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Pharmaceutical Validation of Medication Orders Using an OWL Ontology and Business Rules

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Abstract. In this paper we present an application of pharmaceutical validation of medication based on an OWL ontology and business rules or more specifically clinical decision rules. This application has been developed based on a prototype that enables business users to author, execute and manage their Business Rules over OWL Ontology. This prototype is based on the Business Rule Management System (BRMS) IBM WebSphere ILOG JRules.

Keywords. OWL ontology, business rules, clinical decision rules, pharmaceutical validation.

Introduction

Ontologies are more and more used to model business knowledge thanks to their power of expressiveness and flexibility. Business Rules are a description of a business policy, encoded in a natural controlled language. They define or specify constraints of some aspect of the business [1].

In this paper, we present a method that allows business users to author business rules, in a natural controlled language, from an OWL (Web Ontology Language) ontology of pharmaceutical validation business activity [2]. The OWL ontology models the most pertinent entities (concepts and properties) of pharmaceutical validation activity. The rules, test on the values given to the entities described in the ontology and assert if a medication order is valid or not.

Business rules and ontology have already been combined to support clinical decision [3]. However, end user involvement in the design and the implementation of ontology – based business rules is a neglected aspect [2]. In this study we propose to involve the end user (pharmacists, physicians, nurses) and to experiment the business rules designed as a clinical decision rules – based alert system.

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1. Method

JRules offers an infrastructure that enables business users to author, - in a controlled natural language -, execute and mange business rules in a collaborative way. It uses an object oriented model to formalize the business domain called *BOM* (*Business Object Model*). The *BOM* represents the entities of a given business. It is generated over from the *XOM* (*eXecutable Object Model*) which is the model enabling the execution of rules.

1.1. Authoring Business Rules over OWL Ontologies

To enable business users to author business rules, in a natural controlled language, we developed the *JRules OWL plug-in*. This plug-in exploits infrastructure offered by JRules to import OWL ontologies within it. The main component for authoring rules in JRules is the *BOM*. For this, we performed a mapping of OWL concepts (TBox) into the *BOM*. Thus, when we import an OWL ontology within JRules, the BOM is automatically generated and the functionalities offered by the BRMS can be used [4].

1.2. Executing Business Rules over OWL ontologies

To execute business rules authored over ontologies, we perform a second mapping of OWL/BOM entities to a XOM using Jena. Jena is a Java framework, including an ontology API for handling OWL ontologies, which allows to generate Java objects from the entities of the ontology. These Java objects then constitute the XOM. The use of Jena provides an execution layer for the OWL ontologies. This execution layer provides inference mechanisms on this model and the mapping of OWL concepts, properties, and individuals to a Java object model .

2. Experimentation

We used a pharmaceutical validation use case to implement clinical decision rules for pharmaceutical validation of medication orders at the HEGP hospital [5].

The ontology used to build this business application and the authored business rules that we will show in the following have been built based on the work presented in [2].

The ontology is composed of 17 concepts and 25 properties. We will focus on 5 concepts and their properties used to author the rules. The ontology contains a concept **Patient** which has **LabResult** and is concerned by a **Prescription.** A **Prescription** contains a list of **Drug** and has a **DosageRegimenPhase**.

The rules authored over this ontology test on the *presentation name* of a **Drug**, the *dosage unit* and the *dosage* of the **DosageRegimenPhase** of a **Prescription** and on the **GFR (Glomerular Filtration Rate)** of the **LabResult** of a **Patient**. Depending on the values given to these properties, they assign if a **Prescription** is *valid* or not.

When the user imports the ontology into JRules, it automatically generates the BOM. Then, the domain experts (pharmacists and physicians) author the clinical decision rules in natural controlled language. Two examples of authored rules are presented in the following (see Figure 1 and 2).

Figure 1. GLUCOPHAGE (Metformin)-1000

Figure 2. GLUCOPHAGE (Metformin)- 850

After the rule authoring, the pharmacist enters the data concerning a prescription and launches the execution of the rules which will determine if the prescription is valid or not. For example, he enters data concerning a prescription given a patient who has the GFR of his lab result equals to 90. The dosage regimen phase of the prescription is "*TABLET"* and its dosage is 4. The prescription contains a drug called *"GLUCOPHAGE (Metformin) 1000"*. In this case the rule called "GLUCOPHAGE1 – 1000-TABLET Rule" will be executed and set the validation of the prescription to false.

3. Discussion

Using *JRules OWL plug-in*, we presented an application for pharmaceutical validation of medication orders that implement clinical decision rules, in a natural controlled language, over an OWL ontology.

The business rules depend on the ontology evolution. We develop the Model-Detect-Repair (MDR) approach [6] that enables the consistency maintenance of business rules when ontologies evolve.

The clinical decision rules designed in this study will be integrated with the HEGP clinical information system as an alert system for more assessment.

References

[1] http://www.businessrulesgroup.org (28/01/2012)

[2] Boussadi A, Bousquet C, Sabatier B, Caruba T, Durieux P, Degoulet P. A Business Rules Design Framework for a Pharmaceutical Validation and Alert System. Methods Inf Med 2011;50(1):36-50.

[3] Kashyap V, Morales A, Hongsermeier T. On Implementing Clinical Decision Support: Achieving Scalability and Maintainability by Combining Business Rules and Ontologies. AMIA Annu Symp Proc 2006; 2006:414-418.

[4] Chniti A, Dehors S, Albert P, Charlet J. Authoring Business Rules grounded in OWL Ontologies. In M.D. et al. (EDS.), Ed.,RuleML 2010 : The 4th International Web Rule Symposium : Research Based and Industry Focused : LNCS 6403, Springer-Verlag Berlin Heidelberg

[5] Degoulet P, Marin L, Lavril M, Le Bozec C, Delbecke E, Meaux J-J, Rose L. The HEGP component-based clinical information system. Int J Med Inform 2003;69(2-3):115-126.

[6] Fink M, El Ghali A, Chniti A, Korf R, Schwichtenberg A, Levy F, Puher J, Eiter T. D2.6 Consistency Maintenance. (2011) ONTORULE Deliverable. (http://ontorule-project.eu/deliverables)