

06 Lab

OOP/FP and Collections

Mirko Viroli, Roberto Casadei, Gianluca Aguzzi
`{mirko.viroli, roby.casadei, gianluca.aguzzi}@unibo.it`

C.D.L. Magistrale in Ingegneria e Scienze Informatiche
ALMA MATER STUDIORUM—Università di Bologna, Cesena

a.a. 2024/2025

Outline

- Exercise with Scala's combined OOP/FP programming model
- Exercise with Scala's collections

Getting started

- Fork/clone repository <https://github.com/unibo-pps/pps-lab06>
- Then, follow the instructions in the following slides

Exercise 1: OO/FP lists

- 1) Implement `zipWithValue` that creates a list of pairs, with the second element being the value passed as parameter
- 2) Implement `def length: Int` using `foldLeft`
- 3) Implement `zipWithIndex`: it creates a list of pairs, with the second element being `l-1, l-2, l-3, ..., 0` where `l` is the length of the list.
 - ▶ **Hint:** Directly call `foldRight` to implement this function.
 - ▶ Generalize the generation of indexes and also try to implement using the right index order (`0, 1, 2, 3, ...`)
- 4) Implement `partition`: it partitions the list into the two lists of elements that do and do not satisfy the given predicate
- 5) Implement `span`: similar to `partition`, but here the predicate creates a split point
- 6) Implement `takeRight`: returns a list with the last `k` elements of the original list
- 7) Extend `List` with a `collect` function that accepts a `PartialFunction[A, B]` and performs `map` & `filter` in one shot
 - Try to implement these functions firstly with recursions then using `foldLeft`, `foldRight`, `map`, `flatMap`, and `filter`
 - **NB!** if some methods cannot be implemented with `fold*` or `map/flatMap`, try to generalize the operation in a new method.

Exercise 2: mini management application

Practice implementing a management application using Scala collections and OOP/FP concepts

- Reimplement in Scala the system described in <https://bitbucket.org/mvioli/oop2018-esami/src/master/a03b/e1/Test.java>
- Notes
 - ▶ This time you have to rewrite the java interface + enum in Scala
 - ▶ Follow the line guides described in class (prefer immutable var over mutable val, ...)
 - ▶ You can look to the solution (<https://bitbucket.org/mvioli/oop2018-esami/src/master/a03b/sol1/ConferenceReviewingImpl.java>)

Exercise 3: collections (Optional)

- Take a look at the examples in Lecture slides
- For each kind of collection (sequence, set, map) and mutable/immutable version:
 - ▶ Create a collection
 - ▶ Read (i.e., query) the collection (e.g., for size or specific elements)
 - ▶ Update the collection
 - ▶ Delete elements from the collection

Evaluate the performance of collections

- Write a program or tests showing the efficiency or inefficiency of collection types of your choice. Think about an effective organisation of such an evaluation program.
 - ▶ You are given a `PerformanceUtils` module with helper functions
 - ▶ Note: this is a *naïve* form of “microbenchmarking” (an effective approach for measuring performance should take into account several issues and work statistically)
- Please take a look at the performance profiles of the collection:
 - ▶ <https://docs.scala-lang.org/overviews/collections-2.13/performance-characteristics.html>
- Share your results e.g., with your peers in the forum of the course
- Consider also to be inspired by similar explorations:
 - ▶ <https://www.lihaoyi.com/post/BenchmarkingScalaCollections.html>
 - ▶ <https://github.com/Ehyaiei/scala-collection-benchmark?tab=readme-ov-file>
- Try to find a scenario where mutable list outperforms immutable list:
 - ▶ Describe a trait which may use both mutable and immutable data structures
 - ▶ Implement the trait using mutable (e.g., `List`)
 - ▶ Implement the trait using immutable (e.g., `MutableList`)
 - ▶ Note! Compare with the corresponding collection (e.g., `List` vs. `MutableList`, `HashSet` vs. `Set`)
 - ▶ Compare the performance of the two implementations