Queries with For

Queries with `for`

The for notation is essentially equivalent to the common operations of query languages for databases.

Example: Suppose that we have a database `books`, represented as a list of books.

```scala
case class Book(title: String, authors: List[String])
```

A Mini-Database

```
val books: List[Book] = List(
  Book(title   = ”Structure and Interpretation of Computer Programs”,
       authors = List(”Abelson, Harald”, ”Sussman, Gerald J.”)),
  Book(title   = ”Introduction to Functional Programming”,
       authors = List(”Bird, Richard”, ”Wadler, Phil”)),
  Book(title   = ”Effective Java”,
       authors = List(”Bloch, Joshua”)),
  Book(title   = ”Java Puzzlers”,
       authors = List(”Bloch, Joshua”, ”Gafter, Neal”)),
  Book(title   = ”Programming in Scala”,
       authors = List(”Odersky, Martin”, ”Spoon, Lex”, ”Venners, Bill”)))
```

Some Queries

To find the titles of books whose author's name is "Bird":

```
for (b <- books; a <- b.authors if a startsWith "Bird,")
yield b.title
```

To find all the books which have the word "Program" in the title:

```
for (b <- books if b.title indexOf "Program" >= 0)
yield b.title
```

Another Query

To find the names of all authors who have written at least two books present in the database.

```
for {
  b1 <- books
  b2 <- books
  if b1 != b2
  a1 <- b1.authors
  a2 <- b2.authors
  if a1 == a2
} yield a1
```

Another Query

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  a1 <- b1.authors
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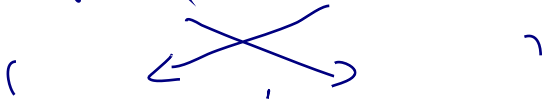
```

("Effective Java", "Java Puzzlers")



Why do solutions show up twice?

How can we avoid this?

Modified Query

To find the names of all authors who have written at least two books present in the database.

```
for {
  b1 <- books
  b2 <- books
  if b1.title < b2.title
  a1 <- b1.authors
  a2 <- b2.authors
  if a1 == a2
} yield a1
```

Problem

What happens if an author has published three books?

```
O    The author is printed once
O    The author is printed twice
```
[✓ The author is printed three times]
```
O    The author is not printed at all
```

$$\begin{tikzcd} & B1 \arrow[dl, dash] \arrow[dr, dash] & \\ B2 \arrow[rr, dash] & & B3 \end{tikzcd}$$

Problem

What happens if an author has published three books?

```
O    The author is printed once
O    The author is printed twice
O    The author is printed three times
O    The author is not printed at all
```

Modified Query (2)

Solution: We must remove duplicate authors who are in the results list twice.

This is achieved using the `distinct` method on sequences:

```
{ for {
    b1 <- books
    b2 <- books
    if b1.title < b2.title
    a1 <- b1.authors
    a2 <- b2.authors
    if a1 == a2
  } yield a1
}.distinct
```

Modified Query

Better alternative: Compute with sets instead of sequences:

```
val bookSet = books.toSet
for {
  b1 <- bookSet
  b2 <- bookSet
  if b1 != b2
  a1 <- b1.authors
  a2 <- b2.authors
  if a1 == a2
} yield a1
```