



An LLM-Driven Conversational Assistant For Learning Database And Information Systems In Higher Education

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ABSTRACT

The integration of artificial intelligence in education has significantly enhanced the effectiveness of digital learning environments. In particular, large language models (LLMs) have enabled the development of intelligent conversational systems capable of supporting personalized learning experiences. This study presents an LLM-powered chatbot framework designed to assist students in learning database concepts and information systems in higher education. The proposed framework utilizes advanced natural language processing techniques to understand student queries and generate context-aware responses related to database management systems, structured query language (SQL), and core information system concepts. The system architecture integrates an LLM-based conversational engine with a knowledge base containing course materials, examples, and query explanations. Through this integration, the chatbot can provide real-time assistance, concept clarification, and interactive learning support. The framework also incorporates intent recognition, context tracking, and adaptive response generation to improve interaction quality and learning efficiency. A prototype implementation was developed and evaluated using typical academic queries related to database design, normalization, and SQL operations. Experimental results demonstrate that the proposed chatbot significantly improves student engagement, provides quick access to learning resources, and assists in understanding complex database topics. The framework can serve as an intelligent tutoring assistant within e-learning platforms and university learning management systems. Overall, the study highlights the potential of LLM-driven conversational agents to enhance teaching and learning processes in database and information systems education.

Keywords: Large Language Models (LLMs), Educational Chatbots, Database Education, Information Systems Learning, Natural Language Processing, Conversational Artificial Intelligence, Intelligent Tutoring Systems, Higher Education Technology.

I. INTRODUCTION

The rapid advancement of artificial intelligence technologies has significantly influenced modern educational environments, enabling more interactive and personalized learning experiences. Among these technologies, large language models (LLMs) have emerged as powerful tools capable of understanding and generating human-like text, thereby facilitating intelligent conversational systems. In higher education, these systems can be used to develop chatbots that assist students in learning complex academic subjects. Particularly in the fields of databases and information systems, students often encounter challenges in understanding theoretical

concepts, query structures, and practical implementations. Intelligent chatbot systems powered by LLMs can provide immediate assistance, explanations, and examples, helping learners overcome these challenges effectively.

Database management systems and information systems form the backbone of many computing and business applications. Students studying these subjects must understand topics such as database design, normalization, query processing, and structured query language (SQL). Traditional classroom instruction may not always provide continuous support outside lecture hours, which can limit students' ability to clarify doubts in real time.



With the integration of LLM-driven chatbots, learners can interact with an intelligent system capable of answering questions, explaining database concepts, and providing step-by-step guidance for problem solving. This approach enhances accessibility to learning resources and supports self-paced learning.

Recent developments in natural language processing have enabled conversational agents to maintain contextual understanding and generate accurate responses based on user queries. By integrating an LLM with domain-specific educational content, a chatbot can serve as a virtual teaching assistant for database and information systems courses. Such systems can interpret student questions expressed in natural language and provide relevant explanations, examples, and learning recommendations. This capability reduces the dependency on static learning materials and promotes an interactive educational environment.

This research proposes an LLM-powered chatbot framework designed to support learning in database and information systems courses within higher education institutions. The framework focuses on providing real-time academic assistance, improving student engagement, and facilitating better comprehension of database-related topics. By combining conversational AI with educational resources, the system aims to enhance the learning process and support students in acquiring both theoretical knowledge and practical skills in database management and information systems.

II. LITERATURE SURVEY

1. Title: ChatGPT for Teaching and Learning: A Review of Applications in Higher Education

Author: Zhai, X., Chu, X., Chai, C. S., et al.

Abstract:

This study investigates the potential applications of large language model-based conversational agents in

higher education. The authors analyze how generative AI tools such as ChatGPT can support teaching, learning, assessment, and academic assistance. The paper highlights the advantages of conversational AI in providing instant feedback, answering student queries, and improving engagement in online learning environments. It also discusses ethical considerations, including academic integrity and responsible AI use. The results indicate that LLM-powered systems can serve as intelligent assistants for both instructors and students when integrated appropriately into educational platforms.

2. Title: Conversational Agents in Education: A Systematic Review

Author: Winkler, R., & Söllner, M.

Abstract:

This research presents a systematic review of conversational agents used in educational contexts. The study evaluates the design, implementation, and effectiveness of chatbots in supporting learning activities. The authors identify several benefits, including personalized learning support, automated tutoring, and improved accessibility to educational resources. The paper also categorizes chatbot applications across different domains and highlights challenges such as limited contextual understanding and scalability. The findings suggest that conversational agents can significantly enhance student interaction and learning outcomes when properly designed.

3. Title: Artificial Intelligence in Education: Promises and Implications for Teaching and Learning

Author: Holmes, W., Bialik, M., & Fadel, C.

Abstract:

This work explores the impact of artificial intelligence technologies on modern educational systems. The authors discuss how AI-driven tools, including intelligent tutoring systems and chatbots,



can support personalized learning experiences. The paper outlines the potential of AI to analyze learner behavior, provide adaptive content, and offer continuous academic support. The study also emphasizes the need for responsible implementation and the development of ethical frameworks to guide AI adoption in educational institutions.

4. Title: Intelligent Tutoring Systems and Their Role in Personalized Learning

Author: Woolf, B. P.

Abstract:

This paper examines the design and application of intelligent tutoring systems (ITS) that provide personalized educational assistance to learners. The study explains how AI techniques can model student knowledge, identify learning gaps, and deliver customized feedback. The author highlights the ability of tutoring systems to simulate human-like teaching interactions and support self-paced learning. The findings demonstrate that AI-based tutoring systems improve student understanding and performance across multiple academic disciplines.

5. Title: Applications of Natural Language Processing in Educational Chatbots

Author: Pérez, J. Q., Daradoumis, T., & Puig, J. M.

Abstract:

This research focuses on the integration of natural language processing techniques in the development of educational chatbots. The authors describe how NLP enables chatbots to interpret user queries, maintain conversation context, and generate relevant responses. The paper presents case studies where educational chatbots assist students in answering questions, providing explanations, and guiding them through course materials. The results indicate that NLP-based chatbots can significantly improve accessibility and interaction in digital learning environments.

III. EXISTING SYSTEM

In current educational environments, learning support for database and information systems courses primarily relies on traditional teaching methods such as classroom lectures, textbooks, and static e-learning platforms. Many universities use Learning Management Systems (LMS) that provide course materials, assignments, and discussion forums for students. Although these platforms allow students to access learning resources, they often lack interactive assistance capable of addressing individual student queries in real time. As a result, students frequently depend on instructors or peer discussions to resolve doubts related to complex database concepts such as normalization, query optimization, and structured query language (SQL).

Several existing educational systems incorporate rule-based chatbots or simple automated response systems to provide limited academic support. These chatbots typically rely on predefined question-answer pairs or keyword-matching techniques to respond to student queries. While such systems can handle basic questions, they often struggle to understand complex or context-dependent queries. Their responses are generally restricted to a fixed knowledge base, which limits their ability to provide detailed explanations or adaptive learning support. Consequently, students may receive incomplete or irrelevant responses when interacting with these traditional chatbot systems.

Furthermore, most existing platforms do not effectively utilize advanced natural language processing or contextual understanding mechanisms. This limitation reduces the system's capability to interpret diverse student queries expressed in natural language. In database and information systems education, where students require step-by-step explanations and practical examples, these conventional systems often fail to deliver comprehensive guidance. Therefore, there is a need for more intelligent and adaptive conversational systems that can provide accurate, context-aware



responses and support personalized learning experiences for students studying databases and information systems in higher education.

IV. PROPOSED SYSTEM

The proposed system introduces an LLM-powered chatbot framework designed to support the learning of database and information systems in higher education. The system utilizes advanced large language models and natural language processing techniques to understand student queries and generate context-aware responses. Unlike traditional rule-based chatbots, the proposed framework can interpret complex questions related to database concepts, structured query language (SQL), database design, and information systems. The chatbot interacts with students through a conversational interface, allowing them to ask questions in natural language and receive accurate explanations, examples, and guidance in real time.

The architecture of the proposed system integrates several components, including a user interface, a query processing module, a large language model engine, and a domain-specific knowledge base containing course materials and database-related resources. When a student submits a query, the system processes the input using natural language understanding techniques and forwards it to the LLM module. The model analyzes the context of the query and retrieves relevant information from the knowledge base to generate an informative response. This response is then delivered back to the user through the chatbot interface, enabling interactive and continuous learning support.

In addition, the proposed system incorporates contextual memory and adaptive response generation to improve the quality of interactions. By maintaining the context of previous queries, the chatbot can provide more accurate and personalized responses. The system can also offer additional explanations, SQL query examples, and conceptual clarifications based on the student's learning needs. Through this

approach, the framework enhances student engagement, facilitates better understanding of database and information system topics, and acts as an intelligent virtual assistant for academic support in higher education environments.

V. SYSTEM ARCHITECTURE

The system architecture of the proposed LLM-powered chatbot framework for database and information systems learning is designed to provide an interactive and intelligent educational support system. The architecture consists of several interconnected components, including the user interface, query processing module, large language model (LLM) engine, knowledge base, and response generation module. These components work together to process student queries, analyze the context, and generate accurate responses related to database and information systems concepts. The architecture ensures smooth communication between the user and the AI-driven system while maintaining efficiency and scalability.

The process begins with the user interface, where students interact with the chatbot through a web-based or application-based platform. Students can enter their questions related to database topics such as SQL queries, database normalization, data modeling, and information system concepts using natural language. The input query is then forwarded to the query processing module, which performs preprocessing tasks such as tokenization, intent detection, and query interpretation. This module ensures that the user query is properly structured before being sent to the language model for further analysis.

After preprocessing, the query is passed to the large language model engine, which acts as the core intelligence of the system. The LLM analyzes the input query, identifies its context, and retrieves relevant information from the domain-specific knowledge base, which contains academic resources, database examples, lecture notes, and SQL query references. Using advanced natural language



processing capabilities, the model generates meaningful and context-aware responses that help students understand the requested topic.

Finally, the response generation module formats the generated output into a clear and understandable response before delivering it back to the student through the chatbot interface. The system may also maintain a contextual memory of previous interactions to provide more coherent and personalized responses during ongoing conversations. Through this architecture, the chatbot can effectively support students in learning database and information systems concepts by providing real-time explanations, examples, and academic guidance.



Fig 5.1: Structure of the Proposed System

VI. IMPLEMENTATION

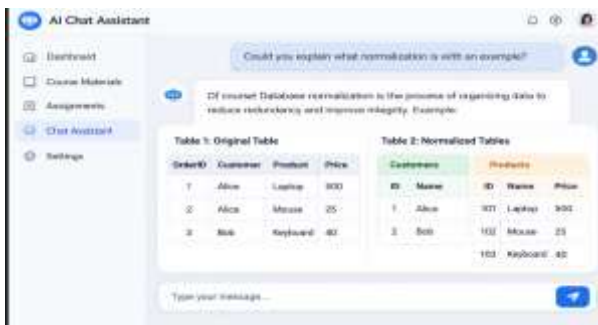


Fig 6.1: Dataset Loading and Exploration



Fig 6.2: Chat Assistant



Fig 6.3: Understanding Database Indexing



Fig 6.4: Create Table

VII. CONCLUSION

This study presented an LLM-powered chatbot framework designed to support the learning of database and information systems in higher education. The proposed system leverages the



capabilities of large language models and natural language processing to provide an intelligent conversational interface that assists students in understanding complex database concepts. By enabling students to interact with the chatbot using natural language, the system offers real-time explanations, SQL query examples, and conceptual guidance related to database design, normalization, indexing, and other core information system topics. The architecture of the framework integrates a user interface, query processing module, large language model engine, and a domain-specific knowledge base to ensure accurate and context-aware responses. Through this integration, the chatbot functions as an intelligent virtual assistant that enhances accessibility to learning resources and supports self-paced learning. The system also improves student engagement by providing immediate feedback and personalized explanations, which are often not available in traditional learning environments.

Overall, the proposed LLM-driven chatbot demonstrates significant potential in improving the effectiveness of digital learning platforms in higher education. It reduces dependency on manual academic support while helping students gain a better understanding of database and information systems concepts. Future work can focus on expanding the knowledge base, integrating the system with learning management systems, and incorporating adaptive learning mechanisms to further enhance the educational experience.

VIII. FUTURE SCOPE

The proposed LLM-powered chatbot framework for database and information systems learning can be further enhanced in several ways to improve its effectiveness and applicability in educational environments. One potential direction is the integration of the chatbot with Learning Management Systems (LMS) used by universities and colleges. By connecting the chatbot with platforms such as online course portals, the system can provide personalized academic assistance based on course materials,

assignments, and student progress.

Another important future enhancement involves incorporating adaptive learning capabilities. By analyzing student interactions, learning patterns, and frequently asked questions, the chatbot can tailor responses according to the individual needs and knowledge levels of students. This would enable the system to provide more personalized explanations, recommend learning resources, and guide students through complex topics in databases and information systems.

The system can also be expanded to support multimodal learning, including diagrams, interactive examples, and visual explanations for database concepts such as entity-relationship modeling and query optimization. Additionally, integrating speech-based interaction and multilingual support would make the chatbot more accessible to a wider range of students from different educational backgrounds.

Furthermore, future research can focus on improving the accuracy, security, and reliability of the chatbot by incorporating advanced fine-tuning techniques and domain-specific datasets related to database management systems. The framework could also be extended to support other computer science subjects such as data structures, operating systems, and software engineering. These improvements would transform the chatbot into a comprehensive intelligent tutoring system capable of supporting a broader range of educational applications in higher education.

IX. REFERENCES

- [1] X. Zhai, X. Chu, C. S. Chai, et al., "ChatGPT for education: Opportunities and challenges," *Computers and Education: Artificial Intelligence*, vol. 4, 2023, Art. no. 100138. DOI: <https://doi.org/10.1016/j.caeai.2023.100138>
- [2] R. Winkler and M. Söllner, "Unleashing the potential of chatbots in education: A state-of-the-art analysis," *Proceedings of the Academy of*



Management Annual Meeting, 2018.

DOI:

<https://doi.org/10.5465/AMBPP.2018.15903abstract>

[3] W. Holmes, M. Bialik, and C. Fadel, *Artificial Intelligence in Education: Promises and Implications for Teaching and Learning*, Boston, MA, USA: Center for Curriculum Redesign, 2019.

DOI:

<https://doi.org/10.13140/RG.2.2.18403.04646>

[4] B. P. Woolf, *Building Intelligent Interactive Tutors: Student-Centered Strategies for Revolutionizing E-Learning*, Morgan Kaufmann, 2010.

DOI: <https://doi.org/10.1016/C2009-0-20118-8>

[5] J. Q. Pérez, T. Daradoumis, and J. M. Puig, “Rediscovering the use of chatbots in education: A systematic literature review,” *Computer Applications in Engineering Education*, vol. 28, no. 6, pp. 1549–1565, 2020.

DOI: <https://doi.org/10.1002/cae.22326>

[6] T. Brown et al., “Language models are few-shot learners,” *Advances in Neural Information Processing Systems*, vol. 33, pp. 1877–1901, 2020.

DOI:

<https://doi.org/10.48550/arXiv.2005.14165>

[7] J. Devlin, M. Chang, K. Lee, and K. Toutanova, “BERT: Pre-training of deep bidirectional transformers for language understanding,” *Proceedings of NAACL-HLT*, 2019, pp. 4171–4186.

DOI: <https://doi.org/10.18653/v1/N19-1423>

[8] A. Vaswani et al., “Attention is all you need,” *Advances in Neural Information Processing Systems*, vol. 30, 2017.

DOI:

<https://doi.org/10.48550/arXiv.1706.03762>

[9] S. Adamopoulou and L. Moussiades, “Chatbots: History, technology, and applications,” *Machine Learning with Applications*, vol. 2, 2020, Art. no. 100006.

DOI:

<https://doi.org/10.1016/j.mlwa.2020.100006>

[10] M. Okonkwo and A. Ade-Ibijola, “Chatbots applications in education: A systematic review,” *Computers and*

Education: Artificial Intelligence, vol. 2, 2021, Art. no. 100033.

DOI:

<https://doi.org/10.1016/j.caeai.2021.100033>

[11] K. F. Hew, C. K. Lo, G. S. Tang, and C. M. Huang, “Using chatbots to support student learning: A systematic review,” *Educational Research Review*, vol. 27, pp. 1–16, 2019.

DOI:

<https://doi.org/10.1016/j.edurev.2019.100289>

[12] D. K. Elson, N. Dames, and K. McKeown, “Extracting social networks from literary fiction,” *Proceedings of ACL*, 2010.

DOI:

<https://doi.org/10.3115/1858681.1858687>

[13] I. Goodfellow, Y. Bengio, and A. Courville, *Deep Learning*, Cambridge, MA, USA: MIT Press, 2016.

DOI:

<https://doi.org/10.7551/mitpress/10243.001.0001>

[14] J. L. Kolodner, “Case-based reasoning in education,” *The Knowledge Engineering Review*, vol. 11, no. 3, pp. 1–27, 1996.

DOI:

<https://doi.org/10.1017/S0269888900001204>

[15] R. Dale, “The return of the chatbots,” *Natural Language Engineering*, vol. 22, no. 5, pp. 811–817, 2016.

DOI:

<https://doi.org/10.1017/S1351324916000243>