PATTERN RECOGNITION

Basic Information

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

Course period	From September 1st till February 1st, 1 semester
Study credits	3 ECTS credits
Duration	108 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

«Pattern Recognition» is an extensive course, which is designed to give a student the skill to perform the recognition analysis using machine learning for the various medical problems. It provides the background in various aspects of the pattern analysis, including machine learning and statistical approaches. Additionally, the course provides the prior knowledge about various medical imaging system, which suppose to enhance the efficiency of recognition.

For the successful graduation of the course, the students are expected to freely operate the information measures, which suits for the pattern recognition.

The important part of this course is the practical part, which includes the spatio-temporal pattern analysis and graph-based pattern recognition. The last part of the course is dedicated to the recognition errors estimation.

The course is designed to cover a wide range of possible pattern analysis algorithm structures, which are special for a given area or a given organ.

Course Aims

- To help students to study a new discipline or to ameliorate the existing knowledge in pattern analysis.
- To assist students to construct their own strategy of medical data pattern recognition algorithms.
- To give students the understanding of how to estimate the errors of the pattern recognition algorithm.
- To introduce the basic principles of functioning of the medical imaging systems.

Course Objectives

The course has been designed to:

- ensure that students are familiar with basic recognition routines.
- ensure that students know the main information and entropy measures, which are suitable for the most medical pattern analysis.
- give students the optimal structures of the pattern analysis algorithms for the medical data analysis.
- give students an appreciation of the spatio-temporal analysis routines.
- provide students with the principles of the recognition errors estimation.

Learning Outcomes of the Course

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

- choose the metric and information measure for the given pattern analysis,
- construct the machine-learning algorithm for the pattern recognition,
- estimate the error of the resulted pattern recognition.

Course (module) Structure

Learning Activities	Hours
Lectures	-
Practice sessions / Seminars,	36
Self-study Assignments	72
Final Exam (including preparation)	-
Total study hours	**108**

Course Outline

Week	The title of the course subsection	Practice session / Assignments	Hours
• Semester 2			
1-6	Basics of Pattern Recognition	• Information measures for pattern recognition • Correntropy • Markov models in recognition • Home assignment No 1	(-/12/24)
7-12	Image Pattern Recognition	• Machine-intelligence pattern recognition • Entropy and discrimination in pattern recognition • Medical imaging systems • 3D object reconstruction techniques • Home assignment No 2	(-/12/24)
13-18	Advanced Pattern Recognition	• Statistical pattern analysis • Spatio-temporal patterns • Graph-based pattern recognition • Error estimation in pattern recognition • Home assignment No 3	(-/12/24)
	Pass/Fail Exam		

Course Instructors and Tutors, Contact Information

Instructor	Contact Information
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Assessment

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

• use various information and entropy measures for the pattern recognition (20 points maximum),

• construct the machine-intelligent algorithms for pattern recognition with a good accuracy (40 points maximum),

• perform the statistical and spatio-temporal analysis of the given pattern recognition problem (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. He, R. et al. (2014) *Robust Recognition via Information Theoretic Learning*. Springer, Cham.
2. Fink, G. (2008) *Markov Models for Pattern Recognition*. Springer, Berlin, Heidelberg.
3. Wang, P. (2011) *Pattern Recognition, Machine Intelligence and Biometrics*. Springer, Berlin, Heidelberg.
4. Mayer et al. (2018) *Medical Imaging Systems*. CC BY.
5. Zheng, N. and Xue, J. (2009) *Statistical Learning and Pattern Analysis for Image and Video Processing*. Springer, London.
6. Quan, L. (2010) *Image-Based Modeling*. Springer, Boston, MA.

7. Bunke, H., Kandel, A. and Last, M. (2008) *Applied Pattern Recognition*. Springer, Berlin, Heidelberg.
8. Bhanu, B., Lin, Y. and Krawiec, K. (2005) *Evolutionary Synthesis of Pattern Recognition Systems*. Springer, New York, NY.