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An ontology-based intelligent system for recruitment

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Abstract

Nowadays, employment has a huge social importance. Current tools for facilitating job searches lack in providing intelligent matching between employer advertisements and the curriculum vitae of the candidates. The objective of this research work was to develop an intelligent web portal to serve as service provider in recruitment tasks. This portal aims at helping people living in the region of the South-east of Spain to find a job. For this purpose, the knowledge of the recruitment domain has been represented by means of ontology, which has been used to guide the design of the application and to supply the system with semantic capabilities. Furthermore, the ontological component allows for defining an ontology-guided search engine which provides more intelligent matches between job offers and candidates' curricula. Finally, this work covers the design of the ontology and the development of the web portal. Both issues are discussed and some validation results are presented.

Keywords: Ontologies; Employment; Web portal

1. Introduction

Semantic structures and models are becoming very important in the information technologies field and, in particular, in web applications. In this sense, the semantic web ideated by Tim Berners-Lee (Berners-Lee, Hendler, & Lassila, 2001) is close to come true and lots of semantic web-related applications and languages are being created. The semantic web is based on machine-processable semantics of data. The backbone technology utilised for it is Ontologies, which aim at interweaving human understanding of symbols with their machine processability. Moreover, ontologies present two main advantages, namely, shareability and reusability. These properties make them very attractive and powerful for representing domain knowledge. Thus, the knowledge they contain can be used in different applications, for different purposes and by different people. But ontologies can also be used for other stages in the development of a web application. For example, applying ontologies for modelling applications can result in a stronger and more consistent knowledge model.

On the other hand, numerous services are provided to serve the large population of users that every day navigates on the web. Many of those services are developed by means of web portals, which have become easy and useful tools to capture and manage huge volumes of information. Employment is one of the sectors to which authorities worldwide have paid much attention in the last years due to its social importance. In line with this, several web portals have been implemented related to the employment domain and, in general, they have been well accepted by the users. However, current unemployment portals do not make use of the advantages provided by semantics-related techniques. In this work, a public web portal developed by using semantic web technologies (i.e. ontologies) is presented. Thus, a semantics-based design has been applied to the development of this employment web portal. To be more precise, ontology has been built to guide and support the development of that portal. This facilitates the implementation of a semantic matching engine in the application between offers and requests. For it, an ontology-guided intelligent search has been used, so that the offers in which a user is interested can be obtained.

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The referred web portal is nowadays facilitating the access to the labour market, specially for users from the North-west of the region of Murcia, which is located in the South-East of Spain. In fact, this web portal is an institutional meeting point for unemployed people and companies offering job positions and formation opportunities in the aforementioned geographical region.

The structure of the remainder of this paper is as follows. In Section 2, some notes on ontological engineering and the use of ontologies in web portals are presented. Section 3 describes the ontological model used in the work described here. The domain ontology designed is presented in Section 4. The design of the web portal is discussed in Section 5, whereas its validation process is explained in Section 6. Finally, some related work and conclusions are put forward in Section 7.

2. Ontological engineering

The notion of ontology has received multiple definitions along the history. In the computing filed, different definitions of ontology have been given in a similar sense to the philosopher Quine's interpretation (Quine, 1961), who said that everything that can be quantified exists. One of the best known definitions is Tom Gruber's (Gruber, 1993): 'ontology is an explicit specification of a conceptualization'. This definition was refined by Borst (Borst, 1997), stating that 'ontology is a formal specification of a shared conceptualisation'. In this context, formal refers to the need of machine-understandable ontologies. This definition emphasises the need of agreement in carrying out a conceptualisation. On the other hand, shared refers to the type of knowledge contained in the ontologies, that is, consensual, non-private knowledge. In this work, this definition of ontology is adopted. In literature, different classifications of types of ontologies can be found according to different criteria. This work focuses on domain ontologies, which refer to the detailed structuring of a context of analysis with respect to the sub-domains which it is composed of; i.e. they define domain specific conceptualisations. It must be pointed out the difference among domain ontologies and domain knowledge, because the latter describes domain factual situations whereas the former imposes descriptions on the domain knowledge structure and content.

Ontologies provide a common vocabulary of an area and define -with different levels of formality—the meaning of the terms and the relations between them. Knowledge in ontologies is mainly formalized using five kinds of components: classes, relations, functions, axioms and instances (Gruber, 1993). Classes in the ontology are usually organized in taxonomies. Sometimes, the definition of ontologies has been diluted, in the sense that taxonomies are considered to be full ontologies (Studer, Benjamins, & Fensel, 1998).

One of the main problems with ontologies is that of their construction. In fact, there are many methodologies for building ontologies although none of them can be considered standard.

Despite the difficulties related to its construction, ontologies are more and more used in different fields. The increasing interest in and need for ontologies can be drawn from (Brewster et al., 2004), where current and future problems and challenges for ontologies are analysed. In Ref. Chandrasekaran, Johnson, and Benjamins (1999), two uses of ontologies are identified: vocabulary and content. As far as the first use is concerned, ontology can be seen as representation vocabulary. They are often specialised to some domain or subject matter. It is not the vocabulary as such that qualifies as ontology, but the conceptualisations that the terms in the vocabulary are intended to capture. The representation of vocabulary provides a set of terms with which to describe the facts in some domain, while the body of knowledge using that vocabulary is a collection of facts about a domain. However, there continues to be inconsistencies in the usage of the term ontology. At times, theorists use the singular term to refer to a specific set of terms meant to describe the entity and relation-types in some domain.

On the other hand, ontologies are also seen as content theory. One of the main interests in ontologies is due to the alternation of focus between content theories and mechanism theories in AI. Ontologies are essentially content theories because their main contribution is to identify specific classes of objects and relations that exist in some domain.

Ontological analysis clarifies knowledge structure. Ontologies are necessary for obtaining vocabularies for representing knowledge. The first step in devising a knowledge representation system and vocabulary is to perform an effective ontological domain analysis. Therefore, clarifying the terminology enables the ontology to work for coherent and cohesive reasoning purposes. Moreover, ontologies enable knowledge sharing. The result of ontological analyses includes domain terms, general terms and terms that describe behaviour. Ontologies capture the intrinsic conceptual domain structure. In ontological analysis, terms are associated with concepts and relations in the ontology are then needed. This knowledge representation language can be shared with others who have similar needs for representing knowledge in the same domain. Shared ontologies can form the basis for domain-specific knowledge representation languages.

Ontologies are considered essential in two of the current most relevant research areas: knowledge management and the semantic web. Thus, in Benjamins, Fensel, and Gómez-Pérez, (1998), the importance of ontologies is highlighted for performing efficient knowledge management. There, the authors state that characterising a domain in ontological terms facilitates an intelligent access to the information. This idea has been put in practice by many researchers in the last years. An evolution of this idea can be found in Ref. Berners-Lee et al. (2001). There, ontologies are considered necessary for the development of the semantic web. Ontologies can enhance the functioning of the web in many ways. They can be used to improve the accuracy of web searches, because the search program can look for only those pages referring to specific concepts rather than those using ambiguous keywords. Pages are linked to ontology pages that define information about the domain. All that information is processed by a computer and could be used to answer queries that currently