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Departamento de Informática y Automática

Analítica Visual aplicada a la Ingeniería de Ontologías

Tesis Doctoral - RESUMEN

D. Juan Francisco García Navarro

Directores:

Dr. D. Francisco José García Peñalvo
Dr. D. Roberto Therón Sánchez

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Resumen

La representación del conocimiento se ha definido como un conjunto de reglas ontológicas provistas con la capacidad para realizar inferencias. Uno de los esquemas de representación de conocimiento más ampliamente difundido lo constituyen las ontologías. En términos muy generales, las ontologías son ampliamente utilizadas en la Ingeniería del Conocimiento, la Inteligencia Artificial y las Ciencias de la Computación.

Una problemática en la representación del conocimiento desde un punto de vista semántico, es la complejidad de los procesos de creación, gestión, análisis y reusabilidad de los modelos ontológicos que representan estas estructuras de conocimiento. El soporte automático o semiautomático a los procesos relacionados con la representación de conocimiento, suele enfrentar diversos problemas durante el proceso de modelado de datos ontológicos, que acaban por comprometer la comprensión y el desarrollo de los modelos. Esto puede tener como resultado, procesos de desarrollo y gestión complejos, ineficientes y, así mismo, una escasa reutilización de los propios modelos ontológicos. Muchas de las herramientas que soportan estos procesos, no son lo suficientemente robustas para realizar eficientemente todas las tareas involucradas en los flujos de trabajo.

Esta tesis toma como dominio de investigación esta problemática, y plantea como objetivo principal la definición de diversos procesos para la gestión del ciclo de vida de las ontologías, sustentados en un enfoque de Analítica Visual, un área de investigación basada en el uso de representaciones visuales, que se enfoca en el uso del proceso cognitivo humano para el análisis de información.

El enfoque que sigue la Analítica Visual destaca al usuario como punto central en el proceso de análisis, y todos los mecanismos que intervienen en este enfoque se definen tomando en consideración, como aspectos principales, el usuario y la interacción de este con las herramientas de cómputo. Estos mecanismos facilitan el razonamiento analítico, al maximizar la capacidad humana para percibir, entender y razonar acerca de conjuntos de datos complejos

y dinámicos.

Los procesos involucrados en el ciclo de vida de las ontologías (creación, gestión, análisis y reutilización), describen flujos de trabajo formados por diversas actividades. Estas actividades se han definido tomando en consideración las principales metodologías para el desarrollo de modelos ontológicos.

Por otro lado, también es necesario que estas actividades estén soportadas por mecanismos y herramientas que permitan su desarrollo de forma eficiente. Estos mecanismos son principalmente, técnicas de visualización robustas y provistas de una interacción que permita al usuario a través de su capacidad, desarrollar abstracción, concepción, entendimiento, representación y aprendizaje de conocimiento.

A lo largo de esta tesis se detallan los flujos de trabajo y los mecanismos propuestos para el desarrollo de los procesos para el modelado de datos basado en ontologías. Teniendo en cuenta estos mecanismos, se ha implementado una herramienta denominada OWL-VisMod, y se han evaluado desde dos perspectivas. La primera de ellas se basa en la usabilidad de las tareas definidas, mientras que la segunda se enfoca en la funcionalidad de la herramienta y todas las técnicas de visualización e interacción.

La evaluación de usabilidad consiste en el desarrollo del proceso de creación de un modelo ontológico, de acuerdo a las tareas propuestas. Este desarrollo se ha realizado por un grupo de usuarios, quienes emitieron una valoración sobre la usabilidad de la herramienta. Por otro lado, la evaluación de funcionalidad, se ha realizado primero, a través de un proceso de análisis sobre un modelo ontológico existente, de acuerdo al flujo de trabajo definido para este proceso, y segundo, a través de un proceso de creación de un nuevo modelo ontológico de datos, para un sistema real en un dominio específico, en este caso, en el sector del turismo.

Los resultados de las evaluaciones han indicado, por un lado, que los procesos, los flujos de trabajo y las tareas definidas, son coherentes con los objetivos definidos. Este resultado se debe en gran parte a que estas tareas se han adaptado a partir de metodologías previamente definidas. Por otro lado, la evaluación de funcionalidad en el caso de estudio, ha permitido detectar algunos aspectos mejorables, así como también ha servido para la validación general de la herramienta y las diversas técnicas de visualización e interacción implementadas en ella.

Palabras Clave

Representación del Conocimiento, Ontologías, Analítica Visual, Procesos

Abstract

Knowledge Representation has been defined as a set of ontological rules provided with the capacity to perform inference. It basically consists of a set of symbols that represent a specific domain, enriched with a set of functions to perform reasoning. This reasoning aims to perform inference, most of times based on the use of any kind of logics. Ontologies represent one of the most widely used schema representations. They are mainly used in the Knowledge Engineering, Artificial Intelligence and the Computer Science fields.

The main problem with the Knowledge Representation from a semantic point of view, is the complexity of the processes of creation, management, maintenance and reusability of the ontological models. The automatic support to the processes that manage the knowledge, usually have to face diverse problems during the modelling process. These problems affect the comprehension and the development of these ontological models, causing complex and unefficient processes and low levels of reusability of these ontologies.

The current tools that support these processes, have diverse problems, due to they are not robust enough to efficiently develop all the tasks involved in the workflows.

This thesis has taken this problematic as its starting point. It aims to develop the processes for developing and managing the life cycle of ontologies based on a Visual Analytics approach, where the user becomes to be the central point in the analysis process. Furthermore, all the mechanisms involved in this approach, have been defined taking into account, the user and his interaction with the computers. These mechanisms, make easier the analytical reasoning, because they maximise the human capacity to perceive and understand about complex and dynamic data sets.

The processes involved in the ontologies'life cycle, describe the whole sequence of activities in the workflows, to create, manage and reuse ontologies. These activities and workflows have been defined taking into account the main methodologies for developing ontological models. Moreover, each of these ac-

tivities and workflows, is supported by Visual Analytics and interaction techniques.

The user interaction represents a crucial aspect for developing ontology-based data models. The user, supported by computer mechanisms, defines the representation of a certain domain using an ontological model. These mechanisms, are completely defined according to the human capabilities to perform abstraction, conception, understanding, learning and knowledge representation. This user-centered approach, represents the main approach taken of the Visual Analytics field.

Through this thesis, all the workflows for developing ontology-based data models are completely described and detailed. Furthermore, all the mechanisms implemented in a tool called OWL-VisMod, that support the development of these processes are also described. These mechanisms have been evaluated based on two approaches: the first one is the usability of the tool, and the second one is the functionality of the tool and all the visualisation and interaction techniques.

The usability evaluation consists of the development of the creation process of an ontological model, according to the proposed tasks. This development has been performed by a group of users that evaluate the usability of the tool. On the other hand, the functionality evaluation has been performed, first, through an analysis process of an existing ontology, and second, through the creation of a new data ontological model, according to the workflows defined to these processes.

This creation process has been developed over a real scenario, of a recommend system for tourism activities. This evaluation has let to perform diverse tests of the tool, about its capacity to cover all the functionality aspects needed for a real-scenario system.

The results of these evaluations, have indicated firstly, that the processes, workflows and the defined tasks, are coherent to the defined objectives. Secondly, the functionality evaluation in the case-study, has let to detect diverse aspects that were improved or fixed, as well as the validation of the tool and the diverse visualisations and interaction techniques.

Keywords
Knowledge Representation, Ontologies, Visual Analytics, Processes

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