The improvement of the semantic classification tool to a SOA to ensure a better tutoring

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Abstract

For a best collaboration between tutor and learner and relatively to discussion forum, we have proposed to tutor a semantic classification tool of messages, which helps him to manage the mass of messages accumulating during the time. The tool provides a semantic classification mechanism based on a chosen theme. For a classification more intelligent semantically, and focusing more the chosen theme, our tool incorporates essentially a formal OWL ontology. The reuse and interoperability offered by ontology remain restrictive in the tool's knowledge base. To overcome this limitation, the improvement of the SOA architecture already proposed will be presented in this paper.

An implementation of our classifier using the composite application concept will also be explained. The respect of standards: XML, SOAP, WSDL and BPEL in our implementation, will guarantee the tool's interoperability with platforms which solicit its classification service, while allowing its reuse with a high degree of granularity.

Keywords: *SOA, reuse, interoperability, ontology, web service, messages, discussion forum, semantic classification, composite application, orchestration.*

1. Introduction

The tutor plays roles enabling it to offer a multitude of services to learners. He plays the role of a facilitator who helps learners to choose their project, facilitating their expression. The tutor is also a moderator who synthesizes, criticizes and structures content, while managing and improving completion times of activities. In addition, the tutor may also play the role of an expert who helps learners to find documents and resources while providing them with his personal experience, without forgetting his emotional support [1].

Help the tutor who is faced with a large mass of messages sent by students, and to which he should respond in the short time, returns to assist learners in their learning cycle, and then overcome the sense of isolation that they feel during their training, thereby minimizing the rate of abandonment of learners [2]. All this shows the importance of tutoring in a training distance, and the need to provide to tutor a tool of classification message. To do this we took tutoring as scope of our semantic classification tool.

The semantic classification tool of messages of a discussion forum, and which we proposed in [3] and [2] is based on the integration of ontology. To reinforcing the semantic classification, and make classification more intelligent in term of semantic, and enjoy also of all qualities that a formal ontology provides, we integrated a formal OWL ontology in our classifier tool [4] [5]. The formal OWL ontology designed and created is the subject of a set of interrogation using our algorithm of selection of new terms from the formal OWL ontology [6]. The set of new terms generated, constitutes the essential element leading to the construction of the LSA matrix. The LSA method is then applied to the LSA matrix, whose rows represent the new terms generated by the algorithm of selecting, while the columns represent all the messages of the discussion forum.

The integration of the formal OWL ontology ensures the property of reuse, making possible the reuse of the ontological knowledge base by other applications. The ontology provides also interoperability between systems and enables the exchange of knowledge between these systems. The reuse and interoperability provided by the integration of OWL ontology still restrictive to the ontological knowledge base of our classifier.

The convergence of the majority of new applications to reuse and interoperability, encouraged us to make our classifier reusable in its entirety without restrict ourselves only to its knowledge base. For this, we proposed to adapt a service-oriented architecture to our classification tool by

identifying two web services which represent a high degree of granularity for our classifier tool [7].
The purpose of this paper is to improve the Service Oriented Architecture (SOA) presented previously. In this paper we aim also to implement the composite web services of our tool. In our implementation we adopt the notion of orchestration for composing our services, and converging towards a composite application that follows the concept of service-oriented architecture and that respects the web standards: HTTP, XML, SOAP, WSDL, UDDI and BPEL. The respect of web standards will make our tool reusable with a large granularity through these composite services, while enabling its interoperability with applications that solicit its classification service.

We will adopt the following plan. In Section 2 we mention the importance of tutoring in a system of E-learning. We will also describe in section 2 the communication and collaboration tools which are proposed to tutor, and in particular we specify the importance of those asynchronous as the discussion forum, while explain the problem that this type of tool generates. In section 3, we describe the essential compounds on which is based our semantic classification tool presented in [6]. The importance of making our classifier reusable and interoperable in its entirety without restricting ourselves to its knowledge is also presented in the third section. In section four we give some definitions of reuse and interoperability, with showing the importance of these two qualities. The adaptation of a SOA for our classification tool to ensure interoperability and reuse will be explained in the fifth section. In this section we also present the definition of SOA in general and the definition of web services in particular. To make choice of the mechanism that can help us to compose our application, a comparison of choreography and orchestration is also done in section five. The flexibility allowed by orchestration, and the set of advantage cited in favour of the standard BPEL are encouraged us to use them to implement our composite application. An improvement of the Architecture Oriented Services proposed in [7], is then explained in section five, while giving the new architecture of our classifier tool. Section six is dedicated to explain the implementation of the prototype of our composite application. At the end we give a conclusion and prospects for our next works.

2. The importance of the tutoring side in a system of e-learning

2.1 The tutoring side in a system of E-learning

According to the Dictionary of Education Legendre (1993, p. 1378), "The tutor is a guide, an instructor who teaches a single person or a small group of students both; he is an advisor to students" [8].
The presence of tutoring in E-learning system is essential, so its absence can cause many difficulties for the learner, when he is not autonomous. The presence thus of a tutor can facilitate collaboration and autonomy of learners [9].
The tutor is led to play a very important role for ensuring a better development process for distance learning, while giving good support to learners. He helps them to feel more motivated to learn better, while freeing themselves from the feeling of isolation which constitutes the main cause of the totalities of abandonments of learners in distance education [10]. The need to improve progressively the existing tutoring systems is consistent, and this by integrating more functionalities that enable greater collaboration (learner tutor side).
In an E-learning formation, tutor plays a major role in the training cycle of learners. Specifically, the tutor helps learners to assimilate the courses that are presented on the platform of E-learning.
According to Bernadette Charlier and her colleagues [1]; for the success of learning, the tutor must be identified, and his interventions can thus be defined according to four complementary roles. The tutor can then play the role of facilitator who helps learners to choose their project, facilitates their expression, listens to other learners, and takes into account the views of their peers. Moderation is one of the roles that the tutor can also play, and this by synthesizing and criticizing, structuring the content, and managing and reinforcing the completion times of activities. The expertise is also a quality that must be present in tutor, and this in order to help learners to find documents and resources, and by furnishing them his personal experience. At last, we can say that tutor is responsible to be engaged personally, and encourages learners by offering them an emotional support [1]. Therefore, the tutor who presents a key member of all groups associated with a virtual classroom, and who provides the tutoring, consists in facilitate the achievement of the goal as efficiently as possible. To overcome the constraints of distance, the activity of knowledge construction which links the tutor at learners must be supported by computer [11].
To collaborate with learners, the tutor has a set of communication and collaboration tools that apply to distance education according to the time parameter. Those communication and collaboration tools can be part of two families. The first family is the synchronous tools which require the presence of users at the time of the communication. For their part, asynchronous communication tools don't require time constraints, and thus they offer more freedom for users [2].
The asynchronous communication tools like email, FAQs, mailing lists and discussion forum, are then the most used,

due to their flexibility, because it's not necessary to find common slots time, and they allow users to manage their time according to their availability [2].

2.2 The discussion forum: A collaboration asynchronous tool

Being an asynchronous communication tool, the discussion forum allows to remotely assembling discussion groups and make possible all the time the communication between participants. It also mediates the exchange and keeps the track. All messages exchanged during a discussion are stored and can be read and reread by all who have access [2]. The discussion forum allows on one hand, a greater freedom to users, because there is no time constraints during the exchange of messages, where a good flexibility through manipulation. However, this type of tool poses persistent problems during them handling, as the mass of messages generated during the communication and the heterogeneity of topics. We establish thus that the large volume of messages exchanged generates unwanted noise, which is proportional to the number of contributor, and which makes them reading, an operation heavy and not practice [2]. All this presents an obstacle preventing the tutor to carry out its mission, which the principal aim, is to ensure better learning for learners. To overcome this problem a semantic classification tool of messages of a discussion forum has already been proposed [6].

3. The proposed semantic classification tool

Our classification tool [23] [6] is based on the LSA method. Based on singular value decomposition (SVD), the LSA method can find similarities between the documents (texts, sentences, words) [12] [13].
To reinforcing the classification of our tool in integrating the semantic aspect to it and thus get better results, we have used some technologies provided by the Semantic Web in particular a formal OWL ontology.
Ontology is an explicit specification of a conceptualization of a domain, formed by concepts and relations that allow humans and machines have everything they need to understand and reason about an area of interest or a portion of the universe [14]. The specificity of ontology is its formal grammar.
Ontology corresponds therefore to a controlled and organized vocabulary, and to explicit formalization of relations established between the different vocabulary terms. The formalization can be done using the RDF (S) and OWL [15]. Based on the syntax of RDF / XML, OWL takes advantage of the universality of XML syntax and provides the ability to write web ontologies. In addition to the possibilities offered by the ontology to the user by giving him the opportunity to describe the properties and classes, OWL provides tools for comparing the properties and classes. With a broad vocabulary and a real semantic formalism, OWL provides to machines a great capacity to interpret web content offered by RDF and RDFS [15].
All these qualities in favor of formal ontology OWL, were encouraged us to use it to formalize our ontology.
The use of a selection algorithm of new terms by querying the OWL ontology [6] presents a key element of our semantic classifier.
The architecture proposed in [6] can be summarized according to the diagram of Figure 1:

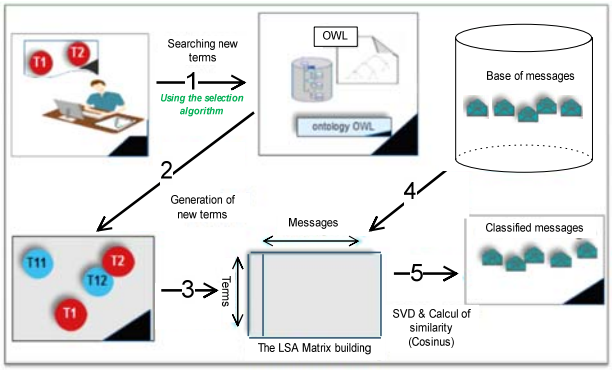

Fig. 1 – The classical architecture of the semantic classification tool based on OWL ontology

In addition to the significant benefits that ontology proposes in general [13], and the benefits in particular of a formal ontology, the ontology guarantees also the property of reuse, making possible the reuse of the ontological knowledge base by other applications. The ontology ensures also interoperability between systems and allows the exchange of knowledge between these systems.
The architecture, on which our classification tool is based, shows that the OWL ontology is the only reusable and interoperable part of our classifier tool (Figure 1). To make our classifier reusable in its entirety without restricting ourselves to its knowledge base, we have proposed in [7], a service-oriented architecture (SOA). This type of architecture should satisfy most of the tool's reuse, its interoperability in relation to platforms which solicit its service of classification.

4. The importance of interoperability and reuse

Among quality factors in E-learning platforms, we found that interoperability is a quality factor more and more requested by users, because it represents a critical functionality in open environments like the Web. The

satisfaction of the property of interoperability is necessary, because it guarantees a better usability and greater reuse [16]. Interoperability has become a necessity to meet the needs of information exchange between heterogeneous information systems; it reflects the ability of an information system to collaborate with other systems with very different natures some times [17]. Among the objectives defined by our research team, we find that the reuse and interoperability of component and service has a large important part. Developing an open platform for the integration, development and management of distributed software components is the targeted objective. In this perspective we aim to make our classifier tool reusable by any platform of E-learning, while guaranteeing its interoperability with those systems.

4.1 Reuse

Reuse is defined as the means for the reuse of content and components for different purposes, in different applications, in different products, in different contexts and by different modes of access [16]. It's like the concept of taking something that has already been designed and developed for one purpose and using it for a similar or another purpose [18]. Reuse is a topic that is not new to the science and engineering realms [18].

4.2 Interoperability

The concept of interoperability has not a single definition. Interoperability is generally defined as the ability of a system to interact with another. Interoperability is also defined as the ability to communicate with a system and to access to the functionalities of this system. From engineering point of view, we defined this concept by the ability of two programs to work together without any particular interfacing effort [19]. According to the IEEE Standard Computer Dictionary, interoperability is defined by: "Ability for two (or more) systems or components to exchange information and to use the information that has been exchanged" [20]. Cyrille Simard in his turn has defined interoperability as the means which allows the use of content and components developed by an organization on a given platform by other organizations on other platforms [21]. For Said Kadri [17]; we can say that two systems are interoperable when they have a mutual comprehension of the elements that they share, and when they are able to dynamically discover the different data sources. The exchange of messages and requests must also be possible between two systems so that they are interoperable, while functioning as a single unit for common tasks, and using the functions of each other. We also find that two interoperable systems operate as clients and servers. The property of interoperability between two systems must allow communication even with the internal incompatible components, without forgetting the approximation of Multi-source queries [17].

4.3 A Service Oriented Architecture toward reuse and interoperability

Implement a service-oriented architecture consist to structure an application, a block of application or a system information to contractualised services which making a functionality while maintaining a service contract. The implementation of global services between application blocks, by entering into a policy of interoperability is the first challenge addressed by the SOA. The second challenge is the search for reuse within an application block or an application, particularly in an infrastructure services or in a business services unit, by entering into a policy of reuse [22].
The SOA also has the advantage of supporting both the distribution and asynchronous mode. In addition, it offers a transparency versus to infrastructures (something indispensable in a context of heterogeneity) [32].
All objectives outlined by the type of service-oriented architecture, has encouraged us to adopt SOA for our classification tool, for ensuring interoperability and reuse of its components.

5. Adaptation of our classification tool to a SOA

The main function of the platforms E-learning is to provide to learners the best activities with the right tools at the right time according to its needs. If an E-Learning is a collection of activities or processes, its functionality can be divided into a number of autonomous functions, which can then be realized separately in form of autonomous applications or e-services, using the technologies of the approach service oriented [23]. This last has found an echo, and that has been used in order to improve or complete features of E-Learning [24].
The founding principle of our semantic classifier is to assist the tutor in a device of E-Learning; it must firstly be interoperable with platforms for distance learning soliciting its classification service. Secondly, the classifier should be reusable with a high degree of granularity, respecting web standards. To satisfy the properties mentioned above, we propose to adopt SOA to our semantic classifier, by decomposing it into web services around which new computing standards are emerging, where the ease of architectural approach of service-oriented type [25].

5.1 The Service Oriented Architecture

The need for business agility has become imperative. The agility of the information system is satisfied if it is integrated and responsive. To Make dialoguing two different systems in a flexible and easily way is a persistent problem, and an overall integration of type "loosely coupled" is needed [26]. The concept of SOA is a form of mediation architecture, which is an interaction model application, which implements services. These services are on one hand, with high internal consistency with use of a central exchange format, usually XML, and they are in another hand in external couplings as "cowardly", by calling an interoperable layer of interface, usually a web service. SOA is a very effective response to problems faced by companies in terms of reuse and interoperability between different systems that implement their information systems [34].
In SOA there are three composition levels:
The first level consists of discovering from process modelling, the exposed operations by the business services. It's a grouping of activities that form the functional scope and that we want to expose to consumers. In the second level, operations and phases found during the modelling process will then be decomposed to services associated to categories. Each operation and each phase becomes thus an orchestrator of appeal to the services exposed by categories. The third level depends on the use or not of an object oriented language. This is to decompose each service exposed by a category in the form of methods attached to classes which constitute the category of belonging. This decomposition is done only on classes of the category of belonging, not on the classes of other categories: it's the principle of isolation of categories between them [26]. This decomposition shows that the concept of service can take three forms: business service, service exposed by a category, and service internal to a category.
The main implementation of these concepts and on which the SOA rests, is based on web services [27].

5.2 Web Service

Web service is a computer program which allowing communication and exchange data between heterogeneous applications and systems in distributed environments [34]. The web service interacts with other web services using messages based on XML, and routed by Internet protocols [28]. The architecture of Web services has imposed itself due to its simplicity, readability and its normalized foundations. The web service is a concept based on three essential elements. The first element is the SOAP protocol, which based on XML, and which allows the exchange of information. The second element is the WSDL language, which based on XML, and which allows to describe the service settings. In the end, we find the UDDI element, which represents a distributed architecture, and which allows holding of the description of services [29] [23].

5.3 The composition of web services: choreography or orchestration?

The composition of web services specifies which services need to be invoked in what order and how to manage exception conditions. For this, there are two mechanisms: the choreography and the orchestration [30].

5.3.1 Choreography

To compose web services using the choreography mechanism, each web service involved in the process, knows exactly when its operations must be executed, and with which, the interaction should take place. The choreography is based on collaboration, and it's mainly used for exchanging messages at the public business process (figure 2) [31]. The choreography traces then the sequence of messages that may involve several Web Services [30]. In addition, and Contrary to the orchestration, there is no central coordinator [30].

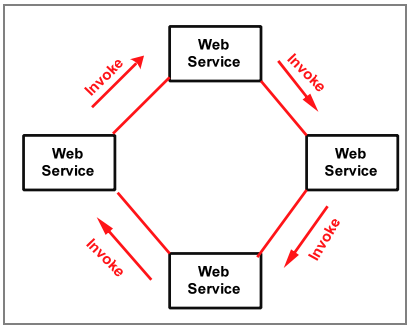

Fig. 2 – Composition of Web services based on Choreography [31]

5.3.2 Orchestration

Apply the principle of orchestration returns to describe the interaction of services at messages level using the business logic and the order of interactions execution. The orchestration plays on the fact that all the composite web services have no knowledge to be mixed in a composition, and to be part of a business process [30]. In orchestration, the web service invoked is under the control of a central single process (another web service). This core process coordinates the execution of various operations proposed

by the web services that participate in the process (Figure 3) [31].

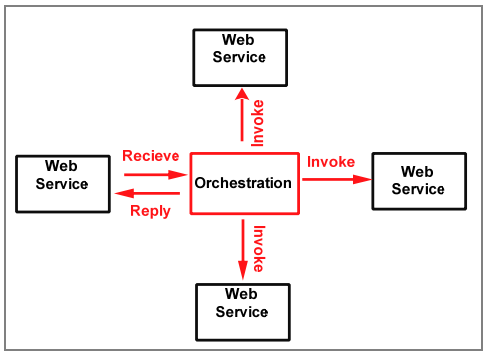

Fig. 3 – Composition of Web services based on Orchestration [31]

The orchestration provides a rapprochement more flexible than the choreography. Its simplicity is due on one hand to the fact that the leader or coordinator of the entire business process is known. On other hand, the orchestration has the potential to incorporate the composite web services without worries and without that they are conscious of belonging to a business process [30] [31].
For our work we chose the concept of orchestration for composing the web services, thanks to the benefits offered by it in comparison with the choreography.

5.3.3 BPEL: language of definition of the business process

To define the business process, and thus specify the composite web services, there are several languages. Among these languages we cite BPEL (Business Process Execution Language), which represents the result of the unification, and the evolution of three different attempts to standardize definitions of business processes: XLANG, WSFL and WSCL. Based on XML, BPEL is the most complete standard that exists for describing business processes. In addition it's the most industrially supported, and the better accepted by developers [30]. It describes the interaction of business processes based on web services, both within and between companies. The companies using BPEL may well define their business processes and ensure interoperability not only on the scale of the enterprise, but also with their Commercial partners within a web services environment. With BPEL it's possible to make interoperability between commercial activities, which are based on different technologies [30].
Thanks to the set of advantages cited above, we opted for the standard BPEL for composing the web services of our semantic classification tool.

5.4 The architecture oriented services adopted for our classifier tool

We presented in [7] the granulation of the semantic classifier in the form of web services, following the SOA architecture (Figure 4).

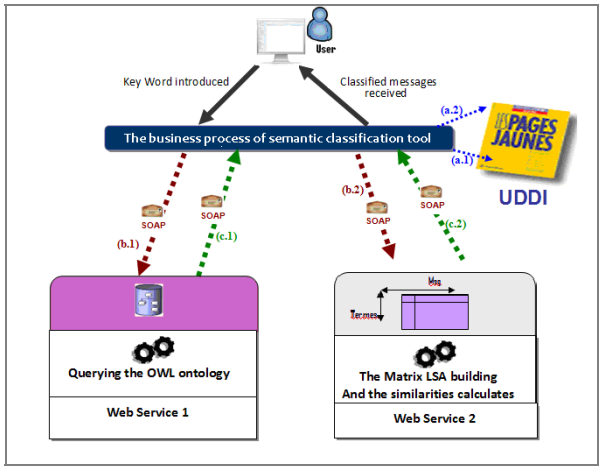

Fig. 4 – The SOA adopted for our classifier tool

In this work, we propose to improve the granularity proposed, following the concept of composite application, and component service.
To realize this work a modeling of service composition is required.

5.4.1 Modeling of the semantic classifier

To make modelling of services composition of our classifier, we chose the sequence diagram.
The sequence diagram found shows clearly the sequences of communication unrolling of between the services of our classifier. We note that our tool can then be decomposed into two composite web services.
The first web service is "QueringOntology", it allows querying the ontology. This service represents the semantic part of the classification tool. The service "QueringOntology" implements the selection algorithm proposed in [6], and therefore generates new terms that are semantically close with the keywords from the entrance, by interrogating a formal OWL ontology using the SPARQL language.
The "QueringOntology" service receives in input from the business process "SemanticClassification" a SOAP message which wraps all the keywords entered by the user, and sending to it in response an another SOAP message, which wraps all new terms generated from the OWL ontology (Figure 5).

The second web service “ApplyLSA”, allows the construction of the LSA matrix (Lexical table), based on the messages of the discussion forum, and all the terms generated through the ontology, and which are sent by the business process "SemanticClassification" via a SOAP message. The second service is also applying the singular value decomposition to the starting LSA matrix, to get the matrix of singular value decomposition (SVD). The calculation of similarity applied to the columns of the SVD matrix is also a task entrusted to this web service. As result, the “ApplyLSA” service sends a SOAP message which contains all classified messages, while following the theme of the user’s query (Figure 5).
The sequence diagram (Figure 5) shows clearly that the business process "SemanticClassification" plays the role of orchestrator and describes the order of invocation of the composite web services.

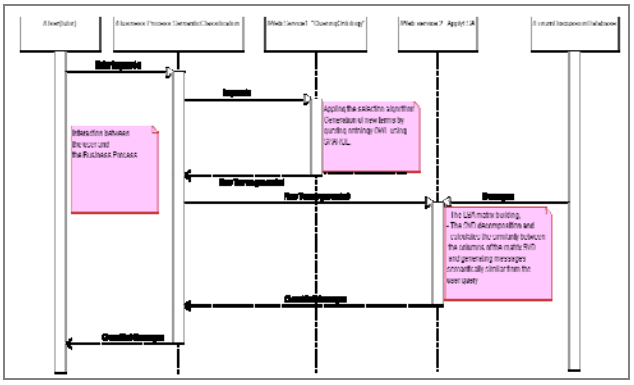

Fig. 5 – The sequence diagram of the web services of our semantic classifier.

5.4.2 The Improvement of the proposed Architecture Oriented Services of our semantic classification tool

The Improvement worn on the service-oriented architecture of our classifier which is already proposed in [7], aims to better detail each component, by making explicit the role that it plays in our tool.

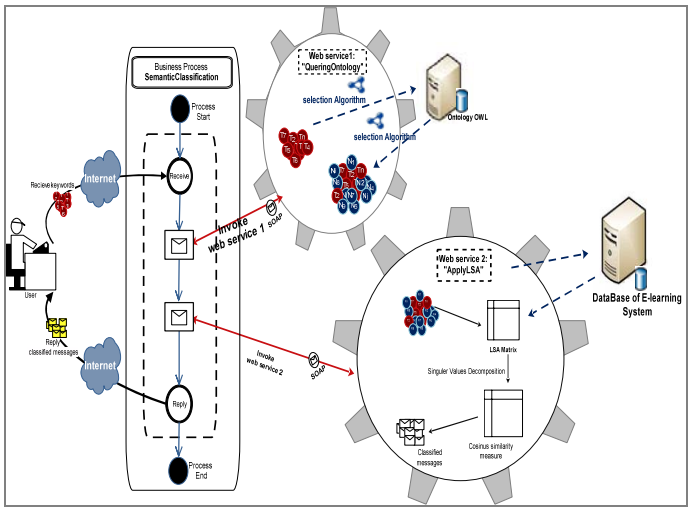

Fig. 6– The SOA architecture of the semantic classifier

The user launches his request for classifying messages of the forum discussion by introducing a set of keywords. This set of keywords is well received by the business process “SemanticClassification”, which in its turn invokes the first Web service “QueringOntology”. The “QueringOntology” service takes care of querying the ontology, based on the algorithm of selection of new terms already proposed in [6], and using the Ontology’s URI. The set of new terms found, will be then returned to the business processes, that in turn invokes the second Web service Web "ApplyLSA" by communicating this set of new terms. Based on messages from the database of the discussion forum, and all new terms generated via the ontology, the web service "ApplyLSA" built then the LSA matrix. The "ApplyLSA" service applies then the singular value decomposition to the LSA matrix, and obtains the SVD matrix, and passes to the calculation of similarities between the columns of this last matrix. On receipt of the response of web service "ApplyLSA", the business process responds the user by sending to him a message "reply" that envelops the set of messages that follow his desired theme.

6. Implementation

The implementation of our classification tool returns to develop a composite application which is based on the business process "SemanticClassification (Figure 7). This process communicates with two web services via SOAP messages.

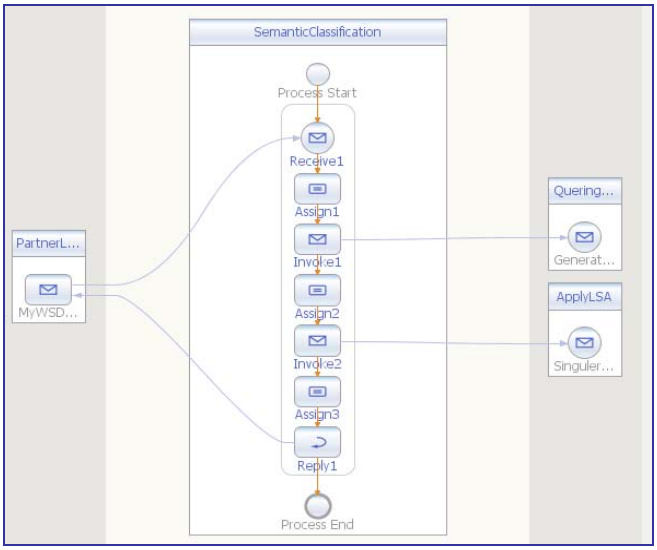

Fig.7– The implementation of "SemanticClassification" business process, and our composite application

The first web service "QueringOntology" queries the OWL formal ontology, applying the selection algorithm of terms [6]. This web service is based on tools cited as the Jena API dedicated to the creation of Semantic Web applications, and the manipulation of ontologies. Our web service also calls Pellet [33], which is an engine designed for reasoning on description logics, and accepting input OWL files. In addition to the two first elements, we also cite the SPARQL query language [6].

The implementation of the second web service "ApplyLSA", calls the “Jama” package, which allows for the singular value decomposition, and the cosinus similarity measure to calculate similarities [6].

The prototype of the system developed always allows classifying messages, according to a desired thematic, while always respecting the objectives set previously for our classifier. Improving our tool at the level of its architecture, and which has become a composite application, and that follows SOA concept, did not reduce the degree of its effectiveness in terms of semantic classification, but on the contrary, it allows a gain in terms of reuse and interoperability, and which are guaranteed by the type of Service Oriented architecture.

7. Conclusion and prospects

In order to ensure the reuse and interoperability with systems that solicit its classification service, our semantic classification tool has being the subject of an implementation which respects the type of service-oriented architecture.

The integration of OWL ontology, and the relevance of the selection algorithm which queries it, allows a best semantic classification which we approved in a previous work. In addition, this integration has also guaranteed the reuse of ontology as a knowledge base that can be used by another application, without forgetting interoperability property which is also allowed.

In this work, an improvement of the semantic classification tool is performed, basing on the concept of composite application, and by implementing all the identified web services which we detailed more, while respecting the principle of SOA. The respect of web standards like HTTP, XML, SOAP, WSDL and UDDI, and which they constitute the kernel of SOA, implies the respect of the architecture of this type. To implement the composition of web services in our application, we used the mechanism of orchestration, because it's an approximation more flexible, and offering advantages compared to the choreography. The respect of web standards is also guaranteed at the orchestration's level and this by using the BPEL language, which is a standard for the description of existing business processes more complete. In addition, BPEL is the most industrially supported, and the best accepted by developers.

The improvement made to our semantic classification tool enabled us to guarantee on one hand the property for reuse for all its components, and a complete reuse is therefore possible for the classifier. On another hand, the interoperability of the tool with platforms that require its classification service is also possible.

The discussion forum posts come from different databases, which may be of various data sources (relational DBMS, object-oriented DBMS, a web page, etc. ...), and of different structures (tables of different structures). Our classifier has to access to data sources of different platforms of E-learning according to the type of database, its structure, and using language (SQL, OQL, XQuery, etc. ...) corresponding to access the desired data with a high transparency. As prospect, we aim to find a way which allows the access of our classifier to the different data of the platforms, regardless of their types, or their structures.

References

[1] B. Charlier, A. Daele, F. Docq, M. Lebrun, S. Lusalusa, R. Peeters, N. Deschryver, " tuteurs en ligne : quels rôles quelle formations", in Actes du Symposium international du C.N.E.D, Poitiers, 1999

[2] S. Lgarch, " Une approche sémantique de classification de messages d’un forum de discussion basée sur la méthode LSA", DESA Report, Mohammadia School of Engineers (EMI), Mohammed Vth university Agdal, 2008.

[3] S. Lgarch, D. Bouzidi, S. Bennani, "Une approche sémantique de classification de messages d’un forum de

discussion basée sur la méthode LSA", in the firts Workshop of New Generation Networks: Mobility, WNGN'08, FST of Fès, 2008.

[4] S. Lgarch, M. Khaldi Idrissi and S. Bennani, "Toward a use of ontology to reinforcing semantic classification of message based on LSA", in world academy of science, engineering and technology. Issue 66, June 2010, ISSN. 2070-3740, pp. 1489-1495.

[5] S. Lgarch, M. Khaldi Idrissi and S. Bennani, "Reinforcing semantic classification of message based on LSA. The third edition of the International Conference on Web and Information Technologies", June 2010, ISBN. 978-9954-9083-0-3, pp. 381-392, Marrakech, Morocco.

[6] S. Lgarch, M. Khaldi Idrissi and S. Bennani (2010). "A selection algorithm of terms from OWL ontology for semantically classify messages". International Journal of Engineering Science and Technology, Vol. 2(11), 2010, pp 6788-6800.

[7] S. Lgarch, M. Khaldi Idrissi and S. Bennani, "Adoption of a SOA to converge towards a reuse and an interoperability of the semantic classifier of messages", in the proceedings of the 4th. International Conference on Information Systems and Economic Intelligence (SIIE '11), February 2011, Marrakech, Morocco.

[8] A. Daele, F. Docq, "tuteur en ligne: quelles conditions d'efficacité dans un dispositif d'apprentissage collaboratif à distance ?", in Communication au colloque de l'AIPU, 2002

[9] J. Rodet and A. Goll, "Les interventions tutorales facilitant l'autonomie et la collaboration des apprenants à distance", Theme 5, a proposed formation for Epistema (European leader in distance learning technologies), 2010

[10] R. Faerber "Accompagner les apprentissages à distance et collaborer en petits groupes". Quatrième congrès AECSE 2001, Villeneuve d'Ascq, France.

[11] D. Bouzidi "Collaboration dans les cours hypermédia du système de télé- enseignement SMART-Learning ", doctoral thesis, Mohammadia School of Engineers (EMI), Mohammed Vth university Agdal, 2004.

[12] Y. Bestgen "Analyse sémantique latente et segmentation automatique des textes". Actes des 7es Journées internationales d'Analyse statistique des Données Textuelles, Louvain-la-Neuve, Presses universitaires de Louvain: 172-173. 2004

[13] S. Lgarch, M. Khaldi Idrissi and S. Bennani, "Adaptation of classification semantic approach of messages of a discussion forum based on the LSA method to ontology", in the 3d International conference on SIIE; Sousse, Tunisia; 18-20, 2010, ISBN. 978-9973-868-24-4, pp. 29-36.

[14] A. Moujane, D. Chiadmi and L. Benhlima, "Semantic Mediation: An Ontology-Based Architecture Using Metadata", CSIT 2006, Amman, Jordanie, 2006.

[15] K. Dubost « Ontologie, thésaurus, taxonomie et Web sémantique »
http://www.la-grange.net/2004/03/19.html

[16] S. Laalaj, "Évaluation de l'interopérabilité d'une plate-forme de téléapprentissage". Mémoire de Maîtrise en informatique, University of Quebec, Montreal, 2006.

[17] S. KADRI, "Interopérabilité des bases de données hétérogènes et réparties". Mémoire de Magister spécialité Informatique, University of Mohamed Boudiaf, M'sila, Faculty of Sciences and Engineering Sciences ,2006.

[18] J. Searle, J. Brennan, "General Interoperability Concepts. In Integration of Modelling and Simulation", pp. 3-1 – 3-8. Educational. Notes RTO-EN-MSG-043bis, Paper 3. Neuilly-sur-Seine, France: RTO. Available from: http://ftp.rta.nato.int/public/PubFullText/RTO/EN/RTO-EN-MSG-067/EN-MSG-067-03.pdf, 2007

[19] J. Le Duigou, " Cadre de modélisation pour les systèmes PLM en entreprise étendue application aux PME mécaniciennes ", doctoral thesis, École Centrale de Nantes, France, 2010.

[20] A. Geraci, IEEE Standard Computer Dictionary: Compilation of IEEE Standard Computer Glossaries. IEEE Press, 1991.

[21] C. Simard, "Normalisation de la formation en ligne, Enjeux, tendances et perspectives", document d'orientation stratégique, préparé pour l'Agence universitaire de la francophonie (AUF), Bureau Amérique du Nord, NordSud.org, 2002.

[22] Livre Blanc : "Architecture Orientée Services (SOA) Une politique de l'interopérabilité", Mars 2005.

[23] I. Madjarov, " Des services web pour le e-Learning". e-IT, Premier numéro http://revue-eti.net/document.php?id=354, 2005.

[24] D. Aleksandar, S. Krassen, "Web-service architecture for tools supporting life-long e- Learning platforms". Proceedings of the 5th International TEN Competence Open Workshop, Stimulating Personal Development and Knowledge Sharing, 2008.

[25] A. Derycke, V. Chevrin and J. Rouillard, "Intermédiations Multicanales et Multimodales pour l'E-Formation: l'Architecture du Projet Ubi-Learn", Actes de la Conférence EIAH 2005, Montpellier, ATIEF, INRP (eds), 2005.

[26] S. GEAY, P. Repetto and S. Vicard, "Les Architectures Orientées Services". Travaux d'Etudes de Licence d'Informatique, 2005.

[27] V. Monfort, S. Goudeau, "Web services et l'interopérabilité des SI: WS-I, WSAD / J2EE, Visual Studio.NET et BizTalk", Dunod, 2004.

[28] S. Rampacek, "Sémantique, interactions et langages de description des services web complexes", doctoral thesis, l'Université de Reims Champagne, 2006.

[29] J.M. Chauvet, "Services Web avec SOAP, WSDL, UDDI, ebXML... ", Eyrolles, Paris, 2002.

[30] N. Arenaza, "Composition semi-automatique de Services Web". Rapport de Projet de Master, Ecole Polytechnique Fédérale de Lausanne, 2006.

[31] A. Albreshne, P. Fuhrer, J. Pasquier, "Web Services Orchestration and Composition: Case Study of Web services Composition". Working paper, 2009.

[32] M. Khalidi Idrissi, F. Merrouch, S. Bennani, " Analyse des situations e-learning : abstraction et modélisation". In the proceedings of SIIE '09, Hammamet, Tunisia.2009

[33] Pellet :http://www.standard-du-web.com/web_ontology_language.php

[34] http://fr.wikipedia.org

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