



A Case for Side-Effects

Effective Programming in Scala

Benefits of Side-Effects

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Why do we have side-effects at all?

Because doing otherwise also has drawbacks...

“Pure” Random Number Generator: Definition

Let us try to implement a random number generator without using side-effects.

```
class Generator(previous: Int):  
  def nextInt(): (Int, Generator) =  
    val result = previous * 22_695_477 + 1  
    (result, Generator(result))  
end Generator
```

```
object Generator:  
  def init: Generator = Generator(42)
```

(We use a Linear Congruential Generator.)

“Pure” Random Number Generator: Usage

The operation `nextInt` returns a random `Int` value and the next Generator to use:

```
val gen1 = Generator.init
val (x, gen2) = gen1.nextInt()
println(x) // 953210035
val (y, _) = gen1.nextInt()
println(y) // 953210035
val (z, gen3) = gen2.nextInt()
println(z) // -570911984
```

“Pure” Random Number Generator: Usage (2)

The between operation can be implemented like this in the class Generator:

```
def between(x: Int, y: Int): (Int, Generator) =  
  val min    = math.min(x, y)  
  val delta  = math.abs(x - y)  
  val (randomValue, nextGenerator) = nextInt()  
  ((randomValue % delta) + min, nextGenerator)
```

“Pure” Random Number Generator: Usage (2)

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    ((randomValue % delta) + min, nextGenerator)
```

Our random number generator can be used like this:

```
val gen1 = Generator.init  
val (windowSide, _) = gen1.between(1, 4) // windowSide = 2  
val windowArea = windowSide * windowSide // : Int = 4
```

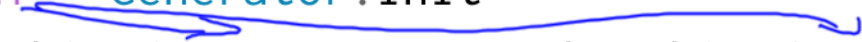
“Pure” Random Number Generator

We can now interchangeably use `def` or `val`, this doesn't affect the behavior of our program!

However, we have to use each Generator only once.

The problem becomes worse if several parts of our program use random numbers:

```
val gen1 = Generator.init  
getSomething(gen1, getSomeOtherThing(gen1))
```

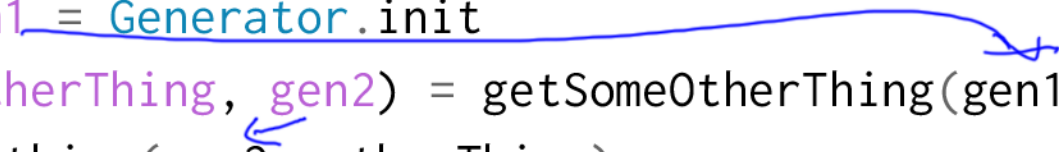
A blue arrow originates from the variable `gen1` in the first line and points to its first occurrence as an argument in `getSomething` in the second line. Another blue arrow originates from the same `gen1` and points to its second occurrence as an argument in `getSomeOtherThing` in the second line, illustrating that the same generator instance is used twice.

Here, by passing `gen1` at two places (as a parameter of `getSomething` and `getSomeOtherThing`) we will get the same random numbers in both places!

Context Threading

The correct way to use our random number generator is the following:

```
val gen1 = Generator.init
val (otherThing, gen2) = getSomeOtherThing(gen1)
getSomething(gen2, otherThing)
```

A diagram illustrating context threading. A blue arrow originates from the variable 'gen1' in the first line and points to the 'gen1' argument in the 'getSomeOtherThing' function call in the second line. Another blue arrow originates from the 'gen2' variable in the second line and points to the 'gen2' argument in the 'getSomething' function call in the third line.

The operation `getSomeOtherThing` needs to not only take an instance of `Random` as parameter, but also to return the next instance to use.

When we call `getSomething`, we must be careful to use `gen2` and not `gen1`.

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When we call `getSomething`, we must be careful to use `gen2` and not `gen1`.

Arguably, this is more tedious to write than using the side-effecting random number generator, `scala.util.Random`:

```
getSomething(getSomeOtherThing())
```

Summary

“Pure” alternatives to side-effects introduce accidental complexity by requiring developers to explicitly carry over the “context” they operate on.

Note that there are techniques to simplify this task, but they come with constraints.

There is no silver bullet. Just use the approach that works best for you by taking into account their pros and cons.