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AI numerical and simulation use cases for AEC (Architecture, Engineering, Construction)

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Abstract- Service-oriented architecture, as a software architecture with features such as loose connection, hiding internal implementation, autonomy, composability and reuse of services, advantages such as improving interaction, ability to reduce information technology costs and increase speed and Agility has brought organizations in such a way that it has turned this architecture into the dominant architecture in the supply of web services. But making available a wide range of services in the form of service-oriented architecture has made security problems more prominent, now the issue of security is raised as the most challenging concerns of this architecture. Artificial intelligence security is a more appropriate approach in choosing optimal security services.

Keywords- artificial intelligence-architecture-engineering-construction.

Introduction

Service-oriented architecture is a new and evolving way of building distributed applications. Services are distributed components with well-defined interfaces that process and exchange XML messages. Choosing a service-oriented approach can be useful in providing solutions that are not limited to the scope of organizations and departments. By using service-oriented architecture, in a company that has different systems and applications with different platforms, it is possible to create an integrated solution with high independence in a way that ensures uniform and uncoordinated work flow. As an example of service-oriented architecture when shopping, online shows its application in the form of architecture suitable for web-based services. When the customer places his order, he must provide his credit card information, which is usually provided by a provider (service- The secondary supplier is confirmed and charged. When the order is accepted, the company of the recipient of the order provides the shipping service and delivers the goods to the customer. In this case, if a company that is partially inactive does not stop the sales process.

Service-Oriented Architecture

Service: There are various definitions of service. Srivasan and Treadwell have defined the service as a software component that is provided to the caller through the network [1]. On the other hand, Agriwal considers the service to have the following characteristics [2]:

- A service is an implementation of a well-defined business function; Like a customer.
- The service can be used by its customers in several applications or different business processes.
- A service itself can include several other services.

The service is independent of the implementation and can be created in different development environments. In general, if a function is well defined and can be isolated from other related tasks, it can be classified as a service.

Architecture

Software architecture takes into account functionality, usability, reusability, sustainability, the

ability to understand constraints and limitations of technology and aesthetics, using a formal description of the system, which provides objectives, functions, external visible characteristics and their interfaces. defines in such a way that it also considers the internal components of the system and their relationships [1].

Service-Oriented Architecture

Horowitz and his colleagues, in response to the question of what is service-oriented architecture, state that this architecture is a new approach to building information technology systems, in a way that enables businesses to use their existing and current assets as tools. leverage and at the same time be able to respond to the inevitable changes in their business. From their point of view, organizations should pay attention to service-oriented architecture in order to get rid of technological limitations [3]. In general, different definitions have been presented for service-oriented architecture, each of which has explained its characteristics with a specific approach. In [4], service-oriented architecture is a method for creating reliable distributed systems in a way that its facilities are presented as services. presents and emphasizes more on the loose connection of service interactions. In another definition, this architecture is introduced as a strategic framework of technology that allows all internal and external systems to provide or receive well-defined services.[5] On the other hand, the image of service-oriented architecture shown in source [6] is a method for designing and implementing extensive enterprise software through the connection between services that have properties of loose connection, coarse grain and reusability. are; It becomes possible. Service-oriented architecture can be examined from different perspectives, each person or beneficiary has an image of service-oriented architecture according to his position [7]. Professional experts of service-oriented architecture enable a set of services that the organization wants to provide to its customers or partners. Architects is a style of architecture that contains rules, patterns and criteria that lead to the creation of features such as modularity, packaging, loose coupling, reusability, and composability, and in terms of structure, it consists of a service provider and a service requester.

Principles of service-oriented architecture

Service orientation is rooted in software architecture. A problem is broken into smaller and well-defined parts, and each part is a smaller problem with less complexity. In this way, a complex entity is divided into small and solvable components in such a way that the problem is solved by the performance of these components, while service orientation is the privileged and excellent mode of implementing this method; This theory has been implemented in the past in different ways such as object-oriented programming [8]. Some of the basic principles in service-oriented architecture are:

- Reusability is achieved by using technology-independent standards and separating the service implementation from the reusability interface. This concept leads to increasing agility in responding to new needs and reducing incurred costs due to the lack of need to design new services.
- Standardized service contract In order to establish interaction between services, communication rules must be officially defined and published, so there must be a contract including things such as defining the name and address of the service, operations, input and output messages for each operation and the type of this data [9].] Loose connectivity of services is a situation in which a service needs to know another service in order to interact with it, but remains independent of it [10].
- Hiding the internal implementation, the only part of the service that is visible to partners and the environment is the service interface, which is published under the form of a contract. How to implement the operation is hidden from the environment and may even be changed without the client's knowledge or a new technology may be used, without changing the interface and service definition [11].
- The combinability of services can be used as a component of a new composite service in cases of need, and there are no restrictions in this regard. But in the meantime, compositional capability is emphasized in such a way that the service-oriented process is controlled by the parent that combines the partner processes.

Service autonomy: although they use each other due to the feature of reusability, they should not have much correlation with each other; Rather, they must have their own logic and function. Autonomy leads to the elimination of dependence on other services, which hinders the development of the service.

Service statelessness: Services have minimized the maintenance of information that is specific to an activity. In other words, due to the fact that they can

be reused, the state control and registration is not done in the service.

Ability to identify and discover: the service use contract must be identifiable by partners and all agents who are allowed to use them.

materials and methods

In this research, the main articles in English and Farsi were searched in PubMed, Scopus Cochrane Library, Springer ,Google Scholar Direct Science and in Iran database including SID. To find articles in the title search database, the words: "Artificial Intelligence", "Architecture", "Engineering", "Construction" and their English equivalents along with the prepositions AND and OR were used.

Discuss

Advantages of service oriented architecture

The emergence of service orientation can be considered more of an evolutionary state in the history of information technology, which combines successful design elements that are the product of previous perspectives with new elements that have taken advantage of technological changes. The product of service orientation is:

- Service-oriented architecture increases the inter-organizational interaction of organizations, which is one of the requirements for survival in today's business environments. In other words, this architecture is a requirement of today's borderless organizations [12].
- Service-oriented architecture reduces IT costs of organizations due to not having a single platform.
- By using this approach, organizations respond to the changes in their environment with more speed and agility. From a different point of view, the benefits of service-oriented architecture can be examined from the perspective of different people involved in providing services to customers [13].
- The chief executive officer of information technology systems have the necessary flexibility, so it will not be an obstacle to change and evolve processes, and new products and processes can be easily implemented.
- Chief Information Technology Manager The problem of integration of information systems is one of the concerns of information technology managers of organizations, which is eliminated with this approach. Therefore, the ability to respond to the needs of the profession increases [14].
- Information systems project manager divides projects into smaller projects so that they can be done independently.
- Developers of information systems, the problem of integration and connection of an information system with other systems is eliminated. Systems can be called in different conditions.
- Users of information systems, the problem of transferring information between information systems has disappeared, and the complexities of technology are hidden from the eyes of users. The systems simply meet the needs of users [15].

Disadvantages of service oriented architecture

Although service-oriented architecture has significantly reduced many problems in the field of information technology; However, it has led to challenges and problems that are mentioned below:

Although service-oriented architecture is proposed as a new approach in system design, it also has some complications [16].

In this architecture, the need for design standards is felt.

Due to making available a wide range of services using different services, this architecture suffers from significant security problems.

Artificial intelligence

Definition of artificial intelligence

In fact, many consider the beginning of artificial intelligence to be 1950, when Alan Turing wrote the famous Turing Test paper on how to build an intelligent machine. According to John McCarthy, artificial intelligence is the knowledge of building intelligent machines or programs. Other definitions of artificial intelligence can be given as follows [17]

Artificial intelligence is a branch of computer science that examines the computational requirements of actions such as perception, reasoning and learning and provides a system to perform them.

Artificial intelligence is the study of ways to transform a computer into a machine that can perform actions performed by humans [18].

In this way, it can be seen that the last two definitions have completely clarified the two points of the first definition:

An intelligent being or machine means a machine or a human-like being. A tool or a machine that is supposed to carry intelligence will resemble a human being [19].

It is a computer. In addition, today's computers with completely mechanical and logical methods have been able to act beyond human abilities in some aspects of reasoning. Currently, computers have reached a degree of progress and a huge investment has been made on these machines, assuming this which is not the best choice, at least they are the most accessible, cheapest and most common choice for implementing intelligence [21].

Genetic algorithm

Machine learning, as one of the broad and widely used branches of artificial intelligence, deals with the regulation and discovery of methods and algorithms based on which computers and systems gain the ability to learn. Genetic algorithm is a model of machine learning whose behavior is based on biological evolution and using Darwin's idea of evolution. Artificial intelligence has tried to find the optimal answers as much as possible, taking inspiration from nature. Fields such as the security system of the human body, in which countless patterns of invading viruses are intelligently stored, or the method of finding the shortest path to food sources by ants, all represent parts of biological intelligence. Genetic Algorithm in 1970 by John Holland was introduced This method is implemented by creating a population of possible solutions, each of which is presented in the form of a chromosome. Therefore, a large set of possible solutions is produced, each of which is evaluated using a fitting function, then a number of solutions produce the next generation solutions. In this way, during successive generations, the search space evolves in a direction that reaches the desired solution, so the genetic algorithm is a suitable tool for solving optimization problems [22]. The way genetic algorithm works is generally according to the following cycle:

First, all the people in the selected population are evaluated, then new people are generated using combination and mutation operators, and old and duplicate people are removed. Each cyclic repetition of the mentioned process produces a new generation. The first generation is created randomly, the genetic operators evaluate the merit of the generations and move the problem towards the optimal solution.

Artificial intelligence

In this research, the use of artificial intelligence approach is suggested to choose the appropriate security services. Among artificial intelligence techniques, genetic algorithm technique has been selected. As mentioned earlier in the second chapter, the data mining technique has been of interest to researchers in the field and has been used many times; On the other hand, this technique requires a large amount of data to extract its patterns, so it is recommended to use the genetic algorithm technique. The genetic algorithm goes through the following steps to optimize options [23], [24]:

Creating an initial population of solutions The first step of this algorithm is creating an initial and random population from a set of possible solutions. Each solution in this algorithm is known as a chromosome. Chromosomes of the first generation are created randomly or with basic knowledge. Calculating the fit of all the chromosomes of the current generation through a fitting function. In this step, the fit is calculated for all the chromosomes in one generation. The fitting function is a function with the objective of maximization and minimization. This function is defined according to each problem, its value determines the degree of fitness and appropriateness of each chromosome[22].

Selection of next generation chromosomes: After calculating the fitness level of each generation, more fit chromosomes are used to produce the next generation. Some chromosomes with very high fitness are directly transmitted to the next generation. The rest of the chromosomes are also created by applying the mutation and crossover operators on the graceful chromosomes of the previous generation. For this purpose, using techniques, two chromosomes of the current generation are selected as the chromosomes of the parent generation. With a certain probability, two children will enter the next generation after applying the intersection and mutation operators [25].

Stopping by creating a new generation of chromosomes, first the stop condition of the algorithm is checked. If established, the work condition is terminated; Otherwise, the algorithm returns to the second step and the algorithm continues until the stopping condition is reached [26].

As mentioned, the genetic algorithm uses intersection and mutation operators to generate children. The function of these operators is as follows [21], [24]: The intersection operator of this operator is applied in a single-point or multi-point manner. . For the implementation of the intersection operation, a constant called the probability of intersection (PC) is considered. In each, a random number in the range of zero and one is generated by executing the intersection operator. If the generated random number is smaller than the intersection probability value, the intersection operation is performed, otherwise the intersection is not applied. In the single-point intersection operator, first, an

intersection point is randomly selected; Then the parent's chromosomes are broken from that point. The result of this failure is two child chromosomes. While one of the children got the first part from the first parent and the second part from the second parent; The other child takes the first part from the second parent and the second part from the first parent [23]. The mutation operator receives the mutation of a chromosome as input and changes each of its genes with a small probability. For example, if the chromosomes are binary, the mutation operation can lead to the conversion of zero gene to one and vice versa [17].

Conclusion

Today, the use of service-oriented architecture to provide services for customers is increasing day by day, with the expansion of the application scope of this architecture as the dominant architecture in the supply and provision of web services, paying attention to its security categories as one of the main challenges In this regard, it has been suggested to IT managers that it is necessary to identify security problems, including the numerous threats and attacks of this software architecture. In addition, there are many security solutions to deal with the risks of this architecture. Choosing the right security options from a wide range of options is a constant concern. It has been the decision makers. While it is impossible to make a proper decision without considering the criteria, in addition, approaches and methods should be taken into consideration to select appropriate solutions. This research has paid attention to the aforementioned issues. Today, the use of service-oriented architecture to provide services for customers is increasing day by day. With the expansion of the application scope of this architecture as the dominant architecture in the supply and provision of web services, paying attention to its security categories as one of the main challenges of information technology managers has been considered as a necessity in this work. In this regard, the need to identify security problems including threats and multiple attacks of this software architecture and the effect of various techniques including artificial intelligence techniques in choosing appropriate security solutions according to the security criteria of the researcher has been investigated.

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