

43075-01 Shape modelling and analysis

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Exercise sheet 2

Introduction: 7. March 2023

Discussion: 14. March 2023

Introduction

In this exercise you will write your first small Scala programs. The goal is that you are sufficiently proficient with Scala such that you can read, understand and make minor changes in existing Scalismo programs.

1. Scala

Use VSCode and Scala-CLI to experiment with Scala. Make sure that the IDE Support for Scala (Metals) is running and gives you suitable hints. This should automatically happen if you open a folder in VSCode, in which you have executed the command `scala-cli setup-ide .` before.

If *Metals* is running correctly, it should look somehow like this:

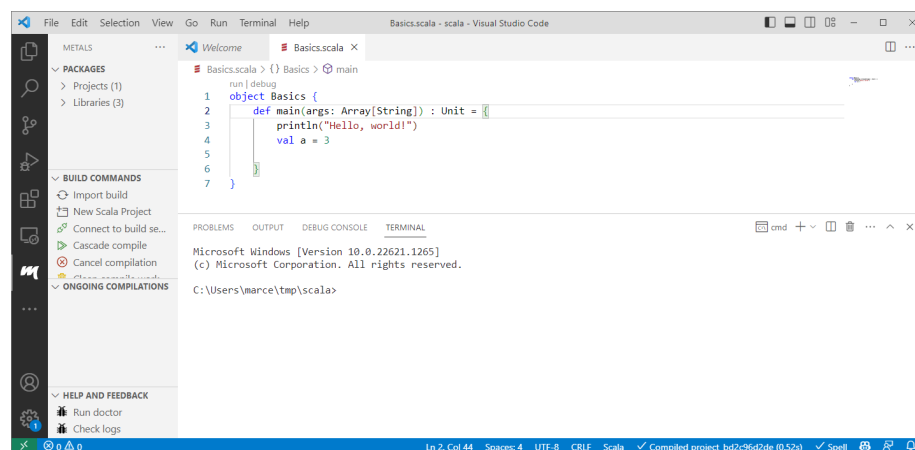


Figure 1: vscode-metals

Try to solve the following, basic Scala exercises.

Simple expressions

- Declare and initialize variables of different data types (`Int`, `Double`, `Boolean`, `String`).
 - Should you use `var` or `val`? What is the difference?
 - Do you need to specify the type? Can VSCode show you the type when you have not specified it?
 - What happens when you specify a type annotation but it does not correspond to the type of the value?
- Write a program to convert a given string to an integer using the `toInt()` method.

Functions

- Write a program to define a function that takes two integers as input and returns their sum.
- Write a program to find the factorial of a given number using recursion.
- Write a function that takes a function `f : Int -> Int` and an integer `x` as arguments and returns the value `f(f(x))`.
- Write a function `compose` that takes a function `f : Int -> String` and a function `g : Int -> Int` as inputs and returns the composed function $f \circ g$.

Object orientation

- Create a class `Vector2D`, which represents a vector in two dimensional space.
 - Implement the method `plus`, which adds two vectors and returns a new vector of type `Vector2D`.
 - Implement the method `dot`, which computes the scalar product
 - Can you rename the method `plus` to `+`?
 - Create two instances of the `Vector2D` class and test the methods. Also test if equality works as you would expect. Do you see a difference when you make the class a case class?

Control structures

Read the chapter about Control structures in the Scala book:

- <https://docs.scala-lang.org/scala3/book/control-structures.html#the-otherwise-construct>
- Write a function, which takes three numbers as an argument and returns the largest number

- Write a program that prints a multiplication table, showing all the products $i \cdot j$ for $i, j \in [1, \dots, 9]$
 - Change your program such that only products that can evenly be divided by 4 are printed.

Collections

Read the two chapters about Collections in the Scala book:

- <https://docs.scala-lang.org/scala3/book/collections-classes.html>
- <https://docs.scala-lang.org/scala3/book/collections-methods.html>

Solve the following exercises:

- Write a function that takes a list of numbers as input and returns a new list of numbers which only contains the even numbers
- Write a program that takes a list of tuples (name, age) as input and returns a new list with only the names of the people who are over 18 years old.
- Write a program that takes a list of lists of integers as input and returns the sum of all the integers in the nested list.

2. Scalismo

Study the Scalismo code in Tutorial 1. Can you understand what is going on? Try to solve the exercises you find in the tutorial.

- <https://scalismo.org/docs/Tutorials/tutorial01>

3. Theory

Work through the theory parts of week 2 of the online course

- <https://shapemodelling.cs.unibas.ch/ssm-course/week2/>

You can add questions and topics that you would like to discuss in class to the Etherpad on Adam:

- https://adam.unibas.ch/goto_adam_xpdl_1553025.html

Note, you don't have to work through the practical parts of the online course. We will work through it together in class.