

An Investigation of Fuzzy Oriented Logic in Cloud Infrastructures

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Abstract:

With tremendous benefits with methodologies associated with fuzzy logic, it has been widely used in every field of study. Numerous obstacles exist in cloud computing which is to be overcome with the use of fuzzy based logic. The primary goal of this study is to examine the applicability of fuzzy in the most challenging problems of cloud based research. Additionally, investigation the fuzzy methodologies utilized to solve cloud computing-related challenges are also addressed. A systematic review of the literature had reviewed to identify entirely interesting areas of cloud computing, to categorize the most significant and critical aspects of cloud study, to examine existing problem-solving techniques in each cloud area, and to examine the use of fuzzy logic in every of the said areas to address various problems. Fuzzy logic may be utilized in any area of research, including cloud computing, to solve problems and enhance effectiveness, yet many cloud computing researchers have employed fuzzy logic approaches to conduct their research in order to optimize the system's performance.

Keywords: Cloud, Fuzzy Logic, Uses

Introduction:

Internet-based cloud technology is developing platform that delivers consumers with low-cost services. Using web browsers and the internet, cloud users can avail these services from any location. It provides on-demand computing resources that can be sold [1]. It is environmentally responsive, profitable, pay-on-demand, accessible through a web browser, available around the clock, infinite storage, recovery procedures, serviceability, flexibility, data security, virtualization, Resource demand, user - friendly, agility, very little development effort, and high productivity [2]. Other drawbacks include the need for a continuous internet connection, the inability to work with a slow internet connection, the lack of options, the lack of transparency, the vendor lock-in, the unknown location of the hardware and servers, and the transfer of control. Essentially, there are 3 different platforms and three major models in the cloud. Infrastructure as a Service, Platform as a Service, and Software as a Service are cloud computing service models. Other service models, such as Storage as a Service and Network as a Service, are also available. Cloud computing development may be broken down into three broad categories: Private, Public and Hybrid Clouds. Like other cloud models, the community model is also available. Cloud computing has a number of obstacles to overcome because of its relative newness in comparison to other technologies. Although cloud computing has overcome many challenges, it is still overwhelmed by issues such as vendor lock-in and regulatory issues, data transportability, privacy and security, interoperability, consistency, accessibility, and vendor lock-in. There is more information on cloud computing in the paper's second section.

In 1965, Zadeh invented the concept of fuzzy logic, a form of artificial intelligence (AI). Fuzzy Logic provides a simple method for generating a judgement. The fuzzy system's input values are ambiguous, confused, and imprecise, but they are loud and clear [3, 4]. It is based on previous systems' reinforcement of true and false values. There are no hard and fast rules in a system using fuzzy logic; instead, model parameters and rules are implemented with values that fluctuate between zero and one (true). Fuzzy logic is widely used in cloud computing because of its many advantages, including its quick response time, capacity to deal with ambiguity, and logical reasoning.

In order to construct fuzzy logic systems, humans must use their knowledge and abilities. With their application, microprocessors and washing machines have gained a lot of advantages. Fuzzy logic and cloud computing have been combined to improve service selection and scheduling algorithms. However, no gap analysis or recommendations for how to close the gap have been made by any of the few authors who worked on fuzzy applications in cloud computing [6]. To summarize, here's how it's organized: It begins in the second section with a brief introduction to fuzzy logic; in the third section, a discussion of fuzzy logic methodology; in the fourth section, an examination of cloud computing integration; in the fifth section, a consideration of fuzzy logic's usage in cloud computing; and in the sixth section, a summary and conclusions.

Fuzzy Logic:

The fuzzy based logic is often applied to uncertain conditions and inaccuracies, and fuzzy signifies a something that is not clear or hazy. Fuzzy logic describes information in a way that is difficult to properly define. In the context of partial truth, it was utilized to deal with concepts of ambiguity [10]. A Boolean logic called fuzzy logic is also used to collect values that are ambiguous or unclear. This is a more practical and less expensive option. As a further example, fuzzy logic is employed in a wide range of fields of study from biology and medicine to computer technology, microwave ovens and washing machines. Flexible, less complex, easy to construct the fuzzy system, and decrease organization development time are just few of the advantages of fuzzy logic [12]. Fuzzy logic, on the other hand, has a number of drawbacks, including the fact that it is exclusively based on Boolean logic, is extremely complex, requires a great deal of data as input, difficult issues demand more calculation, and it takes a long time to generate a large number of fuzzy rules. As shown in Fig. 2, crisp values are utilized as input for fuzzy logic, which then fuzzifies the values, applies a number of rules, defuzzifies the data, and returns the values to their original crisp state. The decision is the result of the fuzzy logic. Figure 3 depicts a fuzzy model with four input modules, as shown in the figure. Fuzzification is the first step in fuzzy logic, which takes crisp values and transforms them into fuzzy ones. 'The interface is used to analyze the information and then Defuzzification is used to transform them into crisp values according on the knowledge of the user. Various fuzzy sets and membership functions make up fuzzy logic. The member ship functions have a range of values between 0 and 1. Fuzzy logic is implemented using MATLAB facilities, which include 11 membership functions.

Fuzzy logic and cloud computing:

Because of the qualities and features of cloud computing, several fields are merging with cloud technology, one of which is fuzzy logic. When it comes to Artificial Intelligence, Fuzzy Logic is a component that was proposed by Zadeh in the 1960s. A clear approach for reaching an unequivocal conclusion based on doubtful, uncertain, loose, noisy, or missing input data is provided by fuzzy logic (also known as fuzzy reasoning). It is a sort of logic that distinguishes between more than only true and false conditions. In contrast to traditional frameworks, fuzzy logic goes beyond the simple true or false dichotomy that is supported by standard frameworks. Fuzzy Logic is a collection of enrollment capacities that determines that it may assist multi-esteemed reasoning as the level of trust changes between genuine and fictitious information. Fuzzy Logic is widely used in Cloud Computing because to the extraordinary reaction time it has to vulnerabilities and the fact that it thinks in a logical manner. The Fuzzy Logic system is composed of four primary components: the Fuzzifier, the Rule Base, the Inference Engine, and the Defuzzifier.

The use of fuzzy logic in cloud computing:

Fuzzy logic is employed in practically all fields of study, including cloud computing, and is very effective. During a comprehensive analysis of the literature, the authors discovered that fuzzy logic has made significant contributions to the field of cloud computing by helping to tackle a variety of difficulties. Taking use of the flexibility and benefits of fuzzy logic, the researchers were able to tackle their cloud computing-related day-to-day and complicated difficulties by taking advantage of its capabilities. However, despite the fact that fuzzy logic is employed in practically every field of cloud computing research, we have identified 12 of the most significant and commonly used domains of cloud - based solutions where researchers applied fuzzy logic and successfully addressed the issue statement.

1. Load Assessment.
2. Resource Scheduling.

3. Management of Resources.
4. Improving the Reliability of the System.
5. Quality of Service (QoS) Optimization.
6. Evaluation of Trust.
7. Storage and Archiving Service.
8. Service Selection.
9. Security and privacy.
10. Cloud Computing on Mobile Devices

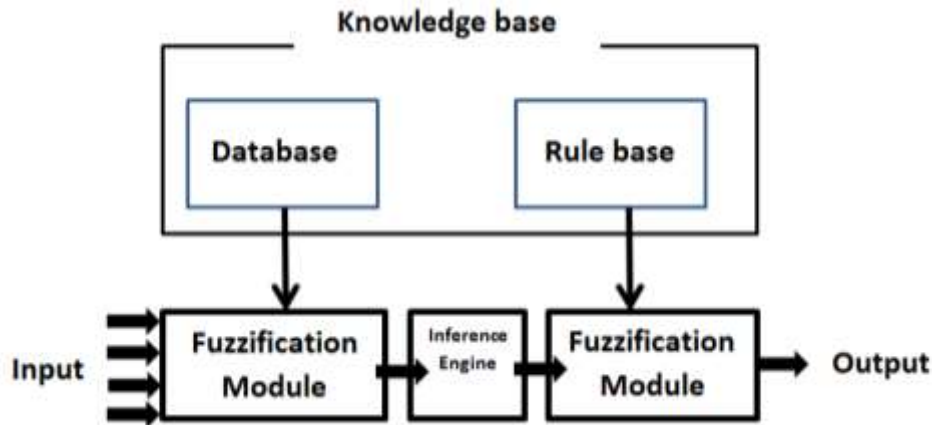


Figure 1: Fuzzy Process Model

Similarly to using fuzzy logic in cloud technology, we selected ten of the most valuable and essential areas where the majority of the research was performed using both technologies at the same time. Figure 1 depicts a classification of fuzzy logic in cloud computing, which is divided into three categories. After that, each aspect of fuzzy-based cloud computing is covered in detail, including the background, current methodologies, and fuzzy techniques.

1. Load Assessment/Balancing

The major benefit of this system is its scalability, which allows users to expand their networks and applications without having to change the network infrastructure. In network administration, load balancing is a methodology and a continuous process that distributes the load of a network homogeneously across the thousands of servers of a network in order to prevent overloading an only one computer system and in order to enhance the capacity, maximum usage of resources, decrease the response time, and also maximize the throughput of a given network. A continuous automated process, load balance and scaling takes place without the need for user participation.

2. Resource Scheduling

Resource Scheduling is the most important aspect of Cloud Computing after that of storage. A job is a piece of work that must be completed within a certain time frame. Work Resource Scheduling is the process of allocating resources to a given project for a specific period of time in order for the job to be completed. In order to ensure that basic similarities between jobs are satisfied and that the total time required to complete all tasks is kept to a minimum, the job is distributed among resources in an appropriate manner. The primary goal of Resource scheduling is to maximize the usage of available resources. It shortens the time spent waiting for a job. Work scheduling entails determining the good amounts for job execution within the constraints of available time.

3. Management of Resources

Because of the large number of processes relative to the available resources in Cloud Systems, the implementation approach necessitates the usage of Resource Management. It is a tough undertaking to implement resource scheduling approaches in cloud computing since it involves the allocation of resources in multiple locations, and the systems have a variety of load situations, user requirements, and financial concerns that must be addressed. A large number of researchers carried out their research in cloud computing, notably in resource scheduling, and a large number of researchers addressed such difficulties [37–40] in this field. To ensure the secure distribution of resources and to

increase security, Kamalanathan Chandran and colleagues employed fuzzy logic in cloud services to design a trustworthy and reputational model for cloud computing. Zhijia Chen and colleagues introduced dynamic resource scheduling strategies in a cloud computing system, which were based on fuzzy logic methodologies. According to the authors, they were able to better match user requirements with resource availability while also enhance the effectiveness of scheduling algorithm [41].

4. Improving Reliability

When it comes to cloud computing, reliability is now the most crucial thing to consider since it offers the cloud user with a sense of security and happiness with the system. To increase the dependability of a cloud computing environment, a variety of strategies may be utilised, such as load balancing, task scheduling, allocation, resource management, and many more techniques as well. All of these strategies work together to increase the system's overall dependability. A review of the literature revealed that several investigations were undertaken in the cloud technology area to increase system reliability by protecting it from potential dangers, attacks, and vulnerabilities, whilst most researchers used conventional techniques to improve system reliability by claiming that proposed methods are the criteria for increasing system reliability. The performance of the system was improved by a large number of authors using traditional techniques, whereas the reliability of the system was improved by a small number of authors using the advantages of fuzzy logic, such as in [48], where the researchers are using fuzzy logic for resource management to enhance the system reliability.

5. QoS Optimization

Computing in the cloud is a relatively new development in the world of information technology, and it allows users to access a variety of services through the internet using web-based software programs. The primary goal of cloud resource management is to identify optimal cloud resources. Since cloud vendors are more concerned with their bottom line, clients may end up paying more than they need to. There is no denying that cloud customers have an interest in selecting cloud resources that satisfy particular QoS needs. As a result, cloud service providers and cloud customers' a like need to find a way to reconcile the conflicting demands of payment and quality-of-service performance. Because the cloud computing services are shared by more than one user, balancing the services amongst shared users is a difficult task.

6. Evaluation of Trust

The trust system is a fantastic way for increasing cloud security since it is transparent. It is the most new and important information security mode that provides security states, information security controls, reliability, and strategies for leadership by highlighting and conveying malicious entities that are completely reliant on changing over and extracting the results from detailed integrated in various structures and gathering criticism evaluations on a consistent basis. It is the most recent and important information security mode that provides security states, information security controls, reliability, and strategies for leadership. There are many different aspects to the concept of trust. The dependability of the system, its scalability, the scheduling methods, and the accessibility of the sources are some of the factors to consider [59–62]. Xu Wu's research on the trust system for the cloud infrastructure [63] used fuzzification for the clouds environment as a result of its study. The primary objective of this study is to reduce confusion and fuzziness while also ensuring that the assessment of the trust is accurate. In addition to assisting the suggested model in accurately determining the confidence level in the cloud service provider, the fuzzy assisted to demonstrate that the findings were accurate. In a similar vein, [64] suggested that fuzzy logic be utilized to determine the trustworthiness of cloud computing service providers.

7. Storage and Archiving Service.

There are several instances of storage providers that provide cloud-based free storage services in exchange for the creation of an account on their website, among other things. Google Drive is a very well storage solution for those who have an email address associated with it; likewise, drop box is another example of a cloud storage service, and so on. Various academics did their research in this field in order to ensure the secure environment and reliability of storage across the cloud networking infrastructure. The researchers have presented a plethora of online cloud techniques, storage optimization techniques, safe handling algorithms, storage authentication algorithms, and a plethora of other sorts of algorithms in the past, and this process is ongoing [69–71]. When it comes to cloud storage services, fuzzy logic is utilized specifically to protect the storage devices while also ensuring that they are always

available. Using fuzzy logic in conjunction with game theory, the concept of evidence, Christian Esposito and colleagues [72] were able to identify the most appropriate smart storage. Fuzzy logic approaches were employed by Yannan Li, Yong Yu, and colleagues [73] for the goal of integrity auditing cloud storage, in order to eliminate uncertainties in the suggested model.

8. Service Selection

Cloud service selection is a difficult process, and as a result, cloud users want good advice and understanding of the features selection tools in order to make informed decisions. The majority of the time, the work of service selection is carried out using Multi Criteria Decision Making or Multi-Attribute Decision Making approaches. Despite the fact that there are other approaches available in the literature review, the writers of this research discovered more suitable decision-making procedures than the others. Currently, in the domain of service selection, both of these strategies are often employed by the researchers in their research.

9. Security and privacy

Information Protection and Privacy When it comes to technology, risks and dangers are always present, but with the advent of cloud, these two areas have become much more prominent, since new innovations bring with them an increased number of risks and vulnerabilities, as well as new opportunities. In cloud computing, security and privacy are the most important and most significant issues to consider. As a result, substantial research in this field, such as [87–89], has been done. When it comes to cloud computing, security and privacy are broad concepts. In fact, every component of cloud computing need security and privacy in order to keep its data and equipment safe. Various well-known organizations, such as and others, have released their norms for cloud security, recognizing the critical nature of information security and privacy.

10. Cloud Computing on Mobile Devices

In the last few of years, there has been a steady improvement in the fields of personal technology, cloud technology, and green computing. The integration of mobile computing and cloud computing has resulted in the development of an excellent technology known as mobile cloud computing (MCC), which allows for the introduction of mobile offerings over the computing and the internet, which are easily accessible via a web browser and are billed on a pay-per-use basis. Numerous challenges have arisen as a result of the growth of Mobile Cloud Computing, bringing them to the attention of the industry and academia. These concerns include diversity, safety, confidentiality, memory, cell battery capacity, energy consumption, performance, and availability.

Conclusion

Cloud computing is still in its infancy compared to previous technologies. Still, this technique has immense research potential. Fuzzy Logic is used in cloud computing to enhance cloud scheduling algorithms and cloud service selection. The author based on the implementation of fuzzy inference system with cloud technology in many domains and methodologies. The authors listed the most crucial and problematic domains of cloud computing where fuzzy logic has been deployed to assist industry/researchers. In this research, we examined the current and classic approaches to problem solving, and its use of fuzzy logic to optimize and solve the same issues. We also examined every work that employed cloud computing fuzzy logic. The work helps academics combine fuzzy logic with standard methodologies to better solve challenges.

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