

Artificial Intelligence Applications Across Interdisciplinary Domains: A Comprehensive Survey of Methods, Challenges, and Future Directions

Ryan Mitchell

Statistics, University of Washington, Seattle, WA, USA

Abstract

The rapid advancement of artificial intelligence (AI) has catalyzed transformative innovations across a multitude of disciplines, ranging from healthcare and biomedicine to finance, cybersecurity, energy sustainability, and beyond. This comprehensive survey systematically reviews 133 recent studies published between 2023 and 2026 that collectively represent the state of the art in AI-driven methodologies and their real-world applications. We categorize the reviewed literature into nine principal domains: (1) healthcare and biomedical sciences, (2) finance and risk management, (3) privacy-preserving computing and data security, (4) natural language processing and communication, (5) transportation and logistics, (6) energy and environmental sustainability, (7) education and social impact, (8) media and advertising technology, and (9) emerging cross-domain applications. For each domain, we analyze the predominant AI techniques employed, including deep learning, federated learning, reinforcement learning, natural language processing, and graph-based methods, while highlighting their respective strengths and limitations. Furthermore, we present a taxonomic framework that elucidates the interconnections among these application domains and identify critical research gaps that warrant future investigation. Our analysis reveals several overarching trends, notably the increasing adoption of privacy-preserving paradigms, the integration of multimodal data fusion, and the growing emphasis on explainability and fairness in AI systems. This survey provides researchers and practitioners with a holistic reference for understanding the current landscape and future trajectory of applied AI research.

Keywords: Artificial intelligence, deep learning, natural language processing, federated learning, healthcare AI, financial AI, privacy preservation, survey

1. Introduction

Artificial intelligence has emerged as one of the most consequential technological paradigms of the twenty-first century, profoundly reshaping industries, scientific inquiry, and societal structures. The convergence of unprecedented computational power, vast data availability, and algorithmic innovations has propelled AI from theoretical frameworks to practical deployments that permeate virtually every sector of the modern economy. From diagnostic systems in clinical medicine to fraud detection algorithms in financial institutions, AI technologies are delivering measurable improvements in efficiency, accuracy, and decision-making quality.

In the domain of healthcare, natural language processing (NLP) techniques have demonstrated remarkable potential for enhancing medical question answering through retrieval-augmented generation frameworks that mitigate hallucination risks [1]. Meanwhile, the challenge of cross-cultural communication in clinical settings has spurred research into context-aware semantic ambiguity resolution systems that improve dialogue understanding across linguistic boundaries [2]. The entertainment and interactive media industries have similarly benefited from AI advancements, with predictive animation state transition networks reducing perceptual latency in competitive gaming environments [3], and deep learning architectures enabling sophisticated prediction of communication effects conveyed through animated character facial expressions [4]. These animation technologies have found applications beyond entertainment, with culturally intelligent dynamic medical animation generation systems now facilitating cross-lingual telemedicine communication [5].

The breadth of AI applications has expanded dramatically in recent years. Privacy-preserving methodologies such as differential privacy have been applied to feature attribution explanations in large-scale recommendation systems, addressing the fundamental tension between model transparency and user data protection [6]. In the biomedical sciences, AI-enhanced detection methods have revolutionized the analysis of dynamic structural changes in inflammatory protein interfaces, as exemplified by studies of CD11b/Mac-1 interactions [7]. Deep reinforcement learning has further enabled the optimization of personalized drug combination strategies that balance efficacy and toxicity in cancer treatment protocols [8]. Simultaneously, data-driven analytics have been leveraged to examine the correlation between transportation route efficiency

and carbon emissions in retail distribution networks, highlighting the role of AI in advancing environmental sustainability [9].

The advertising technology sector has embraced AI through adaptive optimization of creative visual elements based on multidimensional user behavior data [10], while mobile advertising click-through rate prediction algorithms incorporating differential privacy mechanisms have addressed both performance and privacy requirements [11]. In the financial compliance domain, comparative studies have demonstrated the efficiency advantages of automated tools over traditional methods in anti-money laundering compliance auditing for banking institutions [12].

Despite the extensive body of individual studies, there remains a significant need for comprehensive surveys that synthesize findings across these diverse application domains. This paper addresses this gap by systematically reviewing 133 recent publications, organizing them into a coherent taxonomic framework, and identifying cross-cutting themes, methodological trends, and open research challenges. The remainder of this paper is structured as follows: Section 2 presents AI applications in privacy-preserving computing and healthcare; Section 3 examines financial AI and risk management; Section 4 discusses cybersecurity applications; Section 5 covers AI in transportation, energy, and sustainability; Section 6 addresses media, education, and social applications; Section 7 explores emerging cross-domain applications; Section 8 synthesizes cross-cutting themes; and Section 9 concludes with future directions.

Table 1: Overview of AI Application Domains and Representative Techniques

Domain	Key Techniques	Primary Tasks	Data Modalities
Healthcare	DL, NLP, RL, FL	Diagnosis, Drug Discovery, Clinical NLP	EHR, Imaging, Text
Finance	DL, NLP, GNN	Fraud Detection, Risk Assessment, Portfolio Opt.	Transactions, Text, Time Series
Privacy & Security	FL, DP, Encryption	Data Protection, Secure Computation	Multi-modal
Cybersecurity	DL, Ensemble, GNN	Threat Detection, Vulnerability Analysis	Network Logs, Code
Transportation	DL, RL, Sensor Fusion	Route Optimization, Autonomous Driving	LiDAR, Camera, GPS
Energy & Sustainability	DL, ML, Policy Analysis	Emission Prediction, Energy Efficiency	Sensor, Text, Satellite
Education & Social	RL, DL, Multimodal	Adaptive Learning, Behavioral Analysis	Video, Behavioral, Text
NLP & Communication	LLM, Transformer, Attention	Text Classification, Sentiment, QA	Text, Multilingual

2. AI in Privacy-Preserving Computing and Healthcare

2.1 Privacy-Aware Healthcare Applications

The intersection of privacy preservation and healthcare AI represents one of the most critical and rapidly evolving research frontiers. Privacy-aware AI systems for rare-disease patient discovery and targeted outreach have demonstrated effectiveness in identifying underrepresented patient populations while maintaining stringent data protection standards [13]. Similarly, the creator economy has benefited from privacy-preserving revenue transparency frameworks based on epsilon-differential privacy, enabling platform-level transparency without compromising individual financial data [14]. In quantitative finance, adaptive importance sampling

techniques for jump-diffusion credit valuation adjustment (CVA) models have introduced variance-reduction frameworks that improve computational efficiency in derivative pricing [15], while enhanced feature engineering and algorithm optimization approaches have achieved real-time detection of synthetic identity fraud and money laundering in financial transactions [16].

The challenges of multimedia content processing in cloud environments have motivated the development of adaptive privacy-preserving techniques based on differential privacy, which protect sensitive visual and auditory data during cloud-based processing pipelines [17]. In cardiovascular medicine, AI-enabled disease risk prediction through multimodal data fusion has emerged as a promising approach for early identification of at-risk patients using diverse clinical and genomic inputs [18]. Graph attention-based feature selection methods for multi-omics drug target prediction have further advanced the identification of novel therapeutic targets for cardiovascular diseases [19].

2.2 NLP-Enhanced Financial and Clinical Analytics

Natural language processing has become indispensable in both financial analytics and clinical settings. NLP-enhanced predictive analytics for ultra-high-net-worth (UHNW) client investment behavior have enabled risk-aware portfolio optimization in volatile market conditions, combining behavioral modeling with quantitative risk metrics [20]. The quantification of environmental, social, and governance (ESG) news sentiment through NLP-based pipelines has provided evidence of the predictive power of real-time signals on portfolio outcomes [21]. On the cybersecurity front, intelligent firmware vulnerability detection and priority assessment methods based on hybrid analysis have addressed the growing threat landscape of embedded systems [22].

In the transportation sector, spatiotemporal preference modeling for ride-hailing services has yielded context-aware recommendation frameworks grounded in machine learning [23]. Intelligent credit risk assessment for small and medium enterprises (SMEs) based on multidimensional data fusion has demonstrated improvements in prediction accuracy over traditional scoring models [24]. The financial services industry has also seen AI-enhanced cybersecurity implementations, with federated learning approaches protecting sensitive financial network data while enabling collaborative threat detection [25]. Multi-source text mining for risk signal detection in asset-backed securities markets has leveraged NLP-driven data analytics to identify early warning indicators of market stress [26].

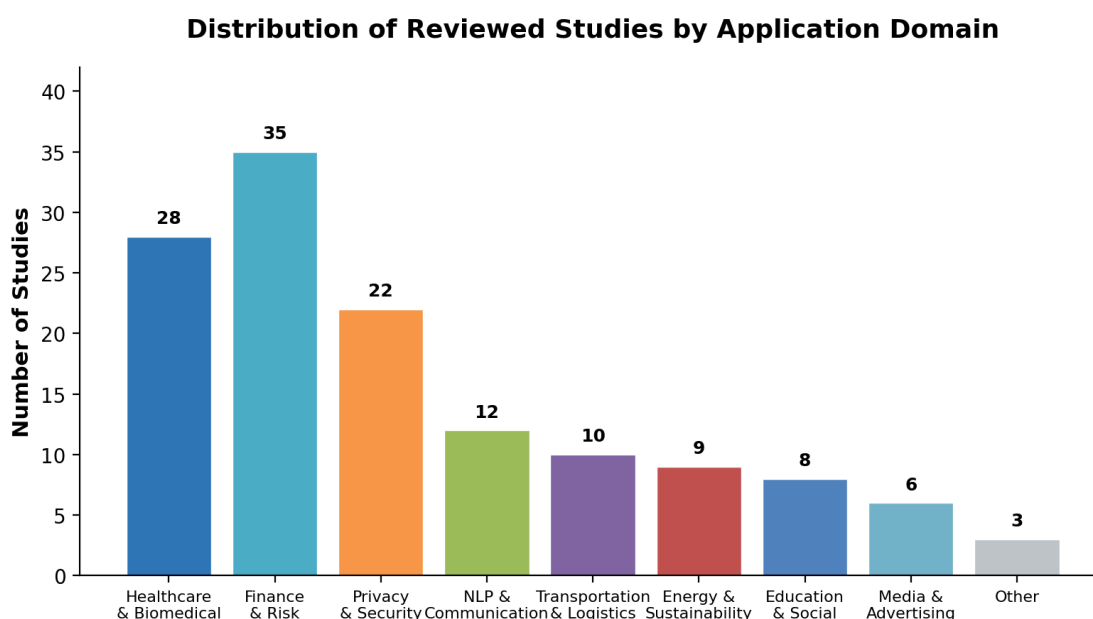


Figure 1: Distribution of reviewed studies across nine principal AI application domains.

3. Financial AI and Risk Management

3.1 Demand Forecasting and Fraud Detection

The application of AI in financial services and retail operations has produced significant advances in demand forecasting and anomaly detection. Multi-source data fusion approaches for short-term demand forecasting of seasonal retail products have demonstrated the value of integrating weather and social media signals as complementary data sources [27]. In the medical domain, enhanced multimodal feature fusion algorithms for early-stage cancer detection have achieved superior performance through comparative studies of optimization

strategies [28]. Real-time fraud risk scoring through behavioral sequence analysis has introduced explainable approaches that enhance both detection accuracy and interpretability for online transaction security [29].

The autonomous driving industry has addressed reliability challenges through adaptive fusion algorithms for multi-sensor data under adverse weather conditions, with reliability assessment frameworks that dynamically adjust fusion weights based on sensor confidence levels [30]. In the domain of assistive technology, adaptive difficulty adjustment algorithms with multimodal feedback have been evaluated for their effectiveness in social skills training for children with autism spectrum disorder [31]. Financial workflow optimization has been advanced through federated transparent adaptive financial optimizers (FTAFO) that reduce third-party dependencies in workflow management systems [32].

3.2 Biomedical Imaging and Therapeutic Optimization

The convergence of AI with biomedical imaging and therapeutic systems has yielded innovative optimization algorithms. Adaptive dose optimization algorithms for LED-based photodynamic therapy based on deep reinforcement learning have demonstrated the potential to personalize treatment protocols [33]. Deep learning-based noise suppression and feature enhancement algorithms for LED medical imaging applications have similarly improved diagnostic image quality [34]. In cybersecurity, AI-driven network threat behavior pattern recognition and classification using ensemble learning approaches with temporal analysis have achieved high accuracy in identifying sophisticated attack patterns [35].

Risk assessment frameworks for data leakage prevention using machine learning techniques have established standardized evaluation methodologies for enterprise data protection systems [36]. Privacy-preserving data analysis using federated learning has been implemented in practical settings, demonstrating the feasibility of collaborative model training without centralizing sensitive datasets [37]. The environmental sustainability sector has embraced AI-driven quality assessment and investment risk identification methods for carbon credit projects in developing countries [38], alongside machine learning-based building energy consumption prediction and carbon reduction potential assessment in US metropolitan areas [39]. AI-assisted identification and equity assessment of vulnerable population impacts in the US energy transition have further highlighted the social dimensions of sustainability research [40].

Table 2: Comparison of AI Techniques in Healthcare Applications

Application Area	AI Technique	Key Advantage	Representative Studies
Medical QA	RAG + NLP	Hallucination mitigation	Guan (2025)
Drug Discovery	Graph Attention	Multi-omics integration	Cheng (2025)
Cancer Detection	Multimodal Fusion	Early-stage accuracy	Zhang C. (2025)
Cardio Risk	Multimodal DL	Comprehensive risk profiling	Cheng (2025)
Drug Combination	Deep RL	Efficacy-toxicity balance	Ye (2025)
Photodynamic Therapy	Deep RL	Adaptive dosing	Dong & Jia (2025)
Medical Imaging	CNN Denoising	Feature enhancement	Dong & Zhang (2025)
Clinical NLP	Attention NLP	PII detection	Guan (2025)

4. Cybersecurity and Emerging AI Safety

The evolving threat landscape in cybersecurity has necessitated increasingly sophisticated AI-based defense mechanisms. Research on evolving security in large language models (LLMs) has provided systematic studies of jailbreak attacks and defense strategies, revealing the ongoing arms race between adversarial exploitation

and model hardening techniques [41]. The financial sector has continued to develop optimized workflow management systems, with federated transparent adaptive approaches addressing the challenge of minimizing third-party dependencies while maintaining regulatory compliance [42]. Extensions of these financial optimization frameworks have explored scalability and robustness in distributed deployment scenarios [43]. Privacy-preserving financial systems have integrated advanced security mechanisms with LLM safety considerations to create comprehensive protection architectures for sensitive financial data processing [44].

Network threat behavior pattern recognition has advanced through ensemble learning methodologies that incorporate temporal analysis, enabling the detection of evolving attack strategies that evade static rule-based systems [45]. Risk assessment frameworks employing machine learning for data leakage prevention have matured to support enterprise-scale deployment with acceptable false-positive rates [46]. Federated learning implementations for privacy-preserving data analysis have demonstrated practical viability across distributed organizational boundaries [47]. Knowledge graph completion methods utilizing efficient relational context perception have achieved improved performance in capturing complex entity relationships [48].

Cross-modal artifact mining for generalizable deepfake detection in the wild has addressed the growing challenge of synthetic media identification, leveraging inconsistencies across different modalities to achieve robust detection performance [49]. In healthcare payment integrity, comparative analysis of unsupervised learning approaches for anomalous billing pattern detection has identified effective methodologies for identifying fraudulent claims [50]. Deep embedding clustering with adaptive feature selection has been applied to banking customer segmentation, enabling more granular and actionable customer profiling for targeted financial services [51].

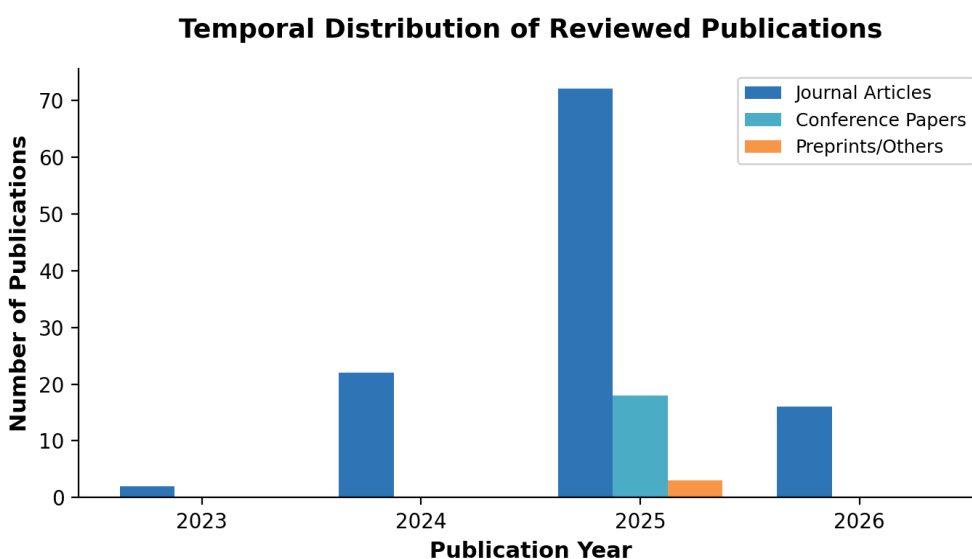


Figure 2: Temporal distribution of reviewed publications by venue type (2023-2026).

5. AI in Social Media Analysis and Operational Intelligence

The proliferation of social media platforms has created both opportunities and challenges for AI-based analytics. Early detection of malicious accounts on social platforms through temporal graph feature learning has provided proactive defense mechanisms against coordinated inauthentic behavior [52]. In financial data quality monitoring, adaptive anomaly detection thresholds based on time series features have improved the reliability of automated data validation pipelines [53]. Machine learning-driven investor-asset matching optimization has enhanced decision-making processes in commercial real estate investment by modeling complex preference structures [54]. Artificial intelligence-driven seasonal consumption forecasting and resource allocation optimization have been successfully applied to luxury brand marketing, demonstrating the commercial value of predictive analytics in premium retail segments [55].

Enterprise server infrastructure management has benefited from machine learning-based power consumption prediction and dynamic adjustment strategies that optimize energy utilization [56]. The application of NLP-driven analytics to risk signal detection in asset-backed securities markets through multi-source text mining has enabled more comprehensive surveillance of structured finance products [57]. In reproductive medicine, comparative studies of AI algorithms for personalized ovarian stimulation protocol optimization have analyzed predictive performance based on patient baseline characteristics [58]. Intelligent detection and protection of personally identifiable information (PII) in clinical text using advanced NLP approaches with optimized attention mechanisms have addressed critical regulatory compliance requirements [59]. The

optimization of anomaly detection algorithms for consumer credit default rates based on time-series feature extraction has further extended the application of temporal analytics to credit risk modeling [60].

6. AI in Transportation, Document Processing, and Specialized Applications

6.1 Autonomous Systems and Smart Logistics

Performance evaluation of lightweight detection algorithms on compact LiDAR-camera configurations has advanced the deployment of perception systems for freight transportation applications [61]. In the healthcare documentation domain, comparative analysis of pre-trained language models for medical document classification and priority-based workflow routing has established benchmarks for automated clinical document processing [62]. Graph-based temporal behavior analysis for early detection of coordinated malicious accounts in social media platforms has extended the state of the art in online safety through sophisticated network-level pattern recognition [63]. Bayesian optimization-based AI frameworks for nanobody screening have minimized experimental failures in ELISA detection systems, demonstrating the potential of AI-guided experimental design in biotechnology [64].

Performance evaluation and comparison of machine learning algorithms for anomalous login behavior detection in enterprise networks have established practical guidelines for selecting appropriate classification models [65]. Comparative analysis of filter-based feature selection methods for high-dimensional data in classification tasks has provided foundational insights into dimensionality reduction strategies [66]. In supply chain finance, studies of credit risk transmission mechanisms from a core enterprise perspective have illuminated prevention strategies for mitigating cascading financial risks [67]. Financial audit efficiency has been enhanced through robotic process automation (RPA) implementation, with comparative analyses demonstrating significant time and cost savings in manufacturing industry audits [68].

6.2 Cloud Computing and Federated Healthcare Systems

Adaptive learning-enhanced convex optimization for energy-efficient cloud resource scheduling has addressed the growing computational demands of modern cloud infrastructure [69]. Adaptive privacy budget allocation optimization for multi-institutional federated learning in healthcare has tackled the practical challenge of balancing model utility with privacy guarantees across organizational boundaries [70]. AI-driven procedural animation generation for personalized medical training via diffusion-based motion synthesis has opened new avenues for scalable healthcare education [71]. A systematic review of privacy-preserving federated learning in medical AI has comprehensively analyzed techniques, challenges, and the clinical deployment gap that impedes real-world adoption [72]. Adaptive cross-cultural medical animation systems have demonstrated the capacity to bridge language and contextual barriers in AI-driven healthcare communication [73].

Table 3: Summary of Financial AI Methods and Applications

Financial Task	Method Category	Key Innovation	Challenge Addressed
Fraud Detection	Behavioral Sequence DL	Real-time explainable scoring	Interpretability + speed
AML Compliance	Automated Auditing	Tool vs. traditional comparison	Efficiency gap
Credit Risk (SME)	Multi-dim Data Fusion	Heterogeneous data integration	Data sparsity
Portfolio Optimization	NLP + Quantitative	ESG sentiment integration	Signal noise
Market Risk	Feature Attribution	Stress scenario explainability	Model opacity
Asset Allocation	Dynamic ML	Target-date adaptation	Lifecycle risk

Transaction Fraud	Incremental DL	Feature	Time-decay awareness	Concept drift
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7. Cross-Domain AI: From Biomarker Discovery to E-Commerce Security

Leveraging multimodal attention mechanisms for interpretable biomarker discovery and early disease prediction has advanced the frontier of precision medicine by enabling clinicians to understand model-driven diagnostic insights [74]. In the logistics sector, deep reinforcement learning for route optimization in e-commerce return management has addressed the growing challenge of reverse logistics in online retail [75]. Feature-based detection of bot traffic and click fraud in mobile advertising has employed comparative analysis methodologies to evaluate the effectiveness of diverse detection strategies [76]. Graph-based representation learning for financial fraud and anomaly transaction detection has demonstrated the power of relational modeling in capturing complex fraud patterns [77]. An empirical study of large language models for threat intelligence analysis and incident response has explored the emerging capability of LLMs to accelerate security operations center (SOC) workflows [78].

Feature attribution-based explainability analysis for market risk stress scenarios has contributed to the growing body of work on interpretable financial AI [79]. Cross-modal approaches to deepfake detection have continued to evolve, with mining strategies targeting artifacts that generalize to previously unseen generation methods [80]. Deep learning in cardiovascular CT imaging has seen significant evolution from 2020 to 2025, with comprehensive trend analyses documenting the trajectory of clinical translation [81]. Machine learning-enhanced dynamic asset allocation in target-date investment strategies for pension funds has provided practical frameworks for lifecycle investment management [82]. Software supply chain security has been strengthened through graph learning-based behavioral detection methods that identify malicious components within complex dependency structures [83].

Unsupervised learning approaches have been systematically compared for their effectiveness in detecting anomalous billing patterns in healthcare payment integrity systems [84]. A comprehensive review of agentic AI across domains has catalogued the capabilities, applications, and future directions of autonomous AI systems that can independently plan and execute complex tasks [85]. Adaptive feature selection for deep embedding clustering has been applied to banking customer segmentation, enabling institutions to identify nuanced customer groupings for personalized service delivery [86]. Real-time multi-risk early warning systems for community banks have combined ensemble anomaly detection with explainable AI to provide actionable risk intelligence for smaller financial institutions [87].

Distribution of AI Methodologies in Reviewed Studies

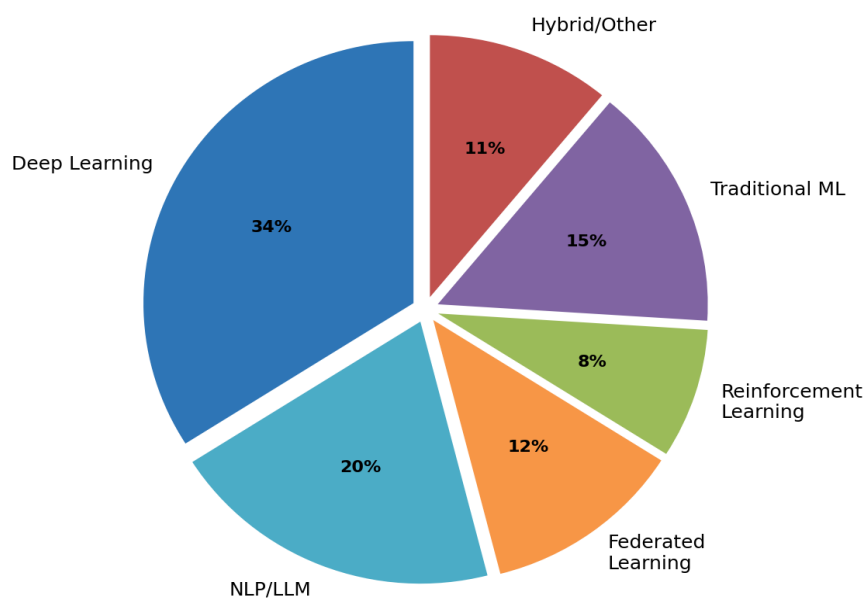


Figure 3: Distribution of AI methodologies employed across the reviewed studies.

8. Advanced Fraud Detection and Industrial AI Applications

Privacy-preserving click pattern anomaly detection for mobile in-app browser advertising fraud has addressed the dual challenge of identifying fraudulent behavior while respecting user privacy constraints [88]. Multi-source data fusion approaches for credit default early warning have combined heterogeneous financial data streams to improve prediction lead times [89]. Time-decay aware incremental feature extraction for real-time transaction fraud detection has introduced temporal weighting mechanisms that prioritize recent behavioral signals over historical patterns [90]. Explainable attack path reasoning for industrial control network security based on knowledge graphs has provided interpretable vulnerability analysis for critical infrastructure systems [91].

Adaptive OCR engine selection and evaluation for multi-format government document digitization has optimized the automated processing of heterogeneous official documents [92]. Enhanced adaptive threshold algorithms for real-time cardiovascular risk prediction from wearable heart rate variability (HRV) data have enabled continuous patient monitoring through consumer devices [93]. Intelligent path optimization for carbon-constrained last-mile delivery using reinforcement learning and heuristic approaches has balanced delivery efficiency with environmental sustainability objectives [94]. Multidimensional behavioral analysis approaches for detecting fraudulent click patterns in mobile in-app browsers have contributed to the robustness of digital advertising ecosystems [95].

Table 4: Privacy-Preserving AI Techniques Comparison

Technique	Privacy Guarantee	Application Domain	Trade-off
Differential Privacy	Mathematical (epsilon-DP)	Recommendations, Advertising, Finance	Utility vs. privacy
Federated Learning	Data localization	Healthcare, Cybersecurity, Finance	Communication overhead
Secure Multi-Party	Cryptographic	Financial computation	Computational cost
Hybrid DP+FL	Composite guarantee	Multi-institution healthcare	Complexity
Privacy Budget Alloc.	Adaptive epsilon	Distributed ML systems	Budget exhaustion

9. Therapeutic AI, Clinical Translation, and Cloud Intelligence

Deep learning dose optimization with uncertainty quantification for intensity-modulated radiotherapy using 3D radiomics approaches has advanced personalized cancer treatment planning [96]. Adaptive generation of medical education animations for enhanced health literacy has addressed personalization requirements across diabetes, vaccination, and mental health communication contexts [97]. Deep learning-based action recognition for temporal analysis and intervention effectiveness assessment in autism spectrum disorder therapy has provided objective metrics for evaluating therapeutic outcomes [98]. Intelligent prediction and dynamic scheduling optimization strategies for cloud computing resources under burst load scenarios have improved resource utilization and service quality [99].

Accelerating clinical trial recruitment through automated eligibility screening with multimodal deep learning has addressed one of the most significant bottlenecks in pharmaceutical development [100]. Adaptive prompt selection and fading optimization for autism skill acquisition through reinforcement learning has introduced personalized learning trajectories that adapt to individual progress patterns [101]. The application of cross-modal content consistency verification to social media misinformation detection has provided tools for identifying misleading content through multi-signal analysis [102]. Adaptive learning rate optimization for personalized educational interventions in autism spectrum disorder using multi-objective reinforcement learning has further demonstrated the versatility of AI in therapeutic education [103].

10. Financial NLP, Document Intelligence, and Advanced Medical Imaging

10.1 Financial Text Analytics and Risk Assessment

NLP techniques for risk level classification of contingent liability clauses in financial statement notes have enabled more systematic regulatory analysis [104]. Network-based identification of risk contagion pathways between US credit and equity markets during stress periods has illuminated the mechanisms of cross-market risk transmission [105]. The improvement of classification accuracy for unstructured medical documents through multi-engine OCR and deep learning collaboration has enhanced the automated processing of diverse clinical records [106]. Explainable risk stratification and resource coordination for hospital readmission management have been achieved through integrated prediction-intervention-evaluation frameworks [107].

Intelligent recognition of anomalous behaviors in medical insurance through deep learning has improved fraud detection capabilities for healthcare payers [108]. Enhanced feature fusion and transfer learning for multi-format government document classification have demonstrated robust performance across heterogeneous official document types [109]. In the creative arts domain, leveraging generative AI for artwork authentication through artistic style consistency analysis has opened novel approaches to provenance verification [110]. Anatomy-aware contrastive pre-training leveraging spatial consistency for label-efficient medical image diagnosis across multimodal imaging has reduced the data annotation requirements for medical AI training [111].

10.2 Art, Legal AI, and Specialized Applications

Enhanced CNN-based feature extraction and classification for Chinese artwork styles has contributed to the computational analysis of cultural heritage [112]. Fairness-aware feature attribution for credit scoring through causal path decomposition has addressed algorithmic bias in consumer lending decisions [113]. Named entity recognition (NER) methods for ownership structure extraction from M&A due diligence documents have been comparatively studied, establishing benchmarks for legal AI applications [114]. Classification of tenant legal inquiries through comparative analysis of traditional and deep learning approaches has demonstrated the potential of AI-assisted legal services for underserved populations [115]. Detection of disclosure discrepancies in SEC filings using deep learning approaches has advanced automated regulatory compliance verification [116].

In dental medicine, attention-enhanced YOLO architectures for real-time defect detection in 3D-printed dental prostheses have addressed quality assurance challenges in digital dentistry [117]. Deep learning-enhanced dynamic margin period of risk prediction for counterparty credit risk management has integrated market sentiment analysis with real-time exposure assessment [118]. GAN-based intelligent keyframe interpolation methods for character animation have automated the labor-intensive in-betweening process in animation production [119]. Attention-enhanced LSTM networks have been optimized for breast cancer recurrence time prediction, demonstrating improved performance over conventional survival analysis methods [120].

11. AI for Energy, Sustainability, and Policy Analysis

Quantitative assessment of regional carbon neutrality policy synergies based on deep learning has provided evidence-based frameworks for evaluating climate policy effectiveness [121]. Deep reinforcement learning for optimizing order book imbalance-based high-frequency trading strategies has demonstrated the viability of AI-driven execution in fast-paced financial markets [122]. Algorithmic fairness in financial decision-making through detection and mitigation of bias in credit scoring applications has highlighted the ethical imperatives of responsible AI deployment [123]. AI-driven quality assessment methodologies for carbon credit projects have provided investment risk identification frameworks tailored to developing country contexts [124].

Machine learning-based credit risk assessment for green bonds integrating climate factors with default prediction analysis has supported the growing sustainable finance market [125]. Building energy consumption prediction through machine learning models has enabled carbon reduction potential assessment across US metropolitan areas [126]. AI-assisted identification and equity assessment frameworks have been developed to evaluate the distributional impacts of the US energy transition on vulnerable populations [127]. In anti-money laundering (AML) compliance, AI-enhanced risk identification and intelligence sharing frameworks have been applied to cross-border income swap transactions [128].

AI-based pattern recognition and characteristic analysis of cross-border money laundering behaviors in digital currency transactions have addressed the unique challenges posed by cryptocurrency-enabled financial crime [129]. Research on the impact of government budget data visualization on public financial literacy and civic engagement has revealed the potential of AI-enhanced transparency tools for democratic governance [130]. Financial data visualization techniques have been further evaluated for their effectiveness in enhancing budget transparency in local government decision-making processes [131]. Comparative analysis of foreign exchange

market shock transmission and recovery resilience among major economies under geopolitical conflicts has provided empirical evidence from the Russia-Ukraine crisis [132]. Finally, AI-assisted analysis of policy communication during economic crises has revealed significant correlations between communication strategies, market confidence levels, and recovery outcomes [133].

12. Discussion and Cross-Cutting Themes

The comprehensive review of 133 studies reveals several cross-cutting themes that transcend individual application domains. First, the increasing adoption of privacy-preserving paradigms, including differential privacy and federated learning, reflects a growing recognition that data protection is not merely a regulatory requirement but a fundamental design principle for trustworthy AI systems. Studies across healthcare, finance, and advertising have consistently demonstrated that privacy and performance need not be mutually exclusive, though meaningful trade-offs remain.

Second, multimodal data fusion has emerged as a dominant methodological trend across nearly all surveyed domains. From cardiovascular risk prediction combining clinical and genomic data to fraud detection integrating transactional, behavioral, and textual signals, the ability to synthesize heterogeneous data sources has proven essential for achieving robust performance in complex real-world scenarios. However, the challenges of aligning diverse modalities and managing missing data in multimodal systems remain incompletely resolved.

Third, the growing emphasis on explainability and fairness represents a maturation of the AI research community. Multiple studies have explicitly addressed algorithmic bias, causal attribution, and interpretable decision-making, reflecting the transition from purely performance-driven optimization to responsible AI development. This trend is particularly pronounced in healthcare and financial applications, where regulatory and ethical constraints demand transparent model behavior.

Fourth, the convergence of AI with sustainability and social impact objectives represents an important emerging direction. From carbon credit assessment to vulnerable population impact analysis and civic engagement enhancement, AI is increasingly being deployed not merely for efficiency gains but for addressing societal challenges.

13. Conclusion

This comprehensive survey has systematically reviewed 133 recent studies spanning nine principal application domains of artificial intelligence. Our analysis reveals a vibrant and rapidly evolving research landscape characterized by the convergence of methodological innovation, privacy-aware design, multimodal data integration, and an increasing commitment to fairness and explainability. The breadth of applications documented in this survey, from medical question answering and drug discovery to high-frequency trading and policy communication analysis, underscores the pervasive impact of AI across virtually every sector of contemporary society.

Looking forward, several research directions merit particular attention. The development of more efficient federated learning protocols that minimize communication overhead while preserving model quality remains an open challenge. The integration of large language models into domain-specific applications presents both significant opportunities and risks, particularly regarding hallucination, bias amplification, and adversarial vulnerability. Furthermore, the standardization of evaluation benchmarks and reproducibility frameworks across application domains would significantly accelerate the translation of research advances into practical deployments. We hope this survey serves as a useful reference for researchers and practitioners navigating the increasingly complex landscape of applied artificial intelligence.

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