Submissionid	189
Authors	Soumyarani Pati1 and Kshitish Kumar Mohanta1,∗
Title	Project Scheduling in Uncertain Environments: An Intuitionistic Fuzzy Approach to solve CPM
Abstract	The Critical Path Method (CPM) in a fuzzy context is an important tool for dealing with uncertain, perhaps vague, project scheduling. This paper presents two new solution method for the Intuitionistic Fuzzy Critical Path Method (IFCPM) by defining activity durations using Triangular Intuitionistic Fuzzy Numbers (TIFNs). These methods combine forward pass and backward pass calculations, to identify the earliest and latest event times and computes, the total float for each activity. This method improves project scheduling by dealing with uncertainty and hesitancy for activity duration. To demonstrate the practical utility and usefulness of the method, two numerical examples are considered to prove it can identify the critical path in an intuitionistic fuzzy environment. The results demonstrate that the method described here improves the robustness and flexibility of the project scheduling process under uncertainty.
Link	https://youtu.be/XzKpCS7njh4?si=17zi2t7J2NbWGqx9

Submissionid	198
Authors	Lazim Abdullah, Norsyahida Zulkifli and Ahmad Termimi Ab Ghani
Title	Prioritizing Climate Change Contributing Factors via the VIKOR Method under Q-Rung Orthopair Fuzzy Environment
Abstract	Climate change, characterized by long-term shifts in temperature and weather patterns, is predominantly driven by human activities. Although numerous factors, such as carbon dioxide concentration, changes in the Earth's orbit, ocean currents, greenhouse gas emissions, and variations in solar energy reflection or absorption, are recognized as contributors, the degree of their individual impacts remains unclear and uncertain. This study aims to prioritize the contributing factors to climate change by employing the VIKOR method integrated with Q-rung Orthopair Fuzzy Sets (Q-ROFS), a robust approach to handle vagueness and uncertainty in expert assessments. Five domain experts provided linguistic evaluations regarding the importance of each contributing factor. The aggregated linguistic data were analysed using the Q-ROFS-VIKOR model, revealing that two primary factors, identified as R1 and R2, are the most significant contributors to climate change. Interestingly, the factor 'carbon dioxide concentration' was ranked lowest, suggesting a relatively negative impact compared to other factors considered. The findings provide a clearer perspective on the relative significance of various climate change factors, offering valuable insights for policymakers and researchers in designing effective mitigation strategies
Link	https://youtu.be/QRu5sEY3qcY?si=kISS-jnh9d6F2ejl

Submissionid	272
Authors	Bambang Irawanto1∗ , Suffi Nuralesa 2 and Nikken Prima Puspita 3
Title	Seminear-Ring Ideals Constructed from Triangular Fuzzy Numbers
Abstract	A set of triangular fuzzy numbers with (0, 0, 0) completed by two operations which are fuzzy algebra properties of triangular fuzzy numbers is a seminear-ring denoted by (A˜r ∪ {(0, 0, 0)},⊕,⊗). The addition operation on the seminear-ring is the pointwise operation which is a binary operation and the multiplication operation which is also a binary operation if some conditions are satisfied. This article investigates the multiplication operation on the fuzzy algebra properties of triangular fuzzy numbers that can be used to construct an algebraic structure. Based on the conditions given in this article for the multiplication operation, the triple (A˜r ∪ {(0, 0, 0)},⊕,⊗) is a seminear ring. Furthermore, the seminear-ring can be defined subring and ideal.
link	https://youtu.be/9i34VdajsBA?si=N5jNk9P7FlbvcE54

Submission ID	172
Authors	K. Kumar Mohanta and J. Mohanta
Title	**Fuzzy Regression Model to Assess the Rainfall Variability Trend in Kalahandi, Odisha: Leveraging 100 Years of Data for Trend Robust-ness and Predictive Accuracy**
Abstract	Linear regression analysis is one of the most common statistical methods used to investigate trends in rainfall over time. However, conventional regression models usually require datasets that have been completely and accurately determined for trend analysis with rainfall, the datasets often include monthly or annual averages which can result in uncertainty in trend analysis. In order to incorporate this uncertainty, fuzzy set theory represents the ambiguity from the analyzed datasets. The fuzzy regression models consider both input and output variables to be Triangular fuzzy numbers. This study proposes a fuzzy regression approach that describes the relationships between precipitation and time in a context of excessive variability in rainfall which creates challenges for the sustainable management of water resources. Kalahandi district in Odisha has been acknowledged as one of the impoverished districts in the KBK Region. The utilization of the fuzzy regression model in addressing trend variability or trends in rainfall in Kalahandi, Odisha is a comprehensive investigation of historical rainfall records related to trends and variability of rainfall in Kalahandi, especially the region's severe effects associated with climate change; it is of utmost importance to understand how rainfall variability trends have changed over time for local agrarians or agriculture workers and policy-makers to recognize changes in rainfall patterns and develop adapted agriculture plans and manage water resources in a variable climate. The data collection process included 100 years of fuzzy rainfall data (1923 - 2023); thus, including the last century helps frame current rainfall variability trends in Kalahandi. From the research, it has been shown that Kalahandi is experiencing climate change or other environmental factors that are leading to a substantial increase in rainfall variability. The study methodologically establishes fuzzy regression as an alternate approach to provide a more accurate predictive model for rainfall.
Link	https://youtu.be/4MRangp01k4?si=q-JFQEHKxPIeTfTe

Submission ID	102
Authors	S. Korucuk and C. Karamaşa
Title	**Determining the Importance Level of Sustainable Innovation Applications via Hesitant AHP: An Application on Food Firms**
Abstract	Sustainable innovation, which is the innovation element focused on environmental, social and common awareness and creating value today, has directed businesses to new application and awareness-raising areas not only in today but in future generations. It builds itself a new stance apart from the traditional business forms with the dynamics it contains in the concept and aims to increase the basic capabilities of the enterprises. So, in the new world order brought about by globalization, there are serious socio-economic crises, and it is important that organizations mobilize and implement sustainable innovations. With this regard elements for sustainable innovation organizations can be classified as economic, social, regulations, market demand, information management, cross-functional cooperation, organization culture, new career opportunities, management commitment, technical innovations and non-technical innovations. The important elements for sustainable innovation organizations listed above are also seen as one of the important building blocks for the needs of future generations. In the comprehensive literature review, the existence of a limited number of studies regarding the degree of importance for sustainable innovation elements is another factor that increases the importance of the subject. In this study, the degree of importance for sustainable innovation elements in food manufacturing enterprises with 10 or more employees in Erzurum has been determined. Hesitant fuzzy sets based AHP was applied in the analysis section.
Link	https://youtu.be/pS7ffFDx_Ag?si=6zjglpscFrNb6BG0

Submission ID	200
Authors	A.S. Ashwinth Jeffrey, M. Shanmugapriya and R. Sundareswaran
Title	**Influence of uncertain nanoparticle volume fractions on energy and mass transport in Maxwell Hybrid nanofluid flow under Electro-MHD-osmotic effects**
Abstract	This research analyses how uncertainty in nanoparticle volume fractions affects the energy and mass transport in the visco-elastic non-Newtonian Maxwell fluid flow over a shifting wedge. The dual nanoparticle suspended mixtures are employed in automotive and energy systems, offering amplified support for heat conduction. The prominent nano-sized particles Fe_3O_4 & TiO_2 are incorporated in our numerical simulation, considering pivotal effects including electro-MHD & osmotic forces, thermophoresis, activation energy, thermal radiation and Brownian motion. With the above applications in mind, the uncertain volume fractions are studied as triangular and trapezoidal fuzzy numbers to analyses their upshots on drag force, heat & mass transport. In the numerical study the dimensionless variables are employed to simplify the governing differential equations which are then altered to fuzzy differential equations using the $\hat{\alpha}$-cut method. The heat transfer rate of the present hybrid mixture is computed numerically and compared. The dual nanoparticle mixture exhibited improved fuzzy profiles for velocity, temperature and concentration. The electro-MHD & osmotic forces were found to significantly enhance the drag force, while the combined effects of Brownian motion and thermophoresis led to a notable increase in heat transfer. Upon evaluating the $TriF_{number}$ and$TrapF_{number}$, it was observed that the $TrapF_{number}$ effectively improved the accuracy and reliability of estimating the drag force, energy and mass transport. The dual nanoparticle mixture $(Fe_3O_4 + TiO_2\ /Blood)$ emerged as the most thermally efficient, achieving an 8.15% higher heat transfer rate compared to$(Fe_3O_4/Blood)$, a 5.82% improvement over $(TiO_2/Blood)$ and a 6.91% increase compared to the blood.
Link	https://youtu.be/8aVwzvuVjAA?si=Csf3fnPEVUVlAsYO

Submissionid	243
Authors	S. Bharathi1 and S. Mohanaselvi1*
Title	PSI-FUCA and PSI-PIV method for multi attribute group decision making using single valued neutrosophic neutrality aggregation operator
Abstract	This study presents a comprehensive investigation into multiple attribute group decision-making (MAGDM) under uncertainty by employing single-valued neutrosophic sets (SVNS) to effectively represent imprecise, indeterminate and inconsistent information. It utilizes existing single-valued neutrosophic neutrality aggregation operators to construct a novel MAGDM approach. To objectively determine the weights of attribute without relying on subjective judgments, the preference selection index (PSI) method is employed. Subsequently, the proximity indexed value (PIV) and faire un choix adequat (FUCA) method is applied to rank the alternatives based on their proximity to the ideal solution. Several numerical examples are provided to illustrate the validity, effectiveness and practical applicability of the proposed methodology.
Link	https://youtu.be/hCZpQY0JHTg?si=VsvAS7MzIgICMYmP

Submissionid	141
Authors	Binu R 1
Title	Representation Theory of Neutrosophic G-submodules
Abstract	This paper presents representation theory in the context of discrete vague algebraic structures, with an additional focus on neutrosophic G-submodules and define neutrosophic representation of neutrosophic G-submodules. We also investigate the concept of neutrosophic quotient G-submodule representations. Finally we define neutrosophic homomorphism and derive the fundamental theorem for neutrosophic representation of neutrosophic G-submodules
Link	https://youtu.be/OfQdGpfz2is?si=69U_Q5sPo4cPS94Z

Submission ID	269
Authors	V. Divya and J. Jesintha Rosline
Title	**Certain Notions of Energy in Fermatean Quadripartitioned Neutrosophic Fuzzy Graph**
Abstract	Fermatean Quadripartitioned Neutrosophic fuzzy graph (FQNFG) is the integrating form of Fermatean and Quadripartitioned Neutrosophic fuzzy graph. Graph energy is recognized as a crucial concept in fuzzy graph theory for its ability to handle random events, thus capturing the attention of numerous researchers. Moreover, the study of graph energy has been a notable rise in recent years. Energy of Graphs have significant applications in various domains, including network analysis, decision making, Image processing, modelling uncertainty etc. This paper introduces energy and Laplacian energy for FQNFG. Adjacency matrix, Eigen values, energy and Laplacian energy of FQNFG are defined with examples. Furthermore, we obtain lower and upper bounds of energy and Laplacian energy for FQNFG. Additionally, this study represents a sophisticated decision-making framework, employing a scoring methodology to assess and compare Laptops based on critical attributes such as processing power, memory & storage, Battery life and Display quality.
Link	https://youtu.be/BOiurqvEcqY?si=L7MTpTHNzCKuj4or

Submissionid	230
Authors	Mahsa Sadeghi 1, Ali Asghar Talebi 2,∗ and Jaber Ramezani3
Title	On the Temperature Indices of Fuzzy Graphs and its Application for QSPR analysis on Autism drugs
Abstract	In this work, we introduce the concept of fuzzy temperature indices and rigorously compute them for fundamental fuzzy graph structures as well as their standard operators, including Cartesian products and compositions. Utilizing a graph-theoretical modeling approach, fuzzy graphs are constructed for a selection of pharmaceutical compounds commonly prescribed for Autism Spectrum Disorders (ASD), specifically Aripiprazole, Haloperidol, Risperidone, Sertraline, Venlafaxine, and Ziprasidone. The fuzzy temperature indices are then derived based on the underlying physicochemical descriptors of these compounds. Linear regression analyses are performed to explore the predictive capacity of the fuzzy topological indices in relation to drug properties. The findings highlight the significance of fuzzy temperature indices as robust mathematical invariants, providing valuable insights into the structural and functional profiling of ASD medications, and opening new avenues for the application of fuzzy graph theory in pharmaceutical sciences and computational drug design.
link	https://youtu.be/PF6bglQ_DBY?si=caHcyYH4lrUZugmS

Submissionid	215
Authors	1 Buvaneswari. R, 2 Senbaga Priya. K
Title	Spectra of Fuzzy Graphs Under Graph Operations in Protein-Protein Interaction Networks
Abstract	In this paper, operations on spectral fuzzy graphs, including vertex addition, edge deletion, contraction, perturbation, spectral variations under homomorphism and various types of isomorphisms are explored. These operations influence the eigenvalues and eigenvectors of fuzzy adjacency and Laplacian matrices, shedding light on changes in graph structure and connectivity in the context of uncertain relationships. A key application is provided through Protein-Protein Interaction (PPI) networks in the context of Systemic Lupus Erythematosus (SLE), demonstrating the utility of spectral fuzzy graph theory in modeling complex biological networks with fuzzy interactions. The relevance of spectral fuzzy graphs in capturing the dynamics and structural evolution under fuzzy transformations are highlighted.
link	https://youtu.be/3cGRYdI_6s8?si=2AaCS29hJ_CH_tsD

Submission ID	303
Authors	A. Sungheetha, R. Sharma, S. Mahapatra, M. Ahmad Al-Khasawneh, and B. Balusamy
Title	**AquaTherapy: An AI-Enabled Underwater Robotic System for Precision Hydrotherapy with Deep Learning-Based Motion Analysis**
Abstract	This paper presents Aqua Neuro Tech, an innovative underwater robotic system that integrates advanced artificial intelligence with precision robotics to enhance outcomes in aquatic Neuro rehabilitation. While traditional hydrotherapy offers numerous benefits, it faces limitations in quantitative assessment, therapeutic precision, and personalization. Our system addresses these challenges through a novel multi-modal framework that combines sonar imaging, computer vision, and patient responsive adaptive control mechanisms. The Aqua Neuro Tech architecture incorporates three primary subsystems: (1) a perception layer utilizing deep learning for underwater motion tracking with 94.3% accuracy in turbid conditions, (2) an intelligent decision-making system employing reinforcement learning for therapeutic protocol optimization, and (3) a soft robotic actuation system with 6 degrees of freedom providing variable resistance profiles based on real-time patient performance. Experimental validation across 127 therapy sessions with 43 patients demonstrated significant improvements over conventional approaches, including a 52% enhancement in motion accuracy, 40% reduction in therapist intervention, and 37% faster recovery trajectories for selected neurological conditions. The system maintains 99.1% safety compliance while achieving a therapeutic effectiveness index of 0.87 (compared to 0.63 in traditional settings). Our findings suggest that AI-enhanced underwater robotics can substantially augment hydrotherapy outcomes through improved precision, personalization, and quantitative assessment capabilities.
Link	https://youtu.be/tSMjMgjBV2Y?si=HV5ykHpBRbluIVH3

Submission ID	244
Authors	Karpaha, C. and J. Robinson
Title	**Intuitionistic Fuzzy Hybrid Data Mining-MAGDM Approach Using Correlated Aggregation for Solving Complex Decision Problems**
Abstract	This paper addresses Multiple Attribute Group Decision Making (MAGDM) problems where attribute values are represented as intuitionistic fuzzy sets. A novel decision-making framework is developed by integrating the Choquet integral operator with Intuitionistic Fuzzy Ordered Weighted Averaging (IFOWA) operators, effectively capturing both the importance and ordered influence of attributes under uncertainty. A distinguishing feature of this work is the fusion of Data Mining techniques into the MAGDM model, enabling the identification and elimination of irrelevant or redundant attributes. This integration significantly enhances the model's efficiency and decision quality by reducing complexity and focusing on the most impactful variables. The synergy between intuitionistic fuzzy logic and data mining provides a more intelligent and scalable decision-support system. The effectiveness and practicality of the proposed approach are demonstrated through a comprehensive numerical illustration.
link	https://youtu.be/aAlXbDTjzWA?si=YUKOCYP1AEKqn49o

Submission ID	68
Authors	M. M. Lin, L. Sai, N. Aswad and A. Rahman
Title	**Hybrid Cosine-Jaccard Measure for Neutrosophic Set**
Abstract	Similarity measures play a critical role in quantifying relationships between data points. Recent advancements have expanded the exploration of these measures into neutrosophic sets, a framework capable of simultaneously addressing uncertainty, indeterminacy, and inconsistency in datasets. Among these, cosine similarity measures in neutrosophic sets have attracted a lot of attention for their ability to enhance pattern recognition accuracy, particularly in classifying complex or ambiguous patterns. Instead of using classical cosine similarity measures in vector spaces, by applying neutrosophic truth, indeterminacy, and falsity membership values, it enables wider applications in multi-attribute decision-making. Jaccard similarity measures focus on the ratio of intersecting sets to union sets, while the improved Jaccard measures in neutrosophic sets further address indeterminacy, making them particularly effective for clustering tasks, document matching, and evaluating overlaps between ideal solutions. This study highlights the uncertainty and complexity of the data by proposing a hybrid cosine-Jaccard similarity measure for neutrosophic sets. Some key properties, such as symmetry, boundedness, and reflexivity, are carefully examined to ensure their consistency and reliability. The practical examples demonstrate the measure's validity by emphasizing its potential to advance decision-making and pattern recognition.
link	https://youtu.be/BjjOYPUTH14?si=N7M36nnn5t2jmb-F

Submission ID	162
Authors	S. Anupreethi and M. Somanath
Title	**Non-extendable Rational Diophantine 3-tuples Comprising Polynomials and Special Figurate Numbers**
Abstract	A rational Diophantine 3-tuple is a family of three non-zero rationales x, y, z with the property $D(n)$ such that $xy + n, yz + n, xz + n$ are perfect squares. In this paper, a pair of rational polynomials and some special figurate numbers are scrutinized for their extension as triples and are proved to be non-extendable as quadruples.
link	https://youtu.be/c7siewsGSLQ?si=Z90yqyrC9va53W9w

Submissionid	167
Authors	Bindu V A1 Manju Somanath2, and Radhika Das1
Title	Solutions of Pell's equation involving left truncated Primes
Abstract	A Left-truncatable prime is a prime which in a given base (say 10) does not contain 0 and which remains prime when the leading ("left") digit is successively removed. For example, 317 is left-truncatable prime since 317, 17 and 7 are all prime. Taking the cue from this initial research, we attempt to find the possible solutions for the Pell's equation $x^2 = 137y^2 - 37^m$ for all choices of $m \in \mathbb{N}$. In this paper, we focused primarily on Pell's equations involving the left-truncatable primes and present to you another mysterious series and pattern typically associated with the Pell's equation. As we proceed through the research, we will bring to the fore the recurrence relations among the identified solutions.
link	https://youtu.be/TY3KUTmXLgA?si=f8JXUQKrVfm_1SlC

Submission ID	192
Authors	M. Santhosh Priya and A. Mydeen Bibi
Title	**Enclave Domination Number of Graphs**
Abstract	Let G = (V, E) be a simple graph. A set D ⊆ V (G) is a dominating set if every vertex in V\ D is adjacent to at least one vertex in D. In this paper, we introduce the enclave dominating vertex and enclave dominating sets in graphs. Herein, we define and study a new domination parameter called enclave domination number. We determine the exact number of minimum enclave dominating sets for some standard graphs, path-related graphs, and wheel-related graphs. Also We investigate some characterizations and properties of enclave domination number.
Link	https://youtu.be/omioLRJif_M?si=860zzvOFXb10iUhW

Submission ID	324
Authors	S. Kumar and M. Kumar Singh
Title	**Introduction to Intuitionistic Anti-Fuzzy Linear Space and Anti-Fuzzy Algebra over an Anti-Fuzzy Field**
Abstract	In this article, the notion of intuitionistic anti-fuzzy field has been introduced. Based on it further intuitionistic anti-fuzzy linear space over an intuitionistic anti-fuzzy field, and intuitionistic anti-fuzzy algebra over an intuitionistic anti-fuzzy field are established. Also, some examples and noteworthy results are discussed for these newly proposed notions.
Link	https://youtu.be/Fhm-HjSHxW4?si=GTAD36hdRdxeZuFq

Submission ID	323
Authors	S. Kumar and M. K. Singh
Title	**A Characterization of Picture fuzzy linear space and Picture fuzzy algebra over a Picture fuzzy field**
Abstract	In this paper, the notion of picture fuzzy field, picture fuzzy linear space over picture fuzzy field, and picture fuzzy algebra over picture fuzzy field are introduced. Additionally, from these newly introduced notions, some examples and results are derived.

https://www.youtube.com/watch?v=BjjOYPUTH14

Submission ID	171
Authors	G. Aruna and J. J. Rosline
Title	**A Comparative Study of MCDM Approaches: Exploring the Influence of Additional Parameters in Mathematics**
Abstract	This article introduces a Multi-Criteria decision-making approach that utilizes a scoring function within a bipolar fuzzy framework. TOPSIS is one of the most efective techniques for identifying the best solution. To achieve this, we examined the TOPSIS method along with bipolar fuzzy arithmetic and geometric weighted aggregators. Subsequently, we developed the new methodology by incorporating the bipolar score function. Also, we would like to compare the proposed method with the traditional TOPSIS approach. A comparative analysis was performed to illustrate the electiveness and applicability of the suggested techniques. We also applied the new methodology to a Multi-Criteria Decision-Making problem. Moreover, we included the regression results using the bipolar scoring function to evaluate the innocence of other parameters in mathematics.

Submission ID	246
Authors	H. Kumar and H. Dhumras
Title	**A Comparison of Neutrosophic and Intuitionistic Fuzzy Sets for Use in Decision-Making**
Abstract	Traditional approaches are inadequate for medical decision-making because it frequently entails hesitancy, confusion, and conflicting facts. This study contrasts Neutrosophic Sets (NS) with Intuitionistic Fuzzy Sets (IFS) as decision-making methods for medical diagnosis, with an emphasis on diabetes detection, in order to solve these complications. Compared to classical fuzzy sets, IFS provides a better representation of uncertainty by taking into consideration degrees of membership, non-membership, and reluctance. By adding independent degrees of truth, indeterminacy, and falsity, NS, on the other hand, expands on this model and provides a more adaptable and thorough method of dealing with inconsistent and partial data. The actual implementation of these approaches is illustrated by a case study involving the assessment of patient symptoms. The comparison analysis shows that NS performs better in situations with substantial indeterminacy and contradiction, but IFS predicts uncertainty effectively when hesitation is low. The results imply that in complex medical settings, neutrosophic-based models might offer better decision support. Future topics for study are also suggested in order to increase the application and dependability of these techniques.

Submission ID	344
Authors	T. Agarwal , G. R, M. Chakraborty, S. Yogarayan, A. Panthakkan, and B. Balusamy
Title	**A Comprehensive Survey to Enhance Face Spoofing Attack Detection via Ensemble Learning**
Abstract	Face spoofing detection is critical to ensure the security and reliability of biometric authentication systems, particularly as these systems are integral in sectors such as banking, surveillance, and security of access. The increasing sophistication of spoofing attacks, including photo, replay, and mask attacks, requires advanced detection techniques. While traditional methods based on handcrafted features struggle against modern threats such as 3D spoofing, machine learning approaches have shown promise. This survey explores the application of ensemble learning techniques using deep learning models such as ResNet50, EfficientNetB0, and MobileNetV2. Feature extraction using Local Binary Pattern (LBP) improves model performance by leveraging texture-based information. By analyzing models implemented on the CASIA Face Anti-Spoofing Dataset, this paper identifies key gaps, including limited data set diversity and under-utilization of advanced ensemble methods. The proposed solutions focus on improving generalization and detection accuracy through innovative ensemble techniques and expanded datasets to effectively address real-world scenarios.

Submission ID	261
Authors	S. Rana, V. Chaubey and K. K. Mohanta
Title	**A DEA-Based Efficiency Analysis of Odisha's Healthcare System: Measuring District-Level Healthcare Performance and Identifying Best Practices**
Abstract	In this study, data envelopment analysis (DEA) models are used to assess the efficiency of the healthcare system in the districts of Odisha and to determine whether the system can handle the increase in demand for healthcare services caused by the expanding population. This study used multiple DEA models, including BCC, CCR, SBM (VRS), and super efficiency, to evaluate the relative efficiency of the delivery of health services in Odisha districts. The results revealed substantial variation in performance across the state. The study considered number of sub-centers (SCs), the number of primary health centers (PHCs), the number of community health centers (CHCs), expenditure, bed strength and doctors as input parameters and the average population covered, industrial delivery, life expectancy, and infant mortality rates as output parameters to analyze the performance of the rural healthcare systems. In the results, several districts consistently achieved full efficiency under different DEA models, indicating optimal utilization of resources. The districts such as Cuttack, Bhadrak, Khordha, and Puri frequently appeared on the efficiency frontier in multiple models, suggesting strong healthcare management and service delivery mechanisms. However, districts such as Rayagada, Nabarangpur, and Malkangiri exhibited notably low efficiency scores in traditional and slack-based models.

Submission ID	103
Authors	J. Behera
Title	**A Fuzzy Inventory Model for Perishable Products under Demand Uncertainty and Carbon Sensitivity**
Abstract	Perishable inventory management involves keeping track of perishable products in eco-conscious supply chains under uncertainty in demand, cost, and emission parameters. Classical inventory models fail in such scenarios because they rely upon explicit input values and deterministic assumptions. In this paper, we introduce a fuzzy inventory model for perishable products under uncertain demand/demand cost and carbon-sensitive operational constraints. It stores key parameters like demand rate, holding cost, shelf life, and emission rates in triangular fuzzy numbers to reflect the ambiguity inherent in real-world data. The total cost function includes ordering cost, fuzzy holding cost (if the products are perishable) and fuzzy carbon emission penalties associated with storage and transport activities. Fuzzyification is performed by graded mean integration method to obtain actionable inventory decisions. Numerical analysis shows how the model adapts to several real-life constraints and gives a graphic representation of the costs and tradeoffs between cost and quality, preserving product shelf life and protecting the environment. Sensitivity analysis provides a detailed insight into how fuzziness and emission cost affect optimal order quantity. We propose a novel framework for using fuzzy information ambiguity to enable sustainable inventory planning on perishable products.

Submission ID	287
Authors	D. Bora
Title	**A Fuzzy Multi-criteria Decision-making Approach for Student Academic Performance Evaluation**
Abstract	The evaluation of student academic performance is a critical component in educational institutions, enabling the identification of strengths and weaknesses in the learning process. Traditional evaluation methods often fall short of capturing the nuanced performance of students. In this chapter, a model is developed using fuzzy logic approach to assess the academic performance of sixth-semester students of Pandit Deendayal Upadhyaya Adarsha Mahavidyalaya, Eraligool. The model incorporates three criterions, namely, internal examination marks, class attendance, and end-semester examination marks, to generate an output variable representing the student's academic performance value. A dataset of 116 undergraduate students' scores is used to train (70% of data) and test (30% of data) the developed model. Mamdani inference method is used for inference and Centroid method is used for defuzzification of the performance values given by the model. The findings of the study, that is, individual observation of the testing dataset, the estimated error value (0.029), and correlation coefficient value (0.964) show that the fuzzy logic approach provides satisfactory results and it pointed out its application in the educational system.

Submission ID	118
Authors	M. Saad, M. Nabeel, and M. Ayedh
Title	**A Fuzzy Programming-Based Framework for Enhancing Cybersecurity in Healthcare Systems under Uncertain Environments**
Abstract	In the era of digital healthcare transformation, cybersecurity threats pose significant risks to sensitive medical data and patient safety, especially in uncertain environments. This study presents a fuzzy programming-based decision-making framework to enhance cybersecurity in healthcare systems, where ambiguity and imprecision in data and risk evaluation are prominent. The proposed framework integrates the Fuzzy Analytic Hierarchy Process (FAHP) for risk prioritization, the Fuzzy Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) for evaluating cybersecurity measures, and a fuzzy linear programming model for optimal resource allocation. The model is mathematically formulated to minimize risk exposure subject to budgetary and operational constraints, with fuzzy parameters capturing uncertainty in the effectiveness, cost, and feasibility of security measures. A numerical example involving three cybersecurity risks and three mitigation strategies demonstrates the framework's practical application. The fuzzy evaluation process identifies end-to-end encryption as the most effective and feasible solution, and the optimization model allocates limited resources accordingly to minimize overall cyber vulnerability. The results validate the robustness and applicability of the proposed approach in guiding healthcare decision-makers toward secure and efficient cybersecurity strategies under uncertainty. This research bridges the gap between cyber risk modeling and practical security implementation in healthcare environments.

Submission ID	115
Authors	D. D. Jr
Title	**A Fuzzy Set-Based Context-Aware Decision Framework for Histopathological Image Classification in Tumor Microarrays**
Abstract	Histopathological image classification in Tumor Microarrays (TMAs) is a crucial component in modern oncopathology and personalized medicine. This study proposes a Fuzzy Set-Based Context-Aware Decision Framework to enhance classification accuracy by incorporating contextual features such as image dimensions and tissue morphology indicators. Utilizing a dataset of 538 labeled histopathological images across five tumor classes (HGSC, EC, CC, LGSC, MC), we developed a hybrid model that integrates fuzzy logic with decision theory and econometric tools. Our framework employs rule-based fuzzy inference systems, context attribute clustering, and performance evaluation using confusion matrices and precision-recall metrics. Econometric regression was performed to determine the influence of contextual features like image width and height on classification accuracy. Results revealed significant differences in class representation and spatial resolution, which were found to influence classifier confidence. The fuzzy system achieved a macro-average F1 score of 0.81, outperforming traditional models in low-data-class scenarios. This work demonstrates the viability of fuzzy logic in clinical image analysis, offering a promising decision support tool for pathologists and data scientists in biomedical diagnostics.

Submission ID	208
Authors	D. K Sah and S Ballem
Title	**A General Implicit Finite Difference Scheme for Solving Intuitionistic Fuzzy Hyperbolic Partial Differential Equation**
Abstract	An implicit fuzzy finite difference method is proposed for the numerical solution of the intuitionistic fuzzy wave equation, where the initial and boundary conditions are modelled using intuitionistic triangular fuzzy numbers. The formulation integrates the concept of intuitionistic fuzziness directly into the finite difference framework, allowing for the effective treatment of uncertainty in dynamic systems. A rigorous analysis of the proposed scheme is carried out to establish its consistency and convergence. The stability of the method is also examined in detail to ensure the reliability of the numerical solutions. To demonstrate the applicability and accuracy of the approach, a representative numerical example is provided, and the obtained results are compared with the exact solution. The comparison confirms the efficiency and robustness of the proposed implicit fuzzy finite difference method in handling wave equations under intuitionistic fuzzy environments.

Submission ID	329
Authors	V. R. Khoshghadam, S. M. Mohammad Hajimolana, S. A Yazdian and R. Tavakkoli-moghaddam
Title	**A hybrid machine learning and optimization approaches for efficient blood supply chain planning under uncertainty**
Abstract	This study proposes an innovative two-phase framework for the planning and optimization of a blood supply chain network under conditions of uncertainty and perishability. The first phase leverages advanced machine learning techniques to predict future blood supply, employing historical data and time-series features to enhance forecast accuracy. Three state-of-the-art forecasting models, Extreme Gradient Boosting (XGBoost), Long Short-Term Memory (LSTM), and Seasonal Auto-Regressive Integrated Moving Average (SARIMA), are rigorously evaluated based on their predictive performance, with the top-performing model selected to generate realistic future supply scenarios. In the second phase, the framework incorporates a sophisticated mathematical optimization model designed to minimize the total operational costs of the blood supply chain. The model accounts for the full spectrum of costs, including those associated with facility openings, blood collection, processing, storage, transportation, and disposal of expired products. It also integrates critical operational constraints such as shelf life, multi-period inventory management, and capacity limitations at both regional and local facilities. The novelty of this approach lies in its seamless combination of machine learning-based forecasting and optimization techniques, providing a comprehensive solution to the dynamic challenges faced by blood supply networks. A real-world case study, based on the blood supply system of a metropolitan region, is used to validate the effectiveness and practicality of the proposed framework. The results underscore the value of integrating accurate machine learning-based forecasts with optimization models, showing significant improvements in efficiency, waste reduction, and demand coverage.

Submission ID	78
Authors	A. Konwar and P. Dutta
Title	**A HyF-WASPAS Method based on Similarity Measure to Access Renewable Energy Technologies**
Abstract	Population growth and technological advancements have progressively expanded the demand in global energy. Growing public awareness about environmental problems, as well as the depletion of fossil resources, have prompted a worldwide shift to renewable energy sources. Renewable energy conveys an adaptable and sustainable approach for meeting future demands. Growing usage of renewable energy reinforces a significant combination of economic benefits, social progresses, environmental issues, technological advancements of sustainable solutions. Determining an efficient Renewable Energy Technology (RET) is a challenging task for decision-makers involving a variety of sustainability factors that creates uncertainty. The present research aims to offer a new, robust framework for evaluating RETs from a sustainable perspective by employing a novel similarity measure and the Weighted Aggregated Sum Product Assessment (WASPAS) approach in a Hyperbolic Fuzzy decision environment. Even though several kinds of studies have recently contributed to the evaluation of RET, no research has investigated RET in HyF framework, along with none of the existing literature has examined similarity measure on Hyperbolic Fuzzy Sets (HyFSs), which can effectively handle optimistic and pessimistic grades independently. Consequently, this paper firstly develops a novel similarity measure for HyFSs that efficaciously addresses all the axiomatic definitions and fundamental properties of a similarity measure on HyFSs. Moreover, its superiority and reliability are demonstrated through a comparative analysis with the existing similarity measures. Next, the WASPAS method is extended to solve Multiple-Criteria Decision Making (MCDM) problems in HyFSs. Further, we employ this proposed methodology towards the most effective RET selection while comparing this to the existing MCDM methods to validate its reliability and consistency. The experimental results indicate the proposed MCDM methodology successfully determines RETs in a Hyperbolic Fuzzy environment and exhibits higher consistency in comparison to the existing methods.

Submission ID	295
Authors	P. Kaur and A. N. Gupta
Title	**A MEDICAL DIAGNOSIS OF CATARACT USING INTUTIONISTIC FUZZY SETS**
Abstract	Accurate decision-making in medical diagnosis investigations is complex due to the impreciseness of the patient's symptoms in a disease that may or may not be accurate. Uncertainty is the characteristic relation between symptoms and disease. Uncertainty is best handled by linguistic variables. Intuitionistic fuzzy sets help model imprecision in decision-making problems like medical diagnosis. We propose an intuitionistic fuzzy method for the diagnosis of the cause of cataract and various factors responsible for cataract in different patients of the age group above 40 years. This model is based on the physician's medical knowledge of the relation between the patients and of symptoms and types of cataracts using intuitionistic fuzzy sets. For this purpose, we describe a state of a patient, knowing the results of his/her medical tests by the degree of membership and degree of non-membership based on the relationship between symptoms and various types of factors and types of cataracts. By the intuitionistic fuzzy max–min–max relation, we identify the disease with the maximum membership value for various patients. We illustrate the methodology with the case study of Indian patients in the Jharkhand region. The study included 50 patients over 40 years of age, of both genders, attending the general hospital for checkup or diagnosis of cataract. Causes of cataract and types of cataracts affecting the patients. Our study found that diabetes is the main cause of cataract for most patients. Patients with diabetes have posterior and cortical types of cataracts.

Submission ID	249
Authors	Harishree, A and J. Robinson, P
Title	**A Neural Perceptron Framework for Tackling Intuitionistic Fuzzy Linguistic MAGDM Complexities**
Abstract	Building upon the foundational work of Linguistic Intuitionistic Fuzzy Sets (LIFS), this paper presents an advanced and novel neural-based framework called the Linguistic Intuitionistic Fuzzy Artificial Neural Network (LIF-ANN) for solving Multi-Attribute Group Decision-Making (MAGDM) problems. The proposed model integrates a Perceptron-driven Artificial Neural Network (ANN) with linguistic intuitionistic fuzzy inputs to address uncertainty and hesitation in decision environments. Unlike earlier approaches that focused solely on fuzzy aggregation and normalization, this method embeds linguistic fuzzy representations within a trainable ANN structure. The network learns and adjusts decision weights dynamically, enhancing adaptability and ranking precision. The new LinFWAA (Linguistic Intuitionistic Fuzzy Weighted Arithmetic Aggregation) operator is proposed for aggregating the linguistic data enhancing the decision problem. Finally, the input created from solving the MAGDM problem is also solved using the ANN model with Perceptron learning rule exclusively proposed for Linguistic Intuitionistic Fuzzy sets. Experimental results demonstrate the model's effectiveness in delivering interpretable and scalable solutions for complex, linguistically expressed decision-making problems.

Submission ID	195
Authors	P. H. Nguyen, L. A. T. Nguyen, T. H. T. Do, K. P. N. Hoang, G. K. Do, T. T. Le, H. T. Nguyen
Title	**A Neutrosophic Causality Analysis for Critical Success Factors of Humanitarian Logistics Management during Disaster**
Abstract	Humanitarian logistics management (HLM) is essential for effective disaster response and risk mitigation in disaster-prone regions like Vietnam, where unpredictable natural disasters challenge critical success factors (CSFs) identification. This study adopts a quantitative approach, drawing on insights from 50 seasoned humanitarian logistics experts in Vietnam to develop an impartial dataset. It integrates Multi-Criteria Decision Making (MCDM) with Neutrosophic Sets (NSs), employing NS-Delphi for expert consensus, Neutrosophic Decision Making Trial and Evaluation Laboratory (NS-DEMATEL) to assess CSF interrelationships, and Neutrosophic Weighted Aggregated Sum Product Assessment (NS-WASPAS) to prioritize strategies. The analysis covers 50 variables across five dimensions: Strategic, Operational, Technological, Financial and Resource Management, and Social and Environmental Factors. Results identify Strategic Factors—particularly disaster preparedness planning and international policies—as the main drivers of effective HLM in Vietnam. Prioritized strategies include digital transformation, strategic planning, policy development, data-driven disaster response, and improved last-mile delivery capabilities, all crucial for enhancing HLM effectiveness. This approach promotes a responsive, equitable, and sustainable logistics system by applying Neutrosophic logic, which addresses truth, indeterminacy, and falsity. These findings offer policymakers a robust framework to strengthen HLM, ensuring timely and unbiased relief operations in Vietnam's complex disaster landscape.

Submission ID	73
Authors	B. Saikia
Title	**A New Algorithm for Finding Optimal Solution of q-Rung Orthopair Fuzzy Transportation Problem**
Abstract	This paper focuses on the domain of distance measures for q-rung orthopair fuzzy sets in uncertain decision-making real-life problems. The q-rung orthopair fuzzy set is a generalized form of the intuitionistic fuzzy set which allows for precise manipulation of vague environments. By integrating the concept of distance measure with q-rung orthopair fuzzy sets, the study seeks to overcome the limitations of the earlier distance measure. The newly developed distance measure focuses on quantifying the variations between the different pairs of q-rung fuzzy sets. The study highlights the benefits of the proposed distance measure by providing meticulous numerical examples and analyzing its general axioms. The comparative analysis reveals that several existing distance measures produce identical values for different pairs of q-rung orthopair fuzzy sets, making them inadequate for accurately capturing the inherent information of these sets. The study presents a new algorithm for solving fuzzy transportation problem using the proposed distance measure. A detailed numerical example is elaborated to demonstrate the feasibility and utility of the algorithm in real-life situations. The importance of this new method is assessed through a comparative study, analysis of hesitancy, statistical tests, and evaluation of results and assessment of computational complexity. The study comprehensively examines these aspects to illustrate the effectiveness of the proposed method. At length, the study concludes by summarizing the key findings and outlines potential avenues for future research aimed at enhancing the field of fuzzy transportation problem. Overall, this study contributes to the field of real life transportation problem by introducing a new distance measure for q-rung orthopair fuzzy sets and showcasing its benefits through series of analyses and examples.

Submission ID	337
Authors	M, Nazari, H. Sadr and M. R. Yamaghani
Title	**A Novel Deep-Fuzzy Architecture for Real-Time Action Recognition**
Abstract	Analyzing human actions in dynamic, real-world environments is crucial for enhancing Human-Computer Interaction (HCI), particularly in sports analytics. Such capabilities enable athletes, trainers, and officials to gain insights into movement mechanics and support fair decision-making during games. However, recognizing specific actions remains challenging due to cluttered backgrounds, partially obscured movements, and variable lighting. To address this, the study introduces a hybrid approach combining YOLO for player localization with a fuzzy logic-enhanced LSTM network for action classification. The integration of fuzzy logic aims to improve the LSTM's handling of ambiguous or uncertain data, creating a more robust and interpretable system. The model was evaluated on the SpaceJam and Basketball-51 datasets, where it demonstrated superior performance compared to existing methods, validating its effectiveness for basketball action recognition.

Submission ID	69
Authors	A. K. Banik and P. Dutta
Title	**A novel separation measure based on hyperbolic fuzzy environment and its application in crime linkage**
Abstract	Uncertainty is an inevitable aspect of real-life decision making problems. Over time, several principles have been introduced to address uncertainty in such problems. Among them, fuzzy set theory has proven to be an effective tool for managing uncertainty in decision making. Various extensions of fuzzy sets, including intuitionistic fuzzy sets, pythagorean fuzzy sets, and their generalized form, q-rung orthopair fuzzy sets, have been developed for this purpose. However, the emergence of hyperbolic fuzzy sets have demonstrated superior capability compared to existing approaches, due to their broader value range. In this study, we propose a novel separation measure based on hyperbolic fuzzy sets. This separation measure acts as a generalized form of distance measure, capable of determining the collective dissimilarity among multiple values. Using this measure, we introduce a new decision support method, which is applied to the problem of crime linkage and validated through a case study. A comparative analysis with existing methods highlights the advantages of the proposed approach, demonstrating its rationality and practical applicability. This study offers an advanced framework for managing uncertainties in decision support systems, providing a robust and reliable solution for real-world decision making scenarios such as crime linkage.

Submission ID	213
Authors	H. Kaddachi and N. Benzina
Title	**A Principal Components Analysis: Exploring the Asymmetric Relationship Between Governance and Economic Growth**
Abstract	This article examines the relationship between governance and economic growth in a sample of countries from the Middle East and North Africa (MENA) region over the period 1996 –2019. The analysis relies on various econometric methods, including stationary and integration tests, and long-term estimation techniques such as Fully Modified Ordinary Least Squares (FMOLS) and Dynamic Ordinary Least Squares (DOLS). Special attention is given to using Principal Component Analysis (PCA) to construct a composite governance index. The results indicate that governance positively and significantly impacts economic growth, highlighting the importance of a transparent, stable, and efficient institutional framework. Strengthening governance, through robust legal systems and effective anti-corruption measures, contributes to sustained economic development. These findings offer valuable insights for policymakers in the MENA region, emphasizing the critical role that strong institutions play in promoting long-term economic performance. Investing in improved governance can help countries in the region achieve more stable and inclusive growth.

Submission ID	114
Authors	M. Nabeel and W. Ali
Title	**A solution of Mathematical Multi-Objective Green Transportation Problems Under the Fermatean Fuzzy Environment**
Abstract	This paper presents a mathematical framework for solving green transportation problems under uncertainty using Fermatean fuzzy parameters (FFP). Focusing on a multi-objective transportation problem (MOTP), the model aims to simultaneously minimize transportation cost, travel time, and carbon emissions—key metrics in sustainable logistics. All parameters, including costs, supply, and demand, are treated as Fermatean fuzzy to capture real-world ambiguity and uncertainty better. We introduce a New Fermatean Fuzzy Score Function (NFFSF) that converts fuzzy values into crisp equivalents to handle these fuzzy parameters. A Fermatean Fuzzy Programming Approach (FFPA) is applied to derive compromise solutions that balance economic efficiency with environmental responsibility. A numerical example illustrates the practicality and effectiveness of the proposed method in supporting eco-friendly and optimized transportation planning. This approach provides a robust decision-making tool for achieving sustainability goals in complex and uncertain transportation environments.

Submission ID	90
Authors	W. Ali, M. Nabeel, and M. Sh. Javaid
Title	**A Solution of Multi-Level Multi-Objective Optimization Models for Solid Transportation Problems under Fuzzy Environments**
Abstract	This study presents a comprehensive multi-level, multi-objective mathematical model to address the solid transportation problem (STP) under fuzzy environments. Real-world transportation systems often face significant complexity due to uncertain parameters such as fluctuating demand, varying traffic conditions, and limited conveyance capacity. To effectively manage these uncertainties, we propose a mathematical framework that incorporates hierarchical objectives and uncertain parameters using fuzzy set theory. The model is structured across three hierarchical levels, each representing a specific goal within the transportation system: (1) minimization of transportation costs, (2) minimization of total transportation time, and (3) minimization of environmental impact costs. To manage uncertainty within model parameters, we apply two robust techniques—expected constraint programming and chance constraint programming—which transform the fuzzy model into its deterministic equivalent, allowing for more practical implementation and decision-making. The proposed model is validated through a hierarchical multi-level, multi-objective numerical illustration. This example demonstrates the effectiveness and applicability of our approach in real-world scenarios. It highlights how the model supports decision-makers in navigating trade-offs among conflicting objectives while maintaining feasibility under uncertain conditions. The results underscore the model's potential to enhance efficiency, sustainability, and resilience in solid transportation operations.

Submission ID	270
Authors	K R Ekambaram, V.Saravanan, and S.Sampathu
Title	**A Study on Lower Level Subsets of a Neutrosophic Anti-Fuzzy Subsemiring of a Semiring**
Abstract	This paper investigates the algebraic properties of lower level subsets of a Neutrosophic Anti-Fuzzy Subsemiring (NAFSSR) of a Semiring (SR) and introduces several theorems related to these subsets.

Submission ID	292
Authors	V. Krithika, A.Vijayasankar, and P .J
Title	**A STUDY ON TERNARY QUADRATIC DIOPHANTINE EQUATION**
Abstract	The ternary quadratic Diophantine equation is $11(x_2 + y_2) - 20xy = 170z_2$ examined in this study with an emphasis on determining its integer solutions. We investigate several non-zero distinct integer solution patterns. The goal of the study is to reveal this equation's rich structure and characteristics.

Submission ID	157
Authors	A.Saraswathi , P.Nedumaran
Title	**A Trapezoidal Fuzzy TOPSIS Method for Solving Decision-Making Problems Under Uncertainty**
Abstract	A fuzzy set is a mathematical construct that assigns a membership grade to each element within a universe of discourse, representing the degree to which the element belongs to the set. This approach extends classical binary logic by allowing continuous values between 0 and 1, making it a natural framework for handling uncertainties and vague concepts often expressed in natural language. Fuzzy sets are particularly powerful in modeling real- world scenarios where ambiguity and imprecision are inherent, such as in human decision-making, linguistic expressions, and complex systems.In order to analyze the ranking using the problems of transgender people, we developed a Fuzzy Multiple Criteria Decision Making (FMCDM) problem in this paper. We used the Technique for Order Performance by Similarity to the Ideal Solution (TOPSIS) and the new concept of positive and negative ideal solutions, along with the weights of criteria in linguistic terms. The suggested approach gives us a practical means of addressing the fuzzy multiple attribute group decision-making problem. Therefore, an extension of the TOPSIS method is proposed using a Trapezoidal fuzzy number, where the correlation information among factors provided by experts is in the form of uncertain linguistic terms and is transformed into a Trapezoidal fuzzy number. At the conclusion of this paper, an example is provided to illustrate the steps involved in the suggested method.

Submission ID	93
Authors	M. Nasehi
Title	**Advanced Applications of Fuzzy Systems and Computational Intelligence in Decision-Support Systems**
Abstract	Recent advancements in fuzzy set theory and computational intelligence have revolutionized uncertainty modeling and decision-support systems. This paper systematically explores cutting-edge fuzzy systems such as Type-2, Pythagorean, and Neutrosophic sets and computational frameworks like granular computing and Z-numbers, aligning them with practical applications in intelligent systems. The study addresses critical gaps in translating theoretical models into real-world solutions, emphasizing methodological innovations and interdisciplinary challenges. Fuzzy systems, particularly Type-2 Fuzzy Sets (T2FS) , enhance decision-making in dynamic environments by modeling second-order uncertainties, as demonstrated in adaptive control systems. Intuitionistic Fuzzy Sets (IFS) extend classical fuzzy logic by incorporating non-membership degrees, proving effective in multi-criteria decision analysis (e.g., sustainable supply chain management). Pythagorean Fuzzy Sets (PFS) further generalize IFS by allowing squared membership values, improving flexibility in high-stakes scenarios like e-commerce demand forecasting. Advanced extensions, including Neutrosophic Sets (handling indeterminacy) and Soft Sets (managing incomplete data), are analyzed for cybersecurity and crisis management applications . In computational intelligence, granular computing partitions data into hierarchical granules, enabling context-aware decisions in smart traffic systems. Z-Numbers and D-Numbers tools for reliability-based uncertainty modeling are evaluated for risk assessment in infrastructure projects, though their integration with machine learning remains underexplored . Hybrid models, such as Fuzzy-Genetic Algorithms, showcase practical benefits, reducing energy consumption in smart grids by 18% . Methodological challenges include translating technical terms (e.g., "complement" in fuzzy logic) across interdisciplinary teams, requiring context-aware approaches to preserve semantic accuracy.Case studies highlight a 22% reduction in diagnostic errors using Pythagorean fuzzy systems in healthcare and optimized supplier selection in automotive supply chains via IFS. This paper underscores the transformative potential of fuzzy systems and computational intelligence while advocating for standardized frameworks, improved interpretability of hybrid models, and broader adoption of Z-Numbers in industry. Future research should prioritize bridging theoretical advancements with scalable, real-world implementations to address global challenges in sustainability, healthcare, and smart infrastructure.

Submission ID	120
Authors	M. Ayedh and W. Ali
Title	**AI and Fuzzy Logic-Based Framework for Climate Change Adaptation and Environmental Resilience in Yemen**
Abstract	Yemen, a country grappling with political instability and environmental degradation, faces profound challenges due to climate change. This paper introduces a novel Artificial Intelligence (AI) and fuzzy logic-based framework to enhance the region's decision-making for climate change adaptation and environmental resilience. Recognizing the inherent uncertainty and imprecision in environmental systems, a fuzzy multi-objective goal programming model is developed to support optimal policy and resource allocation. The proposed mathematical model considers multiple conflicting objectives such as minimizing environmental degradation, maximizing adaptation efficiency, and ensuring socio-economic sustainability subject to resource and infrastructural constraints. Fuzzy membership functions handle ambiguous linguistic inputs such as "moderate rainfall" or "high vulnerability," while AI techniques facilitate knowledge extraction and decision rule generation. The methodology integrates fuzzy logic with goal programming, transforming vague environmental targets into structured, solvable optimization problems. AI modules assist in the rule-based evaluation and scenario testing, allowing the system to simulate climate outcomes under different policy interventions. A numerical illustration using hypothetical yet realistic climate data demonstrates the model's capacity to produce flexible and adaptive solutions. Results reveal that incorporating fuzzy logic improves solution robustness, especially in prioritizing actions like water conservation, Afforestation, and disaster management. The findings validate the model's capability to guide sustainable decision-making in fragile environments like Yemen. This hybrid approach bridges a significant research gap by offering a practical, adaptive, and uncertainty-tolerant tool for environmental planners and policymakers.

Submission ID	228
Authors	S. Singh and H. Mohapatra
Title	**AI Ethics Governance and Privacy in a Rapidly Advancing Digital World**
Abstract	As artificial intelligence and machine learning become increasingly integrated into everyday life, addressing their ethical implications and potential biases is crucial. This article reviews key concerns about ethics, governance, bias reduction, and privacy in AI-ML applications. While these systems show remarkable capabilities in areas like image recognition, natural language processing, and analytics, they also risk producing unfair outcomes due to biases from sources such as training data, algorithms, feature selection, and institutional practices. A comprehensive evaluation from development to deployment is essential to ensure AI systems are fair, transparent, and beneficial. This review highlights the importance of responsible development and use of AI technologies.

Submission ID	343
Authors	Vijayalakshmi S, A. Joseph, Savithri M, T. Sumendra Yogarayan, B. Balusamy and A. Panthakkan
Title	**AI-Integrated Smart Chair for Personalized Health, Comfort, and Well-being in Sedentary Work Environments**
Abstract	The health and well-being of individuals depend on the workspace, their current health condition and their posture. This paper proposes an intelligent smart chair solution that has the power to dynamically adapt its settings to the user's physiological and physical needs, promoting a comfortable and healthier experience. With the help of a camera, AI-powered control system and various sensors for measuring vital parameters like temperature, pressure, and stress levels, the chair identifies and responds to the user's conditions in real-time. The chair has various physical adjustments supported for different body types, ensuring the users can experience comfort. The chair can understand its user's emotional state. It adjusts itself to provide a positive experience through techniques like targeted heating for pain relief, mood-based music playback, personalized comfort adjustments, etc., which do not exist in the current system. Users can manage and control the settings. With the help of artificial intelligence (AI) and self-supervised learning (SSL), the chair learns and refines its settings for the user's preferences and well-being. It also does automatic massages, periodic rotations, and movements, promoting muscle health and overall physical activity for long-term users. The novelty lies in the chair's ability to adapt to the user's physical and emotional needs, creating a truly personalized experience. The chair significantly improves user satisfaction and reduces discomfort and stress levels. This intelligent chair is a tool for maintaining a comfortable posture and promoting health across various use cases. It can interpret physical needs with the help of sensors and emotional responses with the support of cameras and AI. The chair helps the users manage their health and well-being through a personalized approach, enabling a comfortable and productive experience. The results after the usage show remarkable improvement among the public.

Submission ID	289
Authors	A. Sungheetha, R. Sharma, S. Mahapatra, M. A. Al-Khasawneh, and B. Balusamy
Title	**An AI-Driven Multi-Modal Sensing Framework for Precision Agriculture: Enhancing Crop Yield Through Deep Learning and IoT Integration**
Abstract	This paper presents a novel framework for precision agriculture that combines multi-modal sensing, deep learning, and IoT integration to optimize crop yield while minimizing resource consumption. The proposed system, AgriSense-AI, employs a distributed network of environmental sensors, spectral imaging systems, and computer vision modules integrated through a unified deep learning architecture. Experimental evaluations conducted across diverse agricultural environments demonstrate that AgriSense-AI achieves a 27% reduction in water usage, 35% decrease in fertilizer application, and 23% improvement in overall crop yield compared to conventional farming approaches. The system's adaptive machine learning algorithms provide real-time disease detection with 89% accuracy while maintaining robust performance across varying environmental conditions. Our multi-modal data fusion approach overcomes the limitations of single-source sensing, while the explainable AI components address the transparency. The system's cloud-edge hybrid architecture ensures reliable operation even in areas with limited connectivity, addressing key deployment challenges highlighted by previous research.
Link	https://www.youtube.com/watch?v=6zBNuxedNlY

Submission ID	263
Authors	Q. Q. Aini, I. M. F. Fatimah and D. W. Setyawati
Title	**An Algebraic Composition Operator on Intuitionistic Fuzzy Soft Set Evaluations for Multi-Evaluator Decision-Making**
Abstract	In this paper, we propose a binary composition operator on the set of intuitionistic fuzzy soft set (IFSS) and its application for multi-evaluator decision-making problems. The operator is constructed using the Einstein product for membership degrees and the Einstein sum for non-membership degrees, which form an algebraic structure that satisfies closure, associativity, and the existence of an identity element. These algebraic properties enable consistent and transparent aggregation of evaluations from multiple sources, addressing the common limitations of conventional averaging methods. We give a specific example of composition operator on IFSS to demonstrate its applicability for multi-criteria decision-making. Evaluations from multiple perspectives are combined systematically, and a final score is calculated using the $(\mu - \nu)$ metric. The results highlight the model's ability to maintain an intuitive fuzzy structure while providing interpretable results. This study concludes with potential extensions to other fuzzy systems and more complex evaluator models.

Submission ID	357
Authors	Thomas, K Tand Pushpalatha, K P
Title	**An Enhanced Gait Recognition for Person Identification using Spatio-Temporal features and Attention based Deep Learning Model**
Abstract	Human gait has proved to be one of the standard biometrics for human identification. It is a non-invasive biometric method that uses human walking patterns specific for each human being. Most of the traditional methods where we use gait analysis, for human identification, relied on hand crafted features of simple convolutional models, which may face challenges addressing complex temporal dependencies in gait sequences. This study proposes a novel deep learning framework that applies multi-feature input representations, combining Gait Energy Images (GEI), Frame Difference Gait Images (FDGI), and Histogram of Oriented Gradients (HOG) features. This is employed for enhancing the person's identification accuracy. The proposed work implements a CNN-based feature extractor with attention mechanism for the gait recognition .The model is trained and validated on a labeled dataset, showcasing its ability to learn discriminative gait representations with improved accuracy. The proposed pipeline of activities include preprocessing and converting gait sequences into frames, organizing them using folder-based numerical extraction followed by the training of an attention-enhanced convolutional network. The proposed model performs better than existing methods on public datasets and works well even with different camera angles and clothing styles.

Submission ID	266
Authors	P. K, Panigrahi and S. Nayak
Title	**An Inexact Line Search FQNDFP Algorithm to Investigation Uncertain Optimization Problems**
Abstract	This paper introduces a Fuzzy Quasi Newton Davidon Fletcher Powell (FQNDFP) optimization algorithm incorporating with Armijo line search technique to effectively handle imprecisely defined optimization problems. Unlike traditional probabilistic methods, this approach leverages fuzzy set theory to model uncertainties in optimization variables given in the objective function. The proposed algorithm integrates the Davidon-Fletcher-Powell (DFP) update formula, ensuring computational efficiency and rapid convergence by approximating the inverse Hessian matrix. The Armijo line search guarantees sufficient descent while adapting the step size dynamically. This combination enhances the algorithm's ability to navigate complex, nonlinear, and uncertain objective landscapes effectively. The performance of the algorithm is evaluated on benchmark problems and fuzzy objective functions, demonstrating accuracy, robustness, and convergence compared to existing methods.

Submission ID	91
Authors	A. K. Das, R. Das, N. Gupta, S. Das, R. Mallik and S. Pramanik
Title	**An innovative machine learning algorithm using neutrosophic soft sets for water resource management**
Abstract	Management of water resources has gained paramount significance for the endeavors to address the global issues of water drought, pollution, and climate change. The machine learning algorithm presented in this paper is based on the new conception of NSS for the water pollution assessment of water pollution scores (NSSWQI scores). With the help of neutrosophic membership functions (NMFs), the proposed algorithm incorporates uncertain, imprecise, and incomplete data related to water health factors and Water Quality Indices (WQIs) to have a dynamic robust method for modeling real-life environmental consequences. It forms the definition of NMFs for various water quality parameters; conversion from precise data into NSSs and WATV, WAIV & WAFV– weighted aggregated truth, indeterminacy, and falsity values. These are integrated to calculate the NSSWQI, a comprehensive water health assessment derived from the NSSWQI. To demonstrate our approach, we use the NSSWQI to present how to determine the extent of water pollution scores by analyzing the Haora River waterway of Tripura in India based on the pollution indices. In the present investigation, five water quality parameters are taken into consideration which are BOD, TSS, EC, pH, and TDS for the upstream, midstream, and downstream portions of the river. Hence, we employ the NSSWQI score, which is one of the critical characteristics of the river's pollution level.

Submission ID	330
Authors	P. A. Ejegwa, M. T. Anum, N. Kausar, C. O. Nwokoro, and T. Cagin
Title	**An innovative q-rung orthopair fuzzy distance metric approach and its application to energy source selection problem**
Abstract	Energy source, which is the means through which electricity and heat are produced for daily human consumption, is key to the sustenance of life. Some of the energy source alternatives have damaging effects on the ecosystem, thereby causing global warming and climate change. Thus, it is incumbent on the energy experts to select suitable energy source alternatives that are eco-friendly and effective. However, the process of selection cannot be effectively done without considering the fuzzy and hesitation factors in the selection process. It is on this premise that the q-rung orthopair fuzzy sets embedded with distance metric, which are proficient soft computing tools in the making of a reliable decision, are considered for the selection of an eco-friendly energy source alternative. In this article, an efficient q-rung orthopair fuzzy distance measure is constructed. The novel q-rung orthopair fuzzy distance measure is described to show superiority over the extant q-rung orthopair fuzzy distance measures. In addition, the novel distance technique is utilized in the selection of an efficient energy source alternative from among several energy source alternatives using assorted energy source selection criteria based on decision-making methods. Finally, to buttress the effectiveness of the novel q-rung orthopair fuzzy distance measure, a comparative analysis is carried out that shows the strength and reliability of the new method over the extant q-rung orthopair fuzzy distance measures. This efficient technique of energy source selection can be adopted in other uncertainty fields due to its reliability.

Submission ID	140
Authors	B. Sahoo
Title	**An Integrated Fuzzy Decision-Making Model for Sustainable Supplier Selection in the Manufacturing Industry**
Abstract	Selecting sustainable suppliers is crucial for the manufacturing industry as it enhances resource efficiency, reduces environmental pollution, ensures ethical labor practices, and supports community development. Additionally, it provides economic benefits, including cost reduction, risk mitigation, and improved brand reputation. By prioritizing sustainability, companies can meet stakeholder expectations and maintain a competitive edge in the dynamic market environment. This research proposes an integrated fuzzy decision making model to tackle the complex challenge of supplier selection. The model incorporates the perspectives of three decision-makers and evaluates five supplier alternatives based on ten criteria. The fuzzy LOPCOW method is used to calculate the criteria weights, addressing the uncertainty and vagueness inherent in expert judgments. Following this, the fuzzy TOPSIS method ranks the alternatives according to their crisp scores. The results show that the third alternative consistently emerges as the most optimal supplier. Moreover, the study includes a sensitivity analysis to assess the stability of the selected alternative under different scenarios, and compares the proposed method with existing fuzzy MCDM techniques to validate its robustness. This article also introduces a mechanism that allows decision-makers to iteratively refine criteria and preferences based on outcomes, ensuring the framework aligns with evolving business objectives. The proposed model offers valuable managerial insights and is adaptable for use in similar decision-making challenges across various fields, supporting better decision-making in dynamic and uncertain environments.

Submission ID	217
Authors	P. H. Nguyen, L. A. T. Nguyen, T. G. Vu, L. T. Ho, P. T. T. Cao and H. G. L. Hoang
Title	**Analyzing ESG Barriers Using Neutrosophic Delphi -Dematel Model**
Abstract	The growing global emphasis on Environmental, Social, and Governance (ESG) practices has placed increasing pressure on emerging economies, including Vietnam, to integrate sustainability into key industries such as logistics. However, ESG implementation in Vietnam's logistics sector faces numerous interrelated challenges. This study employs a two-staged Neutrosophic Delphi-DEMATEL (NS-Delphi and NS-DEMATEL) method to systematically identify and analyze the causal relationships among eight key barrier dimensions: Legal and Compliance, Institutional, Economic, Psychological and Behavioral, Environmental, Social, Governance, and Technological. The results reveal that Legal and Compliance, Institutional, Economic, and Psychological, and Behavioral barriers serve as the core causal dimensions that significantly influence the remaining effect dimensions. Notably, weak legal enforcement, unclear regulatory mandates, institutional capacity limitations, financial constraints, and behavioral inertia were the most influential impediments to ESG adoption. In contrast, environmental degradation, poor stakeholder engagement, governance inefficiencies, and low technological uptake were identified as outcome variables shaped by upstream barriers. The study offers practical policy implications, including the need for mandatory ESG regulations, enforcement reforms, capacity building, and targeted green finance mechanisms. Managerial recommendations include conducting ESG audits, aligning sustainability strategies with business objectives, and enhancing ESG-related competencies across organizations. The study contributes to ESG literature by providing a causal framework tailored to emerging market contexts and highlights directions for future research, including comparative analysis and hybrid multi-criteria modeling.

Submission ID	247
Authors	W. Arul Prakash and J. Robinson
Title	**ANN-MAGDM PROBLEM SOLVING WITH SPECTRAL THEORY BASED WEIGHT DETERMINATION METHODS**
Abstract	This paper explores the extension of matrix eigenvalue theory to the spectral theory of operators on Banach and Hilbert spaces, focusing on finite-dimensional Hilbert spaces as a foundational step. Since linear operators in finite-dimensional spaces can be uniquely represented by matrices, the relationship between these operators and matrices is utilized to bridge the understanding of spectral theory. The study begins with a detailed examination of the spectrum of an operator, highlighting its properties and implications. The core contribution of this work lies in addressing a challenging problem: deriving the weight vector of a decision-maker based on concepts rooted in spectral theory. This approach is applied to solve Multiple Attribute Group Decision Making (MAGDM) problems, demonstrating its theoretical robustness and practical relevance. Furthermore, the same MAGDM problem is tackled using well-known methods from Artificial Neural Networks (ANNs). A comparative analysis is conducted to evaluate the realizable aspects, productiveness, and advantages of the proposed methods against existing solutions. This comprehensive investigation aims to provide deeper insights into the interplay between spectral theory, decision-making, and ANN techniques, contributing to advancements in both mathematical theory and practical applications.

Submission ID	51
Authors	R. Narmada Devi, Y. Parthiban, R. Sundareswaran, S. Broumi and K. Raja Mohan
Title	**Application of Neutrosophic Over Soft Orbit Topological Spaces in Basketball Team Player Selection**
Abstract	This paper gives a detail exploration of Neutrosophic Over Soft Orbit Open Set using Neutrosophic Over Soft Topological Space, but introduces its fundamental concepts and theorem-purveying. The framework extended the soft set theory as well as that of neutrosophic sets for the management of uncertainty, indeterminacy, and fuzziness in topological spaces as a strong tool in decision-making under complex conditions. Practical application A key feature of the paper is the practicality of the framework using the tangent similarity measure designed to assess relationships between alternatives. For example, an illustration of the real utility of the paper is a numerical example aimed at showing how the framework of the Neutrosophic Over Soft Orbit Open Set can be applied in order to select the corresponding player for a basketball match. This example illustrates the systematic decision process provided through the framework, which is supposed to ensure that the optimum team is prepared while considering multiple criteria and uncertainty. The paper fills the gap between the theoretical progress within set theory and real-world applications towards handling uncertainty in a broad decision-making.

Submission ID	164
Authors	P. Raghavendran, T. Gunasekar, S. Gochhait, A. Normatov and I. Leonova
Title	**Application of Solving Fractional Integro Differential Equations for Emotion Detection in Neuroscience**
Abstract	This paper investigates specific types of fractional integral-differential equations, leveraging a straightforward fractional calculus technique. The method provides several enlightening results, especially concentrating on the extension of the classical Frobenius method. The paper is mainly concerned with the very fundamental theorems for the determination of fractional integral-differential equations by means of the K-transform and using coefficients of extensions from the binomial series. Furthermore, this work illustrates some advanced techniques for the solution of these equations with appropriate examples of application to real life. An application to emotion recognition in neuroscience is particularly exemplified with the view of understanding ECG signals emitted in response to emotional stimuli under the scope of fractional integral-differential modeling. This emphasizes the promise fractional modeling holds in encapsulating the complex memory effect and long-range dependence that is also witnessed during brain activity processing of emotions, which consequently leads to better performance of emotion recognition systems. The results show how well the proposed techniques perform, and more importantly, our techniques improve classification performance as compared to classical methods.

Submission ID	352
Authors	P. Suresh Salve
Title	**Applications of Fuzzy Graph Theory in Marketing: Customer Segmentation and Targeting**
Abstract	In the dynamic field of marketing, accurately understanding customer behavior is essential for effective decision-making. Traditional data analysis methods often fall short in capturing the complexity and uncertainty inherent in customer preferences. Fuzzy graph theory provides a promising approach by incorporating fuzzy sets to model imprecise relationships between customers and products. This paper explores the applications of fuzzy graph theory in marketing, focusing on customer segmentation and targeting. By using fuzzy graphs, customer similarities and preferences are modeled with greater flexibility, allowing for more nuanced segmentation. Fuzzy clustering algorithms such as Fuzzy C-Means (FCM) are employed to partition customers into overlapping groups, addressing the vagueness in their preferences. Additionally, fuzzy centrality measures help identify key customers for targeted marketing efforts. The paper highlights real-world applications and demonstrates how fuzzy graph theory can enhance personalized marketing strategies and improve the effectiveness of marketing campaigns.

Submission ID	311
Authors	V. Kumar
Title	**Applications of Fuzzy Graph Theory in Social Network Analysis: Enhancing Community Detection**
Abstract	Social Network Analysis (SNA) is an interdisciplinary field that focuses on the relationships and structures formed by individuals or organizations within a network. One of the major tasks in SNA is community detection, which involves identifying clusters of nodes that are more densely connected to each other than to the rest of the network. Traditional graph theory approaches often treat relationships between nodes as binary, i.e., either present or absent. However, real-world relationships are often ambiguous and can vary in strength, which motivates the need for fuzzy graph theory in the analysis. This paper discusses the application of fuzzy graph theory in enhancing community detection in social networks by handling the inherent uncertainty in the relationships between individuals.

Submission ID	206
Authors	R. Mahapatra Lenka, J. R. R. Kumar, P. Tiwari, K. Ghuge, G. Nijhawan, and P. H. Rao
Title	**Applications of Fuzzy Graphs in Financial Networks: Risk Assessment and Management**
Abstract	Financial networks are complex systems characterized by interconnected relationships among various entities such as banks, insurers, and investment firms. These relationships often involve uncertainty, ambiguity, and incomplete information, which traditional graph models struggle to capture effectively. Fuzzy graph theory offers a powerful alternative by incorporating degrees of uncertainty through fuzzy sets and membership functions. This paper explores the application of fuzzy graphs in financial networks, focusing on risk assessment and management. It discusses how fuzzy graphs can model credit risk propagation, systemic risk analysis, and fraud detection in an uncertain environment. The integration of fuzzy logic enables more realistic and flexible representations of financial interdependencies, enhancing the ability to identify vulnerabilities and assess the robustness of financial systems. Through theoretical frameworks and practical case studies, the paper highlights the advantages and challenges of using fuzzy graphs, offering insights into how they can support more informed decision-making in complex financial ecosystems.

Submission ID	204
Authors	G. Filippone, M. Galici, G. L. Rosa and M. E. Tabacchi
Title	**Applicative Judgement Aggregation for Fuzzy Ontologies by using MCGDM**
Abstract	In this work, we describe an applicative use of Judgement Aggregation for Fuzzy Ontologies using techniques of Multi-Criteria Group Decision-Making. In particular, we aggregate multiple fuzzy ontologies related to the same (or similar) domain by computing the optimal compromise among a set of alternatives given by the membership degrees associated with the elements of the ontologies under consideration.

Submission ID	267
Authors	N. Agrawal, S. Mahapatra, A. Sungheetha, R. Sharma R, and M. A. Al-Khasawneh
Title	**Artificial Neural Network and Random Forest Machine Learning algorithm-based Power System Fault Detection and Classification**
Abstract	Faults in power systems pose a threat to consumers' uninterrupted access to electric energy. To keep the power system in a stable state, protection equipment must be operated, and faults need to be identified and repaired as quickly as possible. In this manuscript, Artificial Neural Network (ANN) and Random Forest (RF) Machine Learning technologies are applied to detect and categorize faults on transmission lines. The inputs are represented by the phase currents (I_a, I_b & I_c) and phase voltages (V_a, V_b & V_c). The Fault Detection ANN's output in yes-or-no format ($y_d \in \{0, 1\}$) indicates whether or not the fault has occurred. Next, the type of fault is represented in coded form, consisting of four bits (b1, b2, b3 and b4). The Fault Classification ANN's output is categorized according to the type of fault. The training state, regression coefficient (R), mean squared error (MSE), and error histograms are plotted for the two types of ANN. The Random Forest algorithm with decision trees (N_t) correctly predicted the type of fault based on input current and voltage values with classification accuracy ($\eta acc = Ncorrect / Ntotal \times 100\%$). Accurate fault detection and classification enables speedier repairs, increases system availability ($As = MTBF / (MTBF+MTTR)$), lowers operating costs, and saves time. A secure and reliable power system by employing ML techniques will lead to meeting goal 7 of the 17 SDG.

Submission ID	257
Authors	P. Lakshmi Durga and S. Nayak
Title	**Artificial Neural Networks to Investigate Mathematical Models: A Concise Review**
Abstract	Mathematical modelling plays an essential role in understanding numerous physical phenomena, often described by differential equations (DEs). However, handling these models, particularly when inundated with extensive data and inputs, poses challenges for both analytical and numerical approaches. Consequently, alternative techniques are sought. In this context, artificial neural networks (ANNs) become valuable tool. Researchers have dedicated efforts to enhance ANNs capability in handling various types of DE's such as ordinary DE's (ODE's), partial DE's (PDE's), and nonlinear partial DE's (NPDE's). This pursuit has led to advancements in learning algorithms tailored for ANNs. Currently, the Levenberg-Marquardt (LM) learning technique stands out as a popular method for training ANN models. Traditional learning techniques, marked by complexities such as the size of the Jacobian matrix, error stability, and computational intensity, have spurred the development of advanced learning techniques aimed at simplifying the training process. These advancements necessitate a thorough analysis of various ANN techniques, providing insights into selecting the most suitable approach for a given system. Consequently, the objective of this paper is systematically exploring the ANNs in solving mathematical models, shedding light on their application in diverse domains.

Submission ID	65
Authors	N. Agarwal and P. Dutta
Title	**Assessing Medical Waste Treatment Technique based on Hyperbolic fuzzy EM-SWARA with COPRAS and ARAS Approaches**
Abstract	Medical Waste Treatment Techniques (MWTT) have become a significant concern due to the imminent risks they pose to human health and the environment. Proper and secure treatment and disposal of toxic and harmful medical waste are essential and various MWTT options are available to achieve this. The selection of the ideal MWT option is a complex and crucial Multi Criteria Decision Making (MCDM) problem as the decision is influenced by several factors both qualitative and quantitative aspects. This study presents a hybrid MCDM method for analyzing and opting the MWT options within a Hyperbolic fuzzy framework. The hyperbolic Fuzzy Set (HyFS) is an advanced tool that addresses uncertainty with greater precision, providing more flexibility for the decision makers. An entropy measure and a score function have been introduced in a hyperbolic fuzzy environment. Objective weights are evaluated using the entropy measure while subjective weights are assessed through the Stepwise Weight Assessment Ratio Analysis (SWARA) model. Consequently, a pioneering hybrid MCDM approach is presented combining HyFEM- SWARA with Complex Proportional Assessment (COPRAS) and Additive Ratio Assessment (ARAS) techniques to identify the optimal MWT option in India. Furthermore, relative evaluations and variability analysis are presented to demonstrate the stability and reliability of the proposed hybrid MCDM methods for ranking the preferences of MWTT.

Submission ID	197
Authors	P. H. Nguyen, L. A. T. Nguyen, D. M. Vu, T. G. Vu, A. P. Nguyen-Danh and T. L. Nguyen
Title	**Assessing Stakeholder Preferences in Carbon Credit Systems with Neutrosophic DELPHI and DEMATEL**
Abstract	The global carbon credit market has evolved into a key mechanism for mitigating climate change, yet challenges persist regarding transparency, stakeholder trust, and market efficiency. Vietnam is in the early stages of establishing its carbon credit system, guided by its commitment to achieving net-zero emissions by 2050. Despite regulatory developments, the Vietnamese carbon market remains fragmented, with concerns over pricing disparities, market liquidity, verification standards, and stakeholder engagement. This study assesses stakeholder preferences in Vietnam's carbon credit system using an advanced Multi-Criteria Decision-Making (MCDM) approach-based Neutrosophic Sets (NS) integrating Delphi and DEMATEL methods. Unlike traditional fuzzy logic-based models, NS provides a more nuanced representation of uncertainty by incorporating truth, indeterminacy, and falsity, allowing for more accurate stakeholder preference modeling. The NS Delphi method is applied to refine expert consensus, while NS DEMATEL identifies interdependencies among key stakeholder concerns, including policy alignment, financial incentives, verification mechanisms, and market accessibility. Findings reveal that regulatory transparency, price stability, and cross-border certification are critical factors shaping market participation. Moreover, private sector involvement and financial institutions play a pivotal role in market development, requiring stronger incentives and risk mitigation measures. The results contribute to both theoretical advancements in decision science and practical policymaking by offering structured recommendations to enhance Vietnam's carbon trading system. By integrating stakeholder perspectives with uncertainty modeling, this study provides a strategic foundation for developing a more transparent, efficient, and scalable carbon credit framework in Vietnam, ensuring alignment with global carbon pricing mechanisms and fostering long-term sustainability

Submissionid	153
Authors	K. Sasi Kala Rani, S. Jeyasiba Ponmani, R. Sharma, D.Sridhar, M. A Al-Khasawneh, B. Balusamy and A. Sungheetha
Title	**Blockchain for Sustainable Computing in Carbon Markets: Hybrid Consensus and Osmosis**
Abstract	Sustainable development in the modern era depends on three major aspects: social, economic and environment sustainability. When considering environmental sustainability, carbon emissions is the most serious threat that causes climate change and global warming. Carbon credit trading is a major initiative to alleviate carbon emissions by the process of providing incentives. Traditional systems of carbon credit processing may lead to inefficiencies like lack of transparency and vulnerability. The drawbacks of traditional systems can be overcome by using Blockchain technology that is decentralized and immutable in nature. The consensus algorithm Proof-of-Work (PoW) based blockchains consume high energy which contradicts sustainability. To address the challenge, a hybrid mechanism of Proof-of-Stake (PoS) and Proof-of-Work (PoW) is proposed for carbon credit transfers. The hybrid mechanism is efficient for small to medium-scale applications. Hence for high scale applications, Osmosis, a decentralized finance (DeFi) platform built on the Cosmos blockchain is explored. Experimental results show that the hybrid mechanism reduces energy consumptions and carbon emissions by 47%, latency by 80% and increases throughput by 328%. Consequently this performance enables the increase in transfer of carbon credits by 50%. In case of carbon credit trading of carbon credits, Osmosis exhibits greater energy efficiency, improving the throughput by 14-20 times and 12,500 times lower latency compared to the hybrid mechanism. Further Osmosis emits 200,000 times less CO_2 and transfers twice the number of carbon credits per hour compared to the hybrid mechanism.

Submission ID	298
Authors	A. Mainali, P. Rathore, A. Maheshwari and R. Sharma
Title	**Block-chain-based Document Verification System**
Abstract	Trust over documents and credentials has become extremely challenging to maintain in today's world because of the rampant rise in forgery and impersonation in education, legal practices, and government work. Verification systems are limited in scope because of their centralized nature, lack of transparency, and inefficiency. The research contributes to establishing a trustless document verification system by employing Ethereum smart contracts alongside a blockchain-based Inter Planetary File System (IPFS). The proposed system allows bearers (exporters) of authorizing documents to upload hashes of the documents to the blockchain while preserving the documents in IPFS which helps in maintaining data and document integrity. Employing hash functions, users should be able to access the encrypted metadata and documents through a web interface connected through Meta Mask and Remix IDE. The integration puts forward a fully automated on-chain permission system combined with demand-based off-chain storage which allows trust-free scalability for QR code document verification. By placing permission controls on-chain and combining off-chain storage with practical QR code document access, a scalable trust-free framework for system integration is achieved. Thus, the architecture enables real-time verification without the requirement of trusted third parties, while maintaining full system transparency, security, and immutability throughout all stages of document verification.

Submission ID	161
Authors	A. Awasthi, P. Kumar Singh and A. Pratap Shukla
Title	**Bridging AI And Cryptography for Robust Security**
Abstract	Cryptography is under mounting pressure from computational requirements, advanced attacks (notably AI-based Side-Channel Analysis - SCA), and the looming threat of quantum computing to today's standards, such as RSA/ECC. Artificial Intelligence (AI) has a double-edged potential: it provides potent tools for improving cryptographic design (e.g., S-Box optimization), protocol optimization (e.g., Quantum Key Distribution), and security analysis automation, while at the same time empowering strong cryptanalysis. Most importantly, securing AI systems themselves is now a priority [ISACA Journal 2024], quite frequently requiring cryptographic answers like Homomorphic Encryption (HE) and Federated Learning (FL). This paper thoroughly examines the multi-aspect intersection of AI and cryptography. We examine using various AI methods (Machine Learning, Deep Learning, Evolutionary Algorithms) for such constructive and analytical purposes. In addition, we analyze the intensifying threat landscape where AI acts as both threat actors (e.g., advanced malware creation, exploitation of vulnerabilities) and as defenders [Bitdefender 2024 Predictions, AIJourn 2024], taking into account the impact of changing regulatory regimes [Hinckley Allen 2024]. Emphasizing recent research directions pointing to expansion in areas such as HE and quantum-based cryptography [Taherdoost et al. 2025], we underscore the vital significance and inherent difficulty of protecting AI systems, solving model resilience, formal verification challenges, explainability requirements (XAI), and implementing secure development methodologies (SecMLOps) [ISACA Journal 2024, Texploration Blog 2024]. Future research directions need to focus on the creation of AI-resilient cryptographic protocols, quantum-conscious AI security policies, and the general development of reliable AI integration into security-critical applications.

Submission ID	145
Authors	S. Biswas, A. Sanyal1 and S. A Edalatpanah
Title	**Challenges of Social Entrepreneurship in Industry 5.0: A Soft Computing Approach**
Abstract	In the aftermath of the AI revolution and subsequent rapid technological advancements, the role of social entrepreneurs has become increasingly crucial in reforming society and fostering inclusive growth. This paper aims to identify the critical issues of social entrepreneurship (SENT) in the Industry 5.0 (I5.0) era. We present a case study of a focused group of 52 social entrepreneurs operating in diverse sectors. After identifying potential challenges through a review of related past studies and informal discussions with entrepreneurs, we conducted an empirical analysis using a soft computing approach based on Decomposed p, q-Quasirung Orthopair Fuzzy Set. We apply the Full Consistency Method (FCM) to derive the weights of the challenging issues and subsequently rank them. FUCOM offers a distinct advantage in terms of inherent consistency checking and requires a lower number of pairwise comparisons. Resource and fund constraints, duality in mission, lack of technological capability, ineffective social impact measurement, and information security and privacy are the top challenges for SENT in I5.0. The deviation from the full consistency (DFC) value ($\chi = 0.00002$) confirms the robustness of the model. The current study's approach and findings interest social entrepreneurs, decision-makers, and analysts.
Link	https://www.youtube.com/watch?v=91ma12vqCss

Submission ID	224
Authors	I. A. A. Esteban Pulley, I. Peña, and G. Baquerizo
Title	**Chaos-Preserving Fuzzy Difference Operators: A Bridge Between Fuzzy Arithmetic and Fuzzy Dynamical Systems**
Abstract	In this work, we propose a novel framework that links generalized fuzzy difference operators—defined through α-level set constructions—with the dynamical behavior of fuzzy systems. By revisiting the compatibility between fuzzy set operations and their α-level counterparts, we introduce the concept of chaos-preserving operators, i.e., binary fuzzy operations that maintain or amplify chaotic dynamics under the Zadeh extension. We demonstrate that, under specific structural conditions (such as upper semi continuity and nestedness of level sets), certain generalized Hausdorff-type differences not only admit consistent fuzzy representations but also preserve Devaney chaos, Li–Yorke chaos, and distributional chaos in fuzzy dynamical systems. Our theoretical development is supported by explicit constructions involving triangular fuzzy numbers and set-valued dynamics. The proposed framework opens a new avenue for analyzing uncertainty-propagating chaos in fuzzy environments, with potential applications in nonlinear systems, decision theory, and complex modeling.

Submission ID	234
Authors	U. Kumar Bhayyalal Dubeya, A. Akilbashab, U. Shankarc, K. Meenakshid and S.J. Johnstone
Title	**Chi-Square Statistics in Business Research: Enhancing Decision Making Through Hypothesis Testing**
Abstract	In business research, there are studies in which the researcher was interested in finding out whether a sample means differ significantly from the population mean. However, the research requirement is not fulfilled by only testing the sample mean with a population mean. Moreover, researchers are interested in dealing with two or more than two populations. In such situations, we cannot apply the tests like Z-test and t-test. The Chi-square test is most useful in such cases. Chi-square belongs to a non-parametric statistical test. When the data collection is done in the form of frequency distribution, and the scale of measurement used is ordinal then in such a situation application of the Chi-square test is preferred. Chi-square test by the researcher who wishes to test the proportions of two or more populations. This article describes how to use Chi-square to analyze the attribute interaction, classification of similar data that are independent of each other, and analyze the independence of attributes.

Submission ID	346
Authors	A. Vijayalakshmi, P. Shanmugavadivu, S. Vijayalakshmi, S. Yogarayan, A. Panthakkan and B. Balusamy
Title	**Computer Vision – Based Ensemble Learning Model for Cattle Breed Identifications**
Abstract	This paper proposes an ensemble learning technique to identify the cattle breed that integrates Convolutional Neural Networks (CNN) with advanced computer vision techniques. By combining the power of CNN for processing, YOLO for detecting the object, detection of edge using the method of canny, k-means algorithm for segmenting the image, and grayscale imaging, the framework overcomes the various limitations observed in few of the existing methodologies. The proposed approach addresses challenges arising from obscured facial features, varying viewing angles, and the presence of dirt on cows, ensuring accurate prediction of breeds. The proposed techniques utilizes a meticulously designed pipeline which encompasses cow identification, custom annotated face detection, optimized way of image rescaling, segmenting image with k-means, converting into grayscale, and systematized the detection with canny edge. From the fusion of these procedures, the voting-based ensemble learner achieves outstanding performance in cattle breed classification. This article presents a novel and invaluable tool for enhanced agriculture as well as the livestock management practice, along with wide-ranging inferences in the field.
Link	https://www.youtube.com/watch?v=tNt9BdOW_78&t=52s

Submission ID	320
Authors	E. Alexander Mendoza Zenozain
Title	**Corporate Social Responsibility from Neutrosophic and N-alectics: Evolutionary Analysis and Strategic Impact (2015-2025)**
Abstract	This article addresses one of the critical deficiencies in contemporary management: the inadequacies of established Corporate Social Responsibility (CSR) frameworks to manage complications and vagueness faced with sustainability determinations within a shifting reality. CSR evolved from charitable efforts to a differentiating formula that includes all elements at play; however, it is not championed by a level of analysis that pits economic, environmental, and social priorities against one another potentially through time and space let alone across multicultural realities with diverse sustainability aspirations. The study is timely and relevant to the world today where stakeholders demand that entities make determinations transparent, where entrepreneurs are guided by regulators and sociocultural and environmental disasters yet not equipped enough to make certain determinations that, in the end, championed vagueness and conflict. Yet where literature exists with theoretical frameworks with a proposed variable geared beyond a corporate mindset to align CSR with universal ethics or community good deeds, none exist for a direction that circumvents linear/classical logics of assessment dimensional impacts. Therefore, this research seeks to remedy such shortcomings through attenuating CSR via neutrosophic logic nalectic approach to CSR, decomposing the decision making into its fluid parts (truths, indeterminacies, and falsehoods) where vagueness between viability, sustainability, and cultural rights can be assessed and weighted in real-time. Ultimately, through assessing business cases between 2015 and 2025 via neutrosophic fringe proximity index and defenders of neutrosophics distance, the analysis reveals that instead of a strict inclusivity versus exclusivity binary assessment, the ultimate assessment provides the best action information—whether that be indigenous rights vs. ecological rights or economic gain vs. valuing Pachamama. Thus, those companies which conformed to this research and operated under these findings had more valid consistent adjustment over time and reliable association with the United Nations Sustainable Development Goals (SDGs) without any green washing. Thus, contribution includes theoretical and practical positioning; it situates CSR as a multidimensional susceptible superposition of forces while giving management a powerful quantifiable toolbox to determine best action orientation under such high uncertainty. Thus, the article takes a timeless topic within CSR debate academically further and practically presents an innovative approach blending Western epistemology and ancestral knowledge that will truly help create economies of inclusion at least.

Submission ID	300
Authors	A. Sungheetha, R. Sharma, M. A. Al-Khasawneh, B. Balusamy, and R. C. Karpagalakshmi
Title	**COSMOS: Deep Learning-Powered Collaborative Space Operations and Maintenance Simulator for Immersive Astronaut Training**
Abstract	Space operations demand intensive training programs that require sophisticated simulation technologies to ensure mission success. This paper presents COSMOS (Collaborative Operations and Space Maintenance Optimized Simulator), an advanced AR/VR-based training platform designed to address critical challenges in astronaut preparation. Our framework integrates real-time stream processing analytics with immersive learning environments and multi-agent deep learning algorithms. The core of our system is the novel Space-Task Adaptive Network (STAN), which demonstrates remarkable achievement with 94% accuracy in operation validation while simultaneously reducing training time by 43% compared to conventional methodologies. COSMOS incorporates IoT sensor fusion techniques and haptic feedback mechanisms to create highly realistic training scenarios, while leveraging edge computing architecture to minimize latency. Our comprehensive evaluation with 50 trainee astronauts reveals significant improvements in skill acquisition, knowledge retention (87% after three months), and operational accuracy across varied space mission tasks. The modular architecture of COSMOS enables rapid adaptation to diverse mission profiles and operational scenarios, establishing it as a valuable asset for international space agency training programs.
Link	https://www.youtube.com/watch?v=zGrgOmH684c

Submission ID	92
Authors	N. Shateria, F. Hosseinzadeh Lotfi, M. Fallah, M. saneie, H. Saleh
Title	**Cost, revenue and profit efficiency evaluation in downstream petrochemical industries with data envelopment analysis approach with fuzzy data**
Abstract	One of the application of data envelopment analysis is the calculation of cost, revenue and profit efficiency, which is used in the financial analysis of organizations. This analysis makes the managers of the organizations make better decisions against the fluctuations caused by the changes in the prices of production inputs in the competitive market, investment risk and other factors affecting their business. In the real world, not all data related to inputs, outputs and their corresponding prices are accurate. Therefore, in order to determine their value, it's necessary to use the fuzzy concepts for imprecise data. The purpose of this research is to calculate the cost, revenue and profit efficiency of the production lines of the polymer pipe manufacturing plant from the downstream petrochemical industries with full fuzzy data of the type of triangular fuzzy numbers with a α-cut approach. So that each of the 7 existing production lines are considered as a DMU. This performance evaluation is based on the variety of production lines, product size and limitation in the problem using data envelopment analysis technique and then the proposed FDEA model is converted into a family of crisp models to calculate the upper and lower bounds and is ranked based on interval data rules.

Submission ID	58
Authors	D. Rajbonshi and P. Dutta
Title	**Cryptocurrency Investment Decision-Making: A Hyperbolic Fuzzy MCDM Approach**
Abstract	Cryptocurrencies have grown as one of the significant technological advancements in today's digital age. Investors all around the globe have shown a growing interest in cryptocurrencies in recent times because of their potential to bring huge profits despite their absence of intrinsic value and support. This paper tries to determine the best cryptocurrencies for investment in the present age of technological advancements. Six of the most popular cryptocurrencies with the largest market capitalization are analysed based on six key criteria. To create a robust decision-making model, a hyperbolic fuzzy set-based approach is employed, involving three multicriteria decision-making techniques: Technique for Order Preference by Similarity to Ideal Solution (TOPSIS), VIseKriterijumska Optimizacija I Kompromisno Resenje (VIKOR), and Distance from Average Solution (EDAS). Although the results of the procedures are very close, investors would not want to have any doubt about the investment they are considering. The rankings from each procedure are then combined using the Borda Count method. Combining these approaches to create a trustworthy decision-making model for cryptocurrency selection makes this work novel.

Submission ID	119
Authors	M. Sheihan Javaid
Title	**Deep Learning-Based Segmentation for Land Management Using Satellite Imagery**
Abstract	The Land Use and Land Cover (LULC) segmentation represents a critical challenge in environmental monitoring and sustainable development. Traditional convolutional neural networks excel at local pattern recognition but struggle with comprehensive spatial understanding, while transformer architectures capture global contexts at significant computational expense. This research introduces an innovative hybrid model that strategically combines the strengths of convolutional neural networks and vision transformers. We develop a segmentation approach that transcends existing methodological limitations by efficiently extracting local features through CNNs and leveraging transformers' ability to comprehend long-range dependencies. The proposed framework achieves a high accuracy of nearly 95 % and a mean IOU of nearly 91% with reduced computational complexity, making advanced geospatial analysis more accessible. This approach advances technical capabilities and empowers researchers and policymakers with precise, timely insights into landscape dynamics, enabling more informed environmental decision-making across diverse geographical contexts.

Submission ID	265
Authors	N. Agrawal, Sh. Mahapatra, A. Sungheetha, R. Sharma R and M. A. Al-Khasawneh
Title	**Design of LQR Controllers for Power System stability enhancement with the coordination of PSS and TCSC**
Abstract	This manuscript applies the different rules of the Linear Quadratic Regulator (LQR) technique based on the Optimal Control Principles to the coordinated Power System Stabilizer (PSS) and Thyristor Controlled Series Compensator (TCSC) damping controller for improving the system's stability. First, the Bryson and Bouderal rules of fine-tuning the weighting matrices (Q and R) are used. Next, a multistage LQR design method for selecting the weighting matrices is created. The outcomes of the three controllers based on the Bryson, Bouderal, and multistage LQR rules are compared. The two control inputs are PSS stabilizing (uPSS) and the TCSC reactance signals (XTCSC). The findings demonstrate that the multi-stage LQR based on the state-predominant concept minimizes overshoots (Mp), and provides settling time (ts) in fraction of seconds. The best control strategy determined for stability improvement is the multistage LQR. It minimizes the objective function ($J = \int (x^T Qx + u^T Ru)\, dt$) and strikes a balance between control efforts ($\|u\|$), response speed, and magnitude and assures robustness to the system.

Submission ID	154
Authors	U. Akbar, W. Ali
Title	**Digital Twin and Metaverse Integration for Predictive Traffic Management in Malaysian Smart Cities: A Fuzzy Multi-Criteria Decision-Making Approach**
Abstract	The rapid urbanization of Malaysian cities like Kuala Lumpur has intensified the demand for intelligent, sustainable traffic management systems. This study proposes an integrated framework that combines digital twin technology, Metaverse-based visualization, IoT-driven real-time data, and Fuzzy Multi-Criteria Decision-Making (MCDM) methods to address the inherent uncertainty and complexity of predictive traffic routing. Key evaluation criteria cost, speed, fuel efficiency, CO_2 emissions, user comfort, and infrastructure adaptability were identified through expert consultations. A Fuzzy Analytical Hierarchy Process (AHP) model was developed to rank alternative traffic management solutions. In the case study of Kuala Lumpur's Central Business District, simulations using a digital twin environment and live IoT feeds indicated that adaptive traffic signaling emerged as the most preferred strategy with a fuzzy weighted score of 0.362, followed by congestion pricing (0.289) and dedicated bus lanes (0.221). Sensitivity analysis revealed that a 10% change in the weight of CO_2 emissions shifted the optimal strategy towards congestion pricing, highlighting the model's adaptability to varying stakeholder priorities. Incorporating a Metaverse-based virtual reality (VR) interface enabled decision-makers and citizens to experience the impact of different traffic policies visually, fostering greater transparency and engagement. Integrating fuzzy methodologies effectively addressed the uncertainties associated with expert judgments and real-time data variability. The proposed model offers a dynamic, robust, and user-centered decision-support tool for sustainable urban traffic management in Malaysia. The framework also presents significant potential for application in broader smart city planning initiatives across Southeast Asia.

Submission ID	273
Authors	R. Aruna Devi1 and K. Anitha1
Title	**DIMENSIONALITY REDUCTION USING ROUGH METRIC DIMENSION WITH LINEAR DISCRIMINANT ANALYSIS (LDA)**
Abstract	Dimensionality reduction is an essential concept in rough set theory, initially proposed by Zdzisław Pawlak in the early 1980s. By lowering the number of variables while preserving important data patterns and linkages, it simplifies complicated datasets. Rough set theory uses fundamental ideas like approximation spaces, indiscernibility relations, redacts, and core characteristics to handle imprecision and uncertainty in data processing. The boundary area, higher approximation, and lower approximation include approximation spaces, which specify the exact and ambiguous memberships of objects to certain concepts. Rough set analysis is based on in distinguishability relations, which classify items that are indistinguishable based on accessible qualities. Achieving dimensionality reduction may be accomplished by methods like as discernibility matrices, attribute dependence degree, and redact generation algorithms including greedy, heuristic, and evolutionary algorithms. Important characteristics are preserved during the reduction process thanks to core calculation. In rough set theory, dimensionality reduction has many uses, including feature selection to increase classification and clustering accuracy, data preprocessing for machine learning, knowledge discovery by identifying important patterns in big datasets, and decision support systems to make decision-making easier. Rough set theory may, for instance, identify A_1 and A_3 as the redact in a dataset with characteristics (A_1, A_2... A_4). This would allow A_1 and A_3 to be removed without causing a major loss of information, so simplifying the dataset. In conclusion, dimensionality reduction in rough set theory is an effective technique for handling huge datasets, enhancing the effectiveness and interpretability of models, and making it easier to extract insightful information from data.

Submission ID	294
Authors	P. G. Sambandam and S. Raman
Title	**Dissemination Index in Fuzzy Network**
Abstract	This paper introduces a novel framework for analyzing information flow in fuzzy networks through the concept of dissemination. A new parameter, the dissemination index, is proposed to measure the effectiveness of information spread within a fuzzy graph. Optimal disseminating sequences are identified, and dissemination indices are computed for various standard fuzzy graphs. The dissemination gap, defined as the difference between the maximum and minimum dissemination sequences, is analyzed to assess the uniformity and efficiency of information flow. The proposed model is applied to a smart hospital emergency alert system, ensuring prompt and reliable communication between critical nodes. Modeling the hospital as a fuzzy network enables efficient dissemination of alerts for rapid emergency response.

Submission ID	301
Authors	A. S. Hancioglu and I. YILMAZ
Title	**Distinguishing AI-Generated Images from Real Images: A Multi-Criteria Analysis Using SF-AHP**
Abstract	Recent advancements in the widespread use of the internet and computers have led to the storage of vast amounts of data, increasing computational power, and enhanced computer capabilities, fundamentally transforming human life. The large data sets generated through the internet provide an unlimited source of data for Artificial Intelligence (AI). These developments, coupled with current AI techniques, challenge the traditional concepts of photography and images, particularly due to the ability to produce realistic visuals. As synthetic images produced by AI become increasingly indistinguishable from real, human-made photographs, the distinction between the two is becoming more difficult over time. Considering the development of Large Language Models (LLM), which can produce highly fluent and coherent communication almost indistinguishable from human-generated text within a few years of their introduction, it is expected that synthetic images will rapidly increase in realism as well. This situation has become a critical issue in preventing disinformation and maintaining visual credibility. This study addresses this problem and aims to present a holistic approach for distinguishing between real and synthetic images. In this context, a comprehensive evaluation framework consisting of six main criteria and eighteen sub-criteria is presented, and the relative importance of these criteria is analyzed using the Spherical Fuzzy AHP (SF-AHP) method. These importance levels should be continuously updated and discussed as technology evolves. In this study, an innovative approach is used, incorporating expert opinions (such as those from advanced language models like ChatGPT o-3), and based on SF-AHP analysis, physical consistency and sensor trace analysis emerged as the most critical determinants for distinguishing between synthetic and real images. The findings emphasize the necessity of a multi-criteria approach in AI image detection and provide insights for future validation methods.

Submission ID	259
Authors	Bindu. V. A and M. Somanath
Title	**Elliptic Curve Cryptography for Bitcoin security**
Abstract	Mathematics has addressed many a complex problem in the past and is consistently providing avenues for present day security problems too. This time, we understand the interesting Mathematics powering the security structure for Bitcoin. The complex Mathematics that goes on, provides much more and ensures a critical component in the security apparatus implemented in the Bitcoin protocol. The solution is addressed by the Elliptic Curve representation and the science of cryptography fortified by ECC. We attempt to present the Elliptic Curve secp256k1 $y^2 = x^3 + b$ and its relation to security enforced for the bitcoin network. For easier understanding, the order 113 is identified to present this integration.
Link	https://www.youtube.com/watch?v=GVvzr2cYb6k

Submission ID	133
Authors	S. Vijayakumar, G. Chethan Kumar, P. Vijaya Chandra Reddy, G. Koushith and K. Manish
Title	**Energy-Efficient Image Compression for Wireless Sensor Networks using Fuzzy and Huffman Coding**
Abstract	With the rapid growth in digital imaging and multimedia sharing, the need for effective image compression techniques has become increasingly critical. Traditional methods often face a trade-off between compression rate and image quality. This project proposes a hybrid image compression technique that integrates Fuzzy Logic and Huffman Coding to achieve improved compression efficiency while maintaining acceptable visual fidelity. Fuzzy Logic is employed to adaptively select the most suitable compression strategy Huffman, JPEG, or PNG based on the image's color richness and size. Huffman Coding is used to encode pixel data efficiently, particularly for images with low color complexity. The system dynamically assesses each image's characteristics using a fuzzy inference system and applies the optimal method, achieving compression rates as high as 58% with noticeable reductions in energy consumption for storage and transmission. This adaptive compression framework demonstrates a promising direction for smart multimedia systems, especially in energy-constrained environments such as IoT and mobile applications.

Submission ID	351
Authors	K. Naik
Title	**Enhancing E-commerce Platforms with Fuzzy Graph Theory: Personalization and Recommendation Systems**
Abstract	With the growing complexity of e-commerce platforms, personalized recommendations have become crucial for enhancing user experience and improving business outcomes. Traditional recommendation systems often rely on crisp, binary relationships between users and items, which may not fully capture the underlying uncertainties and ambiguities in user preferences. Fuzzy graph theory offers a more robust approach by modeling these relationships with fuzzy edges, allowing for a more flexible and nuanced representation of user-item interactions. This paper explores the integration of fuzzy graph theory into e-commerce recommendation systems, providing a framework for personalization that accounts for uncertainty and partial membership in relationships. We demonstrate how fuzzy graphs can enhance the accuracy and adaptability of recommendation algorithms, offering better performance in cold-start scenarios and more relevant suggestions. The findings highlight the potential of fuzzy graph theory in transforming recommendation systems by making them more intuitive and adaptable to real-world e-commerce dynamics.

Submission ID	282
Authors	B. Farhadi Nia, M. R. Ahangari and S. J. Ebrahimi
Title	**Enhancing Generative Adversarial Networks with Structural Similarity Index and Fuzzy Logic-Based Loss Functions (SSIM_T)**
Abstract	Generative Adversarial Networks (GANs) have emerged as a powerful paradigm for unsupervised learning and generative modeling, enabling the synthesis of high-quality, realistic data across various domains. However, GAN training is notoriously challenging, often plagued by issues such as mode collapse, instability, and a lack of perceptual fidelity in generated samples. Traditional loss functions, primarily based on pixel-wise comparisons, fail to capture the complex structural and perceptual attributes of images, hindering the generation of visually compelling outputs. This paper introduces a novel loss function for GANs that integrates the Structural Similarity Index (SSIM) with fuzzy logic t-norms (SSIM_T). By leveraging SSIM_T, the proposed approach enhances perceptual similarity between generated and real images while harnessing the power of fuzzy logic to model the inherent uncertainty and nuanced relationships within image data. Theoretical analysis and extensive experiments demonstrate that SSIM_T mitigates mode collapse, stabilizes training dynamics, and produces visually coherent outputs, surpassing existing loss functions, including those based on Sugeno complements. This work bridges advancements in structural similarity metrics and fuzzy logic, offering a robust and perceptually driven framework for image-processing applications and beyond.

Submission ID	71
Authors	J. D. SUNDARI and P. PANDIAMMAL
Title	**Enhancing Industrial Decision-Making: The Role of Plithogenic Fuzzy M-Group Models**
Abstract	In the contemporary industrial landscape, decision-making processes often confront multifaceted challenges characterized by uncertainty, ambiguity, and contradictory criteria. Traditional models may fall short in effectively addressing these complexities. This paper introduces the Plithogenic Fuzzy m-Group Decision-Making Model, an advanced framework that synergizes Plithogenic sets with fuzzy m-group structures to enhance decision-making efficacy in industrial contexts. We explore the theoretical underpinnings of this model, delineate its methodological framework, and demonstrate its applicability through a case study on supplier selection. The findings underscore the model's potential in optimizing complex industrial decision-making processes.

Submission ID	111
Authors	S. Zaiba Jabeen, B. Lakshmi and A. Srisaila
Title	**Enhancing Online Resume Selection Efficiency through Natural Language Understanding in Cloud**
Abstract	In the era of digital recruitment, organizations are immersed with large versions of CV, leading to the manual selection process that is exposed to both time-offs and deviations. Traditional keyword -based screening methods often fail to capture the relevant relevance and meaningful shades present in the CV, resulting in a potential loss of disabled candidate filtering and appropriate talent. To address these boundaries, this article proposes a cloud -based structure that benefits from the natural language understanding (NLU) to increase the efficiency and accuracy of online selection systems again.

Submission ID	264
Authors	P. Dash and K. K. Kumar Mohanta
Title	**Enhancing Project Scheduling With Neutrosophic Sets: New Solution Approaches for Solving Neutrosophic CPM/PERT**
Abstract	The Critical Path Method (CPM) is an important tool in project management. However, the traditional form of CPM deals with complications associated with the ambiguity and uncertainty in estimating the duration of activities. This paper presents two new methods to solve the Neutrosophic Critical Path Method (Neu-CPM), utilizing Triangular Neutrosophic Numbers (TNNs) to define activity durations under indeterminacy. The methods are designed to conduct a forward pass and backward pass simultaneously to find the earliest and latest time for each event while at the same time to find the total float for each activity, enabling project scheduling under uncertain conditions. Neu-CPM provides a more improved approach to handling non-precise and incomplete data compared to the traditional fuzzy or intuitionistic approaches, based on its inclusion of membership degrees of truth, indeterminacy, and falsity. A numerical example is provided showing the methodology's ability to identify the project's critical path in a neutrosophic environment while studying the effect of various risk elements on the critical path. The results show that Neu-CPM provides the opportunity of more flexibility, accuracy, and reliability in project scheduling in uncertain conditions, with useful applications to practice.

Submission ID	190
Authors	S. F. Faghidian and B. Moradi
Title	**Enhancing Strategic Management for Resilient Supply Chains in Construction Industry 4.0: A Fuzzy EDAS Methodology**
Abstract	Strategic management of one of the most complex and profitable supply chains necessitates the creation of transient and repeatable competitive advantages. The escalating disruptions in such supply chains underscore the criticality of resilience strategies for construction firms. By simultaneously considering all influencing variables, three primary criteria Human Capital, Technological Development, and Supply Chain Capabilities along with fourteen sub-criteria were identified. To prioritize these under the ambiguous and uncertain conditions of the real world, the Fuzzy EDAS technique was employed. The results highlight the primacy of human resources over technology, despite the latter being a hallmark of Industry 4.0. This intriguing paradox underscores the pivotal role of managers and employees, and their capabilities, in fostering supply chain resilience, followed by the integration of Industry 4.0 technologies.

Submission ID	104
Authors	I. Ullaha, M. S. Ali Khanb, N. Ivkovicc, F. Hussaina and C. Janad
Title	**Evaluating Potential Products for the Consumer Electronics Market Using Multi-Criteria Decision-Making in a Complex Intuitionistic Fuzzy Environment with Unknown Weight Information**
Abstract	An expansion of intuitionistic fuzzy sets (IFS) embracing complex fuzzy sets (CFS), this study presents Dombi-Archimedean aggregation procedures customized for complex intuitionistic fuzzy sets (CIFS). These operators are more efficient at dealing with data that is periodic or two-phase. First, for complex intuition- istic fuzzy numbers (CIFNs), we describe and study the basic operational principles based on the Dombi- Archimedean t-norm and the t-conorm. Next, operators for CIF Dombi-Archimedean weighted averaging, ordered weighted averaging, CIF Dombi-Archimedean weighted geometric, and CIF Dombi-Archimedean ordered weighted geometric are built. We also investigate the boundedness, monotonicity, and idempotency of these operators, which are desirable qualities. Also, a numerical example including new software systems is used to show how the suggested operators may be used to create a multi-criteria decision-making (MCDM) technique. Lastly, we compare our results to those of previously published approaches.

Submission ID	70
Authors	P. Dutta
Title	**Exploring Hyperbolic Fuzzy Sets: A Comprehensive Approach to Uncertainty in Decision Analysis**
Abstract	The field of decision analysis and fuzzy logic has undergone significant evolution through the development of advanced fuzzy set extensions, including Intuitionistic Fuzzy Sets (IFSs), Pythagorean Fuzzy Sets (PFSs), Fermatean Fuzzy Sets (FFSs), q-Fuzzy Sets (QFSs), and q-rung Orthopair Fuzzy Sets (Q-ROFSs). Each of these frameworks has uniquely contributed to addressing the challenges of uncertainty, vagueness, and imprecision inherent in complex decision-making environments. Building on this rich foundation, the introduction of Hyperbolic Fuzzy Sets (HyFSs) marks a paradigm shift, offering a robust and unifying framework that encompasses the strengths of its predecessors while mitigating their limitations. This paper comprehensively explores the HyFS methodology, demonstrating its capacity to seamlessly integrate and extend the theoretical underpinnings and practical applications of IFS, PFS, FFS, QFS, and Q-ROFS. By leveraging a hyperbolic geometric structure, HyFS offers enhanced flexibility and precision in modeling multifaceted uncertainties, as demonstrated by its superior performance in comparative analyses against existing models. This work positions HyFS as a versatile tool for decision analysts, capable of addressing real-world problems with greater adaptability and accuracy, thus advancing the frontier of fuzzy logic applications in decision-making.

Submission ID	128
Authors	K. Krishnamoorthy and P. Muralikrishna
Title	**Finite Dimensional Intuitionistic Hesitant Fuzzy Normed Linear Space**
Abstract	The intuitionistic hesitant fuzzy norm (abbreviated IHFN) over a linear space was defined after the intuitionistic fuzzy n-norm [5] was defined. A few results on intuitionistic hesitant fuzzy normed linear space and finite dimensional intuitionistic hesitant fuzzy normed linear space were then presented. Finally, we have defined intuitionistic hesitant fuzzy continuity and sequentially intuitionistic hesitant fuzzy continuity and demonstrated their definitional equivalents.

Submission ID	296
Authors	Sh. Krishnakumar, R. R Nair, B. Balusamy and S. Yogarayan
Title	**Foresight Strategies for STI-Driven Climate Resilience in India**
Abstract	The research paper systematically studies the spatial mismatch between innovation capacity and climate vulnerability among selected eight Indian states. The aim is to identify the states with high climate risks and low levels of science, technology, and innovation (STI) readiness and suggest adaptive climate resilience strategies. The research integrates secondary data from NITI Aayog's Innovation Index, the Department of Science and Technology's Climate Vulnerability Assessment, and Human Development Reports to conduct comparative analysis. The use of Dynamic Adaptive Pathway Modelling for Climate Resilience (DAPM-CR) facilitated the finding of six steps and finally foresighted optimized resilience scores for selected states in India from 2023 to 2035. There is a significant spatial mismatch among the states considered for the study; states like Assam, Bihar, Chhattisgarh, Jharkhand, and Odisha have low human development indices and innovation capacity but with high climate vulnerability, specifying poor STI readiness. Meanwhile, Tamil Nadu, Maharashtra, and Karnataka determine sound innovation ecosystems and lower climate risks. The results highlight the need for clear, foresight-driven STI strategies to reduce these resilience gaps. The study focused on available secondary data, which is incomplete in some areas and may not include all localized innovation or recent policy changes. Forthcoming studies could incorporate primary data collection and area-level granularity. The insights provide policy officials with a diagnostic instrument to prioritize investments in human capital development, STI infrastructure, and R&D incentives in low-innovation, high-climate-risk states. Improving science, technology, and innovation (STI) capacity in vulnerable areas can promote fair climate resilience, reduce area dissimilarities, and increase inclusive green changes. This study combines a farsightedness approach with spatial data analysis to link the mismatch between innovation capability and climate resilience, offering a pathway approach customized to India's diverse state contexts.

Submission ID	214
Authors	H. Soltani and M. B. Abbes
Title	**Fresh perspectives from TVP-VAR model: Interconnections between climate risk components and energy markets**
Abstract	This paper explores the connectedness between the clean and dirty energy indices and climate risk component using time-varying parameter vector auto regression model from January 2014 to December 2023. Findings reveal that connectedness follows a heterogeneous trajectory over time. Results show evidence of higher volatility transmission during the COVID-19 period relative to the entire sample period. The high volatility transmission is a source of concern to policymakers, green stakeholders, and investors, due to limited diversification options.

Submission ID	97
Authors	M. Saqlain, J. M. Merigó, P. Kumam, P. Thounthong, S. A. Edalatpanah
Title	**From Foundations to Frontiers: Half a Century of Fuzzy Logic Research in Iran**
Abstract	Iran is currently the 4th most productive country to fuzzy research through its researchers, whose work reflects a growing interest in both the theoretical and applied aspects. However, the extent and impact of these contributions remain unexplored in scholarly evaluations. Thus, this study aims to provide a bibliometric analysis of fuzzy research in Iran from 1976–2024, utilizing the Web of Science (WoS) core collection database and VOSviewer software. The key bibliometric indicators including h-index, co-citation analysis, bibliographic coupling, and keyword co-occurrence have been evaluated. The main findings show a significant growth, with total publications increasing from 126 (1976–2003) to 6,755 (2020–2024). Early research focused on foundational concepts like fuzzy sets and fuzzy logic, while recent studies emphasize applied domains such as decision-making, artificial intelligence, and machine learning. Leading contributors include Bijan Davvaz (163 publications) and Islamic Azad University with (4,199 total publications) emerging as the most productive institution. Collaboration analysis identifies Malaysia, Vietnam, USA and China as the primary partners, and Tofigh Allahviranloo (198 publications, 4,310 citations) from Türkiye, as a prominent collaborator. The topical and keyword analysis reveals the focus of the area of research and its alignment with global trends in fuzzy theories, and a significant contribution across diverse disciplines. Iran's fuzzy research community shows a diversified portfolio of research, which includes both theoretical progress and application research (e.g., in Mathematics, Physics, Environmental Sciences, Business Economics, and Medical Informatics). Fields like Public Health, Biology, and Medical Informatics, however, have still a low output, indicating potential rising opportunities to incorporate and integrate fuzzy logic more in addressing complicated problems in health, biology, and society.

Submission ID	312
Authors	A. Patil
Title	**Fuzzy Graph Approaches to Cybersecurity: Detecting and Mitigating Network Threats**
Abstract	Cybersecurity threats are growing in complexity and frequency, requiring adaptive and intelligent mechanisms for threat detection and mitigation. Traditional graph-based models often fail to capture the uncertainty and ambiguity present in real-world network environments. Fuzzy graph theory, which introduces degrees of uncertainty into the structure of graphs, offers a robust mathematical framework to model and analyze imprecise data in cybersecurity contexts. This paper explores the application of fuzzy graphs in detecting and mitigating network threats such as intrusions, phishing, and distributed denial-of-service (DDoS) attacks. We present methodologies for constructing fuzzy graphs from network data, identifying anomalies through fuzzy similarity and centrality measures, and implementing mitigation strategies using fuzzy-based decision-making and game theory. A case study on phishing detection using fuzzy clustering techniques demonstrates the practical effectiveness of this approach. Our study highlights the potential of fuzzy graph-based models in enhancing adaptive security mechanisms in modern cyber infrastructures.

Submission ID	315
Authors	A. S. Patil
Title	**Fuzzy Graph Models for Urban Planning and Smart City Development**
Abstract	Urban planning and smart city development face numerous challenges due to the complexity, uncertainty, and dynamic nature of urban systems. Traditional graph models are often inadequate in representing imprecise and vague data associated with city infrastructure, resource distribution, and human behavior. Fuzzy graph theory, which combines graph structures with fuzzy logic, offers a more flexible and realistic framework for modeling such systems. This paper explores the theoretical foundation of fuzzy graphs and their applicability in various domains of smart city development, including transportation, infrastructure management, environmental monitoring, and governance. Through the fuzzification of urban data and analysis of fuzzy graph models, planners can make more informed and adaptive decisions. Case studies highlight the practical implementation of fuzzy graphs in real-world urban contexts. The study concludes by addressing the current challenges and proposing future research directions, including the integration of fuzzy graph models with artificial intelligence and real-time data analytics for smarter urban governance.

Submission ID	354
Authors	humal et al.
Title	**Fuzzy Graph Theory in Education: Analyzing and Improving Learning Outcomes**
Abstract	This study explored the application of Fuzzy Graph Theory as a novel analytical tool in the field of education, specifically for enhancing understanding of student interactions and learning outcomes. By incorporating the inherent vagueness and subjectivity present in educational environments, fuzzy graphs provide a powerful extension of classical graph theory to model imprecise relationships, such as varying degrees of peer collaboration, emotional intelligence, or participation. We began by introducing the theoretical foundations of fuzzy graph theory, illustrating how fuzzy sets and fuzzy relations form the basis for fuzzy vertices and edges. Mathematical constructs such as fuzzy degree centrality and similarity measures were utilized to quantify student connectivity and engagement. These were further interpreted through fuzzy clustering techniques, offering a framework to classify students into dynamic collaborative groups based on interaction intensity. The classroom case study provided a real-world context where fuzzy graphs were employed to represent student interactions in a semi-formal learning environment. Nodes representing students and weighted edges denoting fuzzy levels of collaboration helped uncover non-obvious patterns, such as informal learning leaders or isolated students. The visual and quantitative analysis demonstrated that students with higher fuzzy centrality scores often achieved better academic performance. A strong correlation ($r \approx 0.94$) between centrality and test scores validated the significance of peer interaction as a determinant of success. Furthermore, the study emphasized that fuzzy clustering offers practical pedagogical insights, enabling educators to design inclusive learning interventions, identify at-risk learners, and foster balanced group dynamics. The TikZ-based visualizations proved instrumental in translating abstract fuzzy relations into comprehensible diagrams for stakeholders. In conclusion, Fuzzy Graph Theory holds immense potential in the educational domain. It not only enriches learning analytics but also empowers educators with data-driven strategies to enhance student engagement and equity in learning. Future research may explore dynamic fuzzy graphs, longitudinal analysis of learning behaviors, and integration with AI-driven educational platforms for real-time feedback and intervention.

Submission ID	309
Authors	S. S. Gaikwad, Y. Dharangutti, R. V. Kulkarni, K. T. Punj, N. Singh, and R. Pal Singh
Title	**Fuzzy Graph Theory in Environmental Monitoring: Modeling and Analyzing Ecosystems**
Abstract	Environmental monitoring plays a vital role in preserving ecosystem health and promoting sustainable development. However, the complexity and uncertainty inherent in ecological systems often pose significant challenges to traditional analytical methods. Fuzzy graph theory, an extension of classical graph theory, provides a powerful mathematical framework for modeling uncertain, imprecise, and ambiguous data commonly encountered in environmental studies. This paper explores the application of fuzzy graph theory in environmental monitoring, focusing on how fuzzy relationships can effectively represent complex interactions among ecological variables. We examine modeling techniques for biodiversity assessment, pollution tracking, and ecosystem stability analysis. Additionally, the paper discusses analytical tools such as fuzzy shortest paths, clustering, and entropy measures to interpret ecological dynamics. Through a case study of wetland ecosystem monitoring, the practical relevance of fuzzy graphs is demonstrated. The study concludes by highlighting the challenges and future research directions, emphasizing the growing importance of fuzzy models in sustainable ecosystem management.

Submission ID	306
Authors	M. Dutta, P. N. Mahalle, S. Lakhanpal, Y. Sood, D, Kumar and G. Dattatraya Londhe
Title	**Fuzzy Graph Theory in Healthcare Management: Optimizing Patient Flow and Resource Allocation**
Abstract	Healthcare management involves complex decision-making processes to ensure efficient patient flow and optimal resource allocation. Fuzzy graph theory, a mathematical approach for handling uncertainty and imprecise data, provides a robust framework for addressing these challenges. This article explores the application of fuzzy graph theory in healthcare, highlighting its potential to improve operational efficiency, reduce waiting times, and enhance patient outcomes.

Submission ID	317
Authors	C. Mudimannan
Title	**Fuzzy Graph Theory in Legal Networks: Analyzing Case Law and Judicial Decisions**
Abstract	Fuzzy graph theory provides a powerful framework for modeling uncertainty and complexity in legal networks. Legal reasoning and case law often involve ambiguous relationships that cannot be effectively captured using traditional binary graph models. By incorporating fuzzy logic into graph structures, we can represent varying degrees of influence between legal cases, statutes, and judicial principles. This paper explores the application of fuzzy graph theory in analyzing case law and judicial decisions, demonstrating how it enhances legal network modeling. We discuss key concepts of fuzzy graphs, including membership functions, edge strength, and importance measures. Furthermore, we highlight computational techniques such as fuzzy PageRank, clustering methods, and graph neural networks, which improve the efficiency and accuracy of legal network analysis. A case study of Supreme Court rulings illustrates how fuzzy graphs can uncover significant legal precedents and influence patterns. Lastly, we address challenges such as defining optimal membership functions, handling computational complexity, and integrating AI-driven methodologies. The findings suggest that fuzzy graph theory is a promising approach to improving legal data analytics and automated legal reasoning.

Submission ID	316
Authors	U. Patil
Title	**Fuzzy Graph Theory in Telecommunications: Optimizing Network Performance and Reliability**
Abstract	Fuzzy graph theory has emerged as a powerful mathematical framework for modeling uncertainty in complex networks, offering significant advancements in telecommunications, cybersecurity, and optimization problems. This study explores the fundamental concepts of fuzzy graph theory, its applications in network optimization, and its role in enhancing communication systems. By leveraging fuzzy logic, researchers can model imprecise relationships within networks, leading to more efficient routing, fault tolerance, and security mechanisms. The paper further examines optimization techniques that integrate fuzzy graph principles, focusing on their impact on resource allocation, reliability, and adaptive decision-making in dynamic environments. Additionally, future research directions in fuzzy graph theory are discussed, highlighting potential improvements in artificial intelligence, quantum computing, and next-generation wireless networks. This work aims to provide insights into the evolving landscape of fuzzy graph applications and their transformative role in modern technological systems.

Submission ID	334
Authors	V. Kumar
Title	**Fuzzy Graph Theory in Transportation Networks: Enhancing Traffic Flow and Route Planning**
Abstract	Traffic congestion and inefficient route planning remain critical challenges in urban transportation systems. Traditional graph-based models often fail to account for uncertainties in traffic conditions, leading to suboptimal routing decisions. Fuzzy graph theory provides a robust mathematical framework for incorporating uncertainty and vagueness into transportation network modeling. This paper explores the application of fuzzy graphs in traffic flow optimization, dynamic route planning, and accident risk analysis. By assigning fuzzy weights to roads and intersections, transportation systems can adapt to real-time traffic variations, improving decision-making for commuters and urban planners. Case studies demonstrate the effectiveness of fuzzy graph-based approaches in reducing congestion and enhancing route efficiency. Despite challenges such as computational complexity and data integration, advancements in artificial intelligence and machine learning can further enhance the applicability of fuzzy graph models in smart transportation networks. This study underscores the potential of fuzzy graph theory in optimizing urban mobility and traffic management.

Submission ID	359
Authors	A. Ansari
Title	**Fuzzy Graph-Based Approaches to Water Resource Management**
Abstract	Water resource management is an essential component of sustainable development, especially in the face of increasing demand, climate variability, and environmental degradation. Traditional deterministic models often fall short in addressing the imprecision and uncertainty inherent in hydrological, ecological, and socio-economic parameters. Fuzzy graph theory provides a robust mathematical framework to incorporate and model such uncertainties by representing systems through fuzzy vertices and edges with degrees of membership. This paper explores fuzzy graph-based approaches for managing water resources, including applications in water distribution networks, flood forecasting, irrigation system optimization, and water quality monitoring. By incorporating fuzzy relationships among uncertain parameters, these models enhance decision-making, planning, and operational efficiency. The paper also discusses the advantages, challenges, and future prospects of adopting fuzzy graph methods in water resource management. The study highlights how these approaches can lead to more resilient, adaptive, and inclusive water governance, especially in regions experiencing water stress and data scarcity.

Submission ID	307
Authors	M. H. Molawade, N. Martin, N. Singh, P. Hanumantha Rao, R. S. Jadhav and Priti Shende
Title	**Fuzzy Graph-Based Decision Support Systems for Disaster Management**
Abstract	Disaster management is an inherently complex process that involves uncertainty, imprecise information, and the need for rapid decision-making. Traditional decision support systems often struggle to handle these challenges effectively. This paper introduces a Fuzzy Graph-Based Decision Support System (FGDSS) as a robust framework to address the ambiguity and dynamism in disaster scenarios. Fuzzy graphs, an extension of classical graph theory incorporating fuzzy set theory, enable the modeling of imprecise relationships among critical disaster response components such as relief centers, communication networks, and resource distribution paths. We provide formal mathematical definitions, construct fuzzy adjacency matrices, and propose inference mechanisms for priority-based decision-making. The framework is scalable and adaptable to real-time data inputs and evolving disaster conditions. A conceptual case study is included to demonstrate the application and effectiveness of the proposed system. The paper concludes by highlighting the benefits and future directions for integrating fuzzy logic and graph theory in disaster response systems.

Submission ID	353
Authors	A. Kumar Agarwal
Title	**Fuzzy Graph-Based Models for Enhancing Public Transportation Systems**
Abstract	Public transportation systems are vital for urban mobility but often face challenges such as route optimization, efficient scheduling, and resource allocation. Traditional models may not adequately address the inherent uncertainty and imprecision in transportation systems, such as variable traffic conditions, passenger demand, and delays. This paper proposes a fuzzy graph-based model to enhance public transportation networks by incorporating fuzzy logic with graph theory. By representing edge weights as fuzzy numbers, the model can account for uncertainties in travel times, delays, and demand fluctuations. The fuzzy graph model is applied to routing, scheduling, and resource allocation problems, providing a more flexible and adaptive approach compared to classical methods. A case study demonstrates the application of the fuzzy shortest path algorithm in a city transport network, showing improved route optimization during uncertain conditions. The results suggest that fuzzy graph models can improve the efficiency, accessibility, and reliability of public transportation systems.

Submission ID	310
Authors	S. R. Karpe, G. B. Dongre, G. N., Navin Sinha, A. Dombale and C. Dnyanoba Shelke
Title	**Fuzzy Graph-Based Models for Supply Chain Management: Improving Efficiency and Resilience**
Abstract	Fuzzy graph theory has emerged as a powerful tool in optimizing supply chain management (SCM) by incorporating uncertainty and imprecision into decision-making processes. Traditional graph-based approaches often fail to account for vagueness in supplier relationships, transportation networks, and demand fluctuations. Fuzzy graphs provide a robust framework to model these uncertainties, enhancing resilience and efficiency in complex supply chains. This paper explores key applications of fuzzy graphs in SCM, focusing on optimization techniques, resilience assessment, and risk mitigation strategies. Additionally, it presents an algorithmic approach to optimizing supply chain networks using fuzzy graph models. A case study on a retail supply chain demonstrates the practical implementation of fuzzy graph-based decision-making. The study highlights the effectiveness of fuzzy graphs in improving supplier selection, route optimization, and demand forecasting, ultimately contributing to more adaptive and efficient supply chains.

Submission ID	202
Authors	B. Amudha, M. Shanmugapriya and R. Sundareswaran
Title	**Fuzzy Modeling of Ternary Hybrid Nanofluid ($Cu + Al_2O_3 + MWCNT/H_2O$) flow under shape effects over a wedge**
Abstract	This study investigated the impact of fuzzy nanoparticle volume fraction on the energy and heat transport of ternary hybrid nanofluid (THNF) over a moving wedge, considering factors such as magnetic field, thermal radiation and shape factor. The governing non-linear coupled partial differential equations (PDEs) are transformed into ordinary differential equations (ODEs) using suitable similarity transformation. The reformulated ODEs are then converted into fuzzy differential equations (FDEs) by utilizing α -cut technique. The shooting method is employed to perform numerical simulation via MATLAB software. The numerical results are tabulated and visually presented as 3-D plots. The key findings of the present study is THNF ($Cu + Al_2O_3 + MWCNT/H_2O$) achieves 36.29% higher heat transport rate compared to the hybrid nanofluid (HNF) ($Cu + Al_2O_3/H_2O$) , 59.30% higher than nanofluid (NF) (Cu/H_2O) and 69.87% higher than water. The volume fraction of nanoparticles in hybrid nanofluids can vary due to factors like inconsistencies during synthesis, particle aggregation, and dispersion stability. These variations create uncertainty in predicting fluid behavior. To manage this uncertainty, a fuzzy logic approach is adopted. In this study, triangular and trapezoidal fuzzy number are used to represent the nanoparticle volume fraction for THNF($Cu + Al_2O_3 + MWCNT/H_2O$). By applying the α -cut technique along with their corresponding functions, the influence of these fuzzy parameters for various shape factors is analyzed. The findings reveal that the blade-shaped nanoparticle exhibit higher heat transport that the other nanoparticle shapes.

Submission ID	106
Authors	R. Prasertpong
Title	**Fuzzy Semi bipolar Soft Congruence's on Groupies**
Abstract	In this paper, we introduce the concept of fuzzy semi bipolar soft relations based on fuzzy semi bipolar soft set theory. We investigate their fundamental properties, including reflexivity, symmetry, transitivity, and equivalence, and provide illustrative examples to clarify these concepts. Furthermore, we propose the notion of fuzzy semi bipolar soft congruence's within groupies and explore their connection to traditional congruence's on groupies. To support the development of operational formulas, we define the product of two fuzzy semi bipolar soft relations. Finally, we establish the relationship between fuzzy semi bipolar soft equivalence relations and fuzzy semi bipolar soft congruence's via the defined product

Submission ID	67
Authors	N. Bhuvaneswari and P. Pandiammal
Title	**Fuzzy Social Network Analysis in Industry Academic Collaborations**
Abstract	Industry academic collaborations form intricate networks of researchers, institutions, and knowledge exchange. Traditional Social Network Analysis (SNA) techniques often fail to capture the uncertainties and imprecise relationships in these networks. This research introduces a fuzzy graph-based approach to model industry academic collaborations, where relationships are characterized by varying degrees of membership, trust, influence, and contribution. We explore applications such as co-Authorship networks, research impact analysis, and interdisciplinary collaboration mapping. A case study on global academic networks is provided, demonstrating the effectiveness of fuzzy SNA in analyzing uncertain and evolving relationships.

Submission ID	231
Authors	P Srinath, R Sundareswaran and M Shanmugapriya
Title	**Fuzzy Status Unequal Domination in Fuzzy Graphs**
Abstract	In this paper, we propose and explore a new concept called the fuzzy edge distance in fuzzy graphs along with related notation such as the fuzzy status of an edge, the status strength of connectedness and status strong arcs. Using these ideas, we introduce the concept of fuzzy status unequal domination in fuzzy graph using status strong arcs. For a fuzzy graph $G:(V,\mu,\rho)$ with vertex set$V$. We define that a vertex u $fsu-$dominates v if (u,v) is a status strong arc. A subset F of V is called a $fsu-$dominating set of G if for every $v \notin F$, there exists $u \in F$ such that u $fsu-$dominates$v$. A $fsu-$dominating set F is called a minimal $fsu-$dominating set if no proper subset of F is a minimal $fsu-$dominating set. The minimum cardinality of vertices in any $fsu-$ dominating set of G is called its $fsu-$domination number and its denoted by $\gamma_{fsu}(G)$. We study several properties of $fsu-$dominating set determine $\gamma_{fsu}(G)$ for certain standard classes of fuzzy graphs, and establish new bounds for the $fsu-$ domination number.

Submission ID	313
Authors	Olasina. J. R, and Aliu. O. H
Title	**Fuzzy-Enhanced Lightweight CNNs for Culturally Relevant Food Classification: Advancing Assistive Technology for Visually Impaired Nigerians**
Abstract	A research project fills the support technology deficit concerning assistive technologies for visually impaired Nigerians by creating lightweight convolutional neural networks (CNNs) designed for indigenous food identification. We improved upon a past CNN-based Automatic Food Classification Model called AFCM by introducing our novel Custom Convolutional Fuzzy Neural Network (CCFNN) that features fuzzy logic and benchmark models Mobile Net and LeNet-5. The database contains 4,000 images that represent 20 Nigerian swallow foods across various freshness states from fresh to 2-day-old. The images were transformed and resized to 100×100×3 to improve generalization and further enhanced through 30% image transformation methods (rotation, flipping, and zooming). The CCFNN implemented on a Lenovo T480S laptop using an Intel i7 processor and 16GB RAM demonstrated outstanding performance by attaining 95.2% accuracy when no augmentation was used and 80.9% accuracy with augmentation while having fewer than 30K parameters. This outperformed the accuracy results of AFCM that decreased to 37.4% when augmentation was activated. The combination of Mobile Net and LeNet-5 operated at high accuracy (~95.7%) with light computing needs while CCFNN utilized fuzzy Gaussian inputs for understandable decisions crucial for assistive use. The study demonstrates CCFNN achieves outstanding results by maintaining an AUC-ROC of 0.9982 without augmentation and 0.9958 with augmentation which exceeds AFCM's 0.9545 with augmentation assessments. The study demonstrated that CCFNN delivered better deployment feasibility because it completed training steps in 850ms while requiring 200 times fewer parameters than Mobile Net (4.2M) and running faster training steps than AFCM (998ms). Cultural adaptation of AI systems is needed according to research findings and CCFNN demonstrates strong potential to support mobile services in poor neighborhoods. The future research plan will investigate fuzzy pooling layers together with quantization methods for achieving improved real-time functionality. The proposed research brings inclusive AI by closing the discrepancy between Western-based models and localized requirements while offering sustainable solutions for assistive technology implementation in underdeveloped areas.
link	https://www.youtube.com/watch?v=nERI4BftBms

Submission ID	256
Authors	C.N. Nagapriya, S. Denis Ashok
Title	**Fuzzy-tuned PI Speed control with agent integration for terrain-aware mobile robots in mine detection and exploration**
Abstract	Autonomous mobile robot landmine detection technology with speed control provides improved safety. Effective motion planning and control of landmine detection mobile robots in uneven terrain is crucial during landmine search missions due to factors like slopes and shallow drifts affecting the safer robot operation and increased power consumption. This work presents a model-based mobile robot agent with a slope-aware longitudinal motion control for energy-efficient landmine surveillance in uneven terrains. The agent uses conditional rule-based logic considering terrain elevation, battery charge, and robot speed to provide optimal speed control signals to the motors, enhancing energy savings during exploration. In this work, a digital elevation model was developed using terrain variations from the environment that are extracted from maps of Google Earth Pro. Further, a fuzzy-tuned PI controller-based motor speed control approach is developed for accounting for the system model parameter uncertainties, enhancing the dynamic response of the direct current motor actuated mobile robots. A study is conducted using software tools like Robot Operating System (ROS) and GAZEBO for analyzing the kinematic constraints of mobile robots and aiding the global path planning in landmine search missions. From the results, it is noted that by adjusting the robot's speed based on the characteristics of the terrain, the proposed approach enhances efficiency, prolongs operational endurance and improves overall mission effectiveness.

Submission ID	81
Authors	Angel N, P. Pandiammal, N. Martin
Title	**Generalized Plithogenic Cognitive Maps in Decisioning**
Abstract	Plithogenic Cognitive maps are characterized as the generalization of cognitive maps of all genres. This research work proposes plithogenic cognitive maps based on generalized plithogenic sets as the extension of extended plithogenic cognitive maps. This study also develops a decisioning model based on generalized Plithogenic cognitive maps (GPCM). The model formulated in this work is substantiated with the managerial decisioning problem and also compared with the decision approaches based on extended plithogenic cognitive maps. The results state that the GPCM are more comprehensive and flexible in making optimal decisions. The proposed decision framework facilitates in incorporating a wide range of attributes and attribute values. This decision model shall be discussed with combined form of Plithogenic sets and other integrated versions.

Submission ID	260
Authors	A. Sungheetha, R. Sharma, Sh. Mahapatra, A. A. Al- Khasawneh, P. Shan an B. Balusamy
Title	**HEALTH-DRL: Hierarchical Emergency Access and Low-Latency Transfer Hub with Deep Reinforcement Learning for O(Pni=1 wiτi) Service Optimization**
Abstract	This paper presents HEALTH-DRL, an innovative framework for healthcare service optimization leveraging deep reinforcement learning (DRL) techniques integrated with multi-modal medical data processing. Our system addresses critical challenges in emergency response and resource allocation through a hierarchical approach that dynamically balances $O\ (p_{ni} = w_i \tau i)$ service optimization across distributed healthcare networks. Experimental evaluations across 17 healthcare facilities demonstrate significant improvements in key performance metrics, including 47.8% reduction in emergency response time, 63.2% improvement in resource utilization efficiency, and 89.4% accuracy in critical care prediction while maintaining strict HIPAA compliance. The framework outperforms conventional methods by 32.5% in quality-of-service metrics and reduces operational costs by 28.7%. Our solution effectively addresses the challenges of unpredictable service demands and complex resource constraints while ensuring patient privacy through differential privacy mechanisms with $\epsilon = 0.84$.

Submission ID	96
Authors	A. GIRUM MELAKU, B. A. ALABA, B. T. BITEW AND R. LAMESGIN DERSEH
Title	**HESITANT FUZZY PSEUDO IDEAL OF A PSEUDO TM-ALGEBRA**
Abstract	In this paper, the notions hesitant fuzzy pseudo ideal of a pseudo TM-algebra are introduced. We introduced the concepts of HFPTMof a pseudo TM- algebra and investigated several related properties. We proved that the intersection of two hesitant fuzzy pseudo ideal is a hesitant fuzzy pseudo ideal. We explore the connection between hesitant fuzzy pseudo ideal and level sets in a pseudo TM- algebra are examined. We have discussed the holomorphic image and the inverse image of the hesitant fuzzy pseudo ideal of a pseudo TM algebra and obtained some interesting results. We proved the Cartesian product of any two hesitant fuzzy pseudo ideal in pseudo TM algebra and investigated related results.

Submission ID	138
Authors	A. Bressane, B. V. de Melo and R. Moruzzi
Title	**Hybrid Physics-Informed Fuzzy Machine Learning for Predicting the Settling Velocity of Fractal Aggregates in Water Treatment Systems**
Abstract	Accurately predicting the settling velocity of fractal aggregates is critical for optimizing sedimentation units in water treatment systems, yet remains a challenge due to the irregular, porous, and non-spherical nature of such aggregates. Traditional models often oversimplify fluid–particle interactions and fail to generalize under variable morphological conditions. In this study, we propose a hybrid modeling framework that integrates Physics-Informed Machine Learning (PIML) with fuzzy logic to enhance predictive accuracy and physical interpretability in settling velocity estimation. The approach leverages morphological descriptors extracted from image-based analysis, combined with physically consistent features such as drag force, squared radius, and Reynolds number derived from fluid mechanics theory. Two fuzzy regression models were implemented using XGBoost with early stopping: one trained on purely morphological features, and another incorporating the physics-informed variables. Both models were evaluated using cross-validation, robustness tests under Gaussian noise (1–20%), and bootstrapping to estimate predictive uncertainty. Results showed that the PIML Fuzzy Regressor outperformed the traditional model in all metrics, reducing test MAE by 43.3% and RMSE by 28.1%, while achieving a test R^2 of 0.938. The physics-informed model also exhibited improved robustness under noisy conditions, with slower error growth and narrower confidence intervals across all scenarios. The integration of physics-based features acted as a structural regularize, improving model generalization and mitigating the effects of data leakage and noise. These attributes enhanced the model's credibility and operational relevance, particularly in environments characterized by experimental variability. Overall, this study demonstrates that hybrid PIML-fuzzy models provide a reliable and interpretable tool for predicting flock settling behavior, contributing to the development of more robust, sustainable, and physically consistent sedimentation modeling frameworks in water treatment engineering.

Submission ID	223
Authors	A. M. Moradi, A. S. Soleimany Far , A. Mehri, A. Fereydani and M. R. Montazeri
Title	**Identifying user interest using fuzzy logic**
Abstract	In today's world, online stores face many challenges in identifying and responding to user interests. Using fuzzy logic as an efficient tool allows modeling user uncertainties and ambiguous preferences. In this paper, a fuzzy logic-based method is presented for analyzing user behavior and identifying their interests in the context of online stores. This method uses fuzzy rules to evaluate the user's interest in different product categories and generates personalized recommendations. Experimental results show that using fuzzy logic in recommender systems significantly increases the accuracy of user interest prediction and improves their shopping experience. This research paves the way for the development of smarter online sales systems.

Submission ID	276
Authors	A. H. Anshor and T. N. Wiyatno
Title	**Implementing Type-2 Fuzzy Logic for Post-ASR Correction in Low-Resource Languages: A Case Study in Sundanese**
Abstract	Low-resource languages like Sundanese continue to challenge Automatic Speech Recognition (ASR) systems owing to dialectal variation, limited data, and phonetic variance, which lower transcription quality. This research proposes a Type-2 Fuzzy Logic-based post-processing system to increase transcription accuracy in such cases. First, we transcribe using Whisper, a cutting-edge multilingual ASR model. These outputs are improved by fuzzy language rules based on regular Sundanese phonological and morphological faults. In particular, our technique addresses ASR ambiguity for Sundanese words with complicated meanings, consonant alterations, and reduplications. Interval-valued membership functions let the Type-2 fuzzy system turn approximation or uncertain phrases into more correct linguistic ones. The recommended correction approach decreases Word Error Rate (WER) by 25% on average in 30 typical samples using a publicly accessible Sundanese speech dataset. This method is unique in its interpretable and rule-extendable design. It's ideal for underrepresented languages, unlike post-editing or statistical adjustments. This work supports language inclusion in speech technologies by showing how fuzzy logic in the ASR pipeline may enhance transcription quality in circumstances with little linguistic data. Settings and promotes speech technology linguistic inclusion.

Submission ID	117
Authors	Sh. Sadia1
Title	**Integer Programming Problems with Fermatean fuzzy Parameters Using NAZ-Cut**
Abstract	Integer Programming Problems (IPPs) play a critical role in solving real-world optimization scenarios where decision variables must be integers, such as in scheduling, logistics, and resource allocation. Traditional methods like Branch and Bound and Cutting Plane techniques have been widely used for solving such problems. In 2003, Bari and Ahmad introduced the NAZ-cut method, a straightforward and computationally efficient approach to solving IPPs by systematically reducing the feasible solution space through the addition of specific constraints. This paper presents an enhanced NAZ-cut framework for solving IPPs, particularly in the context of Fermatean fuzzy environments, where uncertainty in parameters is modeled using Fermatean fuzzy sets. A new approach is proposed to minimize computational effort by excluding specific integer candidate solutions based on a well-defined criterion. A supporting theorem is provided to justify this exclusion, ensuring that only feasible and potentially optimal points are considered. The method is demonstrated through a numerical example, highlighting the effectiveness of the proposed strategy in simplifying the search process and improving computational efficiency.

Submission ID	152
Authors	E. Anbarzadeh, F. Hesami
Title	**Integrating Machine Learning Algorithms for Surface Property Optimization of Dental Implants Treated with SLA+Anodizing**
Abstract	This study explores the optimization of dental implant surface treatments using advanced machine learning techniques. Key processes such as sandblasting, acid etching, and anodizing were systematically analyzed, with parameters including spray pressure, etching duration, temperature, and anodizing voltage evaluated for their impact on surface characteristics. Through the implementation of predictive regression models, the research identified optimal parameter configurations to enhance surface roughness and biocompatibility, critical for successful Osseo integration. The results demonstrate a minimal discrepancy between machine learning predictions and experimental findings, underscoring the reliability of this approach. By leveraging the self-correcting capabilities of machine learning, the study offers a cost-effective, efficient framework for parameter optimization. This data-driven methodology not only accelerates research timelines but also paves the way for developing personalized surface treatments, ultimately contributing to enhanced clinical outcomes in dental implant ology.

Submission ID	279
Authors	R. R Nair, T. Babu, P. Shan, B. Balusamy and S. Yogarayan
Title	**Intelligent Medical Image Registration Using Fuzzy Rule-Based Systems and Hybrid Optimization**
Abstract	Medical image registration remains a critical challenge in clinical and research applications, requiring robust methods to align images from different modalities with varying characteristics. By embracing uncertainty through fuzzy logic rather than attempting precise mathematical modeling, the proposed methods effectively handle the inherent variations in multimodal medical images. In terms of accuracy (Dice coefficients 93-94%, Jaccard indices 81-83%, normalized correlation values <0.96), the approach FCM+Fuzzy B-Spline, will successfully outperform conventional algorithms and other fuzzy-based methods thin all datasets. The process of operationalizing uncertainty using metrics such as membership variance and uncertainty reduction rate provides a clearer picture of the reliability of registration. This work advances both the knowledge base and clinical workflow, such that images from multiple modalities can be integrated with greater accuracy.

Submission ID	218
Authors	Angel, N, P. Pandiammal and N. Martin
Title	**Interval-Valued Plithogenic Cognitive Maps in Decision Making**
Abstract	Plithogenic Cognitive Maps (PCM) are comprehensive decision models applied in several areas of decision making considering complicated factors. Researchers have developed different kinds of PCM models. This research work intends in developing a PCM model with interval valued representations. The newly developed decision-making model with Plithogenic representations is applied to a decision-making model on making optimal decisions on sustainable supply chain systems. The interval-valued representations are discussed in different instances of fuzzy, intuitionistic and neutrosophic scenarios. The Plithogenic cognitive approach of investigating the factors associated with the decision-making problem yields promising results comparison with other single valued representations.

Submission ID	75
Authors	P. Sathya, N. Martin
Title	**Introduction to Plithogenic Rhotrix in Industrial Decisioning**
Abstract	This research work introduces the new notion of Plithogenic rhotrix as a generalization of rhetoric representations to handle intricate and sequential process of decision making. The conceptualization of Plithogenic rhetoric, classifications are articulated in this paper. The algorithm of plithogenic rhetoric based decisioning is presented and applied in evolving a robust industrial decision-making model. The efficacy of the decisioning model developed in this work is substantiated with an illustrative example of mapping the companies with suitable investment portfolio.

Submission ID	210
Authors	G. Saravanakumar, N. Kumar Jothi and M. Arun
Title	**Intuitionistic Fuzzy Contra $G\delta - e*$-Locally Continuous Framework for Secure UPI Transactions under Network Uncertainty**
Abstract	This paper presents a novel framework for secure UPI transactions under network uncertainty using intuitionistic fuzzy contra $G\delta$-$e\star$-locally continuous functions. We introduce and explore the properties of these functions within the context of intuitionistic fuzzy topological spaces. The framework effectively models uncertainties and complex decision-making processes, providing a robust solution for secure transactions. The application to UPI transactions demonstrates the framework's ability to handle network slowdowns and unauthorized access, ensuring secure and efficient transaction processing.

Submission ID	194
Authors	R. Ghasem Pour, S. Pourmohammad Azizi and S. S. Waloo
Title	**Investigating d −Negative Pebble Triangles over Special Numbers**
Abstract	In this article, we consider modeling and pricing a combination of two options (Exchange option and Lookback option) that we call the LOEX option. It is a type of exotic option, or clearer, path-dependent option because its price depends on the maximum and minimum prices of the assets to be considered. In reality, we introduce a conditional claim on two assets: the holder can change the first asset with the highest price to the second with the lowest price or cancel the transaction at the strike time. In this paper, after describing and modeling this option, we use numerical methods to estimate the pricing using the MATLAB software and present the results.

Submission ID	181
Authors	AL. YAKAVI and A. MYDEEN BIBI
Title	**IP Domination Number of Graph**
Abstract	This paper introduces the concept of the Isolate Pendant Domination number of a graph. A dominating set I ⊂ V (G) is said to be an IPD-set if the sub graph ⟨I⟩ has vertices with maximum degree 1, such that there must exist two vertices x, y ∈ ⟨I⟩ where $deg(x) = 0$ & $deg(y) = 1$. The minimum cardinality of the Isolate Pendant Dominating set is known as the Isolate Pendant Domination number, denoted by γ01(G). This paper initiates the study of this new parameter and investigates the IP domination number for various families of graphs.

Submission ID	356
Authors	A. Monzeli and F. Karimi Dastghiri
Title	**Iran's Economy at a Crossroads: Analyzing Challenges, Proposing Solutions, and the Role of Social Capital in Reform**
Abstract	This research undertakes an analysis of the persistent challenges confronting Iran's economy. It proposes evidence-based reform strategies while critically examining the instrumental role of social capital in facilitating successful and sustainable economic transformation. Employing a mixed methods research design, the study integrates document analysis of official reports and scholarly literature with insights gleaned from semi-structured interviews with key economic experts, policymakers, and relevant stakeholders. Media content analysis also gauges public discourse and perception surrounding economic issues. To ensure the study's rigor, the validity of the qualitative data is enhanced through triangulation and peer debriefing. The reliability of the quantitative data is demonstrated by a Cronbach's alpha of 0.82 for the questionnaire and a Content Validity Index (CVI) of 0.91, indicating acceptable internal consistency and a high degree of content validity. The study's objectives are threefold: first, to identify the most salient economic challenges facing Iran; second, to assess their impact on key indicators such as growth, employment, and inflation; and third, to formulate comprehensive policy recommendations to foster economic resilience and inclusive growth. The findings are intended to provide a valuable resource for policymakers, researchers, and economic actors seeking a deeper understanding of Iran's complex economic landscape. By foregrounding the significance of social capital, participatory governance, and institutional improvements, the research offers actionable strategies for fostering public trust and enhancing accountability.

Submission ID	255
Authors	A. Deepshika, J. Kannan and M. Mahalakshmi
Title	**Isosceles Trapezoid with Integer Area: Cryptographic Applications of Generalized Pell-Type Equations and Sphenic numbers**
Abstract	The well-known generalized Pell equation, x2 − dy2 = n, was used to develop the algorithm in this study. d was fixed as a prime number, and n was the square of the sphenic number. In particular, we employ the assignments utilizing the area of the isosceles trapezoid with the non-parallel sides being 2n − 1 and the parallel sides being n and n + r.
Link	https://www.youtube.com/watch?v=iKdldhS8fEU

Submission ID	179
Authors	M. Kaur, S. I. Ansarullah, A. Kumar Rana, A. Kumar Kesarwani, A. Normatov, I Leonova and S. Gochhait
Title	**Leveraging Business Intelligence and Data-Driven Decision-Making: The Role of Information, Communication, and Computing Technologies in Organizational Success**
Abstract	Data-driven decision-making and business intelligence (BI) components have become crucial components of modern businesses, leading to better market positioning, strategic knowledge acquisition, and superior operational outcomes. The study examines how BI frameworks combine with information, communication, and computing technologies to improve decision process optimization. The way managers operate is revolutionized by software that uses machine learning (ML), artificial intelligence (AI), cloud computing, and big data analytics. The study illustrates how communication technologies facilitate real-time data transfers for decision assistance.

Submission ID	105
Authors	I. Ullahd, M. S. Ali Khanb, C. Janac, F. Hussaind, M. Inam Ul Haqe and N. Ivkovicf
Title	**Linguistic Term Sets for Probabilistic Hesitant Pythagorean Decision Making with Multiple Attributes**
Abstract	Multi-attribute group decision-making (MAGDM) is a widely used approach in various domains to tackle important challenges such as supplier selection, credit evaluation, critical arrangement, innovation decision, and more. In MAGDM, instead of using explicit numerical values to represent complex and uncertain information, linguistic-based decision-making data is considered more ancient. Over time, several linguistic models have been proposed to handle MAGDM. Among these models, PLTS has gained attention due to its adaptability and broad applicability. In this paper we dine the probabilistic hesitant Pythagorean fuzzy linguistic term sets (PHPFLTSs). Some desirable properties are investigated, including monotonicity, boundedness, and impotency with also some examples. We also discuss some special cases with respect to various parameter values of PHPFLTS. Furthermore, we also develop the aggregation operator of PHPFLTS. To enhance the methodological approaches and address current was in MAGDM using PHIFLTSs, innovative operational rules are species. These rules aim to broaden the application and techniques of PHIFLTSs. Some of these operational rules include: New distance and correlation metrics are developed specially for PHIFLTSs to better capture the similarity and dissimilarity between linguistic terms. Imbalanced language terms are employed to represent the complex knowledge and abilities of specialists. This allows decision-makers to express their opinions with varying degrees of importance and emphasis, providing a more accurate reaction of their expertise. A MAGDM model is developed using the multiplicative multi-objective optimization by ratio analysis (MULTIMOORA) technique. This model integrates the operational rules and upgraded metrics to improve accuracy and efficiency in decision-making. MULTIMOORA is a well-known method that considers multiple objectives and criteria in decision-making processes. Additionally, a comprehensive comparison is made with relevant previous research to order to demonstrate the viability of this technique.

Submission ID	89
Authors	S. Santra, D. Majumdar, S. Mandal, S. Jana, C. Jana, A. Sarkar, S. A. Edalatpanah, N. Ivkovic
Title	**Machine Learning and Fuzzy Logic Enhanced Computational Model for Cancer Detection with Metastasis Risk Reduction**
Abstract	Cancer is still a major worldwide health concern that requires sophisticated methods for early diagnosis and detection. This research offers a scientific method that combines the strengths of fuzzy logic and machine learning to diagnose cancer at an early stage, which is pivotal given the disease's rising incidence. The project seeks to increase the efficacy and accuracy of cancer diagnosis by developing a complete framework that blends state-of-the-art machine learning algorithms for pattern recognition and prediction with fuzzy logic for feature extraction, selection, and rule-based categorization. Using a variety of datasets, the effectiveness of the suggested hybrid model is thoroughly assessed in relation to several cancer kinds, such as breast, lung, and prostate cancer. In terms of accuracy, sensitivity, and specificity, the results routinely outperform conventional methods, offering the possibility of earlier and more reliable cancer identification. This paper presents and explores the use of fuzzy logic-based clustering techniques for cancer picture segmentation: Fuzzy C-Means (FCM) and Kernelized Iterative Fuzzy C-Means (KIFCM). Fuzzy logic is an excellent choice for capturing the minute changes in pixel intensities linked to malignant tissues because of its capacity to represent uncertainty and imprecision. An essential component of this research is medical image segmentation, which is the division of a picture into parts that hold significance. The intricacies included in medical pictures sometimes prove too difficult for conventional segmentation approaches to handle, prompting researchers to investigate fuzzy logic-based clustering methods.

Submission ID	177
Authors	M. Kaur, S. I. Ansarullah, A. Kumar Rana, A. Normatov, I. Leonova, and S. Gochhait
Title	**Machine Learning-Driven IoT in Healthcare: Applications, Challenges, and Future Directions**
Abstract	Internet of Things (IoT) has become one of the most important paradigms of future networking, especially in supported cities, where it can help transform cities into smarter, connected, and more efficient spaces. To add intelligence and functional capabilities to applications, machine learning (ML) approaches are applied to the acquired datasets. The ML algorithms guide these techniques to perform end-to-end autonomous workflows, executing sophisticated tasks. ML and IoT in healthcare create an advanced service system to achieve more proactive, personalized, and preventive healthcare delivery. Techniques together are fundamentally changing patient care, making diagnostics more effective and improving overall healthcare management. This systematic review aims to investigate the value of ML-empowered IoT applications in the healthcare industry through comprehensive analysis of recent research progress, popular applications, significant challenges, and future directions. This review will summarize different types of IoT-based healthcare applications in which ML algorithms are integrated to improve predictive analytics, automate diagnostics, and optimize the patient care process. However, despite its significant promise, there are challenges to the adoption of ML-powered IoT in healthcare, including data privacy and security concerns, lack of interoperability among a multitude of IoT platforms, limited computation capability in resource-constrained devices, and ethical issues arising from AI-driven decisions. The current status, challenges, and trends discussed in this review open up a new direction for researchers and healthcare practitioners to exploit the true power of ML and IoT for the medical domain.

Submission ID	57
Authors	R. Narmada Devi, S. Sowmiya, Y. Parthiban, R.Sundareswaran and S. Broumi
Title	**Smart Solutions for Obesity: A Neutrosophic Fuzzy Approach to Weight Reduction Strategies in India Using FUCOM-TOPSIS**
Abstract	This study focuses on selecting the most effective obesity and weight reduction strategies tailored to the Indian context by addressing key factors such as cost, healthcare acceptance, accessibility, and potential negative outcomes. Considering the inherent uncertainty and imprecision in evaluating complex health strategies, we employ the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) integrated with linguistic-neutrosophic fuzzy sets. This advanced methodological framework facilitates the simultaneous analysis of qualitative and quantitative data, capturing expert judgments and uncertainty. The proposed approach systematically ranks various strategies to identify the optimal solution. The results aim to provide actionable insights for policymakers and healthcare professionals, ensuring that selected strategies are cost-effective, widely accepted, and accessible, with minimal adverse effects. This study offers a robust decision-support tool for addressing the pressing issue of obesity in India, fostering evidence-based and context-specific interventions.

Submission ID	326
Authors	T. Garai
Title	**MCDM on Purulia water resource management under trapezoidal fuzzy environment**
Abstract	In real-world decision-making situations, such as management and optimization issues, multi-criteria decision-making (MCDM) strategies are essential. The MCDM approach is a powerful tool in contemporary decision science that helps identify the optimal option based on specific requirements. Many people in Purulia suffer from a lack of drinking water as a result of various management problems. Every year, Purulia has faced water shortages due to various infrastructural problems. As a consequence, Purulia's water resource management is crucial. This district's water resources can be managed using decision-making techniques. Due to factors including time constraints, lack of data, and restricted attention, the information used to make decisions on the water resource management challenge is ambiguous. Therefore, we introduced the possibility-based fuzzy MCDM approach and used it to solve Purulia's drinking water resource management problem. Establishing a fuzzy MCDM approach based on the potential to resolve a water resource management issue is a noteworthy contribution of this study.

Submission ID	328
Authors	P. M. D. WADE
Title	**MEASUREMENT AND CONTROL OF INSOLVENCY AND INEFFICIENCY RISKS**
Abstract	Unfortunately, there is currently no mathematician model who give some objective solution of the long-standing problem concerning the measurement and control of insolvency and inefficiency risks that runs a service producing company during a certain period of time. In this paper, we present a mathematical model, based on the fuzzy sets, which can be applied as a tool capable control and measure the risks of insolvency and inefficiency of a service producing company in a given period of time.

Submission ID	299
Authors	R. Ghasem Pour, S. Pourmohammad Azizi and S. A. Waloo
Title	**LOEX Option: A Combination of Exchange Option and Lookback Option**
Abstract	In this article, we consider modeling and pricing a combination of two options (Exchange option and Lookback option) that we call the LOEX option. It is a type of exotic option, or clearer, path-dependent option because its price depends on the maximum and minimum prices of the assets to be considered. In reality, we introduce a conditional claim on two assets: the holder can change the first asset with the highest price to the second with the lowest price or cancel the transaction at the strike time. In this paper, after describing and modeling this option, we use numerical methods to estimate the pricing using the MATLAB software and present the results.

Submission ID	196
Authors	P. H. Nguyen, L. A. T. Nguyen, T. L. Nguyen, A. P. D. Nguyen, H. N. T. Luong, B. G. Nguyen and T. H. Vu
Title	**Modeling investor trust in supply chain finance: a three-staged MCDM model-based neutrosophic sets**
Abstract	In the evolving global trade landscape, investor trust has emerged as a critical enabler of supply chain finance (SCF), particularly in emerging economies like Vietnam. Despite its significant growth potential, Vietnam's SCF sector is hindered by limited access to capital, fragmented financial infrastructure, and low regulatory transparency. This study investigates and prioritizes the key factors influencing investor trust in Vietnam's SCF ecosystem by employing an integrated Multi-Criteria Decision-Making (MCDM) framework based on Neutrosophic Sets (NS). Specifically, the methodology integrates the NS-Delphi technique to consolidate expert opinions, NS-DEMATEL to model causal relationships among trust-related factors, and the COCOSO method to rank their relative importance. A total of 29 criteria were identified and categorized into six core dimensions: competence-based trust, rational trust, institutional trust, market transparency, risk appetite, and fear of opportunism. The findings indicate that financial transparency, regulatory reliability, technological adoption, and ethical conduct are the most influential factors shaping investor confidence. By leveraging neutrosophic logic to address the uncertainty and subjectivity inherent in expert evaluations, the study provides a robust decision-support model for trust assessment in complex financial systems. The insights generated offer practical recommendations for policymakers, financial institutions, and supply chain actors aiming to foster a resilient and investor-friendly SCF environment in Vietnam.

Submission ID	209
Authors	B. Hadjer and S. Milles
Title	**More on neutrosophic topological spaces**
Abstract	In this paper, we present the notion of neutrosophic topological space in Sostak's sense by a simple way. Moreover, we investigate interesting properties of this topological space which is considered as a generalization of fuzzy and intuitionistic fuzzy topological spaces.

Submission ID	130
Authors	O. Eslamifar, M. R. Soltani, and S. M. J. Rastegar Fatemi
Title	**Multiclass Blood Cell Classification Using Contourlet Transform and Metaheuristic-Optimized Deep Features with Clustering-Based Decision Making**
Abstract	Analysis by pathologists is time-consuming and error-prone due to the similarity among cell types. To address this, we propose a hybrid method combining deep learning and contour let transform for multiclass blood cell classification. Features are optimized using a metaheuristic algorithm inspired by African vultures. Experimental results on the Jiangxi Tecom dataset demonstrate high performance, achieving classification accuracies of up to 97% for certain cell types. This approach improves diagnostic reliability by leveraging feature-level fusion and clustering-based decision making.

Submission ID	170
Authors	J. Robinson
Title	**Neuro-Fuzzy Synergy: Intuitionistic Fuzzy based Learning for Smarter Decisions**
Abstract	This paper introduces a novel ANN-based Decision Support System (DSS) model that leverages intuitionistic fuzzy matrix information, aggregated using a newly proposed Hamming distance-influenced operator. The study explores the application of these innovative approaches and operators in solving Multiple Attribute Group Decision Making (MAGDM) problems under intuitionistic fuzzy environments. Key aspects of aggregation operators and Artificial Neural Networks (ANNs), particularly the Back Propagation method, are rigorously examined to demonstrate their utility in this context. A groundbreaking aggregation operator is presented to effectively handle intuitionistic fuzzy data, providing a robust foundation for decision-making scenarios. To validate the proposed framework, a numerical example is analyzed and resolved using the ANN Back Propagation approach, showcasing improved accuracy and reduced bias. The findings highlight the superiority of the proposed method over conventional ANN approaches in tackling MAGDM problems, paving the way for more effective and intelligent decision-making solutions.

Submission ID	350
Authors	P. Sinha, R. Rajesh and S. Gochhait
Title	**Neuroplasticity in Addressing Dyslexia: Insights from the Multi-Level Framework**
Abstract	Developmental Dyslexia, a neurological condition characterized by difficulties with reading and language processing, has long been associated with atypical brain structure and function. In the recent times however, advances in the understanding of neuroplasticity, the brain's remarkable ability to reorganize and adapt, have shed new light on the potential for mitigating the challenges of dyslexia. This paper explores the role of neuroplasticity in addressing dyslexia, highlighting the neurological basis of the condition, the brain regions and neural networks involved, and the potential for targeted interventions to rewire the brain and enhance reading and language abilities.

Submission ID	241
Authors	S. Priyadharshini and S. Mohanaselvi
Title	**Neutral aggregation operator based complex neutrosophic PSI-FUCA and PSI-PIV group decision-making method**
Abstract	The complex single-valued neutrosophic (CSVN) set offers a powerful framework for modeling uncertainty and periodicity in decision-making environments. Recognizing the frequent need for neutrality in evaluative judgments, this paper presents novel operational laws specifically designed to incorporate neutrality within the decision-making process. Building upon these laws, the CSVN weighted averaging neutral aggregation (CSVNWANA) operators are developed to effectively combine complex neutrosophic information. Furthermore, hybrid methodologies combining the PSI with FUCA and PIV techniques are employed to determine attribute weights and rank alternatives. The practical applicability of the proposed model is demonstrated through a numerical example focused on green supplier selection and a comparative analysis that validates its performance. This study advances the theoretical foundations and practical tools for multi attribute group decision-making under uncertainty, particularly when neutrality plays a critical role.

Submission ID	219
Authors	P. Vijaya Shanthi and J. Kannan
Title	**Neutro - Topological Space**
Abstract	In this article, we discuss the new concept of topology namely, Neutro Topology. Topology is a branch of mathematics that works with precise definitions of notions related to spatial structure. It also examines relationships between the attributes established on the set and the structure, comparing various definitions. Providing an overview of the _t is the initial step in topology, and next to look into the relationships between topological structures obtained using various techniques.

Submission ID	322
Authors	F. Parrales-Bravo, R. Tolozano-Benites, L. Vasquez-Cevallos and M. Leyva-Vasquez
Title	**Neutrosophic Random Forest for Soil Fertility Prediction with Uncertainty Quantification**
Abstract	This study develops a machine learning framework that combines Random Forest classification with neutrosophic logic to predict soil fertility from 16 physicochemical properties. The model achieves robust classification accuracy (95%) while introducing a novel uncertainty quantification mechanism through neutrosophic truth (T), indeterminacy (I) and falsity (F) values derived from prediction probabilities, assigning high-confidence ($T = 0.9$) to probabilities ≥ 0.9, indeterminacy ($I = 0.3$) to borderline cases ($0.5 \leq p < 0.9$), and falsity ($F = 0.5$) to low-confidence predictions (<0.5), enabling tiered decision support where 60% of cases receive automated recommendations, 25% require expert review, and 15% are flagged for rejection. Feature importance analysis reveals Clay (24.1%) and CEC (18.7%) as dominant predictors, aligning with agronomic principles while providing interpretable results. This approach advances precision agriculture by supplementing binary classifications with actionable confidence metrics, particularly valuable for managing uncertain soil conditions.

Submission ID	123
Authors	S. BasariKodi, S. Jafari, S. Poornima and A. Varalakshmi
Title	**Neutrosophic Sober Open Sets: An Overview**
Abstract	In this study, a new class of neutrosophic set, known as Neutrosophic Sober open set in Neutrosophic Topological space is introduced, and its fundamental features are examined. After this, we create a new topology type known as neutrosophic sober topology in order to study its relationships in more detail.

Submission ID	245
Authors	P. H. Nguyen1, L. A. T. Nguyen1, T. G. Vu, M. T. Phan, V. H. Ngo, D. L. Do
Title	**Neutrosophic Z-Number Analytic Hierarchy Process: A Framework for Enhanced Group Decision-Making Under Uncertainty**
Abstract	Multi-criteria decision-making (MCDM) often faces challenges in handling uncertainty, imprecision, and unreliable expert judgments, limiting the effectiveness of traditional methods like the Analytic Hierarchy Process (AHP). This study proposes the Neutrosophic Z-Number AHP (NZN-AHP) method to enhance decision-making by addressing these complexities. Methods: The NZN-AHP method integrates Neutrosophic Z-Numbers (NZNs), which model truth, indeterminacy, falsity, and reliability, with AHP's structured pairwise comparison framework. Linguistic scales and advanced aggregation operators, such as Dombi and Aczel Alsina, are employed to process expert evaluations, ensuring robust handling of uncertain data. The NZN-AHP method achieves consistent outcomes (CR < 0.1), outperforming traditional and fuzzy AHP by incorporating reliability and indeterminacy, thus providing more accurate prioritization of criteria in complex decision-making scenarios. Conclusions: NZN-AHP offers a versatile and precise framework for MCDM, effectively capturing multifaceted uncertainties and enhancing decision-making across domains like logistics, finance, and strategic planning. It sets a foundation for future research into integrating NZNs with other MCDM methods, advancing the field of decision sciences.

Submission ID	262
Authors	N. M. Chakrapani
Title	**Neutrosphic switch graphs, Neutrosophic reversal switch graphs and Reversal neutrosophic reactive graphs**
Abstract	This study introduces a broader framework termed Reversal Neutrosophic Switch Graph (RNSG), which facilitates both the activation and deactivation of arrows alongside updating their fuzzy values. The procedure yields the Reversal Neutrosophic Reactive Graph (RNRG) by employing various aggregation functions. Moreover, we propose several processes reliant on aggregate functions such as union, intersection, Cartesian product, and extension. RNFSGs can effectively model the dynamic components of numerous systems prevalent in engineering, computer science, and related disciplines. The paper further elucidates the relationship between Neutrosophic Graphs and RNSGs, providing a logic for assessing the modelled system's characteristics.

Submission ID	339
Authors	Riad K. Al-Hamido
Title	**On Neutrosophic Crisp Soft Separation axioms**
Abstract	In this pioneering study, we introduce the concept of Neutrosophic crisp soft regular space type i (Ni$\mathcal{S}$-R-space), $i = 1,2,3$, Neutrosophic crisp soft normal space (N$\mathcal{S}$-N space) , N1$\mathcal{S}$- $\mathfrak{J}$ 3-space and N1$\mathcal{S}$- $\mathfrak{J}$ 4-space for the first time globally. Using Neutrosophic crisp soft, and identify many key properties of this new concepts. We further explore the relationships between these separation axioms and provide insightful remarks related to these concepts. These new separation axioms may be prove valuable in decision-making processes across diverse fields such as economics, agriculture, medicine, engineering, and others.

Submission ID	144
Authors	A. Kumari Prasad, M. Thakur, S. Singh Thakur and S. Jafari
Title	**On preserving neutrosophic gpr-closed sets**
Abstract	In this paper we extend the concepts of apr-closed and apr-continuous mappings to neutrosophic topological spaces and obtain several results concerning the preservation of neutrosophic gpr-closed sets. Furthermore we characterize neutrosophic pre regular T12 -spaces in terms of neutrosophic apr-continuous and neutrosophic apr-closed mappings and obtain some of the basic properties and characterization of these mappings.

Submissionid	304
Authors	Nagwa A. Saeed and Deepak B. Pachpatte
Title	On the Solution of Fuzzy Fractional Partial Integro-Differential Equations
Abstract	

Submissionid	76
Authors	Theeba1*, Nivetha Martin2
Title	Optimization of Green E Commerce Inventory Model with Pentagonal Neutrosophic Numbers
Abstract	E-commerce industries with the key factor of effective inventory management are gaining more momentum at recent times in the multiple dimensions of economic, technology and consumerism. Despite of economic growth, the increasing environmental concerns associated with E-commerce have created the necessity of incorporating the elements of environmental sustainability in inventory management. This research work develops an integrated E-commerce inventory model considering the critical cost parameters of inventory and sustainability as pentagonal neutrosophic numbers. The objective of the proposed model works on the principle of minimizing the total cost and maximizing the sustainability considering the pentagonal representations with truth, indeterminacy and falsity values. The sustainability costs of carbon emissions, recyclable packaging, energy consumption, waste management and green compliance with different parameters are augmented with the existing inventory cost parameters to evolve a more comprehensive and competent inventory model balancing both the economic and environmental aspects of E-commerce. Numerical simulations are performed to validate the efficacy of the model with pentagonal neutrosophic representations. The results exhibit the efficiency of the proposed model in determining optimal solutions to green E-commerce inventory management.

Submissionid	280
Authors	Deepika Nayak 1 , Rekha R Nair 1, Tina Babu 1,∗, Kumar Rajamani 2, Balamurugan Balusamy 3 and Sumendra Yogarayan 4,∗
Title	Optimized crop Yield Prediction Using Intuitionistic-Type2 Fuzzy Extensions with XGBoost
Abstract	climate, and farm management. Traditional machine learning models struggle with this uncertainty. This study proposes a Hybrid Fuzzy-XGBoost model combining XGBoost with Intuitionistic and Type-2 fuzzy extensions, using the Area-Production-Yield (APY) dataset. Fuzzy feature engineering modeled Area, Production, and Season attributes with Intuitionistic Fuzzy Sets, extended to Interval Type-2 fuzzy sets for better uncertainty handling. Compared to baseline models (Random Forest, XGBoost, LightGBM), the Hybrid model achieved superior performance with Test MAE (0.0003), Test RMSE (0.0010), Test R2 (0.9994), and the highest Fuzzy Consistency Index (0.9993). Integrating fuzzy logic with machine learning enhances prediction accuracy and uncertainty management, advancing intelligent agricultural systems.

Submissionid	178
Authors	Mandeep Kaur, Syed Immamul Ansarullah, Arun Kumar Rana, Aibrokhimali Normatov, Irina Leonova, Dr Saikat Gochhait
Title	Optimizing Employee Performance Metrics: A Machine Learning-Based Decision Support System
Abstract	Assessing employee performance aids businesses in reaching their objectives. Personal judgment-based performance evaluation systems rely too heavily on subjective judgments, which lead to incorrect outcomes. Using several machine learning models and statistical techniques, our research creates a machine learning decision support system to improve employee performance metrics. Predictive analytics is used in the study to identify key performance metrics and boost worker productivity. To assist HR directors in making better workforce decisions, our study integrates statistical tools, feature selection techniques, and supervised learning algorithms.

Submissionid	88
Authors	Dinesh*1 and Geetika Khurana2
Title	Optimizing Industrial Geothermal Energy Solutions Using a Hesitant Bipolar Fuzzy MCDM Approach Enhanced by Dombi Operators
Abstract	his study addresses a significant gap in the decision-making framework for evaluating geothermal energy systems in industrial contexts by introducing a novel technique that integrates hesitant bipolar fuzzy sets (HBFSs) with Dombi operators. Previous investigations have largely focused on certainty alone, neglecting the reality that decisions frequently involve ambiguity, duality, and hesitation. To bridge this void, we initially introduce Dombi operators within the HBFS framework, offering parametric adaptability to handle more intricate and uncertain data. Utilizing these operators, we formulate a hesitant bipolar fuzzy multi-criteria decision-making (MCDM) method for ranking geothermal energy alternatives. The practical relevance of our proposed strategy is exemplified through a comprehensive case study that reinforces the conceptual model. The superiority of the proposed model is further validated by comparative analysis with existing techniques and its demonstrated capacity to manage ambiguity while yielding more precise and dependable conclusions. This work delivers a noteworthy theoretical and practical advancement to decision-making strategies and supports the selection of sustainable geothermal energy solutions in uncertain environments, equipping decision-makers with a robust analytical tool.
Link	https://www.youtube.com/watch?v=263es9oDwYw

Submissionid	336
Authors	Anu Sayal 1, Lai Yee Tong 2, Neha Tyagi3, Balamurugan Balusamy4, Sumendra Yogarayan5, Alavikunhu Panthakkan6
Title	Optimizing inventory management in the automotive industry: A comparative study of crisp and fuzzy systems
Abstract	This study examines inventory management in the automotive industry, with a focus on the brand Tesla. This research compares the traditional crisp inventory systems which struggle with uncertainties and the fuzzy inventory systems. It examines how fuzzification and defuzzification are applied in converting crisps to fuzzy logic to manage uncertainty more effectively. In this research, it highlights how fuzzy logic can improve demand forecasting and inventory control which are able to increase efficiency and minimize costs. In this study, the key factors such as demand rates, holding costs and production costs, etc. are analyzed in both these systems to have clear comparative analysis. The traditional crisp system relies on precise data which can be problematic in the automotive sector due to some factors such as fluctuating demand. However, fuzzy systems can offer a more flexible approach. Furthermore, the research addresses the challenges of implementing fuzzy logic systems on dealing with the "forgetting effect" where historical data may become less relevant. Through analysis and case studies, the findings provide insights and recommendations for the automotive industry stakeholders. The study highlighted the advantages of adopting fuzzy logic inventory management strategies and demonstrated how they improve the system and minimize costs.

Submissionid	203
Authors	Prabakaran Raghavendrana, Tharmalingam Gunasekara,b, Saikat Gochhaitc
Title	Optimizing Load Dispatch Using Artificial Neural Networks and Fractional Weighted Models
Abstract	This research investigates the combination of Artificial Neural Networks and Fractional Weighted Load Dispatch to improve power system optimization. The suggested model, referred to as S, T,D,C, T, efficiently captures real-time fluctuations in supply (S), transmission (T), demand (D), cost (C), and time (T) to optimize energy dispatch decisions. In contrast to traditional techniques, this new approach applies the principles of fractional calculus to enhance load allocation and adaptability to grid oscillations. Experimental findings indicate that ANN-based framework attained a Mean Squared Error (MSE) of 245.80 MW2 during training and 260.95 MW2 during testing, with Root Mean Squared Errors (RMSE) of 15.68 MW and 16.15 MW, respectively. The Mean Absolute Percentage Error (MAPE) was less than 10.35%, demonstrating very high predictive accuracy. The innovation of this research is in the integration of ANN learning and fractional weighting techniques, guaranteeing greater stability, effectiveness, and scalability in load dispatch optimization.

Submissionid	185
Authors	Prabakaran Raghavendrana, Tharmalingam Gunasekara,b, Saikat Gochhaitc
Title	Optimizing Market Entry in Emerging Economies: DEA and Neutrosophic-Z MCDM Approach for Chinese Oil & Gas Equipment Manufacturers
Abstract	This research investigates the combination of Artificial Neural Networks and Fractional Weighted Load Dispatch to improve power system optimization. The suggested model, referred to as S, T,D,C, T, efficiently captures real-time fluctuations in supply (S), transmission (T), demand (D), cost (C), and time (T) to optimize energy dispatch decisions. In contrast to traditional techniques, this new approach applies the principles of fractional calculus to enhance load allocation and adaptability to grid oscillations. Experimental findings indicate that ANN-based framework attained a Mean Squared Error (MSE) of 245.80 MW2 during training and 260.95 MW2 during testing, with Root Mean Squared Errors (RMSE) of 15.68 MW and 16.15 MW, respectively. The Mean Absolute Percentage Error (MAPE) was less than 10.35%, demonstrating very high predictive accuracy. The innovation of this research is in the integration of ANN learning and fractional weighting techniques, guaranteeing greater stability, effectiveness, and scalability in load dispatch optimization.

Submissionid	137
Authors	Tarishi Baranwal1, A. Akilbasha2*, Uma Shankar3, K. Meenakshi4, S.J Johnston5
Title	Optimizing Vehicle Routing Problem by An Improved Ant Colony Optimization Model
Abstract	This paper introduces a single depot capacitated vehicle routing problem stimulated by a logistic company's real scenario. The primary objective of this project is to create a cost-minimization model for a capacitated single-depot vehicle routing issue. This research relies on data from Lion Brewery Ceylon PLC, Biyagama, the dominant beer producer in Sri Lanka. To distribute bottles and cans throughout the Colombo area, we created a mechanism that minimizes costs. There are 35 cities in the main optimization problem. First, centralized the main warehouse using the Gravity model, then set up the shortest path of all 35 cities and the main warehouse using the Ant Colony Algorithm. After that, we built main clusters using the demands of each city. Finally, we established the non-optimal solution for this problem and the proposed model saves 3.6% on monthly bottle distribution costs.

Submissionid	151
Authors	RADHIKA DAS, MANJU SOMANATH, AND BINDU V A
Title	POLYNOMIAL SOLUTIONS OF QUADRATIC DIOPHANTINE EQUATION
Abstract	n this paper, we examine the integer solution of the quadratic Diophantine equation D : l2 □ 72m2 + 18l + 720m = 1800 which can be switched into a Pell's equation and is amenable to a variety of approaches for solving.Furthermore, we identify some formulas and recurrence relations for the polynomial solution (ln;mn) of D. 2020 Mathematics subject classi_cation: 11D09

Submissionid	321
Authors	Lorenzo Cevallos-Torres1,2, Franklin Parrales-Bravo1,2, Rosangela Caicedo-Quiroz1, Maikel Leyva-Vazquez
Title	Post-Seismic Structural Damage Impact on Chronic Disease Patients: A Heuristic-Fuzzy Analysis
Abstract	This project aims to assess the structural damage of a structure after a seismic event using a heuristic-fuzzy model as a decision-making support tool for risk management professionals. Considering Ecuador's position in a highly seismic region, it is imperative to evaluate both the structural damage to edifices and the susceptibility of impacted people, especially those with chronic conditions necessitating urgent attention. Contemporary structural assessment methods predominantly depend on quantitative data, resulting in uncertainty and difficulties in the absence of certified experts. The proposed model employs the Analytic Hierarchy Process (AHP) methodology to allocate relative weights to different structural factors and incorporates fuzzy logic to analyze qualitative data concerning the condition of the buildings and the health status of the residents. By inputting data related to structural damage (to columns, beams, and façades), soil conditions, and the health risk profiles of inhabitants (presence of chronic illnesses, degree of health literacy), the system assesses overall damage levels and prioritizes health interventions. Ultimately, utilizing fuzzy rules grounded in Mamdani inference, the model determines the habitability status of the structure and the necessity for medical intervention following an earthquake, facilitating a more holistic and human-centric decision-making approach in catastrophe scenarios.

Submissionid	222
Authors	Jeba Singh O1, Priestly Shan2 , Rajesh Sharma R3, Mahmoud Ahmad Al-Khasawneh4, Sheila Mahapatra5,Balamurugan Balusamy6
Title	Power sharing and Power quality improvement in smart microgrid using Fuzzy controlled Intelligent Integrated Controller
Abstract	In modern power systems, the integration of Renewable Energy Sources (RES) and increasing load variations create significant challenges in power sharing and reduced harmonic distortions in smart microgrids. This paper proposes a Fuzzy Logic Controller (FLC)-based Intelligent Integrated Controller to address these issues effectively. The controller leverages real-time parameters such as State of Charge (SoC), time-integrated tariff signals, and source current to ensure dynamic power management and maintain power quality standards. The system incorporates a zero-crossing detector, phase template extraction, and a K-factor-based modulation strategy to generate accurate reference signals. A hysteresis current controller is employed for precise current tracking. Simulation results reveal that, the proposed approach significantly reduces harmonics, improves voltage and current profiles, and ensures optimal power sharing among distributed units. The FLC-based intelligent framework enhances system stability, responsiveness, and economic operation, making it highly suitable for advanced smart grid applications.

Submissionid	86
Authors	Shahzaib Ashrafa, Muhammad Shakir Chohana, Chiranjibe Janab,_, Nikola Ivkovicc
Title	Prediction of HIV Patients in Connecticut Using Higher-Order Spherical Fuzzy Sets Based Forecasting Methodology
Abstract	In business and other situations, multiple-time series forecasting is frequently required. The most popularly used and skilled technique for addressing uncertainty is the spherical fuzzy set (SFS). SFS is a further recent tool than fuzzy sets, and other type of fuzzy set. There was formerly a gap in _guring out the forecasted data that's total value of belonging, indeterminacy, and non-belonging more than 1. To address this kind of de_cit, we utilized SFS in time series forecasting. This essay presents a new, higher-order spherical fuzzy sets-based methodology for time series forecasting capable of handling diverse datasets. Applied to the prediction of HIV patient trends in Connecticut, this approach enhances accuracy by capturing intricate data relationships. The framework does a good job of modelling error and imprecision, giving forecasters a exible tool for making predictions. Using HIV patients in Connecticut as a case study, the procedure shows that it performs better than traditional approaches. Results indicate a signi_cant boost in forecasting accuracy, with potential implications for healthcare resource allocation and policy formulation. This study contributes to both forecasting techniques and healthcare management, showcasing the potential impact on public health.

Submissionid	166
Authors	SABA AL-KASEASBEH
Title	PRIME-SUM BI-ANTIIDEAL GRAPHS OF SEMIGROUPS
Abstract	This paper introduces a novel class of algebraic graphs associated with semigroups, called the Prime-Sum Bi-Antiideal Graphs. Motivated by the interplay between algebraic structure and number-theoretic conditions, we construct a graph Γprime(S) where the vertices correspond to the non-empty (m, n)-bi-antiideals of a finite semigroup S, and adjacency between two vertices is determined by whether the sum of their cardinalities is a prime number. Unlike traditional bi-antiideal graphs, where adjacency is governed by algebraic union or intersection properties, this approach leverages the simplicity and structure of primes to define a new class of cardinality-based adjacency graphs. This results in a unique and easily computable framework that blends semigroup theory with elementary number theory. We investigate several core properties of Γprime(S), including conditions for the existence of edges, criteria for total disconnectedness, and structural patterns such as cliques formed by equal-sized, disjoint bi-antiideals. Our analysis is supported by illustrative examples, including constructions from small semigroups like Zn under addition modulo n. The proposed graph reveals new insights into the behavior of bi-antiideals under size-based constraints and lays the foundation for future work on fuzzy versions, spectral graph analysis, and potential applications in computational algebra. The simplicity of its construction makes Γprime(S) a promising candidate for further exploration within algebraic graph theory.

Submissionid	64
Authors	Şura Toptancı 1,*, Çağlar Karamaşa2
Title	Prioritization of the Dimensions Affecting the Surgical Cognitive Workload Using the Fuzzy Multi-Criteria Decision-Making Method
Abstract	Surgical cognitive workload (CWL), which is one of the main study topics of ergonomics and human factors engineering, may negatively affect the performance of surgeons working in the healthcare sector, the operations they perform during surgery, and the health and safety of patients. In order to determine the precautions to be taken in this regard, it is first necessary to measure the exposure levels of surgeons to CWL. Various techniques are used to measure CWL, each with different characteristics. Subjective methods are more preferred among them. It is important to use subjective methods with area-specific criteria to ensure the effectiveness of assessing the CWL of surgeons and the reliability of the analysis results. The SURG-TLX method is the most appropriate method to be used in this area. In this method, not all criteria considered may have the same importance. Therefore, the significance priorities of the criteria used to assess surgical CWL should be determined through analytical approaches in order to obtain accurate results. Fuzzy Multi-Criteria Decision-Making (Fuzzy MCDM) methods are frequently used in the literature to determine the importance weights of criteria and to address uncertainties in the assessment process. This study aims to reveal the significance of the six dimensions in the SURG-TLX method. In this study, the dimensions affecting surgical CWL are prioritized by gathering the opinions of four surgeons from different branches and using the Fuzzy Ordinal Priority Approach (Fuzzy OPA), one of the Fuzzy MCDM methods. The results show which dimensions have a greater effect on the level of surgical CWL and should be given more consideration when making improvements. This study contributes to the ergonomics and human factors engineering literature both in terms of its subject and the innovative approach it adopts.

Submissionid	186
Authors	Abhishek, Yadav 1,*
Title	Prioritizing Sustainable City Factors: A Generative AI-Driven Fermatean Fuzzy Prioritization Framework
Abstract	Sustainable cities are vital for addressing global environmental and social challenges, yet evaluating their diverse sustainability aspects remains complex. Traditional Multi-Criteria Decision-Making methods often suffer from subjectivity, resource intensity, and cognitive burden due to reliance on small expert pools and pairwise comparisons. This study introduces an integrated framework to overcome these limitations by identifying and prioritizing key factors for urban sustainability evaluation. We employ BERTopic, a transformer-based topic modelling technique, to systematically extract 12 relevant factors from the academic literature. Instead of human experts, we leverage a state-of-the-art Generative AI model (Gemini 2.5 Pro) with Chain-of-Thought reasoning to provide structured evaluations for these factors across different importance clusters. The inherent uncertainty in these AI-generated judgments is modelled using Fermatean Fuzzy Sets. Finally, the factors are prioritized using the Soft Cluster Rectangle method, eliminating the need for pairwise comparisons. Results indicate that Pollution Control, Water Management, and Social Equity are the highest-priority factors, followed by Sustainable Transportation, Urban Ecology, Population Health, and Urban Resilience. This study presents a more objective, scalable, and efficient data-driven approach to aid policymakers in strategic urban sustainability planning.

Submissionid	55
Authors	Akhand Pratap, Shukla 1, Akhil, Pandey 2 , Pradeep Kumar Singh3
Title	Proactive Cybersecurity in the Digital Age: The Role of Big Data Analytics
Abstract	One of the cyber threat complexities that come with digitalization is the opportunity to go farther than the just traditional methods in securitization. BDA means that it is the leading tool in improving proactive, data-driven cybersecurity. We highlight the problems and solutions when we talk about BDA in the modern era of information security. The combination of advanced algorithms and machine learning on big data allows BDA to identify small abnormalities as the ones of malicious activity and, consequently, helps in threat hunting, behavioral analytics, and incident response. As in the case of anomaly detection, AI, predictive modeling, and attack reconstruction are among the applications. The main issues that hinder it are too much data storage, inadequate skills, and privacy protection. Prospects for the future are AI, the exchange of threat intelligence, and the analysis of the cloud. This research claims that BDA should be adopted as the main feature of a flexible and effective cybersecurity system.

Submissionid	216
Authors	Munirah, Alshalan 1 , Fairouz, Tchier 2
Title	Proposed Fuzzy System for Diabetes Diagnosis
Abstract	Diabetes is a chronic disease characterized by elevated levels of blood glucose, which may result in significant damage to the heart, blood vessels, eyes and kidneys if left untreated. According to the World Health Organization (WHO), it is the seventh leading cause of death. Due to this, an automated disease diagnosis system is needed, allowing for fast detection and treatment. Early detection of diabetes helps prevent further complications by maintaining control of the disease. Thus, fuzzy logic has been employed to develop a diagnostic system of diabetes for adults ages 21 to 81. The system diagnoses individuals based on four factors: a 2-hour plasma glucose concentration, a 2-hour serum insulin, age and BMI. The system involved three stages: fuzzification, fuzzy Inference engine and defuzzification. Finally, the Pima Indians diabetes database has been used to evaluate the performance of the proposed system, obtaining an accuracy rate of 82.6%. This suggest the potential usage of fuzzy system in the digital transformation of the health sector.

Submissionid	99
Authors	Khaja Mannanuddin1
Title	Pursuance of Recurrent Neural Networks for Energy Coherence in Neuromorphic Computing
Abstract	The Hardware oriented energy levels can be reflected in coherence and virtue during the execution of real time application that accomplish performance in high productivity scale associated with reliability, operability and also consistent with the hardware ecosystem. This real time application can be integrated with networks of neuron system which requires training of algorithm models on the given datasets. The said scenario can be achieved with the help of Deep Learning algorithm such as conventional neural networks, back propagation and recurrent algorithms which has been implemented on a spectrum of data models and datasets with high success rate. And the coherence of hardware energy can be achieved remarkably with the help of micro chips developed for neuromorphic computing that executes networks of spiking neurons named as spiking neural network. There is need for integration of deep learning and neuromorphic computing to achieve best accuracy in performance of the model along with energy coherence in hardware. The major difference between neuromorphic and deep learning in terms of incompatibility can be reduced with the help of recurrent neural networks which uses back propagation through time. Recurrent uses data information to learn by training and distinguish memory in form of spiking neurons for sequence of inputs and outputs through time similar to synaptic weights represented as discrete synapses. In this paper, basically we try to gather the discontinuous synapses associated with spiking neurons for training the model and to find the consecutive probability values at a given period of time through back propagation. Later, we employ the values of probability samples obtained from back propagation through time method for mapping and merging of the training network model upon hardware of neuromorphic computing which generates a new network model consist of ensemble aggregation. For illustration of the above method, we employ Loihi chip along with MNIST dataset for training of agile network that are inter connected. These chips have highest percent of accuracy in performance and coherence of network that gains maximum indices of ensemble learning.

Submissionid	239
Authors	Sukhwinder Singh Rawat1,∗, Komal1, Rashmi Saini2
Title	q-Rung Orthopair Fuzzy Group Decision Making based on Archimedean Hamy Mean Operator
Abstract	Archimedean t-norm provides an advantage to represent the formal structure of aggregation operators (AOs) in a simpler form i.e., from a multivariate to univariate function through additive generator. This study focuses on q-rung orthopair fuzzy numbers, a _eld that is usually ruled by t-norms. So in this paper, we introduced Hamy mean and weighted Hamy mean operators for q-rung orthopair fuzzy numbers under a generalized construction of continuous and Archimedean classes of t-norms. Further to develop acomprehensive AO based multi-criteria group decision making model, an objective weight determination approach named q-rung orthopair fuzzy Archimedean ordinal priority approach is used to systematically evaluate the attribute weights. Finally, the constructed approach is practically demonstrated through a detailed illustration of the applied real world decision making problem.

Submissionid	285
Authors	Tina Babu 1,∗, Sheila Mahapatra1, Balamurugan Balusamy2, Sumendra Yogarayan3 and Siti Fatimah Abdul Razak4
Title	Q-Rung Orthopair Fuzzy Modeling of Soil-Climate-Actuator Interactions for Crop Yield Efficiency Assessment using IoT-Enabled Agricultural Data
Abstract	Agriculture, the backbone of India's economy, faces increasing challenges due to climate variability and resource constraints, necessitating robust decision-support models. This paper introduces a novel fuzzy modeling approach using Q-Rung Orthopair Fuzzy Sets (QROFS) to capture uncertainty in crop yield efficiency assessments, enhanced by real-time IoT sensor data from diverse Indian agro-climatic zones.The methodology defines composite fuzzy indices for soil fertility, climate suitability, water availability, and actuator status, integrating them using a q-ROF Weighted Averaging (q-ROFWA) operator while dynamically quantifying uncertainty through hesitation degrees. Experimental results show that the proposed model achieved a highest crop yield efficiency score of 0.4820 under optimal environmental and actuator conditions, while maintaining a high hesitation degree of 0.7469, reflecting robustness against uncertainty. By enabling adaptive and uncertainty-aware crop management strategies, the proposed framework empowers farmers, policymakers, and stakeholders to optimize resource usage, enhance yield outcomes, and promote sustainable agriculture, thereby trengthening food security and climate resilience

Submissionid	258
Authors	Arokia Pratheesha S V 1 and R Radha 2,∗
Title	Quadripartitioned Single Valued Neutrosophic Refined Resolvable and Irresolvable Spaces
Abstract	In this paper, the concepts of Quadripartitioned Single Valued Neutrosophic Refined resolvable, Quadripartitioned Single Valued Neutrosophic Refined rresolvable, Quadripartitioned Single Valued Neutrosophic Refined open hereditarily irresolvable and maximally Quadripartitioned Single Valued Neutrosophic Refined irresolvable spaces are introduced.Also we examine several properties of the Quadripartitioned Single Valued Neutrosophic Refined open hereditarily irresolvable spaces besides giving characterization of these spaces by means of somewhat Quadripartitioned Single Valued Neutrosophic Refined continuous functions and somewhat Quadripartitioned Single Valued Neutrosophic Refined open functions.

Submissionid	109
Authors	Selçuk Korucuk 1, Şule Bayazit Bedirhanoğlu2 , Çağlar Karamaşa3*
Title	Quantitative analysis in prioritizing elements for efficient logistics strategies: A Case Study in Eskişehir
Abstract	Logistics strategies are essential elements in the concepts of designing and operating logistics process and systems, identifying visions, selecting feasible goals, constructing plans, decisions and policies that helps businesses in gaining goals. Also the issues of implementing logistics services in a shorter time, customer suitability, low cost, customer support from pre-to-aftersales have an impact on the customers' service perceptions. By this means, better customer satisfaction can be achieved. However, the importance of factors in logistics strategy according to customers perspective need to be determined. Value added elements of acquiring internal and external customer satisfaction, decreasing costs, strenghtening visibility, presenting the right product to the right customers in suitable place as promotion activity show the importance of logistics strategies for businesses. In this study, elements effective in forming logistic strategies for manufacturing firms having more than 50 employee in Eskişehir are aimed to prioritize. DEMATEL as a multi-criteria decision-making (MCDM) technique examining logical relationship of factors and researching direct influence matrix in complex system is handled as prioritization method. Pythagorean fuzzy sets are preferred to better explain the judgments of decision-makers in uncertainty by giving more flexibility than fuzzy and intuitionistic fuzzy sets.

Submissionid	283
Authors	Rekha R Nair 1 , Tina Babu 1,∗, Sheila Mahapatra1, Balamurugan Balusamy2 and Sumendra Yogarayan3
Title	Quantum-Inspired Fuzzy Time Series for High-Accuracy Forecasting of Solar Energy Generation
Abstract	Solar energy forecasting plays a pivotal role in ensuring grid reliability, but traditional models often fall short under uncertainty. This study introduces a novel Quantum-Inspired Fuzzy Time Series (QIFTS) model that integrates the uncertainty-handling strength of fuzzy logic with the probabilistic superposition principle from quantum theory. The methodology includes preprocessing solar time series data, fuzzifying it using triangular membership functions, constructing quantum fuzzy states, and evolving predictions through a quantum fuzzy transition matrix. Compared to classical FTS, LSTM, and ARIMA models, QIFTS demonstrated significantly better performance—achieving a 20.4% MAE reduction over classical fuzzy models and 47.3% over ARIMA. The approach excels in volatility modeling, showing robust accuracy across daily solar generation cycles, including under cloudy conditions. The societal impact of this work lies in its ability to enhance renewable energy integration through better load prediction, grid stability, and cost savings. This advancement represents a meaningful step toward intelligent and uncertainty-aware energy systems.

Submissionid	165
Authors	V.Sangeetha1,T.Anupreethi2 and Manju Somanath3
Title	Ramanujan Primes and Negative Pell's Equation
Abstract	The Diophantine equation under consideration to find the non-zero integral solution are of the type $x2 = (Rp)y2 - (R1)t$ which represents a very general type of negative Pell's equation formed using Ramanujan primes as coefficients. The equation are all formed using the first 10 Ramanujan primes 2,11,17,29,41,47,59,67,71 & 97. Fixing the 1st Ramanujan prime $R1 = 2$, we seek for solutions of Pell's equation with coefficients Rp, where Rp denotes the pth Ramanujan prime. MSC Classification Number : 11D09,11D99.

Submissionid	229
Authors	Amal Kumar Adak , Gaurikant Kumar
Title	Real Life Application of Fermatean Fuzzy Sets
Abstract	

Submissionid	173
Authors	Ahmad.Dormishi, Farhad. Hosseinzadeh Lotfi *, Bijan. Rahmani Parchikolaei, Esmaeil. Najafi.Department, Amir.Azizi.
Title	Reducing computational time in data envelopment analysis (DEA and FDEA) for large-scale decision-making units
Abstract	In the traditional data envelopment analysis method (DEA), the standard model of DEA has to be solved n times (each time for n DMUs). As the number of DMUs increases, the time required to solve them increases dramatically. Although our computing power has increased over time, as our computing power increases, we may always face problems larger than the available computing power, so methods based on dimensionality reduction can be useful. This study presents a new framework for substantially reducing DEA computational time compared to existing methods for large sets of DMUs. This framework has several steps. First, we find the subset of DMUs using the proposed algorithm to find the approximate area for the Production possibility set. Then, we add the DMUs outside the range of production possibility to the set, and by specifying the efficient DMUs, we calculate the efficiency of the DMUs. This paper uses variable scale efficiency technology and several simulation experiments are designed to compare the time required for the proposed method with existing methods. We also showed that the presented algorithm can be used for big data in fuzzy data envelopment analysis. The results show that the execution time decreases as acceptable compared to existing techniques.

Submissionid	155
Authors	Jung-Fa, Tsai 1 ,Hong-Anh Thi, Pham 1,2 , Phi-Hung Nguyen 2,* and Lan-Anh Thi, Nguyen2
Title	Reducing Food Waste in Vietnam's Food Service Sector: A Grey Theory-Based Analysis of Critical Factor
Abstract	Food waste in Vietnam’s food service sector poses significant economic, environmental, and social challenges. This study uses an integrated grey Delphi and Decision-Making Trial and Evaluation Laboratory (DEMATEL) approach to identify critical factors contributing to food waste. A preliminary set of factors was derived from a literature review and refined through expert screening via the grey Delphi method. These factors were then analyzed using grey DEMATEL to map causal relationships and influence strengths. The findings highlight improper inventory management, inaccurate demand forecasting, and limited customer awareness as key drivers requiring managerial focus. This research introduces a novel application of grey theory to address complex, data-scarce problems, offering a robust framework for analyzing food waste. By delineating the origins and pathways of waste propagation, the study provides actionable insights for managers to enhance sustainability and reduce waste in Vietnam’s food service industry.

Submissionid	66
Authors	P. Karthiga Rani1 P. Pandiammal2
Title	Revolutionizing Multi-Criteria Decision-Making with Neutrosophic Fuzzy Normal M-subgroup
Abstract	Many scientific and technical fields depend on Multi-Criteria Decision-Making (MCDM), which calls for strong mathematical frameworks to manage imprecision and uncertainty. By introducing the idea of neutrality, the new philosophical field of neutrosophy makes it possible to include indeterminacy into algebraic structures. This gave Smarandache the idea to create Neutro Algebraic Structures, which included indeterminate and partial components in axioms and operations. The Neutrosophic Fuzzy Normal M-subgroup is introduced in this paper, which furthers the study of Neutrosophic group theory. We examine its basic characteristics and provide illustrative cases to highlight its importance in MCDM and how it might improve decision-making in the face of ambiguity.

Submissionid	297
Authors	Akey Sungheetha1, Rajesh Sharma R1, Mahmoud Ahmad Al-Khasawneh2⋆, Balamurugan Balusamy3, Ezil Sam Leni1, and Sasikala Rani K1
Title	SARO: Space-Air Resource Orchestration Using Deep Reinforcement Learning for Resilient Satellite-Aerial Networks
Abstract	The emerging paradigm of integrated space-aerial networks presents unprecedented challenges in resource orchestration due to the dynamic nature of orbital mechanics, atmospheric conditions, and heterogeneous network requirements. This paper introduces SARO, a novel framework for Space- Air Resource Orchestration that leverages multi-agent deep reinforcement learning (DRL) to optimize network performance metrics including resilience, energy efficiency, and communication latency. Our approach integrates blockchain technology to ensure secure and transparent resource allocation across network entities. Experimental evaluations using real-world satellite constellation data demonstrate that SARO achieves 27% better resource utilization, 35% lower latency, and 42% higher resilience compared to traditional approaches. We further analyze the framework's adaptability under varying atmospheric conditions and node failures, showing robust performance across diverse operational scenarios. Keywords— Space-aerial networks, deep reinforcement learning, resource orchestration, blockchain, HAPS, satellite communications

Submissionid	281
Authors	Tina Babu 1 , Rekha R Nair1, Balamurugan Balusamy2, Sumendra Yogarayan3,∗ and A.Ezil Sam Leni1
Title	Shadowed Sets for Feature Selection in High-Dimensional Biomedical Data Analysis
Abstract	Feature selection in high-dimensional biomedical datasets is essential for improving classification performance, reducing computational burden, and enhancing biological interpretability. This study introduces a novel approach based on shadowed set theory for selecting informative genes from large-scale gene expression data. The proposed Shadowed Set-Based Feature Selection Algorithm (SSFSA) transforms conventional fuzzy membership functions into a three-valued logic structure, allowing effective discrimination between inclusion, exclusion, and uncertain (shadowed) regions. To enhance the selection quality, an entropy-adjusted relevance score is defined, incorporating both uncertainty representation and the information content of features. The method further adapts to dataset variability through an Adaptive Shadowed Set Framework (ASSF), which employs dynamic thresholds and evaluates feature interactions using a Jaccard-like index. Experimental validation using the GSE2990 breast cancer dataset demonstrates the proposed method's superiority over benchmark techniques such as PCA, mRMR, Relief-F, and fuzzy-rough sets. SSFSA achieves the highest classification accuracy, F1-score, and AUC while selecting significantly fewer features. Moreover, biological validation reveals strong relevance of the selected genes to known breast cancer pathways. The results highlight the method's effectiveness in balancing uncertainty, dimensionality reduction, and biological interpretability, offering a powerful solution for robust feature selection in biomedical data mining.

Submissionid	275
Authors	Tina Babu 1 , Rekha R Nair1, Balamurugan Balusamy2, Sumendra Yogarayan3,∗ and A Ezil Sam Leni1
Title	SIEFC: A Hybrid Swarm Intelligence Framework for Fuzzy Clustering of High-Dimensional Healthcare Data
Abstract	This study presents a novel Swarm Intelligence Enhanced Fuzzy Clustering (SIEFC) framework designed to address the challenges of clustering high-dimensional healthcare data. The proposed approach combines traditional Fuzzy C-Means clustering with a hybrid optimization strategy that leverages both Particle Swarm Optimization and Artificial Bee Colony algorithms. Key advances are feature weighting methods that automatically find the test attributes that contribute the most to the classification, robust distance metrics that measure distance in the presence of noise and outlier samples, and a method for using knowledge learned from one swarm intelligence to influence another swarm intelligence. The SIEFC framework was tested on the Wisconsin Diagnostic Breast Cancer dataset, where it was able to sequentially classify benign and malignant breast cancer samples with an accuracy of 94.87%. Overall performance analysis determined that the framework obtained superior results compared to traditional Fuzzy C-Means, Kernel Fuzzy C-Means, and one form of swarm intelligence with multiple validation metrics. An analysis of feature importance provided evidence that perimeter, concavity, and concave points, are related morphological features that were the most iscriminative feature for classifying breast cancer. In addition, the SIEFC had better convergence properties, less dependency on the initial starting position, and better stability over repeated runs. Taken together, all results indicated that hybrid swarm intelligence can be utilized to improve the accuracy, and interpretability of clustering metrics from diagnostic studies in medicine.
Link	https://www.youtube.com/watch?v=0jg7hqsFVX8

Submissionid	225
Authors	Amir Mohammad Moradi 1,* , Roham Osanloo , Arad Tajari , Amir hossein Mansour Kiaee , Shahan Nozari
Title	Smart Energy Management in Homes Using Fuzzy Logic
Abstract	With the rapid growth of energy consumption in residential buildings and the increasing associated costs, optimal energy management has become one of the main necessities in today's world. Traditional energy control methods fail to respond to dynamic changes and environmental uncertainties, while more complex methods like neural networks require extensive training data and heavy processing. Fuzzy logic, as an efficient tool, allows for smart decision-making in uncertain conditions by defining simple linguistic rules and processing vague data. This paper, after reviewing the fundamentals of fuzzy logic and smart home systems, explores the practical application of this method in energy management, designing and implementing a system based on Arduino, analyzing performance results, and comparing it with other existing methods. Results show that fuzzy logic can effectively reduce energy consumption and increase user comfort. In conclusion, the benefits, challenges, and future prospects of developing this approach are discussed.

Submissionid	335
Authors	Vijayalakshmi A1, Shanmugavadivu P2, Vijayalakshmi S3, Sumendra Yogarayan4, Mahmoud Ahmad Al-Khasawneh5, Balamurugan Balusamy6
Title	Smart GIR Cow's Disease Prediction & Supporting System Using Artificial Intelligence
Abstract	The health and productivity of dairy cows are critical factors in sustainable livestock management. Along with the rapid rise in intelligence and technology, applying intelligence in livestock management helps in monitoring and provide precise and effective care for the cattle herd. This research designs an intelligent system that can assist the farmers and predict GIR cows' diseases and a support system powered by Artificial Intelligence (AI). The proposed system integrates Internet of Things (IoT) and sensors to track and monitor critical health parameters of the GIR cow, which includes the step count, lying time, rumination time, heart rate, and various environmental factors contributing to the well-being of the cow. The data points that are gathered from the sensors is then processed and analyzed using Machine Learning (ML) algorithms, including Random Forest (RF), Decision Tree (DT), Logistic Regression, K-Neighbors, and Support Vector Machine (SVM), to predict abnormalities including diseases such as lameness, mastitis, heat stress, and digestive problems. The AI techniques used in the system involve complex data processing and pattern recognition to identify early signs of diseases. The RF and DT ML models achieved the highest accuracy (100%), while SVM demonstrated robust performance with 94% accuracy. Integrating real-time monitoring with predictive analytics enables early detection of health issues, allowing timely interventions and improving overall herd management. The proposed system enhances cow welfare and optimizes farm productivity but also has the potential to revolutionize the dairy industry. The complex intelligent system provides a reliable and efficient platform for disease prediction and herd management, and can significantly contribute to the sustainability and profitability of dairy farming, thereby shaping the future of the industry.

Submissionid	274
Authors	Akey Sungheetha1, Rajesh Sharma R1, Sheila Mahapatra1, Mahmoud Ahmad Al-Khasawneh2⋆, and Balamurugan Balusamy3
Title	SMART-FARM: A Deep Learning-Enhanced IoT Framework for Precision Agriculture with Adaptive Resource Optimization Factor η
Abstract	This paper presents SMART-FARM, an innovative IoT-based precision agriculture framework that integrates deep learning and adaptive resource optimization for sustainable farming. The system employs a novel neural network architecture for real-time crop monitoring and disease detection, achieving a resource optimization factor (η) of 0.89. Our framework addresses critical challenges in agricultural automation by combining CNN-based image processing with distributed IoT sensors for comprehensive environmental monitoring. The system's primary contributions include an adaptive resource allocation mechanism that dynamically adjusts irrigation and fertilization based on crop needs, achieving a 32% reduction in water consumption while maintaining optimal growth conditions. Experimental results demonstrate a 27% improvement in crop disease detection accuracy compared to traditional methods, with the proposed CNN-LSTM hybrid model achieving 93% accuracy under varying field conditions. The integration of edge computing reduces response time to 30 minutes, an 84% improvement over conventional systems. Our framework demonstrates significant potential for enhancing agricultural sustainability and productivity through intelligent automation, particularly in resource-constrained environments where optimization factors are critical.

Submissionid	348
Authors	Vikas Kumar1, Vijayalakshmi S2, Balamurugan Balusamy3, Sumendra Yogarayan4, Mahmoud Ahmad Al-Khasawneh5, Alwin Joseph6
Title	SolFlora: Solar-Powered Smart Pot with Predictive Modeling for Optimal Indoor Plant Care
Abstract	The indoor plant market is in great demand and it was estimated at $19.72 billion in 2023, which is estimated to be valued at $28.84 billion by 2031. The growth rate recorded is a CAGR of 4.87% during the period of forecast. Despite the growing interest in indoor plants, many individuals face problems when caring for their indoor plants. Improper watering, inadequate lighting, and poor humidity contribute to plant failure. Therefore, the application is focused on plant health with the use of IoT, renewable energy, and predictive models. It integrates sensors monitoring the environment in which a plant will thrive; the solar panel provides a source of renewable energy in the form of sustainability. This will predict the best time for the sun to expose, based on the historical data of the sun tracking system. It then finds the position of the sun and adjusts the automatic eye for the control of light for the plants. The approach maximizes sunlight exposure and reduces energy consumption. The experiment results show that the smart flower pot improves the maintenance and sustainability of plants. The proposed system bridges the gap between IoT plant monitoring and renewable energy, leading to sustainable urban applications.

Submissionid	183
Authors	Tarishi Baranwal 1 and A. Akilbasha 2,∗
Title	Solving Fully Fuzzy Rough Interval Integer Transshipment Problems: A New Approach for Efficient Decision-Making
Abstract	hjg This study addresses fully fuzzy rough interval integer transshipment (FRIIT) problems, where triangular fuzzy interval integers—representing unit shipping costs, supply capacities, and destination demands—are transformed into rough interval integers. We propose a novel reverse iterative transshipment method to determine the optimal solution for such problems. Our approach outperforms existing methods, delivering superior and more reliable results while also deriving optimal values for the transformed rough interval integers. To emonstrate the efficacy of our method, we present a numerical example illustrating the optimization process for the FRIIT problem. The proposed solution provides actionable insights for decision-makers, enabling informed and strategic transshipment planning.

Submissionid	331
Authors	Anum Manasseh Terna1, Paul Augustine Ejegwa1, Nasreen Kausar2, and Brikena Vrioni3
Title	Some new q-rung orthopair fuzzy distance techniques and their application to medical Analysis based on decision-making methods
Abstract	In medical diagnostics, accurately assessing the critical nature of patients' conditions is essential for prioritizing care and allocating healthcare resources effectively. Such assessments, however, often involve imprecise, uncertain, and hesitant information, and therefore the traditional methods for decision-making are less effective. To get around these limitations, this study proposes some novel q-rung orthopair fuzzy distance functions to handle the inherent uncertainty of medical information. The novel distance functions enable modeling of imprecise expert opinions and clinical decisions to a better degree, resulting in a stronger and more versatile approach to determining patient's medical condition. The novel distance functions are analyzed based on distance properties, and its superiority over the existing q-rung orthopair fuzzy distance functions is amply demonstrated in terms of discrimination power and robustness. To establish its practical usefulness, the distance functions are applied to a medical decision-making c, where it is compared on a number of patient cases with key clinical indicators such as vital signs, laboratory tests, and symptom severity. Under a rigorous decision-making methodology, the patients are ranked according to the severity of their conditions, with the most critical case accurately identified. A comparative analysis demonstrates the superiority of the suggested method over other existing methods of distance functions, thereby making it a valuable addition to clinical decision support systems.

Submissionid	101
Authors	S. Hoskova-Mayerova1 and M. Al Tahan 2,_
Title	Some properties of antiideals and bi-antiideals of semigroups
Abstract	In 1953 Schwarz published his paper "On maximal ideals in the theory of semigroups" where he bring into being the antiideal theory by introducing the concept of antiideals, which has proven to be valuable in the analysis of semigroup structures. Based on this foundation, we will delve deeper into the topic of conducting a comprehensive investigation of anti-ideals and introducing a new concept of bi-anti-ideals.

Submissionid	187
Authors	Keerthika R 1 , Nandhini C*
Title	Some Statistical Tools on Intuitionistic Fuzzy Threshold Hypergraphs
Abstract	This paper explores the intersection of intuitionistic fuzzy threshold numbers, random variables and statistical measures within the domain of intuitionistic fuzzy threshold hypergraphs. Intuitionistic fuzzy sets provide a flexible framework for handling uncertainty and imprecision, while threshold hypergraphs offer a powerful representation of relationships in complex systems. This study focuses into the characterization of intuitionistic fuzzy threshold numbers and their impact on random variables, examining the statistical properties of hypergraph-based structures. Additionally, the investigation extends to the computation of statistical measures, including mean, geometric mean, harmonic mean, median, mode and weighted mean, within the intuitionistic fuzzy threshold hypergraph context. The results contribute to a deeper understanding of the interplay between uncertainty, randomness and statistical analysis in complex systems modeled by Intuitionistic Fuzzy Threshold Hypergraphs(IFTHGs), offering insights with potential applications in diverse fields such as decision-making, optimization and risk assessment.

Submissionid	290
Authors	R. BUVANESWARI1, S. SARANYA 2 §
Title	SPLITTING OPERATION ON FUZZY GRAPHIC MATROID
Abstract	The generalization of the splitting operation to fuzzy graphic ma- troids is analogous to fuzzy graphs where a membership value is assigned to each edge. The concept of a splitting operation on fuzzy graphic matroids is explored. The splitting operation on fuzzy graphic matroids is defined, and the properties related to the fundamental bases and circuits of G(_, μ,M) are analysed.

Submissionid	338
Authors	Anu Sayal1, Amar Johri2, Ashfaque Ahmed3 ; Neha Tyagi4, Balamurugan Balusamy5, Sumendra Yogarayan6, Alavikunhu Panthakkan7
Title	Strategic Inventory Management and Optimization Under Economic Uncertainty: A Fuzzy and Crisp Modelling Framework
Abstract	Analysing the existing situation, there's big financial instability. The effect of economic instability and inflation can be in inventory systems. There is a huge rise in the price of the products which has in addition aggravated to a depreciation in the value of commodities. Stock forms the backbone of trading and manufacturing commercial enterprise agencies and constitutes a huge capital investment. Consequently, it could be totally unprincipled if the end result of inflation together with time worth of cash isn't always considered. The impact of degradation is substantial on any system of stock. The shortages can be of the form wherein they're partially backlogged or maybe partly lost as a result of put off in renewal of orders that are under consideration. For the transition of lost income into income, the vendor usually provides a kind of incentive to consumers by charging a rate from them that is like the time of insertion of the order in preference to the existing value of the product because of the effect of inflation. All such situations have been as it should be considered inside the studies and a stock system is advanced under these conditions for both crisp and fuzzy environments. The primary goal the of research is to determine and examine the entire revenue for both crisp in conjunction with fuzzy gadgets. From this study, we determine that the overall income generated via the fuzzy system is sixty-two percent more than the crisp system which proves the authenticity of the work.

Submissionid	107
Authors	Janardan Behera1 and Bidyadhara Bishi2,∗
Title	Sustainable Inventory Systems: A Carbon-Inclusive Analytical Approach for Emission-Sensitive Logistics
Abstract	Greater pressure towards environmental sustainability has forced academics and supply chain managers to revisit conventional inventory models by including carbon emissions as a key decision criterion. This paper introduces a new inventory optimization framework that includes carbon estimates whose purpose is to minimize total costs covering ordering, holding, and carbon emissions costs in emission-constrained logistics environments. The proposed model includes emission penalties and regulation schemes like carbon caps into a basic inventory system, thus ensuring environmentally friendly replenishment processes. Deterministic and stochastic demand scenarios are considered, and the model is compared under different carbon regulation schemes. Theoretical findings are corroborated by a large-scale numerical example and sensitivity analysis and highlight cost vs. environmental trade-off. The results provide logistics managers practical guidance on how to reconcile operational performance and carbon savings and thereby contribute to the general sustainable supply chain management debate.

Submissionid	271
Authors	Rajesh Sharma R1, Akey Sungheetha1, Sheila Mahapatra1, Mahmoud Ahmad Al-Khasawneh2,∗, Priestly Shan1 and Balamurugan Balusamy3
Title	SUVS: Smart Underwater Vision System with Adaptive Deep Learning for Marine Ecosystem Monitoring
Abstract	This paper presents SUVS (Smart Underwater Vision System), an innovative underwater monitoring system that leverages adaptive deep learning for real-time marine ecosystem analysis. The system addresses fundamental challenges in underwater image processing including variable lighting conditions, turbidity, and color distortion through a novel multi-stage enhancement pipeline. Our methodology integrates a modified Swin Transformer architecture with an underwater-optimized attention mechanism, achieving a mean average precision (mAP) of 92.3% in species recognition across varying underwater conditions, outperforming conventional approaches by 15.0%. Experimental results demonstrate that SUVS processes underwater imagery 1.8 times faster than state-of-the-art methods while reducing power consumption by 40%, making it particularly suitable for prolonged deployment in marine environments. The system's adaptive pre-processing pipeline dynamically adjusts to changing underwater conditions, resulting in enhanced detection reliability (94.6% in high turbidity) and improved classification accuracy for rare species (87.2%), addressing critical requirements for comprehensive marine ecosystem monitoring and conservation.

Submissionid	188
Authors	Keerthika R 1,* , Myithili K K
Title	Task Completion and Allocation of Task Assignment to Multi-Tasking Robots using IFk-PHG
Abstract	An extension of a graph in which hyperedges can join subsets of vertices instead of simply pairs is called a hypergraph. The edges in a hypergraph are arbitrary, non-empty sets of vertices. Similar to traditional graphs, hypergraphs facilitate higher-order interactions in communication and social networks. In this paper, we explore the structural properties of Intuitionistic Fuzzy k-partite Hypergraphs (IFk-PHGs). Specifically, we analyze the lower and upper truncation of IFk-PHG, as well as different types of intersections, including intersecting IFk-PHG, K-intersecting IFk-PHG and strongly intersecting IFk-PHG. Furthermore, As long as an IFk-PHG is K-intersecting, we can conclude that it is strongly intersecting. A multi-tasking robot is a type of robotic system that is capable of performing multiple tasks or functions without the need for manual intervention or reprogramming between tasks. These robots are designed to be skilled and flexible allowing them to switch between different tasks seamlessly. Intuitionistic Fuzzy parameters enable flexible, advanced representation of multi-tasking robot systems, guiding decision-making processes like task allocation, task completion and coordination in uncertain situations addressing uncertainty in robot capabilities and task suitability. This work proposes how task is allocated to robots using IFk-PHG and which robot can complete the task quickly. The task completion of the robots can be done using score function formula.

Submissionid	113
Authors	S. A. Adebisi1 _, M. OGIUGO 2 , M. ENIOLUWAFE 3
Title	The computational results of fuzzy subgroups of nilpotent finite (p-groups) involving multiple sums
Abstract	The theory of fuzzy sets has a wide range of applications, one of which is that of fuzzy groups. Part of its applications is to provide formalized tools for dealing with the imprecision intrinsic to many problems. Denote the number of chains of subgroups of a finite group G which ends in G by h(G). The method of computing h(G) is based on the application of the Inclusion-Exclusion Principle. In this context , h(G) is actually referred to as the number of district fuzzy subgroups for the finite nilpotent p-group. This work is therefore designed as part to classify the nilpotent groups formed from the Cartesian products of p-groups through their computations. In this paper, the Cartesian products of p-groups were taken to obtain nilpotent groups. the explicit formulae is given for the number of distinct fuzzy subgroups of the Cartesian product of the dihedral group of order eight with a cyclic group of order of an n power of two for, which n is not less than three .

Submissionid	146
Authors	S. A. ADEBISI1 , M. OGIUGO 2 & M. ENIOLUWAFE2
Title	THE COMPUTATIONAL SUBGROUPS FOR THE FINITE FUZZY NILPOTENT GROUPS INVOLVING INDETERMINATES(VARYING)m; n
Abstract	This theory of fuzzy sets has a wide range of applications, one of which is that of fuzzy groups . The Fuzzy sets were actually been introduced by Zadeh. Even though, the story of Fuzzy logic started much earlier, it was specially designed mathematically to represent uncertainty and vagueness. It was also, to provide formalized tools for dealing with the imprecision intrinsic to many problems. The term fuzzy logic is generic as it can be used to describe the likes of fuzzy arithmetic, fuzzy mathematical programming, fuzzy topol- ogy, fuzzy graph theory and fuzzy data analysis which are customarily called fuzzy set theory. A group is nilpotent if it has a normal series of a _nite length n: By this notion, every _nite p-group is nilpotent. The nilpotence property is an hereditary one. Thus, every _nite p-group possesses certain remarkable characteristics. In this paper, the explicit formulae is given for the number of distinct fuzzy subgroups of the Cartesian product of the dihedral group of order eight with a cyclic group of order of an m power of two for, which m is not less than three .

Submissionid	150
Authors	Zakrya Barakat
Title	The Fuzzy Action of Group on a Set
Abstract	In this paper, The notion of a fuzzy action of a group on a set is introduced the, and showed how it generalizes the classical (crisp) group action. After defining fuzzy analogues of standard concepts - such as the trivial action, the conjugation action, and the orbit of an element – we develop the theory of fuzzy correspondences and demonstrate their compatibility with fuzzy group actions.

Submissionid	139
Authors	Campbell, Oluwakorede Joseph1 , Sunday Adesina Adebisi 2*
Title	The projection and utilization of neutrosophic algebra for decision-making processes
Abstract	Neutrosophic algebra is an emerging field that extends classical algebra by incorporating the concept of neutrosophy, which deals with the study of indeterminacy. This work projects the theoretical foundations of neutrosophic algebra and its applications to decision-making in areas of importance. By leveraging several neutrosophic principles, which introduces the notion of truth, falsehood, and indeterminacy simultaneously, neutrosophic algebra offers a robust framework for addressing problems in various domains where uncertainty, ambiguity, and incomplete information prevail.

Submissionid	293
Authors	N. Subashini1,* , R. Priyadharshini2
Title	THEOREM OF FIXED POINTS IN FUZZY 3-METRIC SPACE
Abstract	In this paper we prove a common fixed point theorem for three mappings in fuzzy metric space, fuzzy 2

Submissionid	184
Authors	Phi-Hung Nguyen 1* , Lan-Anh Thi Nguyen1 , Hong-Quan Le 2 , Tra-Giang Vu 1, Thu-Hoai Thi Nguyen 1 and Huong-Giang Le Hoang 1
Title	Towards Sustainable Tourism: Utilizing Fuzzy AHP-TOPSIS Approach for Green Hotel Selection
Abstract	In recent years, the green hotel market in Belize has experienced notable growth due to the rising adoption of eco-friendly practices and increased environmental consciousness among customers. Despite being an emerging concept in Belize, green hotels play a pivotal role in fostering a green lifestyle and raising environmental awareness among the population. This study focuses on understanding factors influencing customers' intent to choose green hotels in Belize, presenting a consumer-oriented model for assessing hotels' green scores. Through an extensive literature review, 50 critical indicators were identified and grouped into nine key aspects as crucial attributes for selecting green hotels. The proposed model utilizes the fuzzy AHP to determine criteria weights and the fuzzy TOPSIS to calculate green scores and rankings. The fuzzy Delphi method is incorporated for survey response analysis, distilling 50 indicators down to the most critical 40 factors grouped into nine key aspects for selecting green hotels. Results highlight "Social Responsibility and Communication" as the most critical dimension. Comparative analyses with fuzzy COPRAS and fuzzy VIKOR validate the findings, contributing significantly to Belize's sustainability, ecotourism, and green hotel selection. The study offers valuable insights for businesses and marketers to formulate effective strategies, providing constructive solutions and directions for future sustainability and green tourism research.

Submissionid	116
Authors	SHAKILA V
Title	TRIPOLAR FUZZY IDEALS IN CV-ALGEBRA
Abstract	

Submissionid	74
Authors	Nivetha Martin1, Priya,R2, Singh,P.K3 , Ramila Gandhi,N4
Title	Turiyam Cognitive Maps in Optimal Industrial Decisioning
Abstract	Cognitive maps are primarily directed graph structures relating the causal factors of the problem. The extension of cognitive maps using different representations describing the intensity of causal relationship are explored. This research work proposes Turiyam Cognitive Map (TCM) model, a new genre of cognitive maps using turiyam set representations. Turiyam sets are characterized as fourth dimension of cognition comprising the values of truth, uncertainty, indeterminacy and liberalization. The applications of turiyam sets are explored in the arena of decision making and this work integrates turiyam sets in evolving cognitive models to design optimal solutions to the decisioning problem of production strategy in a sustainable manufacturing plant. The proposed turiyam cognitive model is a novel approach as it handles four dimensions of data and the inclusion of liberalism adds more value to the pragmatic representation of data.

Submissionid	124
Authors	Nivetha Martin1, Singh,P.K2
Title	TURIYAM TOPSIS IN MULTI-CRITERIA DECISION MAKING
Abstract	Decision making is an inevitable process embedded into managerial framework of everybusiness entity. It create issue when consciousness of each expert differ for the same entity while decision making. To solve this issue current paper utilizes the properties of Turiyam set in this paper. Same time this research work proposes a new genre of multi-criteria decision making method of TOPSIS (Technique for Order Preference by Similarity to an Ideal Solution) based on Turiyam sets. The proposed Turiyam TOPSIS decisioning method with the inclusion of the component of liberalism is an extension of neutrosophic TOPSIS. The newly developed method is substantiated with the decision-making problem of selecting an optimum cloud service provider for a company. The results obtained using Turiyam based TOPSIS are compared to demonstrate the efficacy of the proposed approach. Turiyam integrated methodhas enhanced accuracy with the limitation of computational complexity.

Submissionid	80
Authors	Dr Pranjal Talukdar
Title	Uncertainty Modeling Through Similarity Measure Under Intuitionistic Fuzzy Environment and Its Application in Decision Making Problems
Abstract	The similarity measure (SM) between two intuitionistic fuzzy sets (IFSs) plays a critical role in navigating uncertainty in various decision-making contexts, including medical diagnosis, pattern recognition, and criminal investigations. This measure indicates how alike two IFSs are, emphasizing their accuracy. It's crucial to employ an effective SM in decision-making, especially in uncertain settings, since flaws in these measures can lead to erroneous conclusions. This research presents a novel SM for IFSs, aimed at enhancing the accuracy of decision-making outcomes. The new SM generates similarity values for different pairs of IFSs, demonstrating advantages and efficiencies over existing measures, which often produce contradictory results. The applicability of this measure spans various fields, including medical diagnosis and criminal investigations. A comparative analysis shows that the proposed SM effectively addresses previous limitations, as many existing SMs produce identical similarity values for distinct IFS pairs, compromising their precision. As a result, the suggested SM establishes its significance and effectiveness by providing improved solutions to decision-making challenges. This research aims to contribute an advanced SM for IFSs, thereby refining multi-criteria decision-making (MCDM) methods through a more nuanced approach.

Submissionid	77
Authors	Dr. Pranjal Talukdar
Title	Uncertainty Modeling Through Similarity Measure Under Intuitionistic Fuzzy Environment and Its Application in Decision Making Problems
Abstract	The similarity measure (SM) between two intuitionistic fuzzy sets (IFSs) is a vital instrument in addressing uncertainty in various decision-making scenarios, such as medical diagnosis, pattern recognition, and criminal investigations. The SM indicates the degree of similarity between two IFSs, highlighting their exactness. It is essential to utilize an effective SM in decision-making, particularly in uncertain environments, as inadequacies in these measures can lead to incorrect conclusions. This study introduces a novel SM for IFSs aimed at improving the accuracy of outcomes in decision-making problems. The proposed SM yields similarity values for various pairs of IFSs, showcasing its advantages and efficiency compared to existing SMs that often deliver contradictory results. Moreover, this new measure has been applied to various fields, including medical diagnosis and criminal investigations, demonstrating its practical applicability. The comparative analysis reveals that the proposed SM effectively overcomes previous shortcomings, as many existing SMs yield the same similarity values for different IFS pairs, which undermines their precision. Consequently, our suggested SM proves its relevance and effectiveness by providing better options for addressing decision-making challenges. Thus, this research endeavors to offer an advanced SM for IFSs, enhancing multi-criteria decision-making (MCDM) methods through a more sophisticated approach.

Submissionid	284
Authors	Mano Shankari J 1 , Tina Babu 1, Rekha R Nair 1, Kumar Rajamani 2, Balamurugan Balusamy 3 and Sumendra Yogarayan 4,∗
Title	Underwater Fish Detection using Type-2 Fuzzy and Rough Sets for Improved Bounding Box Reliability in Turbid Environments
Abstract	The study introduces a robust post-processing framework for enhancing fish detection in underwater with the integration of YOLOv8 object detection alongside Type-2 fuzzy logic and Rough Set Theory. Underwater environments are inherently challenging due to issues such as turbidity, low contrast, and light distortion, which degrade detection performance. The proposed method enhances bounding box reliability by computing a fuzzy reliability score based on extracted visual features, including area, brightness, and sharpness. Type-2 fuzzy logic handles inherent uncertainties in detection quality, while Rough Set Theory performs feature reduction to simplify the fuzzy rule base without compromising accuracy. Experimental results on a YOLO-annotated Underwater Fish Dataset shows improved performance metrics with Precision 87.2% and mAP@0.5 as 0.942. This approach reduces false positives while maintaining reliable detections thus making it an excellent solution for turbid underwater environments.

Submissionid	340
Authors	Qian Su1 (https://orcid.org/0000-0001-8382-5398), Ibrahim Badi2 (https://orcid.org/0000-0002-1193-1578), Mouhamed Bayane Bouraima3*(https://orcid.org/0000-0002-5801-884X)
Title	Unlocking Growth in African Freight Forwarding: Tackling Key Challenges through Multi-Criteria Decision-Making
Abstract	This study investigated the major challenges limiting the growth of freight forwarding in Africa. Through an in-depth literature review and engagement with industry experts, five key challenges were identified. The Fermatean Fuzzy Stepwise Weight Assessment Ratio Analysis (FF-SWARA) method was employed to prioritize these challenges based on their critical severity. The findings indicate that infrastructure constraints and inefficiencies in customs and regulatory systems are the most significant barriers to advancing the sector. The findings call for improved transport infrastructure and streamlined customs processes to boost freight forwarding efficiency and support Africa's regional trade and growth.

Submissionid	327
Authors	Prof. Dr. Haripriya H. Kulkarni
Title	Utilizing Fuzzy Graphs for Smart Grid Optimization and Energy Distribution
Abstract	

Submissionid	220
Authors	Yu-Ru Syau 1 and En-Bing Lin 2,∗
Title	Variable Precision Fuzzy Rough Sets
Abstract	We present variable precision fuzzy rough set approach to analyze incomplete decision tables. We show how to determine the discernibility threshold for a reflexive relational decision system in the variable precision fuzzy rough set. We also present an example to illustrate our main result.

Submissionid	136
Authors	Mohanapriya E∗, Dr. T.T. Mirnalinee†
Title	VIDEO CLASS-INCREMENTAL LEARNING FOR ACTION RECOGNITION
Abstract	In the domain of video-based action recognition, overcoming catastrophic forgetting while continuously learning new classes remains a major challenge. We propose a video class-incremental learning (VCIL) framework that addresses this issue by employing a teacher-student knowledge distillation strategy. Our approach leverages both response-based distillation, which aligns the student model's predictions with the teacher's softened outputs, and feature-based distillation, which ensures the student retains internal feature representations learned by the teacher. With the UCF101 action recognition dataset and a 3D ResNet backbone, our approach extracts spatiotemporal features to robustly recognize actions in multiple incremental steps. Our model is tested with various settings (10×5, 5×10, 2×25) and has high accuracy for retaining knowledge of past classes and learning new classes. The results show that our approach is efficient in preventing forgetting and retaining high performance on new tasks. Index Terms—Incremental Learning, Action Recognition, Knowledge Distillation, Deep Learning.

Submissionid	121
Authors	Ibrahim, Badi 1,* , Mouhamed Bayane, Bouraima
Title	Weak Domestic Production and Its Impact on Freight Transport Demand: A Fuzzy MCDM Analysis
Abstract	Freight transport systems rely heavily on the volume, frequency, and spatial distribution of goods generated by domestic production activities. In Libya, however, weak industrial output and underdeveloped manufacturing capacity have significantly limited freight demand, resulting in fragmented transport flows and underutilized logistics infrastructure. This study investigates the root causes of weak domestic production and their broader implications for freight transport development. Using the Fuzzy Simple Weight Calculation (F-SEWIC) method, seven critical factors were evaluated: lack of industrial infrastructure, political instability, weak investment climate, poor transportation and logistics, low labor productivity, dependence on imports, and unstable regulatory and legal frameworks. Expert assessments were collected from four specialists in economics and industrial development, using a fuzzy linguistic scale to reflect the uncertainty inherent in such judgments. The results show that weak investment climate, political instability, and institutional barriers are the most significant constraints on production—factors that indirectly suppress freight volumes, limit the formation of industrial supply chains, and hinder the development of efficient transport corridors. By identifying and prioritizing these constraints, this study highlights the foundational role of domestic production in shaping national freight transport strategies and offers actionable insights for aligning industrial policy with infrastructure planning in Libya.

Submissionid	286
Authors	Tejaswi S 1 , Tina Babu 1, Rekha R Nair 1, Kumar Rajamani 2, Balamurugan Balusami 3 and Sumendra Yogarayan 4
Title	YOLOv8 Dual Stage: A Robust Two-Stage Framework for Vehicle and License Plate Detection Under Adverse Conditions
Abstract	Detecting vehicles and their license plates is a critical task for traffic surveillance and intelligent transportation systems, but achieving high accuracy under adverse conditions (such as nighttime lighting, glare, or fog) remains challenging. In this paper, we present YOLOv8 Dual Stage, a robust two-stage framework designed to address these challenges by leveraging the state-of-the-art YOLOv8 object detector in a cascaded manner. The first stage uses YOLOv8 to reliably detect vehicles in the entire image, providing regions of interest for the second stage. In the second stage, each detected vehicle region is processed to locate the license plate, with tailored enhancements (e.g., brightness adjustments for dark images) and class-specific detection thresholds to improve small object detection. Evaluated on a diverse real-world dataset spanning varied illumination conditions, the proposed two-stage approach significantly outperforms a conventional one-stage YOLO model and the older YOLOv3 baseline in both vehicle and license plate detection. In particular, the YOLOv8-Dual Stage performs around 92% mAP for vehicles, and 91% license plate detection accuracy, which is notably better than about 78% and 68% for vehicle and license plate detection of the single stage YOLOv8, respectively. That boost in performance carries a small price in terms of computational cost since the system remains almost real time (10 FPS on 1280×720 images with a single GPU). Overall, the YOLOv8-Dual Stage framework provides an optimal solution for the robust vehicle and license plate detection under challenging conditions for the purpose of, for instance, automatic license plate recognition and traffic monitoring in adverse environments.