Study program: Geoinformation Technologies

Qualification: PhD

General Information	
University	Yerevan State University
Course title	Geospatial Data Mining
Course/Module code	Geoinformation Technologies
Course type	Elective
Year of Study	1st year, 2nd semester
Term/Semester	Autumn (Semester)
Credits awarded	5(ECTS),
Degree	PhD
Enrollment status	Full-Time
Prerequisites and co-requisites (if applicable):	- Proficient knowledge of linear algebra, calculus, probability theory and statistics - Knowledge of GIS and geovisualization - Knowledge of spatial analysis - Knowledge of relational and spatial databases: - Proficient knowledge in programming

Lecturer's details	
Name, surname	Artak Piloyan
Academic title	Associate Professor
Contact details	Email: artakpiloyan@ysu.am
Office hours and consultation schedule	09:00-14:00 Monday, Wednesday, Friday

Commented [LF1]: Very attractive course for PhD students. Only needed in this syllabus to describe better the course contents, and maybe some assignments

Commented [LF2]: describe the distribution, (in class, at home,...)

Course Structure	
Course Goal	This course treats a specific advanced topic of current research interest in the area of handling spatial, temporal, and spatio-temporal data. Major topics include data mining and machine learning techniques on clustering, association analysis, and classification. In addition, students will learn how to use popular data mining tools and how to implement applications in geosecience. The class will expose students to interdisciplinary research on spatial data mining and current industrial practices in handling spatio-temporal data.
Learning Outcomes	On the completion of this course, students should be able to: - Explain the purpose of spatial data mining - Describe a range of data mining techniques and their use in analyzing geomatics data - Identify and select the appropriate techniques for data mining geomatics data - Analyze and the data to construct models - Test models through validation and able to criticize their reliability
Course contents:	1. Characteristics of Spatial Data: This chapter introduces the unique properties and characteristics of spatial data, highlighting the challenges and opportunities associated with handling information that has a spatial component. 2. Spatial Databases and Data Warehouses: Explore the fundamentals of spatial databases and data warehouses, understanding how they are structured to efficiently store and retrieve geospatial information, crucial for effective spatial data mining. 3. Knowledge Discovery in Databases: Delve into the principles of knowledge discovery in databases, focusing on the extraction of valuable patterns and insights from large datasets, with a specific emphasis on geomatics data. 4. Pattern Visualization: Learn techniques for visualizing patterns within spatial data, enabling effective communication and interpretation of complex spatial relationships through various visualization methods. 5. Spatial Prediction (Classification and Regression): Understand how to apply classification and regression techniques to spatial data, allowing for the prediction of spatial patterns and relationships, critical for decision-making in geospatial applications. 6. Spatial Segmentation and Clustering:

	Explore methods for dividing spatial data into meaningful segments or clusters, facilitating the identification of homogeneous regions and patterns within geomatics datasets. 7. Spatial Trends: Investigate spatial trends within datasets, focusing on the identification and analysis of trends and patterns that emerge over space, providing valuable insights for spatial decision-making. 8. Spatial Associations: Examine methods for discovering associations and relationships between spatial entities, enabling the identification of co-occurring patterns and dependencies in geospatial data. 9. Spatial Outliers: Explore techniques for identifying spatial outliers, which are data points that deviate significantly from the expected patterns, helping to detect anomalies and irregularities in geospatial datasets. 10. Spatio-Temporal and Moving Object Databases: Introduce the concepts of spatio-temporal and moving object databases, emphasizing their importance in handling dynamic geospatial data over time and space. 11. Spatio-Temporal and Trajectory Data Mining: Learn advanced techniques for mining patterns and insights from spatio-temporal data and trajectories, enabling the analysis of movement patterns and changes over time. 12. Emerging Trends in Spatial Data Mining: Architectures and Paradigms: Explore the latest developments and emerging trends in spatial data mining, including discussions on new architectures and paradigms that shape the future of handling spatial, temporal, and spatio-temporal data.
Assessment methods and criteria	This course is evaluated as follows: 60% Assignments 15% Final Exam 25% In-class Exercises and Quizzes
Recommended textbooks and links (in order of relevance):	**Recommended Textbooks:** 1. "Spatial Data Mining: Theory and Application" by Shashi Shekhar and Sanjay Chawla 2. "Data Mining for Geoinformatics: Methods and Applications" by Guido Cervone 3. "Geographic Data Mining and Knowledge Discovery" by Harvey J. Miller and Jiawei Han **Online Resources:**

	1. "Spatial Data Mining" by University of California, Santa Barbara: https://www.geog.ucsb.edu/courses/geog576/ 2. "Introduction to Geospatial Data Mining" by Esri: https://www.esri.com/training/catalog/57630432851d31e02a43bba8/introduction-to-geospatial-data-mining/ 3. "Spatial Data Mining and Knowledge Discovery" by Dr. Dimitris Papadias: https://www.youtube.com/watch?v=0z7QDno4i8Q