COURSE DESCRIPTION
DESIGN OF BIOMIMETIC DEVICES

SSD: BIOINGEGNERIA INDUSTRIALE (ING-IND/34)

DEGREE PROGRAMME: BIOINGEGNERIA INDUSTRIALE (P16)
ACADEMIC YEAR 2024/2025

COURSE DESCRIPTION

TEACHER: DANNHAUSER DAVID
PHONE:
EMAIL: david.dannhauser@unina.it

GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE: NOT APPLICABLE
MODULE: NOT APPLICABLE
TEACHING LANGUAGE: INGLESE
CHANNEL: FG A-Z
YEAR OF THE DEGREE PROGRAMME: II
PERIOD IN WHICH THE COURSE IS DELIVERED: SEMESTER II
CFU: 6

REQUIRED PRELIMINARY COURSES

The course has no specific prerequisites. Generally, a range of microfluidic background knowledge among students is expected.

PREREQUISITES

Basic MATLAB (MathWorks, Inc.) skills are helpful, but not mandatory for the course.

LEARNING GOALS

Application of microfluidics and development of machine learning models in the life science field.

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

Knowledge and understanding

The students' needs to elaborate arguments related to all fields of microfluidics. In particular, to the design, fabrication and application of microfluidic devices in the life science filed. The course provides students with knowledge and basic methodological tools needed to design biomemetic

devices and to analyse experimental measurement data. Such tools may allow the student to grasp the causal connections among design rules and microfluidic measurement limitations. The use of machine learning based data analysis will help the student to visualize obtained data and define possible correlation patterns in obtained data sets.

Applying knowledge and understanding

In the end of the first part of the course, students will be able to apply the most suitable microfluidic approach to a given life science task. In more detail, students will apply their theoretical knowledge in a laboratory context. They will achieve the basic knowledge to develop a microfluidic device from the design step until the final measurement step in a laboratory and to manage basic data analysis steps of obtained experimental data. In the end of the second part of the course, students will be able to code their own machine learning based classification routine. Students will understand the differences of basic machine learning concepts and will be able to apply them to real world tasks. Students will learn about open-source alternatives for machine learning applications and apply them on their own personal computer (not mandatory).

COURSE CONTENT/SYLLABUS

The course aims to provide guidelines for the development and use of biomimetic devices with particular attention to the life science field and machine learning based classification. The course will offer fundamental knowledge for the design of biological mimicry strategies used in the field of new therapeutic and diagnostic approaches. Students will learn about the application of biomimetic devices for controlled drug release, biosensors, tissue engineering, single cell analysis, nanomedicine, and synthetic biology. The course will provide useful tools for the design and use of microfluidic devices with special attention on machine learning based object/cell classification approaches.

READINGS/BIBLIOGRAPHY

No textbooks or other reading are needed to follow the course.

TEACHING METHODS OF THE COURSE (OR MODULE)

The course will consist of 24 lectures (6 CFU):

- circa 10-12 frontal lectures about fundamentals and applications of biomimetic devices in the life science filed.

- circa 2-4 lectures in the laboratories to apply microfluidic knowledge to a life science task.

- circa 4-6 frontal lectures about the basic machine learning concepts and parameters.

- circa 2-6 coding lecture of machine learning tasks.

- final project presentation.

(The final project topic will be published in the last lecture of the course and discussed with the students. Project group size should not exceed 3 students. Project topics will cover one argument of the syllabus of the course.)

EXAMINATION/EVALUATION CRITERIA

a) Exam type

☐ Written

- [x] Oral
- [x] Project discussion
- [ ] Other

In case of a written exam, questions refer to

- [ ] Multiple choice answers
- [ ] Open answers
- [ ] Numerical exercises

b) Evaluation pattern

Project material (e.g. MATLAB routine) must be provided to the professor at least 24 hours before the final exam date. Each student will need to present a part of the final project outcome at the exam date to the professor. Students will discuss with the professor the final project outcome and questions related to the syllabus of the course. The final mark will consist of received project material, project presentation and student answers to related questions.