Abstract of the PhD Thesis

Information Management
Dependencies in Research, Education and Business

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With the ever-growing amount of information available in databases and on the web, information systems that manage and process this data have become a center of attention in business, research and education. Dependencies are high-level specifications of the constraints and enrichments within information systems such as knowledge graphs or databases.

Dependencies are at a particularly favorable position in research and teaching of computer science: They are typically specified in declarative, logic-based languages, thus opening up the rich methodological complex of formal methods for research. In recent years, dependencies have been the topic of intensive research interest. Complementing that, fundamental types of dependencies – such as functional and inclusion dependencies – are at many universities an essential part of the curriculum. Thus, dependencies also play a significant role in computer science education. Completing the circle, throughout the last years, we have also witnessed a resurgence of dependencies in business. Taken together, the increasing importance of information systems and the value of dependencies for defining constraints and relationships between information systems make research, education and business in this field a particularly fruitful endeavour.

Despite all that, little of the connection between those three aspects is currently being exploited. Little of modern research on dependencies plays a role in current education. The typical topics in dependency education are far away from what modern industrial systems need. The high computational complexity of many formalisms in research is a prohibitive barrier for many industrial applications on Big Data. In other words, we see the three “islands” of research, education and business applications, all with great potential, but a big, “dangerous” gap between them that few researchers, students or practitioners overcome.

In this work, we show ways of bridging this gap. In terms of impact, apart from a number of research papers at top conferences and journals resulting from this endeavour, the educational aspect of this thesis lead to the inclusion of an advanced dependencies and knowledge graph part in both the undergraduate Databases course, and the master’s Database Design course at the University of Oxford. In addition, it lead to an EU Horizon 2020 project. The practical aspect led to the creation of the start-up DeepReason.ai.