

CITEC Lecture Series 2024

Summary

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I. Introduction

The CITEC lecture series, organized by Prof. Stefan Kopp and Prof. Philipp Cimiano, took place during the summer semester 2024 at the Bielefeld University. It is aimed at interested researchers and students who would like to take a look beyond their daily research. In the midst of routines and corresponding perspectives, we often get stuck with proverbial tunnel vision. Thus, we came to the idea of breaking with said phenomenon and brush up on our knowledge of other people’s research. As part of the Intelligent Systems PhD program, we would like to share our experiences of the CITEC lecture series with you. We are computer scientists in Prof. Britta Wrede’s research group “Medical Assistance Systems” at the Medical School OWL and work in the research projects A03 and A05 of the TRR 318 “Constructing Explainability”.

II. Summary and Contributions

In seven keynote lectures, we were able to get an insight into the work of the attending research groups. Each talk was followed by a lively discussion, and the speakers were able to get feedback on their own research.

(1) One of the main topics discussed at the opening event was ChatGPT for educational purposes. This technology seems to be a promising way to improve education. It has even been shown to be able to pass school exams. However, due to the nature of LLMs, normally simple tasks for computer systems, such as multiplying two numbers, can lead to incorrect results. Therefore, ChatGPT is not an adequate tool for educational purposes out of the box, because its purpose is only to satisfy the user with his answer, without regard to factual correctness or proven educational methods. The research of Prof. Benjamin Paaßen, junior professor of the “Knowledge Representation and Machine Learning” group at the Faculty of Technology, focuses on the development of an advanced tutoring system for modern education. This is achieved by combining human knowledge, structured data and

machine learning. They have developed a first tutoring system for programming homework. It provides qualitative feedback to bridge the gap in homework, making it more like one-on-one tutoring. LLMs are used to generate feedback that should lead to the learner's calculated next immediate goal, rather than just revealing the solution. Choosing the right hint or quality feedback for the next optimal task is a key component of the integrated pedagogical model. In this talk, we identify several preliminary connections to our research objectives. Adapting to the user's needs to enhance understanding of explanations is also addressed in TRR 318, where various factors, such as mental model or success rate, are considered to apply the most effective strategies for the individual.

(2) Prof. Helge Rhodin, head of the working group “Visual AI for Extended Reality” from the Faculty of Technology, reported on his previous research topics and future plans in the second lecture. His report included prevention in sport through virtual reality, an audio viewer for the hearing impaired, as well as his current research on “How does a human learn from an image?” and how this learning process can be represented. Research into systems for people with disabilities has attracted particular interest. Since the establishment of the Medical School OWL, there has been a growing emphasis on improving the lives of people with disabilities. Notably, systems are being developed to aid behavioral therapy, particularly through robotics. Hence, the presentation highlighted several opportunities for future collaboration.

(3) The talk on “Modeling context in situated language generation” was given by Prof. Sina Zarriß, head of the “Computational Linguistics Group” at the Faculty of Linguistics and Literary Studies. Their research improves upon natural language generation of image captions via interpreting scenes not only as a collection of objects, but by also adding context to allow for better identification and perspective. To describe an image, two additional contextually similar images are used to separate the context from the differences. This context can help understand, for example, that a small white pixelated rectangle on a glossy white surface is a toothbrush on a sink when considering a bathroom context. In connection with TRR 318, which focuses on explanations, this concept could be adapted to enhance context-aware explanations by comparing different explanations to identify significant differences.

(4) During the fourth CITEC lecture, Prof. Klaus Neumann, head of the “Collaborative Robotics” working group at the Faculty of Technology, gave a talk on “Machine Learning Magnetic Levitation”. Normally, magnetic force adaptation according to sensor output to control levitation would be considered an engineering task. Prof. Neumann demonstrated

that there are certain cases in which employing multiple machine learning pipelines alongside a variety of relatively inexpensive sensors can yield better results than traditional engineering approaches, even in time-critical applications. Besides magnetic levitation, imitation learning for automation in the context of small and medium enterprises was also presented. Here, for example, the robot can learn to fold a shirt through a few demonstrations. This concept could help the introduction of automation in more fields with smaller production quantities and support digitization. Given necessary levels of explanation and transparency during the process, this method could find a place in the regular household to learn and preform tasks like cleaning the litter box.

(5) Prof. Anna-Lisa Vollmer, head of the working group “Interactive Robotics in Medicine and Care” from the Medical School OWL, reported about her three main topics of interest: Robot learning in interactions with lay users in human-robot teaching situations in a co-construction perspective, social robotics in healthcare and medicine, and the transfer of medical assistance systems to hospitals and the public. Examining her research topics over time reveals how her specific areas of focus, among other things, form a cornerstone of TRR 318. It is becoming clearer that the co-constructive approach in her projects originated years ago and is now being further advanced. Attending the lecture was insightful, as it emphasized the importance of ongoing research efforts. It demonstrated that continuous effort on individual topics is essential for producing partial results that collectively contribute to a cohesive, overarching model.

(6) The working group “Educational Psychology”, with Prof. Kirsten Berthold, Dr. Markus Hefter and Simon Schriek from the Faculty of Psychology and Sports Science, gave insight into their ongoing research in the field of video based learning and the benefits of self-explanations and prompts. Among many other things, they look at how learned knowledge is stored in long-term memory. The focus is always on the human cognitive system, and how learning involves linking material with prior knowledge. They conduct extensive research with students in lectures and support the development of adaptive assistance systems in an interdisciplinary context in corporation with the CITEC. As part of TRR 318, we also look at explanations and concepts of understanding. In order to better operationalize understanding, we have also taken a look at declarative and procedural theories of knowledge. For our own research, we see a lot of overlap with the development of adaptive systems.

(7) In the last lecture, Prof. Joana Cholin from the Faculty of Linguistics and Literary Studies, head of the “Psycholinguistics” working group, talked about “Fluent, dysfluent and creative language production”. She presented the entire process of language production and

pointed out existing research gaps in the topic, on which her work is based. Especially fascinating for us was the understanding of the origin of stuttering. The monitoring and control process at that point creates an error by self-perception, resulting in the repetition of the syllable until the control system deems it correct. In order to understand the structure and production of speech, five different studies with different target groups, such as native speakers, bilingual speakers, speakers with disabilities and others, were presented. These include, for example, studies with aphasics or apraxias, as well as the comparison of early and late bilingual speakers to examine differences in speech production. This research is part of the newly established CRC 1646: “Linguistic Creativity in Communication”. We can imagine interesting collaborations with our TRR 318, especially so within the intersection of communication in the process of explanation.

III. Conclusion

Looking back on the first semester of the CITEC lecture series, we have a very positive impression. The events provided us, as graduate students, with many new insights into the research of other working groups and pleasant discussions. These interactions offered new starting points for our own projects and helped us to better position our work within the broader research landscape.

The series enabled us to step away from the routine of our daily research and gain a comprehensive understanding of the active research being conducted at CITEC. We discovered potential areas for collaboration and further exploration, enriching our knowledge and research endeavors. Additionally, observing the presentations of experienced researchers was both enjoyable and enlightening, offering us valuable lessons in effective communication and presentation techniques that helped enhance our own soft skills. We strongly encourage all interested researchers and students to participate in future events like this and invest their time in these valuable opportunities.