ASIAN BULLETIN OF BIG DATA MANAGMENT
Vol. 4. Issue 4 (2024)
https://doi.org/ 10.62019/abbdm.v4i4.256

Socio Fuzzy Based Performance Evaluation of Cloud Computing Service Model (IaaS)

Syed Younus Ali*, Maya Bint Yousaf, Tabeer Arif, Fariha Ashraf, Muhammad Hassan Nafees

Chronicle

Article history
Received: November 29, 2024
Received in the **revised format:** December 10, 2024
Accepted: December 22, 2024
Available online: December 29, 2024

Syed Younus Ali, Maya Bint Yousaf and Tabeer Arif are currently affiliated with Minhaj University Lahore, Pakistan
Email: younas.csit@mul.edu.pk
Email:mayayousaf.csit@mul.edu.pk
Email: tabeerarif20@gmail.com

Fariha Ashraf is currently affiliated with Lahore College for Women University, Pakistan.
Eamil: fariha.ashraf72@gmail.com

Muhammad Hassan Nafees is currently affiliated with Beijing University of Posts and Telecommunication, Beijing, China
Email: mianhassan041@gmail.com

Corresponding Author*:

Abstract

Socio fuzzy based research is primarily focused on recovery of disaster in cloud computing and the spread of this technology with an enormous speed, which is sufficient to explain the need and desirability of this technology, on the other hand, same distinction is also the main challenge i.e. unplanned growth of cloud computing and relevant technologies. In past we have seen the same issues with World Wide Web, in which we have expanded to such levels that a proper governance and maintenance becarne near to impossible. Rapidly expanding cloud technology with conventional and emerging services is a source of generating huge volumes of data that requires to be addressed for analytics and simply for suitable storage structure. Big data and Internet of things (IoT) are two emerging challenges linked to cloud computing and these two areas are research focus of many scientists. In this research we have proposed a Fuzzy inference system (FIS) which is a blend of cloud technology along with artificial intelligence and cognitive science. We believe that an autonomous and self-evolving intelligent environment is the solution to emerging problems related to cloud technologies. To address the issues of big data and IOT, our proposed model FIS is having the ability to analyze the heterogeneity and homogeneity knowledge structures wherein, machine learning and artificial neural networks have been proposed for semantic, property and feature analysis-Validation of the proposed model FIS is being done through algorithm development as well as by simulating the model in B/IATLAB. Results have shown the positive inclination towards ecosystem relevance with overall perforrnance and interoperability i.e. These two characteristics play a vital role in the intelligent recovery system's long-term viability, while third pararneter is dynamic which may change as per the requirement e.g. reliability, security, cost etc. This research concludes that cloud technology will work better in a comprehensive cloud ecosystem with better management and service parameters for users for cloud-service providers, also the issues of big data and IoT are more manageable and observable in a cloud ecosystem.

Keywords: Socio-Fuzzy Systems, Cloud Computing Performance, Infrastructure as a Service (IaaS), Service Model Evaluation, Performance Metrics, Fuzzy Logic in Cloud Services.

INTRODUCTION

Cloud computing is a term used to describe the availability of computer resources on demand, such as data storage and computational power, without the need for the user to actively manage them. This technology involves data centers that are accessible over the internet by a large number of users. In many cases, functions from central servers are distributed over multiple sites, with edge servers used when the user's connection is close enough. Cloud computing can be limited to a single company, which is known as an enterprise cloud, or made available to a group of enterprises, which is called a public cloud. The primary advantage of cloud computing is its ability to provide consistency and economies of scale by sharing resources. Proponents of public and hybrid clouds claim

that cloud computing can help businesses reduce or eliminate upfront IT technology costs, get their applications up and running faster, and experience better manageability and less downtime. Cloud computing can also allow IT teams to quickly adapt resources to meet fluctuating and volatile demand, which can provide high computing capacity during peak demand. Cloud computing frequently uses a pay-as-you-go model, which may result in unanticipated operating costs if the administration is inexperienced with cloud pricing structures. The growth of cloud computing can be attributed to the broad adoption of hardware virtualization, service-oriented architecture, and autonomic and utility computing, as well as the availability of high-capacity networks, low-cost processors, and storage devices. Although there are various operating systems that can be used in cloud computing, Linux is regarded as the most powerful and widely used operating system, including in Microsoft products (Chen et al., 2017). Cloud computing is becoming increasingly popular due to its many advantages, such as its reliability, high-performance computing, and large data storage capacity.

The interoperability of cloud platforms and their elasticity also make them attractive to users. Cloud computing has great potential to boost emerging enterprise technologies in terms of economics and optimal utilization of service models. Due to the heterogeneous structure of cloud systems, many large-scale organizations are moving their infrastructure to cloud-based systems. One of the most cutting-edge benefits of cloud computing is its ability to manage data recovery and increase business through on-demand delivery (Chen et al., 2017). Using clouds, the organization can cut infrastructure cost and increase the storage cost and pay per use. Cloud computing is a metered service for their services. The main attraction of cloud computing, recourses virtualization for completion of services using virtualization, the services become more attractive, when accessed by any platform (Dubey & Pal, 2017). Cloud computing is giving an assortment of cloud services providers, elite and versatile information stockpiling over the internet & IoTs. The growing number of cloud users on the different platforms such as desktop and window creates an incentive to adopt innovative cloud services in a cloud environment. Cloud computing, in general, can take advantage of the limitless capabilities and resources of cloud-like storage, processing, and communication (Fernandez, Yoshioka, Washizaki & Syed, 2016).

Varity of services, scalable data storage and high performance enlarged the field of computing and providing user need a bas solution. Due to the high demand for data management by the user and big organization, cloud computing gain popularity by offering self-management, automation of cloud services and dynamic load balancing. The organization can better control by rented monitoring the computing resources, instead of investing huge amount of physical cost for data centers (Botta, De-Donato, Persico & Pescapé, 2016). Cloud computing is also a providing the fault tolerance system, system resilience and different type of backup system. fault-tolerance in cloud computing increased the reliability of data and service provision. Fault detection and its recovery modes to its pervious state can enhance the trustworthiness (Castejón, Gavras, Gonçalves, Moiso, Undheirn & Zoric, 2011).

Disaster

Heterogeneous cloud is made up of a variety of hardware and software, including hybrid storage and multiple discs. In cloud-based business, the entire firm data is saved in a cloud database. As a result, in these environments, data security, safety, and recovery are critical. Information that has been processed on the primary host but has not yet been duplicated on the backup site is referred to as data in jeopardy. As result improved data

recovery technology in storage clouds is required in the event of a disaster. Three option for data recovery have been offered (Alshammari, Alwan, Nordin & Al-Shaikhli, 2018).

a. In the case of disaster, the faster disk technology is used to replicate data that is in risk.

b. Changing the polluted page threshold: the amount of clean RAM pages that must be discarded to disk could be decreased.

c. Dangerous device prediction and replacement: a variety of critical variables, such as power consumption, temperature management, carbon credit usage, and the relevance of data (stored on each disc), can be measured over time.

To develop a replace priority list, a mathematical equation will be created base on these factors. Disasters and events are unpredictable occurrences that are often accompanied by a plethora of information that is readily available, depending on one's relationship to the event. Despite the fact that crisis management personnel deal with large volumes of incoming data, members of the public are often left with a lack of timely information that is crucial for personal decision-making and peace of mind (Alshammari, Alwan, Nordin & Al-Shaikhli, 2018). In many cases, members of the public take the initiative to verify information and seek additional information using social connections and available tools, often asking for help from their communities. The nature of contextual knowledge has long been an area of interest for researchers in the fields of human-computer interaction and computer-assisted cooperative work, particularly with regard to the ways in which it is facilitated and influenced by information and communication technology (ICT) (Abreu et al., 2019).

Information management in emergency and safety-critical situations has also been a significant focus for military personnel and has been the subject of extensive research.The attention has now switched to the impromptu ICT-enabled acts of citizens who are directly or indirectly affected by emergencies. This research extends on that analysis by describing hoe information-seeking characteristics are like to issue of location and environment on public-side emergency response techniques that are urgent. Individuals and family groups are not the only once affected by disasters; communities are also affected. The study of the use of information and communication technology (ICT) in community processes during time of crisis is still in its early stages. In this article, we look at how members of the group use ICT to organize in crisis situations.

Disaster Management

Geospatial information enables us to imagine characterized topographical regions and examine the elements and articles inside them, Today, this information assumes a significant part in the debacle the board (DM) area by empowering experts to all the more likely react to, recuperate from and plan for calamity occasions. (Abreu et al., 2019) the information can be utilized to create quick harm appraisals, design and execute search and salvage activities, survey regions inclined to danger chances, and various different exercises. The successful utilization of this information, nonetheless, necessitates that partners have the capacity to get to, oversee and share it. Inescapable web access propels in reasonable innovations and the developing accessibility of open and while free datasets have made it easier to work with these requirements, partners still face significant challenges in accessing and sharing information at all stages of the DM cycle. As a result, this essay seeks to piece together the primary cycles, and (Abreu et al., 2019) which remain one of the most vulnerable to catastrophic catastrophes. Because of the specialized breakthroughs that have unfolded after a 7.0 magnitude earthquake struck

just west of Port-au-Prince on January 12, 2010, Haiti presents a unique scenario for our investigation. Responders were left with a big data void for undertaking aid and recovery exercises soon after the quake, as many of the country's basic pattern databases were obsolete, missing, or simply did not exist (Calcaterra, Cartelli, Di-Modica & Tomarchio, 2019). Significant amounts of information from public and private information providers, international philanthropic organizations, volunteer and specialized networks (V&Cs), and the affected population quickly filled the gap, providing responders on the ground with greater situational awareness for the planning and coordination of their efforts. After the earthquake, the initiatives, organizations, and practices for producing and sharing geospatial datasets have had a significant impact on how various partners access information for disaster management in Haiti today (as in other disaster-affected states). In addition, the influx of new actors, the expansion of spatial data infrastructure (SDI) and community boundary building, and the recognition of the growing importance and value of data for effective collaborative activities are all factors attempting to create new linkages among partners and processes for information sharing within the country.

These improvements were again put under serious scrutiny (Mendonca, Lima, Matos, Ferreira & Andrade 2018). This investigation takes its take off in the repercussions of the Hurricane. to recognize continuous cycles furthermore, it looks into the issues surrounding information sharing and how they are influencing relevant partners. The paper is based on data gathered through participatory perceptions and semi-organized meetings, as well as rational discussions that outline the use of spatial innovations and information for DM exercises in Haiti since the earthquake, as well as larger issues relating to philanthropic cycles in the country and the region as a whole. To more readily comprehend these turns of events, the article is isolated into six segments and continues as follows. Area two provides a quick authentic overview of how information creation, access, and sharing have evolved from the time of the 2010 earthquake to the present day. The institutional and functional features of relevant entertainers working with information-related DM exercise in the country are used to lay out these progressions. Segment three characterizes the examination approach furthermore, restrictions for the examination and, from there on, area four lays out the fundamental discoveries for the examination inside three topical regions: Monetary, Technical and Legal.

Segment five grows the essential discoveries into a scientific conversation which draws from reasonable subjects in a debacle grant, basic topography and enlightening administration examines, and ultimately, segment six finishes up the investigation with contemplations for the more extensive functional ramifications of the exploration (Jain & Jain, 2017). Respondents disclosed that preceding the quake, the absence of satisfactory SDI, slow web pages and dissipating of geospatial information clients in the nation implied that information was principally shared through casual networks; regularly by means of outer stockpiling gadgets like USBs and Disc. Since the tremor, they noted that the SDI in Haiti had been rebuilt and enlarged, and that the generation of information and objects among individual partners had increased (Mendonca, Lima, Matos, Ferreira & Andrade, 2018). Outside sources are needed since hardly any office or organization in Haiti has the specialized or financial resources to meet all of their information needs, Respondents were featured on web geo portals to work with these cycles, as well as some of the new market administrations for the arrangement, the board, and examination of information evaluated in the past area. Dynamic resources are useful for seasonal demand and supply. The on demand self-service is also helpful for different demand variations and meet burst demand to some extraordinary client request. To make this conceivable, a

cloud service provider should clearly have the foundation setup to consequently deal with service level agreement between users and providers (Hou, Gu, Wang & Zhao, 2016).

Machine Learning (ML)

ML is a discipline centered on two interrelated inquiries: The investigation of machine learning is significant both for tending to these essential logical and designing inquiries furthermore for the highly functional programmed it has provided and managed across a wide range of applications. The field of machine learning is focused on two primary questions: how can we improve the logic and design of machine learning algorithms, and how can we utilize these algorithms effectively in various applications? Machine learning research is critical in addressing these questions, and has led to the development of highly efficient programs across a range of fields. A learning problem can be defined as the task of improving performance in a given task through some form of training experience. For example, in the process of learning. (Suguna & Suhasini, 2015). Machine learning is a discipline that focuses on two fundamental questions. It is crucial for addressing these fundamental questions and for the efficient programs produced for various applications. A learning problem is defined as the problem of improving the performance of a task through a training experience. For example, the performance metric to be improved may be the accuracy of a fraud detection classifier, and the training experience may involve a set of historical credit card transactions, each labeled as fraudulent or not.

Alternatively, one may define a different performance metric that assigns a higher penalty when fraud is incorrectly labeled as not fraud than when non-fraud is mistakenly labeled as fraud. One can also define a different type of training experience, such as including unlabeled credit card transactions with labeled examples. Various machine learning algorithms have been developed to cover the wide range of data and problem types encountered across different machine learning problems. Thoughtfully, MI calculations can be seen as looking through a huge space of up-and-comer programs, directed via preparing experience, to discover a program that advances the exhibition metric. MI calculations fluctuate incredibly, to a limited extent by the manner by which they address competitor programs (e.g., choice trees, numerical capacities, furthermore, general programming dialects) and in part by the manner by which they search through this space of projects (e.g., advancement calculations with surely knew assembly ensures what's more, transformative pursuit strategies that assess progressive ages of haphazardly transformed projects) (Ramharuk & Osunmakinde, 2014).

Machine Learning Types

Numerous calculations center around work estimation issues, where the undertaking is epitomized in a capacity (e.g., given an info exchange, yield a "fake" or "not extortion" mark), and the learning issue is to work on the exactness of that work, with experience comprising of an example of known info yield sets of the capacity. In a few cases, the capacity is addressed expressly as a defined utilitarian structure; in other cases, the capacity is certain and gotten through a search measure, a factorization. an enhancement method, or a recreation-based system. Indeed, at the point when certain. the capacity for most part depends on boundaries or other tunable levels of opportunity, what's more, preparing relates to discovering values for these boundaries that advance the presentation metric. Whatever the learning calculation, a key logical also. Commonsense objective is to hypothetically describe abilities of explicit learning calculations also, the inborn trouble of some random learning issue: How precisely can the calculation learn room a specific kind and volume of preparing information? How

powerful is the calculation to mistakes in its displaying suspicions or to blunders in the preparation information? Given a learning issue with guaranteed volume of preparing information, is it conceivable to plan a fruitful calculation or is thig learning issue on a very basic level recalcitrant? (Sambrani, 2016). Indeed, endeavors to portray ML calculations hypothetically have prompted mixes of measurable and computational hypothesis in which the objective is to at the same time portray the example intricacy (how much information are needed to adapt precisely) what's more; the computational intricacy (how much calculation is required) to determine how these rely upon components of the learning calculation such as the portrayal it utilizes for what it realizes. A particular type of computational examination that has demonstrated especially helpful in later a long time has been that of improvement hypothesis (Li et al., 2017).

Comprehensively speaking, Machine Learning calculations are of three sorts Supervised Learning, Unsupervised Learning, and Reinforcement Learning. Likewise, with any strategy, there are distinctive approaches to prepare Al calculations, each with their own benefits and burdens. To comprehend the advantages and disadvantages of each sort of Al, we should start by looking at the kind of information they consume. In machine learning, there are two types of data: labeled data and unlabeled data. In a completely machine-meaningful example, marked information contains both the information and yield bounds, but it still takes a lot of human effort to label the information. In a machine-intelligible structure, unlabeled information only has one or none of the boundaries. This negates the need for human labor, but it necessitates more complex structures (Rajeshwari, 2022).

Cloud Computing Characteristics

By making it easier for users to re-provision, add, or grow technological infrastructure resources, cloud computing can help organizations become more dynamic. Cloud service providers claim that their services help companies save money by converting capital expenses, such as server purchases, into operating expenses in a public-cloud distribution plan. This can lower entry barriers because infrastructure is typically provided by a third party and does not need to be purchased for one-time or infrequently demanding computer operations. The project includes several articles that delve into cost challenges, with most indicating that cost savings depend on the types of supported activities and the types of in-house resources available. (Gaur, Scotney, Parr & McClean, 2015).

Users have the ability to access systems using a web browser regardless of their location or the type of device they are using (such as a PC or mobile phone). This is made possible by off-site infrastructure, which is typically provided by a third-party and can be accessed over the internet, allowing users to connect from anywhere. Because cloud computing systems do not require installation on each user's device and may be accessed from multiple locations, they are easier to maintain (e.g., different work locations, while travelling, etc.). Data centralization in cloud computing may lead to improved security due to increased funding and attention to security concerns by service providers. However, there are concerns regarding the security of stored data and loss of control over important information. Despite these concerns, security in cloud computing is typically as good as or better than that of traditional networks since service providers can invest resources to address security vulnerabilities that many users may not have the ability or financial means to address. As data is spread over a wider area or more machines, and in multi-tenant networks shared by unrelated users, data protection becomes more challenging. It may be difficult for users to access security audit reports. Private cloud

deployments are motivated by users' need to maintain infrastructure control while safeguarding information security. Every consumer, from home users to professionals, wants to keep a backup of their receptive data. And large corporations who are unable to save highly developed data on their own servers choose to hand it over to a third party- Third parties have cloud service services so that they can retrieve data from the remote cloud at any time when it is required, when it is lost in their storage, or when they are unable to recover data due to natural disasters. As users store data in the cloud, they need assurance from service providers that their data is unmovable and that third parties have the right to access it (Jain & Jain, 2017).

"The primary motivation for most modern businesses and organizations to use cloud computing is to reduce infrastructure costs and benefit from information technology. This type of problem can result in the loss of services or a complete loss of data, as well as a number of systems collapsing for a period of time. when it comes to restoring missing data, data integrity is crucial. To meet all of the requirements, a well-organized data enhancement support method is required. The advancement of a cloud-based system cannot be embraced without taking into account the problems that can arise when only one data center is used- Natural and human-caused disasters often include disaster recovery which consists of a set of laws, mechanisms, and behavior to aid in the recovery or continuity of critical technology infrastructure and systems. The following features, such as data files are computed using structural scrambling random address technology (Zheng, Qi, Zhou, Chen, Zhan & Mr, 2014). To reduce the risk of a malfunction resulting in compromised privacy, to ensure service availability and data loss, providers used two or more clouds.

When we use many clouds at the same time, we reduce the chances of others obtaining public cloud resources for data and apps. The three most common barriers to using cloud services are reliability, price, and security. Using a multi-cloud architecture, an enterprise can have more autonomy and flexibility in selecting which workloads should be done and where they should be done. There are several definitions and explanations for cloud computing. Cloud computing allows users to access their data from any location and use their software programs on any device at any time. It is possible to create a o private or public cloud. Anyone with an Internet connection can use public clouds to buy services. A private cloud is a network with a distinct name that hosts services for a small group of people. Cloud computing, whether public or private, aims to provide users with quick and scalable access to computer resources and information technology services.

Followings are the objectives of the study

1. To develop a socio-fuzzy framework for evaluating the performance of the Infrastructure as a Service (IaaS) cloud computing model.
2. To identify and assess the key performance metrics influenced by social and technical factors in the IaaS service model.
3. To analyze the effectiveness of the socio-fuzzy evaluation approach in providing actionable insights for optimizing cloud computing service delivery.

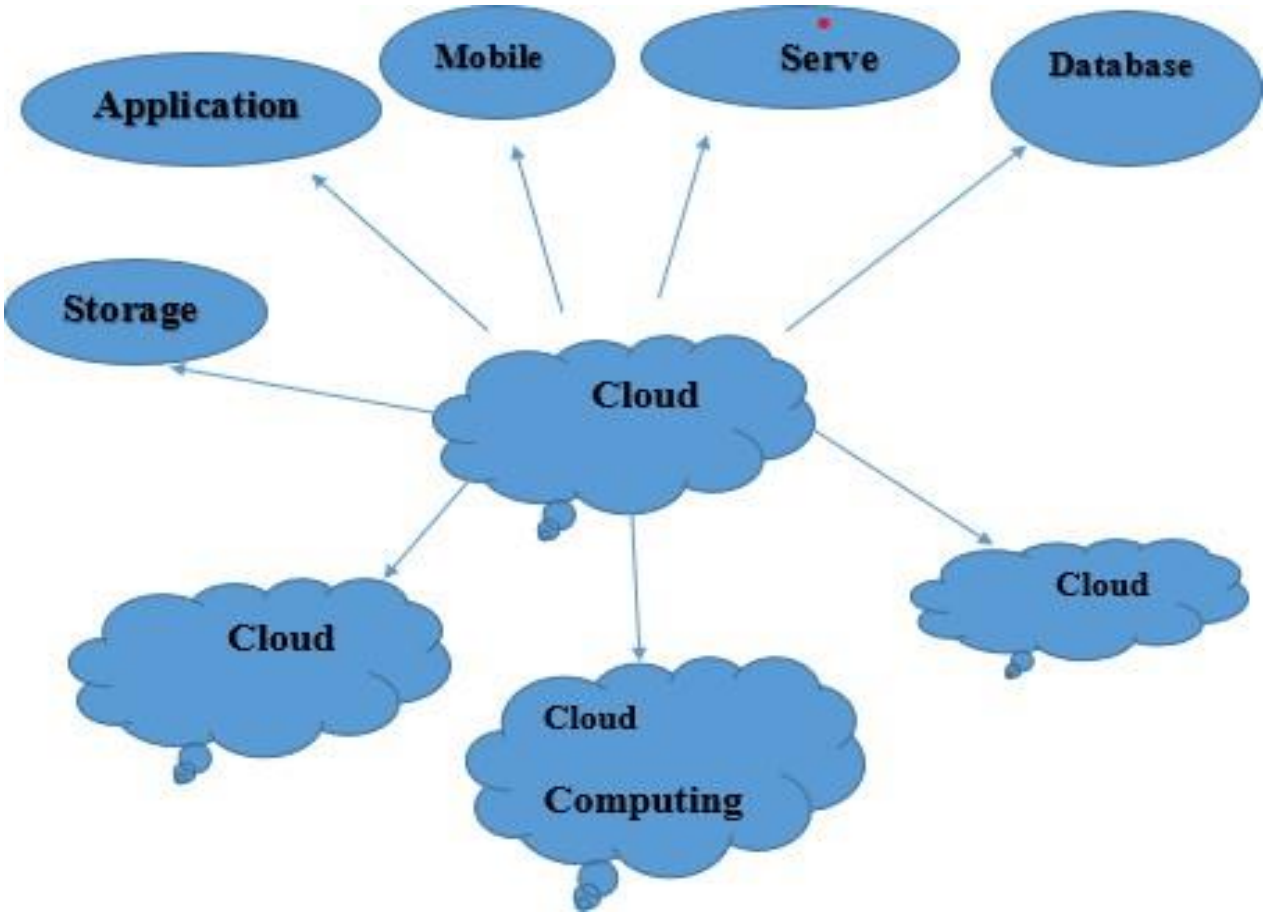


Figure 1:
Cloud Computing (Jain & Jain, 2017)

LITERATURE REVIEW

Disaster recovery strategies for information technology (IT) data, applications, and systems must be improved. IT encompasses data, networking, laptops, wireless devices, servers, networks, and desktops. The recovery time for an IT resource should be determined by its recovery time objective feature or mechanism. A complete IT system requires software, hardware, data, and networking, and the absence of any one of these components can cause the system to malfunction. A data recovery plan is crucial to preventing losses and unnecessary expenses for a company. Regardless of whether the disaster is caused by a major catastrophe like a fire, flood, or severe weather, or by human error, data theft, or another power outage, data recovery is the most important aspect of disaster recovery. A disaster recovery plan should outline the necessary steps to take in the event of a disaster, so that everyone is aware of what needs to be done.

Single Cloud Structural Design

Usman, Ahmad and He (2017) Applying the approach to scale scenarios can be difficult due to certain kernel configurations required. In this case, files are still segmented, and the replica technique based on chunk weight has led to the popularization of "portion placement." The authors also discuss a similar method and introduce PRESIDIO, a framework that reduces or minimizes repetition and evaluates similarity in object storage. In their work on optimizing file partitioning in a digital backup system, the authors present

a model demonstrating how a partitioned network can maintain high availability. Lindman, Kinnari and Rossi (2016) described that after the massive penetration of Cloud Computing, an ever-increasing number of designers are considering moving their applications to the Cloud, in close connection with application relocation, an expanding number of improvement and execution stages, conveyed as PaaS are putting forth their administrations for advancement, sending, and execution of uses that are utilizing as a part of an ideal way the five attributes of the Cloud. Cunningham (2015) the presentation of a brought together segment, the Cloud Governance, is fundamental maintenance in intelligence the last part ambition to empower the improvement of complex single cloud environments. This brought together part is expanding, supplementing, finishing and incorporating center elements from the PaaS layer, such observing provisioning, arrangement, and others, and coordinate elements of the different Cloud recovery system.

Multi Clouds Structural Design

Gaur, Scotney, Parr and McClean (2015) described that the conception of a multi-Cloud backup system has been expanded beyond individual viewers to Cloud operators who want dependable storage as a service. As a result, a generic private, public, or hybrid Data center controller in need of distant storage space, dubbed Home Cloud, can rely on a theoretically endless hybrid Multi-Cloud Storage (MCS) space made up of various Cloud Storage capabilities offered by multiple owners. We designed an MCS module Prototype for this purpose, which allows a home Cloud to use a hybrid multi-cloud storage system. There are two types of methodologies in many Clouds: Federalized Computing and Multi-Cloud. The Degree of coherence between the Clouds involved, as well as the users contact with the Clouds, affects the difference; according to the various Cloud vendors in the first model have agreed to share their resources, whereas there is no such agreement in the second model. The two models are classified in the same way based on the type of co - operation: voluntarily, in Federation, or not, in Multi-Cloud- In the first model, the user interacts with one Cloud and is unaware that the information or functions used belong to a different Cloud. In the second model, the subscriber is familiar of the many Clouds and is authorized for service or resource delivery, or a third party is. The term Multi-Cloud can refer to a client's or a services utilization of several and independent Clouds, according to the above classification and proposal.

The Federated Cloud meets the needs of Cloud providers. The key driving force is the necessity for N9, for the most part to attain fresh wherewithal owed to the scarcity of existing ones? Conversely, N2 and N4 can also be there causes for its use, particularly in the case of regional limits or internal cost-cutting policies. The Multi-Cloud approach meets the needs of cloud clients. Thomas and Valvano (1992) the fusion in academic institutions, Cloud is following the Grid approach by developing Community Clouds, such as Open Cirrus (openeirrus.org). Agreements between large Cloud providers, on the other hand, are difficult to reach, especially when the external provider is expected to contribute resources services for the internal provider's advantage. Zheng, Qi, Zhou, Chen, Zhan and Mr (2014) described that for long-term sustainability, a company must have a disaster recovery plan in place. Virtualization technology makes hardware independent of the systems it runs on, allowing operating systems, software apparatus, and companies to move data to the cloud while improving financial efficiency, growing number of cloud service providers enables their customers to recover from disasters faster and with Less down-time. Sensitive programmers. for example, are held on Amazon's cloud in different data centers around the globe. Amazon's employees have been unable to achieve a completely functional design. When a short-phase disruption occurs at one site, the

consumer is notified and the program is shifted to another location automatically. Any interfaces and processes that rely on this application are protected by electrical systems. For disaster recovery to be successful, information that is critical to a must be backed up on a regular basis and securely stored in multiple. Beyond the production-ready management tools, the research community is working hard to enable the development of novel Multi-Cloud solutions. We only name a few of them in this section. Does a more in-depth investigation. A multitude of causes can lead to vendor lock-in, including services with solid financial preservation, a scarcity of complete applicability of specifications, exclusive APIs, and so on. The issue is not always a result of vendor preferences, but it can be a reflection of the wide range of hardware and software stacks that are required to develop a Cloud examine.

This layout should always be defined by translating the development platform, including its subsystems and relationships, onto a variety of offerings while keeping performance, cost, and security constraints in mind, In this study, we specifically address four performance constraints that are relevant to achieving the resource requirements of 85 each instance type in terms of computational resources use take into account the overall application's perceived performances which is normally measured outside requisites of reaction time and throughput. In terms of security. we're looking for a deployment option that lets us to meet existing security criteria for each individual component as well as the application 90 as a whole. Furthermore, we assume that Service Level Agreements (SLAs) be used to express the security features of both available cloud services and built components and applications Gamez (2008).

Data Costs

The rate of data improvement is expected to be lower. According to the percentage of users, the lower the rate of data recovery, the better: this low cost is the answer magnetism in favor of the consumer. Cost is a significant thought while utilizing cloud assets. Subsequently, regardless of whether a client may essentially need to speed up an information escalated task through scaling up in the cloud, the caused cost might be restrictive. The client may hence acknowledge a more extended fruition time for brought down costs. This would regularly infer that a piece of the cloud-occupant information will be executed by neighborhood assets. The general objective for this method of execution is to limit the season of execution while remaining under a client indicated cost requirement. It ought to be noticed that the compromise between the expense and season of execution is nontrivial for two reasons. In the first place, in most cloud conditions today. there is an expense related with recovering information for handling outside of the cloud (Bonvin, Papaioannou and Aberer, 2009).

Second, the expense is subject to not just the quantity of cases utilized, yet how long they are utilized. information proprietor rents extra room in information workers in a few servers all throughout the planet and pays a month to month utilization based genuine lease. Each virtual hub is answerable for the information in its vital reach and ought to consistently attempt to keep information accessibility over a specific least degree of certainty while limiting the related expenses (for example dormancy and cost). To this end, a virtual hub can be accepted to go about as an independent specialist for the information proprietor to accomplish these objectives. Time is thought to be parted in ages. Badhel and Chole (2015) at every age, a virtual hub might recreate or relocate its information to another worker or self-destruction (for example erases its information copy). It additionally pays a virtual lease, which is characterized later in this segment and it is an intermediary of the conceivable genuine lease, to the worker where its information is put

away. These choices are made dependent on the question rate for the virtual hub, the leasing costs and the upkeep of high accessibility upon disappointments. There is no worldwide coordination and each virtual hub acts freely, e virtual tease of every worker is reported at a board and is refreshed toward the start of another age.

Data Integrity

Data integrity is a crucial aspect of backup and recovery services, as it ensures that the server's state and structure are complete and unchanged during transmission and collection. It is a measure of the trustworthiness and reliability of the information on the server. Data integrity is also concerned with the validity and accuracy of data throughout its lifecycle, and organizations place a high emphasis on it to avoid compromised data and associated risks. Various factors can harm data integrity, but it can be preserved by duplicating or transferring data without any intentional tampering. To maintain data integrity, error checking methods and validation procedures are often employed. Manzoor, Taha and Suri (2016) in case to take a well-organized cloud service, it can be meet the user's Privacy safety demand and trust. This article preferred a cloud service assessment model based on privacy- up to date and trust. The model launches the time failure factor to explain the problem that the trust passage changes extra, proceed into account independent deal amount given independent weights, it maps the straight trust determining process based on combining weights and service attributes, revolving the straight trust timeliness, coherence. simultaneously, the model takes a Standard cloud model of a technique for privacy data safety, in case the user can select authentically, trusted operation to interact (Wagle, Guzek, Bouvry & Bisdorff, 2015).

Data Confidentiality

User data files must always be kept private; File formats that are personal to a single client must be smart enough to hide from those other clients on the clouds when accessed, even if a large number of users are using the cloud at the same time. Data Confidentiality manages securing against the disclostire of data by guaranteeing that the information is restricted to those approved or by addressing the information so that its semantics stay available just to the individuals who have some basic data (e.g., a key for sorting out the enciphered data). A critical component of privacy is that it helps assemble trust. To have their data shared isn't just a break in protection; however, it will annihilate representative trust, certainty and unwaveringness. It will likewise cause a misfortune in efficiency. Severe information insurance rules Should be followed while overseeing private data. Financial position of the company by cutting procurement cost and enhancing operational productivity.

Business must find best potential return on every dollar they spend in the order to compete successfully, obtain the resources they need to expand and develop, and generate a healthy bottom line. Finding ways to attain and improve cost-effective is a critical component of any long-term business plan. Cost efficiency approaches, being one of the most widely employed business efficiency tactics today, may be used effectively by enterprises of all sizes and sorts (Shaik & Sasikumar, 2014) Cost-cutting methods, when combined with the correct software and digital technologies, may help businesses make more strategic decisions that drive innovation, transform procurement into a value-creation center, md lower operating costs while enhancing operational efficiency and profitability. In a commercial cloud computing environment, wireless carriers have their oven priced systems for billing consumers. The three basic categories comprising cloud resources are computation, storage, and bandwidth. This section has provided a detail

review of research conducted by other scientists in relevant domains like cost efficiency, data integrity and remote data backup system. From distributed networks to the role of agency in cloud computing is covered along with emerging trends and challenges in the domain of disaster recovery or more precisely intelligent cloud computing. Existing work has shown the interest and efforts done by many researchers in the domains related to problem statement there are various solutions proposed for disaster recovery in terms of storage, intelligence, and service management and performance measurement. All these segments give directions to establish a model for an evolvable and recovery in clouds.

METHODOLOGY

Fuzzy memory is a type of logic in furzy mathematics where the actual value can be a real number between 0 and I, inclusive. Its being worn to arrangement with halt- truth. Where in the true value ranges from absolutely true to absolutely false. However, in Boolean logic, a variables true value can only be the input variable 0 and 1. However, fuzzy logic had been studies as infinite-valued logic since 1920s, primarily by UKasiewicz and Tarsk. These approaches can identity, define. Modify. Analyze, and utilize ambiguous and unreliable relevant data. From systems engineering to artificial intelligence, fuzzy logic has been employed in a range of applications. Fuzzy logic is a type of processing that uses "levels of validity" instead of the true or false" (1 or 0) Boolean logic that currently underpins computers. Consider fuzzy logic to be the true essence of thinking. and basic, or logical. Reasoning to be a component of that as well.

Capability of Proposed Fuzzy System

1. The suggested Platform's capabilities include determining the categorization of services supplied by server fewer computing providers, managing the variety of various operations offered by various recovery vendors, and classifying readily available cloud goods through the network, management of versatility of different services offered by various recovery vendors classified readily available cloud products over the network.
2. Fuzzy logic is widely used in various AI systems and technologies such as machine navigation, consumer electronics, medicine, software, chemicals, and aerospace, among others.
3. Gears selection in automobiles is an example where fuzzy logic is employed, taking into account factors like engine load, traffic environment, and driving approach.
4. In dishwashers, fuzzy logic is utilized to determine the washing approach and produce a quality that seems to be based on factors such as the type of dishes and the amount of food residue on dishes. • Fuzzy logic is also used in fax machines to modify the drum voltage based on variables such as humidity, visual frequency, and altitude.
5. The aircraft industry employs fuzzy logic to govern satellite and spacecraft altitude control based on environmental parameters.
6. In natural language processing, fuzzy logic is used to detect semantic relationships between words and other linguistic characteristics.
7. Fuzzy logic is utilized in environmental control systems like air conditioners and heaters to regulate output based on factors such as present temperature and goal temperature.
8. Fuzzy logic has various applications in decision-making systems, including business rules engines. It allows for dealing with partial truth, where the truth value can be somewhere between true and false, using many-valued logic. In a fuzzy inference system, variables' truth values can range from 0 to 1, and rules are used to assign responsibilities to the output vector based on the interpreted values of the input vector. Fuzzy logic is useful when the

truth of a sentence cannot be determined as entirely true or entirely false, but instead becomes a matter of degree.

Evaluating Socio Fuzzy Based Performance Evaluation of Cloud Computing Service Model

The proposed model for evaluating the performance evaluation of cloud computing service model of following five major modules which are shown in figure.

1. Availability
2. Security
3. Reliability
4. Outage

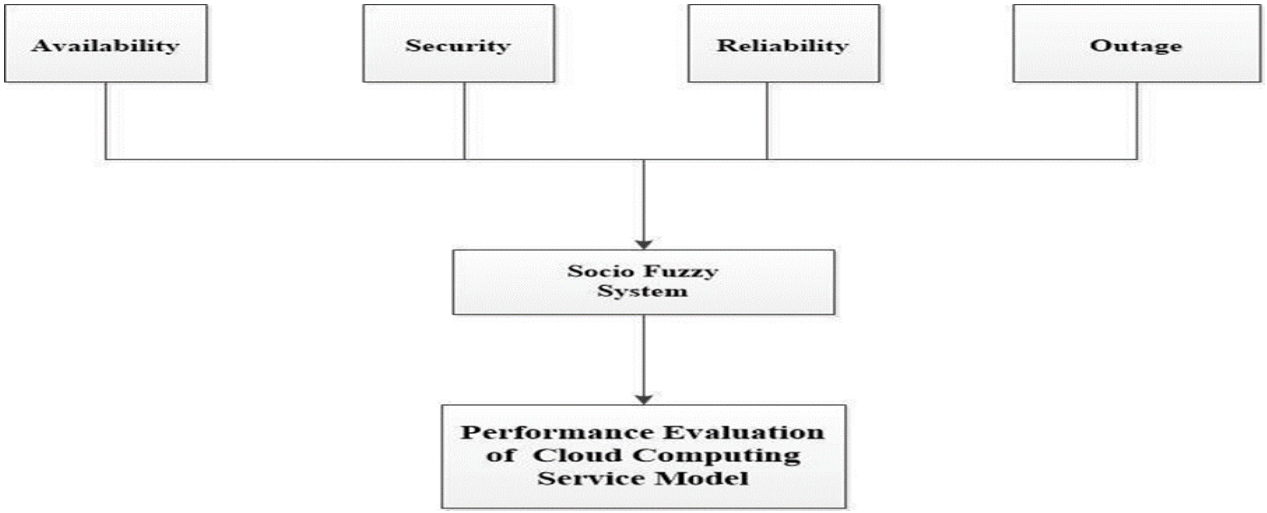


Figure 2:
Proposed Model for Evaluating SFPEC

In this processing stage, a specific number is turned into a fuzzy linguist variable (fuzzification), each applicable rule (or data) is triggered, and a result is generated for each, and then the results are merged (inference). Finally, the combined result is turned back into a specified control output value in the output value in the output step (defuzzification).

Design Challenges

The autonomous cloud service discovery, validation, verification, and cloud service classification is complex task due to heterogenous structure of cloud system. Designing cloud services classification, different types of challenges in order to collect the desired datasets.

Multi-Cloud Services

The word of intercloud and cloud-of-cloud which are similar to multi-cloud. These concepts imply that cloud computing does not have to be Limited to a single cloud. In their example, a gloomy sky combines numerous hues and pattens of clouds, resulting in a variety of implementations and administrative worlds. Recent research has focused on the multi-cloud environment. Which handles multiple clouds without relying on any one of them. In a multi-cloud there are two layers: the inner-cloud at the bottom and the inter-cloud at the top. In the interclouds, the Byzantine fault resistance finds a home. We will

start by going over the preceding three decades' worth of Byzantine protocols. Byzantine faults are software or hardware problems in cloud that typically pertain to inappropriate behavior and intrusion resistance. There are also arbitrary and crash faults in it. Byzantine Fault tolerance has been the subject of extensive research since its inception (BFT).

Standardization Issue of Multi Cloud

Furthermore, many people think of BFT as a cloud service that is only of academic interest. "This lack of interest in BFT contrasts sharply with the degree crash fault tolerance mechanisms used in large-scale systems. As previously stated, BFT protocols are not suitable for single clouds. According to Vukolic, one of the disadvantages of BFT for the inner-cloud is that it, like fault-tolerant protocols, requires a high degree of failure independence. It- a cloud node encounters Byzantine failure, it is reasonable to utilize a different operating system, implementation, and hardware to prevent the failure from spreading to other cloud nodes. Furthermore, if a specific cloud is targeted, the Attacker may be able to gain control of the cloud's the inside equipment.

Proposed Evaluating Socio Fuzzy Based Performance Evaluation Of Cloud Computing Service Model

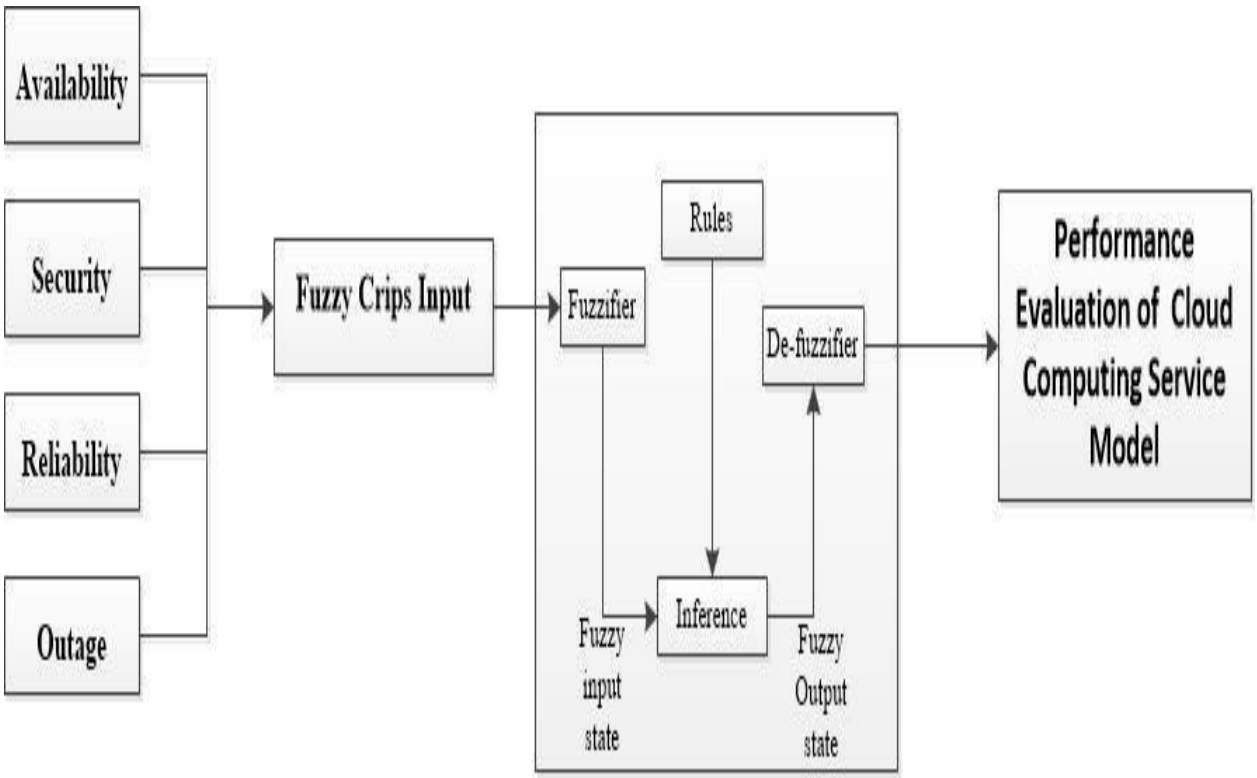


Figure 3:
Proposed Model for SFPEC

The proposed socio fuzzy based performance evaluation of cloud computing service model and elaborated different modules from connectivity and processing perspective. As per our research objectives, this model is designed to provide autonomous self-evolving mechanism as explained in learning module and memories. On the other hand, it is also capable of analyzing the recovery properties and categorizes it according to evaluation performance as discussed in relevance and disaster modules. Machine leaning module has been explained to expose the potential and possibilities to address big data or 10T

problems by having an intelligent cloud recovery performance. An important module is performance analyzer which perform evaluation of candidate clouds with dynamic parameters — as it is presumed that emerging technology is changing swiftly therefore, fixed / certain parameters may fulfill the requirements of this research but may not be able to cope up with future demands, The overall model provides the modular explanation of a cloud evaluation performance of disaster recovery which may act as a central platform for various cloud services along with autonomy and self-evolving features. This chapter covers the validation of our thought and arte fact. We have proposed a detail algorithm to explain the functionality and different criterion in our proposed recovery system for member evaluation performance. Visualization explains the flow and the interactivity of the algorithm which starts from the first phase of SFPEC model.

RESULTS AND DISCUSSIONS

Simulations and Results MATLAB 2014 is used to generate simulation results. MATLAB is also used in modeling, simulation, algorithm development, prototyping, and variety of other industries. Three data inputs and one output parameter are used to reproduce the results. The proposed based SF-PEC in this article not only identifies output, but also illustrates many sorts of output, such as SF-PEC base on the rules present in the lookup, a lookup rules diagram is build using fuzzy logic design. Cloud Evolution Management In intelligent evaluation performance of service model recovery in cloud system, automation of cloud services according to the service model can result in cloud evolution. Cloud service management performing clustering the cloud services within service model and helpful for categorization/classification of cloud services. The evaluation performance in cloud system is interconnected with cloud resources, different cloud services, seller, reseller and applications for cloud users.

The evaluation performance in cloud system may include big data application hubs, big data cloud plug-ins, big data analytical tools and different big data resources. Due to evaluating structure of cloud services, many parameters can be used for cloud management in the evaluation performance of disaster recovery in cloud system. Selecting different parameters based on user preferences can reflect the dynamism in the cloud. Evaluation performance of disaster recovery in cloud system is a broader term where many stack holders can take part in defining the homogeneous and heterogeneity properties within different categories of cloud services. Within evaluation performance of disaster recovery in cloud system, the following parameter can be used to define the progress of a certain part of the evaluation performance of disaster recovery in cloud system.

1. Data Availability
2. Data Security
3. Data Reliability
4. Data Outage

Input Fuzzy Sets

This system's membership function provides curve output values lunging from 0 to 100, as well as a mathematical function that generates numerical parameters for input and output variables. The first layer (Data Dependency, Data Cost, Data Security, Data Storage, and Data Reliability) considered as level 1; rest of layer is correspondence.

Table 1:
Input Variable Range

Sr #	Input Parameters	Ranges	Semantic Sign
1	Data Availability	[0 0 20 25] [20 35 60 65] [60 65 100100]	Low Average High
2	Data Reliability	[0 0 20 30] [20 30 70 80] [70 80 100100]	Low Average High
3	Data Security	[0 0 20 30] [20 30 70 80] [70 80 100100]	Public Semi-public Private
4	Data Outage	[0 0 20 30] [20 30 80 90] [80 90 100 100]	Incapable Moderate Capable

Rule based

In FIS, I/O Rules play a crucial role. These rules are used to create the fuzzy inference system (FIS). I/O rules are generated in this chapter using a lookup table, which may be found in Table II Below is a proposed I/O rule that is dependent on FIS

Membership Function

The membership function is an important component of fuzzy logic, which represents the curve values that range between 0 and 100. It is a mathematical notation used for input and output variables. The proposed SFPEC system has been represented in Table 1 for layer 1, including the FIS input/output variables with graphical and mathematical representation. The table also shows the FIS input/output variables of layer 2, along with their graphical and mathematical representations. Rows 1-5 in Table 1 represent the input membership function, while row 6 represents the output membership function.

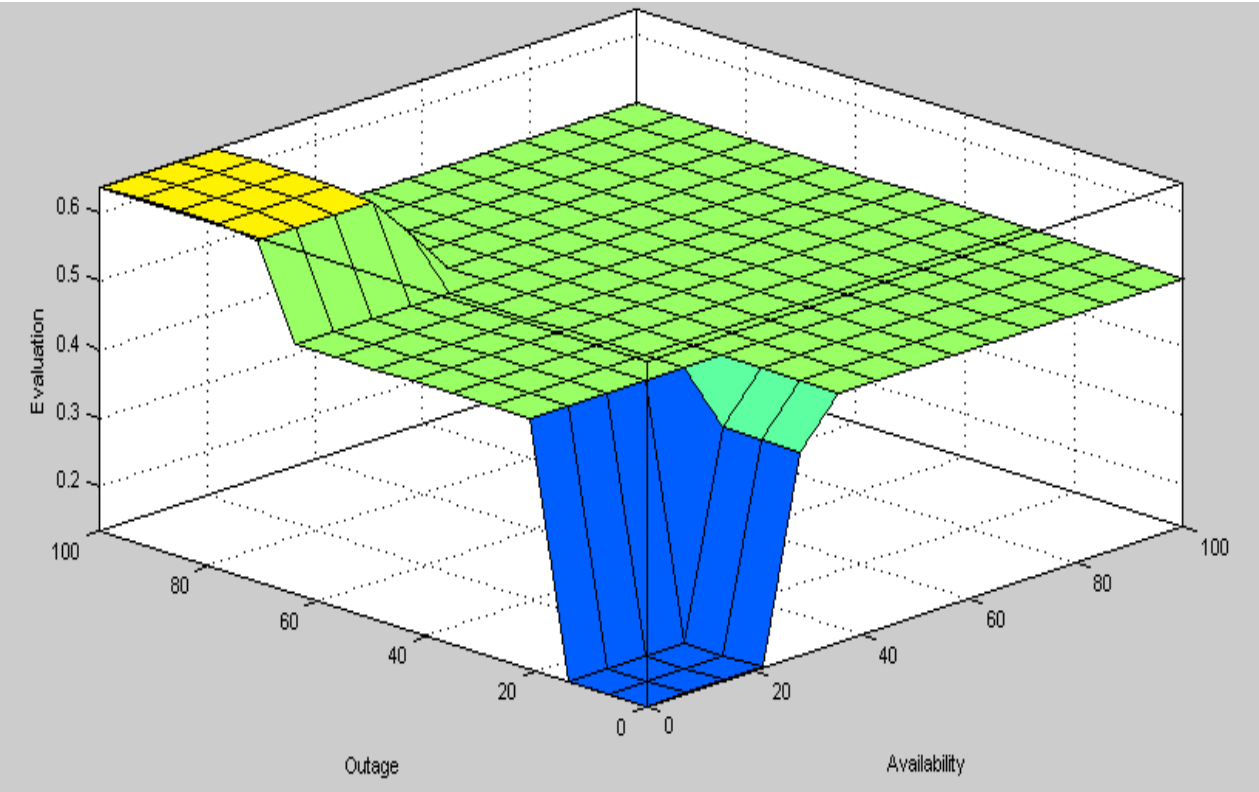
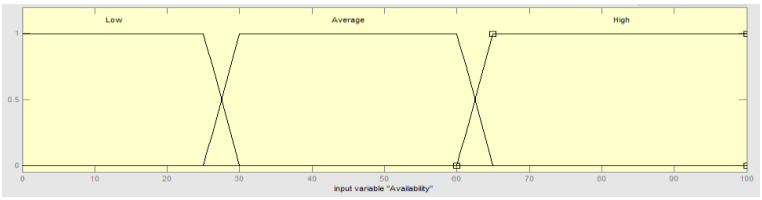
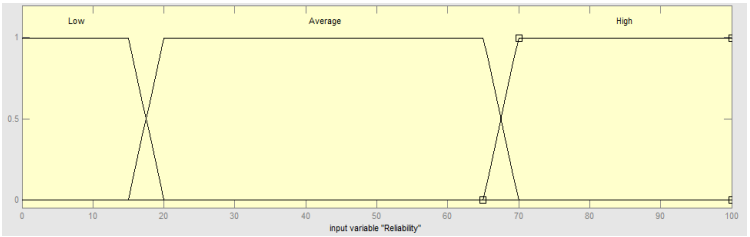
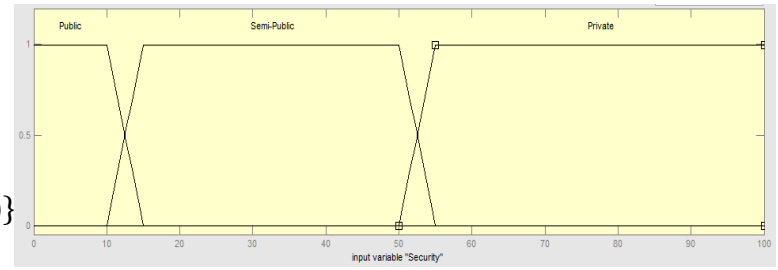
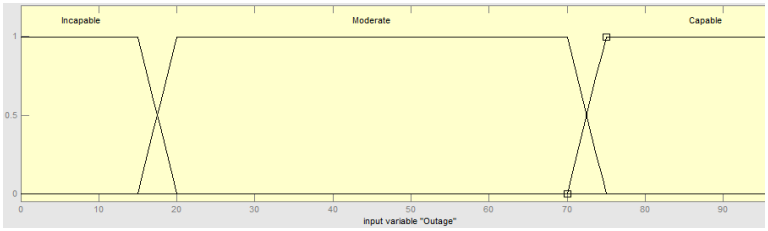


Figure 4:
Surface of Proposed Rule SF-PEC based on Outage along with Availability

Table 2:
Input/output Variables Membership Function Proposed SFPEC

Input/ Output	Membership Function	Graphical Representation of SFPEC
A=μ D, C(a)	μA (a) = {max (($\frac{30-a}{5}$), 0)}5 μA (a)= {max (($\frac{a-25}{55}$,1, ($\frac{65-a}{5}$), 0)} μA (a) = {max (($\frac{a-60}{5}$,1), 0)}5	
R= μ D, C(r)	μR (R) = {max ((1, $\frac{20-r}{5}$), 0)}5 μR (R) = {max (($\frac{r-15}{5}$,1, $\frac{70-r}{5}$), 0)} μR (R) = {max (($\frac{r-65}{5}$,1), 0)}	
S= μ D, C(S)	μS(S) = {max ((1,$\frac{15-s}{5}$), 0)} μS (S = {max (($\frac{r-10}{5}$,1, $\frac{55-a}{5}$), 0)} μS (S) = {max (($\frac{a-50}{5}$,1), 0)}	
R= μ D, C(O)	μO (O) = {max ((1,$\frac{20-o}{5}$), 0)} μO (O) = {max (($\frac{o-15}{5}$,1,$\frac{75-o}{5}$), 0)} μO (O) = {max (($\frac{o-70}{5}$,1), 0)}5	

Output Variables

Table 3:
Output Variable Ranges

Sr #	Output of SFPEC	Ranges	Semantic Sign
1	Performance	0 0 0.25 0.3	Low
2	Evaluation	0.25 0.3 0.7 0.75	Average
		0.7 0.75 0.7 0.75	High

FIS Defuzzification for Case-2

Figure 4.2 Represent the 3D view of surface of proposed Rule SF-PEC based on Data Realibility and data availability. It Observed that SF-PEC Good (Yellow shade), Week or Poor (Bluish shade) otherwise Satisfactory results (Greenish Shade).

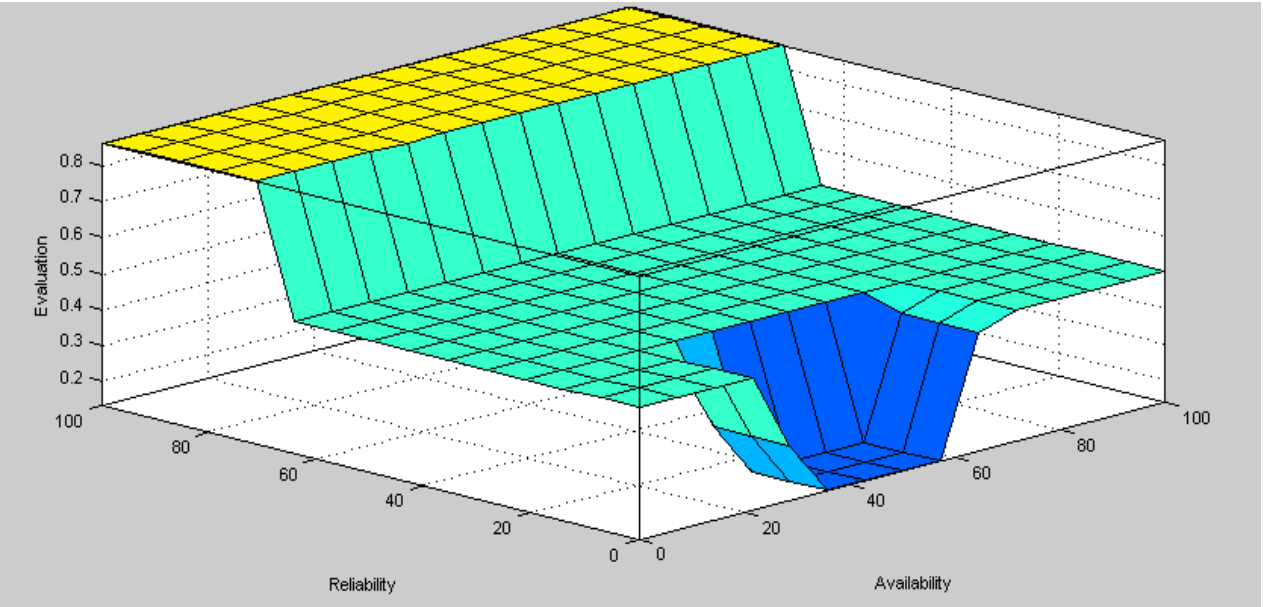


Figure 5:
Surface of Proposed Rule SF-PEC based on Reliability along with Availability

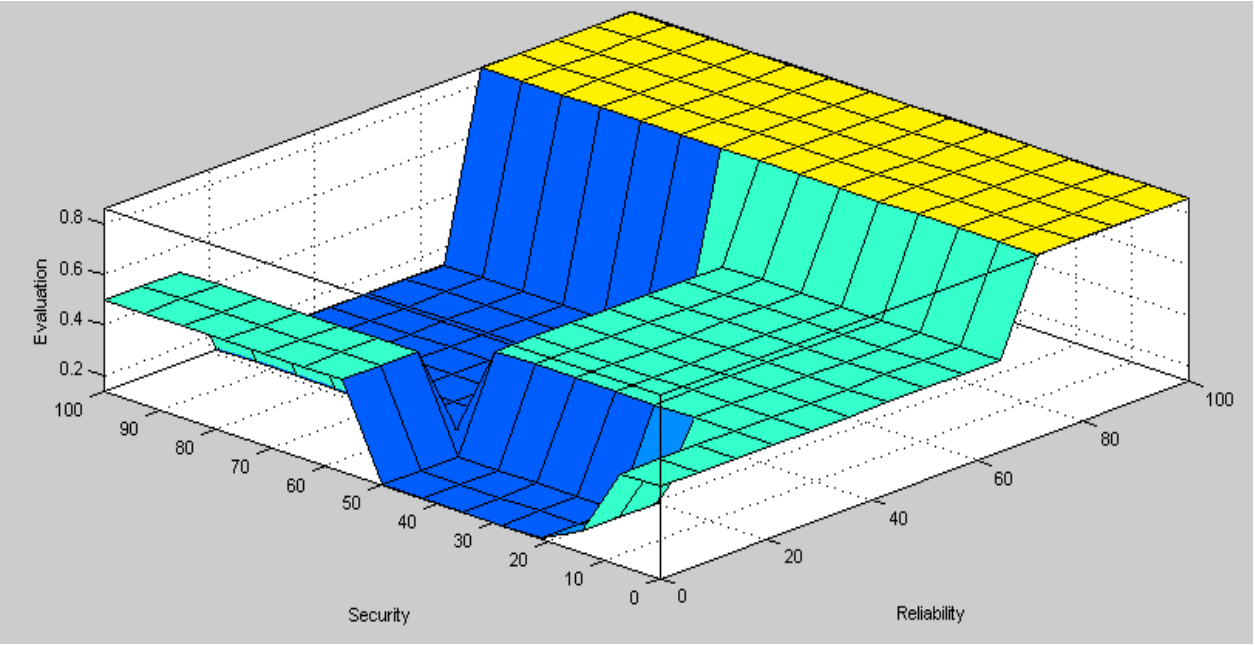


Figure 6:
Surface of Proposed Rule SF-PEC based on Security along with Reliability

FIS Defuzzification for Case-3

Figure 4.3 Represent the 3D view of surface of proposed Rule SF-PEC based on Data outage and data availability. It Observed that SF-PEC Good (Yellow shade), Week or Poor (Bluish shade) otherwise Satisfactory results (Greenish Shade).

SIMULATION AND RESULTS

Lookup Diagram for Case 1: Figure 4.4 shows that if the availability is low and security is private and reliability is average and outage is moderate the performance evulation is Normal.

Figure 7:
Lookup diagram for porposed SF-PEC

Lookup Diagram for Case 2: Figure 4.5 shows that if the avability is low and security is

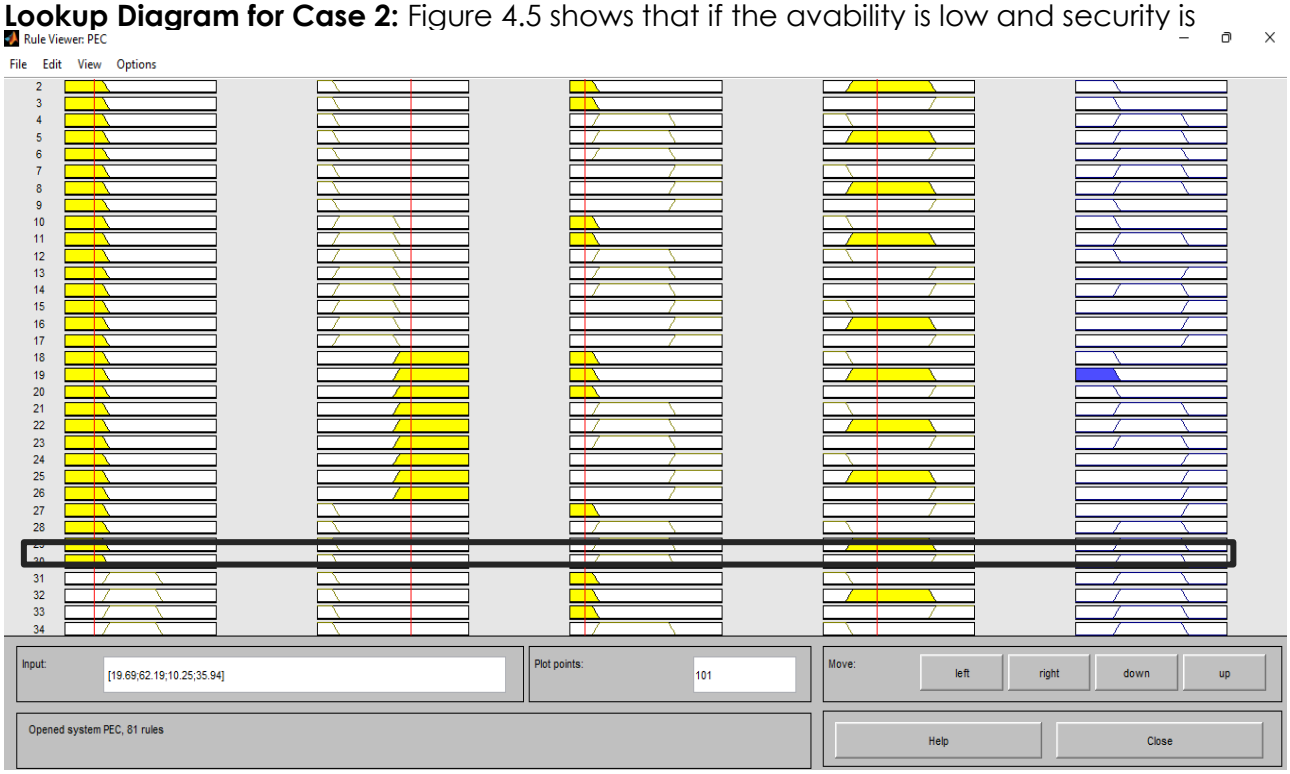


Figure 8:
Lookup diagram for porposed SF-PEC

Lookup Diagram for Case 2: Figure 4.5 shows that if the avability is low security is Semi-Public and rebility is high and outage is Moderate then Performance evulation is High.

Figure 9:
Lookup diagram for porposed SF-PEC

CONCLUSION

Cloud computing and infrastructure is a rapidly growing technology at individual and corporate level. This fast pace desired the establishment of such measures which can regularize the expansion i.e., instead of a mushroom growth like world wide web, it is important to provide a central platform to cloud services for better management and governance. The cloud platform, storage, and network are all part of the environment. Infrastructural and security issues that develop as a result of Single- Cloud provider manage both apps and data. sensitive information, such as medical records, is uploaded for safekeeping. Users, on the other hand, on the cloud, they have no control over their data. It's impossible to know if the data is being misappropriated. In a Single-Cloud setting, data owners are unable to access their data. Ensure that the data is secure. The cloud is completely under your control provided by the service provider developing a relationship of trust with a cloud service the choice of a provider is crucial in deciding whether or not to relocate cloud. There are a number of other variables that could put distrust taking place the protection of the system.

Employees who may or may not be trustworthy are among the sources of data in the cloud. Employees that are interested and may compete with or upset the company owner of the data Employees of cloud service companies and several cloud tune providers cloud service companies have tampered with confidential information. The data is kept during cloud. A single cloud setup may perhaps furthermore experience significant management costs for big amounts of data, as well as data loss issues. Data security is ensured by distributing data and applications over multiple clouds. This multi cloud design ensures soaring records accessibility while also corresponding tons, managing resources, and securely storing data. The records holder possibly will have faith in the cloud owner ability to protect their numbers. This framework also facilitates the

integration of private and public clouds, resulting in increased transparency, flexibility, and resource management efficiency. Homomorphism-based encryption and decryption are necessary in this idea. The management layer is an essential component of a Multi-Cloud system's design, allowing for data and application sharing, integration, load balancing, and other functions. Each cloud was only a few inches in diameter. It is in charge of the process' execution. If sensitive data is to be stored on the cloud, security is essential. be safeguarded prevent appropriation or other types of disruption Data owners who upload sensitive data to the cloud must employ cloud properties like scalability and device mobility with caution. Two advantages are independence and remote access. The data of cloud users is protected by the cloud service provider, who may or may not be a trustworthy third party with a direct involvement.

In a single cloud setup, data stealing can occur when any aspect of the cloud is compromised, therefore security must always be questioned. Data theft does not occur when encrypted data is distributed across numerous clouds since a single-cloud architecture is insufficient for a bad influence to access all data. As a result, a multi- cloud design provides the essential data protection in the cloud. High Availability: In a Service Level Agreement (SLA), uptime is an important statistic for service quality. When one section of the network becomes delayed in a multi-cloud architecture Even when a DRP is in place and staffs have been trained to use it, disaster recovery poses various problems. It's possible that DR won't go as planned. After a calamity, they may out to be insufT1cient. The A natural disaster's enormity cannot be predicted at any same time, an organization may face multiple disasters. It's nearly impossible to plan for this situation. As a consequence, there will be some data loss. DR necessitates collaboration amongst multiple departments; simple sharing it may be difficult to share accurate information among organizations. It is difficult to maintain communication before, during, and after a disaster. Communication is difficult during and immediately after a conflict. In some circumstances, knowledge becomes obsolete fast, while in others, communication channels may collapse.

For these reasons, DRPs frequently include test procedures in which various levels of disasters are simulated; the study of the outcomes can aid in the plan's refinement. More serious recovery concerns develop when backups are damaged or the backup process fails. Several firms that encounter large-scale data damage and/or disruption discover that recovery does not deliver the desired answers because the media are unusable or the data cannot be restored. Setting up a procedure that retrieves data from the backup medium, restores it, and reviews it on a regular basis is the simplest method to deal with this danger. This approach should investigate the causes of any test failures in Order to identify and correct backup problems. eight stages of the DR process for resolving defect are recognize, react, recover, restore return to normal, rest and relax, reevaluation, and re-documentation. The goal and boundaries of a healing process should be investigated initially. This step should encompass employee safety and critical business functions (CBFs). When a disaster is declared, all required personnel should be alerted, and a disaster recovery plan should be implemented. Management and the staff in charge of recovery plan should be implement. Management and staff in charge of disaster recovery should lead the response to the incident. They determine the course of action to be taken, and then key systems should be restored. At this stage, if necessary, migration to another institution may be initiated, fie systems that had been identified beforehand are then restored. After the exercise is completed, the entire process should be evaluated to establish an organization's strengths and shortcomings in the event of a disaster.

DECLARATIONS

Acknowledgement: We appreciate the generous support from all the supervisors and their different affiliations.
Funding: No funding body in the public, private, or nonprofit sectors provided a particular grant for this research.
Availability of data and material: In the approach, the data sources for the variables are stated.
Authors' contributions: Each author participated equally to the creation of this work.
Conflicts of Interests: The authors declare no conflict of interest.
Consent to Participate: Yes
Consent for publication and Ethical approval: Because this study does not include human or animal data, ethical approval is not required for publication. All authors have given their consent.

REFERENCES

Abreu, T., Moreira, J. R., Minussi, C.R., Lotufo, A.D.P. and Lopes, M.L.M, (2019). Short-term multinodal load forecasting using a fuzzy-artmap neural network. 2019 IEEE PES Conference on Innovative Smart Grid Technologies, ISGT Latin America, 8(4), 1-6. doi:10.1109/ISGT-LA.2019.8895486

Abualkishik, A.Z., Alwan, A.A. and Gulzar, Y. (2020). Disaster recovery in cloud computing systems: An overview. International Journal of Advanced Computer Science and Applications, 11(9), 702-710.doi:10.14569/IJACSA.2020.0110984

Alzain, M.A., Pardede, E, soh, B. and Thom, J.A. (2012). Cloud computing security: From single to multi-clouds. Proceedings of the Annual Hawaii International Conference on System Sciences, 65(9), 5490-5499.https://doi.org/10.1109/HICSS.2012.153

Alshammari, M.M., Alwan, A.A., Nordin, A. and Al-Shaikhli, I.F. (2018). Disaster recovery in single-cloud and multi-cloud environments: Issues and challenges. 4th IEEE International Conference on Engineering Technologies and Applied Sciences, ICETAS, 65(2), 1-7. https://doi.org/10.1109/1CETAS.2017.8277868

Bangui, Fl., Buhnova, B., Rakrak, S. and Raghay, S. (2017). Smart mobile technologies for the city of the future. In 2017 Smart City Symposium Prague (SCSP), 7(1), (pp. 1-6). IEEE doi: 10.1109/SCSP.2017.7973851

Badhel, S.P. and Chole, V. (2015). An efficient and secure remote data back-up technique for cloud computing. International Journal of Computer Science and Mobile Computing, 4(6), 361-369. https://www.ijcsmc.com/docs/papers/June2015/V4I6201584.pdf

Bedi, RK., Singh, J. and Gupta, S.K. (2019). MWC: an efficient and secure multi- cloud storage approach to leverage augmentation of multi-cloud storage services on mobile devices using fog computing. Journal of Supercomputing, 75(6), 3264-3287. doi:10.1007/s11227-018-2304-y

Bessani, A., Correia, M., Quaresma, B., André, F., & Sousa, P. (2013). DepSky: dependable and secure storage in a cloud-of-clouds. Acm transactions on storage (tos), 9(4), 1-33. https://doi.org/10.1145/2535929

Bonvin, N., Papaioannou, T.G. and Aberer, K, (2009). Dynamic cost-efficient replication in data clouds. In Proceedings of the 1st Workshop on Automated Control for Datacenters and Clouds, 7(3), 49-56.https://doi.org/10.1145/1555271.1555283

Botta, A, De-Donato, W., Persico, V. and Pescapé, A. (2016). Integration of cloud computing and internet of things: A survey. Future Generation Computer Systems, 56(14), 684-700. https://doi.org/10.1016/j.future.2015.09.021

Brazdil. P.B, and Soares. C. (2000). A comparison of ranking methods classification algorithm selection. In European Conference on Machine Learning, 74(3), 63-75. doi:10.1007/3-540-45164-1_8.

Calcaterra, D., Cartelli. V., Di Modica. G. and Tomarchio, O. (2019). A comparison of multi-cloud provisioning platform. 81(4), 507-514.doi:10.5220/0007765005070514

Castejón, H.N.. Gavras. A., Gonçalves. J.M., Moiso, C., Undheirn, A. and Zoric, J. (2011). Towards a dynamic cloud-enabled service eco-system. 2011 15th International Conference on

Intelligence in Next Generation Networks, 21(7), (pp. 259-264. doi: 10.1109/ICIN.2011.6081086

Chen, Nf., Ma, Y., Li, Y., wu, D, Zhang, Y. and Youn, c.H. (2017). Wearable 2.0: Enabling human-cloud integration in next generation healthcare systems. IEEE Communications Magazine, 55(1), 54-61. doi: 10.1109/MCOM.2017.1600410CM

Chen, Z.N, Chen, K, Jiang, JL., Zhang, L.F., wu, S., Qi, Z.W., Hu, c.NL wu. Y.w., sun, Y.z., Tang, H, sun, AB. and Kang, Z-L. (2017). Evolution of cloud operating system: From technology to ecosystem. Journal of Computer Science and Technology, 32(2), 224-241. doi: 10.1007/s11390-017-1717-z.

Choo, K.K.R., Rana, OF. and Rtýarajan, M. (2017). Cloud security engineering: theory, practice and future research. IEEE Transactions on Cloud Computing, 50(7), 372-374. doi: 10.1109/TCC.2016.2582278

Cui, W., Kim, Y. and Rosing, T. S. (2017). Cross-platform machine learning characterization for task allocation in 1oT ecosystems. 2017 IEEE 7th Annual Computing and Communication Workshop and Conference, CCWC 2017, 5(2), 1-6. doi: 10.1109/ccwc.2017.7868438

Dubey, A. and Pal, S. (2017). Dynamic service composition towards database virtualization for efficient data management. In 2017 7th International Conference on Cloud Computing Data Science & Engineering-Confluence, 74(8), 519-526. IEEE. doi: 10.1109/confluence.2017.7943206

Fernandez, F.B„ Yoshioka, N., Washizaki, and Syed, MM. (2016). Modeling and security in cloud ecosystems. Future Internet, 8(2), 13-19. https://doi.org/10.3390/fi8020013

Gamez. D. (2008). Progress in machine consciousness. Consciousness and Cognition, 17(3), 887-910. https://doi.org/10.1016/j.concog.2007.04.005

Gaur. A-. Scotney, B., Parr, G. and McClean, S. (2015). Smart city architecture and its applications based on LOT. Procedia Computer Science, 520(8), 1089-1094. https://doi.org/10.1016/j.procs.2015.05.122

Gu. Y., Wang, D. and Liu, C. (2014). DR-Cloud: Multi-cloud based disaster recovery service. Tsinghua Science and Technology, 19(1), 13-23. doi: 10.1109/tst.2014.6733204

Hou, Gu, L, Wang, Y. and Zhao, T. (2016). An autonomic monitoring framework of web service-enabled application software for the hybrid distributed HPC infrastructure. Proceedings of 2015 4th International Conference on Computer Science and Network Technology, ICCSNT, 71(5), 85-90. doi: 10.1109/iccsnt.2015.7490712

Indira, N., & Devi, S. R. (2018, February). Cloud secure distributed storage deduplication scheme for encrypted data. In International Conference for Phoenixes on Emerging Current Trends in Engineering and Management (PECTEAM 2018) (pp. 146-149). Atlantis Press

Jain, H. and Jain, R. (2017). Big data in weather forecasting: Applications and challenges. Proceedings of the 2017 International Conference On Big Data Analytics and Computational Intelligence, ICBDACI, 2017(9), 138-142. doi: 10.1109/ICBDACI.2017.8070824

Jiao, L, Lit, Du, W. and Fu, (2014). Multi-objective data placement for multi-cloud socially aware services. In IEEE INFOCOM 2014-IEEE Conference on Computer Communications , 43(8), 28-36. https://doi.org/IO.1109/1NFOCOM.2014.6847921

Jin, Y. and Min, S. (2016). Stadam: A new SLA trust model based on anomaly detection and multi - cloud. 2016 1st IEEE International Conference on

Computer Communication and the Internet, 2016(7), 396-399. https://doi.org/10.1109/CC1.2016.7778951

Kanwar, N., Goswarni, A.K. and Mishra, S.P. (2019). Design issues in artificial neural network (ANN). Proceedings - 2019 4th InternationalConference on Internet of Things: Smart Innovation and Usages, 10 TSIU, 2019(8), 1-12. https://doi.org/10.1 109/10T-SIU.2019.8777337

Laituri, M. and Kodrich, K. (2008). On line disaster response community: People as sensors of high magnitude disasters using internet GIS. Sensors, 8(5), 3037— 3055. https://doi.org/10.3390/s8053037

Lindman, L, Kinnari, T. and Rossi, M. (2016). Business roles in the emerging open- data ecosystem, IEEE Software, 33(5), 54-59. https://doi.org.10.1109/MS.2015.25

Li X., Liu, Y., Kang, R. and Xiao, L. (2017). Service reliability modeling and evaluation of active-active cloud data center based on the IT infrastructure. Microelectronics Reliability,75(6),271-282. https://doi.org/10.1016/j.microrel.2017.03.009

Manzoor, S., Taha, A. and Suri, N. (2016). Trust validation of cloud IaaS: a customer- centric approach. In 2016 IEEE Trustcom /BigDataSE / ISPÄ, 8(3), (pp. 97- 104). IEEE. doi: 10.1109/trustcom.2016.0051

Markova, O.M., Semerikov, S.CL, Striuk, A.M., Shalatska, H.M., Nechypurenko,

P.P. and Tron, V.V. (2019). Implementation of cloud service models in training of future information technology specialists. CEUR Workshop Proceedings, 2433(8), 499-515. https://doi.org/10.55056/cte.409

Mendonca, J. , Lima, R. , Matos, R. , Ferreira, J. and Andrade, E. (2018). Availability analysis of a disaster recovery solution through stochastic models and fault

injection experiments. Proceedings - International Conference on Advanced Information Networking and Applications, ALVA, 201(3), 135-142. https://doi.org/10.1109/AINA.2018.00032

Olveezky, P.C. and Thorvaldsen, S. (2006). Formal modeling and analysis of wireless sensor network algorithms in real-time maude. 20th International Parallel and Distributed Processing Symposium, IPDPS, 2006(8), 121-132. https://doi.org/10.1109/1PDPS.2006.1639414

Rajeshwari, B. S., Dakshayini, M., & Guruprasad, H. S. (2022). Workload Balancing in a Multi-Cloud Environment: Challenges and Research Directions. Operationalizing Multi- Cloud Environments: Technologies, Tools and Use Cases, 129-144.

Ramharuk, V. and Osunmakinde, I. (2014), Cloud robotics: A framework towards cloud-enabled multi-robotics survivability. ACM International Conference Proceeding Series, 28(2), 82-92. https://doi.org/10.1145/2664591.2664602

Sambrani, Y. Rajashekarappa. (2016). Efficient data backup mechanism for cloud computing. International Journal of Advanced Research in Computer and Communication Engineering, 5(7), 92-95. doi:10.17148/IJARCCE.2016.5719

Shaikh, R.A.R. and Sasikumar, M. (2014). Dynamic parameter for selecting a cloud service. International Conference on Computation of Power Energy Information and Communication. ICCPEIC, 43(7), 32-35. doi: 10.1109/ICCPEIC.2014.6915335

Shklovski, L, Palen, L. and Sutton, J. (2008). Finding community through information and communication technology in disaster response. In Proceedings of the 2008 ACM conference on Computer Supported Cooperative Work, 9(5), 127-

136. https://doi.org/10.1145/1460563.1460584

Stamelos, L, Angelis, L, Oikonomous A. and Bleris, G.L. (2002). Code quality analysis in open source software development. Information Systems Journal, 12(1), 43-60. https://doi.org/10.1046/j.1365-2575.2002.00117.x

Suguna, S. and Suhasini, A. (2015). Overview of data backup and disaster recovery in cloud. 2014 International Conference on Information Communication and Embedded systems, ICICEs,2014(6),971-978.

https://doi.org/10.1109/1CICES2014.7033804

Thomas, J.A. and Valvano, M.A- (1992), Tolq is required for cloacin DPI 3 susceptibility in Escherichia coli expressing the aerobactin/cloacin DE 13 receptor IutA. FEMS Microbiology Letters 91(2), 107-111. https://doi.org/10.1111/j.1574-6968.1992.tb05193.x

Usman, M., Ahmad Jan, M. and He, X. (2017). Cryptography-based secure data storage and sharing using HEVC and public clouds. Information Sciences, 387(2), 90-102. https://doi.org/10.1016/j.ins.2016.08.059

Vanbrabant, B. and Joosen, W. (2014). Configuration management a multi-cloud enabler. In Proceedings of the 2nd International Workshop on Cross-Cloud Systems, 9(3), (pp. 1-3). https://doi.org/10.1145/2676662.2676672

Wagle, S.S., Guzek, M., Bouvry, P. and Bisdorff, R. (2015). An evaluation model for selecting cloud services from commercially available cloud providers. In 2015 IEEE 7th International Conference on Cloud Computing Technology and Science (CloudCom), 21(5), 107-114. doi: 10.1109/CloudCom.2015.94

Sambrani, Y. Rajashekarappa.(2016). Efficient data backup mechanism for cloud computing. International Journal of Advanced Research in Computer and Communication Engineering, 5(7), 92-95.

Zhang, S, Li, X., Long, Nf., Zhu, X and Wang, R. (2017). Efficient kNN classification with different numbers of nearest neighbors. IEEE Transactions on Neural

Networks and Learning Systems,2915(4),1774-1785.doi: 10.1109/TNNLS.2017.2673241

Zheng, P., Qi, Y.. Zhou, Y., Chen, P., Zhan, J. and M.R. (2014). An automatic framework for detecting and characterizing performance degradation of software systems. IEEE Transactions on Reliability, 63(4), 927-943. https://doi.org/I().1109/1X20142