Ontology based Recruitment Process

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Abstract: In our research we explore the benefits resulting from the application of Semantic Web technologies in the recruitment domain. We use currently available standards and classifications to develop a human resource ontology which gives us means for semantic annotation of job postings and applications. Furthermore, we outline the process of semantic matching which improves the quality of query results. Finally, we propose an architecture of an evaluation system based on Semantic Web technologies.

1   Introduction

Nowadays many business transactions are carried out via Internet. Human resources management has also discovered Internet as an effective communication medium. The German Federal Employment Office (BA), for examples, launched the platform "virtual employment market" in December 2003. This initiative is an effort to increase transparency of the job market and to decrease the duration of job procurement. In spite of high investments, these goals have not been reached yet. One of the main problems of the BA portal is the necessity for all participants of the virtual employment market to use the proprietary data exchange format issued by the BA. Furthermore, defects in quality of data and query results have been observed. Our research addresses these problems by applying Semantic Web technology to recruitment processes.

The section 2 briefly describes a typical recruitment process and suggests areas for application of the Semantic Web technologies. Subsequently, in section 3, we present our human resource ontology founded on currently available standards and classifications. In

section 4 we outline the process of semantic matching which improves the quality of query results. Finally, we propose an architecture of a prototype recruitment portal based on Semantic Web technologies.

2   Recruitment Process

From an organization's viewpoint, a typical recruitment process can be divided into four main phases: describing the requirements of the job position, publishing the job posting, receiving of applications, and final decision making.

Nowadays, job postings are written in form of free text using uncontrolled vocabulary. In contrast, semantic annotation of job postings using concepts from a controlled vocabulary, based on Semantic Web technologies, results in language independent descriptions and better machine processability, i.e. improved matching of job postings and applications.

There exist as many ways to post a job offer on the Web as there are places where an applicant can look for a job. There are Web sites and online portals financed by publishing fees, corporate Web sites, and portals run by state job centers like the German Federal Employment Office (BA)[1] and the Swedish National Labour Market Administration (AMS)[2]. Job exchange portals differ substantially according to market scope and positioning, supported functionality, and selection methods. To maintain an overview on so many portals is next to impossible. With the Semantic Web one would publish an RDF [W3C04b] annotated job posting only on the organization's web site, which in turn, would be crawled by various job portals. Consequently, job postings would reach more potential applicants, which would result in higher market transparency. Moreover, both employers and applicants would benefit from a semantic description of job postings and applications. Applicants could reuse their semantically annotated profiles, that is to say, to send them to different employers instead of filling in different web forms. Employers would also benefit from automated matchmaking between job requirements and applications, which would deliver a ranked list of best matching candidates and thereby reduce administrative costs.

3   Human Resource Ontology

In the first step in realizing our human resource scenario, we have created a human resource ontology (HR-ontology) by integrating some existing widespread standards and classifications. To avoid redundancy we decided to form sub-ontologies (see Fig. 1) which are used in both job posting and job application descriptions. Our HR-ontology is mainly based on the German version of the HR-XML standard developed by the HR-XML Consortium[3]. HR-XML is a library of more than 75 interdependent XML schemes which define data components for various HR transactions, as well as options and constraints govern-

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[1] http://www.arbeitsagentur.de/
[2] http://www.ams.se/
[3] http://www.hr-xml.org/

ing the use of these components. We adapted the `Job Position Seeker` and `Job Position Posting` segments from HR-BA-XML (German version of HR-XML) with respect to requirements of our scenario.

In the course of our work we have realized that the recruitment process today is no longer restricted to the national level. Hence, to specify the `Industry` sub-ontology we use both the German Classification of the Industry Sector (WZ2003)[4] and the North American Industry Classification System (NAICS)[5]. As occupational classification we utilize the German Occupation Code (BKZ)[6] and the Standard Occupational Classification (SOC)[7] System.
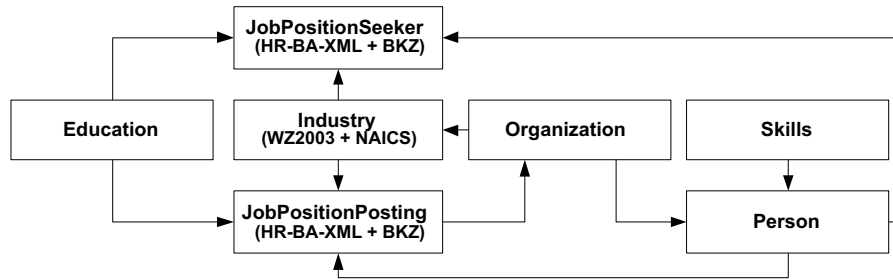

Figure 1: Sub-ontologies within the HR-ontology

In the `Skills` sub-ontology we defined concepts representing competencies, which are used to describe job requirements as well as applicant's skills. This ontology also provides means for specifying the competence level of a certain skill. Furthermore, we developed a `Person` sub-ontology for describing personal information of job applicants and an `Organization` sub-ontology to specify the employer companies.

Our HR-ontology is modelled with the Web Ontology Language (OWL) [W3C04a]. Descriptions of job postings and applicant's profiles are stored in RDF (Resource Description Framework) [W3C04b] format using the pre-defined vocabulary from our HR-ontology.

4 Semantic Matching of Job Postings and Job Applications

Having job position postings and job position seekers described using controlled vocabulary from our HR-ontology allows us to perform semantic matching, i.e. the calculation of the degree of semantic similarity between an applicant's profile and job requirements. Consequently, for a given job position a ranked list of the best matching candidates can be delivered as a result, and vice versa.

Inside both a job posting as well as a job application we group pieces of information into

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[4]http://www.destatis.de/allg/d/klassif/wz2003.htm

[5]http://www.census.gov/epcd/www/naics.html

[6]http://www.arbeitsamt.de/hst/markt/news/BKZ_alpha.txt

[7]http://www.bls.gov/soc/

"thematic clusters", e.g. information about competencies and skills, information regarding the industry sector of the job position, and job position details. In our approach, we compare each thematic cluster from a job posting with the corresponding cluster from a job application. The final similarity between an applicant's profile and a job posting is calculated as the sum of the similarities between these thematic clusters. Since information provided within each cluster is represented using controlled vocabulary from our HR-ontology, we compute the similarity between thematic clusters based on the similarity between their concepts. In our method, using some ideas from [ZZLY02], we determine the similarity between two concepts by their respective positions in the concept hierarchy and additionally by the similarity between their properties (relations with other concepts). An example property of a concept from the "skills cluster" (e.g. java programming) is the competence level (having another concept as its value, e.g. beginner). Furthermore, within the user interface (see Fig. 2) users are given the opportunity to specify the importance of different concepts (job requirements). The concept similarity will be then justified by the indicated "weight", i.e. the similarity between more important concepts will have greater influence on the cluster similarity.

5 Architecture of the Evaluation System

To examine the impact of the application of Semantic Web technologies on the job market we are currently developing a recruitment platform. The technical architecture of our system (see Fig. 2) is divided into: data layer, application logic, and front-end layer. This architecture is similar to [BS02] with additional functionality for automatic crawling of job postings from different web sites.
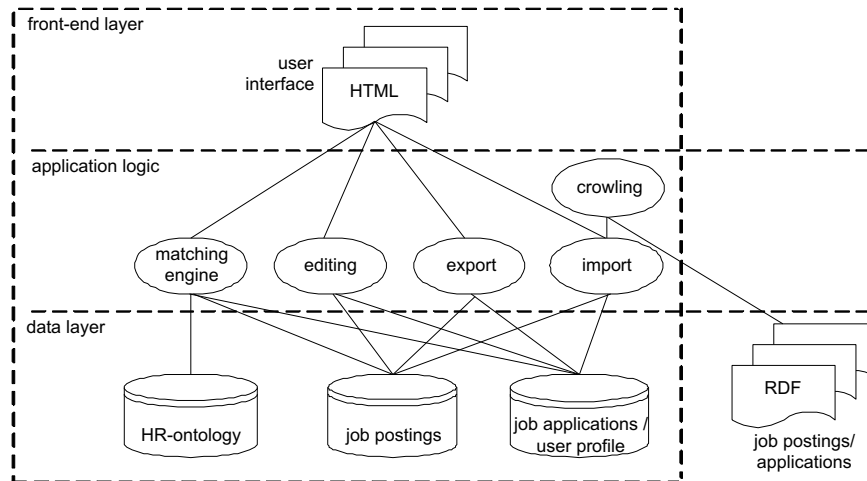

Figure 2: Architecture of the Evaluation System

RDF-repositories located at the data layer store the human resource ontology and all collected descriptions of job postings and user profiles. The application logic provides services for querying the database and editing its content. Moreover, at this layer the semantic matching of job postings and applications is performed. On top of the architecture, the front-end layer offers a browser-based user interface which accepts input from and presents ranked query results to the user, and another interface providing services for import and export of RDF-encoded job postings and applications.

6   Conclusion

In this paper, we proposed an application of Semantic Web technologies in the recruitment domain. We described the human resource ontology used within our approach, which provides us means for semantic annotation of job postings and job applications. Using controlled vocabularies, in contrast to free text descriptions, results in a better machine processability, data interoperability and integration. Moreover, having job postings and user profiles semantically annotated, enables us to perform semantic matching which significantly improves query results and delivers a ranked list of best matching candidates for a given job position. Finally, we described the system architecture of the recruitment portal based on Semantic Web technologies.

In the next step of our research, we plan to implement the recruitment portal founded on the ideas presented in this paper. Our research is embedded in the KnowledgeNets project which researches the impact of the Semantic Web technologies on the business models of participants of electronic markets. KnowledgeNets is part of the InterValBerlin Research Center for the Internet Economy [In04b, In04a] and is funded by the German Ministry of Research BMBF.

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