Ausschreibung für eine Wissenschaftliche Arbeit

Typ der Arbeit / Type of work (ankreuzen / tick as appropriate):

- [ ] Bachelorarbeit
- [ ] Seminararbeit [ ] Einfache Vergabe [ ] Doppelte Vergabe [ ] Dreifache Vergabe
- [x] Projektarbeit [ ] Einfache Vergabe [ ] Doppelte Vergabe [ ] Dreifache Vergabe
- [x] Diplom-/Masterarbeit

Vorläufiger Titel DE oder EN (je nach angebotener Sprache / depending on the language offered):

Development of Chatbot integrated with a Bayesian network (Increase of causal abilities of the language model)

Beschreibung DE oder/or EN (je nach angebotener Sprache / depending on the language offered):

Ausgangslage / Initial situation , Problem statement / Problemstellung

Industrial maintenance refers to the systematic practice of keeping machines and production systems in optimal working condition. Essential to industrial operations, maintenance involves tasks such as inspections, repairs, and replacements necessary to prevent downtime and extend the life of equipment. The annual loss due to lacking maintenance in the USA alone amounts to 220 billion US dollars (Thomas und Weiss 2021). Measures can be taken either reactively, after the occurrence of a damage event, or proactively (prescriptive and predictive) to directly prevent damage from occurring. Advances in Large Language Models (LLMs) are leading to LLMs being used as maintenance chatbots to provide technicians with quick access to complex maintenance data and instructions, increasing efficiency and accuracy in fault diagnosis and repair.

While useful, LLMs do not inherently reference factual data, giving out hallucinations because they are primarily statistical models that generate text based on patterns and associations learned from a vast dataset (Yao et al. 2023). Furthermore, LLMs can only justify the causal-effect-relationship between two or more variables with difficulty, which is why an output is only reliable to a certain degree. Causal AI is crucial for deciphering the cause-effect relationships in maintenance, offering a profound understanding that goes beyond correlation.

This research addresses the integration of Causal AI to enhance language-based maintenance systems reliability and quality of outputs. By employing Retrieval-Augmented Generation (RAG), this study aims to improve the factual accuracy of LLM outputs, utilizing BNs for probabilistic reasoning, which are expected to enhance the interpretability and reliability of maintenance decisions. By comparing these methods on the same scenarios it fills a significant gap and enables a practical guide to select the appropriate methods for maintenance departments.

Ziele / Objective DE oder/or EN:

Chatbot with integrated Bayesian Network (building on our chatbot sleeve)
Bayesian network
Complex Model
Possibility to co-author a scientific publication

Hauptaufgaben / Main tasks DE oder/or EN:

Transformation of Knowledge Graph into Bayesian Network
Integration of the Bayesian network into Chatbot
Evaluation of this Chatbot in regards to causal AI KPI

General Tasks:
Contributing to one of the biggest research projects regarding empathical AI (Fraunhofer Emotion)
Literature Research
Programming
Planning

Scientific Writing

Schlagwörter / Tags DE UND/AND EN: (Getrennt durch Schrägstrich / separated by slash) e.g: Industrie 4.0/ Maschinelles Lernen / Industry 4.0/Machine Learning

Chatbot / LLM / Bayesian network / RAG / AI

Fachgebiet(e) / Areas of expertise e.g: Knowledge Based Maintenance, Circular Economy:

Generative AI / Knowledge Based maintenance

Erwartete Studienrichtung des Studenten: (ankreuzen) / Expected field of study of the student: (check)

- [x] Informatik / Computer Science
- [ ] Informatikmanagement / IT management
- [ ] Maschinenbau / mechanical engineering
- [ ] Wirtschaftsinformatik / Business informatics
- [ ] Wirtschaftsingenieurswesen-Maschinenbau / Industrial engineering-mechanical engineering
- [ ] Sonstige Studienrichtung / Other fields of study:

Sprache / Language: (ankreuzen / check)

- [ ] Deutsch
- [x] Englisch

Spezielle Fähigkeiten, die der Student mitbringen muss / Special skills that the student must have:

Fascination for Generative AI and its possibilities
Ability to learn
some experience in GenAI and programming with LLMs would make it easiert for you but some general programming experience will do

Beginndatum / Start date: 01/10/2024	**Erwartetes Ende / Expected ending:** 01/04/2025

Name des Verfassers / Name of the author: Ruben Hetfleisch

Hinweise für den Verfasser dieser Ausschreibung

Nachdem die Ausschreibung vollständig ausgefüllt wurde, bitte an wiss.arbeitenBTSP@tuwien.ac.at senden.

Falls eine Arbeit vergeben wurde oder nicht mehr benötigt wird, bitte dies umgehend an wiss.arbeitenBTSP@tuwien.ac.at melden!