Master's Thesis Proposal

Empowering Citizen Spatial Analysis: Utilizing Large Language Models with 3D GIS Datasets

Urban planning and spatial analysis often require the integration of Geographic Information Systems (GIS) for effective decision-making. However, the complexity of GIS platforms and the specialized expertise required for their operation can present barriers to entry for non-GIS experts such as citizens. This thesis introduces a novel method for democratizing GIS capabilities using Large Language Models (LLMs), empowering non-experts to interact with GIS layers through natural language commands, thereby enhancing spatial understanding and facilitating informed decision-making.

Leveraging advanced LLMs such as ChatGPT, GPT4All, LocalAI, etc., the aim is to develop a user-friendly platform that enables intuitive interactions and natural language queries. By seamlessly integrating LLM capabilities with semantic 3D city models such as CityGML or BIM, non-expert users can gain access to powerful GIS functionalities for spatial analysis and decision-making. For example, a citizen could inquire, "How many buildings in Arccistraße have total energy consumption less than the average consumption in Munich?". In CityGML, every building has an adresse and can have some generic attributes such as energy consumption of a building. An expert in GIS would find the answer to the question easily, but not a normal person. Therefore, we would use LLMs to make it possible for non-Expert users to ask questions and get immediate simplified answers.

The conceptual framework of this thesis requires first reading existing research in the domains of Large Language Models (LLMs) and investigating semantically strutured spatial datasets (such as CityGML or IFC BIM models…) that could be used to establish a theoretical foundation for the proposed solution. The design and components of the proposed solution should outline the choosen LLM, its metadata and capabilities, and the 3D datasets and databases to use with a couple of scenarios and use cases to be handled by the LLM. The conceptual framework architecture should provide a roadmap for designing and implementing the solution, guiding the development process towards achieving the desired objectives.

In the practical phase of this research, the objective is to translate the conceptual framework into a functional prototype, implementing the proposed solution and evaluating its effectiveness in enhancing spatial understanding for non-GIS experts. This phase involves designing an intuitive user interface using JavaSript and developing a function calling module to interpret user queries and interact with open 3D and GIS datasets/APIs using Python or Nodejs.

Basic knowledge in CityGML and/or IFC, and programming knowledge (Python, Javascript) are required.

Organization:	Chair of Geoinformatics (TUM)
Supervisor:	Prof. Dr. Thomas H. Kolbe, M.Sc. Khaoula Kanna
Email:	thomas.kolbe@tum.de , khaoula.kanna@tum.de