

## MSc in Applicable Mathematics – 2022/23

### Notice Regarding MA407 Algorithms and Computation and MA421 Advanced Algorithms

Dear incoming MSc in Applicable Mathematics Student

In the MSc in Applicable Mathematics regulations you are required to take at least one course in **MA407 Algorithms and Computation** or **MA421 Advanced Algorithms**. This document provides information on the following two aspects of this option choice:

1. While MA421 builds on MA407, it is possible for students with sufficient prior knowledge in programming and the theory of algorithms and data structures to take MA421 without taking MA407.
2. For students without any or only very limited prior programming experience, some preparation for MA407 is necessary.

#### 1. Prerequisites for MA421 Advanced Algorithms

If you have a sufficiently strong background in Computer Science, you should consider taking only the advanced course MA421 and not the introductory MA407. In particular, if you have substantial programming experience in Java and you have already learned the following topics (which are covered in MA407), then **MA407 is not suitable for you**: running time analysis, correctness of algorithms, sorting algorithms, dynamic data structures (such as linked lists, stacks, binary search trees), some fundamental algorithm design paradigms (such as recursion, dynamic programming, and greedy algorithms).

MA421 will assume knowledge of these topics. In addition, it will assume sufficient knowledge of the programming language Java, which is also taught in MA407. If you studied the topics listed above and learned a programming language which supports object-oriented programming other than Java, then you may still choose not to take MA407. However, it is your responsibility to prepare for MA421 by learning Java. To this end, note that we only use basic Java functionality in these two courses. In particular, we neither need advanced Java libraries (such as those for graphical user interfaces, input/output handling, or web applications) nor do we cover exception handling, packaging, and most aspects of access modifiers, inheritance and generics. If you can solve from the online material (accompanying a book used for MA407)

<http://introcs.cs.princeton.edu/java/home/>

Web exercises 19 and 21 in Section 2.1, Web exercises 3 and 8 in Section 3.3, and Web exercises 40 and 43 in Section 4.2, and know how to implement a binary search tree in Java (without using libraries), then your Java proficiency is sufficient for MA421.

**If you want to take MA421 but not MA407 you need to get the permission of the MA421 lecturer (Professor Konrad Swanepoel).** He can also give you further advice on how to prepare for MA421.

**Any student taking MA407 can take MA421** to get a deeper understanding of the subject of algorithms.

## 2. Preparing for MA407 Algorithms and Computation

The course MA407 **Algorithms and Computation** for the MSc in Applicable Mathematics includes as an integral part programming in the computer language Java. An introduction to programming in Java is given in a series of pre-sessional classes and continued during the course. However, this introduction is necessarily rapid. So, students who have never done any programming may easily fall behind. (In fact, MSc students from previous years experienced this as a major difficulty.) For that reason, if you do not have any or have only very little programming experience, please take some time to prepare for the course and learn some basics with the following two steps.

**Step 1:** For a playful first contact with computer programming experiment with some programs on <https://www.khanacademy.org/computing/>, which allows you to explore basic elements of the programming language JavaScript (using the Processing library). This language is different from Java, but is simpler to begin with. You may want to start with the introductory video at <https://www.khanacademy.org/cs/welcome-to-computer-science/882454257>

and then also look at different tutorials on

<https://www.khanacademy.org/computing/computer-programming>

while experimenting with the code. Many of these tutorials have an emphasis on graphical elements – which we shall not work with in the course, but which make them fun. But the tutorials treating mathematical expressions, variables, booleans, if statements, and if/else statements introduce important elementary programming concepts, which we will use in Java.

**Step 2:** In the course we will use the book “Introduction to Programming in Java” by Robert Sedgewick and Kevin Wayne, which is accompanied by an excellent collection of online resources: On

<http://introcs.cs.princeton.edu/java/home/>

you can find information on how to install Java to your computer and how to write your first simple programs. In particular, working through Sections 1.1, 1.2, and 1.3 of

<http://introcs.cs.princeton.edu/java/10elements/>

and attempting some of the exercises (for example Exercise 5 of 1.1, Web Exercises 17 and 18 of 1.2, and Web Exercises 22 and 28 of 1.3) will give you an ideal preparation for the course.

Best wishes,

**Professor Konrad Swanepoel (Lecturers for MA407) and  
Dr Tugkan Batu (Lecturer for MA421)**