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№	Статья и ссылка	Аннотация
1	Uvaliyeva, I., Assanova, B., Khassenova, Z., Mukasheva, R., Karimkyzy, B., & Karassenko, K. (2025). PREDICTING DIABETES PROGRESSION USING AN ENSEMBLE OF CNN, RNN, AND LSTM MODELS . *Scientific Journal of Astana IT University*, *24*, 5–14. https://doi.org/10.37943/24JNSS7017	This article presents an integrated approach to predicting diabetes progression based on an ensemble of multiple deep neural network architectures. To enhance diagnostic accuracy and reliability, convolutional neural networks (CNN), recurrent neural networks (RNN), and long short-term memory (LSTM) models are jointly utilized within a clinical decision support framework. The optimal combination of their predictions is achieved through the Dirichlet ensemble method, which adaptively distributes weights among individual models according to their validation performance. Hyperparameter optimization using the Grid Search algorithm allows systematic selection of training parameters, network depth, activation functions, and regularization techniques, ensuring better convergence and reducing overfitting risks. The study involves a comprehensive data preprocessing pipeline, including normalization, balancing, and One-Hot Encoding of categorical features, to manage heterogeneous medical datasets and minimize the effect of missing or noisy information. Experimental evaluation demonstrates that the proposed ensemble model significantly outperforms individual CNN, RNN, and LSTM architectures in terms of accuracy, sensitivity, and stability, achieving improved generalization ability and robustness to data variability. This research emphasizes the potential of ensemble deep learning approaches to strengthen modern clinical decision support systems (CDSS). The developed framework enables more precise and interpretable diagnostic predictions, contributing to early diabetes detection and prevention strategies. Furthermore, the proposed methodology can be extended to other medical classification problems, providing a flexible and adaptive analytical tool for healthcare applications. The findings confirm that adaptive ensemble methods based on the Dirichlet distribution can serve as a foundation for reliable,

		transparent, and intelligent clinical decision-making in future healthcare systems. **Keywords:** Neural network ensembles, Dirichlet distribution, CNN, RNN, LSTM, diabetes prediction, clinical decision support, Deep learning
2	Ukenova, A., Bekmanova, G., Yergesh, B., & Altaibek, M. (2025). INTERFACE DESIGN OF AN INTELLIGENT INTERACTIVE LEARNING SYSTEM. *Scientific Journal of Astana IT University*, *24*, 15–35. https://doi.org/10.37943/24VEWA2615	This study presents the design, implementation, and evaluation of an Intelligent Interactive Learning System that employs multimodal interaction to improve the adaptability, accessibility, and engagement of digital education. Conventional e-learning platforms typically rely on static and text-based resources, which restrict personalization and reduce learner motivation. The proposed system integrates natural language processing, speech synthesis, and avatar-based interfaces to deliver lectures through synchronized speech, gestures, and facial expressions. The system automatically processes uploaded lecture scripts and slide presentations, segmenting and aligning them to generate interactive video lectures. A novel contribution of this work is the incorporation of customized Kazakh-language support, implemented through intonation modeling, dependency parsing, and gesture mapping to enhance inclusivity for underrepresented linguistic communities. The system performance was evaluated using Facebook's variational inference text-to-speech model. Experimental results demonstrate real-time capability, with an average latency of 25.5 ms, throughput exceeding 4,200 characters per second, and low computational resource requirements. These findings confirm the suitability of the system for deployment in resource-constrained environments without compromising speech quality or responsiveness. Compared with conventional tutoring and static e-learning platforms, the system additionally provides automated assessment generation, multimodal feedback, and accessibility functions such as subtitles and adjustable playback controls. The study contributes a scalable model for intelligent, avatar-based learning that integrates speech synthesis, real-time interaction, and cultural-linguistic

		inclusivity. Future work will focus on extending personalization through adaptive learner modeling, incorporating affective computing for emotion-sensitive interaction, and enabling interoperability with established learning management systems. **Keywords:** multimodal interfaces, speech synthesis, avatar-based system, gestures, face mimics, Kazakh language
3	Ramazanova, Z., Baiken, Y., Matkarimov, B., Urazbayev, A., Myngbay, A., & Aituov, B. (2025). AN INFORMATION TECHNOLOGY APPROACH TO PREDICT BREAST CANCER USING MACHINE LEARNING. *Scientific Journal of Astana IT University*, *24*, 36–48. https://doi.org/10.37943/24UTRW4400	Breast cancer continues to be the most encountered malignancy in women globally and a leading cause of cancer-related mortality. This study describes an Information Technology approach to evaluate interpretable machine-learning methods for breast cancer prediction using routine clinical data and to situate performance against prior literature. All calculations are based on the Breast Cancer Wisconsin Diagnostic dataset (569 instances; malignant/benign labels) hosted by the UCI Machine Learning Repository. Each sample corresponds to a breast mass classified as malignant or benign. Four supervised machine learning models were applied: Logistic Regression with L1 penalty, Random Forest, Decision Tree, and Naïve Bayes, and compared the area under the ROC curve (AUC), accuracy, sensitivity, and specificity using DeLong's test with Holm correction. The reproducible pipeline consisted of preprocessing, recursive feature elimination for feature selection, and a 5-fold cross-validation for hyperparameter tuning. Among the four models, the L1-penalized Logistic Regression yielded the best results, with an AUC indicating accuracy, sensitivity, and specificity of 99.6% (97.3%, 95.2%, 98.6%) on the test sets, respectively. This study illustrates the effective integration of supervised machine learning methods into diagnostic systems to produce early, accurate, interpretable diagnoses of disease. This study reinforces the proposed information technology approach for breast cancer prognosis. Limitations of the study are a moderately sized, homogeneous cohort, and restricted focus on structured variables, which may enhance internal validity while restricting generalizability. Our findings contribute to an emerging body of literature

		that well-tuned, regularized logistic regression provides a reasonable baseline against which breast cancer risk and other study outcomes can be compared, and a pragmatic route toward trustworthy AI in oncology. **Keywords:** information technology, breast cancer, machine learning, model and feature selection, 5-fold cross-validation
4	Makhataeva, Z., Atymtay, N., Meiramov, R., Nauryzbaikyzy, G., Sadirova, K., & Huseyin Varol, A. (2025). MULTILINGUAL AUTOMATIC SPEECH RECOGNITION INTERFACE FOR TYPING: USABILITY STUDY AND PERFORMANCE EVALUATION FOR KAZAKH, RUSSIAN, AND ENGLISH. *Scientific Journal of Astana IT University*, *24*, 49–63. https://doi.org/10.37943/24AHNP6638	We present a multilingual automatic speech recognition (ASR) system for Kazakh, Russian, and English designed for the trilingual community of Kazakhstan. Although prior research has shown that speech-based text entry can outperform conventional keyboard typing for human–computer interaction and interaction with large language models (LLMs), little is known about its performance and usability in low-resource multilingual contexts, particularly for Kazakh. To address this gap, we fine-tuned a Whisper-based model on additional Kazakh speech data, achieving a large reduction in Kazakh word error rate (WER) from 21.55% with the OpenAI baseline to 8.84%, while preserving competitive performance for Russian and English. We then conducted a user study with 38 participants from Nazarbayev University, who performed dictated reading and editing tasks in all three languages. We evaluated performance using WPM, CPM, WER, and CER, and assessed usability and cognitive effort using the System Usability Scale (SUS) and the Raw NASA Task Load Index (NASA-TLX). Participants reached high speech-based typing speeds without editing and moderate speeds with editing across all three languages. Importantly, there were no statistically significant differences between Kazakh, Russian, and English in error rates, cognitive load, or perceived usability. Users reported low cognitive load (NASA-TLX < 40) and consistently high usability (SUS > 80%), indicating that the interface is efficient, easy to use, and requires minimal mental effort. These results demonstrate that Kazakh-adapted Whisper enables accurate, usable, and low-effort multilingual ASR, and highlight the potential of speech-driven text

		entry systems for trilingual contexts such as Kazakhstan. **Keywords:** automatic speech recognition (ASR), cognitive load, usability, human-computer interaction (HCI), human-AI interaction, speech-based typing
5	Sinchev, B., Mukhanova, A., & Sadykova, T. (2025). ALGORITHMS OF NP-COMPLETE PROBLEMS. PART II. *Scientific Journal of Astana IT University*, *24*, 64–74. https://doi.org/10.37943/24MIOD6580	This paper presents an analytical and algorithmic framework for solving NP complete problems, specifically focusing on the Subset Sum Problem (SSP). The study aims to develop polynomial time algorithms capable of efficiency identifying a *k*-element subset from an *n*-element set of positive integers, where the sum of the elements equals a predefined certificate. In an n-element set of positive integers without repetition, the goal is to find a *k*-element subset ( ), whose sum of elements is equal to the certificate . In this second part of the work, a sample of a subset with odd power is considered (in the first part - a sample of with even power which determines the complexity of the proposed algorithms for solving the subset sum problem. The obtained USPTO patents [20] present a computer system for ultra-fast processing of big data with a volume of finite and a processing speed proportional to the execution time *T* with the required memory for power *k*=3. The proposed approach is based on the mapping , the arguments of which are the certificate and the elements of the set and the union of the required subsets obtained from the two-dimensional array from the set taking into account the mapping and the given certificate Then the sampling time of the subset of odd cardinality with the given certificate and the required space satisfy the conditions *T* , which are obtained based on solving the problem of the sum of the required subset from the set of natural numbers . Overall, the findings establish a theoretical foundation for ultra-fast computing systems and data-intensive applications, aligning with modern computational complexity and big data paradigms. **Keywords:**

		NP-complete problems, polynomial algorithms, subset sum problem, big data, information retrieval
6	Sharipova, S., Abzhanova, D., Toxanov, S., & Biloshchytskyi, A. (2025). DEVELOPMENT OF A NEURAL NETWORK-BASED MODULE FOR FORECASTING ATMOSPHERIC POLLUTANT EMISSIONS. *Scientific Journal of Astana IT University*, *24*, 75–84. https://doi.org/10.37943/24WXPA8545	The prediction of emissions to air is a crucial and complex task for environmental monitoring and air quality management. Accurate forecasting is essential for the timely adoption of mitigation measures and for ensuring regulatory compliance. However, traditional statistical methods often perform inadequately because they poorly capture non-linear dependencies, intricate interactions between variables, and long-term temporal patterns, all of which ultimately decrease forecasting accuracy. The work presents an emission prediction software module based on a neural network with LSTM architecture. The input factors used were the concentrations of the main pollutants (NO, NO_2, SO_2, CO, solid particles) as well as meteorological indicators including air temperature, humidity and flow rate. Data provided by the operating enterprises, including 39,803 lines with increments of 20 minutes, were pre-processed: cleared from skips, normalized parameters and forming training sequences of 72 steps, corresponding to the daily interval. Additional exploration analysis was performed, which revealed the presence of expressed daily and weekly cycles, as well as correlations between weather conditions and concentrations of pollutants. The built model showed the ability to reproduce emission dynamics with acceptable accuracy, which is confirmed by MSE 0.87 and R^2 0.86 values. The developed module is integrated into the current monitoring system and provides a user-friendly interface for building real-time forecasts. The results are consistent with current research, but the work is applied as a tool used in practical activities. In the future, it is planned to expand the set of factors and explore the possibilities of using ensemble architecture to improve the accuracy and robustness of forecasts. **Keywords:** neural networks, air pollution forecasting, atmospheric pollutant emissions, environmental monitoring, predictive modeling

7	Neftissov, A., Honcharenko, T., Biloshchytskyi, A., Kazambayev, I., & Dolhopolov, S. (2025). ENSEMBLE MACHINE LEARNING FOR GLOBAL HYDROLOGICAL PREDICTION . *Scientific Journal of Astana IT University*, *24*, 85–98. https://doi.org/10.37943/24DKYV6003	Accurate global hydrological prediction is vital for sustainable water management but is often hindered by data complexity and fragmentation. This study introduces an advanced machine learning framework to predict long-term average discharge using widely available global hydrological station metadata, aiming to develop a highly accurate and generalizable model for large-scale water resource assessment. The methodology utilized the Global Runoff Data Centre (GRDC) dataset, applying extensive feature engineering to station characteristics and a logarithmic transformation to the discharge variable. A diverse set of algorithms was trained, including a custom deep neural network with specialized architecture and several gradient boosting machines. These individual models were then integrated into a final Meta Ensemble model through an optimized weighting strategy to maximize predictive performance. The framework was rigorously validated on an independent test set. The Meta Ensemble model demonstrated superior predictive power, achieving a Coefficient of Determination (R^2) of 0.954. This performance significantly surpassed that of both baseline methods and the individual advanced models. Analysis of the results confirmed that the model learned hydrologically meaningful relationships, identifying catchment area and geographical location as the most influential predictors. The findings confirm that a data-driven ensemble framework can accurately predict key hydrological characteristics using only station metadata. This approach offers a powerful and scalable alternative to traditional modeling, holding significant potential for water resource assessment in data-scarce regions and serving as a robust foundation for future intelligent monitoring systems. **Keywords:** hydrological modeling, machine learning, ensemble learning, discharge prediction, water resources monitoring
8	Ryspayeva, M., & Salykova, O. (2025). IMPACT OF LOSS FUNCTION ON SYNTHETIC BREAST ULTRASOUND IMAGE	The BUSI (Breast Ultrasound Images) dataset is small and imbalanced, which limits the effective training of deep learning diagnostic models. Generative Adversarial

	GENERATION. *Scientific Journal of Astana IT University*, *24*, 99–112. https://doi.org/10.37943/24MMIK3887	Networks (GANs) offer a promising and increasingly popular solution for synthesizing realistic medical images to augment scarce training data and improve overall model generalization. This study investigates the impact of loss function selection in our previously published Deep Generative Adversarial Network with Wasserstein Gradient Penalty and Transfer Learning (DGAN-WP-TL). Two configurations were evaluated: one trained using Wasserstein GAN with Gradient Penalty (WGAN-GP) and another trained using Binary Cross-Entropy (BCE) loss. The experiments were conducted on the BUSI dataset with perceptual loss weights $\lambda = 0.5$, 3.0, 5.0, 7.0, and 10.0. Model performance was comprehensively assessed using Fréchet Inception Distance (FID), Kernel Inception Distance (KID), Learned Perceptual Image Patch Similarity (LPIPS), and Multi-Scale Structural Similarity Index (MS-SSIM). Results demonstrate that WGAN-GP consistently outperformed BCE across all λ values, generating images with higher fidelity, improved realism, and greater visual diversity. The superiority was most pronounced for $\lambda = 3.0$ and $\lambda = 5.0$, where WGAN-GP achieved the lowest KID and FID and the most balanced diversity–fidelity trade-off. The best-performing DGAN-WP-TL configuration (WGAN-GP, $\lambda = 5.0$) achieved KID = 0.14, FID = 179.42, LPIPS (fake–fake) = 0.49, and MS-SSIM (fake–fake) = 0.18. These results highlight the crucial role of loss function design in medical image synthesis. Overall, the study confirms that WGAN-GP provides superior image realism and variability, making it the preferred choice for high-quality, clinically relevant synthetic data generation, while BCE remains a lightweight and practical alternative for constrained computational environments. **Keywords:** BUSI dataset, DGAN-WP-TL, WGAN-GP, BCE loss, synthetic medical images, loss function analysis
9	Biloshchytskyi, A., Neftissov, A., Kazambayev, I., Amangeldi, M., Kirichenko, L., & Medetkhan, A. (2025). CORRELATION-MATRIX–	Currently environmental state became very actual in the world, especially in Kazakhstan. Air pollution of industries is a major threat to the environment and health of the people,

	DRIVEN DIAGNOSTICS OF INDUSTRIAL EMISSIONS: A PEARSON BASELINE WITH SCATTER-PLOT EVIDENCE . *Scientific Journal of Astana IT University*, *24*, 113–124. https://doi.org/10.37943/24QUFK4295	especially in areas with high reliance on coal-powered power stations in electricity production. Fossil fuels in Kazakhstan are the largest electrical source, and they contribute to the emission of sulfur dioxide (S), nitrogen oxides (N), carbon monoxide (CO), and the particle matter (PM). Although, to formulate diagnostic and monitoring procedures at industry level it is crucial to determine relationships among emissions. The study approaches the Pearson correlation method on data taken from an automated emission monitoring system at the Coal Power Plant in Kazakhstan. The aim of the study is to discover linearity between emission indicators and industrial combustion. The observed correlation heat map and scatter-plots indicate positive trends among the CO and S, inverse correlation between CO and , and insufficient relation of CO and NO. These results show the key combustion processes, which involve reduced oxygen supply leading to the incomplete oxidation and simultaneous increased sulfur emissions. The three-dimensional description of CO dependence on S and further explains the coupled emission response and supports the explanation of underlying regularities in the operation. The correlation-based framework has diagnostic capabilities of the early identification of inefficient combustion regimes and enables scalable and data-driven methods of emission control. The research finds that Pearson-based analytics can be used to offer a strong and interpretable predictive modeling and regulatory monitoring foundation of future air-quality management in industries. **Keywords:** emission diagnostics, Pearson correlation, automated monitoring system, air pollution, combustion efficiency, coal power plant
10	Kazambayev, I., & Mekhtiyev, A. (2025). INTELLECTUAL HARDWARE-SOFTWARE COMPLEX FOR FIBER-OPTIC SYSTEM MONITORING WITH CLASSIFICATION OF THE EVENTS AND RECOMMENDATIONS. *Scientific Journal of Astana IT University*, *24*,	Currently, there are many different methods of monitoring extended facilities. However, the most accurate, efficient, and more accessible methods are using fiber-optic sensors. This study examines existing methods based on the application of optical time-domain reflectometry (OTDR). Data from three main databases, namely Web of Science, Scopus, and Google Scholar, were

	125–137. https://doi.org/10.37943/24IGEY3068	considered as existing solutions. Among the existing types, the possibility of using interferometers was also taken into account. However, such systems are expensive and very sensitive. At the same time, OTDR systems have huge disadvantages, such as the relatively low sensitivity of such systems, the closeness of the solution, and the lack of integration. However, all the disadvantages, except for the proprietarity, can be eliminated by using a neural network. Therefore, a system based on an open architecture is proposed with the possibility of application on new and already installed monitoring systems using a neural network for classification and an expert system for assessing the situation and recommendations for the implementation of restoration work. A universal intelligent hardware–software complex is proposed, which includes modules for signal preprocessing based on Fourier transform, statistical filtering using the three-sigma method, event classification, and interpretation. The suggested developed system enables noise suppression, event recognition (vibration, bending, cable breakage), and generation of recommendations through artificial intelligence. A convolutional neural network was used as a neural network for event classification. Recommendations and evaluation were provided using an expert evaluation module based on the use of Copilot, which reduces decision-making time and prevents possible breakdowns. **Keywords:** fiber-optic sensors, Φ-OTDR, optical time-domain reflectometry, intelligent monitoring, power cable diagnostics, interferometer, signal processing, neural networks, machine learning, IoT architecture, predictive maintenance