JetBRAINS

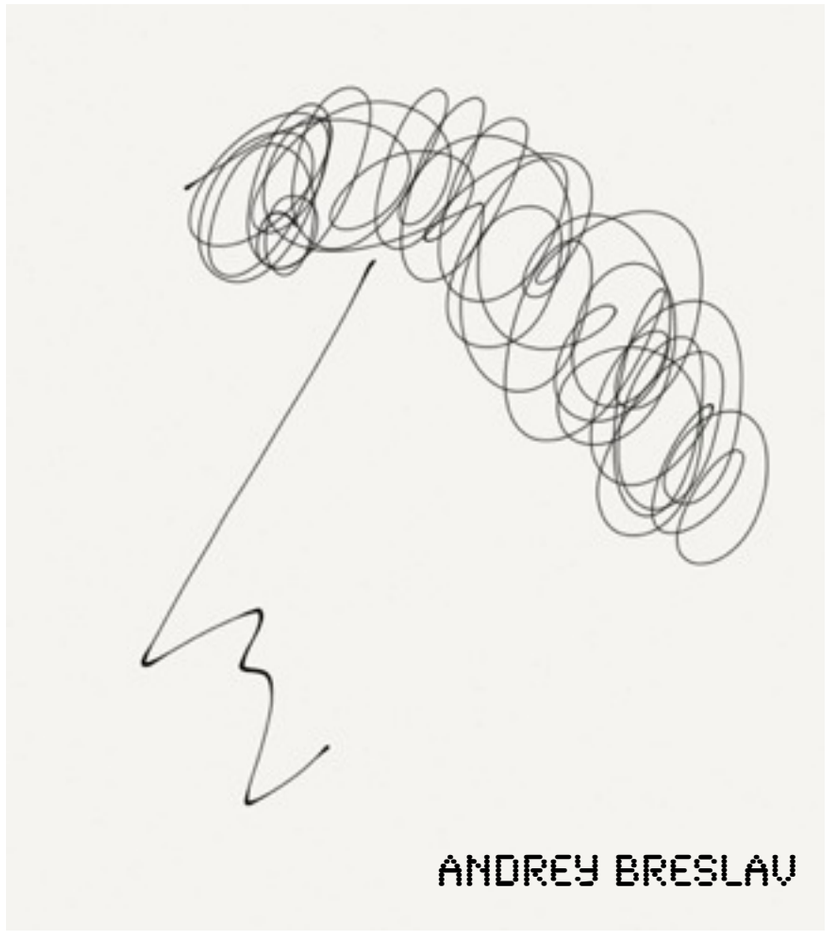
Who's More Functional

Groovy, Kotlin, Scala or Java?

Andrey Breslav

Kotlin

About Me



- Project lead of **Kotlin**
  - ➡ at JetBrains since 2010
- EG member of JSR-335
  - ➡ Project **Lambda**

Prologue

Prologue

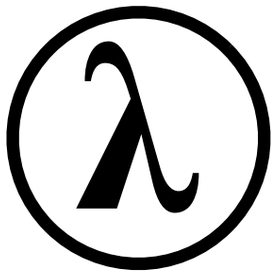
- Dad (or Mom), is Java a functional language?

Prologue

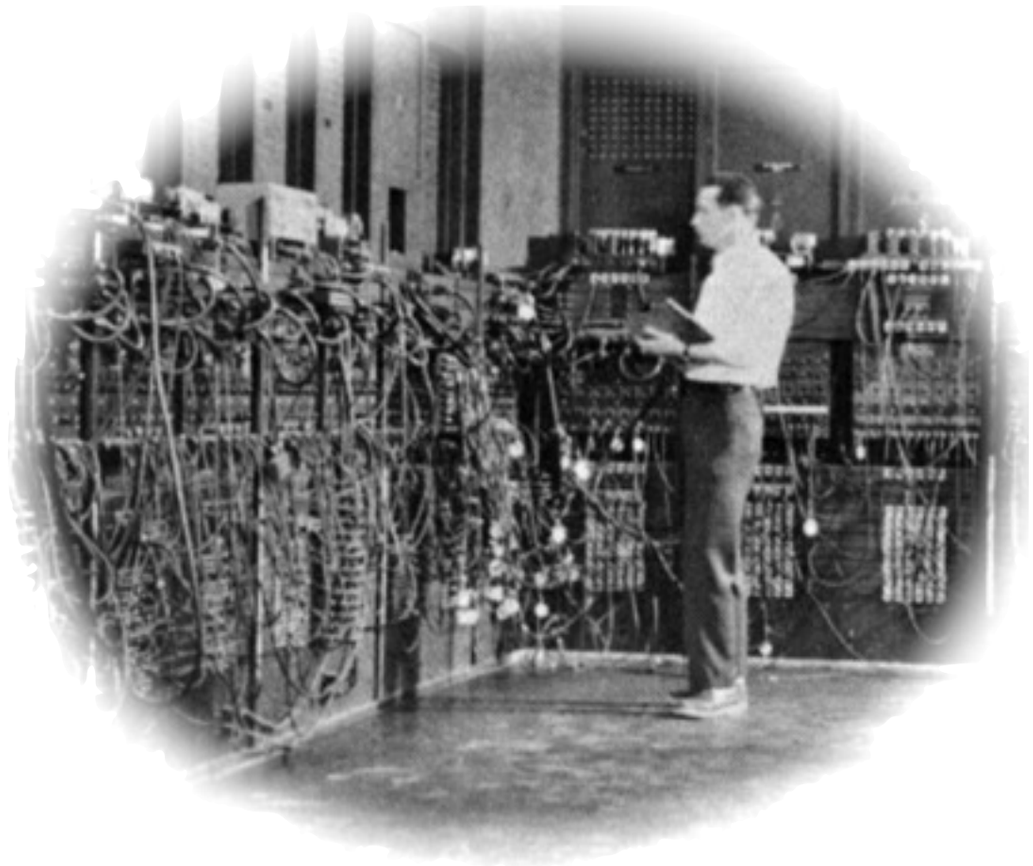
- Dad (or Mom), is Java a functional language?
- Don't you know your dad from your mom?!

What is FP like?

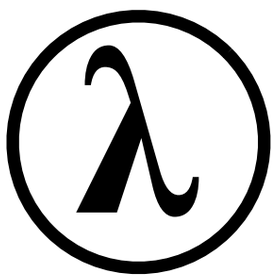
Alonzo Church



1936

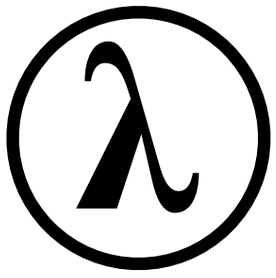


Alonzo Church



1936 1946

Alonzo Church



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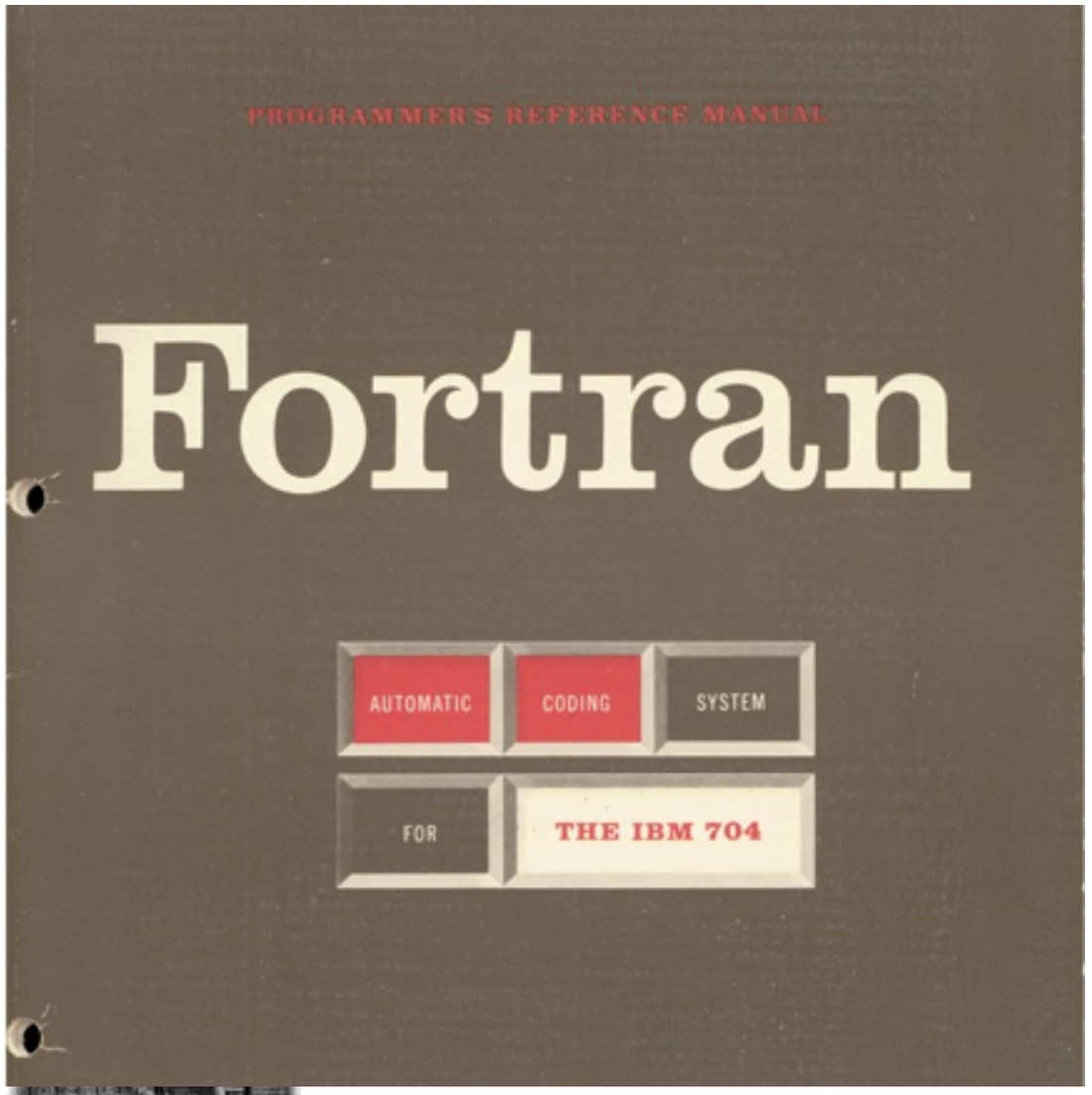
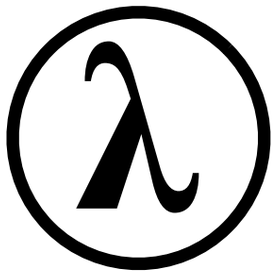
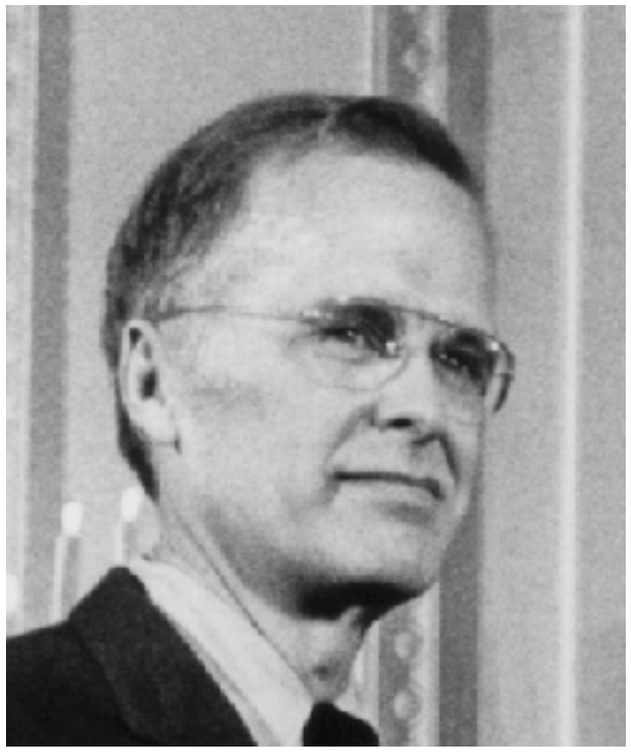


Alonzo Church

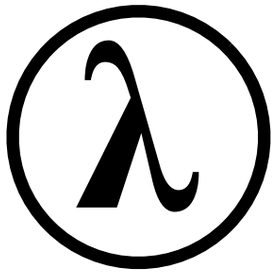


1936 1946 1956



John Backus

Alonzo Church



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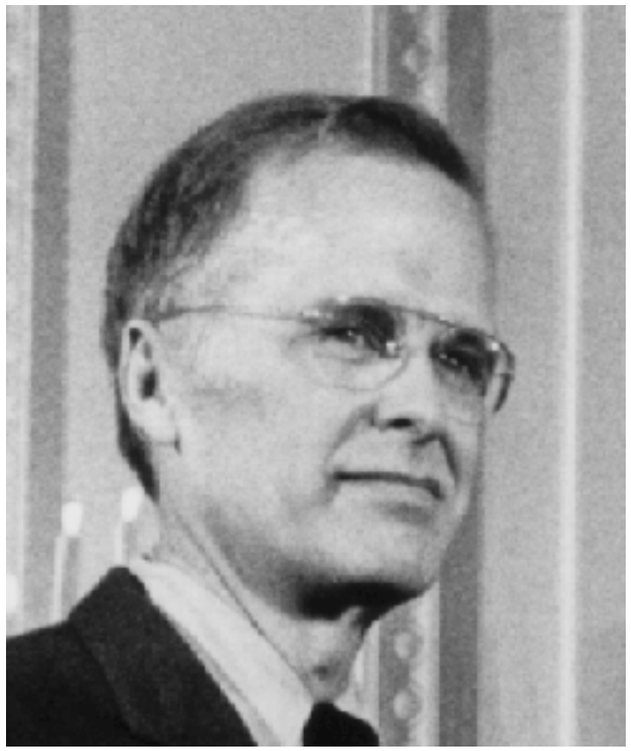
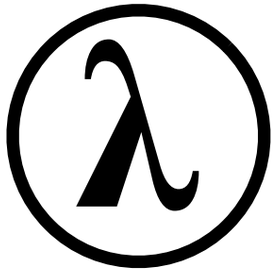


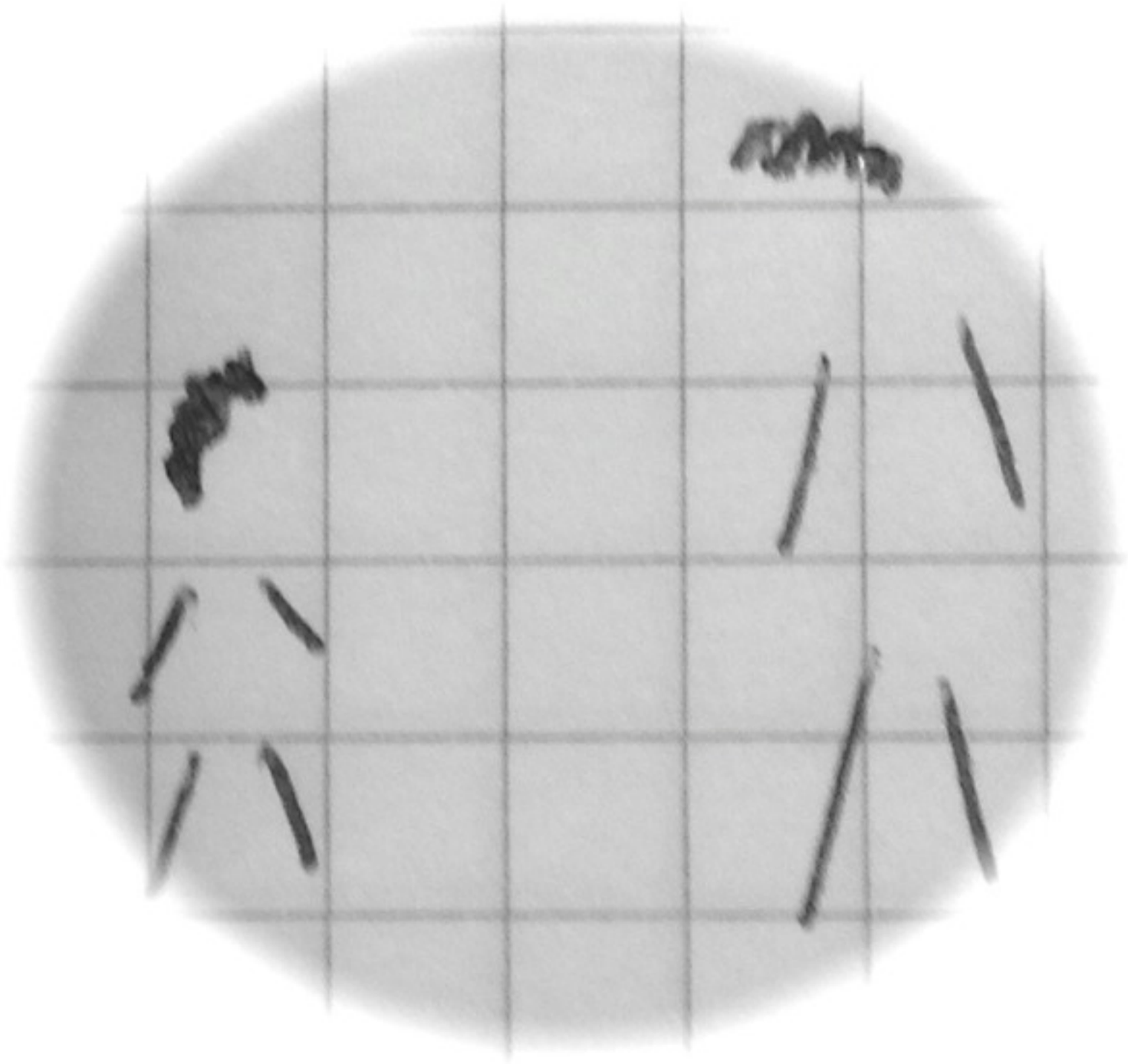
John Backus

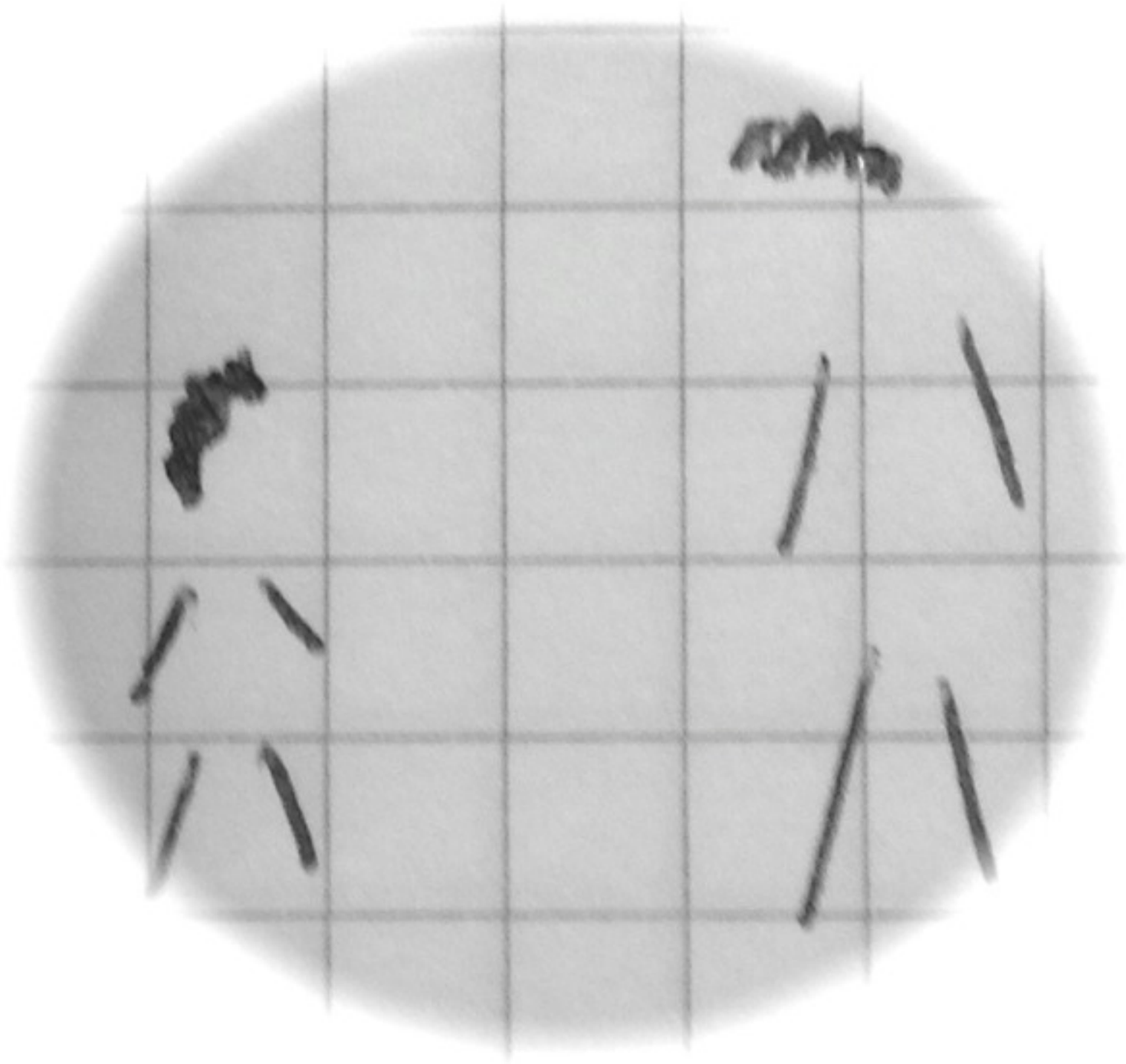
Can Programming be Liberated from the von Neumann Style?

Alonzo Church

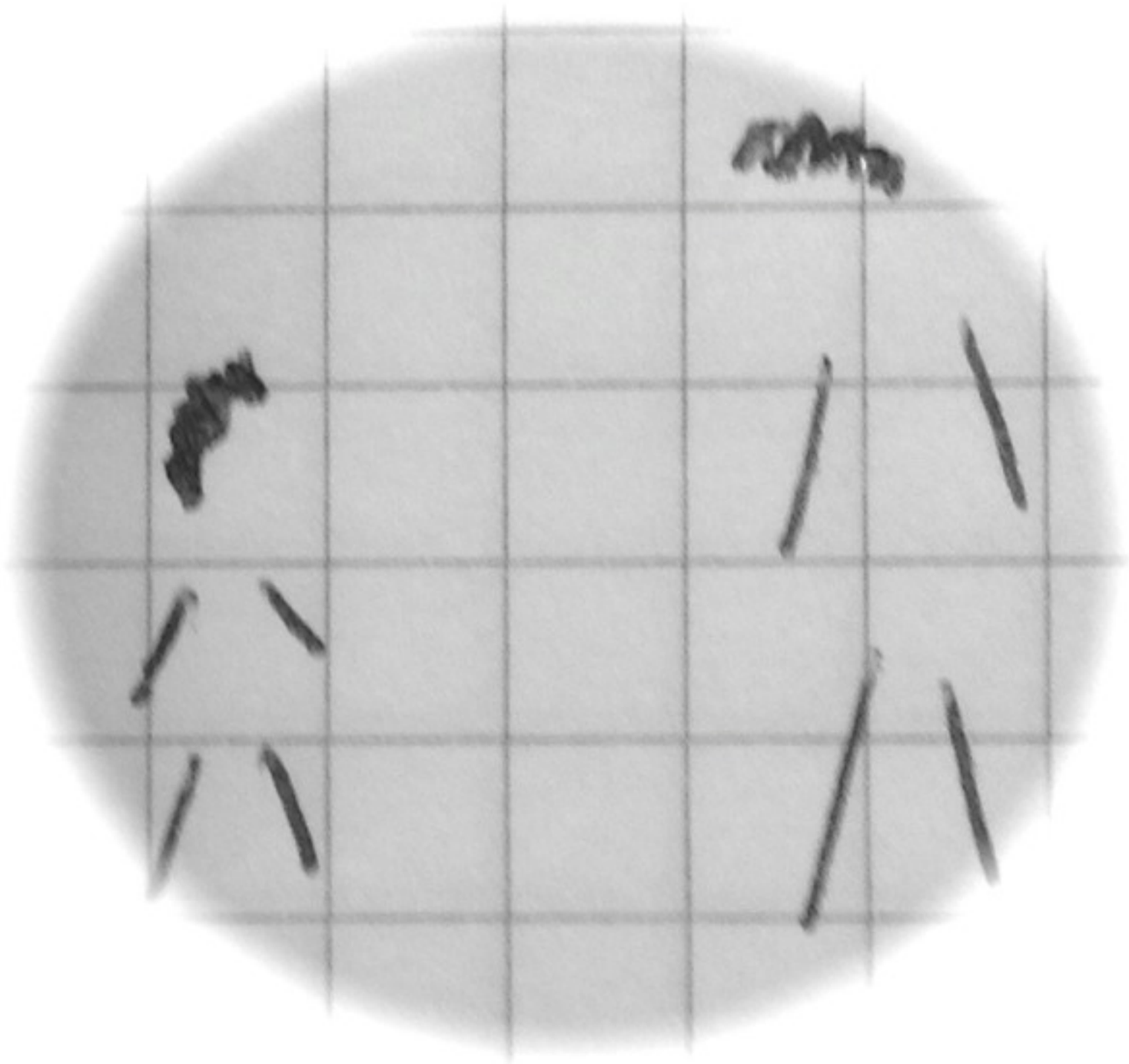


1936 1946 1956 1976



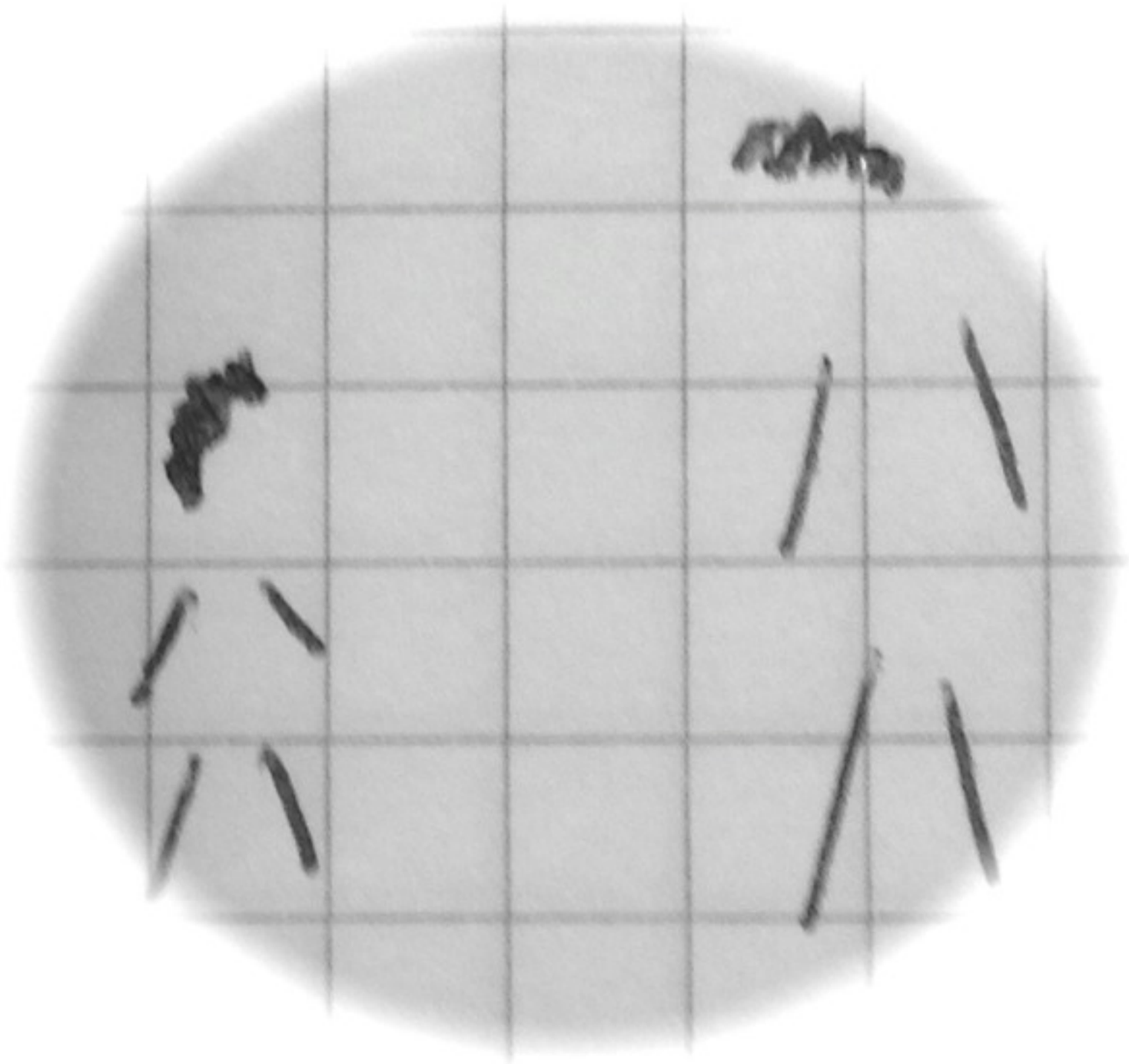


— Dad, what's good about FP?



— Dad, what's good about FP?

— It makes you look smart



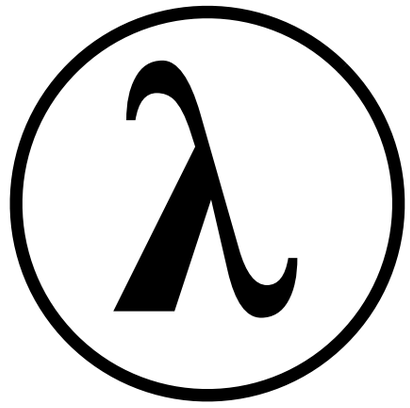
— Dad, what's good about FP?

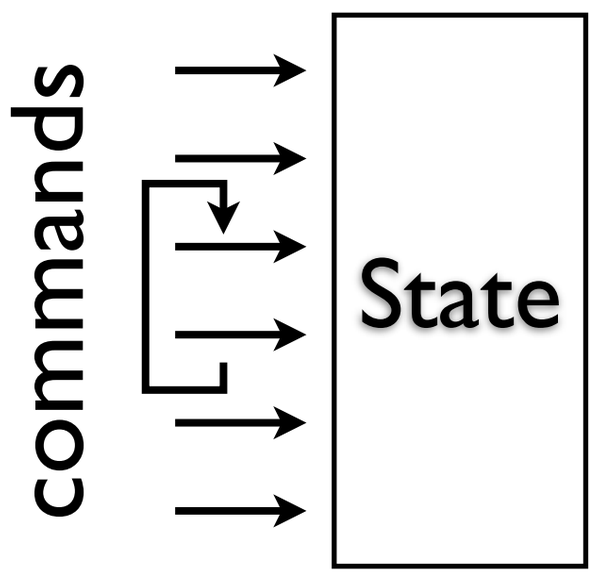
— It makes you look smart

— Like wearing glasses?

Effects (Mutability)

John von Neumann





VS

Inputs

$f(g(x), y)$

Outputs

JetBRAINS

1, 1, 2, 3, 5, 8, 13, 21, 34, ...

Leonardo Fibonacci

1, 1, 2, 3, 5, 8, 13, 21, 34, ...

```
fun fib(n: Int): Int =
    when (n) {
        0, 1 -> 1
        else -> fib(n - 1) + fib(n - 2)
    }
```

Leonardo Fibonacci

1 1 2 3 5 8 13 21 34 .

fun

o Fibonacci

Are you functional?

Kotlin ✓

Groovy ✓

Scala ✓

Java 8 ✓

Recursion

1, 1, 2, 3, 5, 8, 13, 21, 34, ...

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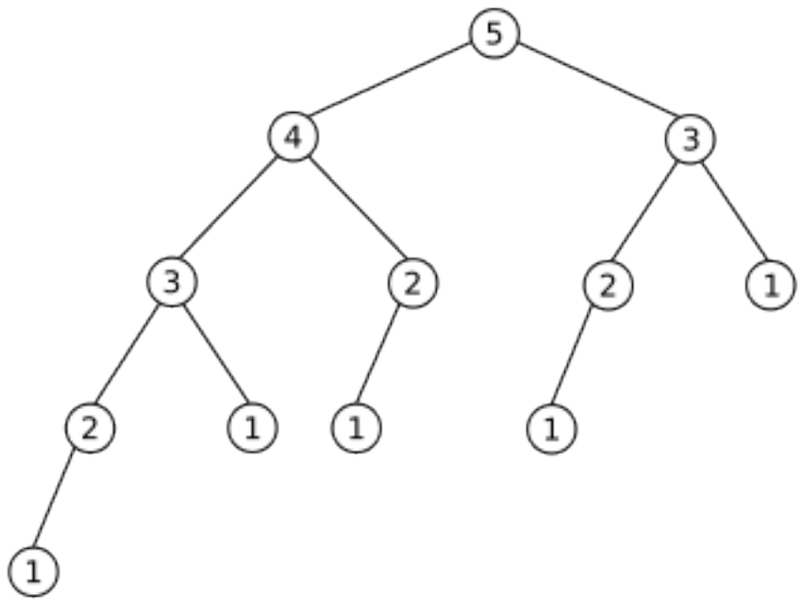
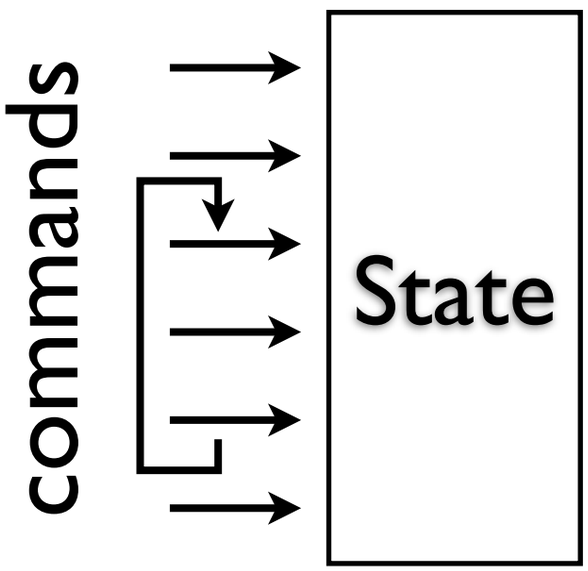


1, 1, 2, 3, 5, 8, 13, 21, 34, ...

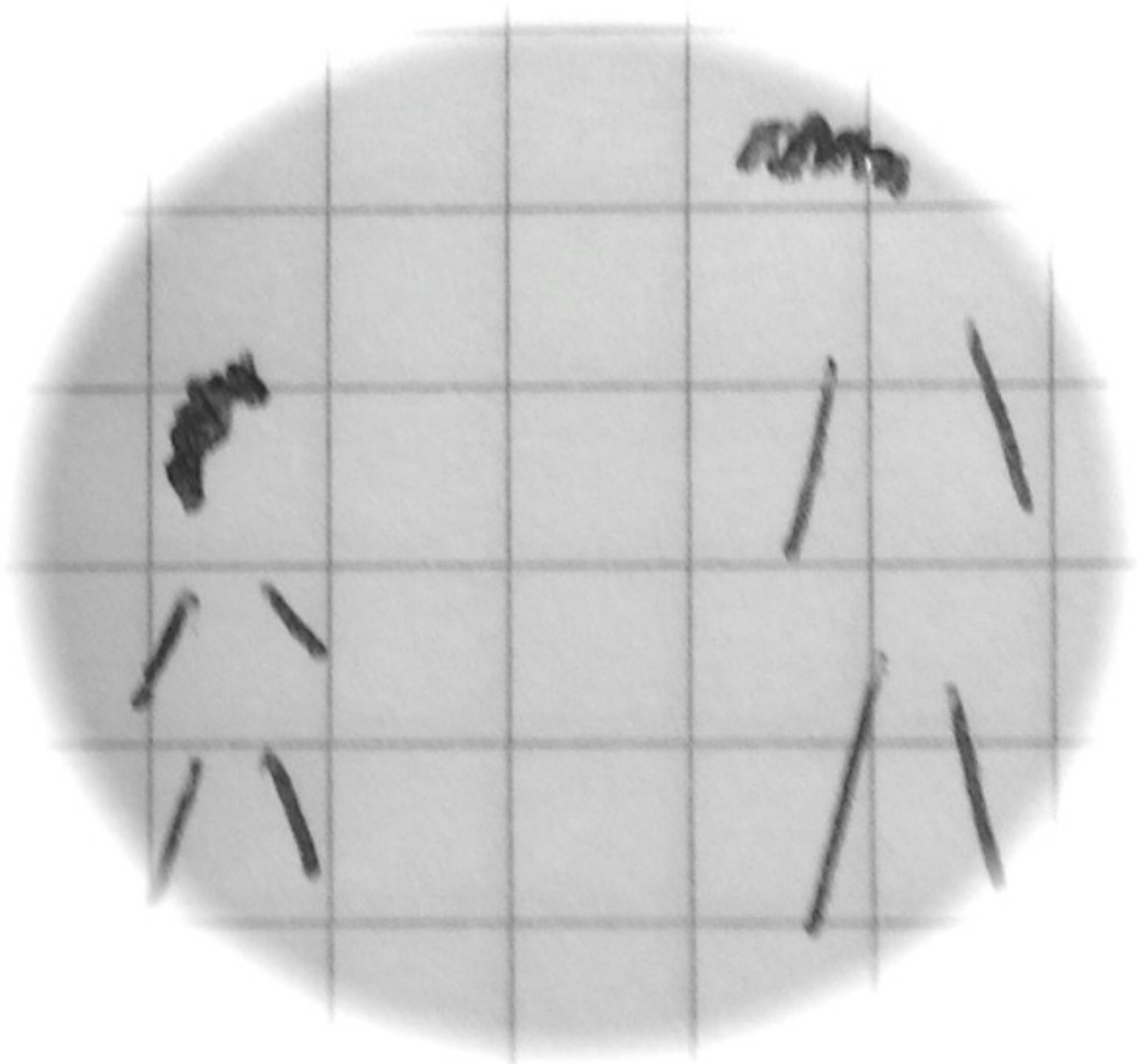
```
fun fib_imp(n: Int): Int {
    var a = 1
    var b = 1
    for (i in 1..n) {
        val t = a + b
        a = b
        b = t
    }
    return a
}
```

Leonardo Fibonacci



Effect-Free

Effect-Free



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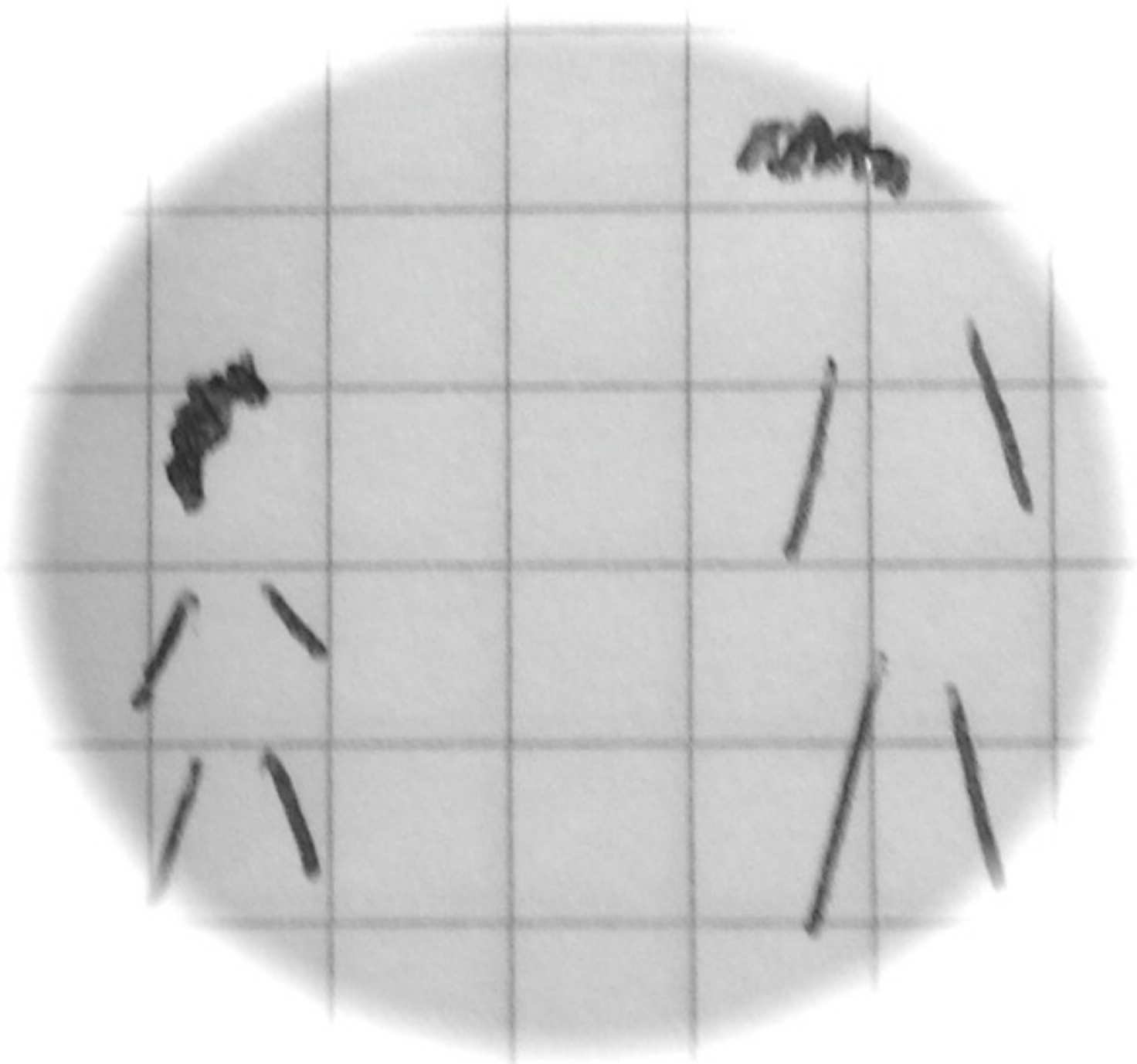
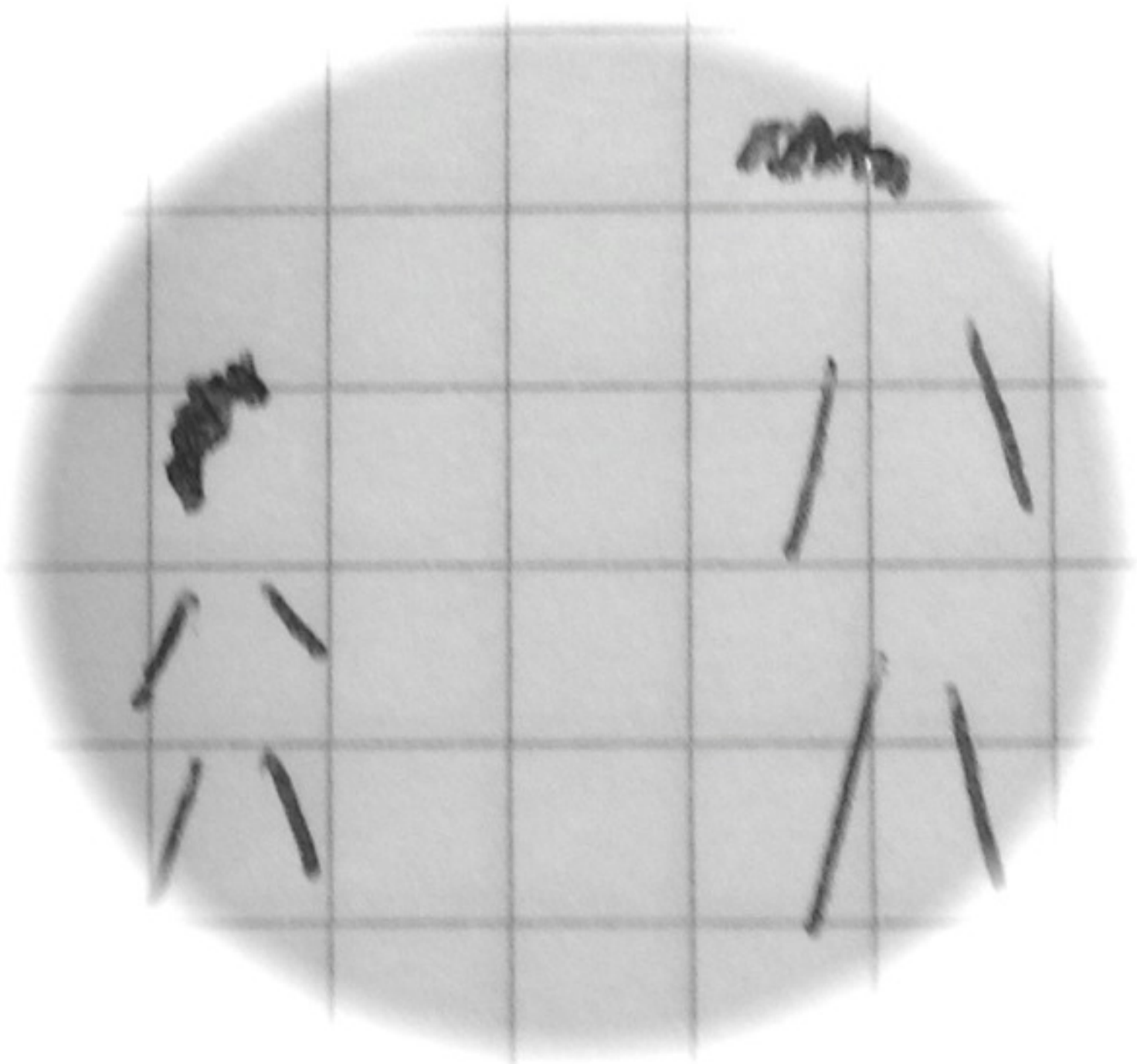


— Dad, how do I

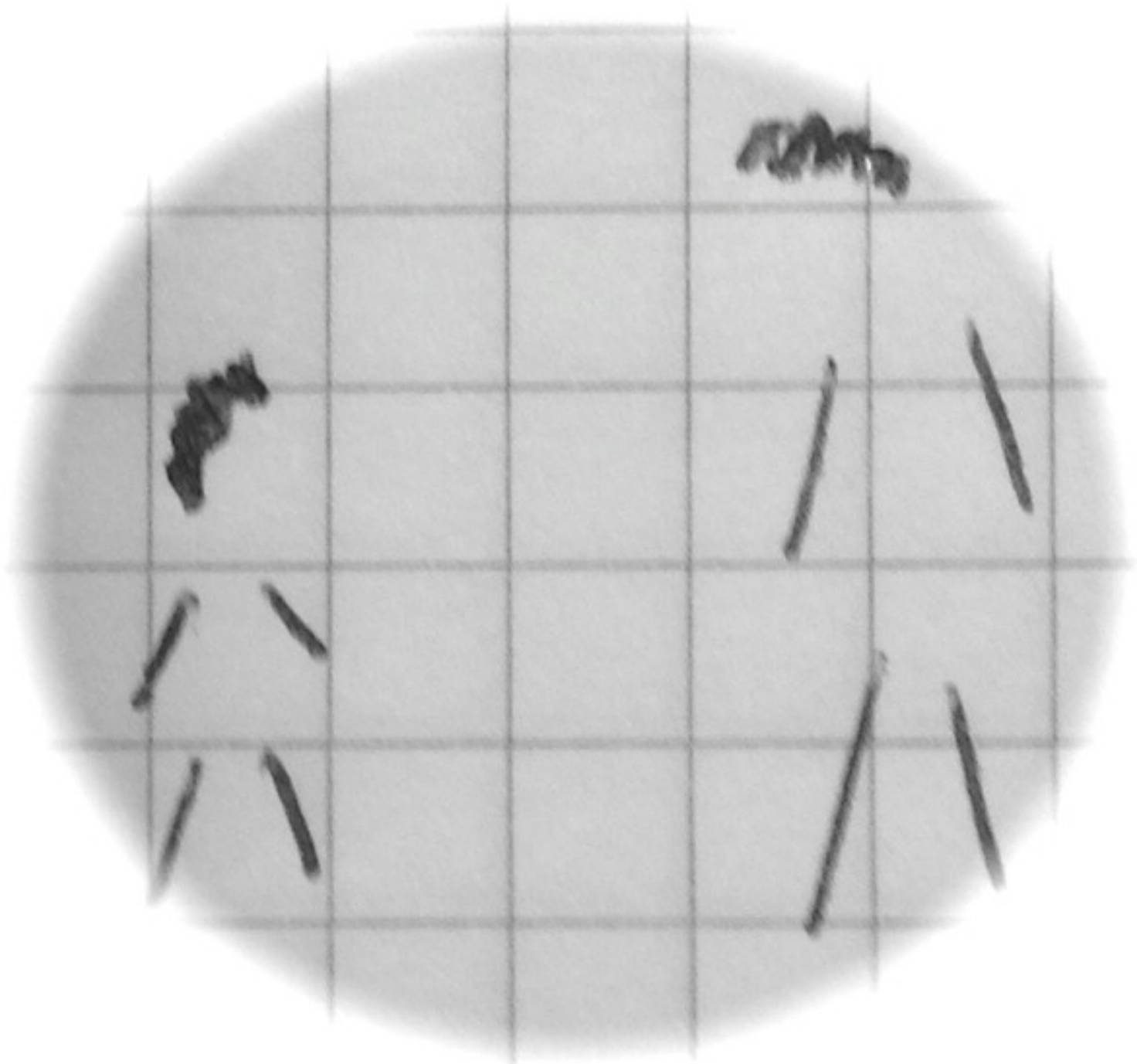
Effect-Free



— Dad, how do I

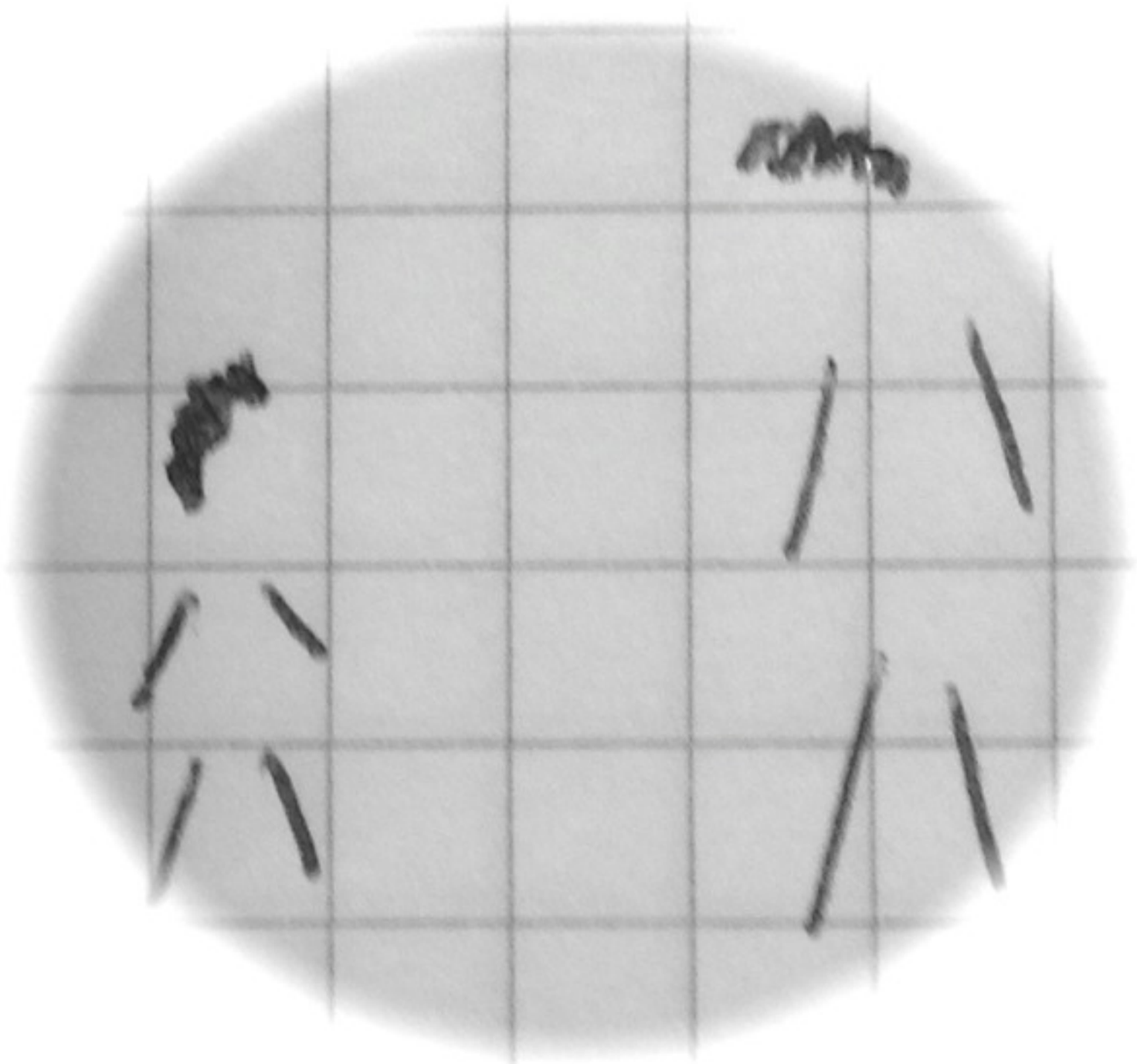
- print("Hello")?

Effect-Free



- Dad, how do I
  - print("Hello")?
  - write to a file?

Effect-Free



- Dad, how do I
  - print("Hello")?
  - write to a file?
  - do both?

Effect-Free

Are you functional?

	Recursion	Pure
Kotlin	V	X
Groovy	V	X
Scala	V	X
Java 8	V	X

v do I

ello")?

a file?

?

Summary

- FP makes things simpler
- Sometimes at a huge price

- Our languages are **not purely functional**

Higher Order

FP brings order :)

FibonacciTest

```
assertEquals(1, fib(0))
assertEquals(1, fib(1))
assertEquals(2, fib(2))
assertEquals(3, fib(3))
assertEquals(5, fib(4))
assertEquals(8, fib(5))
assertEquals(13, fib(6))
assertEquals(21, fib(7))
```

FibonacciTest

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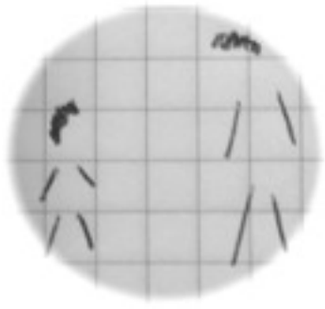

– How do I test both implementations?

test(f)

```
fun testFib(fib: (Int) -> Int) {

    assertEquals(1, fib(0))
    assertEquals(1, fib(1))
    assertEquals(2, fib(2))
    assertEquals(3, fib(3))
    assertEquals(5, fib(4))
    assertEquals(8, fib(5))
    assertEquals(13, fib(6))
    assertEquals(21, fib(7))

}


testFib({ n -> fib(n) })
testFib { n -> fib_imp(n) }
```

test(f)

Are you functional?

	Recursion	Pure	HO
Kotlin	V	X	V
Groovy	V	X	V
Scala	V	X	V
Java 8	V	X	V

```
testFib({ n -> fib(n) })
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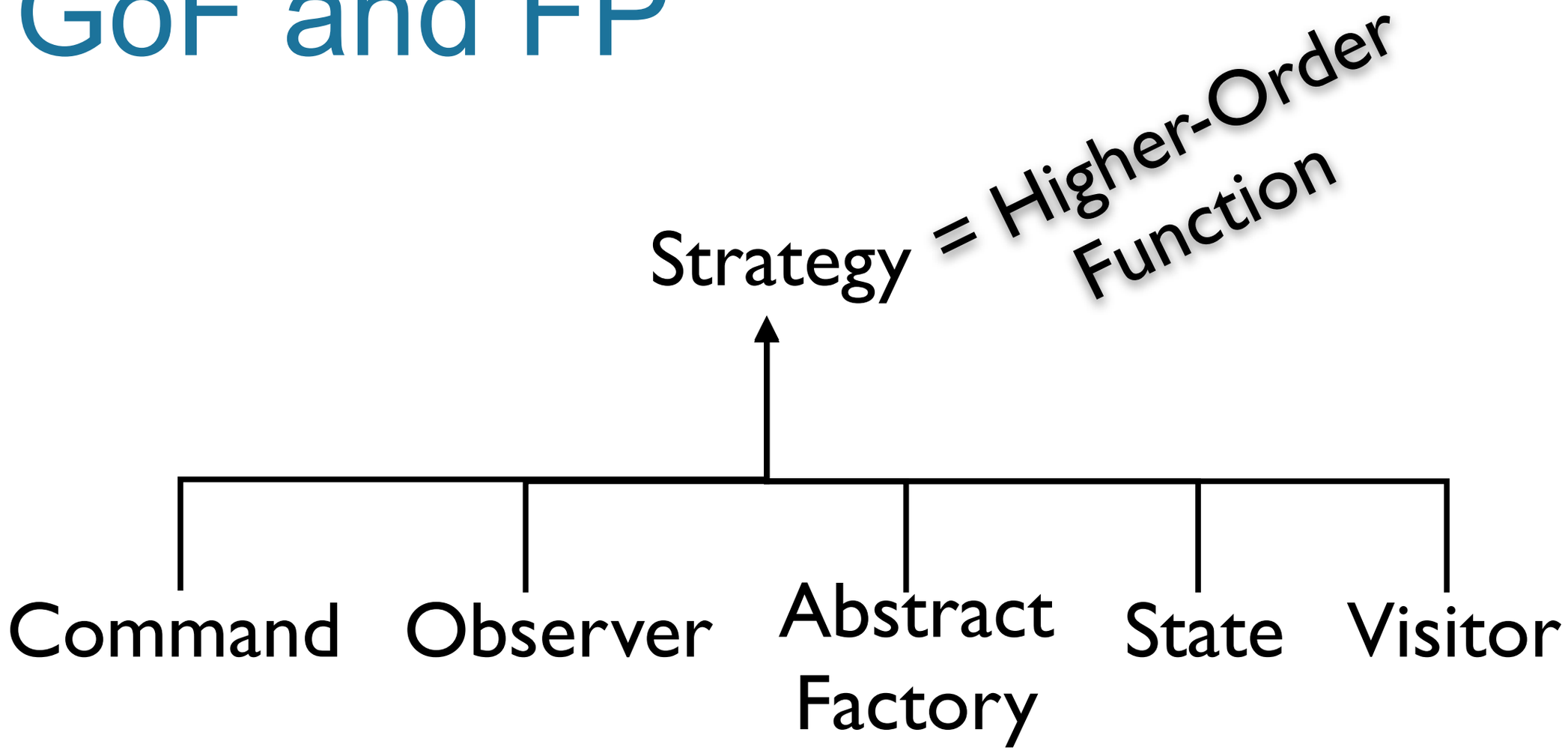
```

GoF and FP


Strategy ≡ Higher-Order Function
Command
Observer
Abstract Factory
State
Visitor

Internal Iteration

```
users.forEach { user ->
    user.sendMessage("Hello from admins!")
}
```

Internal Iteration

```
users.forEach { user ->
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}
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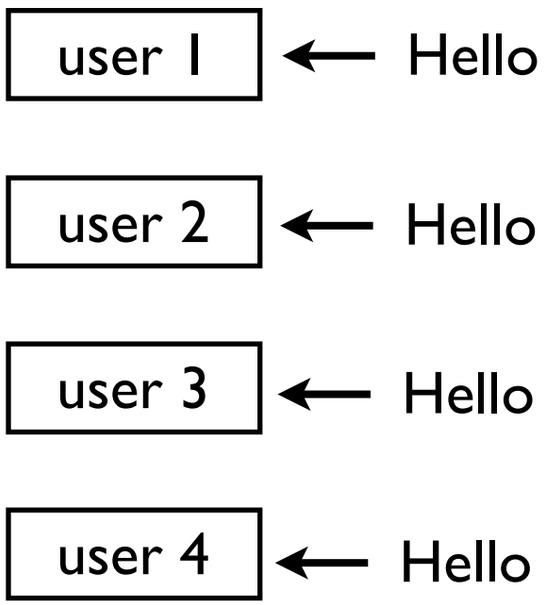
users: ArrayList



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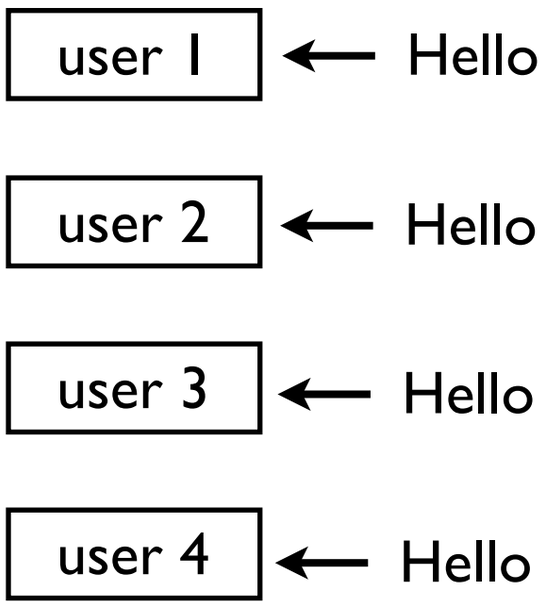

users: ParallelCollection

Internal Iteration

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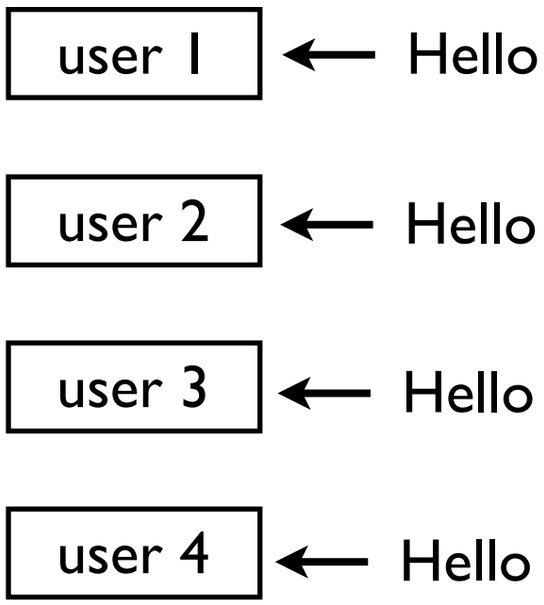
users: ArrayList



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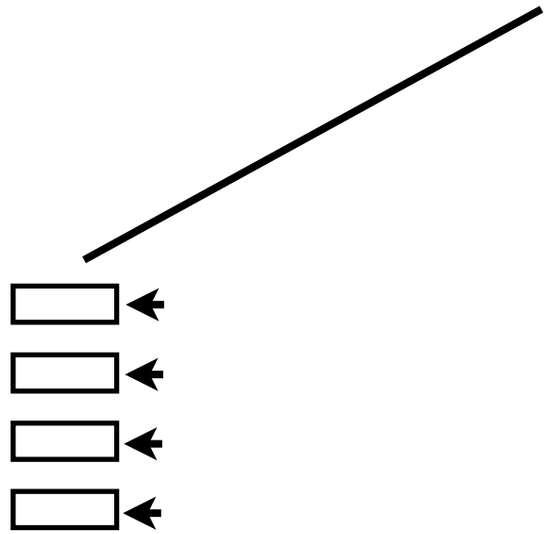

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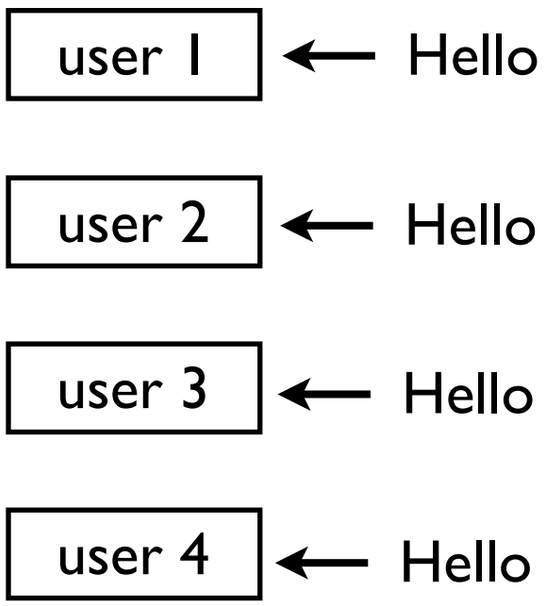

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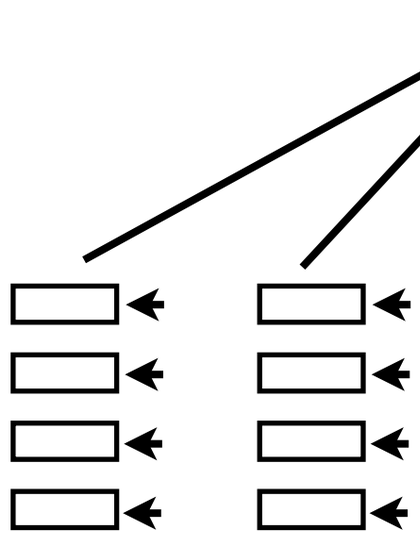

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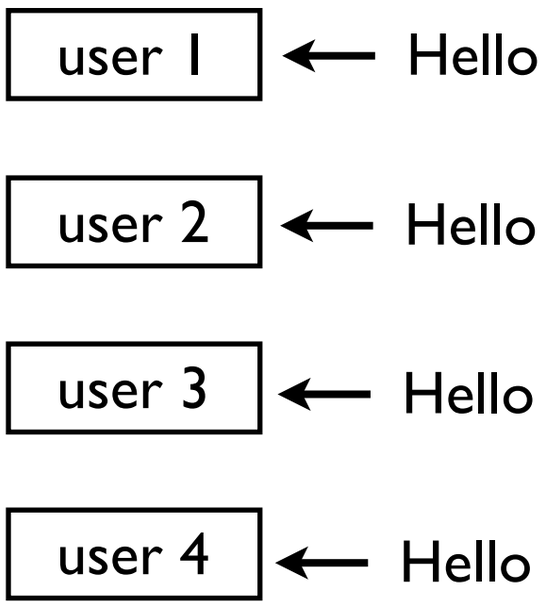

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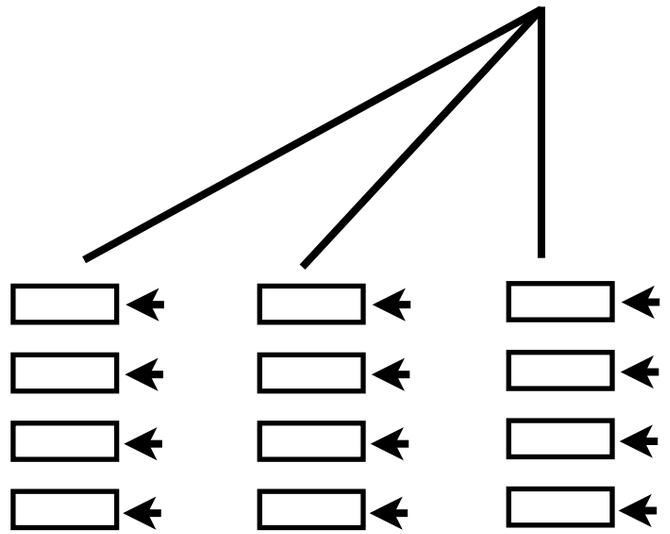

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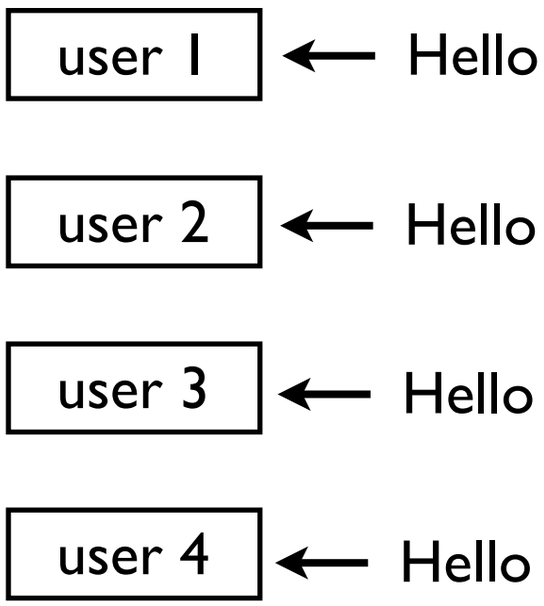

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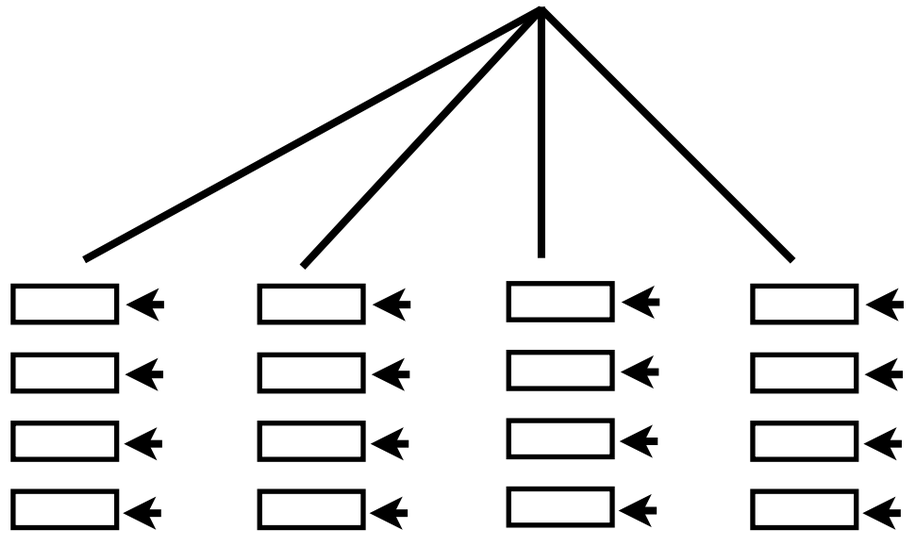

Summary

- Good old callbacks/strategies
- Very important abstraction

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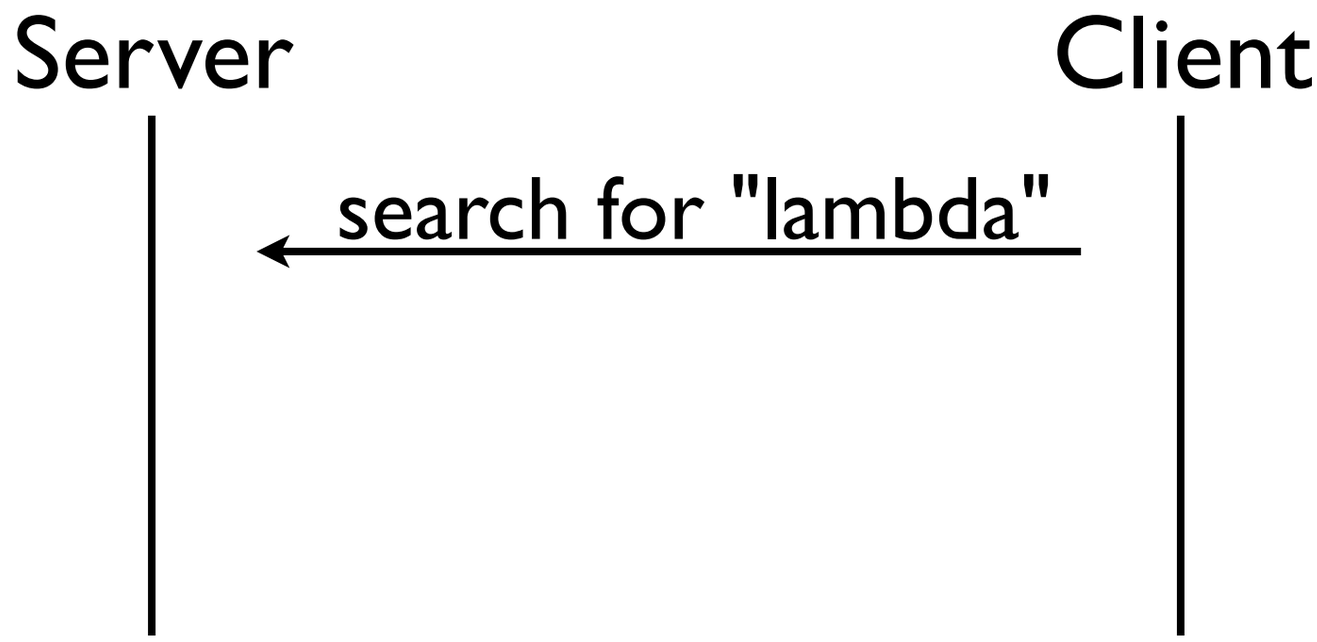
ADT

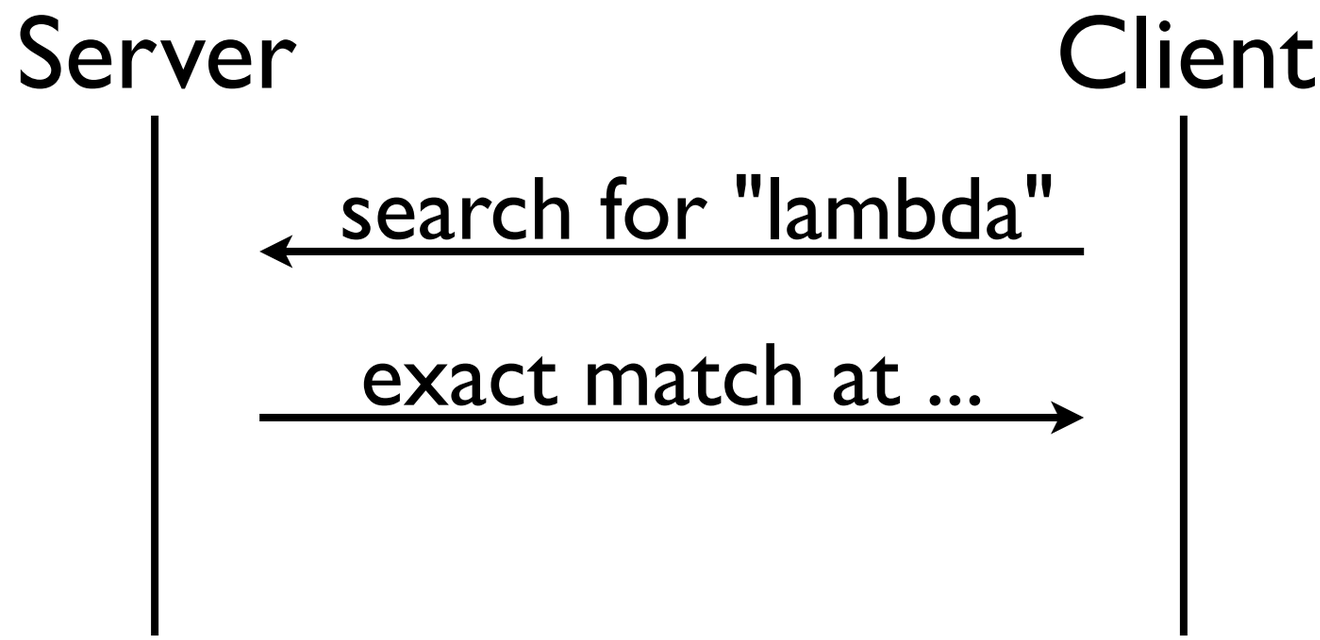
What is your "A" for?

Example: Messages

Example: Messages



Example: Messages



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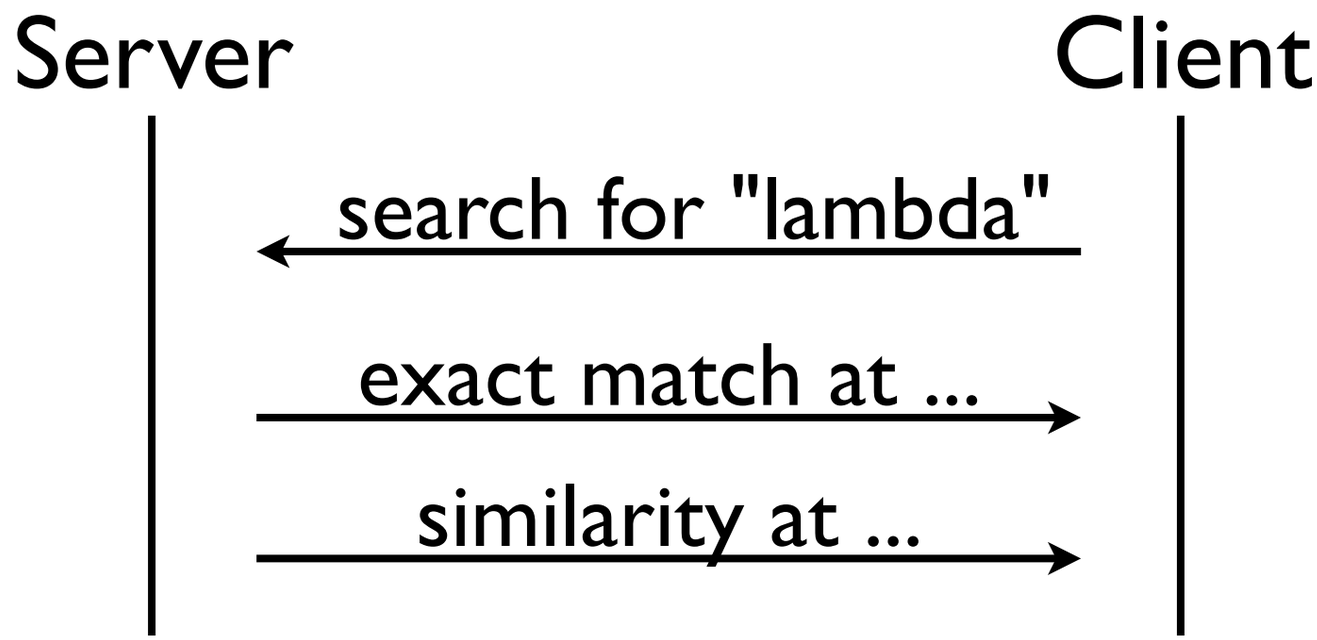
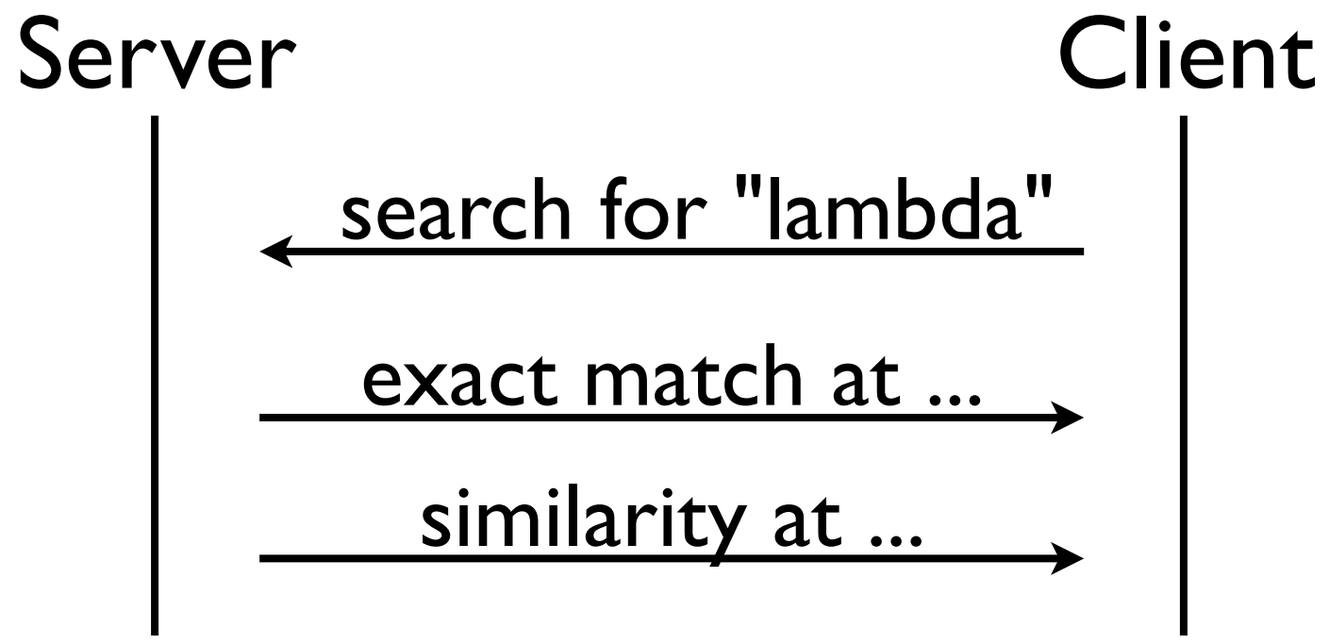
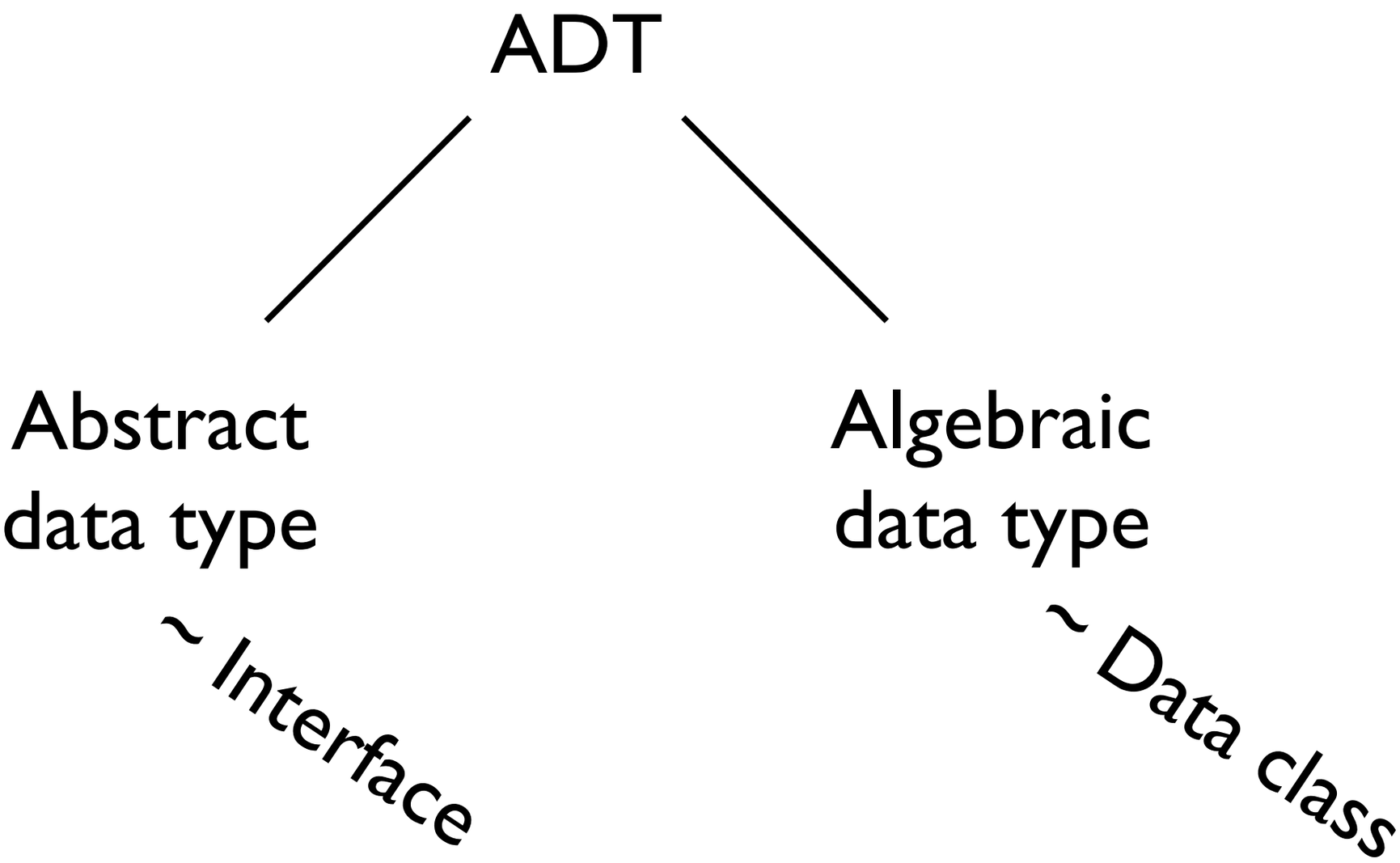


Example: Messages




```
message ::= search for term
          | exact item
          | similar item
```


ADT
Abstract data type
~ Interface
Algebraic data type
~ Data class

Are you functional?

	Recursion	Pure	HO	ADT
Kotlin	✓	✗	✓	✓
Groovy	✓	✗	✓	✓
Scala	✓	✗	✓	✓
Java 8	✓	✗	✓	✓

ADT in Kotlin

```
abstract class Message

class SearchFor(val term: String) : Message()
class ExactMatch(val at: Location) : Message()
class Similarity(val at: Location) : Message()
```

```
server.send(SearchFor("word")) { m ->
    when (m) {
        is ExactMatch -> println("Found at ${m.at})")
        is Similarity -> println("Similar at ${m.at})")
        else -> println("Unknown message: $m")
    }
}
```

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Utilization

You may have your cake, but can you eat it too?

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Up to **5** HO-functions **for free**!

Kotlin

Static Utility Methods

```
map(filter(collection, { x -> x > 5 }), { x -> x * x })
```

backwards!

Static Utility Methods

```
map(filter(collection, { x -> x > 5 }), { x -> x * x })
```

backwards!

as opposed to

```
collection
        .filter { x -> x > 5 }
        .map { x -> x * x }
```

Extension Functions

```
fun Collection<Int>.filter(f: (Int) -> Boolean): List<Int> {
    val r = ArrayList<Int>()

    for (x in this) {
        if (f(x)) {
            r.add(x)
        }
    }

    return r
}
```

Extension Functions

Receiver Type

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Extension Functions

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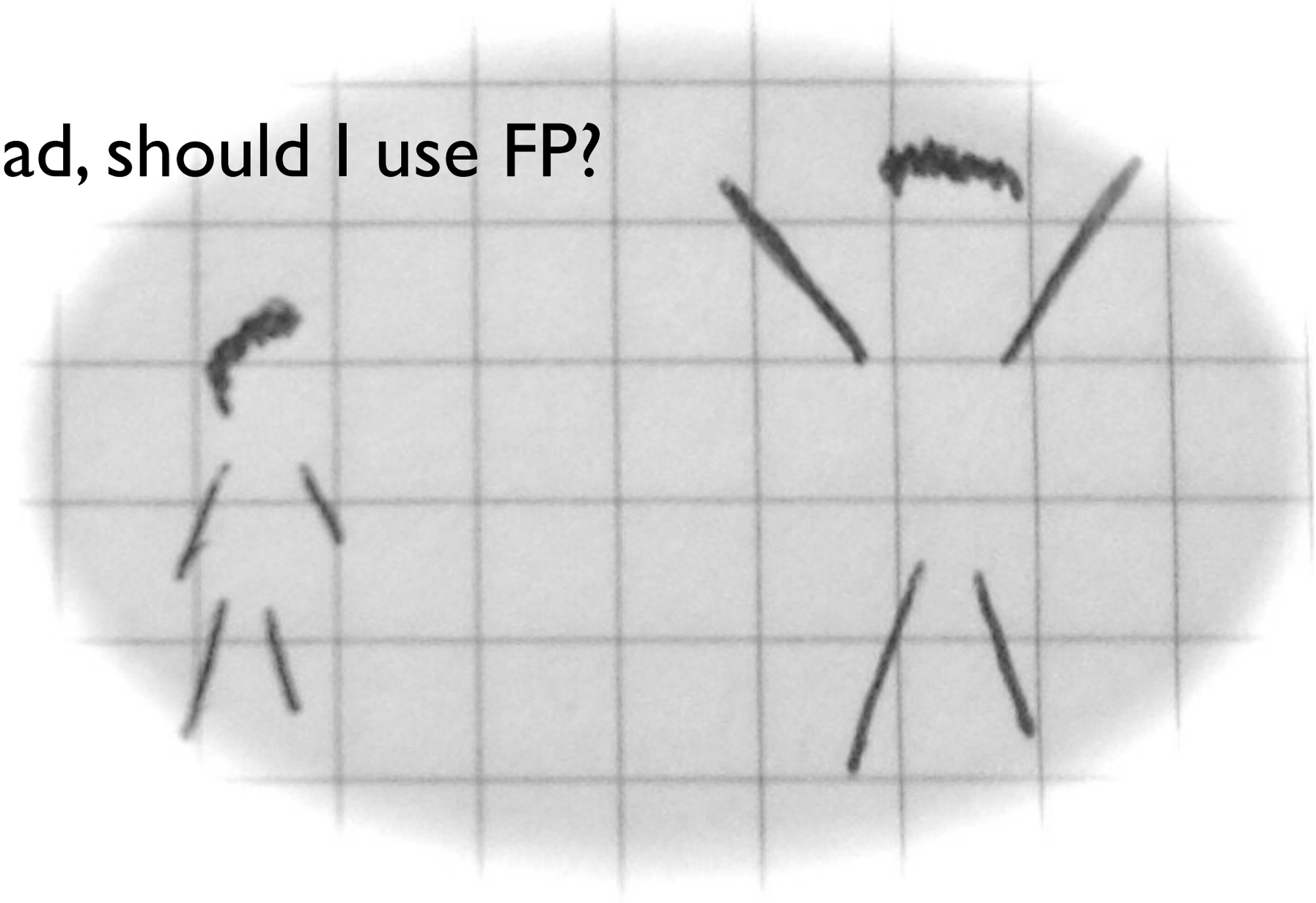
receiver

Summary

- Extending existing types
- Without changing the classes

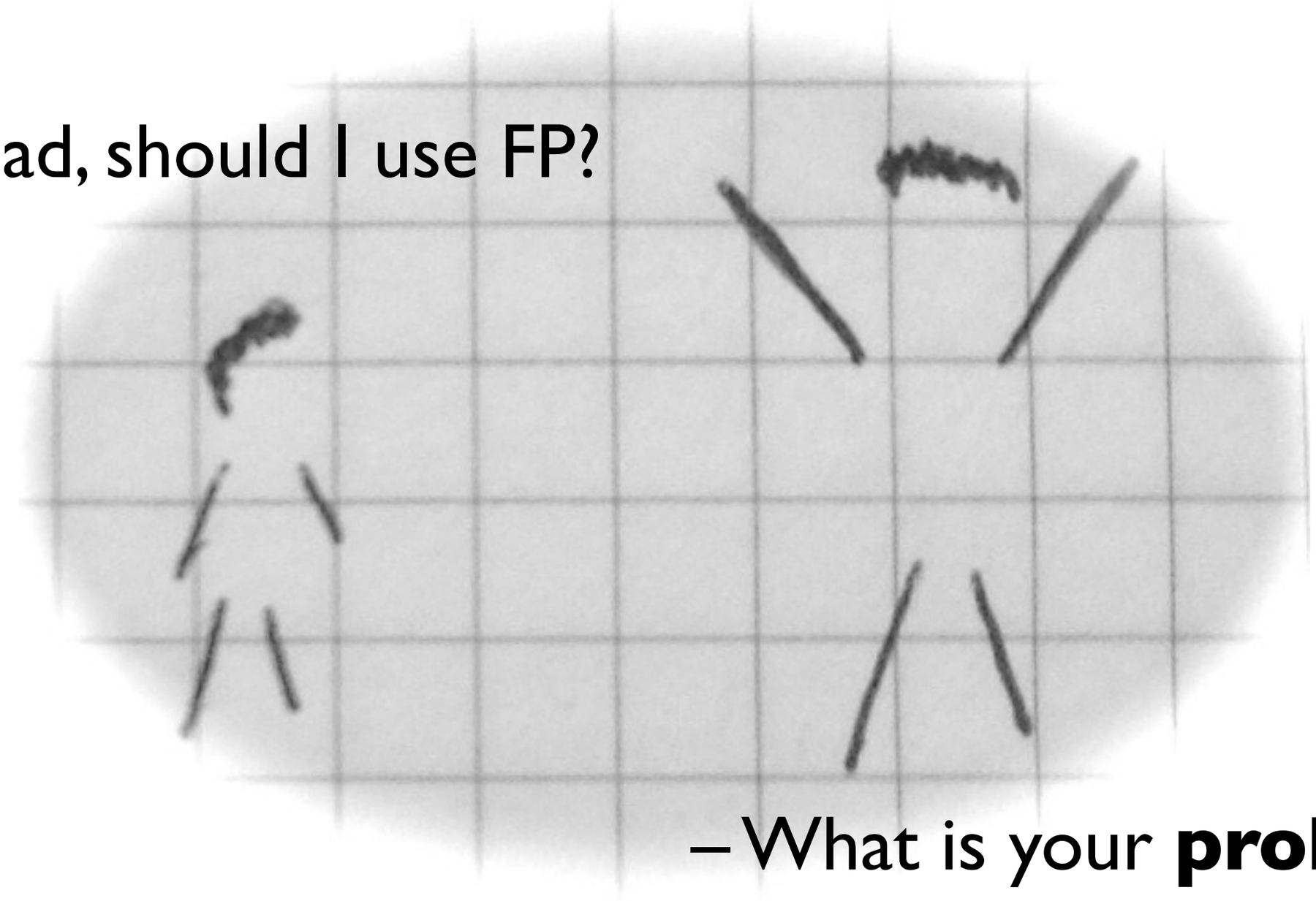
Epilogue

– Dad, should I use FP?



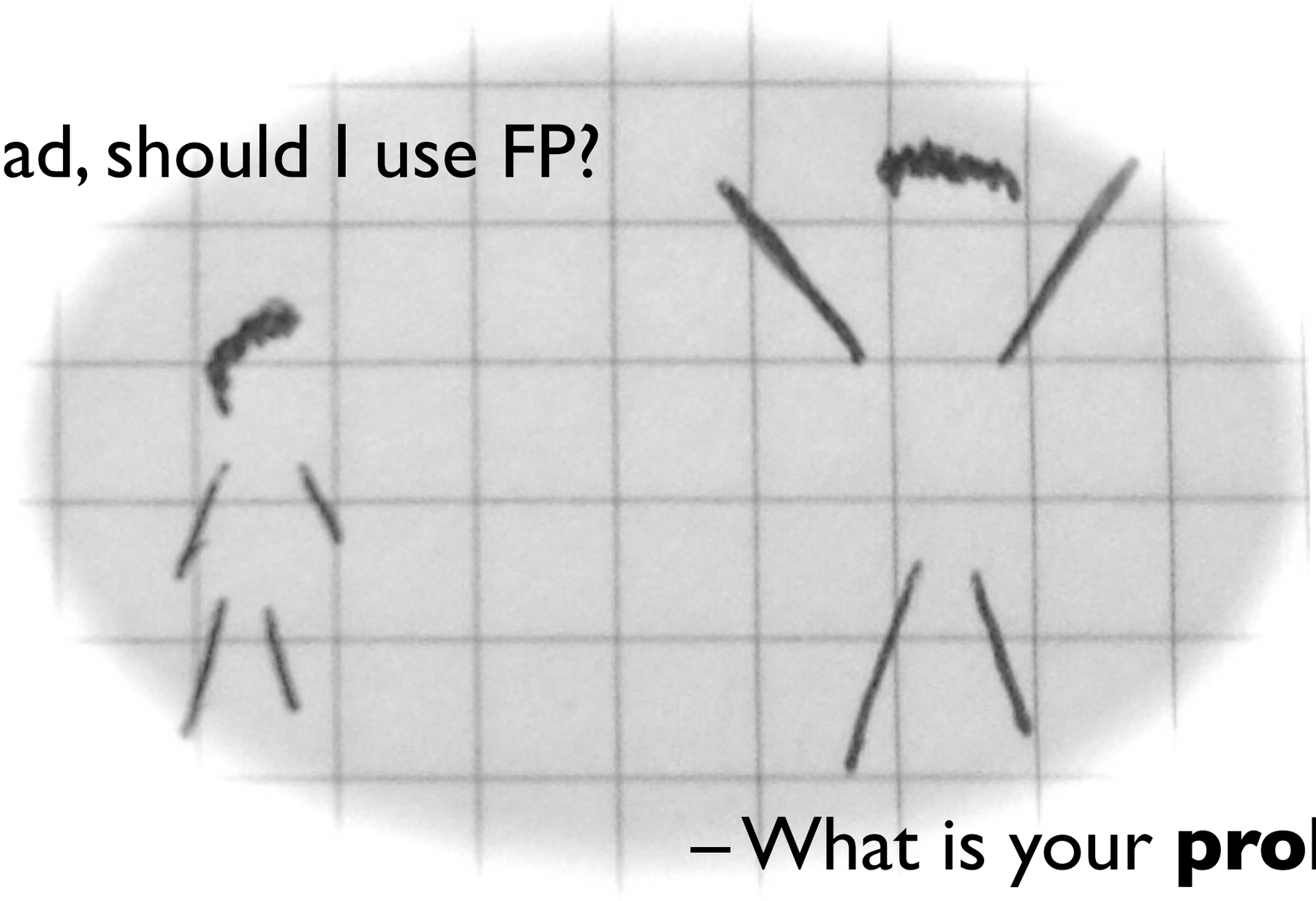
Kotlin

– Dad, should I use FP?



– What is your **problem**?!

– Dad, should I use FP?



– What is your **problem**?!

P.S. Kotlin is cool :) http://kotlin.jetbrains.org

Kotlin Resources

- Docs: http://kotlin.jetbrains.org
- Demo: http://kotlin-demo.jetbrains.com
- Code: http://github.com/jetbrains/kotlin
- Twitter:
  - @project_kotlin
  - @abreslav