AG2418 Geospatial artificiell intelligens (GeoAI) 7.5 credits

Geospatial artificiell intelligens (GeoAI)

This is a translation of the Swedish, legally binding, course syllabus.

If the course is discontinued, students may request to be examined during the following two academic years

Establishment

The official course syllabus is valid from the autumn semester 2024 in accordance with decision by Head of School : A-2023-2330

Grading scale

A, B, C, D, E, FX, F

Education cycle

Second cycle

Main field of study

Built Environment

Specific prerequisites

A completed Bachelor of Science in engineering, natural sciences, environmental science, geography, planning, and mathematics.

Documented knowledge in linear algebra, equivalent contents in the course SF1672 and probability theory and statistics, 3 credits equivalent to contents in the course SF1918, 3 credits or equivalent knowledge approved by the examiner.

And documented knowledge in English equivalent English B according to the Swedish upper secondary school system.

Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

Intended learning outcomes

· Upon completing this course, participants will have gained a comprehensive understanding of Geospatial Artificial Intelligence (GeoAI), enabling them to proficiently employ AI techniques in geospatial analysis and application and effectively harness the potential of geospatial big data for informed decision-making. At the end of this course, the students will be able to:

- Develop a solid understanding of AI, machine learning and deep learning in the context of geospatial analysis.

- Deploy traditional machine learning algorithms and more advanced deep learning models effectively for geospatial big data analysis in urban and environmental applications.

- Evaluate model limitations and employ advanced assessment techniques to verify the model performances.

- Develop proficiency in the preprocessing and optimization of geospatial big data for AI and machine learning models.

- Gain practical skills through hands-on experiences using Python, relevant libraries (e.g., scikit-learn, PyTorch), and geospatial tools for data analysis.

Course contents

This course provides a logical progression from the fundamentals of AI in geospatial analysis to practical skills in data preparation, traditional machine learning and deep learning models, and a deep understanding of model limitations in geospatial contexts. Application examples will be given on how GeoAI can be used to support urban and environmental planning decisions. The course is organized in six modules:

Module 1: Introduction to AI for geospatial analysis

- Overview of AI models and their relevance in geospatial analysis

- Case studies highlighting AI's impact on geospatial problem-solving

Module 2: Geospatial Big Data Processing

- Geospatial data acquisition from diverse sources (satellites, UAVs, smartphones, IoT sensors)

- Data preprocessing techniques for geospatial datasets

- Feature engineering and data transformation for AI modeling

- Hands-on exercises in geodata machine learning ready dataset preparation

Module 3: Machine learning models for geospatial analysis

- Fundamentals of machine learning algorithms

- Practical applications and limitations of machine learning in geospatial contexts

- In-depth exploration of ML models, such as Random Forest and Gradient Boosting, and their use in geospatial analysis

- Model evaluation techniques with a focus on geospatial datasets

Module 4: Deep Learning in Geospatial Analysis

- Transitioning from traditional machine learning to deep learning

- Theoretical foundations of deep learning models (e.g., CNNs, RNNs, GNNs)

- Preparing geospatial data for deep learning models

- Implementing deep learning models for spatial analysis

Module 5: Understanding and Mitigating Model Limitations

- Evaluation of model limitations in GeoAI

- Advanced model assessment techniques (e.g., leave-one-out, K-folds cross-validation)

- Strategies for addressing model limitations

- Real-world case studies highlighting model strengths and weaknesses.

Module 6: GeoAI Applications

- GeoAI application in urban planning decision support

- GeoAI application in environmental planning decision support

Examination

- LAB2 - Laboratory work, 4.5 credits, grading scale: P, F
- PRO1 - Project, 3.0 credits, grading scale: A, B, C, D, E, FX, F

Based on recommendation from KTH's coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

Other requirements for final grade

Participation in the final presentation session

Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.
- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.