Chapter 13
Ontology Maintenance Through Semantic Text Mining: An Application for IT Governance Domain

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ABSTRACT

Manual ontology population and enrichment is a complex task that requires professional experience involving a lot of efforts. The authors’ paper deals with the challenges and possible solutions for semi-automatic ontology enrichment and population. ProMine has two main contributions; one is the semantic-based text mining approach for automatically identifying domain-specific knowledge elements; the other is the automatic categorization of these extracted knowledge elements by using Wiktionary. ProMine ontology enrichment solution was applied in IT audit domain of an e-learning system. After seven cycles of the application ProMine, the number of automatically identified new concepts are significantly increased and ProMine categorized new concepts with high precision and recall.

INTRODUCTION

Intelligent systems are all around us, we use them in cars, mobiles, smart meters and in several other places. These systems are context-sensitive and require domain-specific knowledge to operate. In a case of complex domains, ontologies are widely used to provide the underlying knowledge structure. We followed this ontology based approach in several research projects related to intelligent systems development. The ProKEX research (Gábor & Kő, 2016) aimed to develop a complex application to extract, organize and preserve knowledge embedded in organizational processes in order to (1) enrich the organizational knowledge base in a systematic and controlled way. ProKEX IT solution integrates (a) an organizational process management tool, (b) a learning management tool, (c) a monitoring and feedback tool and (d) data and text mining tools for developing a knowledge base (domain ontology).

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and the interfaces which are responsible for the communication between these components. The text mining solution, which we applied in ProKEX called ProMine was used for ontology enrichment based on the extraction of deep representations from business processes. ProMine extracts new domain-related concepts using a new filtering mechanism to filter the most relevant concepts, based on a novel hybrid similarity measure (Gillani & Kő, 2016).

SAKE (Semantic-enabled agile knowledge-based e-Government) solution (Kő, Kovács, & Gábor, 2011) was utilized in several other fields and projects; especially in the investigation of job market needs, educational system supply and managing information overload gained benefit from it (Kő et al., 2011; Matas, 2012; "UbiPOL “, 2009). In SAKE project ontology development was one of the most complex and time-consuming tasks that required professional experience involving a lot of expert discussions and efforts. Ubipol (Ubiquitous Participation Platform for Policy Making) solution ("UbiPOL “, 2009) is a ubiquitous platform that allows citizens to become involved in policy-making processes (PMPs) regardless of their current location and time. It performs private semantic information retrieval based on an ontology outlined in policies; and ubiquitous data-mining at the device level, along with privacy-preserving data-mining at the server level (Husaini, Ko, Tapucu, & Saygın, 2012; Kő, 2012). In all projects mentioned above, the authors struggled with ontology maintenance and enrichment, because the domain knowledge and the regulatory environment become outdated fast.

Ontologies have been studied for a long time in the fields of semantic technologies, artificial intelligence and knowledge management. Current state-of-the-art research in ontologies has focused on the development methods and possible applications of ontologies (Khondoker & Mueller, 2010; López, Pérez, & Amaya, 2000; Pan, Staab, Aßmann, Ebert, & Zhao, 2012). However, there remain many obstacles for the management and enrichment of ontologies (Gasevic, Zouaq, Torniai, Jovanovic, & Hatala, 2011; Miranda, Isaias, & Costa, 2014). Ontology learning, enrichment and maintenance is an ongoing and complex process, with several challenges (Shamsfard & Abdollahzadeh Barforoush, 2003; Wong, Liu, & Bennamoun, 2012; Zouaq, Gasevic, & Hatala, 2011). It has a key role in ontology management; it tackles the issues to turn facts and patterns from the content into shareable high-level constructs or ontologies.

Any ontology update or maintenance can have several consequences. Deleting or adding an ontology object have effect to other objects, it can modify relations, objects and axioms. In a case of the huge number of ontology objects, regular update requires standard process.

This paper aims to discuss an ontology enrichment and maintenance method, using an innovative text mining solution, namely ProMine. We describe the ontology learning environment based on a semantic text mining method, which is applied to populate, enrich and renew IT governance domain ontology. The method can be used for ontology maintenance and as well as for validation purposes in another domain. Domain experts, in our case IT audit professionals (Certified Information Systems Auditors (CISAs)) prepared the first version of IT governance/IT audit domain ontology, which was populated and enriched with ProMine solution.

IT is a strategic asset and important contributor to economic success (ISACA, 2011). Today in our technology-enabled world, where organizations are faced with digital transformation, the digital presence and protect IT resources are vital to be competitive. IT governance field has a key importance for IT professionals especially for managers. It helps to ensure that the investments in IT generate value and mitigate IT-associated risks, avoiding failure. IT governance has several definitions, like in ISACA glossary: the responsibility of executives and the board of directors; consists of the leadership, organizational structures and processes that ensure that the enterprise’s IT sustains and extends the enterprise’s strategies and objectives. (ISACA, 2017). Governance of Enterprise IT (GEIT) deals with organizing the IT