**Mayanja, A., Dogan, N., & Tasdemir, S. (2025).** Class-weighted reinforcement learning for skin cancer image classification. *EXPERT SYSTEMS WITH APPLICATIONS*, 293. https://doi.org/10.1016/j.eswa.2025.128426

**Abstract**

As our skin is exposed to ultraviolet rays or dangerous chemicals, aberrant growth of skin cells happens which brings up undesirable conditions such as premature skin aging, transposition in skin texture, and the worst-case scenario skin cancer. In the struggle to combat deadly skin cancer, machine learning can be a useful weapon to help dermatologists make better and clearer decisions while diagnosing patients. Despite promising results with numerous machine learning techniques, this field faces data inadequacy, more so the universally available datasets are subjected to data imbalances. In order to tackle the significant class imbalance present in datasets like the HAM10000 skin cancer dataset, this research introduces a class-weighted reward mechanism within the Deep Q-Learning framework that dynamically allocates higher positive rewards for the accurate classification of rare classes and imposes more substantial penalties for the incorrect classification of common classes. This strategy encourages the DQN agent to focus on underrepresented categories during the training process, thereby reducing bias towards majority classes. Quantitative assessment metrics such as Accuracy, Precision, F1-score, Specificity, and Sensitivity were used to evaluate the model. The results showed an accuracy of 97.97 %, sensitivity of 97.74 %, precision of 97.81 %, F1-Score of 97.70 %, and specificity of 97.83 % on a non-augmented dataset of HAM10000. Finally, the model performance was compared to that of already existing research work, and it had an upper hand with considerable differences over the existing ones.

**Keywords**

Machine learning, Reinforcement learning, Neural networks, Deep Q-learning

**Akdemir, E., Barisci, N., Akcayol, M. A., & Dogan, N. (2025).** Selecting generated synthetic features using clustering algorithm for generalized zero-shot learning. *MULTIMEDIA SYSTEMS*, 31(5). https://doi.org/10.1007/s00530-025-01979-z

**Abstract**

Generalized Zero-Shot Learning (GZSL) aims to recognize classes in the test dataset that do not have image samples in the training dataset. GZSL tasks typically place all classes into a semantic space using predefined semantic attributes for seen and unseen classes. Since there are no real images for unseen classes, classifying these classes correctly is a challenging task. To overcome this challenge, synthetic features for unseen classes are generated using generative networks. Based on this approach, we proposed a generator-based GZSL model that selects the best samples using machine learning methods for the generated synthetic features. In our proposed model, we preferred semantically rich representations instead of traditional semantic attributes for semantic information representation. Variational Autoencoder (VAE) and Generative Adversarial Network (GAN) were used together to generate synthetic features. We applied k-means and DBSCAN clustering algorithms to the generated synthetic features and then classified them. To evaluate our proposed model, we conducted experiments on well-known GZSL benchmark datasets AWA2, CUB, and FLO. We extended our experiments to include open-set classes. Comprehensive experiments showed GZSL classification performances of 67.8% on AWA2, 77.0% on CUB, and 92.4% on FLO. Additionally, we observed the improving effect of k-means and DBSCAN clustering algorithms on GZSL classification performance.

**Keywords**

Generalized Zero-Shot learning, K-means, DBSCAN, Variational autoencoder, Generative adversarial network

**Kilif, H., Cinar, I., & Dogan, N. (2025).** Automatic classification of walnut (Juglans Regia L.) species using deep learning methods. *JOURNAL OF FOOD MEASUREMENT AND CHARACTERIZATION*, 19(8). https://doi.org/10.1007/s11694-025-03380-w

**Abstract**

Walnut is an agricultural product with high economic value on a global scale. Walnut species classification is essential for research, conservation, and quality control, yet traditional methods rely heavily on manual identification, which is a time-consuming procedure and subject to human mistakes. With technological developments in the agricultural sector, making use of deep learning algorithms in the classification of products such as fruits, vegetables and grains were becoming increasingly widespread. In this study, it is aimed to automatically classify walnut species using pre-trained deep learning models. Thus, it is aimed at reducing the loss of time, workload and error rates in sorting processes. For this purpose, a dataset consisting of images belonging to Chandler, Kaman1, Fernor, Yalova3 and Maras18 walnut species was created. The dataset consists of 2540 images in total. The images were trained using VGG16, VGG19, ResNet-50, DenseNet-121, and Xception models. The classification was performed using pre-trained deep learning architectures, including VGG16, VGG19, ResNet-50, DenseNet-121, and Xception. Among these models, ResNet-50 delivered the best performance with an accuracy of 97.95% on the original dataset, while the Xception model excelled with 98.54% accuracy when trained with a weighted loss function and 98.27% accuracy with data augmentation. These findings highlight the effectiveness and reliability of ResNet-50 and Xception models for automated walnut species classification. The results underscore the potential of deep learning technologies in improving agricultural practices by offering faster, more accurate, and less labor-intensive alternatives to traditional methods. In comparison, machine learning algorithms such as SVM, RF, and k-NN achieved lower accuracies, with SVM performing best among them at 90.10%. The study provides an important contribution to the use of deep learning technologies in agricultural production processes and suggests solutions that can increase the efficiency of traditional manual methods.

**Keywords**

Agriculture, Deep Learning, Transfer Learning, Walnut Classification, Walnut Species

**Inan, O., & Servi, S. (2025).** New WOA Variants for Superior Meta-heuristic Optimization with Multiple Hunter Whale Leading. *ARABIAN JOURNAL FOR SCIENCE AND ENGINEERING*, 50(23). https://doi.org/10.1007/s13369-025-10677-x

**Abstract**

This study introduces three new algorithms, MPW-WOA, MP-WOA, and MPL-WOA, designed to enhance the exploration capability of the well-regarded whale optimization algorithm (WOA), a meta-heuristic optimization technique. These improvements aim to strengthen the exploration capabilities of the algorithm and converge toward the global optimum solution. The focus of WOA on the leader individual may cause the positions of new individuals to get stuck in sub-solutions. To solve this problem, the proposed algorithms aim to obtain stronger and more consistent results by the effect of the best three whales in various ratios instead of a single leader. After the proposed methods are applied 30 times on 23 benchmark test functions, the mean and standard deviation data are examined. This evaluation is carried out by comparing the three proposed algorithms among themselves by applying the Wilcoxon test, and as a result, the best algorithm is determined as MPW-WOA. The proposed algorithms are compared with WOA and shown to be superior. The results of the best algorithm are compared with the methods in the literature, and it is superior in 16 out of 23 functions. This success is also confirmed by the Friedman test. Furthermore, the three proposed algorithms have been successfully applied to four real-world engineering problems, and especially MPW-WOA has produced the best or competitive results compared to its competitors. The overall evaluations have shown that this algorithm is an effective and promising alternative for many optimization problems.

**Keywords**

WOA, Benchmark functions, Optimization problems, Engineering problem

**Alabed, T., & Servi, S. (2025).** A Lévy flight based chaotic black winged kite algorithm for solving optimization problems. *SCIENTIFIC REPORTS*, 15(1). https://doi.org/10.1038/s41598-025-18196-3

**Abstract**

The Black-Winged Kite Algorithm (BKA) is a relatively new bio-inspired metaheuristic approach developed to tackle challenging optimization tasks by maintaining a balance between exploration and exploitation. In this context, an improved version of BKA is introduced to better handle complex optimization scenarios. Three modified variants are proposed: CBKA, which incorporates logistic chaos-based mapping to improve solution diversity; LBKA, which utilizes Lévy flight to reinforce global exploration capability; and CLBKA, which merges both mechanisms to enhance the balance between exploration and intensification. The algorithms are assessed on 23 standard benchmark problems spanning unimodal, multimodal, and fixed-dimension test sets. CLBKA achieved the global optimum in 20 out of 23 test functions and ranked first in the Friedman statistical test, with the lowest average rank of 2.9348 among eight algorithms. In addition to the Friedman test, the Wilcoxon signed-rank test was also employed to statistically validate the significance of the observed improvements. Experimental findings indicate that CLBKA consistently outperforms the original BKA and various other metaheuristic techniques in terms of convergence reliability, solution quality, and search stability. Moreover, all proposed algorithms were implemented on six practical engineering design problems, including the Gear Train, Welded Beam, Three-Bar Truss, Pressure Vessel, Tension/Compression Spring, and Cantilever Beam design cases, delivering notably better optimization outcomes. In each case, CLBKA consistently outperformed both its baseline and enhanced variants, as well as several state-of-the-art algorithms from the literature, in terms of solution accuracy, convergence speed, and robustness. The performance of all algorithms was statistically validated using the Friedman test, further confirming the significance and robustness of the proposed hybrid strategies. The results confirm that the proposed hybrid strategies significantly enhance the search efficiency of BKA, making CLBKA a reliable and versatile optimizer for a wide range of complex, constrained optimization tasks.

**Keywords**

Black winged kite optimization, Levy flight, Logistic map, Design problems

**Celikdelen, S. O., Inan, O., Servi, S., & Bilici, R. (2025).** Diagnostic Value of Machine Learning Models in Inflammation of Unknown Origin. *JOURNAL OF CLINICAL MEDICINE*, 14(19). https://doi.org/10.3390/jcm14197116

**Abstract**

Background: Inflammation of unknown origin (IUO) represents a persistent clinical challenge, often requiring extensive diagnostic efforts despite nonspecific inflammatory findings such as elevated C-reactive protein (CRP) and erythrocyte sedimentation rate (ESR). The complexity and heterogeneity of its etiologies—including infections, malignancies, and rheumatologic diseases—make timely and accurate diagnosis essential to avoid unnecessary interventions or treatment delays. Objective: This study aimed to evaluate the potential of machine learning (ML)-based models in distinguishing the major etiologic subgroups of IUO and to explore their value as clinical decision support tools. Methods: We retrospectively analyzed 300 IUO patients hospitalized between January 2023 and December 2024. Four binary one-vs-rest Linear Discriminant Analysis (LDA) models were first developed to independently classify infection, malignancy, rheumatologic disease, and undiagnosed cases using clinical and laboratory parameters. In addition, a multiclass LDA framework was constructed to simultaneously differentiate all four diagnostic groups. Each model was evaluated across 10 independent runs using standard performance metrics, including accuracy, sensitivity, specificity, precision, F1 score, and negative predictive value (NPV). Results: The malignancy model achieved the highest performance, with an accuracy of 91.7% and specificity of 0.96. The infection model demonstrated high specificity (0.88) and NPV (0.86), supporting its role in ruling out infection despite lower sensitivity (0.71). The rheumatologic model showed high sensitivity (0.81) but lower specificity (0.73), reflecting the clinical heterogeneity of autoimmune conditions. The undiagnosed model achieved very high accuracy (96.7%) and specificity (0.98) but limited precision and recall (0.50 each). The multiclass LDA framework reached an overall accuracy of 73.3% (mean 66%) with robust specificity (0.90) and NPV (0.89). Conclusions: ML-based LDA models demonstrated strong potential to support the diagnostic evaluation of IUO. While malignancy and infection could be predicted with high accuracy, rheumatologic diseases required integration of additional serological and clinical data. These models should be viewed not as stand-alone diagnostic tools but as complementary decision-support systems. Prospective multicenter studies are warranted to externally validate and refine these approaches for broader clinical application.

**Keywords**

inflammation of unknown origin; machine learning; diagnostic artificial intelligence

**Yurdakul, M., & Tasdemir, S. (2025).** BC-YOLO: MBConv-ECA based YOLO framework for blood cell detection. *SIGNAL IMAGE AND VIDEO PROCESSING*, 19(9). https://doi.org/10.1007/s11760-025-04321-2

**Abstract**

The detection and classification of blood cells from microscopic images plays a vital role in medical diagnosis. However, it is challenging because of the small size, varying shape and dense clustering of cells. Conventional methods rely on manual inspection, which is labor-intensive and depends on expert knowledge. In contrast, Deep Learning (DL) based approaches significantly speed up the process and provide more reliable and consistent results. However, there should be a trade-off between computational costs, model size and accuracy. In this work, we propose the Blood Cell You Only Look Once (BC-YOLO) model built on the YOLOv11 architecture. The backbone of the model is enhanced by replacing traditional convolution structures with MBConv-ECA blocks, resulting in lighter and more efficient feature extraction. This modification reduces computational complexity while increasing accuracy, resulting in a more robust object detection model. The proposed model accurately detects red blood cells (RBC), white blood cells (WBC) and platelets, automating the analysis of microscopic images. Experimental results show that the BC-YOLO Medium model achieves 95.89% mAP@0.5, 92.2% precision and 96.3% recall with 18.5 million parameters and 57.4 GFLOP. The model outperforms not only YOLOv11 but also other YOLO variants and existing studies in the literature. Furthermore, a user-friendly interface has been developed so that end-users can easily upload and analyze microscopic blood cell images as well as inspect the detected cells. In addition, Grad-CAM-based explainability visualizations are also presented to better understand the model's decision-making processes and increase transparency for medical professionals.

**Keywords**

YOLO, Object detection, Blood cell, ECA, MBConv

**Yurdakul, M., Uyar, K., & Tasdemir, S. (2025).** MaxGlaViT: A Novel Lightweight Vision Transformer-Based Approach for Early Diagnosis of Glaucoma Stages From Fundus Images. *INTERNATIONAL JOURNAL OF IMAGING SYSTEMS AND TECHNOLOGY*, 35(4). https://doi.org/10.1002/ima.70159

**Abstract**

Glaucoma is a prevalent eye disease that often progresses without symptoms and can lead to permanent vision loss if not detected early. The limited number of specialists and overcrowded clinics worldwide make it difficult to detect the disease at an early stage. Deep learning-based computer-aided diagnosis (CAD) systems are a solution to this problem, enabling faster and more accurate diagnosis. In this study, we proposed MaxGlaViT, a novel Vision Transformer model based on MaxViT to diagnose different stages of glaucoma. The architecture of the model is constructed in three steps: (i) the Multi Axis Vision Transformer (MaxViT) structure is scaled in terms of the number of blocks and channels, (ii) low-level feature extraction is improved by integrating the attention mechanism into the stem block, and (iii) high-level feature extraction is improved by using the modern convolutional structure. The MaxGlaViT model was tested on the HDV1 fundus image data set and compared to a total of 80 deep learning models. The results show that the MaxGlaViT model, which contains effective block structures, outperforms previous literature methods in terms of both parameter efficiency and classification accuracy. The model performs particularly high success in detecting the early stages of glaucoma. MaxGlaViT is an effective solution for multistage diagnosis of glaucoma with low computational cost and high accuracy. In this respect, it can be considered as a candidate for a scalable and reliable CAD system applicable in clinical settings.

**Keywords**

ConvNeXtV2, ECA, eye diseases, glaucoma diagnosis, MaxViT, vision transformer

**Suyun, S. B., Yurdakul, M., Tasdemir, S., & Bilis, S. (2025).** Triple-Stream Deep Feature Selection with Metaheuristic Optimization and Machine Learning for Multi-Stage Hypertensive Retinopathy Diagnosis. *APPLIED SCIENCES-BASEL*, 15(12). https://doi.org/10.3390/app15126485

**Abstract**

Hypertensive retinopathy (HR) is a serious eye disease that can lead to permanent vision loss if not diagnosed early. The conventional diagnostic methods are subjective and time-consuming, so there is a need for an automated and reliable system. In this study, a three-stage method that provides high accuracy in HR diagnosis is proposed. In the first stage, 14 well-known Convolutional Neural Network (CNN) models were evaluated, and the top three models were identified. Among these models, DenseNet169 achieved the highest accuracy rate of 87.73%. In the second stage, the deep features obtained from these three models were combined and classified using machine learning (ML) algorithms including Support Vector Machine (SVM), Random Forest (RF), and Extreme Gradient Boosting (XGBoost). The SVM with a sigmoid kernel achieved the best performance (92% accuracy). In the third stage, feature selection was performed using metaheuristic optimization techniques including Genetic Algorithm (GA), Artificial Bee Colony (ABC), Particle Swarm Optimization (PSO), and Harris Hawk Optimization (HHO). The HHO algorithm increased the classification accuracy to 94.66%, enhancing the model's generalization ability and reducing misclassifications. The proposed method provides superior accuracy in the diagnosis of HR at different severity levels compared to single-model CNN approaches. These results demonstrate that the integration of Deep Learning (DL), ML, and optimization techniques holds significant potential in automated HR diagnosis.

**Keywords**

Convolutional Neural Network, eye disease, feature fusion, Harris Hawk Optimization, hypertensive retinopathy

**Yurdakul, M., Uyar, K., & Tasdemir, S. (2025).** Webserver-Based Mobile Application for Multi-class Chestnut (*Castanea sativa*) Classification Using Deep Features and Attention Mechanisms. *APPLIED FRUIT SCIENCE*, 67(3). https://doi.org/10.1007/s10341-025-01327-5

**Abstract**

Chestnut (Castanea sativa) is a nutritious food with fiber, vitamins C and B group, minerals such as potassium, magnesium, and iron. In addition to being a nutritious food, chestnuts are used in various fields such as medicine, cosmetics, and energy. All the mentioned characteristics make it a demanded product worldwide. To determine the market price of chestnuts, it is necessary to have a good classification. In traditional approaches, producers classify chestnuts according to their external appearance; however, this is tedious, time-consuming, and prone to errors. There is a need for computer-aided systems to analyze the chestnut varieties. Therefore, a camera system was set up and images of chestnuts belonging to 'Alandız', 'Aydın', 'Simav', and 'Zonguldak' varieties were captured to create a novel dataset. Moreover, a deep-based mobile application was developed to classify chestnut types. After testing the 16 state-of-the-art convolutional neural network (CNN) models, the three most successful models from the 16 CNN models were used as feature extractors, and the extracted features were classified using Decision Tree (DT), Naive Bayes (NB), Support Vector Machine (SVM), Adaboost, and Xtreme Gradient Boosting (XGB) algorithms. Finally, attention modules were integrated to CNN models to enhance accurate classification of chestnut images. The highest result achieved by MobileNet with attention mechanism was accuracy of 99.65%, precision of 99.62%, recall of 99.67%, f1-score of 99.64%, kappa score of 100%, and area under the curve (AUC) of 100%. The chestnut dataset can be used in literature studies for different purposes and the proposed framework can be utilized as a computer-aided decision support system for experts in farming.

**Keywords**

CBAM attention module, Transfer learning in agriculture, Convolutional neural network, Smart crop classification, Machine Learning

**Kucukkara, Z., Ozkan, I. A., Tasdemir, S., & Ceylan, O. (2025).** Classification of chicken *Eimeria* species through deep transfer learning models: A comparative study on model efficacy. *VETERINARY PARASITOLOGY*, 334. https://doi.org/10.1016/j.vetpar.2025.110400

**Abstract**

Eimeria is a protozoan parasite that causes coccidiosis in various animal species, especially in chickens, resulting in infections characterized by intestinal damage, hemorrhagic diarrhea, lethargy, and high mortality rates in the absence of effective control measures. The rapid spread of these parasites through ingestion of food and drinking water can seriously endanger animal health and productivity, leading to significant economic losses in the chicken industry. Chicken Eimeria species are difficult to identify by conventional microscopy due to similarities in oocyst morphologies. In addition, species identification, which is significant in epidemiological studies, is a time-consuming process involving the sporulation stage and various measurements, requiring labor and expertise. Therefore, the objective of this study was to develop an automated system to classify digital micrographic images of sporulated Eimeria oocysts belonging to seven pathogenic species obtained from domestic chickens using deep transfer learning (DTL) models. This study is the first to utilize feature extraction and fine-tuning methods for classification using DTL models. In this study, 17 pre-trained DTL models were utilized for the classification process. The Xception model achieved the highest classification performance with an accuracy rate of 96.4 %, outperforming all the other models. These results highlight the efficacy of the Xception model and show that DTL models have significant potential in classifying Eimeria species. The DTL models applied in this study, which use both feature extraction and fine-tuning methods to enable species classification of sporulated oocysts of primary chicken Eimeria species, may reduce the workload of researchers in the future and can be incorporated into diagnostic tools and adapted for other practical uses in parasitology and other scientific fields.

**Keywords**

Chicken coccidiosis, Deep transfer learning, Digital micrograph analysis, PoultryXception model

**Albayrak, U., Golcuk, A., Aktas, S., Coruh, U., Tasdemir, S., & Baykan, O. K. (2025).** Classification and Analysis of *Agaricus bisporus* Diseases with Pre-Trained Deep Learning Models. *AGRONOMY-BASEL*, 15(1). https://doi.org/10.3390/agronomy15010226

**Abstract**

This research evaluates 20 advanced convolutional neural network (CNN) architectures for classifying mushroom diseases in Agaricus bisporus, utilizing a custom dataset of 3195 images (2464 infected and 731 healthy mushrooms) captured under uniform white-light conditions. The consistent illumination in the dataset enhances the robustness and practical usability of the assessed models. Using a weighted scoring system that incorporates precision, recall, F1-score, area under the ROC curve (AUC), and average precision (AP), ResNet-50 achieved the highest overall score of 99.70%, demonstrating outstanding performance across all disease categories. DenseNet-201 and DarkNet-53 followed closely, confirming their reliability in classification tasks with high recall and precision values. Confusion matrices and ROC curves further validated the classification capabilities of the models. These findings underscore the potential of CNN-based approaches for accurate and efficient early detection of mushroom diseases, contributing to more sustainable and data-driven agricultural practices.

**Keywords**

Agaricus bisporus, mushroom diseases, deep learning, image processing, precision agriculture, smart farming, convolutional neural networks

**Yurdakul, M., Uyar, K., Tasdemir, S., & Atabas, I. (2025).** ROPGCViT: A Novel Explainable Vision Transformer for Retinopathy of Prematurity Diagnosis. *IEEE ACCESS*, 13. https://doi.org/10.1109/ACCESS.2025.3564213

**Abstract**

Retinopathy of Prematurity (ROP) is a severe disease that occurs in premature babies due to abnormal development of retinal vessels and can lead to permanent vision loss. Fundus images are critical in the diagnosis of ROP; however, the examination of fundus images is a subjective, time-consuming, and error-prone process that requires experience. This situation can lead to delayed diagnosis and inaccurate evaluations. Therefore, the need for computer-aided diagnosis (CAD) systems is increasing day by day. Deep learning (DL) methods have a high potential in analyzing such complex images. In this study, a total of 50 DL models, 25 Convolutional Neural Network (CNN), and 25 Vision Transformer (ViT) models were tested to diagnose ROP from fundus images. Furthermore, the ROPGCViT model based on the Global Context Vision Transformer (GCViT) was proposed. GCViT was enhanced with Squeeze-and-Excitation (SE) block and Residual Multilayer Perceptron (RMLP) structures to effectively learn local and global context information. With a dataset of 1099 fundus images, the performance of the model was evaluated in terms of accuracy, precision, recall, f1-score, and Cohen's kappa score. To enhance explainability, the Gradient-Weighted Class Activation Mapping (Grad-CAM) method was utilized to visualize the regions of fundus images the model focused on during classification, providing insights into its decision-making process. ROPGCViT outperformed both 50 DL models and methods in the literature with 94.69% accuracy, 94.84% precision, 94.69% recall, 94.60% f1-score, and Cohen's kappa score of 93.10%. Additionally, the Grad-CAM visualizations demonstrated the ability of the model to focus on clinically relevant regions, enhancing trust and interpretability for experts. The proposed ROPGCViT model provides a robust solution for ROP diagnosis with high accuracy, flexibility, and generalization capacity.

**Keywords**

Retinopathy of prematurity, vision transformer, convolutional neural network, deep learning, squeeze-and-excitation, grad-CAM

**Dagli, I., Inan, O., & Basciftci, F. (2025).** A hybrid Fox optimization algorithm with chaotic maps and polynomial mutation for clustering applications. *EVOLVING SYSTEMS*, 16(4). https://doi.org/10.1007/s12530-025-09750-5

**Abstract**

Clustering of unlabeled data is a critical task for extracting meaningful patterns from large and complex datasets. In this context, metaheuristic optimization-based clustering methods have gained popularity due to their ability to handle nonlinear and high-dimensional search spaces. This study introduces the Hybrid Fox Optimization Algorithm (ECFOX), an improved optimization and clustering method that builds upon the standard FOX algorithm. ECFOX integrates chaotic maps for population initialization and adaptive control, as well as a polynomial mutation operator to enhance solution diversity and local refinement. The Singer chaotic map generates a well-distributed initial population, while the Iterative chaotic map adaptively balances exploration and exploitation. A polynomial mutation operator is periodically applied to refine candidate solutions and maintain diversity. The effectiveness of ECFOX was evaluated in two experimental stages. First, clustering performance was tested on 17 real-world datasets from the UCI Machine Learning Repository, comparing ECFOX with traditional clustering methods (K-means, K-medoids, Fuzzy C-means) and popular metaheuristic algorithms (ChOA, GWO, WOA, PSO, FOX). ECFOX achieved superior results on most datasets. In the second stage, ECFOX was tested on 23 classical benchmark functions to assess its global and local search performance. The results were compared with those of well-known metaheuristic algorithms, including GWO, CHIMP, PSO, ALO, IALO, and the standard FOX algorithm. ECFOX demonstrated superior convergence speed, solution quality, and robustness. Statistical validation using Wilcoxon signed-rank and Friedman tests confirmed the significance of ECFOX's improvements. These findings suggest that ECFOX is a reliable and competitive approach for clustering and general optimization problems.

**Keywords**

Optimization, Clustering, Fox algorithm, Chaotic maps, Polynomial mutation, K-means

**Aydemir, F., & Başçiftçi, F. (2025).** Performance and Availability Analysis of API Design Techniques for API Gateways. ARABIAN JOURNAL FOR SCIENCE AND ENGINEERING. https://doi.org/10.1007/s13369-024-09474-9

**Abstract**

API design refers to the process of developing Application Programming Interfaces (APIs) that expose the functionality of software applications to their clients. This paper provides a performance and availability-related analysis of three modern API design techniques, namely Representational State Transfer, Google's Remote Procedure Call Framework, and Apache Thrift to practically show which of these techniques should be used in the implementation of the API Gateways for performance and availability considering that the gateways undertake a crucial role as they are the backbone of communication in Microservices Architecture and the performance and availability are two critical factors that determine how well API gateways can perform. For our analysis, an API Gateway prototype for each of the three API design techniques was developed by using Microsoft's .NET framework, and load-tests against each of these three prototypes were performed and analyzed. The results of this paper are expected to be helpful for both researchers and practitioners in the software industry who need to choose from different industrial API design techniques for API Gateway development.

**Keywords**

API Gateway, API design technique, Microservices architecture, REST, gRPC, Apache Thrift

**Dasdemir, A., & Ornek, H. K. (2025).** Epileptic seizure prediction with deep learning-based fusion methods. *ENGINEERING SCIENCE AND TECHNOLOGY-AN INTERNATIONAL JOURNAL-JESTECH*, 72. https://doi.org/10.1016/j.jestch.2025.102212

**Abstract**

Accurate prediction of epileptic seizures is important for patient safety and quality of life. This study aims to provide a fair, protocol-controlled comparison of two fusion strategies for EEG-based seizure prediction and to quantify their practical trade-offs. The decision-level pipeline combines posterior probabilities from two independently trained branches: a raw-EEG TCN → GRU with temporal attention model and an STFT-based 2D-CNN → GRU with temporal attention model. Fusion uses a simple calibrated type-2 rule tuned on validation data, and operating thresholds are set by Youden's J. The feature-level pipeline uses the same two encoders—raw-EEG TCN → GRU and STFT-based 2D-CNN → GRU with temporal attention—to extract embeddings, which are then merged by a lightweight learnable fusion block before the final classifier. All networks are trained from scratch. Evaluation is conducted on the CHB-MIT dataset with stratified 5-fold cross-validation, reporting class-imbalance–robust metrics (PR-AUC and sensitivity at 5 % false-positive rate) in addition to ROC-AUC. The decision-level model attains accuracy 97.50 %, sensitivity 96.86 %, precision 97.57 %, F1 97.33 %, specificity 97.43 %, and AUC 0.99, with PR-AUC 0.994 and Sens@5%FPR 0.967. The feature-level model achieves accuracy 97.70 %, sensitivity 96.64 %, precision 98.47 %, F1 97.44 %, specificity 98.62 %, and AUC 0.99, with PR-AUC 0.995 and Sens@5%FPR 0.986. Post-hoc temperature scaling improved probability calibration (e.g., NLL from 0.089 → 0.083 at decision-level and 0.077 → 0.067 at feature-level) without affecting discrimination. An ablation with non-linear descriptors (Higuchi fractal dimension and fuzzy entropy) yielded modest average gains with added computational cost. These results delineate the conditions under which late posterior fusion versus early representational fusion is preferable and indicate that calibrated fusion improves robustness under realistic class imbalance.

**Keywords**

Convolutional Neural Network, Epilepsy, Gated Recurrent Unit, Short-Time Fourier Transform, Temporal Convolutional Network

**Ermetin, O., & Ornek, H. K. (2025).** Deep-learning-based buffalo identification through muzzle pattern images. *ARCHIVES ANIMAL BREEDING*, 68(3). https://doi.org/10.5194/aab-68-473-2025

**Abstract**

The rapid advancement of artificial intelligence systems has accelerated applications across various fields, including animal biometrics. Accurate identification of buffaloes is crucial for producers and researchers to maintain records and ensure effective tracking. In this study, artificial-intelligence-supported buffalo recognition was developed as an identification method for large livestock. Facial images of 11 buffalos from a facility in the province of Yozgat were utilised to create a dataset for the study. All four algorithms demonstrated successful results. Notably, SqueezeNet outperformed the others, with a remarkable 99.88 % accuracy, 0.998 precision, 0.999 recall, and an F1 score of 0.999. Besides this, ResNet101 was the least successful method, with 99.30 % accuracy, 0.979 precision, 0.995 recall, and an F1 score of 0.987. The accuracy of SqueezeNet and GoogLeNet is 99.88 %, and the recall of these algorithms is 0.999. The precision of SqueezeNet is 0.998, while GoogLeNet's precision is 0.997. The F1 scores of SqueezeNet and GoogLeNet are 0.999 and 0.998, respectively.

**Saday, A., & Ozkan, I. A. (2025).** FPGA-based adaptive fuzzy speed control of welding robots with image processing techniques. *WELDING IN THE WORLD*. https://doi.org/10.1007/s40194-025-02153-9

**Abstract**

Developments in the manufacturing industry and the rapid increase in the production need in the sector have led to the widespread use of welding robot systems in manufacturing industrial products. Automating the welding process through robots has increased the precision and quality factor in production, allowing robots to gain an essential place in the industry. In addition, robots have reduced the need for humans during welding, reducing the harm of bright light and toxic gases and contributing to increased safety. However, automating welding processes and reducing human control in production may lead to the emergence of uncontrolled structures against possible system errors. Therefore, it is critical that intelligent control units control the systems to maintain the quality parameters of robotic systems in production and increase their performance. In this study, it is aimed to minimize system errors that may occur due to material defects and external factors in welding operations performed by welding robots and to keep the welding quality at an optimum level. Based on this purpose, an adaptive system has been proposed in which the welding path is defined by sensors and the robot speed and torch position are controlled depending on the welding path geometry. As a result of the study, speed control of the robot depending on the welding path gap was achieved with an adaptive fuzzy logic controller using FPGA (field programmable gate array) on a prototype welding robot. Recommended for publication by Commission XII—Arc Welding Processes and Production Systems.

**Keywords**

Adaptive control of welding robots, Adaptive fuzzy logic, Automated welding robots, FPGA-based fuzzy logic, Robotic image processing

**Ihsan, A., & Sag, T. (2025).** Binary Puma Optimizer: A Novel Approach for Solving 0-1 Knapsack Problems and the Uncapacitated Facility Location Problem. *APPLIED SCIENCES-BASEL*, 15(18). https://doi.org/10.3390/app15189955

**Abstract**

In this study, the Binary Puma Optimizer (BPO) is introduced as a novel binary metaheuristic. The BPO employs eight Transfer Functions (TFs), consisting of four S-shaped and four V-shaped mappings, to convert the continuous search space of the original Puma Optimizer into binary form. To evaluate its effectiveness, BPO is applied to two well-known combinatorial optimization problems: the 0-1 Knapsack Problems (KPs) and the Uncapacitated Facility Location Problem (UFLP). The solver tailored for KPs is referred to as BPO1, while the solver for the UFLP is denoted as BPO2. In the UFLP experiments, only TFs are integrated into the solutions. Conversely, in the 0-1 KPs experiment, the additional mechanisms are (i) greedy-based population strategies; (ii) a crossover operator; (iii) a penalty algorithm; (iv) a repair algorithm; and (v) an improvement algorithm. Unlike KPs, the UFLP has no infeasible solutions, as facilities are assumed to be uncapacitated. Unlike KPs, the UFLP has no capacity constraints, as facilities are assumed to be uncapacitated. Thus, violations cannot occur, making improvement strategies unnecessary, and the BPO2 depends solely on TFs for binary adaptation. The proposed algorithms are compared with binary optimization algorithms from the literature. The experimental framework demonstrates the versatility and effectiveness of BPO1 and BPO2 in addressing different classes of binary optimization problems.

**Keywords**

binary puma optimization, crossover operator, greedy-based population strategies, improvement algorithm, penalty algorithm, repair algorithm

**Sag, T., & Ihsan, A. (2025).** Efficiency analysis of binary metaheuristic optimization algorithms for uncapacitated facility location problems. *APPLIED SOFT COMPUTING*, 174. https://doi.org/10.1016/j.asoc.2025.112968

**Abstract**

This paper introduces binary adaptations of four metaheuristic optimization algorithms: the Binary Coati Optimization Algorithm (BCOA), Binary Mexican Axolotl Optimization Algorithm (BMAO), Binary Dynamic Hunting Leadership Optimization (BDHL), and Binary Aquila Optimizer (BAO). These algorithms were evaluated for their effectiveness in solving Uncapacitated Facility Location (UFL) problems, which aim to minimize total costs associated with customer-facility allocations and facility opening expenses by determining the optimal number of open facilities. Using 15 UFL problem instances from the OR-Lib dataset, the study assessed algorithm performance across 17 transfer functions (TFs), including S-shaped, V-shaped, and other variants, to address the binary nature of these problems. Performance metrics such as the best, worst, average, standard deviation, and GAP values were analyzed for each binary algorithm. Additionally, statistical analyses were conducted to further assess algorithmic performance. The Kolmogorov-Smirnov (KS) normality test was applied to determine the distribution characteristics of the results, followed by either ANOVA or Kruskal-Wallis tests, depending on the normality of the distributions. These statistical tests revealed significant differences in algorithm performance across different problem instances. Rank values were calculated based on GAP values and CPU times to facilitate comparisons across algorithm versions for the 15 UFL problems. Results underscored the critical role of TF selection in optimizing algorithm efficiency: BCOA performed best with TF11, BMAO with TF16 and TF17, BAO with TF10, and BDHL with TF15. Finally, a performance comparison on GAP values was conducted with two state-of-the-art PSO variants adapted for binary optimization. The proposed algorithms demonstrated either superior or competitive performance in solving UFL problems, validating their efficacy in complex optimization tasks and highlighting the influence of TFs on their performance.

**Keywords**

Aquila optimizer, Binary optimization, Coati optimization, Dynamic hunting leadership optimization, Mexican axolotl optimization

**Yasar, A., & Golcuk, A. (2025).** Deep learning and evolutionary intelligence with fusion-based feature extraction for classification of wheat varieties. *EUROPEAN FOOD RESEARCH AND TECHNOLOGY*, 251(7). https://doi.org/10.1007/s00217-025-04720-2

**Abstract**

One of the most important aspects of producing quality wheat is obtaining pure wheat seed varieties. It is of great importance to obtain pure wheat seeds for high grain quality, efficiency, and durability of wheat varieties. For this purpose, collective wheat images of 5 different bread wheat seed varieties registered by computer vision system were taken. Then, 8354 bread wheat grain images were obtained using image processing techniques. The use of important features that affect the image classification is critical for high classification success. The features obtained from CNN models are fused and combined. The optimal feature subset was selected with the whale optimization algorithm (WOA), one of the meta-heuristic algorithms. Each resulting feature set is classified by machine learning algorithms. The best performance in classification results was obtained with the Support Vector Machine (SVM) classifier. The performance of the system was 95.2% with Fusion + SVM and WOA + SVM. The study also provides results of performance metrics such as sensitivity, precision, specificity and F1 score, Matthews correlation coefficient and kappa values. The contribution of the article is as follows the use of the proposed method allows this process to be carried out with fewer features, less time, and less cost, as well as high accuracy in the classification of bread wheat seed varieties.

**Keywords**

Bread wheat seed, Feature extraction, Fusion, MRMR, WOA

**Terzioğlu, H., Gölcük, A., Shakarji, A. M. A., & Al-Bayati, M. Y. (2025).** Comparative Analysis of Deep Learning-Based Feature Extraction and Traditional Classification Approaches for Tomato Disease Detection. AGRONOMY, 15(7). https://doi.org/10.3390/agronomy15071509

**Abstract**

In recent years, significant advancements in artificial intelligence, particularly in the field of deep learning, have increasingly been integrated into agricultural applications, including critical processes such as disease detection. Tomato, being one of the most widely consumed agricultural products globally and highly susceptible to a variety of fungal, bacterial, and viral pathogens, remains a prominent focus in disease detection research. In this study, we propose a deep learning-based approach for the detection of tomato diseases, a critical challenge in agriculture due to the crop's vulnerability to fungal, bacterial, and viral pathogens. We constructed an original dataset comprising 6414 images captured under real production conditions, categorized into three image types: leaves, green tomatoes, and red tomatoes. The dataset includes five classes: healthy samples, late blight, early blight, gray mold, and bacterial cancer. Twenty-one deep learning models were evaluated, and the top five performers (EfficientNet-b0, NasNet-Large, ResNet-50, DenseNet-201, and Places365-GoogLeNet) were selected for feature extraction. From each model, 1000 deep features were extracted, and feature selection was conducted using MRMR, Chi-Square (Chi2), and ReliefF methods. The top 100 features from each selection technique were then used for reclassification with traditional machine learning classifiers under five-fold cross-validation. The highest test accuracy of 92.0% was achieved with EfficientNet-b0 features, Chi2 selection, and the Fine KNN classifier. EfficientNet-b0 consistently outperformed other models, while the combination of NasNet-Large and Wide Neural Network yielded the lowest performance. These results demonstrate the effectiveness of combining deep learning-based feature extraction with traditional classifiers and feature selection techniques for robust detection of tomato diseases in real-world agricultural environments.

**Keywords**

tomato disease detection, deep learning, feature extraction, machine learning, image classification, agricultural AI

**Taleb, S. M., Yasin, E. T., Saadi, A. A., Dogan, M., Yahia, S., Meraihi, Y., Koklu, M., Mirjalili, S., & Ramdane-Cherif, A. (2025).** A Comprehensive Survey of Aquila Optimizer: Theory, Variants, Hybridization, and Applications. *ARCHIVES OF COMPUTATIONAL METHODS IN ENGINEERING*, 32(8). https://doi.org/10.1007/s11831-025-10281-0

**Abstract**

The Aquila Optimizer (AO) algorithm is a well-known Swarm-based nature-inspired optimization algorithm inspired by Aquila's behavior in hunting and catching prey. Since its development by Abualigah et al. (Comput Methods Appl Mech Eng 376:113609, 2021), AO has gained significant interest among researchers. It has been widely applied across various fields to solve optimization problems, owing to its simplicity, ease of implementation, and reasonable execution time. The main purpose of this paper is to provide a comprehensive survey of the AO algorithm and its improved variants (multi-objective, modified, and hybridized). It also illustrates the various applications of the AO algorithm in several domains of problems such as image processing, feature selection, economic load dispatch, wireless sensor networks, photovoltaic power systems, Unmanned Aerial Vehicles (UAVs) path planning, optimal parameter control, and vehicle routing problems. Furthermore, the results of the AO algorithm are compared with some well-known optimization meta-heuristics published in the literature, such as Differential Evolution (DF), Firefly Algorithm (FA), Bat Algorithm (BA), Grey Wolf Optimization (GWO), Moth Flame Optimization (MFO), and Multi-Verse Optimizer (MVO). Finally, the paper concludes with some future research directions for the AO algorithm.

**Yasin, E. T., Ropelewska, E., Kursun, R., Cinar, I., Taspinar, Y. S., Yasar, A., Mirjalili, S., & Koklu, M. (2025).** Optimized feature selection using gray wolf and particle swarm algorithms for corn seed image classification. *JOURNAL OF FOOD COMPOSITION AND ANALYSIS*, 145. https://doi.org/10.1016/j.jfca.2025.107738

**Abstract**

Corn, one of the agricultural products widely grown in the world, is an important nutrient for both humans and animals. Within the scope of this study, four corn cultivars (BT6470, Calipos, Es Armandi, and Hiva) licensed and produced by BIOTEK, were classified based on morphological, shape, and color features extracted from high-resolution RGB images. A dataset consisting of 14,469 individual seed images was constructed to support this classification task. A total of 106 features were extracted from each image and subsequently classified using three machine learning algorithms: Neural Network, Logistic Regression, and Random Forest. In the second stage, the Gray Wolf Optimizer (GWO) algorithm was applied to select and reduce the features to 44. In the third stage, 57 features were selected from the initial set using the Particle Swarm Optimization (PSO) algorithm. As a result, when the classification performances of all three stages were compared, it was found that the Neural Network was the most successful method with accuracy rates of 95.31 %, 95.09 % and 94.72 %, respectively. The results of the study show that the reduced number of features significantly reduces training and testing times. It is seen that the success performance does not change significantly in the classification made by reducing the optimization algorithms of the attribute numbers, and the calculation costs decrease.

**Keywords**

Corn, Machine learning, Classification, Feature selection, Optimization

**Kilci, O., Eryesil, Y., & Koklu, M. (2025).** Classification of Biscuit Quality With Deep Learning Algorithms. *JOURNAL OF FOOD SCIENCE*, 90(7). https://doi.org/10.1111/1750-3841.70379

**Abstract**

This study aims to reduce time, costs, and human errors in quality control processes for biscuit production by employing deep learning models to detect defective products. Two datasets were created. One for binary classification (defect and no defect) and another for multi-class classification (overcooked, texture defect, and not complete). Among the tested models, EfficientNet achieved the highest performance, with 93.89% accuracy, 96.74% precision, and a 95.38% F1 score in binary classification, and 95.03% accuracy in multi-class classification. ResNet showed comparable performance with accuracy rates of 93.38% and 95.23% for the respective datasets. While XceptionNet and MobileNet exhibited slightly lower accuracy rates, they delivered competitive F1 scores, particularly in detecting texture defects. Grad-CAM visualizations highlighted EfficientNet's superior focus on critical defect regions, reinforcing its suitability for industrial applications. These findings demonstrate the potential of deep learning models for efficient and precise quality control in industrial food production.

**Keywords**

biscuit classification, deep learning, grad-CAM, machine learning, quality control

**Avuclu, E., & Koklu, M. (2025).** Fast and Accurate Classification of Corn Varieties Using Deep Learning With Edge Detection Techniques. *JOURNAL OF FOOD SCIENCE*, 90(7). https://doi.org/10.1111/1750-3841.70439

**Abstract**

Correct grading of corn for food production raises the standard of products offered to consumers and maintains product quality. Classification ensures optimal storage and processing conditions. As a result, losses are minimized, costs are reduced, and agriculture becomes more sustainable. When dealing with huge data, classification needs to be done quickly and accurately. A faster way of achieving the same classification success was explored in this study. Deep learning models ResCNN, DAG-Net, and ResNet-18 were used to classify three corn varieties named Chulpi Cancha, Indurata, and Rugosa. With 1050 corn images, the classification process was carried out. A total of three datasets were obtained using Canny edge detection algorithm (CEDA), Sobel edge detection algorithm (SEDA), and normal color images (CI). Based on experimental studies with CI, the accuracy values of 0.9952, 1, 0.9952; 0.9933, 1, 0.9933; and 0.9952, 1, 0.9952 were obtained for Chulpi Cancha, Indurata, Rugosa corn varieties using ResCNN, DAG-Net, and ResNet-18 deep learning models, respectively. With the images generated by CEDA, the accuracy values for Chulpi Cancha, Indurata, and Rugosa corn varieties were 0.9904, 1, 0.9904; 0.9952, 0.9990, 0.9961; and 0.9952, 1, 0.9952, respectively. Using ResCNN, DAG-Net, and ResNet-18 deep learning models, accuracy values were obtained. Based on the images obtained through SEDA, the accuracy values for Chulpi Cancha, Indurata, and Rugosa corn varieties were 0.9933, 1, 0.9933; 0.9952, 1, 0.9952; and 0.9952, 1, 0.9952 using ResCNN, DAG-Net, and ResNet-18 deep learning models, respectively. ResCNN, DAG-Net, and ResNet-18 models trained faster than CI.

**Keywords**

corn classification, deep learning

**Kilci, O., & Koklu, M. (2025).** Automated Classification of Biscuit Quality Using YOLOv8 Models in Food Industry. *FOOD ANALYTICAL METHODS*, 18(5). https://doi.org/10.1007/s12161-025-02755-5

**Abstract**

It is of great importance for food safety and consumer satisfaction that industrial food products are durable, hygienic, and flawless. Robust products protect the physical integrity of the product by preventing damage that may occur during the production and transportation processes, which meets the expectations of the consumer. Hygienic production conditions prevent foodborne diseases by minimizing the risk of microbial contamination and protect consumer health. Perfect products strengthen the brand image with their aesthetic and satisfactory features and increase consumer loyalty. In the study conducted in this context, the classification of defect and no defect conditions of biscuits in the food industry was examined using YOLOv8 models. A summary dataset consisting of 4990 biscuit images was created and the biscuits were initially divided into two categories: defect and no defect. Later, defect biscuits were classified into three subcategories: not complete, overcooked, and texture defect. As a result of experiments with YOLOv8 models, binary classification (defect, no defect), the highest accuracy rate was achieved in the YOLOv8-m, YOLOv8-l, and YOLOv8-x models with 96.78%, while the highest accuracy rate in the triple classification (not complete, overcooked, and texture defect) performance was achieved in the YOLOv8-m model with 96.99%.

**Keywords**

Biscuit classification, Deep learning, YOLOv8

**Yasin, E. T., Erturk, M., Tassoker, M., & Koklu, M. (2025).** Automatic mandibular third molar and mandibular canal relationship determination based on deep learning models for preoperative risk reduction. *CLINICAL ORAL INVESTIGATIONS*, 29(4). https://doi.org/10.1007/s00784-025-06285-6

**Abstract**

Objectives This study explores the application of deep learning models for classifying the spatial relationship between mandibular third molars and the mandibular canal using cone-beam computed tomography images. Accurate classification of this relationship is essential for preoperative planning, as improper assessment can lead to complications such as inferior alveolar nerve injury during extractions.

Materials and Methods A dataset of 305 cone-beam computed tomography scans, categorized into three classes (not contacted, nearly contacted, and contacted), was meticulously annotated and validated by maxillofacial radiology experts to ensure reliability. Multiple state-of-the-art convolutional neural networks, including MobileNet, Xception, and DenseNet201, were trained and evaluated. Performance metrics were analysed.

Results MobileNet achieved the highest overall performance, with an accuracy of 99.44%. Xception and DenseNet201 also demonstrated strong classification capabilities, with accuracies of 98.74% and 98.73%, respectively.

Conclusions These results highlight the potential of deep learning models to automate and improve the accuracy and consistency of mandibular third molars and the mandibular canal relationship classifications.

Clinical Relevance The integration of such systems into clinical workflows could enhance surgical risk assessments, streamline diagnostics, and reduce reliance on manual analysis, particularly in resource-constrained settings. This study contributes to advancing the use of artificial intelligence in dental imaging, offering a promising avenue for safer and more efficient surgical planning.

**Keywords**

Cone beam computed tomography, Deep learning models, Dental imaging, Mandibular canal, Mandibular third molar, Medical image analysis

**Cengel, T. A., Gencturk, B., Yasin, E. T., Yildiz, M. B., Cinar, I., & Koklu, M. (2025).** Automating egg damage detection for improved quality control in the food industry using deep learning. *JOURNAL OF FOOD SCIENCE*, 90(1). https://doi.org/10.1111/1750-3841.17553

**Abstract**

The detection and classification of damage to eggs within the egg industry are of paramount importance for the production of healthy eggs. This study focuses on the automatic identification of cracks and surface damage in chicken eggs using deep learning algorithms. The goal is to enhance egg quality control in the food industry by accurately identifying eggs with physical damage, such as cracks, fractures, or other surface defects, which could compromise their quality. A total of 794 egg images were used in the study, comprising two different classes: damaged and not damaged (intact) eggs. Four different deep learning models based on convolutional neural networks were employed: GoogLeNet, Visual Geometry Group (VGG)-19, MobileNet-v2, and residual network (ResNet)-50. GoogLeNet achieved a classification accuracy of 98.73%, VGG-19 achieved 97.45%, MobileNet-v2 achieved 97.47%, and ResNet-50 achieved 96.84%. According to the results, the GoogLeNet model performed the damage detection with the highest accuracy rate (98.73%). This study encompasses artificial intelligence and deep learning techniques for the automatic detection of egg damage. The early detection of egg damage and accurate interventions highlights the significant importance of using these technologies in the food industry. This approach provides producers with the ability to detect damaged eggs more quickly and accurately, thereby minimizing product losses through timely intervention. Additionally, the use of these technologies offers a more efficient means of classifying and identifying damaged eggs compared to traditional methods.

**Keywords**

automatic detection, deep learning, egg damage, egg quality, image classification

**Meraihi, Y., Taleb, S. M., Bhuyan, B. P., Benayad, A., Ivanova, G., Dogan, M., Yasin, E. T., Koklu, M., Ramdane-Cherif, A., & Mirjalili, S. (2025).** A Comprehensive Review of Archimedes Optimization Algorithm with its Theory, Variants, Hybridization, and Applications. *ARCHIVES OF COMPUTATIONAL METHODS IN ENGINEERING*. https://doi.org/10.1007/s11831-025-10451-0

**Abstract**

The Archimedes Optimization Algorithm (AOA) is a recent physics-based metaheuristic inspired by Archimedes' principle. Since its introduction by Hashim et al. in 2021, it has gained significant attention and has been applied to various real-world optimization problems. Its popularity stems from its simple structure, adaptability, ease of implementation, and satisfactory convergence. This paper presents a comprehensive review of the AOA algorithm, including its modified, multi-objective, and hybrid variants, and examines its applications in several domains such as classification, feature selection, parameter tuning, scheduling, photovoltaic systems, wireless networks, and clustering. The performance of the AOA algorithm is evaluated against some well-known metaheuristic algorithms, including Genetic Algorithm (GA), Differential Evolution (DE), Tabu Search (TS), Firefly Algorithm (FA), Bat Algorithm (BA), Whale Optimization Algorithm (WOA), Grey Wolf Optimizer (GWO), Sine Cosine Algorithm (SCA), and Marine Predators Algorithm (MPA), and results demonstrates its superiority in most cases (72,22%) with stable dispersion in box-plot analyses. Finally, future research directions for improving the effectiveness and applicability of the AOA algorithm are outlined.

**Saadi, A. A., Taleb, S. M., Yahia, S., Dogan, M., Yasin, E. T., Meraihi, Y., Koklu, M., Mirjalili, S., & Ramdane-Cherif, A. (2025).** A Comprehensive Survey of Henry Gas Solubility Optimization Algorithm with its Theory, Variants, and Applications. *ARCHIVES OF COMPUTATIONAL METHODS IN ENGINEERING*. https://doi.org/10.1007/s11831-025-10304-w


**Abstract**

Henry Gas Solubility Optimization (HGSO) algorithm is a well-known physics-based nature-inspired optimization algorithm inspired by the behavior of Henry's law. The HGSO algorithm, developed by Hashim et al. in 2019, has attracted significant interest from scientists and researchers. It has been widely applied to solve various optimization problems in different fields due to its unique structure, simplicity, easiness of implementation, and reasonable execution time. This paper explores and examines over 200 previous existing research on the HGSO algorithm covering its advancements, enhanced variants (multi-objective, hybridized, and modified), and a wide range of real-world applications such as intrusion detection, wireless sensor networks, optimal parameters control, photovoltaic systems, image processing, and feature selection. Additionally, The performance of the HGSO algorithm is assessed using 23 IEEE CEC benchmark functions in comparison with 14 well-regarded optimization meta-heuristics published in the literature. Furthermore, the results of the HGSO algorithm are compared with some of its key variants. The survey also provides a critical evaluation of HGSO's convergence behavior, highlighting its strengths and limitations. Finally, the paper concludes with some potential directions for future work. The insights gained from this survey offer valuable guidance for researchers aiming to apply or enhance the HGSO algorithm in a wide range of optimization problems.

**Incekara, H., Cizmeci, I. H., Saritas, M. M., & Koklu, M. (2025).** Classification of almond kernels with optuna hyper-parameter optimization using machine learning methods. *JOURNAL OF FOOD SCIENCE AND TECHNOLOGY-MYSORE*. https://doi.org/10.1007/s13197-025-06494-7

**Abstract**

Almonds are an agricultural product with nutritious features. Almond species are important in terms of marketing and in terms of sustainability. Traditional almond classification methods can be time-consuming and expensive. In addition, Machine Learning (ML) methods stand out due to the tendency of human errors in the classification. ML methods can give both faster and more accurate results. This study aims to improve the performance of ML methods in the classification of almonds. In the study, almond data obtained from the data set were first processed with image processing methods. In this process, the noise and shadows in the images were removed. Then, 26 different features were extracted from the almond images. These extracted features were processed using SVM, RF, FCNN, LightGBM, CatBoost, and XGBoost ML methods in the classification process. It has provided accuracy, especially in SVM, FCCN, and XGBOOST models, and high values in metrics such as F1-Score. In the OptHO-SVM method, where Optuna was applied, the accuracy increased from 90.06 to 96.53%, while in the OptHO-FCNN method, the accuracy increased from 94.23 to 96.40%. In addition, significant improvements were observed in loss metrics such as Log Loss; Log Loss value improved by 58.75% in the OptHO-SVM method.

**Keywords**

Almond classification, Machine learning, Hybrid machine learning, Optuna hyperparameter optimization

**Eser, M., Bilgin, M., Yasin, E. T., & Köklü, M. (2025).** Using Pre-Trained Models in Ensemble Learning for Date Fruits Multiclass Classification. *Journal of Food Science*. https://doi.org/10.1111/1750-3841.70136

**Abstract**

Date fruits are a primary agricultural product that comes in a variety of textures, colors, and tastes; hence, the correct classification is crucial for quality control, automatic sorting, and commercial applications. Deep learning has surely shown critically improved image classification duties. In this research, the classification of nine different date fruit types by means of four well-known convolutional neural networks (CNNs), that is, DenseNet121, MobileNetV2, ResNet18, and VGG16 as well as an ensemble learning approach was objected. It is evaluated the proposed Dirichlet Ensemble which entails the predictions from the individual CNN models and the baseline architecture across multiple epochs. Toward the assessment, the accuracy, precision, recall, and F1-score were used. The results of the experiments revealed that the Dirichlet Ensemble is better than any single model out there with an accuracy of 98.61%, precision of 98.71%, recall of 98.61%, and an F1-score of 98.62%. DenseNet121 and MobileNetV2 were the standalone models with the highest accuracy of 96.92% and 95.83%, respectively, which is why they are very useful for a limited computing system. ResNet18 was by far the best model with a final accuracy of 92.35% and even outperformed VGG16 by 16%. VGG16's unsatisfactory performance with an accuracy of 73.24% clearly indicates its inability to handle complex classification tasks. The present work also showed the effectiveness of ensemble learning in enhancing the accuracy and robustness of classification. Future research could be investigating more advanced ensemble strategies and fine-tuning techniques to improve the generalization of modeling in food classification applications.

**Keywords**

Date Fruits, Dirichlet Ensemble, Ensemble Learning, Image Classification

**Yasin, E. T., & Köklü, M. (2025).** A Comparative Analysis of Machine Learning Algorithms for Waste Classification: Inceptionv3 and Chi-Square Features. *International Journal of Environmental Science and Technology*. https://doi.org/10.1007/s13762-024-06233-z

**Abstract**

Effective waste management requires the correct categorization of recyclables. It is possible to classify organic waste and recyclable waste using machine learning techniques. Accurately sorting waste is important for improving recycling processes, however separating organic waste from recyclables remains a challenge. This study aimed to provide the importance of machine learning in the field of waste management and automate classification of solid waste. We compared the accuracy of three machine learning classifiers based on the Chi2 feature selection method. Feature extraction was performed using the InceptionV3 deep convolutional neural network. The training of three machine-learning classifiers was performed using the extracted features. Based on a labeled waste classification image dataset, the performance of the classifiers was evaluated. Despite using any of the feature's selections, SVM attained an accuracy of 96.3%, Decision Tree an accuracy of 85.8%, and KNN an accuracy of 94.9%. However, with feature selection using Chi2, a slight decrease in accuracy was observed. We demonstrate that machine learning algorithms can classify solid household waste with an automated model. Using the findings from this study, we can create a system that achieves optimal efficiency in terms of waste classification and management. This system can then be implemented in the real world.

**Keywords**

$Chi^2$, Classification, Feature extraction, InceptionV3, Machine learning, Solid waste, Waste management

**Cinar, A. C. (2025).** A synergistic oversampling technique with differential evolution and safe level synthetic minority oversampling. *APPLIED SOFT COMPUTING*, 172. https://doi.org/10.1016/j.asoc.2025.112819

**Abstract**

Classification problems often face challenges when dealing with imbalanced datasets, leading to decreased performance. To address this issue, balancing the dataset becomes imperative for improved classification accuracy. Among various methods proposed in the literature, oversampling techniques are fundamental approaches to mitigating class imbalance. Synthetic Minority Over-sampling Technique (SMOTE) is a foundational technique in this domain. However, a more refined approach, Safe-Level-SMOTE, selectively utilizes crucial minority instances to generate synthetic samples. Another notable method, the Differential Evolution-Based Oversampling Approach for Highly Imbalanced Datasets (DEBOHID), leverages a differential evolution algorithm to handle highly imbalanced datasets effectively. This study presents a novel oversampling method (SL-D) that integrates Safe-Level-SMOTE with DEBOHID. SL-D offers three distinct variants: SL-D-Max, SL-D-Min, and SL-D-Mean, each tailored to specific scenarios. We introduce an adaptive calculation mechanism for the proposed method's crossover rate (CR) parameter. Our experimentation utilizes Decision Trees (DT), Support Vector Machines (SVM), and k-nearest neighbor (kNN) classifiers across forty-four highly imbalanced datasets. Results indicate that the SL-D-Max variant outperforms nine state-of-the-art oversampling approaches, as evidenced by superior performance metrics such as G-Mean and Area Under the Curve (AUC). Furthermore, statistical analysis employing the Friedman Test confirms the significant superiority of SL-D-Max. This study underscores the efficacy of the proposed hybrid oversampling technique in addressing imbalanced data classification challenges and highlights its potential for practical applications.

**Keywords**

Imbalanced learning, Safe-Level-SMOTE, Differential evolution, Oversampling, Class imbalance

**Pektas, A., Hacibeyoglu, M., & Inan, O. (2025).** Hybridization of the Snake Optimizer and Particle Swarm Optimization for continuous optimization problems. *ENGINEERING SCIENCE AND TECHNOLOGY-AN INTERNATIONAL JOURNAL-JESTECH*, 67. https://doi.org/10.1016/j.jestch.2025.102077

**Abstract**

The Snake Optimizer (SO), despite its reasonable performance in a variety of continuous optimization problems, struggles by inefficient exploration, stagnation in local optima, and a slow convergence. To improve exploration, accelerate convergence, and avoid local optima, the velocity vector of Particle Swarm Optimization (PSO) was integrated into the Snake Optimizer (SO), resulting in the proposal of the Snake Optimizer Particle Swarm Optimization (SO-PSO) metaheuristic method. To evaluate the applicability of the proposed SO-PSO method, it was evaluated on continuous numerical problems (CEC-2017) and seven real-world engineering problems, benchmarking its performance against contemporary metaheuristic algorithms, including WOA, PSO, GWO, EO, LSHADE, and SO. A comparative analysis of six metaheuristics and SO-PSO was conducted on 30 shifted and rotated benchmark problems across dimensions and population sizes of 30, 50, and 100, as well as seven engineering challenges with population sizes of 30, 50, and 100, each evaluated over 30 independent runs. According to the Friedman ranking results from 270 experimental tests on CEC17 functions, SO-PSO, WOA, PSO, GWO, EO, LSHADE, and SO achieved rankings of 1.62, 6.5, 5.91, 4.18, 1.98, 4.53, and 3.28, respectively. Regarding the results of the engineering functions, SO-PSO, WOA, PSO, GWO, EO, LSHADE, and SO achieved rankings of 1.82, 6.19, 3.95, 4, 3.38, 4.34, and 4.33, respectively. Besides, the proposed SO-PSO shows statistically significant difference from other methods in 96.42 % and 93.65 % of experimental tests obtained from Wilcoxon's signed-rank test in CEC17 functions and engineering problems, respectively. Consequently, SO-PSO demonstrated superior performance over other metaheuristics based on experimental and statistical test results.

**Keywords**

Engineering design problems, Hybrid optimization, Metaheuristic algorithms, Particle Swarm Optimization, Snake Optimizer

**Bilban, M., & Inan, O. (2025).** Comparative Analysis of Machine Learning Methods with Chaotic AdaBoost and Logistic Mapping for Real-Time Sensor Fusion in Autonomous Vehicles: Enhancing Speed and Acceleration Prediction Under Uncertainty. *SENSORS*, 25(11). https://doi.org/10.3390/s25113485

**Abstract**

This study presents a novel artificial intelligence-driven architecture for real-time sensor fusion in autonomous vehicles (AVs), leveraging Apache Kafka and MongoDB for synchronous and asynchronous data processing to enhance resilience against sensor failures and dynamic conditions. We introduce Chaotic AdaBoost (CAB), an advanced variant of AdaBoost that integrates a logistic chaotic map into its weight update process, overcoming the limitations of deterministic ensemble methods. CAB is evaluated alongside k-Nearest Neighbors (kNNs), Artificial Neural Networks (ANNs), standard AdaBoost (AB), Gradient Boosting (GBa), and Random Forest (RF) for speed and acceleration prediction using CARLA simulator data. CAB achieves a superior 99.3% accuracy (MSE: 0.018 for acceleration, 0.010 for speed; MAE: 0.020 for acceleration, 0.012 for speed; R2: 0.993 for acceleration, 0.997 for speed), a mean Time-To-Collision (TTC) of 3.2 s, and jerk of 0.15 m/s3, outperforming AB (98.5%, MSE: 0.15, TTC: 2.8 s, jerk: 0.22 m/s3), GB (99.1%), ANN (98.2%), RF (97.5%), and kNN (87.0%). This logistic map-enhanced adaptability, reducing MSE by 88% over AB, ensures robust anomaly detection and data fusion under uncertainty, critical for AV safety and comfort. Despite a 20% increase in training time (72 s vs. 60 s for AB), CAB's integration with Kafka's high-throughput streaming maintains real-time efficacy, offering a scalable framework that advances operational reliability and passenger experience in autonomous driving.

**Keywords**

AdaBoost, Apache Kafka, Artificial Neural Networks, autonomous vehicles, Gradient Boosting, k-Nearest Neighbors, machine learning, Random Forest, Chaotic AdaBoost

**Bilban, M., & Inan, O. (2025).** Optimizing Autonomous Vehicle Performance Using Improved Proximal Policy Optimization. *SENSORS*, 25(6). https://doi.org/10.3390/s25061941

**Abstract**

Autonomous vehicles must make quick and accurate decisions to operate efficiently in complex and dynamic urban traffic environments, necessitating a reliable and stable learning mechanism. The proximal policy optimization (PPO) algorithm stands out among reinforcement learning (RL) methods for its consistent learning process, ensuring stable decisions under varying conditions while avoiding abrupt deviations during execution. However, the PPO algorithm often becomes trapped in a limited search space during policy updates, restricting its adaptability to environmental changes and alternative strategy exploration. To overcome this limitation, we integrated Lévy flight's chaotic and comprehensive exploration capabilities into the PPO algorithm. Our method helped the algorithm explore larger solution spaces and reduce the risk of getting stuck in local minima. In this study, we collected real-time data such as speed, acceleration, traffic sign positions, vehicle locations, traffic light statuses, and distances to surrounding objects from the CARLA simulator, processed via Apache Kafka. These data were analyzed by both the standard PPO and our novel Lévy flight-enhanced PPO (LFPPO) algorithm. While the PPO algorithm offers consistency, its limited exploration hampers adaptability. The LFPPO algorithm overcomes this by combining Lévy flight's chaotic exploration with Apache Kafka's real-time data streaming, an advancement absent in state-of-the-art methods. Tested in CARLA, the LFPPO algorithm achieved a 99% success rate compared to the PPO algorithm's 81%, demonstrating superior stability and rewards. These innovations enhance safety and RL exploration, with the LFPPO algorithm reducing collisions to 1% versus the PPO algorithm's 19%, advancing autonomous driving beyond existing techniques.

**Keywords**

autonomous vehicles, apache kafka, CARLA simulator, levy flight, proximal policy optimization

**Ozer, A. S., & Cinar, I. (2025).** Real-Time and Fully Automated Robotic Stacking System with Deep Learning-Based Visual Perception. *SENSORS*, 25(22). https://doi.org/10.3390/s25226960

**Abstract**

This study presents a fully automated, real-time robotic stacking system based on deep learning-driven visual perception, designed to optimize classification and handling tasks on industrial production lines. The proposed system integrates a YOLOv5s-based object detection algorithm with an ABB IRB6640 robotic arm via a programmable logic controller and the Profinet communication protocol. Using a camera mounted above a conveyor belt and a Python-based interface, 13 different types of industrial bags were classified and sorted. The trained model achieved a high validation performance with an mAP@0.5 score of 0.99 and demonstrated 99.08% classification accuracy in initial field tests. Following environmental and mechanical optimizations, such as adjustments to lighting, camera angle, and cylinder alignment, the system reached 100% operational accuracy during real-world applications involving 9600 packages over five days. With an average cycle time of 10–11 s, the system supports a processing capacity of up to six items per minute, exhibiting robustness, adaptability, and real-time performance. This integration of computer vision, robotics, and industrial automation offers a scalable solution for future smart manufacturing applications.

**Keywords**

computer vision, industrial automation, programmable logic controller integration, real-time object detection, robotic stacking, smart manufacturing

**Cinar, I. (2025).** Comparative analysis of machine learning and deep learning algorithms for knee arthritis detection using YOLOv8 models. *JOURNAL OF X-RAY SCIENCE AND TECHNOLOGY*, 33(3). https://doi.org/10.1177/08953996241308770

**Abstract**

Knee arthritis is a prevalent joint condition that affects many people worldwide. Early detection and appropriate treatment are essential to slow the disease's progression and enhance patients' quality of life. In this study, various machine learning and deep learning algorithms were used to detect knee arthritis. The machine learning models included k-NN, SVM, and GBM, while DenseNet, EfficientNet, and InceptionV3 were used as deep learning models. Additionally, YOLOv8 classification models (YOLOv8n-cls, YOLOv8s-cls, YOLOv8m-cls, YOLOv8l-cls, and YOLOv8x-cls) were employed. The "Annotated Dataset for Knee Arthritis Detection" with five classes (Normal, Doubtful, Mild, Moderate, Severe) and 1650 images were divided into 80% training, 10% validation, and 10% testing using the Hold-Out method. YOLOv8 models outperformed both machine learning and deep learning algorithms. k-NN, SVM, and GBM achieved success rates of 63.61%, 64.14%, and 67.36%, respectively. Among deep learning models, DenseNet, EfficientNet, and InceptionV3 achieved 62.35%, 70.59%, and 79.41%. The highest success was seen in the YOLOv8x-cls model at 86.96%, followed by YOLOv8l-cls at 86.79%, YOLOv8m-cls at 83.65%, YOLOv8s-cls at 80.37%, and YOLOv8n-cls at 77.91%.

**Keywords**

YOLOv, classification, deep learning, knee arthritis detection, machine learning.