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№	Статья и ссылка	Аннотация
1	Akbarov, B., Makhanov, K., Kanymgaziyeva, I., Imanbayev, T., Abeuov, N., & Dissyukov, C. (2025). DESIGN AND DEVELOPMENT OF CIRCULARLY POLARISED ANTENNA FOR RFID SYSTEM. *Scientific Journal of Astana IT University*, *23*, 6–15. https://doi.org/10.37943/23GDLZ8527	This paper presents the research and development results of circularly polarised antennas used in radio frequency identification (RFID) systems. Such antennas play a crucial role in improving reliability, orientation independence and reading range of RFID systems in industry, transport and logistics. The frequency range under consideration is 860-900 MHz (UHF), which is widely used for passive RFID technologies due to its favorable propagation characteristics and compatibility with international standards. A printed antenna from FEIG ELECTRONIC GmbH (Germany) was used as a reference for the developed antenna. This paper presents the results of a similar antenna but without the use of a symmetry transformer. The elimination of this component reduces the overall design complexity, improves manufacturability and minimizes manufacturing cost, making the design more suitable for mass deployment. The printed dipole was developed on a 1.6 mm thick FR4 substrate with a relative dielectric constant of 4.3 and a dielectric loss tangent of 0.02. The dimensions of the developed printed dipole correspond to 332 mm × 34 mm × 1.6 mm. The printed dipole and the overall design of the developed RFID antenna were pre-simulated in the software environment “CST Studio Suite”, which allows accurate simulation of the electromagnetic behavior. This modelling step was necessary to optimize the input matching, radiation efficiency and circular polarization characteristics. The frequency of the designed antenna was 868 MHz (|S11| < -10 dB). and the radiated power was measured to be -11.7 dBm. The layout of the printed dipole was designed using Altium Designer software. The prototype assembly proceeded following model-based and electromagnetic simulation techniques. A Spectrum Rider FPH spectrum analyzer conducted test measurements which supported the theoretical prediction results.

		The proposed framework demonstrates great promise as an inexpensive solution with high detection efficiency for modern RFID systems operating in diverse conditions. **Keywords:** Antenna, circular polarisation, radio frequency identification (RFID), reader antenna, Ultra High Frequency (UHF)
2	Raikhan, M., Aitimova, S., Bektaev, A., Zhumanbayeva, T., Keneshbayev, B., & Abdikarimova, A. (2025). ASSESSMENT OF UNPROFITABILITY OF COMPULSORY EMPLOYEE ACCIDENT INSURANCE TARIFFS IN KAZAKHSTAN. *Scientific Journal of Astana IT University*, *23*, 16–34. https://doi.org/10.37943/23CAME2815	Compulsory insurance of employees against industrial accidents is an important social protection tool in Kazakhstan, but the current rates are insufficiently stable and do not cover the actual risks, which leads to financial imbalances among insurers and reduces the level of compensation for employees. The purpose of this study is to identify the reasons for the unprofitability of existing rates and to develop proposals for their modernization based on modern risk assessment methods. The study used actuarial calculations, including analysis of loss ratios, payments, and total expenses, as well as the construction of linear trends to forecast future losses. In addition, statistical modeling methods were used, including probability distributions and Markov chains, which made it possible to justify the introduction of a differentiated tariff system and a bonus-malus mechanism for enterprises depending on the level of industrial injuries. The results of the analysis showed an increase in the loss ratio from 11.87 percent in 2020 to 35.33 percent in the second quarter of 2024 and an increase in the aggregate loss ratio from 65.6 to 73.1 percent. The calculations determined a new base rate of 0.6842 percent compared to the current level of 0.59 percent, reflecting the need to revise insurance rates to ensure the financial stability of the system. A two-tier tariff model has been proposed, taking into account industry and occupational risks, as well as a bonus-malus mechanism that creates economic incentives for employers to invest in improving occupational safety and reducing the number of accidents. The practical significance of the study lies in the possibility of applying the results obtained by insurers, government agencies, and employers in forming a balanced and

		sustainable compulsory insurance system capable of simultaneously strengthening the financial stability of the insurance market and increasing the social protection of workers. **Keywords:** compulsory accident insurance (CAI), actuarial calculations, loss ratio, base rate, bonus-malus, occupational risk, insurance rates, social protection
3	Abildaeva, Z., Uskenbayeva, R., Konyrbaev, N., Beketova, G., Lakhno, V., & Desiatko, A. (2025). INNOVATIVE APPROACHES TO AGRICULTURAL MARKETING: NSGA-II AND K-MEANS FOR STRATEGIES IN THE AGRO-INDUSTRIAL COMPLEX. *Scientific Journal of Astana IT University*, *23*, 35–45. https://doi.org/10.37943/23ORHF6321	The relevance of this study is determined by the urgent need to improve marketing strategies in the agro-industrial complex (AIC) of Kazakhstan, where competitiveness and sustainability depend not only on production efficiency but also on effective promotion of agricultural products. Rapid digitalization and regional market heterogeneity create new challenges for enterprises that cannot be solved by traditional heuristic or single-objective approaches. The purpose of the research is the development of a hybrid method for multi-criteria optimization of marketing budget allocation in the AIC of Kazakhstan. The objective of the experiment is to test the hypothesis that such a method provides more balanced solutions in terms of efficiency, coverage, and cost compared to baseline approaches. The methodology is based on combining the evolutionary NSGA-II algorithm with K-means clustering. The first stage identifies Pareto-optimal distributions of marketing resources, while the clustering procedure segments the obtained strategies into groups with distinct efficiency-cost trade-offs. Input data were derived from synthetic simulations reflecting typical market conditions and real indicators of several agricultural enterprises. The results of computational experiments demonstrate that the proposed method outperforms single-objective optimization. In particular, it achieved higher average efficiency (1.56 vs. 1.10), wider coverage (1.39 vs. 0.95), and greater hypervolume (0.67 vs. 0.45). Clusters with combined use of digital and television channels provided the most effective balance of performance indicators, while radio and print media remained relevant for enterprises with moderate

		budgets. The novelty of the study lies in integrating evolutionary optimization with machine learning for marketing strategy design in the AIC. The obtained data can be applied by managers and policymakers for media planning, budget allocation, and the development of adaptive strategies that strengthen competitiveness and contribute to export growth. **Keywords:** agro-industrial complex (AIC), digital marketing, agromarketing, strategy, target functions, optimization, hybrid method, machine learning, agricultural products
4	Basheyeva, Z., Oralkhanov, D., Orazov, T., & Soltan, G. (2025). DEVELOPMENT AND IMPLEMENTATION OF AN AUTOMATED WEB-BASED KPI MANAGEMENT AND DASHBOARD SYSTEM AT ASTANA IT UNIVERSITY. *Scientific Journal of Astana IT University*, *23*, 46–62. https://doi.org/10.37943/23MZIN6824	Evaluating Key Performance Indicators (KPIs) of faculty and staff is critical to ensuring accountability and promoting institutional effectiveness in higher education. However, the management of these processes often relies on manual, error-prone systems, creating significant administrative burdens. This study addresses these challenges by presenting a novel, replicable framework for translating complex institutional regulations into an automated, multi-stakeholder KPI management system. We detail the design and implementation of a web-based platform at Astana IT University, which was developed by programmatically encoding the institution's official KPI calculation and validation rules. The system features a multi-perspective analytical ecosystem, providing role-specific dashboards for faculty, review committees, department heads, and central administration to support synchronized decision-making. The core scientific contribution is a holistic methodology that combines stakeholder-driven requirements analysis with a "Policy-as-Code" approach to create a transparent, auditable, and scalable solution. Preliminary results indicate significant improvements in efficiency and data accuracy, demonstrating the framework's effectiveness. This study contributes not only a practical solution for KPI management but also a validated methodological blueprint for digital transformation applicable to other higher education institutions facing similar regulatory and administrative complexities.

		Future work will explore the integration of predictive analytics to enable early intervention in cases of underperformance. Additional modules such as goal-setting tools, peer comparison features, and customizable reporting templates are also planned to enhance usability and strategic planning capabilities. By fostering a data-driven culture and ensuring alignment with institutional goals, such systems can play a key role in long-term academic quality assurance and workforce development. **Keywords:** KPI, automated system, dashboard analytics, performance management, web application, digital transformation, faculty assessment, staff productivity, role-based interface
5	Ussenov, B., Temen, A., Srymbetov, Z., Yeshmukhametov, A., & Akhmetov, T. (2025). DEVELOPMENT OF A VIRTUAL REALITY-BASED FIRE SAFETY TRAINING SYSTEM FOR APARTMENT RESIDENTS. *Scientific Journal of Astana IT University*, *23*, 63–77. https://doi.org/10.37943/23LTJV6054	Fire safety training is crucial for preventing injuries and property damage during emergencies. Traditional training methods, such as physical drills and lectures, suffer from low engagement, high costs, and limited realism. Virtual reality technology offers an innovative approach to improve fire safety education by providing an immersive and interactive training environment. This paper presents the development of a virtual reality-based fire safety training system for apartment residents, designed for a head-mounted display. The system incorporates realistic fire simulations and mechanics for interactive fire extinguishing. Our study explores both qualitative and quantitative measurements of a virtual reality (VR) training model, comparing it with alternative video-based training for fire safety. The experiment involved 20 participants who underwent training using either our VR system or video instructions, divided into two groups. After the VR training, participants completed a presence questionnaire and a knowledge test. Objective metrics included overall escape time and completion rate. Subjective data were collected through semi-structured interviews conducted after the experiments. Results indicate a significant difference in presence scores and higher knowledge scores for the VR group (VR: M = 10.9, SD = 2.37; Video: M = 7.3, SD = 1.33). These

		findings suggest that immersive VR training enhances procedural learning and situational awareness more effectively than passive video instruction. The study contributes to the field of VR in safety education by offering empirical evidence of its advantages and highlighting gaps in user engagement and realism in conventional methods. Limitations include the small sample size and short-term retention measurement. Future work will explore larger-scale evaluations and the integration of AR for blended learning experiences. **Keywords:** fire safety training, virtual reality, immersive learning, fire simulation, interactive training, head-mounted display, emergency preparedness, risk-free training
6	Abdikenov, B., Zhaksylyk, T., Imasheva, A., Orazayev, Y., & Suleimenova, D. (2025). FUSION VIEW-NET: DUAL-VIEW DEEP LEARNING FOR ROBUST MAMMOGRAPHIC BREAST CANCER CLASSIFICATION. *Scientific Journal of Astana IT University*, *23*, 78–90. https://doi.org/10.37943/23OUMR1748	Breast cancer is still one of the top causes of cancer-related death for women globally, and better patient outcomes depend on early identification. Although mammography is the main imaging modality used for screening, the delicate nature of early clinical symptoms and inter-reader variability sometimes compromise diagnostic accuracy. We examine the application of deep convolutional neural networks (CNNs) to automated classification of mammogram images in this work. FusionView-Net (FV-Net) is also presented, a novel dual-view integration framework that combines data from mediolateral oblique (MLO) and craniocaudal (CC) views to improve diagnostic precision. To produce a more comprehensive depiction of the breast tissue than conventional single-view methods, FV-Net combines contextual and spatial data from both standard perspectives. Two publicly available mammography datasets, which have been properly divided to allow for both seen-unseen data configurations and cross-dataset generalization testing, are used to assess the approach. A variety of CNN architectures are evaluated on separate and combined datasets, including ResNet18 and a specially created CNN. Findings indicate that FV-Net significantly increases model robustness and classification accuracy, as evidenced by consistently better F1 scores

		and ROC AUC values, especially when combined with ResNet18 and the custom CNN. The necessity for flexible models in actual clinical settings is shown by generalization studies, which further highlight the significance of dataset diversity by showing a noticeable drop in performance when domain shifts are present. Our results demonstrate how well multi-view fusion works for CNN-based mammography classification and provide useful guidance for choosing architectures and training methods. The development of trustworthy, broadly applicable AI technologies to assist radiologists in the early diagnosis of breast cancer is made possible by FV-Net. **Keywords:** Deep Learning, Mammography, Breast Cancer, Computer-Aided Diagnosis (CADx), Medical Image Analysis, Classification
7	Rzayeva, L., Nyssanov, N., Tendikov, N., Kirichenko, L., Kozhakhmet, Z., & Batkuldin, A. (2025). ADVANCED IMAGE COMPRESSION METHODS: A COMPARATIVE ANALYSIS OF MODERN ALGORITHMS AND THEIR APPLICATIONS. *Scientific Journal of Astana IT University*, *23*, 91–102. https://doi.org/10.37943/23ZLAI3218	The paper examines in detail the modern methods of image compression, focusing on how advanced algorithms are used in practical digital imaging systems. The study examines many compression methods, including LZMA, LERC, ZSTD and their mixed forms and compares how well they perform in terms of compression ratio, time required, memory efficiency and how much information entropy they keep. Machine learning methods for compression are used in the analysis, focusing on how they work with images from medical imaging as well as satellite data. Experiments are performed on standardized datasets, with the main goal of following the theoretical limits set by Shannon's Source Coding Theorem. The study shows that using modern hybrid algorithms, it is possible to compress data by at least 4:1 and keep it safe, with LZMA and LERC combinations performing best when the data is subject to entropic constraints. The results show that using parallel processing leads to a 60% decrease in processing time when compared to traditional single-threaded methods. The results strengthen the theories and techniques needed for the next generation of compression systems, mainly for handling high-resolution images quickly.

		Keywords: machine learning, hybrid algorithms, ZSTD, parallel processing, hyperspectral imaging, data compression, perceptual quality, adaptive coding, wavelet transform, rate-distortion
8	Soltan, G., Bekkaliyev, Z., Issayev, A., Akzhol, N., & Basheyeva, Z. (2025). APPLYING DATA ANALYTICS AND BI SYSTEMS TO BUILD A STUDENT DIGITAL PROFILE: THE CASE OF ASTANA IT UNIVERSITY. *Scientific Journal of Astana IT University*, *23*, 103–115. https://doi.org/10.37943/23JOZI8138	Modern challenges of the digital transformation of education require the development of new approaches to assessing academic success and monitoring students' educational trajectories. This study presents a functional model of the data analytics system and visualization of the digital profile of a graduate of Astana IT University (AITU), based on the Integrated IGPA (Integrated Grade Point Average) indicator, which combines the academic, research, and social achievements of students. The aim of the work is to create a system of analytics, visualization, and interpretation of data reflecting the comprehensive development of students and their readiness for professional activity. The theoretical part examines modern approaches to educational analytics in higher education. A critical analysis of scientific sources, including research on learning analytics, educational data mining, and the formation of digital profiles of students, was carried out. The emphasis on technical aspects and insufficient connection with educational practice reveals the main limitations of the existing models. The empirical part uses anonymized data from AITU students for 2022–2024, covering the indicators of Grade Point Average (GPA), Indicators of Research-Oriented Study (iROS), and Social Competition Indicators (SSCI). Dashboards built with the help of Power BI made it possible to visualize and interpret educational trajectories. The use of machine learning algorithms (K-means clustering, PCA analysis) ensured the typologization of student profiles. Using Python and the scikit-learn, seaborn, and pandas' libraries allowed us to deeply explore the relationships between IGPA components. The results of the study demonstrate the possibilities of personalized academic support, strategic management of

		educational processes, and increased transparency of student achievement. The developed model can serve as a basis for making managerial decisions and improving the quality of educational programs in the context of digital transformation. The proposed approach can be scaled and adapted to other educational institutions, regardless of their size and specialization. Flexibility in integrating additional indicators reflecting the unique goals and values of a particular educational environment facilitates the model's versatility. **Keywords:** digital graduate profile, integral GPA, educational analytics, data visualization, digital transformation of education, automation of data analysis, interactive dashboards
9	Chepashev, D., Maximkina, Y., Zhussupova, G., Zhilkibayev, R., & Merekeyev, D. (2025). RECOGNITION OF THE WATER SURFACE ACCORDING TO ICEYE DATA USING MACHINE LEARNING. *Scientific Journal of Astana IT University*, *23*, 116–136. https://doi.org/10.37943/23KUWI4163	The growing frequency of floods and the resulting socio-economic losses highlight the need for accurate and automated tools for detecting and monitoring water surfaces. This study presents a methodology for automatic water surface recognition based on high-resolution ICEYE synthetic aperture radar (SAR) data. The algorithm is implemented in the Google Earth Engine environment and uses the Random Forest machine-learning model trained on manually labeled “water” and “land” classes derived directly from the radar imagery. Preprocessing, performed in ESA SNAP, included radiometric calibration, Range-Doppler terrain correction, and speckle filtering to ensure accurate backscatter representation. The trained model was applied to ICEYE VV-polarized images acquired over Uralsk, Kazakhstan, on April 20–21, 2024, during a major regional flood. To validate the results, the Random Forest–derived masks were compared with those obtained using traditional methods such as Otsu and fixed-threshold classification, as well as optical masks generated from Sentinel-2 NDWI and MNDWI indices. Quantitative evaluation showed an overall accuracy of 76.8 % and a kappa coefficient of 0.535, while the area under the ROC curve (AUC

		= 0.91) indicated strong discriminatory capability. The Random Forest model demonstrated greater spatial precision and reduced false-positive mapping compared to threshold-based methods, confirming its suitability for operational flood monitoring. The proposed approach highlights the potential of ICEYE data for near-real-time water surface mapping, especially under cloud-covered conditions where optical sensors are ineffective. Moreover, the developed workflow ensures reproducibility and can be integrated into automated flood-response systems for rapid situation assessment. In the future, incorporating additional polarimetric and texture features is expected to further enhance model performance and extend its applicability to diverse hydrological environments. **Keywords:** ICEYE, synthetic aperture radar, machine learning, Random Forest, decision trees, water recognition
10	Auyezova, A., Aitim, A., & Sinchev, B. (2025). METHODS AND ALGORITHMS FOR SOLVING THE PROBLEM ON THE SUM OF SUBSETS. *Scientific Journal of Astana IT University*, *23*, 137–148. https://doi.org/10.37943/23AFRZ7022	We study special-case algorithms for the subset-sum problem when the subset size is fixed to , using algebraic and geometric formulations that yield practical procedures with clear time and space bounds. The subset sum problem is one of the fundamental problems in computational complexity theory. It consists of determining whether, given a finite set of non-negative integers, there exists a subset whose sum of elements is equal to a predetermined number. This problem belongs to the class of nondeterministic polynomial time complete (NP-complete) problems: its solution can be verified in polynomial time, but an efficient algorithm for the general case has not yet been found. The goal of our research is to find new methods for solving the subset sum problem for special cases using algebraic and geometric approaches. The proposed method is based on a polynomial formulation of the problem inspired by Waring's conjecture for polynomials and the Neumann–Slater theorem. The main idea is to construct polynomials whose coefficients contain information about the sum of the elements of a subset. Using Vieta's theorem

		and the Euclidean algorithm, the problem is reduced to checking whether certain algebraic conditions are satisfied. The article proposes two lemmas proving the polynomial solvability of the subset sum problem for subset cardinality two and three. Based on them, two algorithms are developed: one uses value mapping and a fusion method, the other is based on a geometric criterion for collinearity of points obtained by transforming set elements. The algorithms demonstrate efficiency in terms of time and memory and do not require division into verification and decision stages. Effective methods for solving it allow us to develop faster algorithms for intelligent information processing, optimization of computing processes, and construction of reliable data protection systems. Our results establish polynomial-time solvability only for these fixed-???? cases and do not claim consequences for the general subset-sum problem or for the P vs NP question. **Keywords:** NP-complete class, polynomial solvability, subset sum problem, time, space, complexity theory, big data
11	Semchenko, A., Baiseitov, G., Shandronov, D., & Kutpanova, Z. (2025). MODELING THE EFFECTIVENESS OF FPV DRONE OPERATOR TRAINING USING SIMULATORS AND ONLINE PLATFORMS. *Scientific Journal of Astana IT University*, *23*, 149–159. https://doi.org/10.37943/23WKCN1585	This article examines the key conditions and factors influencing the training efficiency of FPV drone operators through simulators and online platforms in Kazakhstan. The study aims to address the lack of standardized methodologies and national frameworks for UAV operator training by identifying socio-economic, technical, and pedagogical determinants that shape learning outcomes. Using a mixed-method approach combining literature analysis, comparative assessment of international practices (USA, China, the UK, and Australia), and mathematical modeling, the research formalizes the relationship between simulator-based learning, real flight practice, and external factors. The proposed integrated model E(t) quantifies training efficiency as a dynamic function of simulation-based skill acquisition, reinforcement through practical flights, and the impact of organizational and infrastructural conditions. Results demonstrate that hybrid training pathways –

		combining intensive simulator preparation with supervised real flights – significantly enhance skill retention and operational safety while reducing costs and training time. Comparative analysis of global ecosystems reveals that advanced training systems increasingly integrate virtual and augmented reality (VR/AR) and artificial intelligence (AI) for adaptive learning and error analytics, whereas Kazakhstan faces challenges of uneven infrastructure development and limited access to standardized resources. The findings underscore the need for national adaptation of international best practices, the creation of domestic simulation centers, and the development of unified educational standards for FPV operator certification. The proposed model and recommendations can serve as a foundation for policy development, simulator design, and academic curricula, contributing to the formation of a skilled workforce and the sustainable growth of the national drone industry. **Keywords:** FPV drone, simulation-based training, training efficiency, UAV education, hybrid learning, VR/AR, AI, Kazakhstan
12	Omarova, P., Neftissov, A., Borsikbayeva, A., Kazambayev, I., Biloshchytskyi, A., & Aubakirova, A. (2025). NUMERICAL SIMULATION OF WATER FLOW THROUGH A POROUS MEDIUM: VERIFICATION BY THE LIN 1999 EXPERIMENT. *Scientific Journal of Astana IT University*, *23*, 160–171. https://doi.org/10.37943/23FVQL2644	The presented study verifies a numerical model of fluid flow through a porous structure based on the experiment by Lin (1999). Water flows through porous media with a free surface are common in hydraulic engineering applications, such as dam breaks, seepage through dams, and the operation of wave protection structures. For a more accurate forecast, numerical modeling and verification should be performed using reliable experimental data. The experiment studied flow motion after a sudden removal of a partition (analogous to a dam break) in a rectangular channel with a porous obstacle. The laboratory setup had dimensions of 0.892 m × 0.37 m × 0.44 m, and the porous insert of 0.29 m × 0.37 m × 0.44 m was placed in a section of 0.3–0.59 m along the X-axis. Thus, the porous barrier blocked the cross-section of the channel, and water could flow only through its pores. This work helps to convey the forecast and allows to adequately simulate natural

		"jams" of branches and stones. This work demonstrates how, using such a verified model, it is possible to predict the flow dynamics in real conditions: water level changes, velocity field and coastal sediment accumulation zones. In addition, obtained data can serve as a basis for early warning of environmental risks and development of measures to protect water resources. In the future, it is planned to apply the model to a real section of the Talas River for a more detailed and reliable assessment of water pollution processes. **Keywords:** porous media; numerical simulation; damb break, river pollution, water level.
13	Abdikenov, B., & Suvorov, V. (2025). CHALLENGES IN GENERALIZING BREAST MRI TUMOR SEGMENTATION ACROSS MULTIPLE DATASETS . *Scientific Journal of Astana IT University*, *23*, 172–184. https://doi.org/10.37943/23AAOF8219	Accurate segmentation of breast tumors in dynamic contrast-enhanced magnetic resonance imaging (DCE-MRI) is essential for precise diagnosis, treatment planning, and quantitative analysis. While deep learning methods have achieved strong performance in controlled research settings, their ability to generalize across diverse clinical datasets remains underexplored and poses a major barrier to clinical adoption. In this study, we evaluate the cross-dataset generalizability of a 3D Residual U-Net model using the multicenter MAMA-MIA benchmark, which consolidates four publicly available breast MRI collections annotated by expert radiologists. A leave-one-out experimental design is employed, with three datasets used for training and validation, and the remaining dataset held-out for independent testing to simulate real-world deployment scenarios. Model performance is assessed using Dice coefficient, Precision, and Recall, alongside quantitative analysis of tumor volume estimation accuracy. The best Dice score achieved by our model was 0.683 when tested on the NACT subset. Results show a consistent degradation in segmentation accuracy when models are applied to unseen datasets, indicating that performance declines significantly outside the distribution of the training data. The most pronounced drop occurs when the DUKE dataset serves as the held-out test set, where the model struggles to adapt to differences in pre-release preprocessing

		strategies. A targeted qualitative review of 160 representative scans further reveals key factors contributing to both successful and failed segmentations, including variations in image field of view, temporal enhancement patterns, acquisition era, and artifact prevalence. Overall, these findings underscore the importance of accounting for dataset heterogeneity, domain shift, and standardized preprocessing in the development of robust, clinically deployable breast MRI segmentation models capable of generalizing across institutions and imaging protocols. **Keywords:** Breast Cancer, Magnetic Resonance Imaging, Tumor Segmentation, Deep Learning, Model Generalizability, Medical Image Analysis, model robustness
14	Biloshchytskyi, A., Kuchanskyi, O., Andrashko, Y., & Neftissov, A. (2025). DEVELOPMENT OF TIME SERIES FORECASTING MODELS FOR AIR POLLUTION BASED ON DEEP SPARSE TRANSFORMER NETWORKS. *Scientific Journal of Astana IT University*, *23*, 185–198. https://doi.org/10.37943/23VUWJ5711	This study investigates the application of fractal analysis and deep learning methods for forecasting pollutant emissions from the Ekibastuz coal-fired power plant. The research is based on time series of NO, NO_2, and PM_{10} concentrations collected by industrial sensors during 2023–2024. To assess long-term dependencies, an R/S analysis was performed, and the results demonstrated stable persistence with average Hurst exponent values exceeding 0.67. This confirmed the appropriateness of employing models capable of capturing long-range memory in the data. In the second stage, a Deep Sparse Transformer Network (DSTN) architecture was implemented and adapted to the task of emission forecasting under different boiler operating modes. DSTN combines the advantages of transformer-based models with a sparse attention mechanism, which reduces computational complexity and enables efficient handling of long sequences. The model was trained using the PyTorch framework on a dataset of more than 67,000 records, with forecasting performed at horizons of 1, 6, 12, and 24 steps. The highest accuracy was achieved for short-term forecasts: the coefficient of determination for NO_2 reached 0.95 at a one-step horizon and decreased to 0.38 at 24 steps. For NO and PM_{10}, R^2 values ranged from 0.93 to 0.26. These findings

		indicate that DSTN is a highly effective tool for short-term forecasting but less accurate at longer horizons due to error accumulation. The results confirm the practical value of integrating fractal analysis with transformer architectures for emission monitoring and coal power plant operation management. The proposed approach can be embedded into industrial control systems to enable timely responses to peak emissions, optimize combustion modes, and mitigate environmental risks. **Keywords:** deep sparse transformer network, air pollution forecasting, fractal analysis, long-term memory, environmental monitoring
15	Sissenov, N., Ulyukova, G., Satybaldina, D., & Goranin, N. (2025). INTEGRATED APPLICATION OF MABAC, CODAS AND ARAS METHODS IN ASSESSING THE RELIABILITY OF INFORMATION SYSTEMS. *Scientific Journal of Astana IT University*, *23*, 199–214. https://doi.org/10.37943/23GTAR2557	In the modern digital world, the reliability of information systems has become one of the most important factors that determine the stability and efficiency of organizations. Even short-term system failures can cause serious financial losses, data breaches, and reputational damage. Therefore, assessing and improving the reliability of information systems is an essential part of ensuring their overall quality and resilience. To achieve an objective and comprehensive evaluation, this study applies multi-criteria decision-making (MCDM) methods that take into account both technical and organizational factors. The main focus is on the ARAS (Additive Ratio Assessment) method, which not only ranks the studied systems but also expresses the reliability level in percentage form. This makes the results clear, comparable, and easy to interpret in practice. For additional verification and comparison, the MABAC and CODAS methods were used. They help confirm the stability of rankings and support the validity of the conclusions drawn from the ARAS method. The selection of assessment criteria was based on the international standard ISO/IEC 25010:2023, which defines the quality model for software and information systems. Expert evaluations were carried out across ten characteristics — functionality, performance, compatibility, usability, reliability, security, maintainability, portability, recoverability, and adaptability. Using this data, all three MCDM methods were applied to calculate

		and compare the reliability of selected systems. The results show that ARAS provides a clear quantitative measure of reliability, while MABAC and CODAS strengthen the analysis by verifying ranking consistency. The combination of these approaches offers a practical and reliable framework for evaluating the quality and dependability of modern information systems. **Keywords:** information systems, reliability, multicriteria analysis, MABAC method, CODAS method, ARAS method, comparative analysis
16	Zhomartkan, N., Pavlenko, A., Baiburin, Y., & Alhuyi-Nazari, M. (2025). MODELING AND WEB-BASED VISUALIZATION OF FLOOD ZONES: A CASE STUDY OF THE BUKTYRMA RIVER SECTION. *Scientific Journal of Astana IT University*, *23*, 215–230. https://doi.org/10.37943/23KFOU5095	This study focuses on flood risk assessment in a vulnerable reach of the Buktyrma River basin, located in the East Kazakhstan region. The main goal was to develop and validate a modelling workflow that uses open-access data and software to simulate flood dynamics and visualize the results through an interactive GIS-based interface. The approach involved statistical analysis of 24 years of annual maximum discharge and water level data from gauging station to define a representative flood event. Terrain data were derived from the 30 m Copernicus Digital Elevation Model, which was used to construct the hydraulic geometry of the study area. Two-dimensional flood modeling was carried out in HEC-RAS 6.6, incorporating spatially differentiated Manning's roughness values based on cadastral land-use classification maps. The modeling results were verified using satellite imagery from Landsat 7 by calculating the Normalized Difference Water Index for the 2018 flood event, which had a 4 % exceedance probability. The comparison showed a high degree of agreement, indicating that the simulated flood zone overlapped 87 % with the NDWI-derived water mask, and the total inundation area differed by less than 2 %. Model outputs such as flood depth, flow velocity, and cross-sectional profiles were visualized, and the resulting flood map was uploaded within a web-GIS platform. The study demonstrates a transparent and cost-effective methodology that can be applied

		to other river basins in Kazakhstan, offering a practical tool for spatial planning, risk mitigation, and early warning systems based entirely on publicly available data and software. **Keywords:** flood modelling, HEC-RAS, web-GIS, NDWI, Landsat-7, Copernicus DEM, Buktyrma River
17	Alpar, S., Adilbayeva, M., & Karashbayeva, Z. (2025). COMPARATIVE RESULTS OF USING DEEP LEARNING MODELS WITH ENSEMBLE METHODS FOR WILDFIRE ASSESSMENT. *Scientific Journal of Astana IT University*, *23*, 231–242. https://doi.org/10.37943/23EUQO3546	Wildfires are an increasingly transnational global environmental and socio-economic problem. In fact, their frequency, intensity and destructive power has grown drastically over the past decades largely driven by climate change, unsustainable land management and other human activities. Climate change has shown through rising global temperatures, longer and hotter droughts, and greater wind speeds, has fostered the perfect environment for fires to spark and sweep through the land. Kazakhstan is one of the Central Asian countries where the effects of climate change are making such disasters not only more frequent, but much worse. This vulnerability was tragically illustrated by the recent large-scale forest fire that swept across the Abay region, resulting in considerable ecological harm and exposing serious deficiencies in early detection and response capabilities. These advancements all point to an increasing, pressing need for more innovative, rapid, and dependable ways to evaluate, anticipate, and reduce wildfire risks. To address these issues, in this study we present a state-of-the-art ensemble-based deep learning approach to improve the accuracy and efficiency of wildfire detection. Our approach marries the strengths of two other state-of-the-art object detection algorithms, YOLO (You Only Look Once) and SSD (Single Shot Multibox Detector).By training this ensemble based model on a massive and varied dataset of landscape images and real-life wildfires, we're able to get a general detection accuracy of 89%.This combined performance marks a striking advancement from when each model is used individually, especially in reducing false positives and providing more uniform and trustworthy results. Through fusing these models

		together and keeping them in one single unified framework there's a notable boost in state-of-the-art detection accuracy as well as real-time image processing speed capabilities. This is a requirement for any real-time application. These results emphasize the value of using ensemble deep learning methods to enhance wildfire management and response strategies, eventually leading to more effective and proactive efforts. **Keywords:** wildfire assessment, YOLO, SSD, deep learning, ensemble methods, false alarm reduction, machine learning
18	Kaldarova, A., Vasquez, M., & Utemuratova, A. (2025). A STUDY ON THE EFFECTIVENESS OF THE INSTAGRAM APP IN DEVELOPING VOCABULARY OF STUDENTS. *Scientific Journal of Astana IT University*, *23*, 243–255. https://doi.org/10.37943/23XPQT1039	This study examines the effectiveness of Instagram as a tool to improve vocabulary learning among students, focusing solely on quantitative analysis. As social media platforms become integral to students' daily routines, Instagram's visual and interactive features may offer unique benefits for vocabulary acquisition. The aim of this research is to determine whether Instagram enhances vocabulary retention and engagement compared to traditional learning methods. A quantitative method was applied, involving 60 students divided into four groups of 15 each. These groups engaged with vocabulary lessons delivered through Instagram posts, stories, and interactive quizzes over a twelve-week period. Pre/posttests were used to measure vocabulary retention, providing a clear comparison of learning outcomes.The data analysis revealed a statistically significant improvement in vocabulary retention across all groups, indicating that Instagram can serve as an effective supplementary tool for vocabulary development. Additionally, students who interacted more frequently with Instagram content demonstrated better performance, suggesting that consistent social media engagement positively influences learning outcomes. The study highlights the importance of visually appealing and context-rich content in improving memorization and understanding of new vocabulary. Interactive elements, such as polls and quizzes, were especially effective in fostering active learning and sustaining

		student interest. The findings suggest that Instagram's accessibility and familiarity can help bridge gaps in traditional teaching methods, and it makes learning more relatable and enjoyable for students. Teachers may find it valuable to explore similar platforms to create engaging digital learning environments. This research underscores the need to integrate modern technology into education to maximize student participation and outcomes. **Keywords:** English, language, teaching, technology, students, vocabulary, social media, Instagram, interactive learning, learning outcomes