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Modeling Location Preferences in Service Composition Using Distributed Knowledgebase

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Abstract

Successful Composition of a web service in dynamic environment is a big challenge and important research issue. Several service designers may produce similar or different services. In automatic service selection environment service may fail due to functional dissimilarity and non-functional property of the services (QoS) attributes. In this context, any service can be preferred for particular location. These preferences act as QoS attribute and play important role to minimize failure of the service. Knowledge of these location preferences also helps in dynamic service selection. In composition, services are present in heterogeneous environment with different location preferences. In this paper, we have developed a knowledge base for the location preferences, which we have termed as Location Affinity. We have also incorporated semantic matching phenomenon along with affinity matching of the service for distributed environment using distributed description logic.

Keywords: Composite web services; Description logic; Distributed description logic; Location affinity; Semantics

Introduction

Business Organizations are trying to minimize physical human intervention in their trades. They are continuously increasing their involvement on Internet. The Internet evolves its infrastructures in terms of communication as well as application used by the organizations. Several standards have been developed for fulfillment of the business goals. In this context, Service Oriented Architecture has been emerged. SOA has been developed to facilitate automatic execution of enterprise applications to meet a common goal. In this architecture, several services collaborate for fulfilling the certain business objectives in inter organizational manner as well as intra organizational manner. In many cases, more than one service may require to fulfill the same atomic business benefits. In this context, service composition mechanism is required.

In this scenario, instead of functional properties of the services other factors are also important in service selection. These non-functional properties are based on time and geographical region. Most of the researchers focus upon recording the location of the web services as well as users of the web services to recommend services [1-4]. Such recommendation procedures recorded and used the location of the service with collaborative filtering technique to recommend services to the users based on the geographical location clusters. Despite of many research works on recording service location none considered the location preferences of the user for such recommendations. We have investigated the service selection based on user's location preferences minimize the latency factor during service selection and invocation.

This paper is organized as follows. The section 2, introduces the related work on description logic, concepts, roles, subsumption hierarchy and location aware web services. Section 3 describes the description logic and distributed description logic in detail. In section 4, we have developed a distributed knowledgebase that contains the terminology, assertion and interpretation function to provide formulization of meta-model of location affinity as well as the affinity computation. Lastly, Affinity matching model for service composition is presented.

Related Work

In this era of Information Technology various Knowledge Representation mechanisms are available but one of the best knowledge representation and reasoning technique is Description Logics. Baader et al. [5] have stated that description logic provides a mechanism to write logical semantics. According to them, a Knowledge Representation system using Description logic contains two boxes named are terminology box and assertion box. Terminology box contains represents the relationship among concepts related to a particular problem domain and assertion box contains the facts that changes over the time in real world. Description logic also contains the services that provide the facility of reasoning about the facts and concepts. Subsumption hierarchy can also be drawn from these descriptions. This hierarchy defines the part-of relationship among the concepts. They have also proposed various algorithms to reason about the knowledge base. Trigger rules have also been stated and described through forward reasoning process. These algorithms are, structural subsumption algorithms; these algorithms work in two phases, in first phase concept descriptions are normalized and in second phase syntactic structure of the normalized concept description are compared to give the result. Tableau Algorithms uses negation mechanism to check the subsumption for the concepts. Nardi et al. [6] have also suggested the role of Description Logic in other fields of computer science. They have created an application for knowledge representation based on DL. They have discussed various areas where DL is applicable. These areas include Medicines, Digital Libraries, configuration and software engineering. Various authors have given the example illustration for the development of the terminology and assertions in easiest way.

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Breitman et al. [7] have discussed knowledge formulation using an informal example. They have discussed various atomic concepts and roles as well as construction of the complex concepts from the atomic concepts. They have also discussed the difference between the complex concepts and defined concepts using example illustration.

Studer et al. [8] have given case study of automated trip booking by the companies for their employees. The purpose of this trip is meeting and conferences held by the employer. In their example of business trip, they are taking help of various agents to book flights at cheap rates as well as they have taken flights, trains etc. as concepts. They have also used semantic networks, rules and description logic to represent knowledge about business trip of the employees.

Yumein et al. [9] has suggested an algorithm that is based on description logic for composing the web services. He considered each web service request as a concept. Semantic matching phenomenon is used for dynamic composition of web services.

It is an era of heterogeneous distributed computing. It can be achieved using Cobra and RMI. Knowledge Representation mechanism for distributed environment is also required. Several authors contributed in research for distributed description logic. Borgida [10] has suggested the way through which we can implement description logic for distributed systems. Distributed description logic consists of a distributed Tbox which is considered as the set of different local T-boxes and bridge rules for connecting these T-boxes.

They have extended description logic by introducing bridge rules that provide the semantic matching among various distributed problem domains and their interpretation functions. Serafini et al. [11] has suggested a change in semantic matching by introducing local reasoners and a distributed version of tableaux algorithm. Homola [12] has modified the bridge rule by including conjunctive on-to bridge rule to solve their problem domain. Ouziri et al. [13] have used distributed description logic for composing web services in heterogeneous environment. According to them, service composition can be done using semantic connection among service ontologies and reasoning about them. They have used in-to and on-to connection bridge rules among distributed T-boxes and distributed A-boxes. They have also used distributed interpretation of T-Boxes and domain relations. They have proposed distributed reasoning algorithm for web service composition.

Various authors have recommended web services by predicting use's location Tang [1] has stated that few author's used location of the user for QoS prediction and few have used location of web services to predict the QoS values. In their research, they have considered both the location of the user as well as location of the web service for evaluation of the missing QoS parameters of the service. They have used collaborative filtering for such evaluations. They have added service location parameter to the CF algorithm. Their searching mechanism concentrated on identifying nearby geographical location of the target instead of searching the entire dataset.

Gurjar [2] has presented a novel user's location based service recommendation system. They have used model based collaborative filtering algorithm to provide personalized service recommendation. Haihong [3] has proposed a mechanism to identify the problem of parsing while user's location prediction. They have used CF algorithms by adding link prediction that improves the neighbor searching fast and efficient. Xu [4] has given an approach to predict the QoS values using Probabilistic Matrix Factorization and then employing the neighbor experiences on service invocation. He has proposed L-PMF and WL-PMF models, based on feature vector.

Preliminaries

This section gives the basic details, notions and axioms related to the Description Logic. Knowledge representation is important aspect of knowledge engineering and intelligence. This can be done by several mathematical models. Description Logic is one of the mathematical models for representing knowledge as given in Ref. [14-16]. The basic structure of any language contains the set of pre-defined concepts, relationships between those concepts and set of individuals. Every language must have capacity for inferring knowledge about individuals based on pre-defined concepts and their relationships. We can divide the language in to two different concepts, one is known as syntax of the language and other is semantic of the language. In description logic syntax of the language consists of atomic concept, atomic roles and individual. Atomic concepts are unary predicates while atomic roles are binary predicates. All the constants are known as individuals. In the DL for inferring knowledge, we have subsuming relationships between concepts and instance relationship between individuals and concepts. We can make a knowledgebase using DL which includes T-Box and A-Box. The T-Box of any knowledge system is the vocabulary of any application domain while A-Box is assertion about named individuals. In T-box we are also defining complex concepts and atomic roles. The T-box also contains complex roles which can be deduced from the atomic role. To distinguish between Terminology and Assertion we are giving the example of Asia Country concept, this concept gives the abstract knowledge and Assertion. India is name of the country that gives the real fact that it is an Asian country.

Terminology (T): Asian Country

Assertion (A): India

Several languages have been proposed like Attributive Language (AL), Frame based Description Language (FL) etc. In this paper, we have used AL to write predicates. Table given below is describing the various symbols used in attributive language for building Knowledge Base.

With the growth of Internet web services as well as distributed computing evolved in volcanic way. Description logic also extended for distributed computing and termed as distributed description logic. Distributed description logic is considered as the interrelated description logics using semantic connections. Components of DDL are distributed T-box which contains several T-Boxes at different geographical locations. These local T-boxes are associated with each other using the bridge rules. Bridge rules provide semantic connections between local T-boxes. Borgida [10] has defined two kinds of bridge rules into bridge rule and onto bridge rule. into bridge rule state that if x is a concept of local description logic 1 and y is the concept of another description logic 2 than x must subsume y. Onto bridge rule suggest that if x is the concept of local description logic 1 and y is the concept of another description logic 2 than y must be contained in x. Mathematically these rules can be expressed as in Figure 1.

$$i : x \xrightarrow{\subseteq} j : y$$

$$i : x \xrightarrow{\supseteq} j : y$$

To distinguish among these rules we are considering the example of two distributed terminologies of T_1 and T_2. Terminology T_1 contains the job hierarchy of the employees as professional and non-professional employees. Similarly, another terminology T_2 contains the job roles in an un stratified manner. Our problem is to connect these terminologies in distributed environment. Bridge rule can be specified for these two terminologies

Terminology 1	Terminology 2
Employee 1. Professionals Surgeon Heart Specialist ENT Specialist 2. Non Professionals Watchmen Ward boy	Artist Singer Doctor Dancer Staff Worker Personnel Teacher

Figure 1: Distributed Terminologies.

$$T_1: \text{Employee} \xrightarrow{\subseteq} T_2: \text{Staff}$$

$$T_1: \text{Surgeon} \xrightarrow{\supseteq} T_2: \text{Doctor}$$

Role of description logic in the web service

The description logic is used to develop the knowledge retrieval system. This method reuses the existing concepts. The distributed description logic is used to connect to same ideas which are implemented using different naming concepts. The new concepts may derive using existing concepts. The semantics can be developed using the existing knowledge developed by description logic. The web service semantics may also be developed using this description logic.

Computation of Location Affinity

Let us consider the example of e-shopping cart. In this example Buyer, Seller, Retailer, Currier services are involved. Firstly, a buyer request a product from the seller service, in response a seller service redirect the request of the Buyer to the appropriate retailer. Finally, retailer selects the currier service based on the buyer's location affinity and currier service deliver the product to the Buyer. From the Figure 2, we can easily calculate the location affinity (LA) of the various involve services of e shopping cart.

$Seller_1$ (LA)=Delhi, India

$Seller_2$ (LA)=Lko, India

$Seller_3$ (LA)=Allahabad, India

$Retailer_1$ (LA)= Lko, India

$Retailer_2$ (LA)=Delhi, India

$Retailer_3$ (LA)=Allahabad, India

$Currier_1$ (LA)= Delhi, India

$Currier_2$ (LA)=Lko, India

$Currier_3$ (LA)=Allahabad, India

Knowledgebase of Meta-model

In our previous research, we have presented a Meta-Model for defining space based QoS parameters of the web services referred as Location Affinity. This Meta model was categorized based on the geographical division such as Continent, Country, Union Territory, State, City, and Village. Continent is the universal class which is inherited by the all other classes. At the bottom, there is village class that inherits the features of all the above defined category of class. Thus, this model represents the existence of a hierarchical relationship among these geographical divisions. To enrich our proposed work, we are designing a knowledge base of Location Affinity Meta- Model.

Building description logic for a problem domain say D requires specification and identification of atomic concepts, atomic roles, constants to build complex concepts and defined concepts. The first step for writing description logic of location Affinity model is the identification of the concepts and role names. Concept is the term used to define individuals of a particular domain and roles basically describe the relationships that may exist among the given or identified concept names. We have used previously proposed location affinity Meta model for investigating the various concepts and roles. Table 1 is representing the atomic concepts and roles associated to model given in Figure 3.

The possible atomic concepts of our model are Country, Continent, State, District, City, Village, and Union Territories. According to the AL from the suggested concept list we can infer that Universal concept or top concept is Continent other concepts are the part of this universal concept. Village is representing the bottom concept since it has no descendent in the hierarchy. According to the model a country is the part of the continent. Similarly, State is the part of Country and thus here we have used 'is_inside' (Geographically inside) role to associate concepts of our model. Consideration of 'is_bounded by' role is for the thought of country or continent can be bounded either by land or by ocean. Even both possibilities could occur together. According to geographical divisions a district is the specialized form of the city as well as Union territories are the specialized form of states, thus 'is_specialized' role name is considered in the context of these existent relationships. A country may touch the boundary or border of a single country or more than one Country. Similarly, a state may be attached with the border of other states. So, the role name 'has_border' is used to depict such relationships among countries, states, cities and villages respectively.

Concepts	Roles	Complex Concepts
Continent Country State Union Territory District Village	is_inside is_specialized has_border is_capital is_boundedby	AsianCountry Non-AsianCountry NeighbourCountry Non-NeighbourCountry CapitalCity NonCapitalCity RuralArea UrbanArea

Table 1: Identified Concepts and Roles of Meta-Model.

User	Location	Seller1	Seller2	Seller3	Retailer1	Retailer2	Retailer3	Currier1	Currier2	Currier3
U1	Delhi, India	✓						✓		
U2	Lko,India		✓		✓				✓	
U3	Lko,India		✓		✓				✓	
U4	Delhi,India	✓				✓		✓		
U5	Ald,India			✓			✓			✓
U6	Delhi,India	✓				✓		✓		
U7	Delhi,India	✓						✓		
U8	Delhi,India		✓			✓		✓		
U9	Lko,India		✓		✓				✓	
U10	Ald,India			✓			✓			✓

Figure 2: Sample Service Location.

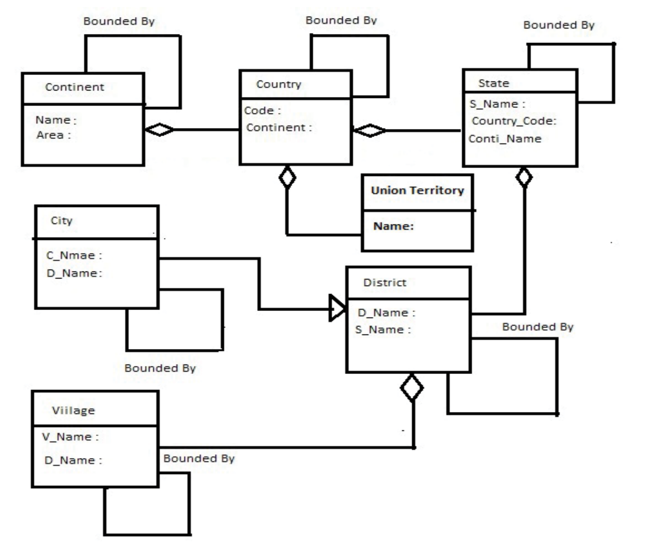

Figure 3: Meta Model of Space Based Quality of Service (Location Affinity).

1) $\text{Country} \equiv \text{Country} \sqcap \exists$ is inside. Continent

(A Country is always part of some Continent. It cannot be part of more than one continent)

2) $\text{State} \equiv \text{State} \sqcap \exists$ is inside. Country

(A state is always part of a country)

3) $\text{UnionTerritory} \equiv \text{UnionTerritory} \sqcap \exists$ is_inside. Country

(Union Territory is the part of a Country)

4) $\text{City} \equiv \text{City} \sqcap \exists$ is_inside. State

(City is always be a part of a state)

5) $\text{District} \equiv \text{District} \sqcap \exists$ is_inside. State

(District is always contained in state)

6) $\text{Village} \equiv \text{Village} \sqcap \exists$ is_inside. City

(Village is the part of City)

7) $\text{Village} \equiv \text{Village} \exists$ is_inside. District

(Village is also the part of the District)

8) Union Territory $\subseteq$ State

(Union Territory is Kind of State)

9) District $\subseteq$ City

(District is always a City)

In knowledge representation formalization T-box define the relationships through which concepts related to particular application domain are associated. Terminology box is used to map concept definition and concept name together. Logical equivalence operator is used for this kind of mapping between concept meaning and concept name. Terminology box contains the vocabulary of the domain and this vocabulary is the combination of the concepts and role names described in this section. Terminology box T contains a finite set of concept definition with no symbolic name defined more than once [5-7]. Here T-Box is defining the vocabulary for the location affinity model. For instance, the following T-Box contains the definition of a Continent, Country, Union Territory, State, City and bottom concept Village. In our proposed model Continent is representing the super concept for the all the other sub concepts. From the model, we can define the new concepts derived from the above given concepts in 1 to 8. In this example, we are discussing the terminology in Asian context, similar terminologies can be designed for the continents other than Asia.

10) $\text{AsianCountry} \equiv \text{Country} \sqcap \exists$ Continent. Asia

(Asian Country define the concept of countries that are the part of the AsianContinent)

11) $\text{NonAsianCountry} \equiv \text{Country} \sqcap \neg \text{AsianCountry}$

(NonAsianCountry concept define the country that is inside the continent other than Asia)

12) $\text{NonCapitalCity} \equiv \text{City} \sqcap \neg \text{CapitalCity}$

(This concept define the city that is not the capital of any Asian country)

13) $\text{RuralArea} \equiv \text{District} \sqcap \neg \text{City}$

(This concept defines the Village area of the Asian Country)

14) $\text{UrbanArea} \equiv \text{District} \sqcap \neg \text{RuralArea}$

(This concept defines the developed area of the Asian Country)

15) $\text{NeighbourCountry} \equiv \text{Country} \sqcap \exists$ has_BorderTo. Country

(A country that has bourder to other country defined as Neighbour Concept)

16) $\text{NonNeighbourCountry} \equiv \text{Country} \sqcap \neg \text{NeighbourCountry}$

(A country that does not have border to Asian country defined as Non-Neighbour Concept)

Inclusion is another important term used in description Logic. It is required to put constraints to model real world concepts. This model consists of following subsumption relations.

17) $\text{CapitalCity} = \text{City} \sqcap \exists$ is_capital. Country

18) AsianContinent $\subseteq$ Continent

(Asian Continent is also a Continent)

19) AsianCountry $\subseteq$ Country

(This indicates that an Asian Country is also a country)

20) CapitalCity $\subseteq$ City

(Capital City is also a City)

21) NonCapitalCity $\subseteq$ City

(Non capital city is also a city)

22) City $\subseteq$ UrbanArea

(City always will be part of Urban Area)

23) Village $\subseteq$ RuralArea

(Villge always will be part of RuralArea)

24) NeighbourCountry $\subseteq$ Country

(Neighbour country will always be a Country)

25) NonNeighbourCountry ⊆ Country

(Non Neighbour country will always be a Country)

Concepts and inclusions given from 11 to 25 are composing terminologies for our model. Assertion implies a fact about the terminology box or assertion is related to real world facts that satisfy the terminology axioms defined in Tbox.

26) Continent(Asia)

27) Asian Country(India)

28) NonAsiaCountry(U.S.A)

29) Union Territory(Delhi)

30) State(UttarPradesh)

31) City(Allahabad)

32) Village(Rambagh)

33) is_inside(Asia,India)

34) is_inside(India,UttarPradesh)

35) is_inside(India,Delhi)

36) is_inside(Uttar Pradesh,Allahabad)

37) is_inside(Allahabad,Rampur)

38) NeighbourCountry (Nepal)

39) NeighbourCountry(China)

40) Has_border(India,Nepal)

41) Has_Border(India,China)

42) CapitalCity(Delhi)

43) is_capital(India,Delhi)

Above given equation 11 to 43 define the Knowledgebase named as Location Knowledge base. This knowledge-base consists of terminologies and inclusions define in 11 to 25 and Assertions defined in 26 to 43. Now, inclusions and subsumptions can be deduced. Since we are here considering only Asian Countries thus we will take only two complex concepts derived from Country atomic concepts these are Asian Countries and Non-Asia Countries and will prove that a country is either Asian or Non Asia but both the cases are not possible. Again, taking 12 we have

44) NonAsianCountry ⊆ ¬ AsianCountry

45) Country ≡ AsianCountry ∪ NonAsianCountry

To prove that again considering 45

AsianCountry ∪ NonAsianCountry

≡ Asian Country ∪ (Country ⋂ ¬ AsianCountry)

//From the rule of Distribution

≡ (Asian Country ∪ Country) ⋂ (Asian Country ∪¬ AsianCountry)

≡AsianCountry ∪ Country

≡ Country

Hence it is proved that a country is either Asian or Non Asian Country.

46) City ≡ CapitalCity ∪ NonCapitalCity

The City may be capital city. This is defined by the concept CapitalCity. Non capital city is defined by the concept NonCapitalCity. So, city concept is included the concept of CapitalCity and NonCapitalCity.

CapitalCity ∪ NonCapitalCity From (12)

≡ Capital City ∪ (City ⊓ ¬ CapitalCity //From the rule of Distribution

≡ (CapitalCity ∪ City) ⊓ (CapitalCity ∪ ¬ CapitalCi ty)

≡CapitalCity ∪ City

≡ City

In the similar manner, a country may either be Neighbour Country or NonNeighbour country both situation is not possible. We are proving this in the same as for the 45 and 46.

47) Country ≡ NeighbourCountry ∪ NonNeighbourCountry

To prove this

NeighbourCountry ∪ NonNeighbourCountry

≡ Neighbour Country ∪ (Country ¬ NeihbourCountry) From (16)

//From the rule of Distribution

≡ (NeighbourCountry ∪ Country) ⊓ (NeighbourCountry ∪ ¬ NeighbourCountry)

≡NeighbourCountry ∪ Country

≡ Country

To reason about our created knowledge base we are using Tableau algorithm [5] that proves the facts using negation. Consider the fact given below.

NonAsianCountry (“America”)

NonAsiaCountry ≡ Country ⊓¬ (Country ⊓∃ Continent.Asia)

NonAsiaCountry ≡ (Country ⊓¬ Country) ∪ ¬ ∃ Continent.Asia

NonAsiaCountry ≡ ¬ ∃ Continent.Asia (“America”)

Thus, we can conclude that USA is an instance of the built knowledgebase.

Distributed Knowledgebase of Meta-Model

In SOA web services are developed by different service providers and hosted at different locations. The Location aware service concept estimates the location of a web service. These web services may be distributed in different countries. We have considered these locations in different angle, which is based on location preferences of any web service. The division of these locations may differ from one country to another country. In some cases, either all divisions are same or some divisions are different. Several research efforts have been taken to model different heterogeneous ontologies for different web services and they have worked for bridging among them we have also proposed a model which facilitates heterogeneous T-Boxes of a web service along with their location affinity.

In the above section, we have proposed detailed view of concepts, roles, interpretation, terminologies and assertions in the context of Indian Country. These T-Boxes and other concepts may entirely different or partially different for another country context. In this view DDL helps to model them. In this paper, we have given one another country T-boxes, A-Boxes etc. and bridging mechanism for making relationship between them.

48) Country≡ Country⊓∃ is_inside. Continent

(A Country is always part of some Continent. It cannot be part of more than one continent)

49) State ≡ State⊓ ∃ is_inside. Country

(A state is always part of a country)

50) Territory ≡ Territory⊓∃ is_inside. Country

(Union Territory is the part of a Country)

51) Shire ≡ Shire⊓ ∃ is_inside.State

52) City ≡ City ⊓ ∃ is_inside. State

(City is always be a part of a state)

53) Town ≡ Town⊓ ∃ is_inside. City

(Town is the part of City)

54) AustrailianCountry ≡ Country ⊓∃ Continent. Australia

(Australian Country define the concept of countries that are the part of the Australian Continent)

55) NonAustralianCountry ≡ Country ⊓ ¬ AustralianCountry

(NonAustrailianCountry concept define the country that is inside the continent other than Australia)

56) CapitalCity= City ⊓∃is_capital.Country

57) NonCapitalCity ≡ City ⊓ ¬ CapitalCity

(This concept define the city that is not the capital of Australia)

58) NeighborCountry ≡ Country ⊓ ∃ has_Border.Country

(A country that has border to other country defined as Neighbor Concept)

59) NonNeighborCountry ≡ Country ⊓ ¬ NeighborCountry

(A country that does not have border to Australian country defined as Non-Neighbor Concept)

Real world facts about the continent Australia can be represented the assertion box given below

60) Continent (Australia)

61) AustralianCountry (Austrailia)

62) NonAustarilianCountry (America)

63) CapitalCity (Canberra)

64) Non CapitalCity (Sydney)

65) NeighborCountry (Indonesia)

66) NeighborCountry (New Zealand)

67) has_border (Australia, New Zealand)

68) has_border (Australia, Indonesia)

69) is_capital (Australia, Canberra)

70) State (New South Wales)

71) Territory (Australian Capital Territory)

72) Shire (Shire of Cardinia)

73) is_inside (Australia, Australian Capital Territory)

74) is_inside (NewSouthWales, Hornsby Shire)

Service composition and execution is highly distributed in nature, so researchers can extend this knowledgebase for distributed environment as well. In the context of our model, geographical division of different continents may vary in accordance to their governance. To understand this statement considers an example of the Australia. It is divided into states and territories and below this it has shire, city and town in hierarchy. A way to connect Indian and Australian geographical division is distributed description logic. The one knowledgebase is for the India. In this the concepts are different like village, district, city etc. In the knowledgebase Australia, the concepts are shire, street, state etc. The geographical division in Australia and India are using different concepts. These two distributed knowledge base can be integrated using the concept of conjunctive bridge rules as given in Ref. [12].

$$\text{District : India} \xrightarrow{\sqsubseteq} \text{Shire : Australia}$$

$$\text{ISCO : Professional} \xrightarrow{\sqsubseteq} \text{WNP : Worker}$$

In the above example two concepts are district and shire. They belong to different domains. The concept district has same meaning in India as shire has meaning in Australia. The bridge rule is sued to connect two such concepts. Similarly, concepts professional and worker are same concepts with different semantics. These can also relate together using the bridge rule. ISCO and WNP are two ontologies.

Agent Based Service Composition

Several research efforts have been made to model composition of the web services. These services may compose either in sequential manner, parallel manner, and loop or under some pre-defined constraints. Successful composition is derived from input and output parameters named as semantic links. The matching phenomenon of semantic links is known as semantic matching. Serafini and Tamilin [17] have proposed a methodology using description logic for web service composition using semantic links and also addressed the QoS contribution in service composition along with semantic matching. While Ref. [13,18] have addressed service composition as well as semantic matching in distributed environment. We have extended the model of service description and service composition. We have argued that location affinity plays important role in semantic matching of the service. Our model combined the semantic matching and affinity matching phenomenon. A web service can be described as the touple (D, P) where D is the task description and P is the set of preconditions. Ref. [13,19] have also defined a Service composition in distributed environment includes set of services and matching le that is represented using a touple <S, M> where S is set of services and M is matching rule.

$S=\{S_1, S_2, S_3, \ldots, S_n\}$

$M=C \times A$

Where C is representing semantic connections and A is representing the affinity connection among the services. Our distributed directed knowledgebase is a touple having

touple $<S_i, S_j, <C_{ij}, A_{ij}>$

Where service S_i, service S_j and the semantic connection C_{ij} and

Affinity Connection A_{ij}. We are stating that two services S_i and S_j can compose if service S_i subsume the precondition of service S_j and precondition of S_i subsume description of S_j as well as Affinity of S_i subsumes affinity of S_j.

We have extended the agent based distributed service composition [13] with affinity matching phenomenon to provide fast service selection based on the service location preferences.

Conclusion

In this paper we have developed a distributed knowledge-base for Location Affinity meta-model. Identification of various atomic and complex concepts has been done to design T-boxes and A-boxes respectively. A new service composition model with location affinity matching phenomenon is introduced. The limitation of our work is consideration a single value location affinity. A service may have multiple values for Location Affinity QoS attribute. In future, we will enhance this work by considering location affinity as a list of values.

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