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Bachelor's Thesis

Context-Aware LLM Chatbots to
Support Students in Solving Coding Exercises

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In the evolving landscape of computer science education, the integration of intelligent tutoring systems is becoming increasingly significant. These systems aim to provide personalized support to students, enhancing their learning experience and proficiency in coding. The current state of research and technology in this domain has seen the development of various educational tools, but there remains a substantial opportunity to leverage the capabilities of Large Language Models (LLMs) to create context-aware chatbots. These chatbots can offer tailored assistance to students, particularly in the realm of programming exercises.
The challenge lies in developing a system that not only understands the intricacies of coding assignments but also adapts to the individual student's progress and knowledge level. The context-aware chatbots must be capable of providing relevant and constructive guidance without revealing solutions or introducing concepts beyond the student's current understanding. This requires a nuanced approach to AI tutoring that respects the curriculum's structure and the student's learning journey.

The primary objective of this thesis is to design and implement a series of specialized chatbots for the "Software Development 1" course on Moodle, each corresponding to different homework exercises (e.g., Exercise 4: Arrays, Exercise 5: Methods, Exercise 6: Fundamentals of Object-Oriented Programming). These chatbots will be informed by specific homework details, learning objectives, and instructional materials from both the practical exercises and lectures. A key aspect of the thesis will be to parameterize the chatbots to ensure they align with the curriculum and do not introduce premature concepts to the students. The deliverables include:

- A framework for creating homework-specific chatbots.
- Implementation of chatbots for selected coding exercises.
- Documentation on the integration of chatbots with Moodle.
- Evaluation of the chatbots' effectiveness in aiding student learning.

The beneficiaries of this research are students who will receive customized support in their coding exercises, educators who can leverage these tools to enhance teaching methodologies, and the broader academic community as it explores the potential of AI in education. Practical applications include the deployment of these chatbots in online learning platforms and their adaptation for various educational contexts.

Candidates for this thesis should have a solid foundation in computer science, familiarity with LLMs, and an interest in educational technology. Skills to be developed include prompt engineering, chatbot design, and effective use of AI in an educational setting.

The thesis is expected to contribute to the field of intelligent tutoring systems. Students are encouraged to aim for publication in relevant computer science conferences such as the International Conference on Intelligent Tutoring Systems (ITS), the Artificial Intelligence in Education (AIED) conference or a more general software education conference such as the SPLASH-E symposium.

Modalities:
The progress of the project should be discussed at least every four weeks with the advisor(s). A time schedule and a milestone plan must be set up within the first 2 weeks and discussed with the advisor(s). It should be continuously refined and monitored to make sure that the thesis will be completed in time. The final version of the thesis must be submitted not later than 31.08.2025.