val counter = context.actorOf(Props[Counter], "counter")  
  
  counter ! "incr"  
  counter ! "incr"  
  counter ! "incr"  
  counter ! "get"  
  
  def receive = {  
    case count: Int =>  
      println(s"count was $count")  
      context.stop(self)  
  }  
}
```

The Actor Model of Computation

Upon reception of a message the actor can do any combination of the following:

- ▶ send messages
- ▶ create actors
- ▶ designate the behavior for the next message