MISE Summer Programming Camp

2023 Edition

There will be 9 classes, each one lasting at most 2 hours with a ~10 minute break in the middle. Classes will be mostly interactive, e.g. showing code and asking the students what they think the result would be, finding the bug in the code, live programming by instructors, solving programming challenges in groups, etc. The bulk of the new content of each class will be presented during the first half, and will spend the second half focusing on examples to highlight the class topic.

At the end of each class, the students will get a worksheet with practice problems that should be solved by the day before the next class. Each problem might have some theoretical background that introduces some new concept related to the class plus one or more problems. Some of the problems will be coding problems, these should be submitted through the Codeforces platform (codeforces.com). Each homework sheet will contain some mandatory and some optional problems (extra credit for those that want to learn more topics), and the mandatory portion will take around 1 hour to complete, on average.

Students will also have the opportunity to work on a class project to use some of the skills learned in class. The class project is optional, but is a great way to have fun creating something new according to one's personal taste. The class project will be announced after week 5 of classes.

Class 1 - Intro to Programming (April 29th)

The students will learn:
- What is a programming language and how it works (10-15 minutes)
- What is Python and how to run it on the browser (installing an IDE will be given as homework) (10-15 minutes)
- Some examples of Python: printing, what is a variable, reading inputs (20-30 minutes)
- Data types in Python: ints, floats, bools, strings (10-15 minutes)
- More examples/review (10-15 minutes)
- Errors (10 minutes)
- Introducing Codeforces (10-15 minutes)

Extra topics to be included in the problem sheet:
- Basic math operators
- Installing your own IDE

Homework 1 (Due May 5th) - My First Programs

Class 2 - Functions and Conditionals (May 6th)

The students will learn:
- Short review of class 1 (5 minutes)
- Comparison and Boolean operators (10-15 minutes)
- If-elif-else conditions (10-15 minutes)
- Some condition examples (e.g. interval/circle intersection) (20-25 minutes)
- Functions (10-15 minutes)
- Variable scope (10-15 minutes)
- Examples with functions (e.g. abs, max, point distance) (10-15 minutes)

Extra topics to be included in the problem sheet:
- Debugging your code

Homework 2 (Due May 12th) - Functions and Questions

Class 3 - Loops (May 13th)

The students will learn:
- Short review of class 2 (10 minutes)
- While loops (10-15 minutes)
- Examples with while loops (e.g. counting digits in integer, most frequent digit) (20-25 minutes)
- For loops (including examples of the range function) (15-20 minutes)
- More examples with loops (e.g. sum of all numbers up to, is it prime) (20-25 minutes)

Extra topics to be included in the problem sheet:
- Importing libraries (e.g. math)

Homework 3 (Due May 19th) - Repetition, Repetition, Repetition

Class 4 - Nested Loops and Lists Part I (May 20th)

The students will learn:
- Short review of class 3 (10 minutes)
- Nesting loops (15-20 minutes)
- Lists, tuples and mutability (20-25 minutes)
- Examples with lists (e.g. counting letters in string, is palindrome) (15-20 minutes)
- More examples (10-15 minutes)

Extra topics to be included in the problem sheet:

- Functions over lists (sort, reverse, etc)
- Looking up Python documentation

Homework 4 (Due May 26th) - Collecting Information

Class 5 - Lists Part II (May 27th)

The students will learn:
- Short review of class 4 (15 minutes)
- 2D lists, ND lists (15-20 minutes)
- Examples with 2D (e.g. boggle) (20-35 minutes)
- List comprehension (10-15 minutes)

Extra topics to be included in the problem sheet:
- Operating over strings as lists

Class Project Introduction (Due July 1st)

Homework 5 (Due June 2th) - Lists of Lists

Class 6 - Recursion (June 3th)

The students will learn:
- Recursion and examples (30-45 minutes)
- Intro to backtracking (20-25 minutes)
- Intro to Dynamic Programming (20-25 minutes)

Extra topics to be included in the problem sheet:
- More Dynamic Programming examples

Homework 6 (Due June 9th) - Did You Mean: Recursion

Class 7 - Data Structures and Performance (June 10th)

The students will learn:
- Reviewing basic data types (10-15 minutes)
- Tuples and Lists (10-15 minutes)
- Sets and Dictionaries (20-25 minutes)
- Code performance (20-25 minutes)
- Algorithmic complexity (20-25 minutes)

Extra topics to be included in the problem sheet:

- Stacks and Queues
- Extra Tricks

Homework 7 (Due June 16th) - Efficient Programming

Class 8 - Object Oriented Programming (June 17th)

The students will learn:
- Methods vs Functions (10-15 minutes)
- Intro to Classes (35-45 minutes)
- Class Inheritance (10-15 minutes)
- Examples (20-30 minutes)

Extra topics to be included in the problem sheet:
- Special methods

Homework 8 (Due June 22nd) - Self Programming

Class 9 - Intro to Data Science (June 23rd)

The students will learn:
- What is Data Science (20 minutes)
- Plotting data with Matplotlib (20-25 minutes)
- Basic Statistics in Python (average, standard deviation, …) (15 minutes)
- The NumPy library (30 minutes)
- Linear Regression (20-25 minutes)

This last class is special, it will be less formal than the previous ones, since we'd need a lot more time to properly teach all these topics. The goal is to give the students an overview of all these topics with lots of examples. It won't have any homework, students are encouraged to work on their class projects, if they chose to do one.