Dynamic Search Engine Platform for Cloud Service Level Agreements Using Semantic Annotation

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ABSTRACT

This article describes how cloud applications are negotiated, deployed, monitored, evaluated and terminated through the service level agreements (SLA). The service definition & their objectives, performance measures, pricing, roles of the involved parties are stated as part of the SLA. Searching for SLA templates from the provider’s place is considered as a cumbersome process for the consumer. Also, it is not guaranteed that retrieved SLAs always match with the consumer requirements. Hence, semantic search engine platforms for cloud SLA using a novel architecture are introduced here. SLA agreements are crawled from the web and annotation is performed in the agreement terms using SLA ontologies to fasten and improve the accuracy of the search process. In the proposed architecture, 3 ontologies are developed for SaaS, PaaS and IaaS as well as 140 SLA documents are gathered. Results revealed that the search efficacy is almost 90% in finding the desired SLA for the consumer to ease negotiation. Moreover, the performance is compared with similar search engine GoNTogle, and it was observed that proposed model produced good results.

KEYWORDS

Cloud Computing, Search Engine, Semantic Web, Service Level Agreements, SLA Ontologies

1. INTRODUCTION

Search engines are used to retrieve the relevant content from the World Wide Web (WWW), which is having more than a trillion of web pages. Conventional search engines such as Google, Yahoo search and Bing provide the search results based on the keywords mapped into the web content. But, it is derived from the fact that web content developers use these keywords deliberately to advertise their services and attract the users to visit their webpages. As a result, irrelevant content is also retrieved (because of the syntactic nature of the search process) in the search results. i.e. results are not meaningful and inappropriate to the user. Also, users are required to spend more time to identify the relevant results from the vast Uniform Resource Locator (URL). To overcome the abovementioned difficulties and optimize the traditional search engine performance, semantic search engines such as Swoogle and DuckDuckGo were introduced (Singh & Sharan, 2013). These engines achieve relevant
and meaningful results based on the concepts and their relationships. Besides, it reduces the search time by retrieving the relevant documents in the first set of URLs returned (Rouch, 2004).

The limitations of traditional search tools can be overcome by semantic engines with the use of semantic knowledge by using ontologies. Semantic mechanisms are effectively used in information retrieval and integration, service discovery, question answering, information management, annotation, recommendation and ranking. Semantic engines require the web content to be annotated earlier for improved search accuracy. In the past, it was the developer’s task to perform the annotation manually which is prone to errors resulting from a number of factors such as user familiarity, personal motivation or the complexity of ontologies, which might negatively affect the annotation procedure (Rodríguez-García et al., 2014). Moreover, the downside of manual annotation applied in the search process is that it is time-consuming and expensive. Hence web content should require semantic annotation using Natural Language Processing (NLP) techniques.

In this paper, semantic search engine is implemented for crawling SLA templates from the World Wide Web and annotating these templates for meaningful search and retrieval. Currently, SLA templates are placed in the provider website which is very difficult for the consumer to search and compare the similar services offered by diversified service providers. Also, SLA templates are descriptive and written in the natural language (English), and consumers always do a tough task in searching the right provider (Van Surksum, 2013). Traditional search engines perform syntax based search in the vast web, resulting in wrong and inappropriate results which are not suitable for the consumer. In this paper, a semantically-enhanced search engine platform is developed which will assist in the process of discovering the SLAs in cloud that best match the user needs.

The proposed search platform working criteria is as follows. Consumer poses a query in the search tab with the brief description of their cloud service requirements and metrics in natural language. Then, the service requirements are mapped with the annotated SLAs residing in the repository, and retrieval is made with the matched documents. Based on the indexing, query results are presented in the form of SLA documents. If the results are not sufficient enough, dynamic search enables the user to fill up the specific requirement constraints and search results are produced using keyword based approach. In this way, this platform implements the semantic annotation based search along with the traditional keyword based search approaches.

The automatic semantic annotation platform implemented here is based on ontology and document evolution process. The continual changes in the SLA templates and ontology terms must be annotated and added in the existing semantic repository. As a result of automated annotation, mistakes due to manual intervention are reduced significantly, and semantic knowledge is increased further. Besides, current semantic search engines lack on ontology and document evolution, which is dealt in this paper. The annotation platform performs semantic content tagging from SLA descriptions based on natural language processing, followed by the semantic search which makes use of this content to assist the consumer in finding the desired service level agreements designed for the service model requirements and expectations. The rest of the paper is organized as follows. Authors described related search engine platforms and different types of annotation in Section 2. The architectural design of the semantic search engine is presented in section 3. The materials and methods are detailed in section 4, followed by implementation and performance analysis is done in section 5. Finally, section 6 compares semantic web search engines and section 7 concludes the paper with future directions.

2. RELATED WORK

There are various search engine platforms proposed in the past based on extraction of semantic knowledge. One of the engines is Swoogle, (Ding et al., 2004; Singh & Sharan, 2013) a crawler-based indexing and retrieval system for searching semantic web documents in Resource Description Framework (RDF) and Ontology Web Language (OWL) formats. It creates metadata of the semantic
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