Research Statement: ***Documents***, *their formats, different methods for processing, emerge as the crucial element in the current trend towards LLMs, where any clever software engineering, any safe-guarding, relies on complete access to, and sound understanding of, this unit of the underlying knowledge.*

academic blog: https://heseltime.github.io/rDai

software-engineering-lead research/LLMs for a11y
& ECM (Enterprise Content Management) consulting and engineering

Jack Cody Heseltine

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Motivation Letter: *IT:U Computational X Doctoral School, NLP Group*

Dear Professor Hou,

I am writing to express my strong interest in joining the Computational X Doctoral School at IT:U to pursue a PhD focusing on LLM topics, especially Governance and, broadly, Knowledge and Reasoning (maybe also Computational Argumentation, which I am new to). My academic and professional journey has uniquely prepared me for this research area, combining a solid foundation in liberal arts, software engineering, and machine learning with practical experience in interdisciplinary collaboration and applied NLP research.

Motivation for Research

Within NLP, my interest in knowledge graphs stems from their potential to make information systems more transparent, accessible, and impactful. This aligns with my ongoing Masters Thesis project, Making Documents Barrier-Free, which aims to democratize document access using LLM technologies. While this project might benefit from RAG aspects, I was inspired by the reverse idea of crowdsourced human as well as machine annotation for a knowledge graph from text, as discussed in End-to-End Argumentation Knowledge Graph Construction. I am particularly drawn to the vision of building web-based argumentation graphs, in the paper's "plan to build a large web-based argumentation graph [to] investigate how [to] exploit it for different computational argumentation tasks such as argument synthesis and argument search" - coming out of an election-cycle-heavy year, I am particularly excited by the application possibility to fake news detection and can definitely envision highly visible IT:U projects that shake up political debate, for example, at various levels in Austria, where this would be just one type of transformation enabled by technology and the current AI age situation, something the university has promised from its outset in the Founding Lab 2023.

Academic and Cultural Fit

My connection to IT:U began in 2023, during the Founding Lab collaboration with Ars Electronica. The Lab fostered a vibrant exchange of ideas, enriched by diverse perspectives, including those from the Global South and queer voices. This experience highlighted the importance of maintaining the founding spirit of inclusivity and innovation as the university transitions into its operational phase. I see my role not only as a researcher but also as an advocate for participatory, democratic development within IT:U, particularly through interdisciplinary collaborations, in the original spirit of the Founding Lab.

This commitment is reflected in my work with the Catholic University Youth (KHJ) in Linz, where I initiated discussions around PostCity as a potential location for IT:U. Through platforms like postuni.at (a project I am now leading), I have actively engaged with the community in an attempt at shaping the university's future in line with what is most likely to be a great future for Linz and Upper Austria as well. These efforts underscore my ability to bridge technical expertise with cultural and social advocacy, a skill set crucial for IT:U's mission, in my opinion.

Academic and Professional Background

I bring to this PhD application a diverse academic background that combines liberal arts, applied engineering, and advanced machine learning:

- Liberal Arts Foundation: I graduated with a Presidential Scholarship from Sarah Lawrence College, a program emphasizing interdisciplinary research, critical thinking, and writing.
- Applied Engineering and Machine Learning: After the COVID-19 pandemic shifted my career trajectory, I pursued a second Bachelor's degree in Software Engineering at the

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University of Applied Sciences, Hagenberg, and a Master's degree in Machine Learning at JKU Linz under Prof. Sepp Hochreiter, starting on this journey during covid and while working for the Red Cross in Linz, at the main blood bank at Linz General Hospital, in the IT and Software Development Department.

This dual education has given me both theoretical depth and practical expertise in symbolic computation, modern AI tools and as far as possible at JKU, NLP too.

- Industry Experience: My role as a consultant Software Engineer at Wolfram Research has allowed me to work on cutting-edge projects integrating symbolic computation with Cloud and Web generally, touching on AI functionality built in the Wolfram product suite as well, the current example being LLM-Kit. These experiences have honed my programming skills (especially Wolfram Language, Python, Java) and my ability to lead interdisciplinary initiatives, such as the seismograph-art installation project at the IT:U Summer School 2024, where I found professional sense of direction to be a driving quality that set me apart but also made me an effective group member and leader.
- Collaborative Projects: My on-going collaboration with IT:U's Dr. Nelson Silva and the Dynamic Projection Institute, exemplifies my ability to translate academic insights into real-world solutions. This project combines technical problem-solving with cultural sensitivity, further reinforcing my alignment with IT:U's vision, and will hopefully host an event in the upcoming Christmas season here in Linz, maybe at KHG.
- At JKU, I followed the AI Masters curriculum with qualifying Bachelors level courses taken on top, maintaining fairly consistent grades but focusing on projects, own research (see also my academic blog), and interdisciplinary and extracurricular collaborations, like the AI in Medicine project at the Medical Faculty at Linz General Hospital, as one example reflected in my transcripts as well. I have also linked the extensive Software Engineering curriculum I followed up to my thesis (a collaboration between JKU and Hagenberg as it turns out), allowing me to translate into practice my ideas as well.

Current JKU AI courses:

- ***Automated Reasoning***
- ***Computer Vision***
- ***AI and Visualization*** *(XAI course)*
- ***Math for AI 3*** *(functional-analysis-focused)*
- ***Communicating AI***
- ***Practical Work in AI*** *(course I am doing practical component of my Masters under)*

Research Direction

My primary research interests lie at the intersection of NLP, knowledge graphs and RAG, and LLMs generally. I am particularly interested in exploring:

- Symbolic-Augmented NLP: Developing robust and explainable AI systems that integrate symbolic reasoning with LLMs, drawing on my background in symbolic computation and current work at Masters level in XAI, as well as a focus of my Masters Thesis.
- Benchmarking for Trustworthy AI: Establishing frameworks for evaluating the robustness and reliability of NLP systems in real-world contexts. This is actually the main goal of my current thesis, answering how effective accessibility annotations are actually measured.
- Retrieval-Augmented Generation (RAG): Leveraging RAG to enhance LLM reliability.

My goal is to contribute to IT:U's mission by advancing the theoretical and practical boundaries of these technologies, while fostering collaborative projects that address societal challenges. I am excited at the prospect of cutting-edge-technology-aided, interdisciplinary work in the many labs of IT:U, right here in Linz.

I am confident that my diverse background, technical expertise, and commitment to interdisciplinary collaboration make me a strong fit for the Computational X Doctoral School. I look forward to the opportunity to discuss my application in greater detail and to contribute meaningfully to the IT:U research community.

Thank you for considering my application. I have included my academic resume and portfolio for your review. Please feel free to contact me for additional information or to arrange an interview.

Sincerely, Jack Heseltine

Thank you for your consideration. Please see also https://heseltime.github.io/