# ICISCM

## Proceedings of

# International Conference on Intelligent Systems and Computational Methods


ICISCM

CONFERENCE **10-07-2024**

# International Conference on Intelligent Systems and Computational Methods (ICISCM)

# CONFERENCE PROCEEDINGS

# About the Conference

The **International Conference on Intelligent Systems and Computational Methods (ICISCM 2024)** is a premier global forum dedicated to advancing the state-of-the-art in data-driven and computational technologies. Hosted in Jakarta, Indonesia, the conference aims to bring together leading academics, researchers, and industry experts to foster interdisciplinary collaboration and accelerate innovations in intelligent systems and smart computing solutions.

**ICISCM 2024** provides a vibrant platform to explore emerging challenges, novel solutions, and future directions in diverse domains including artificial intelligence (AI), machine learning (ML), Internet of Things (IoT), edge and fog computing, cybersecurity, data analytics, and high-performance computing. By uniting expertise from multiple fields, the conference encourages cross-disciplinary dialogue, enabling participants to address complex, real-world problems with holistic approaches.

The conference highlights cutting-edge research breakthroughs, practical applications, and industrial innovations in areas such as optimization, automation, soft computing, and advanced data science. It serves as a bridge between academia and industry, promoting the exchange of ideas and collaboration that translate theoretical insights into impactful solutions.

Through keynote speeches, technical sessions, workshops, and interactive discussions, ICISCM 2024 fosters meaningful engagement and knowledge sharing among participants. Select high-quality papers presented at the conference will be recommended for publication in indexed international journals, further extending the reach and impact of the research.

With a focus on interdisciplinary collaboration, knowledge exchange, and real-world impact, **ICISCM 2024** is committed to driving the development of smart, adaptive, and efficient technologies that shape the future of intelligent systems and computational methods.

# Scope of the Conference

The **International Conference on Intelligent Systems and Computational Methods (ICISCM)** provides a dynamic and inclusive platform to foster interdisciplinary collaboration and advance the frontiers of data-driven technologies. The conference brings together researchers, academicians, industry experts, and policymakers to address contemporary challenges, share innovative solutions, and discuss emerging trends in fields such as artificial intelligence, machine learning, Internet of Things (IoT), edge and fog computing, cybersecurity, and data analytics. **ICISCM** aims to facilitate the exchange of knowledge and ideas that drive innovation and shape the future of intelligent systems.

The conference emphasizes the integration of multiple disciplines to solve complex real-world problems and encourages research that bridges theoretical advancements with practical implementation. Participants present novel algorithms, system designs, computational strategies, and case studies that enhance intelligent, adaptive, and high-efficiency systems. **ICISCM** also explores emerging topics such as predictive analytics, autonomous decision-making, smart automation, and intelligent infrastructures, offering valuable insights into how computational technologies can transform industries, services, and societal processes.

Through structured sessions, workshops, panel discussions, and networking opportunities, **ICISCM** promotes collaboration between academia and industry, enabling meaningful partnerships and knowledge transfer. The conference serves as a global forum for presenting high-quality research, fostering innovation, and inspiring future advancements. By bringing together experts from across the world, **ICISCM** supports the development of scalable, robust, and impactful intelligent systems capable of addressing the evolving demands of modern applications and contributing to societal progress.

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## ABSTRACT

The integration of deep learning in clinical decision support systems (CDSS) holds transformative potential in modern healthcare, particularly in diagnosis, risk assessment, and treatment planning. However, the opacity of deep learning models remains a barrier to clinical adoption, as healthcare professionals require transparent and explainable outputs to ensure trust and accountability. This paper presents a framework for designing interpretable deep learning models tailored specifically for clinical contexts. By incorporating attention mechanisms, layer-wise relevance propagation, and model-agnostic interpretation techniques such as SHAP and LIME, the proposed system enhances both the transparency and the diagnostic accuracy of clinical recommendations. The approach is evaluated on multiple healthcare datasets, including electronic health records and medical imaging, to assess its generalizability across data types. Experimental results demonstrate that the interpretable models achieve performance levels comparable to or exceeding black-box models while providing clear insights into the reasoning behind each prediction. Furthermore, usability testing with clinicians reveals improved user confidence and greater willingness to rely on model outputs when explanations are provided alongside predictions. The study also emphasizes the importance of contextualizing interpretability methods within clinical workflows, ensuring that explanations align with medical reasoning processes. This research contributes a scalable and clinically relevant methodology for embedding interpretability into deep learning architectures, thereby supporting safe, effective, and ethical use of AI in healthcare environments.

**Keywords**: deep learning, interpretability, clinical decision support, explainable AI, healthcare analytics

**ICISCM2024-947**

# INTEGRATING HUMAN-CENTERED EXPLANATIONS IN AI MODELS FOR FINANCIAL RISK ASSESSMENT

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## ABSTRACT

As artificial intelligence continues to influence financial risk assessment, the demand for models that not only perform accurately but also provide transparent and understandable explanations has become increasingly critical. This paper proposes a framework for integrating human-centered explanations into AI models used for financial risk assessment, ensuring that stakeholders, including analysts, regulators, and clients, can comprehend, validate, and trust the system's outputs. The methodology combines advanced predictive modeling techniques such as gradient boosting and neural networks with post-hoc explainability tools like SHAP (Shapley Additive Explanations) and counterfactual reasoning. The design process incorporates user feedback from financial professionals to ensure that the generated explanations align with domain-specific expectations and decision-making practices. A comprehensive evaluation is conducted using real-world datasets from the banking and insurance sectors to measure both predictive accuracy and explanation quality. Results indicate that human-centered explanations significantly improve user trust and model adoption without compromising performance. Additionally, scenario-based testing reveals that explanations tailored to the end user's perspective enhance interpretability across varying levels of financial literacy. The study underscores the importance of aligning AI behavior with human reasoning, particularly in high-stakes financial environments where interpretability is essential for regulatory compliance and ethical accountability. By bridging technical explainability with practical relevance, this work advances the development of AI systems that are not only powerful but also responsible and user-aware.

**Keywords:** explainable AI, financial risk, human-centered design, model transparency, user trust

**ICISCM2024-991**

# DISTRIBUTED FREQUENT PATTERN MINING USING MAPREDUCE FRAMEWORK FOR LARGE-SCALE RETAIL DATA

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## ABSTRACT

Frequent pattern mining plays a crucial role in discovering meaningful associations and correlations among items in large-scale retail datasets. However, traditional data mining techniques face significant scalability issues when applied to massive volumes of transactional data generated by modern retail systems. This paper proposes a distributed approach for frequent pattern mining using the MapReduce framework to efficiently process and analyze large-scale retail data. The methodology involves the parallel implementation of the FP-Growth algorithm, optimized for the MapReduce paradigm to ensure balanced workload distribution and reduced computation time. Large transactional datasets are partitioned across multiple nodes in a distributed computing environment, where local frequent patterns are mined in parallel and then aggregated to form global patterns. The proposed solution is evaluated using synthetic and real-world retail datasets, demonstrating substantial improvements in execution time and scalability when compared to traditional single-node implementations. Experimental results indicate that the system maintains high accuracy in pattern detection while significantly reducing runtime, particularly for datasets exceeding hundreds of gigabytes in size. Moreover, the approach exhibits robust fault tolerance and adaptability to growing data volumes, making it suitable for deployment in cloud-based retail analytics platforms. The research highlights the effectiveness of combining classical data mining algorithms with modern distributed computing techniques to meet the demands of big data environments in the retail sector.

**Keywords:** frequent pattern mining, MapReduce, retail analytics, distributed computing, big data

**ICISCM2024-845**

# SEMANTIC SEGMENTATION USING DEEP NEURAL NETWORKS FOR SCENE INTERPRETATION IN OFF-ROAD ROBOTICS

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## ABSTRACT

Scene interpretation in off-road robotics presents significant challenges due to unstructured terrain, variable lighting, and environmental complexity. This paper proposes a deep learning-based semantic segmentation framework tailored to enhance scene understanding for autonomous navigation in off-road environments. The approach employs a fully convolutional neural network (FCN) architecture augmented with encoder-decoder modules and skip connections to accurately classify each pixel into semantic categories such as vegetation, ground, rocks, water, and obstacles. To improve generalization across diverse terrains, a dataset composed of annotated off-road scenes under varying weather and terrain conditions is constructed, and data augmentation techniques are applied. Pretrained backbone networks such as ResNet and MobileNet are fine-tuned to accelerate convergence and boost segmentation accuracy. Experimental evaluations are conducted on benchmark and custom datasets, demonstrating that the proposed model achieves high intersection-over-union (IoU) scores across critical object classes, with robust performance in low-visibility conditions. The output of the segmentation model is integrated with a navigation stack to enable real-time path planning and terrain assessment for unmanned ground vehicles. The system also incorporates a confidence estimation module to handle uncertain predictions and inform safety decisions. Results from real-world field trials show that the proposed approach enhances environmental awareness and operational reliability, enabling more autonomous and resilient robotic systems in off-road applications such as agriculture, search and rescue, and defense.

**Keywords:** semantic segmentation, off-road robotics, scene interpretation, deep learning, autonomous navigation

**ICISCM2024-805**

# MULTI-MODAL SCENE ANALYSIS FOR AUTONOMOUS NAVIGATION IN COMPLEX OUTDOOR ENVIRONMENTS


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## ABSTRACT

Autonomous navigation in complex outdoor environments requires robust perception systems capable of understanding diverse, dynamic, and unstructured surroundings. This paper presents a multi-modal scene analysis framework that integrates visual, LiDAR, and thermal data to enhance environmental understanding and navigation reliability in outdoor settings. The proposed system fuses complementary data modalities using a deep learning architecture that leverages convolutional and attention-based fusion layers to extract and integrate spatial and semantic features across sensors. Visual data provides rich texture and color information, LiDAR offers precise depth and shape measurements, and thermal imaging contributes additional contrast in low-light or occluded scenarios. The fusion network is trained on a composite dataset comprising urban, forested, and off-road terrains, with diverse conditions such as varying illumination, weather, and cluttered environments. Experimental results demonstrate improved object detection, terrain classification, and obstacle recognition accuracy compared to unimodal systems. The multi-modal output is used to generate real-time semantic maps and safe path predictions, integrated into a navigation stack for autonomous ground vehicles. Performance metrics, including classification accuracy, inference speed, and robustness under sensor degradation, are evaluated. Results from real-world field deployments confirm the system's ability to navigate safely and adaptively through heterogeneous environments. This study highlights the importance of sensor diversity and deep fusion in advancing reliable autonomous navigation and establishes a scalable approach for future intelligent robotic platforms.


**Keywords:** multi-modal perception, autonomous navigation, scene analysis, sensor fusion, deep learning

ICISCM2024-485

# ADAPTIVE POLICY LEARNING FOR AUTONOMOUS AGENTS IN NON-STATIONARY ENVIRONMENTS

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## ABSTRACT

Autonomous agents operating in real-world settings often encounter non-stationary environments, where dynamics, goals, or reward structures evolve over time. Traditional reinforcement learning approaches, which assume fixed environments, struggle to maintain optimal performance in such changing conditions. This paper introduces an adaptive policy learning framework that enables agents to detect, respond to, and learn from environmental shifts during deployment. The proposed method combines meta-learning and continual learning strategies with policy gradient reinforcement learning to create agents capable of online adaptation. An environment change detection mechanism is integrated using statistical divergence metrics and performance feedback, allowing the agent to trigger adaptation routines only when significant shifts are identified. To prevent catastrophic forgetting of previously learned knowledge, experience replay and regularization techniques are employed. Experimental validation is conducted across a series of benchmark tasks, including dynamic grid worlds, variable-goal navigation, and adversarial pursuit-evasion scenarios, simulating real-world non-stationarity. Results show that agents using adaptive policy learning maintain higher cumulative rewards, exhibit faster recovery after environmental changes, and generalize better across unseen variations compared to baseline reinforcement learning models. The study also explores policy reuse and transfer mechanisms to accelerate adaptation across task families. This research demonstrates the importance of flexibility in learning architectures and offers a scalable approach for developing autonomous agents that remain competent and resilient in unpredictable and evolving operational contexts.

**Keywords:** reinforcement learning, adaptive policy, non-stationary environments, autonomous agents, continual learning

**ICISCM2024-657**

# DEEP REINFORCEMENT LEARNING FOR REAL-TIME DECISION MAKING IN DYNAMIC TRAFFIC SYSTEMS

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## ABSTRACT

Managing dynamic traffic systems in real time requires intelligent control strategies that can adapt to fluctuating traffic conditions, varying driver behavior, and unforeseen disruptions. Traditional rule-based and model-driven traffic control methods often lack the flexibility and scalability needed for such complex, non-linear environments. This paper presents a deep reinforcement learning (DRL) framework designed to optimize real-time decision making in dynamic traffic systems. The proposed approach models intersections and traffic networks as Markov Decision Processes (MDPs), where an agent learns optimal control policies through interactions with the environment. A deep Q-network (DQN) and a Proximal Policy Optimization (PPO) algorithm are implemented to train the agent to minimize traffic congestion, reduce vehicle wait times, and improve overall traffic throughput. The system is trained and validated on both simulated traffic environments and real-world traffic datasets, incorporating vehicle flow, signal timing, pedestrian presence, and accident conditions. Results demonstrate significant improvements in metrics such as average travel time and intersection efficiency compared to conventional fixed-timing and adaptive signal control strategies. The model also shows strong generalization capabilities across various traffic volumes and network layouts. In addition, the framework supports multi-agent coordination to handle large-scale traffic systems involving multiple intersections. This study demonstrates the potential of DRL to enable intelligent, data-driven traffic control systems that enhance urban mobility, reduce emissions, and support the development of smart cities.

**Keywords:** deep reinforcement learning, traffic systems, real-time decision making, intelligent transportation, adaptive control

**ICISCM2024-205**

# GENETIC ALGORITHM-BASED OPTIMIZATION FOR MULTI-OBJECTIVE JOB SHOP SCHEDULING


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## ABSTRACT

Job shop scheduling is a classical optimization problem widely encountered in manufacturing and production systems, where multiple jobs with specific operations must be processed on distinct machines with constraints on order and timing. Solving this problem efficiently becomes even more challenging when considering multiple conflicting objectives such as minimizing makespan, reducing machine idle time, and balancing workload. This paper presents a genetic algorithm (GA)-based optimization framework designed to address the multi-objective nature of job shop scheduling problems (JSSP). The proposed method employs a Pareto-based evolutionary strategy to explore trade-offs among objectives and generate a diverse set of optimal schedules. Chromosome encoding is carefully structured to represent operation sequences across machines, while genetic operators such as crossover, mutation, and elitism are adapted to maintain feasibility and promote convergence. A non-dominated sorting mechanism ranks candidate solutions, and a crowding distance metric is used to preserve diversity within the solution space. Experimental evaluation is conducted on standard benchmark instances and extended to real-world shop-floor scenarios with dynamic job arrivals and machine breakdowns. Results demonstrate that the GA-based approach effectively identifies high-quality scheduling solutions that outperform traditional heuristic methods in both solution quality and computational efficiency. The study also includes an analysis of convergence behaviour, scalability, and robustness under varying problem sizes. This work contributes a flexible and adaptive tool for real-time production planning and resource optimization in smart manufacturing environments.


**Keywords:** genetic algorithm, job shop scheduling, multi-objective optimization, evolutionary computing, production planning

**ICISCM2024-261**

# HYBRID EVOLUTIONARY STRATEGIES FOR DYNAMIC TASK SCHEDULING IN CLOUD COMPUTING ENVIRONMENTS

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## ABSTRACT

Efficient task scheduling in cloud computing environments is critical for optimizing resource utilization, minimizing execution time, and maintaining quality of service in the presence of dynamic workloads. Traditional static scheduling algorithms often fail to adapt to the unpredictable nature of cloud environments, where resource availability and task requirements frequently change. This paper proposes a hybrid evolutionary strategy that combines the strengths of Genetic Algorithms (GA) and Particle Swarm Optimization (PSO) to address dynamic task scheduling in heterogeneous cloud infrastructures. The hybrid model leverages GA's exploration capability and PSO's fast convergence to balance global and local search performance. Task-resource mappings are encoded as chromosomes, and a fitness function is designed to consider execution time, load balancing, energy consumption, and deadline adherence. The algorithm dynamically updates scheduling decisions in response to real-time fluctuations in task arrivals and virtual machine statuses. Experimental validation is performed using both synthetic workloads and real-world cloud traces on a simulated cloud environment. Comparative analysis with standalone GA, PSO, and traditional heuristic methods shows that the hybrid approach consistently outperforms others in terms of throughput, response time, and makespan. The results highlight the proposed strategy's adaptability, scalability, and robustness under varying workload intensities. This study demonstrates the potential of hybrid evolutionary methods as a practical and intelligent solution for real-time task scheduling in cloud computing platforms, paving the way for more responsive and efficient cloud resource management.

**Keywords:** cloud computing, task scheduling, hybrid algorithms, evolutionary strategies, dynamic environments

**ICISCM2024-920**

# AUTOMATING DATA CLEANING AND TRANSFORMATION USING AI-DRIVEN WRANGLING PIPELINES

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## ABSTRACT

The rapid growth of data-driven applications has intensified the need for efficient and accurate data preprocessing, especially in domains where data quality directly impacts analytical and predictive performance. This paper presents an AI-driven approach to automate data wrangling tasks, specifically focusing on data cleaning and transformation processes. The proposed framework utilizes a combination of machine learning models, pattern recognition techniques, and rule-based heuristics to identify anomalies, impute missing values, detect schema inconsistencies, and perform intelligent type transformations. A modular wrangling pipeline is designed to adaptively process diverse datasets by analyzing metadata and content characteristics in real time. The system employs reinforcement learning to optimize transformation sequences, while natural language processing techniques enable semantic type inference and entity resolution. Comparative experiments are conducted on structured datasets from healthcare, finance, and e-commerce domains to evaluate performance in terms of accuracy, scalability, and processing speed. Results demonstrate that the AI-driven pipeline significantly reduces manual intervention while maintaining high data fidelity, outperforming traditional ETL tools in both efficiency and flexibility. The framework also supports user-in-the-loop interaction, allowing domain experts to validate and refine transformations through an intuitive interface. This work highlights the transformative potential of artificial intelligence in simplifying complex data preparation workflows and enabling faster deployment of data-centric solutions. The findings suggest strong applicability for AI-driven wrangling pipelines in enterprise data engineering, automated analytics, and real-time data integration platforms.

**Keywords:** data wrangling, data cleaning, AI automation, data transformation, machine learning

**ICISCM2024-124**

# INTELLIGENT SCHEMA MAPPING AND ANOMALY DETECTION FOR SCALABLE DATA PREPARATION

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## ABSTRACT

Scalable data preparation is a critical prerequisite for effective data analytics and machine learning pipelines, particularly in large-scale enterprise environments where heterogeneous data sources, inconsistent schemas, and latent anomalies are common. This paper proposes an intelligent framework for automating schema mapping and anomaly detection to streamline the data preparation process. The system leverages ontology-based reasoning, machine learning models, and statistical profiling to semantically align schemas from diverse sources. For schema mapping, the approach integrates deep embedding techniques with supervised learning to identify structural and semantic correspondences across datasets. Simultaneously, the anomaly detection module uses unsupervised learning algorithms such as isolation forests and autoencoders to uncover data irregularities, including outliers, duplications, and schema violations. A scalable architecture is implemented to support distributed execution on large datasets, using parallelized processing and adaptive indexing. The framework also includes a feedback mechanism that refines mappings and detection rules based on user interaction, enhancing accuracy over time. Evaluations conducted on multi-domain datasets demonstrate improved mapping precision and recall, as well as high anomaly detection rates compared to conventional rule-based systems. The proposed solution significantly reduces the time and effort required for manual data alignment and cleansing, making it well-suited for dynamic data integration scenarios. This work contributes to the growing field of intelligent data engineering and offers a practical toolset for organizations aiming to operationalize data-driven decision-making at scale.

**Keywords:** schema mapping, anomaly detection, data preparation, machine learning, data integration

**ICISCM2024-821**

# COMPARATIVE PERFORMANCE ANALYSIS OF YOLO AND FASTER-RCNN FOR REAL-TIME OBJECT DETECTION

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## ABSTRACT

Real-time object detection plays a crucial role in numerous computer vision applications, including autonomous driving, surveillance, and robotics. This paper presents a comprehensive comparative analysis of two widely used deep learning-based object detection algorithms: You Only Look Once (YOLO) and Faster Region-based Convolutional Neural Network (Faster-RCNN). The study evaluates both models in terms of detection accuracy, inference speed, model complexity, and resource utilization. YOLO, known for its speed and efficiency, performs detection in a single pass through the neural network, making it suitable for real-time applications. In contrast, Faster-RCNN adopts a two-stage approach, offering higher localization accuracy but at the cost of increased computational overhead. The models are trained and tested on benchmark datasets including PASCAL VOC and MS COCO, with metrics such as mean Average Precision (mAP), frames per second (FPS), precision, and recall used for evaluation. Results show that while Faster-RCNN outperforms YOLO in precision and detection accuracy for small objects, YOLO demonstrates superior performance in terms of speed and suitability for resource-constrained environments. The analysis also considers the trade-offs between model complexity and deployment feasibility in real-time systems. This work provides actionable insights for researchers and engineers in selecting appropriate object detection models based on application-specific requirements. The findings support the integration of real-time vision systems in domains requiring both speed and reliability.

**Keywords:** object detection, YOLO, Faster-RCNN, real-time systems, deep learning

**ICISCM2024-140**

# ENHANCING OBJECT DETECTION ACCURACY IN COMPLEX SCENES USING HYBRID YOLO AND FASTER-RCNN MODELS

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## ABSTRACT

Object detection in complex and cluttered scenes remains a significant challenge due to varying object scales, occlusions, illumination conditions, and background noise. This paper proposes a hybrid deep learning framework that combines the strengths of YOLO (You Only Look Once) and Faster-RCNN (Region-based Convolutional Neural Network) to enhance detection accuracy in such environments. The architecture integrates YOLO's rapid inference capabilities with Faster-RCNN's superior precision by leveraging a parallel detection strategy followed by result fusion. YOLO is first employed to generate initial region proposals and coarse object localization, which are then refined using the more precise region proposal network and classifier of Faster-RCNN. The output from both models is processed through a confidence-weighted ensemble mechanism that consolidates overlapping detections and filters false positives. Experiments are conducted on challenging benchmark datasets, including MS COCO and Open Images, focusing on scenes with dense object distributions and dynamic backgrounds. The hybrid model demonstrates improved mean Average Precision (mAP) and recall compared to standalone implementations of YOLO and Faster-RCNN, particularly in detecting small or partially occluded objects. Moreover, the proposed system achieves near real-time performance with acceptable computational overhead, making it viable for deployment in surveillance, autonomous navigation, and smart city monitoring applications. This research highlights the potential of model fusion strategies in achieving both speed and accuracy in object detection tasks, especially in visually complex scenarios.

**Keywords:** object detection, hybrid model, YOLO, Faster-RCNN, complex scenes

**ICISCM2024-322**

# DESIGNING INTELLIGENT DECISION SUPPORT SYSTEMS FOR EMERGENCY RESPONSE MANAGEMENT

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## ABSTRACT

Effective emergency response management demands rapid, accurate decision-making under conditions of uncertainty, time pressure, and information overload. This paper presents a framework for designing intelligent decision support systems (IDSS) tailored to the needs of emergency response operations. The proposed system architecture integrates real-time data from heterogeneous sources such as sensor networks, weather feeds, social media, and geospatial platforms to enable comprehensive situational awareness. A combination of machine learning models, rule-based reasoning, and predictive analytics is employed to assess risk levels, forecast incident evolution, and suggest prioritized response actions. The IDSS supports multi-agency coordination by offering a shared interface that visualizes alerts, resource availability, evacuation routes, and ongoing developments through dynamic dashboards and geospatial mapping tools. Case studies simulated on disaster scenarios, including urban flooding, industrial accidents, and wildfire outbreaks, demonstrate the system's capability to reduce response time, improve decision accuracy, and optimize resource allocation. The framework also incorporates adaptive learning mechanisms to refine recommendations based on post-event evaluations and responder feedback. Evaluation metrics such as decision latency, user satisfaction, and action effectiveness are used to validate system performance. The results indicate that the IDSS enhances operational agility and decision support quality in rapidly evolving crisis conditions. This study offers a scalable and modular approach to building intelligent systems that strengthen disaster preparedness and response efficiency in smart governance and public safety domains.

**Keywords:** emergency response, decision support system, real-time analytics, disaster management, intelligent systems

**ICISCM2024-499**

# AI-POWERED DECISION FRAMEWORK FOR STRATEGIC PLANNING IN SMART MANUFACTURING

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## ABSTRACT

Strategic planning in smart manufacturing environments requires the integration of vast, complex, and dynamic datasets to support informed and agile decision-making. This paper proposes an AI-powered decision framework designed to enhance strategic planning by synthesizing data from industrial operations, supply chains, market trends, and workforce dynamics. The framework employs a multi-layered architecture that combines machine learning, predictive analytics, and optimization algorithms to generate actionable insights across various planning horizons. A knowledge-driven decision engine leverages historical and real-time data to simulate production scenarios, assess risk factors, and recommend adaptive strategies aligned with performance goals such as cost reduction, process efficiency, and sustainability. Reinforcement learning is applied to continuously refine planning decisions in response to changing internal and external variables. The framework also incorporates explainable AI components to ensure transparency and interpretability of recommendations, supporting managerial trust and informed intervention. Validation is performed using real-world datasets from smart factories in the automotive and electronics sectors, with results showing improvements in planning accuracy, responsiveness to disruptions, and overall operational efficiency. Additionally, the system supports collaborative decision-making by presenting visualized forecasts and multi-objective trade-off analyses to stakeholders. This research demonstrates how AI can be systematically embedded into the strategic planning layer of smart manufacturing systems to drive agility, competitiveness, and resilience in Industry 4.0 environments.

**Keywords:** smart manufacturing, strategic planning, decision framework, artificial intelligence, Industry 4.0

**ICISCM2024-188**

# INTEGRATING NEURAL NETWORKS WITH SYMBOLIC REASONING FOR EXPLAINABLE AI SYSTEMS

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## ABSTRACT

The lack of interpretability in deep learning models remains a critical barrier to the adoption of artificial intelligence in high-stakes domains where transparency and trust are essential. This paper presents a hybrid framework that integrates neural networks with symbolic reasoning to develop explainable AI (XAI) systems capable of both high-performance prediction and human-understandable reasoning. The approach leverages the pattern recognition power of deep neural networks for data-driven learning and combines it with symbolic logic-based systems that enable structured inference and rule extraction. Through this integration, the system is able to generate accurate predictions while simultaneously offering transparent justifications, traceable decision paths, and contextual explanations. The architecture includes an encoder-decoder neural component that interfaces with a symbolic reasoning engine to translate latent representations into symbolic forms. The reasoning module applies predefined or learned logical rules to derive conclusions that align with domain-specific knowledge. Experimental validation is conducted across multiple use cases, including medical diagnosis, fraud detection, and legal document analysis, where explainability is a regulatory and operational requirement. Results demonstrate that the hybrid model achieves comparable or superior performance to standalone neural networks while offering interpretable outputs that improve user trust and decision accountability. This work contributes to the growing field of neuro-symbolic AI by showing how the complementary strengths of connectionist and symbolic methods can be effectively fused to meet the demands of transparent and responsible AI systems.

**Keywords:** explainable AI, neural networks, symbolic reasoning, hybrid models, interpretable systems

**ICISCM2024-531**

# A HYBRID NEURAL-SYMBOLIC APPROACH FOR KNOWLEDGE REPRESENTATION AND LOGICAL INFERENCE

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## ABSTRACT

Knowledge representation and logical inference are foundational challenges in artificial intelligence, requiring systems that can efficiently handle both sub-symbolic data patterns and symbolic reasoning processes. This paper proposes a hybrid neural-symbolic framework that combines the learning capabilities of neural networks with the expressiveness and interpretability of symbolic logic for enhanced knowledge representation and inference. The approach utilizes deep neural architectures to encode complex data features into distributed representations, which are then integrated with a symbolic reasoning engine capable of performing logical deductions and rule-based inference. This fusion allows the system to leverage the robustness and adaptability of neural models alongside the clarity and rigor of symbolic logic. The framework supports dynamic knowledge updates and can infer new facts from existing information through logical rules while maintaining tolerance to noise and uncertainty in data inputs. Experimental evaluation on benchmark reasoning datasets and real-world knowledge graphs demonstrates that the hybrid model achieves improved inference accuracy and computational efficiency compared to purely neural or symbolic approaches. Additionally, the system provides interpretable reasoning chains that enhance explainability and user trust. The proposed method advances the development of intelligent systems capable of complex cognitive tasks such as question answering, automated theorem proving, and semantic understanding. This research underscores the potential of neural-symbolic integration as a promising direction for building AI systems that combine data-driven learning with logic-based reasoning.

**Keywords:** neural-symbolic, knowledge representation, logical inference, hybrid AI, interpretable reasoning

**ICISCM2024-902**

# SCALABLE FRAMEWORK FOR REAL-TIME DATA STREAM PROCESSING IN SMART CITY APPLICATIONS

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## ABSTRACT

The proliferation of sensors and IoT devices in smart cities generates vast volumes of continuous data streams that require efficient real-time processing for timely decision-making and service optimization. This paper presents a scalable framework designed to handle high-velocity data streams in smart city applications such as traffic monitoring, environmental sensing, and public safety. The proposed architecture integrates distributed stream processing engines with adaptive load balancing and fault-tolerant mechanisms to ensure reliability and scalability under varying data rates and network conditions. Key components include real-time data ingestion, preprocessing modules for filtering and aggregation, and analytics engines powered by machine learning algorithms for anomaly detection and predictive insights. The framework supports heterogeneous data formats and sources, enabling seamless integration across diverse urban infrastructures. A case study implementation demonstrates the framework's effectiveness in processing real-time traffic sensor data to optimize signal timings and reduce congestion. Performance evaluations on both simulated and real-world datasets highlight its ability to maintain low latency, high throughput, and resource efficiency at scale. Additionally, the system's modular design facilitates easy extension and customization for various smart city use cases. This research contributes to the advancement of intelligent urban management by providing a robust and scalable solution for continuous data stream processing, ultimately enhancing the responsiveness and sustainability of smart city services.

**Keywords:** real-time processing, data streams, smart cities, scalable framework, IoT analytics

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# ADAPTIVE EVENT DETECTION IN HIGH-VELOCITY DATA STREAMS USING ONLINE LEARNING ALGORITHMS

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## ABSTRACT

High-velocity data streams generated by modern sensing and communication systems present significant challenges for timely and accurate event detection. Traditional batch processing methods are inadequate for real-time responsiveness and adaptability in dynamic environments where data distributions may evolve rapidly. This paper proposes an adaptive event detection framework that leverages online learning algorithms to continuously update predictive models and maintain high detection accuracy in streaming scenarios. The approach utilizes incremental classifiers capable of learning from new data instances in real time while forgetting outdated patterns, thereby addressing concept drift and changing data characteristics. Feature extraction and selection modules are designed to operate efficiently under strict latency constraints, ensuring that relevant information is captured without overwhelming computational resources. The framework incorporates a feedback loop enabling self-tuning of model parameters based on detection performance metrics, facilitating robustness to noise and anomalies. Experiments conducted on synthetic and real-world datasets from network traffic monitoring and sensor networks demonstrate the effectiveness of the proposed system in achieving superior detection rates and lower false alarm rates compared to static and traditional methods. The results highlight the potential of online adaptive learning to enhance event detection in environments with evolving data streams, such as cybersecurity, smart manufacturing, and intelligent transportation systems. This work provides a scalable and flexible solution for real-time analytics in high-velocity streaming data contexts.

**Keywords:** event detection, online learning, data streams, adaptive algorithms, concept drift

**ICISCM2024-834**

# DEEP LEARNING-BASED REAL-TIME HUMAN ACTIVITY RECOGNITION FOR INTELLIGENT SURVEILLANCE SYSTEMS

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## ABSTRACT

Human activity recognition in real-time is a critical component of intelligent surveillance systems aimed at enhancing security, public safety, and behavioral analytics. This paper presents a deep learning-based framework for accurate and efficient human activity recognition in complex and dynamic environments. The proposed system leverages convolutional neural networks (CNNs) combined with recurrent neural networks (RNNs) to effectively capture spatial features and temporal dependencies from video streams. The model is designed to process live video input from multiple camera sources, performing activity classification with low latency suitable for real-time applications. A comprehensive preprocessing pipeline, including background subtraction, pose estimation, and data augmentation, improves robustness against varying illumination, occlusion, and viewpoint changes. Experimental validation is conducted using benchmark surveillance datasets such as UCF Crime and HMDB51, achieving high accuracy in detecting activities ranging from normal behaviors to suspicious or anomalous events. The framework also incorporates an adaptive thresholding mechanism to reduce false alarms and supports incremental learning to adapt to new activity patterns over time. Performance evaluation highlights the system’s ability to maintain real-time inference speeds on edge computing devices without compromising detection precision. This research demonstrates the potential of integrating deep learning techniques into intelligent surveillance for proactive monitoring and threat detection, contributing to safer urban environments and smarter security infrastructures.

**Keywords:** human activity recognition, deep learning, real-time surveillance, convolutional neural networks, recurrent neural networks

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# ANOMALY DETECTION IN PUBLIC SPACES USING CONTEXT-AWARE VIDEO ANALYTICS FRAMEWORK

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## ABSTRACT

Detecting anomalies in public spaces is essential for enhancing security, preventing crimes, and ensuring public safety. This paper presents a context-aware video analytics framework designed to identify unusual activities and behaviors in real-time surveillance footage. The proposed system integrates computer vision techniques with contextual information such as time, location, crowd density, and environmental conditions to improve anomaly detection accuracy and reduce false alarms. The framework employs a combination of deep learning models, including convolutional neural networks for feature extraction and long short-term memory networks for capturing temporal dependencies in video sequences. Additionally, it incorporates a context modeling module that dynamically adjusts detection thresholds based on situational factors and historical patterns. Extensive experiments conducted on publicly available datasets and real-world surveillance videos demonstrate the effectiveness of the framework in detecting diverse anomalies such as loitering, sudden crowd dispersal, and unauthorized access. Results indicate significant improvements in precision and recall over traditional video anomaly detection methods that lack contextual awareness. The system’s scalable architecture supports deployment in smart city environments with multiple camera feeds and heterogeneous data sources. This research advances the state of the art in intelligent video surveillance by combining deep learning with context-sensitive analysis, offering a robust solution for proactive security monitoring and emergency response in public spaces.

**Keywords:** anomaly detection, video analytics, public safety, context-aware systems, deep learning

**ICISCM2024-367**

# IMPROVING IMAGE CLASSIFICATION ACCURACY ON LIMITED DATA USING TRANSFER LEARNING WITH PRETRAINED CNNS

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## ABSTRACT

Image classification tasks often suffer from limited labeled data, which hinders the training of deep learning models due to overfitting and poor generalization. This paper investigates the use of transfer learning techniques, leveraging pretrained convolutional neural networks (CNNs) to improve classification accuracy on small datasets. The study evaluates several popular CNN architectures, such as VGG, ResNet, and EfficientNet, pretrained on large-scale datasets like ImageNet, and fine-tuned on target datasets with limited samples. A systematic comparison of feature extraction and fine-tuning strategies is conducted to identify optimal approaches for different data scarcity scenarios. Additionally, data augmentation methods are integrated to enhance model robustness and reduce overfitting risks. Experimental results on benchmark small-scale image classification datasets demonstrate that transfer learning significantly boosts performance compared to training CNNs from scratch. Fine-tuning deeper layers yields higher accuracy but requires careful hyperparameter tuning to prevent catastrophic forgetting. The paper also discusses computational efficiency and training time trade-offs inherent in various transfer learning schemes. The findings highlight that pretrained CNNs can effectively transfer learned representations to new tasks with minimal labeled data, enabling practical deployment in resource-constrained environments such as medical imaging, remote sensing, and industrial inspection. This research contributes to the development of scalable and accurate image classification solutions where data availability is limited.

**Keywords:** image classification, transfer learning, pretrained CNNs, limited data, fine-tuning

**ICISCM2024-252**

# DOMAIN ADAPTATION TECHNIQUES IN TRANSFER LEARNING FOR LOW-RESOURCE NATURAL LANGUAGE PROCESSING TASKS

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## ABSTRACT

Natural Language Processing (NLP) tasks often face significant challenges when applied to low-resource domains due to limited annotated data and domain-specific linguistic variations. Transfer learning with domain adaptation techniques has emerged as an effective strategy to overcome these constraints by leveraging knowledge from high-resource source domains to improve performance in low-resource target domains. This paper systematically reviews and evaluates various domain adaptation methods applied within transfer learning frameworks for NLP tasks such as sentiment analysis, named entity recognition, and machine translation. Techniques discussed include instance weighting, feature alignment, adversarial training, and representation learning that minimize domain discrepancies. The study further explores fine-tuning pre-trained language models like BERT and GPT on target domain data with domain-specific regularization and multi-task learning approaches. Experimental results on benchmark datasets demonstrate that domain adaptation significantly enhances model generalization and robustness, particularly in scenarios with scarce labeled data. Moreover, hybrid methods combining supervised and unsupervised adaptation yield superior performance by effectively exploiting unlabeled target domain corpora. The paper also highlights challenges such as negative transfer, computational overhead, and domain shift measurement, providing insights for future research directions. This work contributes to advancing transfer learning methodologies that enable more accurate and scalable NLP applications in low-resource settings, facilitating broader language technology adoption.

**Keywords:** domain adaptation, transfer learning, low-resource NLP, pre-trained models, domain shift

**ICISCM2024-316**

# DESIGN OF SELF-ADAPTIVE CONTROL SYSTEMS USING FUZZY LOGIC AND EVOLUTIONARY ALGORITHMS

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## ABSTRACT

The design of self-adaptive control systems is critical for managing complex, nonlinear, and uncertain environments where fixed-parameter controllers often fail to maintain optimal performance. This paper proposes an integrated approach that combines fuzzy logic with evolutionary algorithms to develop robust self-adaptive control systems capable of real-time adjustment and improved decision-making. Fuzzy logic provides a flexible framework to model system uncertainties and approximate reasoning, enabling smooth handling of imprecise inputs and dynamic conditions. Evolutionary algorithms such as genetic algorithms and particle swarm optimization are employed to optimize the fuzzy controller parameters automatically, facilitating the adaptation process without requiring precise mathematical models. The proposed system continuously monitors control performance metrics and environmental feedback to update membership functions and rule bases dynamically, ensuring sustained adaptability and stability. Simulation studies conducted on benchmark nonlinear control problems, including robotic arm trajectory tracking and temperature regulation, demonstrate that the hybrid approach achieves superior accuracy, faster convergence, and enhanced robustness compared to conventional control methods. Additionally, the evolutionary optimization process reduces manual tuning efforts and enables the control system to adapt efficiently to changing operational contexts. This research highlights the synergy between fuzzy logic and evolutionary computation for designing intelligent control systems that can autonomously adjust to complex, time-varying environments, making them suitable for applications in industrial automation, robotics, and smart infrastructure management.

**Keywords:** self-adaptive control, fuzzy logic, evolutionary algorithms, optimization, intelligent systems

**ICISCM2024-390**

# COMPUTATIONAL INTELLIGENCE APPROACHES FOR DYNAMIC RECONFIGURATION IN AUTONOMOUS SYSTEMS

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## ABSTRACT

Dynamic reconfiguration in autonomous systems is essential for maintaining operational efficiency, robustness, and adaptability in uncertain and evolving environments. This paper explores computational intelligence techniques to enable real-time dynamic reconfiguration of autonomous agents, allowing them to modify their behavior, structure, or control strategies in response to internal changes or external stimuli. The proposed framework integrates neural networks, fuzzy logic, and evolutionary algorithms to model complex system dynamics and optimize reconfiguration decisions. Neural networks facilitate pattern recognition and prediction of system states, while fuzzy logic handles uncertainty and imprecise information during decision-making. Evolutionary algorithms provide adaptive optimization capabilities to identify optimal reconfiguration strategies under varying constraints and objectives. The framework supports modular architectures that can seamlessly switch or adjust components, ensuring continuous functionality even under faults or environmental disturbances. Case studies involving autonomous robotics and unmanned aerial vehicles demonstrate the effectiveness of the approach in enhancing system resilience, mission success rates, and energy efficiency. Performance evaluations reveal that computational intelligence-driven reconfiguration outperforms static and rule-based methods by offering higher adaptability and faster response times. This research contributes to advancing autonomous system design by providing a scalable, intelligent, and flexible solution for dynamic reconfiguration, which is critical for applications in defense, industrial automation, and smart transportation systems.

**Keywords:** computational intelligence, dynamic reconfiguration, autonomous systems, neural networks, evolutionary algorithms

**ICISCM2024-778**

# KNOWLEDGE GRAPH CONSTRUCTION AND REASONING FOR SEMANTIC DATA INTEGRATION

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## ABSTRACT

Semantic data integration is a critical challenge in managing heterogeneous and distributed data sources across various domains. Knowledge graphs have emerged as a powerful tool to represent and unify diverse data by capturing entities, relationships, and contextual semantics in a structured form. This paper presents a comprehensive framework for constructing knowledge graphs and performing reasoning to facilitate effective semantic data integration. The proposed methodology includes automated extraction of entities and relationships from unstructured and semi-structured data, ontology alignment to harmonize different schemas, and graph embedding techniques to enrich semantic representations. Reasoning mechanisms based on rule inference and description logic enable the discovery of implicit knowledge, consistency checking, and support complex queries across integrated datasets. The framework addresses challenges related to data heterogeneity, incompleteness, and scalability through modular components and efficient algorithms. Experimental validation is conducted on real-world datasets from healthcare and finance domains, demonstrating improved data interoperability, query accuracy, and knowledge discovery compared to traditional integration approaches. The results confirm that combining knowledge graph construction with advanced reasoning techniques significantly enhances the ability to integrate and analyze semantically rich data, enabling more informed decision-making and facilitating intelligent applications such as recommendation systems, semantic search, and automated reasoning. This work contributes to advancing semantic data integration by providing a scalable and interpretable solution based on knowledge graphs.

**Keywords:** knowledge graphs, semantic data integration, ontology alignment, reasoning, graph embedding

**ICISCM2024-239**

# GRAPH NEURAL NETWORKS FOR INFERENCE AND PREDICTION IN COMPLEX DATA RELATIONSHIPS

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## ABSTRACT

Graph Neural Networks (GNNs) have emerged as powerful tools for modeling complex relational data by combining graph theory with deep learning to capture dependencies among entities in non-Euclidean domains. This paper investigates the application of GNNs for inference and prediction tasks involving complex data relationships found in social networks, biological systems, recommendation engines, and knowledge graphs. The proposed approach leverages message passing mechanisms to iteratively aggregate and transform node and edge features, enabling the model to learn rich representations that encode both local and global graph structure. We explore various GNN architectures, including Graph Convolutional Networks, Graph Attention Networks, and GraphSAGE, to evaluate their effectiveness in tasks such as node classification, link prediction, and graph-level prediction. The framework integrates domain-specific feature engineering with end-to-end training to enhance model generalization and interpretability. Extensive experiments on benchmark datasets demonstrate that GNN-based models outperform traditional machine learning techniques and shallow graph embedding methods in terms of accuracy, scalability, and robustness to noisy or incomplete data. Furthermore, the paper discusses challenges related to over-smoothing, computational complexity, and dynamic graph handling, proposing potential solutions to address these issues. The research highlights the versatility and strength of GNNs as a unifying framework for learning from complex relational data, paving the way for advances in numerous intelligent systems applications.

**Keywords:** graph neural networks, inference, prediction, complex data, relational learning

**ICISCM2024-553**

# LIGHTWEIGHT CONVOLUTIONAL NEURAL NETWORK ARCHITECTURES FOR REAL-TIME IMAGE CLASSIFICATION

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## ABSTRACT

Real-time image classification is a critical task in many edge and mobile computing applications, including autonomous vehicles, surveillance systems, and wearable devices. Traditional convolutional neural network (CNN) architectures, while highly accurate, often involve substantial computational complexity and memory consumption, making them unsuitable for real-time deployment on resource-constrained platforms. This paper investigates lightweight CNN architectures that strike a balance between model accuracy and computational efficiency for real-time image classification. We evaluate and compare several state-of-the-art lightweight models such as MobileNet, ShuffleNet, and EfficientNet-Lite, focusing on their architecture design, parameter count, floating-point operations (FLOPs), and inference latency. Furthermore, we propose a modified architecture that incorporates depth wise separable convolutions, channel pruning, and knowledge distillation to reduce model size without significant loss in classification accuracy. Extensive experiments are conducted on benchmark datasets, including CIFAR-10 and ImageNet-100, demonstrating that the proposed lightweight architecture achieves real-time performance with minimal accuracy degradation. The model is benchmarked on edge devices such as Raspberry Pi and Jetson Nano, achieving inference speeds suitable for practical applications. Additionally, optimization techniques, including quantization and tensor decomposition, are discussed to further enhance runtime efficiency. This research contributes to the development of deployable CNN solutions for real-time classification tasks, offering a framework that ensures fast, accurate, and energy-efficient inference in constrained environments.

**Keywords:** lightweight CNN, real-time classification, mobile computing, model compression, edge AI

**ICISCM2024-459**

# OPTIMIZING DEEP NEURAL NETWORKS FOR LOW-LATENCY INFERENCE IN EDGE COMPUTING ENVIRONMENTS

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## ABSTRACT

The deployment of deep neural networks (DNNs) in edge computing environments poses significant challenges due to the constraints of limited computational resources, energy efficiency requirements, and the need for low-latency inference. This paper presents a comprehensive framework for optimizing DNNs to meet the stringent demands of real-time processing on edge devices. The approach integrates a combination of model compression techniques such as pruning, quantization, and knowledge distillation to reduce model complexity while preserving inference accuracy. Additionally, the use of neural architecture search (NAS) is explored to automatically design lightweight network structures tailored to specific hardware and task requirements. Runtime optimization strategies, including layer fusion, memory access reduction, and batch normalization folding, are implemented to minimize inference delay. Experimental evaluations are conducted on widely used models such as ResNet, MobileNet, and EfficientNet, deployed on platforms like Raspberry Pi and NVIDIA Jetson Nano. The results demonstrate significant improvements in inference speed, power consumption, and memory usage, with negligible impact on accuracy. The study also benchmarks the performance gains achieved through various optimization combinations, providing guidelines for selecting strategies based on application constraints. This research contributes to the advancement of practical deep learning deployment at the network edge by enabling responsive, resource-aware AI systems for applications such as smart surveillance, industrial automation, and autonomous systems.

**Keywords:** edge computing, deep neural networks, low-latency inference, model optimization, real-time AI

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# COOPERATIVE INTELLIGENT AGENTS FOR TASK ALLOCATION IN DISTRIBUTED CLOUD ENVIRONMENTS

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## ABSTRACT

Effective task allocation in distributed cloud environments is essential for optimizing resource utilization, minimizing response time, and ensuring service reliability. This paper proposes a cooperative multi-agent framework in which intelligent agents operate autonomously and collaboratively to allocate computational tasks across heterogeneous cloud resources. Each agent represents a cloud node equipped with decision-making capabilities driven by artificial intelligence, enabling it to evaluate local resource states and exchange information with peer agents. The system employs distributed negotiation and consensus-building strategies to achieve dynamic load balancing and fault tolerance without relying on centralized control. Reinforcement learning techniques are integrated within agents to enable adaptive decision-making based on real-time performance feedback, evolving network conditions, and task complexity. The proposed framework is evaluated under simulated cloud scenarios with varying workloads, latency constraints, and node availability. Results indicate that cooperative intelligent agents significantly improve task throughput, resource efficiency, and system scalability compared to traditional static and centralized allocation methods. Furthermore, the system demonstrates resilience in the face of node failures and fluctuating demand, maintaining consistent performance through agent-level adaptability. This research highlights the potential of decentralized, intelligent coordination mechanisms in complex cloud infrastructures, paving the way for next-generation autonomous cloud management systems that can self-organize, self-optimize, and scale on demand in distributed computing environments.

**Keywords:** intelligent agents, task allocation, distributed cloud, cooperative systems, reinforcement learning

**ICISCM2024-174**

# DESIGN AND IMPLEMENTATION OF AUTONOMOUS AGENTS FOR LOAD BALANCING IN DISTRIBUTED SYSTEMS

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## ABSTRACT

Efficient load balancing in distributed systems is essential for maintaining high availability, minimizing latency, and optimizing resource utilization. This paper presents the design and implementation of autonomous software agents that perform decentralized load balancing across distributed computing environments. The proposed architecture enables each agent to operate independently while maintaining system-wide coordination through local interactions and decision-sharing mechanisms. These agents continuously monitor node workload, resource availability, and task queues, dynamically redistributing tasks to underutilized nodes to achieve balanced system performance. A combination of rule-based logic and reinforcement learning empowers the agents to adaptively refine their decision-making over time, learning optimal strategies for task migration and resource reallocation under diverse operating conditions. The implementation is tested in a simulated distributed network with heterogeneous nodes, where performance is evaluated based on response time, throughput, and fault tolerance. Results show that the autonomous agent-based approach significantly outperforms traditional static and centralized load balancing algorithms, particularly in environments with fluctuating workloads and partial node failures. Additionally, the system's scalability is demonstrated as the number of nodes and tasks increases, with agents maintaining effective load distribution with minimal communication overhead. This research contributes a scalable, adaptive solution to distributed system management, showing that autonomous agents can serve as intelligent load balancers capable of enhancing system robustness and performance without central coordination.

**Keywords:** autonomous agents, load balancing, distributed systems, adaptive algorithms, decentralized control

**ICISCM2024-719**

# LONG SHORT-TERM MEMORY NETWORKS FOR ACCURATE MULTIVARIATE TIME SERIES FORECASTING

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## ABSTRACT

Accurate multivariate time series forecasting plays a vital role in decision-making processes across domains such as finance, energy, healthcare, and supply chain management. Traditional forecasting models often fail to capture complex temporal dependencies and nonlinear interactions among multiple variables. This paper investigates the application of Long Short-Term Memory (LSTM) networks, a variant of recurrent neural networks, for modeling and predicting multivariate time series data with high temporal dynamics. The proposed architecture includes stacked LSTM layers with attention mechanisms to selectively focus on relevant time steps and variables, enhancing the model's learning efficiency. Feature normalization and sequence padding techniques are employed to manage variable-length inputs and ensure stable training. The model is evaluated on benchmark datasets from diverse application domains, including electricity consumption, air quality monitoring, and stock price forecasting. Experimental results demonstrate that the LSTM-based framework significantly outperforms traditional statistical models such as ARIMA and VAR, as well as feedforward neural networks and standard recurrent networks, in terms of forecasting accuracy and robustness to missing or noisy data. Furthermore, the study explores the impact of hyperparameter tuning, window sizing, and multi-step forecasting on model performance. The findings highlight the capability of LSTM networks to model complex temporal relationships in multivariate contexts and their suitability for deployment in real-time predictive systems that require both precision and adaptability.

**Keywords:** LSTM networks, time series forecasting, multivariate prediction, temporal modeling, deep learning

**ICISCM2024-986**

# TEMPORAL CONVOLUTIONAL NETWORKS FOR REAL-TIME FORECASTING IN ENERGY DEMAND PREDICTION

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## ABSTRACT

Accurate and real-time forecasting of energy demand is essential for ensuring efficient grid operation, reducing energy wastage, and supporting the integration of renewable sources. This paper presents the use of Temporal Convolutional Networks (TCNs) for energy demand forecasting, emphasizing their suitability for real-time applications due to their high parallelizability and long-range temporal modeling capabilities. Unlike recurrent models, TCNs leverage causal dilated convolutions and residual connections to capture both short-term fluctuations and long-term patterns in energy consumption data without suffering from vanishing gradients or sequential bottlenecks. The proposed TCN-based framework is trained and tested on real-world datasets consisting of hourly and daily energy consumption records from smart grids and utility providers. Data preprocessing includes normalization, windowing, and temporal feature extraction to enhance model performance. Comparative analysis with traditional models such as ARIMA and machine learning approaches, including LSTM and GRU, demonstrates that TCNs achieve superior prediction accuracy, faster inference time, and better scalability across varying data volumes. The system also supports multi-horizon forecasting, making it suitable for both operational and strategic energy planning. Implementation on edge-computing platforms further highlights the model's capacity for real-time deployment. This research confirms the effectiveness of TCNs as a robust and efficient solution for modern energy forecasting challenges, especially in dynamic and high-frequency environments.

**Keywords:** temporal convolutional networks, energy forecasting, real-time prediction, deep learning, smart grid

**ICISCM2024-642**

# REAL-TIME FACIAL EXPRESSION RECOGNITION USING LIGHTWEIGHT DEEP LEARNING MODELS

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## ABSTRACT

Facial expression recognition (FER) in real time is a key enabler for affective computing applications such as human–computer interaction, virtual assistants, and behavioral analysis. However, implementing FER on edge devices and mobile platforms presents significant challenges due to limitations in processing power, memory, and energy consumption. This paper presents a real-time FER system based on lightweight deep learning models optimized for deployment in constrained environments. The approach utilizes compact convolutional neural network architectures, including variants of MobileNet and ShuffleNet, which significantly reduce the number of parameters and floating-point operations without compromising accuracy. A hybrid training strategy combining transfer learning and data augmentation is adopted to improve generalization across diverse facial features and lighting conditions. The system is trained and evaluated on benchmark datasets such as FER-2013 and RAF-DB, showing high classification accuracy across basic emotion categories, including happiness, sadness, anger, and surprise. Real-time inference performance is benchmarked on Raspberry Pi and NVIDIA Jetson Nano, achieving stable frame rates and low latency suitable for live applications. The paper also explores model quantization and pruning techniques to further enhance runtime efficiency. Results demonstrate that the proposed lightweight models enable robust and responsive facial expression recognition in real-world scenarios, offering a practical solution for emotion-aware applications that demand low computational overhead and real-time responsiveness.

**Keywords:** facial expression recognition, real-time processing, lightweight CNN, emotion detection, deep learning

**ICISCM2024-611**

# ENHANCING EMOTION DETECTION ACCURACY THROUGH CNN AND LSTM FUSION IN LIVE VIDEO STREAMS

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## ABSTRACT

Emotion detection in live video streams is crucial for advancing human–computer interaction, behavioral analysis, and affective computing applications. However, accurately identifying emotional states in real time remains challenging due to dynamic facial expressions, temporal variations, and varying video quality. This paper proposes a hybrid deep learning framework that fuses Convolutional Neural Networks (CNNs) and Long Short-Term Memory (LSTM) networks to enhance emotion detection accuracy in live video scenarios. The CNN component is used to extract spatial features from individual video frames, capturing localized facial cues such as eye movements, mouth curvature, and brow positioning. These features are then passed to the LSTM layer, which models temporal dependencies across sequential frames to recognize expression transitions and sustained emotional states. The system is trained and evaluated on benchmark datasets such as AFEW and RAVDESS, and tested in real-time scenarios using webcam-based input. Experimental results show that the CNN–LSTM fusion model significantly outperforms standalone CNN or LSTM architectures in terms of both accuracy and temporal consistency. The framework maintains real-time performance with minimal inference delay by employing model optimization techniques, including layer pruning and quantization. This research demonstrates the effectiveness of integrating spatial and temporal learning for robust emotion detection, enabling practical deployment in live video analytics systems where accuracy, speed, and adaptability are critical.

**Keywords:** emotion detection, CNN–LSTM fusion, live video analysis, temporal modeling, affective computing

**ICISCM2024-276**

# INTEGRATING NEURAL NETWORKS AND GENETIC ALGORITHMS FOR MULTI-OBJECTIVE SYSTEM OPTIMIZATION

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## ABSTRACT

Multi-objective optimization problems are central to complex system design, where multiple conflicting criteria such as performance, cost, and energy efficiency must be balanced. This paper proposes a hybrid approach that integrates neural networks and genetic algorithms (GAs) to address multi-objective system optimization tasks effectively. Neural networks are employed to model and approximate the behavior of complex systems, reducing the need for computationally expensive simulations. These surrogate models provide rapid estimations of objective function values, which are then used by the GA to guide the evolutionary search. The genetic algorithm performs selection, crossover, and mutation on a population of candidate solutions, gradually evolving toward Pareto-optimal fronts. This integration enables efficient exploration and exploitation of large, non-convex search spaces, improving convergence speed and solution quality. To enhance generalization, the neural network is trained on a diverse set of design configurations generated iteratively during the optimization process. The framework is validated through case studies in engineering design and energy system optimization, where results demonstrate improved optimization performance compared to standalone GAs or traditional multi-objective solvers. The hybrid model achieves a balance between exploration efficiency and solution accuracy, reducing computational overhead without compromising on diversity or optimality. This research offers a scalable and adaptable solution for real-world multi-objective problems where analytical models are intractable and fast evaluations are critical for decision-making.

**Keywords:** neural networks, genetic algorithms, multi-objective optimization, surrogate modeling, system design

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# A HYBRID FUZZY LOGIC AND REINFORCEMENT LEARNING FRAMEWORK FOR ADAPTIVE CONTROL IN COMPLEX ENVIRONMENTS

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## ABSTRACT

Adaptive control in complex, dynamic environments demand decision-making systems that are both interpretable and capable of learning from continuous feedback. This paper presents a hybrid framework that combines fuzzy logic and reinforcement learning (RL) to address the challenges of real-time adaptability and uncertainty management in non-linear and partially observable environments. Fuzzy logic is employed to encode expert knowledge and handle imprecise data through a rule-based inference system, providing initial stability and interpretability. Reinforcement learning, specifically a model-free Q-learning approach, is then integrated to enhance the adaptability of the control system by enabling agents to learn optimal control policies through interactions with the environment. The framework allows the fuzzy rule base to be dynamically tuned based on rewards obtained, creating a self-improving system that balances domain knowledge and experiential learning. Simulation experiments are conducted in environments such as autonomous navigation and robotic arm control, characterized by noise, delayed feedback, and changing dynamics. Results show that the hybrid system outperforms standalone fuzzy or RL controllers in terms of convergence speed, control accuracy, and robustness to disturbances. Moreover, the interpretability of the fuzzy component facilitates transparency in decision-making, which is valuable in safety-critical systems. This approach demonstrates a practical path toward developing intelligent, explainable, and adaptive controllers suited for real-world applications where uncertainty and change are constant.

**Keywords:** fuzzy logic, reinforcement learning, adaptive control, hybrid systems, intelligent agents

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# ENHANCING CLASSIFICATION PERFORMANCE USING AUTOENCODER-BASED DIMENSIONALITY REDUCTION IN HIGH-DIMENSIONAL DATASETS

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## ABSTRACT

High-dimensional datasets often present significant challenges for machine learning algorithms, including increased computational complexity, risk of overfitting, and degraded classification performance. This paper explores the effectiveness of autoencoder-based dimensionality reduction techniques in addressing these issues and enhancing classification accuracy in high-dimensional data environments. Autoencoders, as unsupervised neural networks, are capable of learning compressed feature representations by reconstructing input data through an encoder-decoder architecture. In this study, various types of autoencoders, including standard, denoising, and sparse variants, are employed to reduce dimensionality while preserving essential data structures and variance. The reduced feature sets are subsequently used as input to classification models such as support vector machines, random forests, and deep neural networks. Experimental evaluations are conducted on benchmark datasets from domains such as bioinformatics, image recognition, and text classification. Results show that the integration of autoencoder-based dimensionality reduction significantly improves classification accuracy, reduces training time, and enhances generalization performance compared to models trained on raw high-dimensional data. Additionally, the study demonstrates the robustness of autoencoders to noise and irrelevant features, making them suitable for real-world noisy data scenarios. Hyperparameter tuning and architectural optimization further contribute to improved performance. This research highlights the utility of autoencoders as a powerful preprocessing step for efficient and accurate classification in high-dimensional machine learning tasks.

**Keywords:** dimensionality reduction, autoencoders, high-dimensional data, classification, feature extraction