

Name of the subject: Geospatial Methods, Techniques and Complex Systems In The Geosphere		
Teacher(s): Minučer Mesaroš		
Status of the subject: elective		
Number of ECTS points: 15		
Condition: -		
Goal of the subject		
Introduction to modern geoinformation methods and technologies and their application in interdisciplinary research of complex systems in the Geosphere.		
Outcome of the subject		
Acquiring the ability to apply advanced geospatial methods in interdisciplinary research of interactions between different elements of the Geosphere. Developed ability to understand and connect cause-and-effect relationships and interactions between different natural and social spheres. Independent finding and integration of relevant sources of geospatial data as well as application of the most adequate methods of their processing and analysis. Ability of comprehensive and balanced consideration of the most important factors in geospatial problem solving and reasoning in finding optimal and sustainable solutions.		
Content of the subject		
<i>Theoretical lectures</i>		
Sources of structured and unstructured geospatial data, methods of their processing and analysis. Modern platforms and environments for programming in working with geospatial data. Application of machine learning and AI in Geosciences, neural networks, classification, regression, cluster analysis, Deep Learning.		
The concept of complex systems in the Geosphere. System theory, dynamical systems, feedback loops, randomness and stochastic processes, deterministic systems, correlation, linear causality, nonlinear dynamical systems, spatial systems, agent-based models, self-organized criticality, emergence, pattern formation, fractal forms in nature, network theory, thermodynamics of complex systems.		
<i>Practical lectures</i>		
Conducting and presentation of a study based on available geospatial data, software tools and platforms and publishing the research results in the form of scientific paper.		
Recommended literature		
Dejan Stojanović (2018) <i>Fundamentals of R</i> , Institute of Lowland Forestry and Environment, UNS, Serbia.		
Robin Lovelace, Jakub Nowosad, Jannes Muenchow (2020) <i>Geocomputation with R</i> , CRC Press, USA		
Silas Toms, Paul Crickard, Eric van Rees(2018) <i>Mastering Geospatial Analysis with Python</i> , Packt, UK		
Paul Fieguth (2017) <i>An Introduction to Complex Systems (Society, Ecology, and Nonlinear Dynamics)</i> , Springer, University of Waterloo, Ontario, Canada		
Cristoforo Sergio Bertuglia, Franco Vaio (2005) <i>Nonlinearity, Chaos, and Complexity – The Dynamics of Natural and Social Systems</i> , Oxford University Press		
Taweh Beysolow II (2016) <i>Introduction to Deep Learning Using R</i> , Springer, USA		
Mikhail Kanevski, Alexei Pozdnoukhov, Vadim Timonin (2009): <i>Machine Learning for Spatial Environmental Data: Theory, Applications, and software</i> . EPFL Press		
Ian Goodfellow, Yoshua Bengio, Aaron Courville (2016) <i>Deep Learning</i> , MIT, USA		
Number of active classes	Theory: 5(75)	Practice: 5(75)
Methods of delivering lectures		
Oral lectures, individual consultations, seminar papers		
Evaluation of knowledge (maximum number of points 100)		
Seminar paper 50 points		
Oral exam 50 points		