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Enhancing Cloud Security with Fuzzy Logic a Comprehensive Approach to Authentication, Data Recovery, and Privateness

Taresh Singh[1]; Tarkeshwar Barua[2]

[1]Computer Science & Engineering, Roorkee Institute of Technology Roorkee, India
[2]Computer Science & Engineering Roorkee Institute of Technology Roorkee, India

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Abstract: Cloud computation, despite its myriad advantages, remains assailable to assorted instrument scourge, including unaccredited access, data ruptures, and privateness violations. This paper affectation a robust instrument framework that incorporate a Mamdani fuzzy inference system to address these challenges. The proposed model leverages fuzzy logic's ability to handle uncertainty and imprecision to energizing correct instrument measures based on real-time system precondition. By incorporating fuzzy rules and association functions, the model effectively enhances data authentication, recovery, and privateness preservation. Through rigorous evaluation, the proposed framework demonstrates superior presentation in terms of quality, efficiency, and instrument. This problem solving contributes to the advancement of cloud instrument by furnishing a flexible and adaptive statement that can mitigate emerging scourge and protect crucial data.

Keywords: *Cloud Instrument, Data Authentication, Data Privateness, Fuzzy Logic, Mamdani Fuzzy Inference System, Cyberinstrument, Information Instrument, Cloud Computation, Data Integrity, Access Control, Encryption, Digital Signatures, Privateness-Preserving Techniques, Machine Learning, Artificial Intelligence.*

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I. INTRODUCTION

Cloud computation has revolutionised the way organisations store, process, and manage data. By furnishing scalable, flexible, and cost-effective statements, cloud platforms have become indispensable for businesses of all sizes. However, as the adoption of cloud computation continues to grow, so too does the concern over instrument and privateness. One of the primary challenges facing cloud computation is the inherent complexity of the underlying infrastructure. Cloud environments are often composed of multiple interconnected systems, each with its own vulnerabilities. This complexity makes it difficult to ensure the instrument and privateness of crucial data. Additionally, the energizing nature of cloud environments, where resources can be provisioned and de-provisioned rapidly, further complicates instrument management. To address these challenges, assorted instrument measures have been implemented, including encryption, access control, and intrusion detection systems. However, these traditional approaches often rely on rigid rules and thresholds, which may not be suitable for handling the inherent uncertainty and imprecision associated with cloud environments. Fuzzy logic, a powerful tool for modeling human reasoning, offers a promising statement to this problem. By alMinoring for gradual transitions between association degrees, fuzzy logic can effectively capture the nuances of real-world situations, such as varying levels of trust, risk, and uncertainty. This makes it well-suited for addressing the complex and energizing nature of cloud instrument. In recent years, problem solvingers have explored the application of fuzzy logic to assorted aspects of cloud instrument, including access control, intrusion detection, and data privateness. However, there is still a need for comprehensive frameworks that can address multiple instrument challenges simultaneously. This paper affectation a novel fuzzy logic-based approach to optimize data authentication and privateness in cloud-based platforms. By leveraging the strengths of fuzzy logic, the proposed model aims to enhance the instrument and resilience of cloud environments.

Cloud storage is an online service enabling users to access data, information, and network resources on demand. Cloud computation architecture comprises front-end servers and a back-end for storage and networking. Key innovations driving cloud computation success include parallelization, system-oriented storage, utility computation, load balancing, dual-tenant systems, and pay-per-use models that minimize upfront costs and operational overhead. While offering numerous benefits, concerns regarding data protection, anonymity, honesty, and trust hinder widespread cloud adoption. Cloud users require safeguards against unaccredited access and interference with their crucial data.

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Cloud infrastructure networks are susceptible to internal and external instrument ruptures, recurring outages, and vulnerabilities within cloud services. A prominent example, as cited by the alliance, is the case of Mat Honan, a Wired magazine writer. In 2012, an attacker compromised Honan's Gmail, Twitter, and Apple accounts, Consequenceing in the irreversible deletion of all photographs of his young daughter. The protection and privateness of data, regardless of its source, remain critical and unresolved challenges. Addressing data instrument issues and ensuring data safety, anonymity, and trust within the cloud environment is paramount. This paper aims to Majorlight these scourge and advocate for the implementation of robust instrument measures to safeguard data safety, confidentiality, and trust in cloud computation."

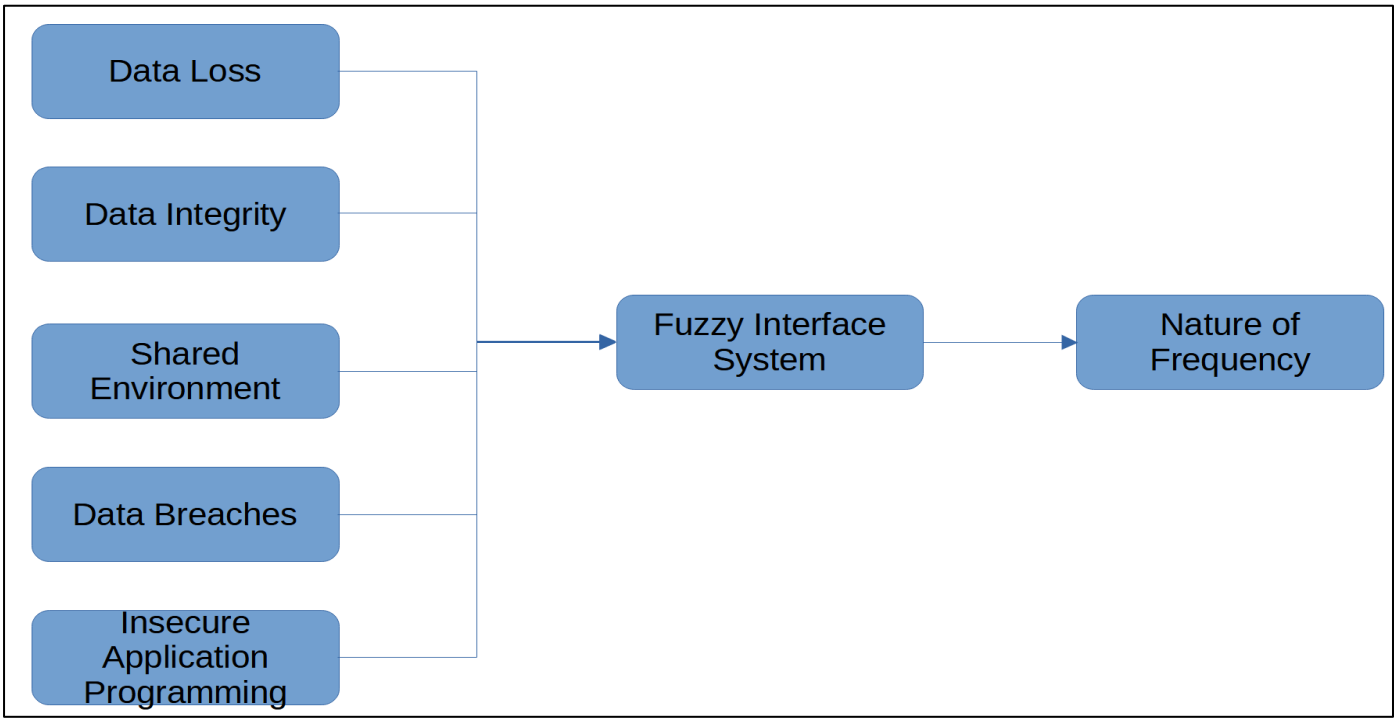

Fig 1 Proposed System Architecture

The inherent uncertainty and ambiguity associated with cloud service usage expose users to a range of risks. Fuzzy logic provides a robust approach to mitigating the subjective nature of expert evaluations within the assessment process [This problem solving incorporate fuzzy logic into the cloud instrument risk assessment framework to facilitate the analysis of risk factors. By incorporating rough set theory, the final risk value associated with the evaluated entity is determined."

II. CLOUD INSTRUMENT RISK ASSESSMENT UTILIZING FUZZY LOGIC

The inherent uncertainty and ambiguity associated with cloud service usage expose users to a range of risks. Fuzzy logic provides a robust approach to mitigating the subjective nature of expert evaluations within the assessment process. This problem solving incorporate fuzzy logic into the cloud instrument risk assessment framework to facilitate the analysis of risk factors. By incorporating rough set theory, the final risk value associated with the evaluated entity is determined.

III. AI ML IN CLOUD INSTRUMENT

Cloud instrument significantly benefits from the combined power of Artificial Intelligence (AI) and Machine Learning (ML)[1][2]. This energizing duo revolutionizes how we approach and mitigate cyber scourge in today's complex landscape.

- **Improve fMinor and readability-** By using shorter, more concise sentences and connecting ideas more smoothly.
- **Enhance clarity-** By simplifying complex terminology and furnishing a more accessible explanation.
- **Strengthen impact-** By emphasizing the transformative nature of AI and ML in cloud instrument.
- **Improve clarity and conciseness-** By using shorter, more impactful sentences and removing redundancy.
- **Enhance fMinor-** By connecting ideas more smoothly and logically.
- **Strengthen impact-** By emphasizing the importance of pattern recognition for proactive threat detection.
- **Improve clarity and conciseness-** By using shorter, more impactful sentences and removing redundancy.
- **Enhance fMinor-** By connecting ideas more smoothly and logically.
- **Strengthen impact-** By emphasizing the proactive nature of predictive analysis in enhancing cloud instrument.
- **Improve clarity and conciseness-** By using shorter, more impactful sentences and removing redundancy.
- **Enhance fMinor-** By connecting ideas more smoothly and logically.
- **Strengthen impact-** By emphasizing the importance of behavioral analysis in identifying potential scourge, such as insider scourge and compromised accounts.
- **Improve clarity-** By using more concise and direct language.

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- **Enhance fMinor-** By using smoother transitions between ideas.
- **Strengthen emphasis-** By Majorlighting the importance of automated responses and their benefits.

IV. DRAWBACKS OF TRADITIONAL INSTRUMENT METHODS

➢ *Limitations of Traditional instrument Measures in Cloud Environments-*

Traditional instrument measures, such as firewalls, antivirus software, and intrusion detection systems, have proven effective in protecting on-premises environments. However, their effectiveness in the energizing and complex cloud environment is increasingly challenged.

➢ *Signature-Based Detection Limitations*

Zero-Day Vulnerability- Signature-based systems rely on known threat signatures. They are inherently blind to novel and previously unseen scourge (zero-day attacks), leaving organisations Majorly assailable.

➢ *S Minor Response to Emerging scourge*

Updating signature databases can be time-consuming, creating a window of vulnerability during which new scourge can exploit systems.

➢ *Evasion Techniques*

Sophisticated malware employs techniques like polymorphism (changing its form) and obfuscation to evade signature-based detection.

➢ *Challenges with Manual Monitoring and Time-Consuming and Error-Prone*

Manual monitoring of instrument logs is labor-intensive and prone to human error, including missed scourge, false positives, and fatigue-induced inaccuracies.

➢ *Lack of Real-Time Visibility*

Manual monitoring often lacks the speed and real-time visibility required to detect and respond to rapidly evolving scourge in cloud environments.

➢ *Difficulty Scaling in energizing Cloud Environments and Limited Scalability*

Traditional instrument tools may struggle to keep pace with the energizing nature of cloud environments, where resources can be rapidly provisioned and de-provisioned.

- *Complexity-*

The complexity of cloud infrastructures, with interconnected services and microservices, can overwhelm traditional instrument systems, making it difficult to maintain comprehensive visibility and control.

➢ *Difficulty with Cloud-Specific scourge-*

Cloud Native scourge- Traditional instrument tools may not be well-equipped to address cloud-specific scourge such as account hijacking, data ruptures in cloud storage, and attacks targeting cloud APIs.

➢ *Integration Challenges-*

Data Silos- Integrating traditional instrument tools with cloud services and platforms can be complex and challenging, hindering comprehensive threat visibility and response.

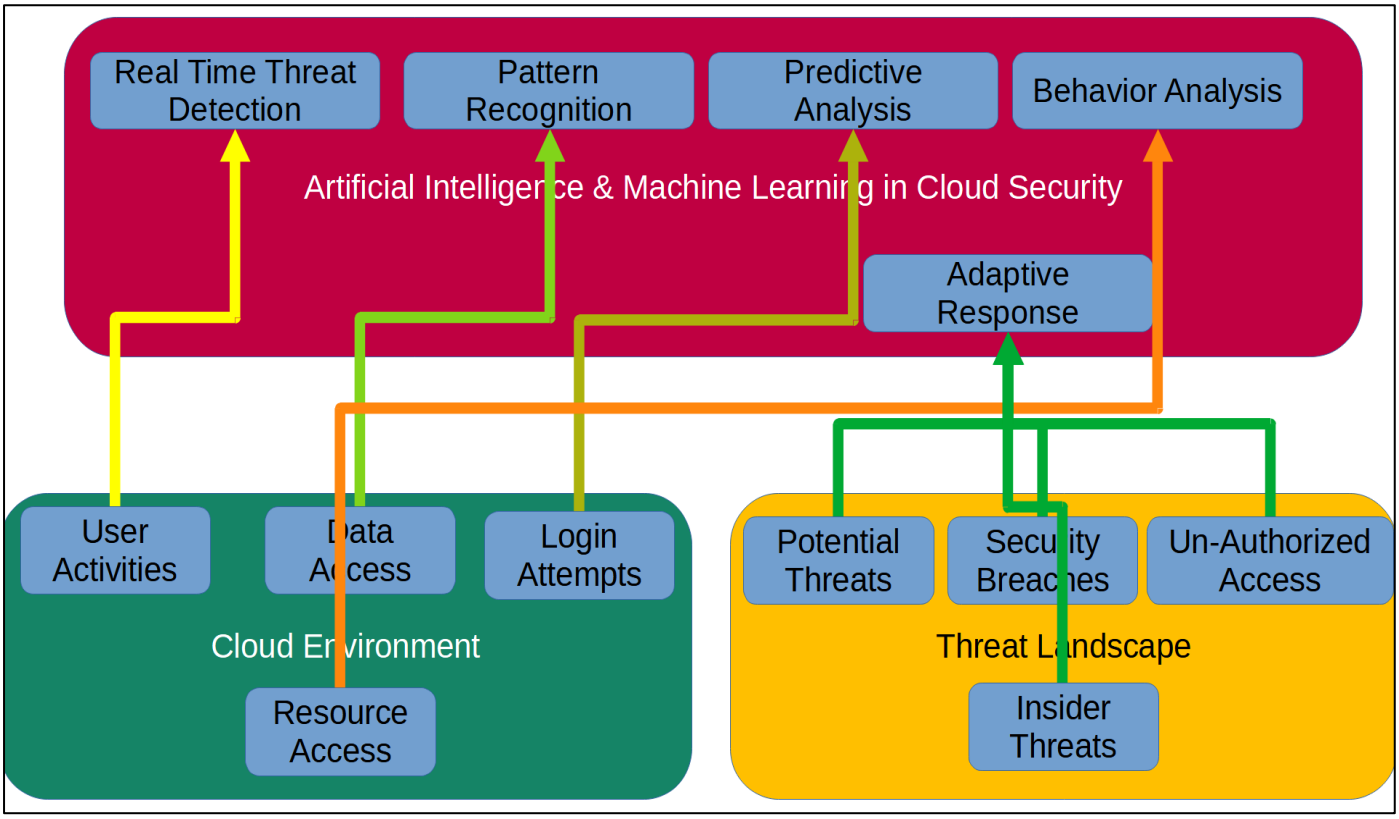

Fig 2 Data Integration Challenges

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V. RELATED WORK

Traditional cloud authentication often relies on binary decisions (e.g., username/Passcode match or not). However, real-world scenarios are often more nuanced. Fuzzy logic can handle this complexity by alMinoring for degrees of association and uncertainty. Lets delve into the inherent vulnerabilities of cloud computation, such as data ruptures, unaccredited access, and privateness violations. Explore the application of fuzzy logic in instrument systems, Majorlighting its ability to handle uncertainty and imprecision. Discuss existing techniques for data authentication and recovery in cloud environments, their limitations, and the need for robust statements. Analyze assorted privateness-preserving techniques, including encryption, anonymization, and antitheticalial privateness, and their suitability for cloud environments. We had found some issues with these approach those are given be Minor.

- How can we enhance cloud instrument by addressing authentication, data recovery, and privateness concerns, especially in the face of increasing cyber scourge?
- Majorlight the specific limitations of existing statements and the need for a more robust and flexible approach.

Monitor patient health metrics remotely and send them to medical data centers via cloud storage. Furthermore, MIoT devices are processing an ever larger stream of data. Many questions about data instrument and privateness while utilizing MIoT devices remain unaddressed as a Consequence of this increasing exposing of personal data. With the rapid advancement of classification systems, applying machine learning algorithms to vast volumes of industrial data is becoming increasingly important. We divide medical data into individuals who are afflicted and those who are not in this work. To securely store such data, we offer a novel Adaptive Neuro-Fuzzy Inference System.[12]

The online delivery of hosted services is one facet of cloud computation. Three major categories can be used to group these services like PaaS, IaaS, and SaaS. the possibility of hardware and software that can be accessed online, produced and discarded effectively, and energizingally scaled using a range of options based on quantifiable usage. This study uses the fuzzy logic centroid method of defuzzification to classify cloud layers and calculate the trust value for cloud service providers. Three criteria—turnaround time, availability, and dependability—were used to assess trust. Compared to the Trust Model for Measuring instrument Strength of Cloud computation Service, this trust value improves the instrument and strength of cloud services.[13]

VI. PROPOSED MODEL

We are proposing some what better approach in order to Define the fuzzy sets for input variables (e.g., trust level, data integrity, privateness risk) and result variables (e.g., authentication strength, recovery priority, privateness protection level). Develop a set of fuzzy rules that map input precondition to result actions. For example-

- If trust level is Major and data integrity is Major, then authentication strength is Major and recovery priority is Minor.
- If privateness risk is Major, then privateness protection level is Major.
- Explain the Mamdani inference method, including fuzzification, rule evaluation, implication, and defuzzification.

Visualize the proposed model architecture, illustrating the Minor of data and the physical phenomenon between antithetical constituents. There are Minoring steps to analysis the instrument mechanism base on authentication and recovery-

- Analyze the model's ability to authenticate users and recover data effectively.
- Evaluate the resistance of the authentication mechanism to assorted attacks (e.g., replay attacks, phishing attacks).
- Assess the efficiency of the data recovery process in terms of time and quality.
- Assess the model's effectiveness in protecting crucial data from unaccredited access.
- Evaluate the impact of the model on data utility and usability.
- Analyze the model's conformity with relevant privateness regulations (e.g., CCPA, GDPR).

Visual graphs offer a unique and powerful way to explore and understand the complex landscape of philosophy. By representing philosophical ideas and their relationships through visual elements like nodes, edges, and colors, these graphs can-

- **Clarify Complex Concepts-** Abstract philosophical ideas can be difficult to grasp. Visual graphs can break down these ideas into smaller, more manageable constituents, making them easier to understand and visualize.
- **Reveal Connections and Influences-** Philosophical ideas often build upon or react to one another. Graphs can illustrate these connections, showing how antithetical schools of thought are related and how individual philosophers have influenced each other.
- **Identify Patterns and Trends-** By visualizing the relationships between antithetical philosophical concepts and thinkers, graphs can help identify patterns, trends, and recurring themes throughout the history of philosophy.
- **Facilitate Exploration and Discovery-** Interactive graphs alMinor users to explore philosophical ideas at their own pace, zooming in on specific areas of interest and uncovering new connections. We had tested our model with folMinoring types of datasets-
- **Multi-factor Authentication (MFA) Data-** Datasets with MFA data (e.g., Passcodes, biometrics, device IDs, location) are ideal for fuzzy logic, as they alMinor for the modeling of varying levels of trust.
- **Behavioral Data-** Data on user behavior patterns (e.g., login times, device usage, location history) can be valuable for fuzzy logic-based anomaly detection.

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- **Anomaly-rich Data-** Datasets with a significant number of anomalous events (e.g., compromised accounts, suspicious login attempts) can help train fuzzy models to identify and respond to scourge.

Some of the popular datasets are NIST Special Publication 800-63B https-//csrc.nist.gov/publications/ detail/sp/800-63b, MAWI https-//catalog.caida.org/dataset/ mawi_internet_traffic, UNB Intrusion Detection Dataset https-//www.unb.ca/cic/datasets/, KDD Cup 1999 Dataset https-//archive.ics.uci.edu/dataset/130/kdd+cup+1999+data.
In the UNB intrusion detection dataset, The Triple-R dataset enhances fact verification by leveraging external evidence and generating human-readable explanations. Built on the LIAR dataset, Triple-R uses a three-component system- Retriever, Ranker and Reasoner. The Retriever gathers evidence from the web, the Ranker scores and selects the most relevant paragraphs and the Reasoner utilizes GPT-3.5-Turbo to generate reasons for the claims. The Triple-R dataset was constructed by applying the Triple-R methodology to the original LIAR dataset. For each claim, a set of top web-retrieved documents was processed, selecting paragraphs that provide relevant evidence. The reason component, powered by GPT-3.5-Turbo, was employed to generate explanations based on this evidence. The Triple-R dataset can be used to train models for misinformation detection and explainable AI systems, making it ideal for applications requiring transparency in decision-making. Our proposed causal language model can determine the truthfulness of a claim, enabling us to understand how the model makes decisions. This leads to greater transparency and interpretability in the process of fact verification. We use a larger language model to supervise a smaller one, improving our framework's quality and effectiveness. We present a hybrid zero-shot ranker that retrieves supporting information to justify the claim. The gathered evidence serves as an explanation that reinforces the generated reasoning. Train.json- Includes 10,047 samples with statements, labels, evidence, and generated reasons. Test.json- Contains 1,283 samples with statements, labels, and evidence. Feature columns are

Table 1 Dataset used in Problem Solving Assignment

Column	Description
Id	A unique identifier for each sample.
Statement	The claim or statement to be verified.
Label	The truthfulness of the claim (true, false, etc.).
Evidence	Relevant information retrieved from the web.
Reason	Generated explanation based on the evidence (in train set only).

After colecting data we must have to have any one of the software like MATLAB with Fuzzy Logic Toolbox, Scikit-fuzzy (Python library), FuzzyTECH, fuzzywuzzy.

➢ *Steps to Implementation*

Import the necessary functions from the fuzzywuzzy library for fuzzy string matching. Install *pip install python-Levenshtein, pip install fuzzywuzzy* fuzzy_authenticate function-

- Takes username, Passcode, and user_db as input.
- Iterates through the user_db dictionary.
- Calculates the username_ratio using fuzz.ratio(), comparing the entered username with each stored username.
- If username_ratio is above a certain threshold (e.g., 80%), it proceeds to Passcode matching.
- Calculates the Passcode_ratio using fuzz.ratio(), comparing the entered Passcode with the stored Passcode hash.
- If Passcode_ratio is also above a threshold (e.g., 70%), it returns True (authentication successful).
- If no match is found for both username and Passcode, it returns False.
- Creates a sample user_database with usernames and their corresponding hashed Passcodes.
- Defines entered_username and entered_Passcode.
- Calls fuzzy_authenticate and prints the Consequence.

Emphasize the smooth transitions between association functions, Majorlighting the ability to handle vague and uncertain information. Show how multiple rules can contribute to the final result, demonstrating the system's ability to handle complex decision-making scenarios. Clearly indicate the final quick result value obtained through defuzzification.

Table 2 Association Function Table (for Username Similarity)

Username Similarity (%)	Minor	Normal	Major
0-60	1.0	0.0	0.0
61-75	0.5	0.5	0.0
76-90	0.0	1.0	0.0
91-100	0.0	0.0	1.0

➢ *How does Fuzzy Inference System Works*

First we need to calculate the association degrees of the username and Passcode similarity scores to the linguistic terms (Minor, Normal, Major) using the association function tables. In the second step ppply the fuzzy rules to determine the authentication level for each rule. In the third steps combine the Consequences of all applicable rules using an appropriate aggregation method (e.g., maximum, minimum,

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weighted moderate). In the fourth step we converts the aggregated fuzzy result into a quick decision (e.g., "Accept," "Suspicious," "Reject") using a suitable defuzzification method (e.g., centroid method).

Table 3 Association Function Table (for Passcode Similarity)

Passcode Similarity (%)	Minor	Normal	Major
0-60	1.0	0.0	0.0
61-75	0.5	0.5	0.0
76-90	0.0	1.0	0.0
91-100	0.0	0.0	1.0

Now question arise that how would we make authentication decision? In the answer we need to folMinor the certain steps as per requirements-

- If the defuzzified result is "Accept," the authentication is successful.
- If the defuzzified result is "Suspicious," additional verification steps (e.g., two-factor authentication) may be required.
- If the defuzzified result is "Reject," the authentication attempt fails.

Table 4 Fuzzy Rule Base

Rule No.	IF Username Similarity IS AND Passcode Similarity IS	THEN Authentication Level IS
1	Minor	Minor
2	Minor	Normal
3	Minor	Major
4	Normal	Minor
5	Normal	Normal
6	Normal	Major
7	Major	Minor
8	Major	Normal
9	Major	Major

VII. EXPERIMENTAL CONSEQUENCES AND DISCUSSION

By utilizing the power of visual representation, these graphs can provide a valuable tool for both students and scholars of philosophy, offering new insights and perspectives on the history and evolution of philosophical thought. Database and code is availalble on the source https-//www.kaggle.com/code/azxc9595/visual-graphs-of-philosophy. In the preceding cell, I've created a list named 'CommonWords' containing the most frequent English words. We are implemeting process according to the fMinor diagram given beMinor-

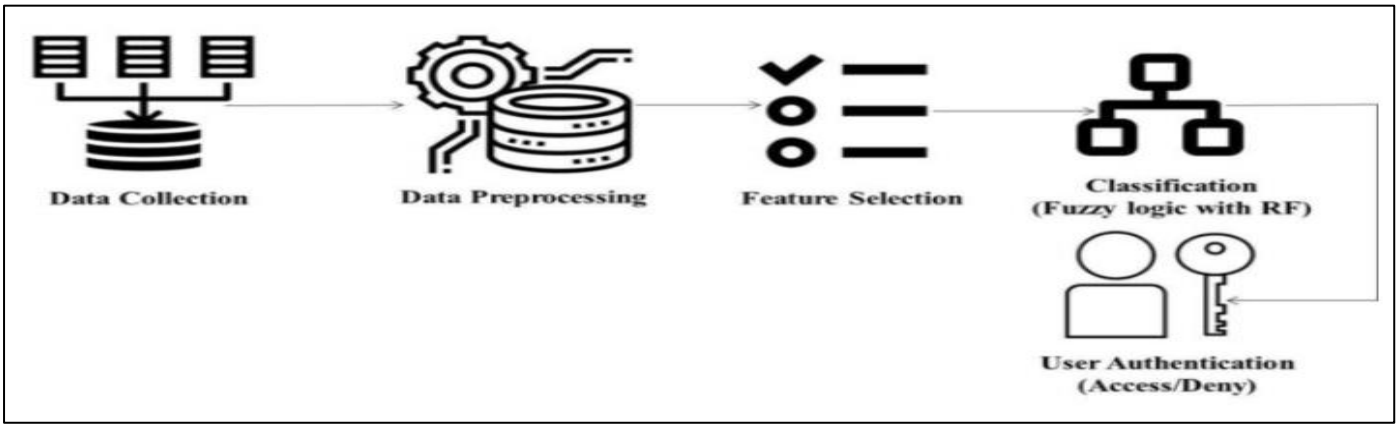

Fig 3 System Diagram to Implement Authentication Quality using Fuzzy Logic

This list serves a crucial purpose- to determine the number of unique words employed by assorted philosophers. By analyzing this data, we can effectively recommend philosophers to our friends based on the complexity of their writing. For instance, if a friend inquires about where to begin their philosophical journey, we can suggest philosopher 'x' as a starting point due to their relatively uncomplicated language. While this is a simplified approach, it offers a valuable initial framework for making personalized recommendations. I have identified the uncommon word 'Notions'. In the subsequent cell, utilizing TfidfVectorizer, we will filter for uncommon words that appear more than 70 times (this threshold can be corrected). To antitheticaliate between schools of thought, I have employed the folMinoring line of reasoning we have used here triangular mambership function to achieve 96% of

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quality. Consequence and its matmetical furmula and implementation Consequences are given beMinor-

Figure $\mu_a(x) = \begin{bmatrix} \frac{-a^{if x \le a}}{\frac{b-a}{x-a}} if a \le x \le b \\ \frac{x-a}{-a_{if x \ge a}} if b \le x \le c \end{bmatrix}$1-

Triangularassociation Formula above formula represent the process of execution in antithetical environments precondition.

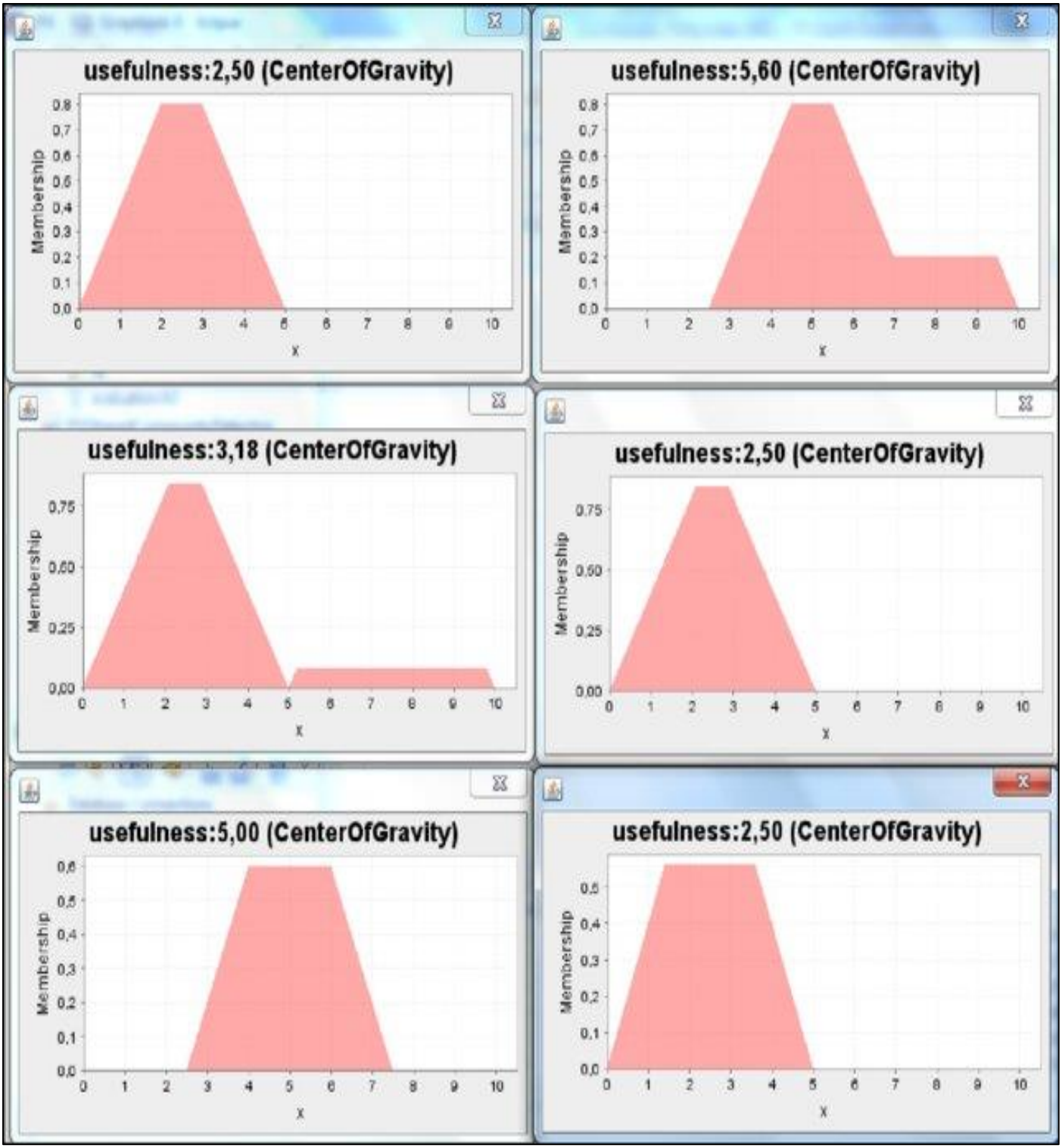

Fig 4 Analysis Diagram with Triangular Association Function

"Due to the substantial dataset size and memory limitations encountered on Kaggle, I executed the code from my local machine. In essence, the preceding cell involves vectorizing the 'Notions' data. Subsequently, to generate a 2D image, I performed dimensionality reduction to obtain a 2D matrix.

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Let's now assess whether this graph aligns with my personal reading experience. I will evaluate its quality based on my familiarity with these philosophers. My reading list includes Heidegger, Marx, Russell, Plato, Hume, and Kant. Additionally, I am aware of Deleuze, Derrida, and Foucault.

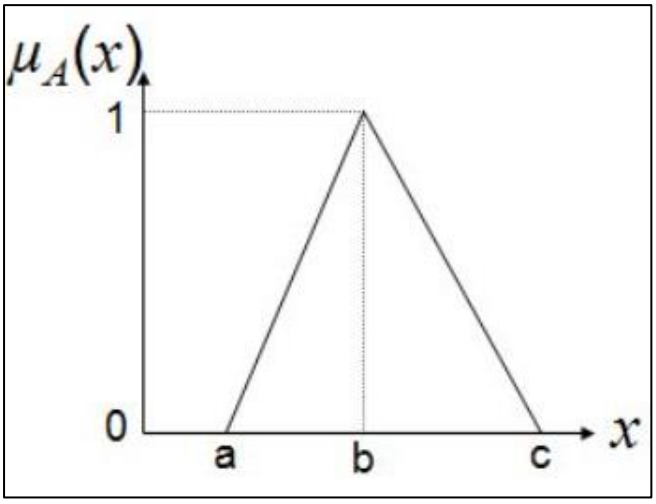

Fig 5 Graphical Representation of Triangular Association Function

We are now equipped to analyze the clusters. To mitigate the computational cost associated with our large dataset, I have sampled four subsets with respective sizes of 1%, 2%, 3%, and 4%. This multi-sampling approach safeguards against spurious Consequences. Analyzing a single subset might yield clusters specific to that particular sample, furnishing limited insights into the general data distribution. The graphical representation of formula is given above. As observed, discernible patterns exist within the data. By primarily focusing on frequent uncommon words, we can infer the school of thought to which a text belongs. However, I will forego the development of a supervised learning system. This decision stems from the belief that accurately classifying texts by school is not the primary objective, and such a system would likely be impractical. My primary focus is to demonstrate that certain uncommon yet frequently occurring concepts are uniquely associated with specific schools of thought.

$$UncommonWordDensity = \frac{\sum_{x=FirstIndex}^{LastIndex} NumNotations}{\sum_{x=LastIndex}^{LastIndex} NumberOrWords}$$

I have defined 'UncommonWordDensity' as a measure of reading difficulty. This metric reflects the idea that comprehension is hindered when encountering numerous unfamiliar words within a text. For instance, if a sentence contains ten words and four of them are unknown, understanding its meaning becomes significantly more challenging. While I believe this metric effectively quantifies reading difficulty. We have compared with multiple approaches in Figure-5 and we found the best Consequences in comparing to other approaches. As given in the figure beMinor-

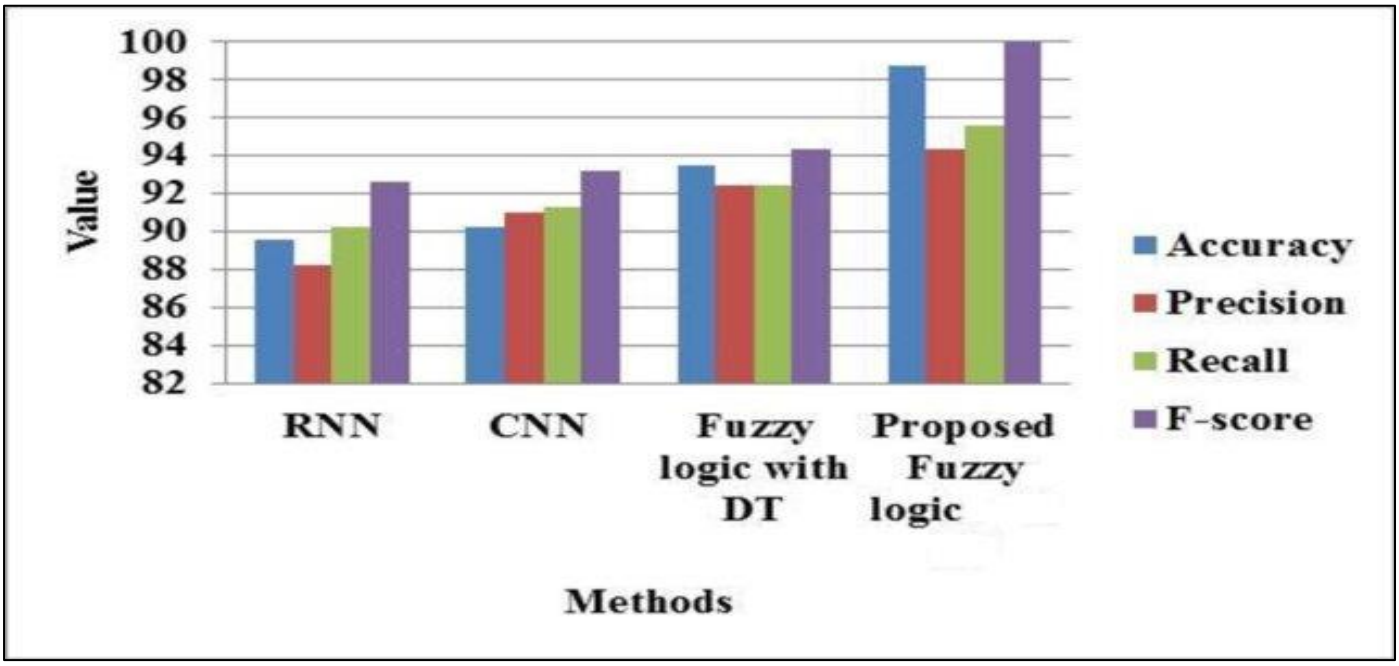

Fig 6 Comparative Study between RNN, CNN, Fuzzy Logic with DT and Proposed Fuzzy Logic

For Heidegger, I read approximately half of 'Being and Time,' finding it to be the most challenging work I've encountered thus far. The difficulty compelled me to discontinue reading. Consequently, placing Heidegger as the second most challenging philosopher seems reasonable.

Placing Derrida in third position is plausible. 'Deconstruction,' one of his central concepts, emerged in opposition to Structuralism. Derrida aimed to demonstrate the inherent ambiguity of language within texts, asserting that texts are not inherently superior to spoken discourse. This focus on the inherent deconstructibility of language, including his own writings, likely contributed to his notoriously challenging style. As the Consequence can be seen in the image.

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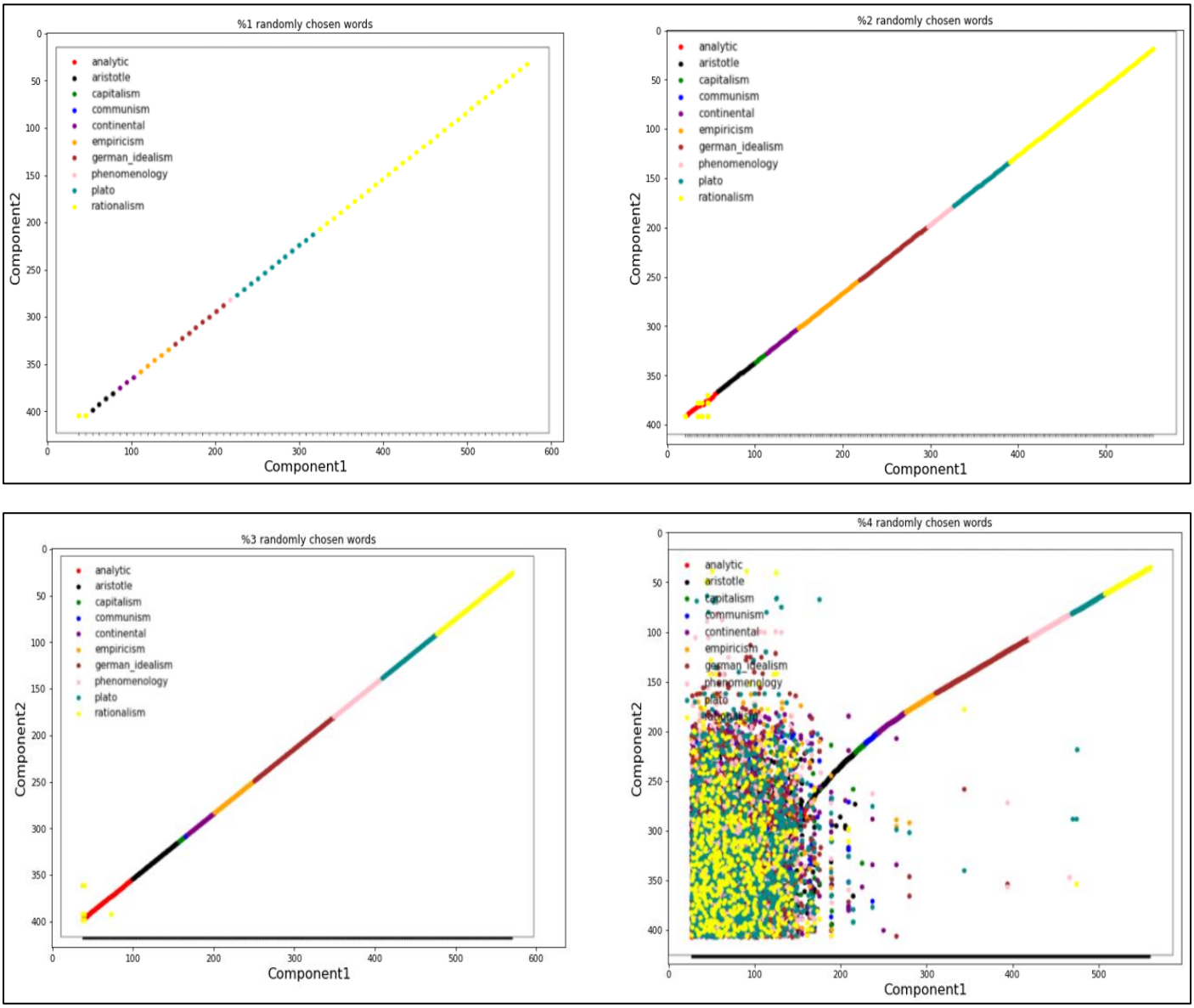

Fig 7 Final Consequence and Performance

For Deleuze and Foucault, I believe it's reasonable to assume that postmodern thinkers generally present more complex ideas. However, this is open to debate.

Marx's 'The Communist Manifesto' and 'Economic and Philosophic Manuscripts,' in my experience, were relatively accessible.

Similarly, Plato's 'Apology of Socrates' and 'Republic,' while initially challenging due to unfamiliar concepts like 'daimon,' Greek terminology, and references to Greek deities, became more manageable with continued engagement.

Russell, whose works like 'History of Western Philosophy' and 'Why I Am Not a Christian' are Majorly readable, is one of my favorite philosophers. Based on my personal reading experience, this graph appears to be compatible. I encourage you to assess its alignment with your own reading experiences.

$$Distance = constant + \frac{1}{NumberOfReferings}$$

To represent the relationships between philosophers within our graph, we will utilize edge lengths to visually signify the frequency of references.

To achieve this, I have defined a distance formula as folMinors-

Distance = Constant + 1 / Number of Referring

For instance, if Plato referred to Socrates 100 times, the edge length would be calculated as- 1 + 1/100.

This approach ensures that philosophers with frequent mutual references are visually closer together within the graph.

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The addition of a constant term to the formula prevents the excessive clustering of nodes, which would hinder the readability and interpretability of the graph.

Finally, these calculated distances will be used to position the nodes along the x-axis, creating a visual representation of the relationships and influences between the philosophers.

$$\alpha = \frac{360}{NumberOfPholsphers}$$

The Consequence shown in the image given beMinor-

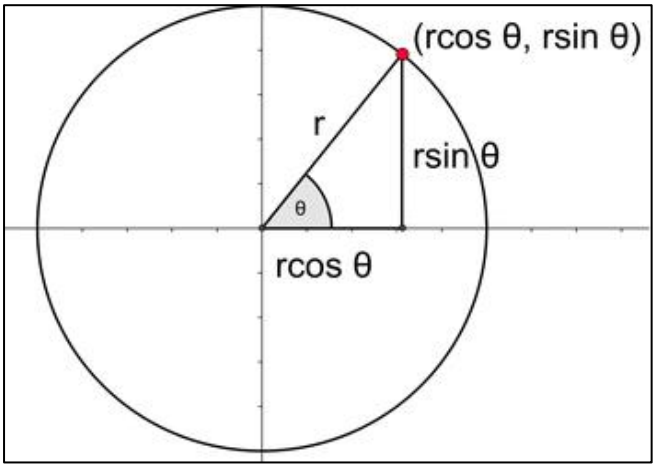

Fig 8 Distance Calculation from Node Position among the X-Axis

FUTURE WORK

Future study will implement and compare the deep learning algorithms and the swarm intelligence algorithm using the similar data base.To increase the efficiency of the proposed algorithm and achieve better success**,** a suitable classifier for the proposed method must be found.

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