

An analysis and solution for automated web service composition: A survey

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Abstract

Objectives: To analyze several different automated web service composition strategies to find issues in automatic Web service composition which leads to give an outlook for necessary works in future.

Methods: The analysis has been done by various methods to provide the automated web services. The different techniques are considered and analyzed to find the most suitable automated web services for efficient performance.

Findings: The various research works has been analyzed and evaluated. From the analysis, the graph search based method is found to be superior for automated web service composition also higher performance is achieved in terms of precision, recall and execution time.

Application/Improvements: The findings of this work prove that the graph search based method provides better result than other approaches.

Keyword: Web services, similarity measure, semantic and ranking.

1. Introduction

The rising development in software design is to construct platform free software components named as web services which are accessible in the distributed background of the internet. The name web services defines an identical method of incorporating net based functions by using Extensible Markup Language (XML) and simple object access protocol (SOAP) over an internet protocol backbone. Web services in which permits various applications from various foundations to interact along with each other without time complexities. Web service composition problem is handled by using several efficient techniques. It is an important issue in the service oriented computing. The issue of automatically assembling web services to outline compositions which optimize specified user preferences is frequently referred as the automated web services composition problem.

The web service community is tackle along with composition, interoperability among services, automated detection and composition. Recently, several enterprises distribute their applications and functionality on the internet. This novel generation of functionalities permits higher efficiency and availability for business. The several applications build functionalities accessible by using a web service arrangement. Web services are self contained modular functionalities defined by a set of process which are network accessible via typical web protocols. The data mining algorithms and effective techniques are introduced to improve the web services.

The capability of web services to construct and incorporate loosely coupled systems has drawn a huge deal of consideration from researchers in the area of automatic web service composition. The mixture of diverse web services to construct composite systems can be hold out through diverse control structures to organize the implementation flow and, consequently, determining the best grouping of web services signify a non-trivial search attempt.

The numerous methods addressing the issue of automatic web service incorporation is presented currently, in both educational and business. The many research scenarios are discussed that the majority of techniques presented in the field, however suitable they may be, but ineffective to take into consideration two significant factors inherent to service composition such as dynamics of data flow between web service operations and potentially dynamic structure of service composition search space [1].

The scenario is attempted to produce an overview of methodology for automatic web service composition. The analysis of methods and approaches are used to produce more similarity as well as semantic concepts and provides quality of services. To achieve the semantic web services the authors are suggested clustering techniques in several

researches. The preprocessing approaches are aimed to remove the unnecessary contents and improve the performance metrics. There is suggested few approaches for semantic similarity measurement such as distance metric for semantic nets, information based measure and similarity for ontology construction.

The analysis of ontology concepts execute service finding depends on the service request objectives in order to determine the candidate services for the composition [2]. The ontology is constructed along with meaningful contents such as synonymous, relationships, entities and attribute values which is extracted for corresponding user request. The word net tool is suggested for more effective web services which provide important advantages in terms of semantic information and high level precision values.

In this research, the main contribution is to deep analyze each method and conclude with the best technique in the literature in terms of semantic web service availability, reliability, retrieval of services, response time and accuracy of automatic web services. The organization of the research is given as follows:

In this section, a brief introduction is given about the web services composition. In section II, various research methodologies are that are to be evaluated are discussed in a detailed manner. In section III, the techniques presented in section II are compared with their benefits and issues. In section IV the methods are evaluated and the numerical results obtained are discussed. Finally in section V, the overall conclusion of the research work is presented.

2. Analysis of research methodologies

In [3] PengCheng Xiong et.al (2010) discussed about the Petri net approach to analysis the web service composition. In this research scenario, multiple web service communication is modeled along with a Petri net named Composition net (C-net). The issue of behavioral compatibility between web services is therefore changed into the deadlock structure problem of a C-net. If services are mismatched, a policy depends on adding supplementary information channels are introduced. The fundamental actions, prearranged behavior, and interfaces between business process execution language (BPEL) procedures are all enclosed through the model elements in a C-net. Through carefully evaluating the construction of C-net, the scenario determine that the compatibility of web services is equal to the subsistence of nonempty smallest siphons, which guides to the constructive technique that the compatibility can be guaranteed through attaching further information channels. Subsequently, after appending information channels in Petri net elements, the process convert the channels back to code in BPEL and attain the novel compatible web services. The real-life holder and BPEL codes authenticate the method and display this approach can be readily put into manufacturing purposes. It is used to reduce the computational complexity in significant by using efficient approaches.

However the algorithm cannot guide to a solution if the technique of adding information channels is not appropriate. Subsequent, the investigation for siphons can be executed offline and the calculation of minimum siphons is easy, in some composite structured C-net, such calculation is costly.

In [4] discussed seeking quality of web service composition in a semantic dimension. In this research, a novel method is proposed by integrating semantic and non functional constraints to evaluate the quality of web service composition. The semantic quality is calculated by semantic similarity between output of service composition and the input required by the users. The non functional quality is fastest services and it is depends on the user preferences. The non functional quality ensures the quality of composition using constraints such as response time, reliability and availability in aspects understandable through most of users. It proposed an algorithm named as genetic algorithm which is used to combine the above two qualities for producing the huge number of web services. Genetic algorithm in which computes the optimal composition among a group of potential solutions. The advantage of this method is to achieve higher fitness values for the optimal composition and ensure the high quality of web semantic services. However it is failed to consider the compositions based on the contextual availability of web services.

In [5] recommended an integrated approach for automated web service composition semantically via artificial intelligence planning methods. The main advantage of this approach is composition process and detection of atomic services both are take part in the composition utilized by the integration of semantic information. Ontology web language (OWL) –services is also named as OWL-S and web service explanations are converted to a planning problem using PDDL. Semantic information in OWL-S is used for composition process enhancement and approximating the optimal composite service if correct solutions are not discovered. Answering, revelation, manipulation and assessment of the produced composite services are achieved by independently maintaining specific planners. This approach enables the composition process for non expert users also. It has been executed by integration of two

software systems such as PORSCE II and VLEPO. PORSCE II is answerable for the transformation procedure, enhancement of semantic and management of outcomes. VLEPO is used for automatically obtain solutions for the problem through invoking exterior planners.

In [6] suggested a model based approach for web services by improving the quality attributes. Service oriented architecture (SOA) describes a theoretical framework for the generation and incorporation of enterprise applications. Within an SOA, the core functionality is recognized through distributed services, which are classically collected to maintain the required business procedures. Nowadays, web services are the primary technology to implement and organize services in various settings. In several commerce fields, web services should demonstrate quality of service (QoS) characteristics such as protection, performance, scalability, and accounting. At present, there is only restricted support for the allocation of QoS attributes to web services, though. The scenario is introduced a model-based approach for developing strategy from a QoS model. This research solution envelop the representation of QoS attributes depends on a meta-model for superiority attributes, the creation of a graphical user interface to organize the modeled QoS attributes, and the transformation into policy descriptions [10]. Lastly, these policies are allocated to the target web services. To greatly automate this approach, the scenario applies methods from model-driven improvement such as model-to model and model-to-code alterations. As a result, the resolution decreases the expenditure and effort while generating QoS aware web services. However it has issue with repository component to store the high quality of service handlers.

In [7] suggested Petri net based approaches for reliability of web services. Ontology web language for services (OWL-S) is one of the most prominent semantic web service ontologies and produces a core ontological structure as well as strategy. The strategy is for describing the possessions and potential of services of composite service procedures specified in OWL-S which facilitates service users to conclude whether the procedure meets non functional requirements. In this research, the probabilistic method is suggested to reliability analysis of OWL-S processes and utilizing the non-Markovian stochastic Petri net (NMSPN) as the base model. Depends on this representation of OWL-S elements, the scenario introduced a systematic approach for computation of the procedure-normal-completion probability as the reliability evaluate. This approach considers the probabilistic constraints of service invocations and messages as model inputs. Thus, this research scenario is analyzed and validated the analytical reliability results via a confidence interval study and performed a reliability sensitivity analysis. The quality of services are computed and analyzed by using the suggested approaches and the services are such as availability, accessibility, reliability, security as well as integrity [11].

In [8] proposed a Services Composition Model (SCM) that provides a concrete solution for the services composition problem by realizing the necessities of a new service by utilizing the requirements of the already running services. They briefly explained about the process of composition ; registration services, discovery of services, selection of services, invoking services, and integration of services. They have developed a text based language called Services Composition Language (SCL) that is used to collect the requirements user's request, Services Composition Language absorbs most of the syntax from VB.net and deals with the services that should be requested to be composed. The SCL is considered a simpler composition language than the available composition BPEL language. The parsing algorithm is proposed to analyze the users requirements, Parse Function parses each line of the inserted composition language and determines if the instruction contains a variable, a return message or a service calling. Than the analyzed information's are used to determine the name of the requested services. The Service Composition algorithm is also proposed for composition process and returns the result of the composition to the user. The SCA algorithm has three steps such as matchmaking stage: the requirements are matched to the service's description, preparation step: the most suitable services from the matched services are selected relying on the composition criterion and then prepared for the next step known as composition, composition step: the matched services are finally integrated and composed.

In [9] discussed the constraint aware approach for web service composition for improving the efficiency. The generation of value added services through automatic composition of preceding ones is attaining most prominent momentum as the prospective in service oriented computing. A huge number of composition techniques are introduced and many of them depend on the input matching and output constraints of services only. However several services in real world are not typically suitable and few appropriate constraints are required by contributors. Those kinds of restrictions are huge impact on service composition however highly disregard by preceding research. Hence in this scenario, two novel concepts are introduced named service intension and service extension. And it enhances a constraint service composition technique in which service conditions are considered. The graph search based algorithm is introduced in this scenario to the common web service composition problem and generates all the

probability of solutions. The preprocessing techniques are used to improve the performance of graph search based algorithm. In this scenario, the methods are satisfied the user requests as well as user preferences. This research work is also used to efficiently and effectively deal with the automated web service composition. The methods and algorithms suggested in this scenario are significantly handling the problem of automatic web service composition when considering the web service conditions. Thus, this scenario is capable to produce semantic and feasible web services for user requests.

3. Comparison methodologies

This section provides an overview about the pros and cons that are occurred in the research methodologies whose functional scenarios are discussed in depth in the previous section. From the following table, it can be predicted a better approach that provides considerable improvement in the proposed scenarios. The table helps in detecting the efficient technique as well as in provisioning the future enhanced than can be performed to overcome its shortcomings.

Table 1. Comparison of Research Methodologies

S.NO	TITLE OF PAPER	AUTHOR NAME	METHOD USED	MERITS	DEMERITS
1	A Petri Net Approach to Analysis and Composition of Web Services	PengCheng Xiong, YuShun Fan, and MengChu Zhou	Petri net based method	Reduces the computational complexity	Performance is reduced due to inappropriate web semantic services
2	Seeking Quality of Web Service Composition in a Semantic Dimension	Freddy Lecue and Nikolay Mehandjiev	Genetic algorithm	Semantic quality is increased	It takes long time for execution
3	An integrated approach to automated semantic web service composition through planning	Ourania Hatz, Dimitris Vrakas, Mara Nikolaidou, Nick Bassiliades, Dimosthenis Anagnostopoulos, and Ioannis Vlahavas	Artificial intelligence (AI) planning technique	High efficiency High degree of automation	Algorithm is complexity hence provides time delay
4	Quality Attributes for Web Services: A Model-based Approach for Policy Creation	Alexander Wahl, Bernhard Hollunder, and Varun Sud	Model driven approach	Reduces the cost Needs are satisfied highly	However it is complex due to lack of documentation
5	A Petri-Net-Based Approach to Reliability Determination of Ontology-Based Service Compositions	Yunni Xia, Xin Luo, Jia Li, and Qingsheng Zhu	non-Markovian stochastic Petri net and probabilistic approach	Accuracy is improved Reliability is increased	More computational cost
6	Software architectural patterns for service composition	Ghadeer Ghazal, Amjad Hudaib and Waffa Maitah	Service composition model	Discover and satisfy the user requests in less execution time	It is not provided semantic web services and efficiency is reduced.
7	Constraint-Aware Approach to Web Service Composition	PengWei Wang, ZhiJun Ding, ChangJun Jiang, and MengChu Zhou	Graph search based method	Reliability is high Semantic services are achieved Performance is improved	It requires further improvement

4. Numerical results

The performance metrics are evaluated by using suggested approaches in this scenario. The metrics are such as precision, recall and execution time to discover the higher performance. The graphical illustration of these metrics in terms of various research methodologies is given and discussed detailed in the following sub sections. The various research methodologies that are analysed in this work are listed as follows

- Petri net based method
- Genetic algorithm
- Artificial intelligence (AI) planning technique
- Model driven approach
- Probabilistic approach
- Service composition model
- Graph search based method

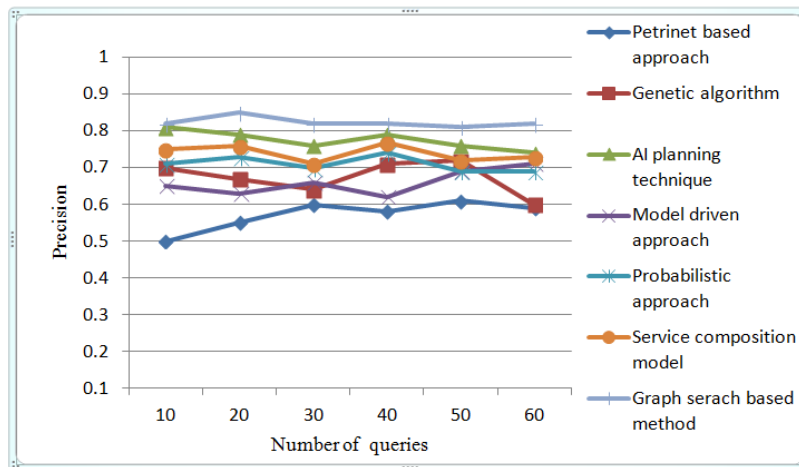
Precision

The precision is calculated as follows:

$$\text{Precision} = \frac{\text{True positive}}{\text{True positive} + \text{False positive}}$$

Precision can be view as a computation of accuracy or quality, whereas recall is a measure of completeness or quantity. In general, high precision indicates that an algorithm returned substantially more relevant results than irrelevant. In a classification task, the precision for a class is the number of true positives divided by the total number of elements labeled as belonging to the positive class.

Figure 1. Precision comparison



In figure 1, the comparison of literature methods in terms of precision is given. In x-axis the number of queries is taken whereas in the y-axis the precision value is taken. From this graph it can be proved that the graph search based method is superior to other techniques.

Recall

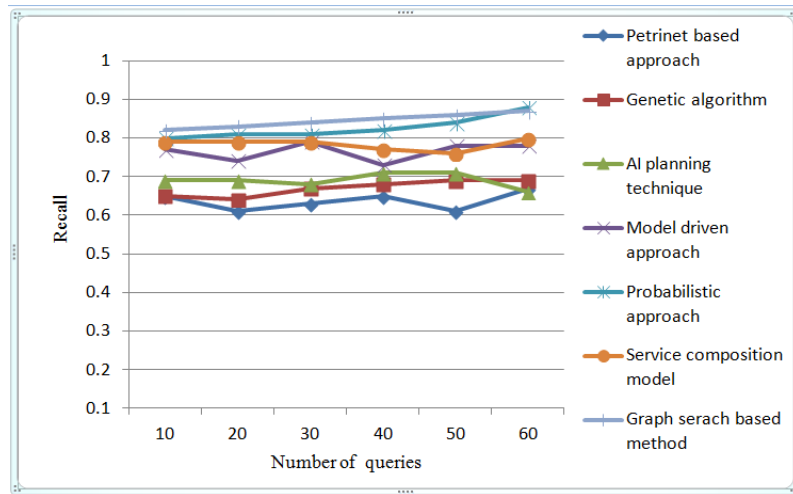
The calculation of the recall value is done as follows:

$$\text{Recall} = \frac{\text{True positive}}{\text{True positive} + \text{False negative}}$$

The comparison graph is depicted as follows:

Recall is defined as the number of relevant documents retrieved by a search divided by the total number of existing relevant documents, while precision is defined as the number of relevant documents retrieved by a search divided by the total number of documents retrieved by that search.

Figure. 2 Recall comparison

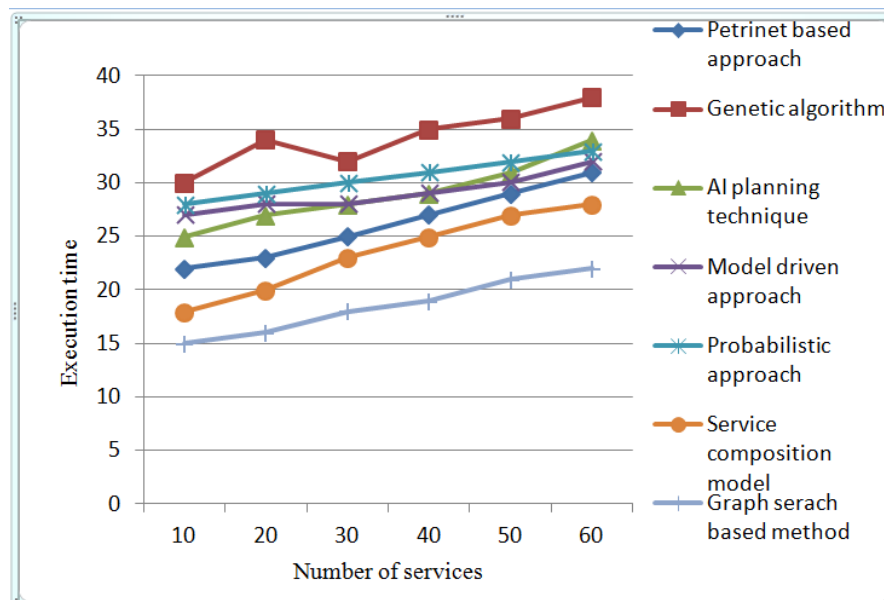


In figure 2, the comparison of literature methods in terms of recall value is given. In x-axis the number of queries is taken whereas in the y-axis the recall value is taken. From this graph it can be proved that the graph search based method is superior to other techniques.

Execution time

In computation, the algorithms are estimated to reduce the time complexity. For number of files the existing and proposed algorithms are executed in various time factor values. The less time execution values called higher performance in the scenario which is provided by using proposed algorithm.

Figure 3. Execution time comparison



In figure 3, the comparison of literature methods in terms of execution time value is given. In x-axis the numbers of services are taken whereas in the y-axis the execution time value is taken. From this graph it can be proved that the graph search based method is superior to other techniques.

5. Conclusion

The automation of composition process is an important factor and it constantly allows handling the growing numbers of available atomic web services. The semantic web services are achieved and the qualities of parameters are improved in terms of reliability, availability, response time and execution time. In this analysis work, survey of different methodologies is conducted and various performance parameters are used to discover the better approach for automatic web service composition problem. The simulations are conducted and the results show that graph search based method is superior to other methods in terms of precision, recall and execution time.

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