University of Potsdam

Exposé

Interdisciplinary Project

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Interdisciplinary Project

The interdisciplinary project is a module of the M.Sc. Computational Science at the University of Potsdam; 12 credit points are awarded for its successful completion. The aim of the module is to acquire up-to-date, specialized knowledge in computer science and related sciences in order to be able to analyze complex and interdisciplinary problems, develop innovative solutions, and evaluate them in a well-founded manner. In addition, the focus is on teamwork, the presentation of work results, and participation in interdisciplinary discussions. [1]
The project is part of the working student position at virtualcitysystems GmbH. virtualcitysystems GmbH (VCS) is a Berlin-based software company specializing in the development of solutions for 3D city models, digital twins and spatial data infrastructures. In particular, it offers tools for the visualization, analysis and management of urban geodata for cities, communes and planning authorities. [2]

Topic

The first idea of the project topic was to deal with Copernicus, the European Union's earth observation program. The question was therefore, which possibilities of use and evaluation are available with Copernicus (or similar platforms like Google Earth Engine). To get an overview, research was done into available and useful data and tools. In addition, various possible research questions and topics were collected and discussed. The shortlist of possible project topics included green space monitoring in urban areas, green roof and solar panel identification, building identification and individual tree identification in urban areas.

GeoAI

GeoAI is a powerful open-source Python platform that combines artificial intelligence with geospatial data analysis and visualization. It can be found at `https://geoai.gishub.org/` and was developed by Qiusheng Wu [3]. GeoAI enables the processing, analysis and visualization of vector, raster and LiDAR data using deep learning methods. For example, the Segment Anything Model (SAM) is used to segment satellite images and YOLOv5 is used to identify infrastructure such as building footprints, solar panels, cars, ships and parking lots. GeoAI has a modular structure and is Python-based, making it flexible to use: existing Python libraries and the integration of custom plugins offer a very wide range of options. Example scripts available on the website show how GeoAI works and can be used as a basis for individual use. The following summarized functions are presented in the sample scripts:

- Visualization of various geodata
- Object recognition of urban infrastructure
- Training software for object recognition
- Wetland mapping

Since the AI models integrated in the GeoAI only need to be trained once, the GeoAI can function as part of an analysis workflow. The following steps are necessary from the raw data acquisition to the visualization of the results of the data processing:

	Process	Tools
1	Data search and data download	Copernicus, Google Earth Engine, OpenStreetMap
2	Data preparation	FME, GDAL
3	Data processing	Object recognition of GeoAI
4	Conversion to streamable data formats	VC Publisher (VCS product for preparing geodata for VC Map and configuring the VC Map)
5	Visualization of the results	VC Map (VCS product for visualization)

Table 1: Analysis Workflow

Automated regular processing of the workflow using an external tool as a scheduler would also be possible; this is not required by VCS for the project.

Solar Panel Identification of GeoAI

The script for solar panel identification is openly available as an example on the GeoAI website. With the example data (area in Sacramento, USA) for which the model was trained, the solar panel identification works almost error-free. When using the model for an area in Berlin, the identification has a high error rate: skylights, greenhouses and shadows are partially identified as solar panels, and there are also some solar panels that are not identified as such despite very low selectivity. In order to be able to use GeoAI for German cities and to obtain more valid results, the model should be retrained with German data.

Project Goal

After consultation with the supervisors, the following goal was formulated:
In the project work, an analysis workflow with all necessary components should be developed, which performs the solar panel identification for a selectable German city and visualizes the results in the VC Map.
The initial focus is on solar panel identification for Berlin, as the necessary data is available at VCS. For this purpose, the AI model is to be retrained using the training scripts in order to achieve the highest possible accuracy rate. If the solar panel identification is successful, a further analysis workflow could be developed for green roof identification. Another option is to implement a time series analysis that documents the development of solar installations in Berlin in recent years. In addition, the results of the identified solar panels can be compared with the entries in the market master register (`https://www.marktstammdatenregister.de/MaStR`). The project work will be done independently, supported by the above-mentioned supervisors.
The following table shows the timeline, which will be used as a guide during the project:

	Timeline	Milestones
1	By the end of May 2025	Data search and data download
2	By the end of May 2025	Data preparation
3	By the end of June 2025	Data processing
4	By the end of June 2025	Conversion to streamable data formats
5	By the end of July 2025	Visualization of results
6	By the end of July 2025	Report and Presentation of project

Table 2: Timeline with milestones

Sources

Parts of the text were created or revised with the help of ChatGPT [4] and the translation service DeepL [5]. Responsibility for the content remains with the author.

[1] University of Potsdam. (2019). Module catalog for the M.Sc. Computational Science program. Retrieved April 30th, 2025.
[2] virtualcitysystems GmbH. (2025). Homepage. Retrieved April 30th, 2025. `https://www.virtualcitysystems.de`
[3] Wu, Q. (n.d.). GeoAI@GISHub. Retrieved April 30th, 2025. `https://geoai.gishub.org/`
[4] OpenAI. (2025). ChatGPT (GPT-4). Used April 30th, 2025. `https://chat.openai.com`
[5] DeepL SE. (2025). DeepL Translator. Used April 30th, 2025. `https://www.deepl.com`