ADVANCED PROGRAMMING

Basic Information

This is a course, which contributes to MSc award in Biology

Course period	From September 1st till February 1st, from February 1st till June 1st, 2 semesters
Study credits	6 ECTS credits
Duration	216 hours
Language of instruction	English
Academic requirements	- BSc degree in Biology, Chemistry, Physics or Environmental Sciences or equivalent (transcript of records), - Good command of English (certificate or other official document)

Course Description

«Advanced programing» is an extensive course, which is designed to advance a student's ability to create the codes for the medical problems. It provides the necessary mathematical and information background for the ability to work with the medical signal and data of any nature.

The most important part of this course is programming for medical data. The students will study to design, simplify and parallel the computations for the given medical problem.

The Self-Adjusting programming part of the course includes the basic techniques to include the interactive component into computations. This will require the parallel learning other courses of the given master program, including the machine learning and classification algorithms.

The course is designed to cover a wide range of possible areas of biology and medicine. Grading this course will help the future specialist to construct and develop the explanation of the observed phenomena.

Course Aims

- To help students study new discipline or to ameliorate the existing knowledge in coding.
- To assist students to manipulate the biological signal to make it informative and suitable for the programming processing.
- To give students the understanding of how to ameliorate the code.
- To introduce the basic principles of functional and structural programming.
- To give the introduction in parallel processing.

Course Objectives

The course has been designed to:

- ensure that students are familiar with a basic self-adjusting of the codes routines.
- give students the interactive programming methods for the given medical problem.
- give students an appreciation of the surrogate scalar and scalarization techniques.
- provide students with the basic routines of multiobjective programming.
- provide students with the basic routines of medical database updating.
- make students know and understand the principles of biological electromagnetic signal programming processing.

Learning Outcomes of the Course

By the end of the course, the students will be able to:

- create the interactive and self-adjusting code,
- perform the scalarization of the code for the given dataset,
- use the up-to-date libraries in coding
- apply the paralleling in the computations.

Course (module) Structure

Learning Activities	Hours
Lectures	30
Practice sessions / Seminars,	30
Self-study Assignments	120
Final Exam (including preparation)	36
Total study hours	**216**

Course Outline

Week	The title of the course subsection	Practice session / Assignments	Hours
• Semester 2			
1-6	Functional Programming	• Self-Adjusting Computations • Code Normalization • Libraries for Functional Programming • Home assignment No 1	(8/8/20)
7-15	Multiobjective Programming	• Scalar Functions and Scalarized Techniques • Integer Linear Programming • Interactive Techniques in Linear Programming • MOLP • Home assignment No 2	(8/8/20)
	Pass/Fail Exam		
1-18	Programming on Medical Data	• Parallel Processing • Databases Updating • Personal health records • Recognition of electromagnetic biological signals • Home assignment No 3	(14/14/80)
	Final Exam		36

Course Instructors and Tutors, Contact Information

Instructor	Contact Information
Yuliya PUTINTSEVA Senior Lecturer at Institute of Fundamental Biology and Biotechnology, Siberian Federal University, Krasnoyarsk	Svobodny, 79 Room 32-13 Tel +7 391 206 2165 Email: AShuvaev@sfu-kras.ru, andrey.n.shuvaev@gmail.com

Assessment

The final exam is an individual problem in the form of a simulated experimental dataset. The student must demonstrate the abilities in:

• creation of the self-adjusting codes (20 points maximum),

• functional and multiobjective programming with parallel computations (40 points maximum),

• making the programming processing of a given biological signal (40 point maximum).

Grade policy:

A (excellent work)	91-100 %
B (above average work)	81-90 %
C (average work)	71-80 %
D (below average work)	50-70 %
F (failed work)	<50 %

Core reading

1. Koopman, P., Plasmeijer, R. and Swierstra, D. (eds.) (2009) *Advanced Functional Programming*. Springer, Berlin, Heidelberg.
2. Antunes, C.H., Alves, M.J. and Climaco, J. (2016) *Multiobjective Linear and Integer Programming*. Springer, Cham.
3. Mukhopadhyay, S. (2018) *Advanced Data Analytics Using Python*. Apress, Berkeley, CA.
4. Al-Taie, M.Z. and Kadry, S. (2017) *Python for Graph and Network Analysis*. Springer, Cham.
5. Wiley, M. and Wiley, J. (2016) *Advanced R*. Apress, Berkeley, CA.
6. Mailund, T. (2017) *Functional Data Structures in R*. Apress, Berkeley, CA.
7. Hu, Z., Petoukhov, S. and He, M. (2018) *Advances in Artificial Systems for Medicine and Education*. Springer, Cham.