https://upright.pub/index.php/ijrstp/

Original Contribution

How Distributed Cloud Computing Works: An Overview

Samuel Koehler[1]

Keywords: Distributed Cloud, Cloud Computing, Multi-cloud, Distributed Computing

International Journal of Reciprocal Symmetry and Theoretical Physics

Vol. 7, Issue 1, 2020 [Pages 24-31]

The cloud computing model is generalized by distributed computing, which allows data and applications to be positioned, processed, and served from geographically dispersed locations to meet performance, redundancy, and compliance requirements. The classic cloud computing model provides users who wish to refrain from constructing, purchasing, or managing their information technology infrastructure with on-demand, metered access to computing resources such as storage, servers, databases, and applications. Public cloud service providers maintain and operate large server farms whose resources are shared amongst users. Users benefit from the isolation and security of their data thanks to virtualization techniques implemented in these server farms. Site redundancy that spans regions allows for recovery during outages or natural catastrophes. In addition, cloud users are not required to be involved in the monitoring or management processes necessary to keep the cloud operational. This study investigates whether distributed cloud service providers guarantee end-to-end management for the best data placement, computing processes, and network interconnections following the above specifications. And when seen from the perspective of someone who uses the cloud, the study offers a unified answer.

INTRODUCTION

Computing in the cloud that is distributed takes place when a cloud provider makes their services available in some different geographic regions. After that, the public cloud provider takes over and is responsible for maintaining these services. With the help of distributed cloud computing, businesses can fulfill regulatory compliance and governance mandates, as well as unique application performance and responsiveness needs. Other criteria, such as the location of the cloud infrastructure in a region different from the standard availability zones of cloud providers, can also be guaranteed by businesses.

Over the past two decades, the technology of computer networks has undergone massive advancements and shifts. The networking of computers has resulted in several innovative developments in computing technology, such as distributed computing and cloud computing. This trend began with the internet, the most widely used computer network. Although "distributed systems" and "cloud computing systems" can refer to slightly different things, the fundamental notion underlying these terms is identical. Because of this, it is vital to have a solid understanding of distributed systems and how they are distinct from traditional centralized computing systems to comprehend cloud computing systems. Therefore, the primary distinction between cloud computing

[1]College of Engineering and Computer Science, University Of Central Florida, USA

and distributed computing will be discussed in this section.

WHAT EXACTLY IS MEANT BY "DISTRIBUTED COMPUTING"?

A distributed system is a collection of independent computers that appears to its users as a single coherent system, as stated by Tanenbaum and Van Steen, editors of the book "Distributed Systems-Principles and Paradigm." Distributed computing is "a collection of independent computers that appears to its users as a single coherent system."

Distributed computing can be defined as the use of a distributed system to solve a single significant problem by breaking it down into several tasks, with each lesson being computed on its own in the individual computers that make up the distributed system (Achar, 2015). This can be done by breaking the problem down into several classes. For example, a distributed system comprises more than one self-directed computer and allows for communication between the computers over a network. By utilizing their respective local memories, all of the computers connected to one another in a network can communicate to accomplish a shared objective. On the other hand, different computer users could have varied requirements, and distributed systems will coordinate the shared resources by assisting the users in communicating with other nodes to complete their unique duties.

If any one of the computers fails, there are toleration procedures in place to deal with the situation. However, the system's cardinality, topology, and overall structure cannot be determined in advance, and everything is considered dynamic.

DISTRIBUTED CLOUD?

An architecture known as a distributed cloud is one in which numerous clouds are used to support edge computing, comply with specific performance criteria, or meet compliance concerns. A public cloud provider centrally controls this architecture. A distributed cloud service is, in its most basic form, a public cloud that is hosted in several places, including the following:

- The infrastructure of the public cloud service provider
- On-premises, at the locations of the end customers, either in the data center or at the edge of the network
- In the data center of a different cloud service provider
- On hardware hosted by a third party or a colocation center

All cloud services are managed as one from a single control plane, even though different locations and regions are involved (Achar, 2018a). This control plane handles the variations and inconsistencies in hybrid and multi-cloud environments. An organization can meet specific requirements for response time and performance, regulatory or governance compliance mandates, or other demands requiring cloud infrastructure to be located anywhere other than the cloud provider's typical availability zones by utilizing this distribution of services.

The proliferation of the internet of things (IoT) and edge computing has been a significant factor in developing dispersed cloud installations. The performance of artificial intelligence (AI) applications that move large amounts of data from edge locations to the cloud requires cloud services to be located as close as possible to edge areas (Achar, 2016). As a result, moving cloud resources to the edge location can significantly improve these applications' performance. In addition, an ever-increasing number of government regulations, such as the General Data Protection Regulation (GDPR) of the European Union, can require that data be located in particular jurisdictions. This requirement may or may not be supported by a given public cloud provider, which is why a distributed cloud is required.

REASONS WHY DISTRIBUTED COMPUTING IS NECESSARY

Distributed computing involves distributing the workload among several connected computers, but distributed cloud computing takes this concept and generalizes it to the cloud architecture itself.

Systems of Centralized Computing, such as those offered by IBM In the realm of technological computation, mainframes have been around for several decades. In centralized computing, a single computer manages the system's peripheral devices and performs all the sophisticated calculations. However, centralized computing systems proved inefficient and expensive when it came to processing large amounts of transactional data and providing assistance for a large number of online users simultaneously (Achar, 2018b). Because of this, cloud computing and distributed computing could use parallel processing technology for commercial purposes.

A distributed cloud is an execution environment in which components of an application are placed at geographically dispersed sites that are acceptable for the application and are chosen to satisfy the application's requirements best. Such needs include:

- Location: to enable more responsive and performant service delivery for specific types of applications, where latency is crucial, and bulk data transfer to and from a central cloud is expensive. This was done for two reasons:
- Regulations: these may demand that data never leaves the user's nation, as is the requirement in the EU; for example, the United States requires that data never leave the country.
- Security ensures that detailed data and procedures are kept within an organization's cloud or data center, even when a public cloud is coupled with those facilities.
- Redundancy: protection against large-scale business disruptions, above and beyond what is offered by local, regional, or national site redundancy.

A Content Delivery Network (CDN) is an example of a distributed cloud. In this cloud, the storage space (for example, video information) is placed in different regions of the world to decrease the time it takes for the content to be delivered. For example, businesses that distribute their material utilizing content delivery networks (CDNs) reap the benefits of scalable storage and performance, both of which are made invisible by the CDN provider.

RELATIONSHIP TO EDGE COMPUTING

"Edge Computing" refers to a solution in which data is processed as closely as feasible to the location at which it was generated. Edge computing can be helpful for certain kinds of applications, particularly those in which low latency and high throughput are essential or would be prohibitively expensive to transport the data to a cloud located further away for processing. In addition to these benefits, edge computing can be advantageous in situations where the underlying transport network has limited capacity, is unreliable, or the data being transferred is too sensitive to be carried through public networks, even when encrypted.

As a result, edge computing is not a distinct paradigm of computing but rather an extension of distributed cloud computing. It is possible to unify the two models by thinking of the edge computing resources as a "micro" cloud data center and connecting the edge storage and computing capabilities to more immense cloud data centers for extensive data analysis and bulk storage.

DIFFERENCE BETWEEN CLOUD AND DISTRIBUTED CLOUD

The distribution of information technology resources and services on demand, such as servers, storage, and databases, to mention a few, is what is meant by "traditional cloud computing." These services are often made available by one of the several hyper-scale cloud providers via a link to the public internet or a private network. Public cloud services, private cloud services (which may include on-premises data centers), hybrid cloud services (which include public and private cloud components), and multi-cloud services are the various ways in which cloud computing can be organized (including multiple public cloud providers).

Distributed cloud computing eliminates the need for distinguishing between public, private, hybrid, and multi-cloud environments. The user organization sees the distributed cloud as a single cloud platform; however, in reality, it comprises multiple components that can include "all of the above." These components include public cloud elements from the primary provider, one or more of its competitors, a private cloud or enterprise data center, and a third-party colocation partner. The primary cloud provider manages all of these distinct components as a single entity, and the eventual customer utilizes them as a single entity.

HOW DOES DISTRIBUTED CLOUD COMPUTING WORK?

When using distributed cloud computing, a cloud provider's total computing power is dispersed across multiple locations, depending on where a customer needs it most. This could be on-premises in the form of data centers or private clouds, or it could be off-premises in the form of public cloud data centers.

The centralized cloud of the provider can be extended with geographically dispersed micro-clouds through the use of distributed cloud computing. The service provider maintains centralized management over the distributed infrastructure, including its operations, updates, governance, security, and dependability. Everything can be accessed through a single cloud and is controlled and managed through a single control plane. Computing in a distributed cloud environment comes with additional features. Users can make requests that specific data remain inside particular zones or that they reach a particular target for either latency or throughput. Service level agreements (SLAs) between the user and the cloud provider already incorporate these aspects into their contracts.

The leading cloud service providers connect their technologies into many geographically scattered data centers to guarantee that they correctly place data, compute, and storage to meet service level agreements (SLAs) transparently.

The ability for service users to not be responsible for the maintenance and operation of their information technology infrastructure is the primary benefit of utilizing cloud services. Another advantage is shifting CAPEX to OPEX using the utility-like model of purchasing computing and storage on demand.

When using dispersed cloud computing, consumers can pay for additional services, such as requesting that particular data remain inside specific areas or that a specific performance target for latency or throughput is fulfilled. Service Level Agreements (SLAs) are what the user and cloud service provider utilize to communicate these requirements to one another. The cloud provider's responsibility is to conceal the intricate details of the SLA compliance process. This can involve constructing new cloud infrastructure in some countries or forming partnerships with cloud providers who are already present in those regions. In addition, high-speed data linkages must be established between the many data centers in different geographic locations.

The major cloud service providers have proprietary technology that can be integrated into these geographically dispersed cloud data centers. This technology ensures intelligent data, computing, and storage placement to meet service level agreements (SLAs). It does so in a manner that is entirely transparent to the customers of the major cloud service providers.

Distributing cloud computing resources to different locations worldwide should be a straightforward process from the user's point of view. An illustration of one way in which customers can deploy compute workloads (at the "cloud's edge" using StackPath) to a range of points of presence (PoPs) around the world with various degrees of CPU power and the number of instances is provided below.

Computing on the cloud and computing that is dispersed across multiple clouds are essentially the same thing. Cloud computing can, however, be expanded beyond geographic areas through the use of distributed cloud computing. When one task is spread across numerous machines located in different places, all networked together, this cloud computing model is referred to as distributed cloud computing. Each computer will be responsible for completing a distinct task component, resulting in the charge being finished more quickly.

Cloud computing presents an opportunity to solve problems by enabling remote network access to a computer's hardware and software. This offers several benefits, including sharing resources, reducing costs, scaling, and operating independently of any platform. Computing in the cloud that is dispersed, on the other hand, refers to a network in which several computers collaborate to achieve a common objective. Every single machine connected to this network contributes to the completion of the overall mission.

In cloud computing, all required resources are accessed and provided through the internet. Distributed cloud computing, on the other hand, involves sharing resources between several computers through a network. Every type of computer has its own set of technical advantages to offer (Shewalkar et al., 2019; Taher-Uz-Zaman et al., 2014; Vadlamudi, 2015; Wittig & Finnie, 1997; Yahaya & Mato, 2017).

Users of distributed cloud computing can make use of additional capabilities that can be acquired for an additional fee. These capabilities can include defining performance targets for latency and throughput and facilities that allow data to be kept inside a particular region. The responsibility for supplying the necessary infrastructure to support this capacity rests squarely on the shoulders of the service provider. In addition, most of the principal distributed cloud service providers have technologies they have built to assist with specific customer requirements and assure transparency.

The use of distributed computing in the cloud is a growing trend primarily geared toward enhancing the operation of enterprises. To put it briefly, computing in a dispersed cloud environment is the future for businesses.

DISTRIBUTED COMPUTING SYSTEM EXAMPLES

Computing in the Cloud That Is Distributed Some Examples

The following are examples of use cases that can be used to justify the implementation of distributed cloud computing:

- World Wide Web
- Google Bots, Google Web Server, Indexing Server
- Social Media Giant Facebook
- Hadoop’s Distributed File System (HDFS)
- ATM
- Cloud Network Systems (Specialized form of Distributed Computing Systems)

Distributed computing systems look like a single system to users, but inside they are connected to numerous nodes that conduct computing work. Google's web server from a user's perspective. Users think the Google web server is a single system where they must log in to Google.com to search for the phrase. Google uses Distributed Computing to construct multiple servers and deploy them across the globe to deliver search results in seconds or milliseconds. Distributed computing architecture with unidirectional control by the primary node is shown below. The primary node sends the task to configured secondary nodes and receives the results.

Intelligent Transport: Autonomously driven trucks moving in the echelon can locally process the data from onboard and road sensors to keep a steady speed and separation between each other and other vehicles, all while sending traffic and engine data back to a central cloud. This allows the trucks to maintain a steady speed and separation between each other and other vehicles. A fleet management application hosted in a regional cloud is responsible for monitoring the journey these vehicles take to reach their destination. This application analyzes data collected from multiple vehicles to determine the most efficient routes and which automobiles require servicing.

Intelligent Caching: A significant over-the-top video service provider utilizes a centralized cloud to transcode and format videos for various device types served across multiple networks. It stores copies of the content in various formats and across many CDNs located in different locations. It pre-positions content in caches closest to end users in a given region, such as storage collocated with cable head ends to serve residential sites or at 5G base stations in dense urban areas for mobile viewing, in the expectation that there will be significant demand for a newly released series in that region.

BENEFITS OF DISTRIBUTED CLOUD

A distributed cloud architecture offers several advantages to its users (Achar, 2019a). These are the things that Gartner highlights as being noteworthy:

- An increase in levels of compliance. Because their very nature distributes them, workloads and data can be located precisely where they need to be to satisfy regulatory requirements.
- An increase in the available time. As a result of the fact that cloud services can be hosted on a user's private network, these services can be cut off from the central cloud or even untethered from it entirely as necessary to provide redundancy by protecting themselves from being affected by a wrecked system.
- Scalability: Not only does adding virtual machines (VMs) or nodes on demand enable rapid scalability, but it also helps improve the overall availability of the cloud system.
- Flexibility: Distributed clouds make it easier to install new services, deploy them, and troubleshoot any problems that may arise.
- A more rapid processing speed. By combining the processing power of numerous computers to work on a single problem, distributed systems can get speedier results. Additionally, the distributed cloud allows specific locations to have more responsive communications.
- Performance. The distributed cloud, in contrast to centralized computer network clusters, has the potential to deliver both superior performance and improved cost performance.

USE CASES FOR DISTRIBUTED CLOUDS

Distributed cloud and edge computing enable many benefits, including simplifying multi-cloud management, enhanced scalability, and development velocity, and deploying cutting-edge automation and decision support apps and capabilities (Achar, 2019b).

Distributed clouds are helpful for various applications, ranging from intelligent edge computing to hybrid deployments and simplifying the management of several cloud environments. Typical applications include the following:

- Edge/IoT. IoT is using AI and machine learning (ML) to improve automobile manufacturing, analyzing medical imaging, intelligent buildings, and smart cities that find the shortest route to parking and turn off the heating after the last employee has left for the evening. New uses for video inference and facial recognition are being developed every day. If the data needed to be transported from the edge back to the cloud or a data center for processing and analysis, many of these apps would be rendered inoperable.
- Optimization of the content. Distributed clouds can take on the role of a content delivery network (CDN), which can enhance the streaming experience and reduce the latency experienced during the loading of web pages. This provides the best user experience possible across various application types.
- Adapting to changing needs. Distributed clouds remove the necessity of constructing new physical infrastructure by making it possible to extend cloud computing to already existing locations. To support the evolving requirements of the enterprise, the cloud footprint can expand along with the needs seamlessly.
- Management with a single transparent layer adopting a strategy that uses dispersed clouds improves visibility into hybrid and multi-cloud deployments. This improvement includes the capacity to manage all of the infrastructure as if it were a single cloud using a single console and a single set of tools.
- Ensure that you comply with all mandates. Regulations on data privacy at the local, national, and international levels have the power to dictate where an individual's personal information must be held and whether or not it can leave the jurisdiction in which it was collected. If the data can't be

moved to the public cloud provider, then the public cloud provider can effectively be moved the data. This ensures that government and regulatory mandates are met, and data will be processed as efficiently as possible and with the least amount of latency possible.

CHALLENGES OF DISTRIBUTED CLOUD

Managing an organization that operates using a multi-site deployment of the cloud presents several issues, including the following:

- Bandwidth. Within a multi-cloud environment that is widely scattered, there is the possibility of distinct connectivity models for each location. For example, moving more computation to the edge might put existing broadband connections under strain, which may necessitate upgrading or altering these connections to satisfy the increased demand for throughput.
- Security. The security of a distributed cloud poses additional issues for cloud providers and end users, given that resources might be situated in different parts of the world and can be co-located with servers and storage resources belonging to other businesses.
- The safeguarding of personal information. For backup and business continuity plans that use scattered data resources, it may be necessary to rethink backup and recovery procedures to guarantee that data is stored in the appropriate geographic locations.

CONCLUSION

In a distributed cloud, services are "distributed" to specific locations in order to lower latency, and these services have access to a single, consistent point of control across both public and private cloud environments. As a result, organizations can see significant improvements in performance due to eliminating latency issues, which also reduces the overall risk of outage or control plane inefficiencies. This can deliver substantial improvements in concert with the organization as a whole.

A public cloud provider, an on-premises network, or a third-party colocation facility are all examples of the types of locations that could host a distributed cloud (Amin, 2019; Bynagari, 2015; Chimakurthi, 2017; Chimakurthi, 2019; Colchester et al., 2016). A distributed cloud spreads not only an application but also the entire computing stack to the places where it is required. For example, the customer using the cloud services perceives the distributed infrastructure as a single cloud entity, and the cloud provider manages all of the components of the distributed cloud as a whole from a single control plane. The provider of public cloud services is still accountable for all cloud operations, including security, availability, updates, and governance of the distributed infrastructure.

REFERENCES

Amin, R. (2019). Innovations in Information Systems for Business Functionality and Operations Management. *ABC Research Alert*, *7*(3), 148–158. https://doi.org/10.18034/abcra.v7i3.546

Achar, S. (2015). Requirement of Cloud Analytics and Distributed Cloud Computing: An Initial Overview. *International Journal of Reciprocal Symmetry and Physical Sciences*, *2*, 12–18. https://upright.pub/index.php/ijrsps/article/view/70

Achar, S. (2016). Software as a Service (SaaS) as Cloud Computing: Security and Risk vs. Technological Complexity. *Engineering International*, *4*(2), 79-88. https://doi.org/10.18034/ei.v4i2.633

Achar, S. (2018a). Data Privacy-Preservation: A Method of Machine Learning. *ABC Journal of Advanced Research*, *7*(2), 123-129. https://doi.org/10.18034/abcjar.v7i2.654

Achar, S. (2018b). Security of Accounting Data in Cloud Computing: A Conceptual Review. Asian Accounting and Auditing Advancement, 9(1), 60–72. https://4ajournal.com/article/view/70

Bynagari, N. B. (2015). Machine Learning and Artificial Intelligence in Online Fake Transaction Alerting. *Engineering International*, *3*(2), 115-126. https://doi.org/10.18034/ei.v3i2.566

Chimakurthi, V. N. S. S. (2017). Cloud Security - A Semantic Approach in End to End Security Compliance. *Engineering International*, *5*(2), 97-106. https://doi.org/10.18034/ei.v5i2.586

Chimakurthi, V. N. S. S. (2019). Application Portfolio Profiling and Appraisal as Part of Enterprise Adoption of Cloud Computing. *Global Disclosure of Economics and Business*, *8*(2), 129-142. https://doi.org/10.18034/gdeb.v8i2.610

Colchester, K., Hagras, H., Alghazzawi, D. & Aldabbagh, G. (2016). A Survey of Artificial Intelligence Techniques Employed for Adaptive Educational Systems within E-Learning Platforms. Journal of Artificial

Intelligence and Soft Computing Research, 7(1) 47-64. https://doi.org/10.1515/jaiscr-2017-0004

Costa, M., Oliveira, D., Pinto, S. & Tavares, A. (2019). Detecting Driver's Fatigue, Distraction and Activity Using a Non-Intrusive Ai-Based Monitoring System. Journal of Artificial Intelligence and Soft Computing Research, 9(4) 247-266. https://doi.org/10.2478/jaiscr-2019-0007

Dipa, D. D., Abedin, K., Khan, M. M., & Hasan, M. M. (2015). Impacts of Energy Subsidy in Bangladesh: An Analysis. *ABC Journal of Advanced Research*, *4*(1), 39-56. https://doi.org/10.18034/abcjar.v4i1.44

Donepudi, P. K. (2017). Machine Learning and Artificial Intelligence in Banking. *Engineering International*, *5*(2), 83-86. https://doi.org/10.18034/ei.v5i2.490

Graziatti, L. V. (2017). The Treaty of Rome EEC and EURATOM 1957. *ABC Research Alert*, *5*(3), Peru. https://doi.org/10.18034/abcra.v5i3.316

Hasan, M. A. ul. (2013). Goodness of Cloud Computing: does Bangladesh ready for it. *Global Disclosure of Economics and Business*, *2*(2), 159-167. https://doi.org/10.18034/gdeb.v2i2.184

Hossain, S., Mrida, M. I. A., Das, P. C., Sayed, A., Rahman, N., & Rashid, M. M. (2015). Mimo Channel and Performance Analysis using OFDM System for Reduced Bit Error Rate. *ABC Research Alert*, *3*(3), Bangladesh. https://doi.org/10.18034/abcra.v3i3.299

Hossain, S., Rahman, M. S., & Yeasmin, S. (2019). Environmental Radioactivity Monitoring and Assessment of Excess Lifetime Cancer Risk to People in Demra Thana, Dhaka, Bangladesh. *ABC Research Alert*, *7*(3), Bangladesh. https://doi.org/10.18034/abcra.v7i3.269

Hughes, R. T. (1996). An evaluation of machine learning techniques for software effort estimation. University of Brighton.

Jordanov, I., Petrov, N. & Petrozziello, A. (2018). Classifiers Accuracy Improvement Based on Missing Data Imputation. Journal of Artificial Intelligence and Soft Computing Research, 8(1) 31-48. https://doi.org/10.1515/jaiscr-2018-0002

Koren, O., Hallin, C., Perel, N. & Bendet, D. (2019). Decision-Making Enhancement in a Big Data Environment: Application of the K-Means Algorithm to Mixed Data. Journal of Artificial Intelligence and Soft Computing Research, 9(4) 293-302. https://doi.org/10.2478/jaiscr-2019-0010

Nasreen, H., & Hassan, M. (2019). Nitazoxanide – A New Option in Biliary Ascariasis. *ABC Research Alert*, *7*(1), Bangladesh. https://doi.org/10.18034/abcra.v7i1.236

Noshi C, Noynaert S. Jerome Schubert. Data Mining Approaches for Casing Failure Prediction and Prevention. presented at the International Petroleum Technology Conference. 2019; IPTC-19311-MS. Available: https://doi.org/10.2523/IPTC-19311-MS

Noshi CI, Noynaert SF, Schubert JJ. Failure Predictive Analytics Using Data Mining: How to Predict Unforeseen Casing Failures? Presented at the Abu Dhabi International Petroleum Exhibition & Conference. 2018;SPE-193194-MS. Available: https://doi.org/10.2118/193194-MS

Ojah M, Emumena E, Collins O, Oduh P, Steve A. Determination of Optimal Well Location in Bounded Reservoirs Using the Dimensionless Pressure Derivative. SPE-203627-MS. presented at the SPE Nigeria Annual International Conference and Exhibition; 2020. Available: https://doi.org/10.2118/203627-MS

Ojha, A., & Bairagi, S. (2013). Corporate Restructuring. *ABC Research Alert*, *1*(1), India. https://doi.org/10.18034/abcra.v1i1.243

Reddy C.S.; Raju KVSN, (2009). An Improved Fuzzy Approach for COCOMO's Effort Estimation using Gaussian Membership Function. Journal of software, 4(5), 452-459.

Achar, S. (2019a). Behavioral and Perceptual Models for Secure Data Analysis and Management. *Global Disclosure of Economics and Business*, *8*(2), 143-152. https://doi.org/10.18034/gdeb.v8i2.653

Achar, S. (2019b). Early Consequences Regarding the Impact of Artificial Intelligence on International Trade. *American Journal of Trade and Policy*, *6*(3), 119-126. https://doi.org/10.18034/ajtp.v6i3.634

Shewalkar, A., Nyavanandi, D. & Ludwig, S. (2019). Performance Evaluation of Deep Neural Networks Applied to Speech Recognition: RNN, LSTM and GRU. Journal of Artificial Intelligence and Soft Computing Research, 9(4) 235-245. https://doi.org/10.2478/jaiscr-2019-0006

Taher-Uz-Zaman, M., Ahmed, M. S., Hossain, S., Hossain, S., & Jamal, G. R. A. (2014). Multipurpose Tactical Robot. *Engineering International*, *2*(1), 21-27. https://doi.org/10.18034/ei.v2i1.204

Vadlamudi, S. (2015). Enabling Trustworthiness in Artificial Intelligence - A Detailed Discussion. *Engineering International*, *3*(2), 105-114. https://doi.org/10.18034/ei.v3i2.519

Wittig, G., Finnie, G. (1997). Estimating software development effort withconnectionist models. Information and Software Technology 39 (7), 469–476.

Yahaya, I., & Mato, U. (2017). Workforce Diversity and Organizational Effectiveness in 21st Century Business Arena. *Asian Accounting and Auditing Advancement*, *8*(1), 24–29. https://doi.org/10.18034/4ajournal.v8i1.46

--0--