IEEE 2025-26 PROJECT LIST	
Deep learning	
CODE	TITLE AND ABSTRACT
26-ANSP-DL-001	**A Deep and Interpretable Learning Approach for Long-Term ECG Clinical Noise Classification** Objective: In Long-Term Monitoring (LTM), noise significantly impacts the quality of the electrocar- diogram (ECG), posing challenges for accurate diagnosis and time-consuming analysis. The clinical severity of noise refers to the difficulty in interpreting the clinical content of the ECG, in contrast to the traditional approach based on quantitative severity. In a previous study, we trained Machine Learning (ML) algorithms using a data repository labeled according to the clinical severity. In this work, we explore Deep Learning (DL) models in the same database to design architectures that provide explainability of the decision making process. Methods: We have developed two sets of Convolutional Neural Networks (CNNs): a 1-D CNN model designed from scratch, and pre-trained 2-D CNNs fine-tuned through transfer learning. Additionally, we have designed two Autoencoder (AE) architectures to provide model interpretability by exploiting the data regionalization in the latent spaces. Results: The DL systems yield superior classification performance than the previous ML approaches, achieving an F1-score up to 0.84in the test set considering patient separation to avoid intrapatient overfitting. The interpretable architectures have shown sim- ilar performance with the advantage of qualitative explanations. Conclusions: The integration of DL and interpretable systems has proven to be highly effective in classifying clinical noise in LTM ECG recordings. This approach can enhance clinicians' confidence in clinical decision support systems based on learning methods, a key point for this technology transfer. Significance: The proposed systems can help healthcare professionals to discriminate the parts of the ECG that contain valuable information to provide a diagnosis.
26-ANSP-DL-002	**A Novel Active Learning Approach for Improving Classification of Unlabeled Video Based on Deep Learning Techniques** Video classification typically requires large labeled datasets which are costly and time-consuming to obtain. This paper proposes a novel Active Learning (AL) framework to improve video classification performance while minimizing the human annotation effort. Unlike passive learning methods that randomly select samples for labeling, our approach actively identifies the most informative unlabeled instances to be annotated. Specifically, we develop batch mode AL techniques that select useful videos based on uncertainty and diversity sampling. The algorithm then extracts a diverse set of representative keyframes from the queried videos. Human annotators only need to label these keyframes instead of watching the full videos. We implement this approach by leveraging recent advances in deep neural networks for visual feature extraction and sequence modeling. Our experiments on benchmark datasets demonstrate that our method achieves significant improvements in video classification accuracy with less training data. This enables more efficient video dataset construction and could make large-scale video annotation more feasible. Our AL framework minimizes the human effort needed to train accurate video classifiers.

26-ANSP-DL-003	**A Novel RMS-Driven Deep Reinforcement Learning for Optimized Portfolio Management in Stock Trading** Algorithmic stock trading has improved tremendously, with Reinforcement Learning (RL) algorithms being more adaptable than classic approaches like mean reversion and momentum. However, challenges remain in adequately depicting market events and generating suitable rewards to influence the trading decisions of an agent in a dynamic environment. This study proposed an improved stock market trading framework termed the RMS-Driven Deep Reinforcement Learning (DRL) model for optimal portfolio management. The research attempts to give a more comprehensive view of the market and, as a result, enhance trading decisions by including consumer information and incorporating news sentiments into the model, in addition to data from typical earnings reports. More specifically, three kinds of DRL models are presented, combined with data from stock earnings reports, Max Drawdown rewards, and sentiment indicators (RMS), known as PPO_RMS, A2C_RMS, and DDPG_RMS, respectively. The findings of this research indicate that the integrated model, mainly the DDPG_RMS effectively outperforms the baseline ^DJI index in many risk-return analyses in ratios showing better risk management, and profitability. The proposed stock trading model generates a maximum cumulative return of 27% with a Sharpe ratio of 0.66, showing an appropriate trade-off between risk and return. This approach, which incorporates sentiment analysis and Max Drawdown rewards, significantly enhances the model's performance in adapting to changing market conditions. Therefore, the results emphasize the appropriateness of integrating sentiment indices with traditional financial data to enhance a trader's performance while also offering essential information to aid in the development of improved trading tactics in continuously changing financial markets.
26-ANSP-DL-004	**Ad Click Fraud Detection Using Machine Learning and Deep Learning Algorithms** In online advertising, click fraud poses a significant challenge, draining budgets and threatening the industry's integrity by redirecting funds away from legitimate advertisers. Despite ongoing efforts to combat these fraudulent practices, recent data emphasizes their widespread and persistent nature. Toward detecting click fraud effectively, this study employed a comprehensive feature engineering and extraction approach to identify subtle differences in click behavior that could be used to distinguish fraudulent from legitimate clicks. Subsequently, a thorough evaluation was conducted involving nine diverse machine learning (ML) and Deep Learning (DL) models. After Recursive Feature Elimination (RFE), the ML models consistently demonstrated robust performance. DT and RF surpassed 98.99% accuracy, while GB, LightGBM, and XGBoost achieved 98.90% or higher. Precision scores, measuring accurate identification of fraudulent clicks, exceeded 98% for models like ANN. In parallel, deep learning (DL) models, including Convolutional Neural Network (CNN), Deep Neural Network (DNN), and Recurrent Neural Network (RNN), showcased strong performance. RNN, in particular, achieved 97.34% accuracy, emphasizing its efficacy. The study underscores the prowess of tree-based methods and advanced algorithms in detecting click fraud, as evidenced by high accuracy, precision, and recall scores. These findings contribute valuable insights to combat click fraud and establish the groundwork for the strategic development of anti-fraud measures in online advertising.

26-ANSP-DL-005	**Advanced EEG Signal Processing and Deep Q-Learning for Accurate Student Attention Monitoring** Measuring student attention during learning remains a challenging task. Traditional methods, such as surveys and observations, are subjective and often inaccurate. While EEG can detect attentional changes, its interpretation is complicated by noise and artifacts. This study introduces an enhanced approach that leverages advanced data preprocessing techniques and a Double Deep Q-Network (DDQN) model, a specialized deep reinforcement learning (DRL) algorithm adept at handling complex, multidimensional EEG data. We employ wavelet transformations to generate robust frequency-based representations of raw multi-channel EEG signals, followed by Butterworth bandpass and notch filters to eliminate noise and artifacts. Dimensionality reduction and feature scaling are achieved employing Principal Component Analysis (PCA) alongside Independent Component Analysis (ICA), leading in cleaner and more representative EEG data. Our method significantly improves the accuracy of attention state classification, achieving a test accuracy of 98.4%. This advancement sets a new standard for utilizing EEG data to monitor attention in educational settings, showcasing the effectiveness of our preprocessing techniques in enhancing the DDQN's neural decoding capabilities.
26-ANSP-DL-006	**Advanced Millimeter Wave Radar-Based Human Pose Estimation Enabled by a Deep Learning Neural Network Trained With Optical Motion Capture Ground Truth Data** Deep learning-enabled method for human pose estimation using radar target lists, obtained through a low-cost radar system with three transmitters and four receivers in a multiple- input multiple-output setup. We address challenges in previous research that often relied on extracting ground truth poses from RGB data, which are constrained by the need for 3D mapping and vulnerability to occlusions. To overcome these limitations, we utilized optical motion capture, which is widely recognized as the gold standard for precise human motion analysis. We conducted an extensive optical motion capture study involving various recorded movement activities, which resulted in *mmRadPose*, a new dataset that enhances existing benchmarks for radar-based pose estimation. This dataset has been made publicly accessible. Building on this approach, we designed an application-tailored radar signal processing chain to generate suitable input for the machine learning algorithm. We further developed an attentional recurrent-based deep learning model, *PntPoseAT*, which predicts 24 keypoints of human poses using radar target lists. We employed cross validation to thoroughly evaluate the model. This model surpasses previous approaches and achieves an average mean per-joint position error of 6.49 cm with a standard deviation of 3.74 cm on totally unseen test data. This excellent accuracy of the reconstructed keypoint positions is particularly remarkable when you consider that a very simple radar was used for the measurements. Additionally, we conducted a comprehensive analysis of the model's performance by exploring aspects such as network architecture, the use of long short-term memory versus gated recurrent units, input data selection, and the integration of multi-head self-attention mechanisms.
26-ANSP-DL-007	**Category-Based Sentiment Analysis of Sindhi News Headlines Using Machine Learning, Deep Learning, and Transformer Models** The rapid growth of digital content has made sentiment analysis (SA) an essential tool for understanding public sentiment and classifying textual data. Despite significant progress in natural language processing (NLP), low-resource languages, particularly Sindhi, remain underexplored due to the lack of computational tools and annotated

	datasets. This study addresses this gap by introducing the Sindhi News Headlines Dataset (SNHD), a novel corpus annotated for both SA and category classification across eight categories: Crime, Economy, Entertainment, Health, Politics, Science & Technology, Social, and Sports. To evaluate the effectiveness of different machine learning (ML), deep learning (DL), and transformer-based approaches, we conduct a comparative analysis of various models on SA and category classification tasks. Furthermore, we leverage Explainable Artificial Intelligence (XAI) techniques, such as Local Interpretable Model-Agnostic Explanations (LIME), to gain insights into model decision-making. Experimental results show that traditional ML models outperform DL and transformer-based models on the SNHD dataset. Specifically, Support Vector Machines with Radial Basis Function (SVM-RBF) achieves the highest performance for SA (0.74 accuracy and weighted F-score), while the Ridge Classifier (RC) delivers the best results for category classification (0.84 accuracy and weighted F-score). Among transformer models, XLM-RoBERTa demonstrates strong performance in category classification (0.82 accuracy and weighted F- score). These findings establish a benchmark for future research in Sindhi NLP and highlight the potential of hybrid approaches in tackling challenges associated with low-resource languages. This work provides a foundational resource for NLP researchers seeking to advance computational methods for Sindhi and similar underrepresented languages.
26-ANSP-DL-008	**Comparative Study of Machine Learning and Deep Learning Models for Early Prediction of Ovarian Cancer** Ovarian cancer remains one of the most difficult gynecological cancers to detect early, often resulting in poor survival rates. This study presents a comparative analysis of machine learning (ML) and deep learning (DL) models for the early prediction of ovarian cancer using clinical and biomarker data. The dataset undergoes comprehensive preprocessing, including handling missing values, outlier removal, normalization, and dimensionality reduction via PCA. Feature selection methods such as Feature Importance, Recursive Feature Elimination (RFE), and autoencoder-based techniques are employed to enhance model performance. Various classifiers, including KNN, SVM, Logistic Regression, Random Forest, and deep networks like ANN, FNN, CNN, and RNN, are evaluated. Ensemble models such as Bagging, AdaBoost, Stacking, and XGBoost are also implemented. Our results show that the Feedforward Neural Network (FNN), combined with autoencoder-based feature selection, achieved the highest accuracy (85.71%), indicating its potential as a reliable predictive model for ovarian cancer. This comparative study highlights the significance of integrating optimized preprocessing, feature engineering, and model selection for effective early diagnosis.
26-ANSP-DL-009	**Depression Detection in Social Media: A Comprehensive Review of Machine Learning and Deep Learning Techniques** Depression is a widespread mental health disorder that may remain undiagnosed by conventional clinical methods. The rapidly growing world of social media sites such as Twitter, Reddit, Facebook, Instagram, and Weibo has provided new avenues for depression detection using Machine Learning (ML) as well as Deep Learning (DL), which analyze user behavior patterns and linguistic cues for more accurate detection of depression. Many techniques have been developed for this aim over the years. Identifying relevant publications on this topic using current academic search systems is challenging due to the rapid growth of research publications, unclear or limited search terms, and the complexity of citation networks. Several review papers have been published to ease this task by summarizing the methodologies, key findings, and recommendations for future research. However, most current reviews often do not provide a clear overview of the evolution, latest techniques, and challenges. This paper

	aims to address that gap by providing a comprehensive review of ML and DL methodologies for detecting depression on social media. We propose a generic architecture for these systems and present a detailed analysis of methodologies and datasets used for evaluation in this field. In addition, we highlight key open research areas, providing a useful starting point for further research and development. By narrowing our focus to social media, this review contributes to advancing the understanding and application of cutting-edge methods for depression detection. While this review highlights advancements in social media-based depression detection, it excludes alternative approaches like graph-based systems and reinforcement learning, and its focus on social media may limit its applicability to other domains.
26-ANSP-DL-010	**Development of Continuous AMSR-E/2 Soil Moisture Time Series by Hybrid Deep Learning Model (ConvLSTM2D and Conv2D) and Transfer Learning for Reanalyses** Surface soil moisture (SSM) is a crucial climate vari- able of the Earth system that regulates water and energy exchanges between the land and atmosphere, directly influencing hydrological, biogeochemical, and energy cycles. However, satellite-derived SSM, particularly from the Advanced Microwave Scanning Radiometer AMSR-E/2, is limited by radio frequency interference, vegetation effects, frozen ground, and significant spatial and tempo- ral data gaps. By excluding data points affected by these problems, we are able to train an unaffected system and fill the gaps with high accuracy predictions. We developed a sophisticated deep learning ConvLSTM model that combines convolutional long short-term memory (ConvLSTM2D) layers and convolutional neural network (CNN) layers. The model initially enhances AMSR-2 SSM values across time and space using Advanced SCATterometer (ASCAT) SSM as input. The ConvLSTM model, trained to enhance AMSR-2 SSM, is then fine-tuned by using the transfer learning technique to enhance AMSR-E data. The enhanced AMSR-2 data is used as a target to guide the enhancement of AMSR-E. This approach ensures that gaps in AMSR-E data are filled, while aligning the characteristics with the more consistent AMSR-2 SSM, resulting in a seamless AMSR-E/2 dataset from 2003 to 2023. Unlike previous studies incorporating additional datasets like precipitation, temperature, and digital elevation models, our approach avoids these to prevent redundancy and potential inaccuracies when generating land surface reanalyzes based on data assimilation, since such data are already integrated into the land surface model. The ConvL- STM model achieved a lower root mean squared error of 0.07 for AMSR-2 prediction and 0.04 for AMSR-E via transfer learning demonstrating significant gap-filling accuracy. The enhanced SSM demonstrated a 26% improvement in the correlation with in situ SSM measurements, while maintaining accuracy and consistency in spatial and temporal patterns.

26-ANSP-DL-011	**Dueling Network Architecture for GNN in the Deep Reinforcement Learning for the Automated ICT System Design** This presents an improved deep reinforcement learning-based (DRL) approach for end-to-end models using a Graph Neural Network(GNN). The proposed method aims to improve end-to-end deep Q learning with a GNN by decomposing the GNN-based Q-network structure into two sub-streams to separately estimate the global state value and the state-dependent action advantage instead. By doing that, our dueling GNN architecture can independently learn which states are valuable or not. This is achieved by utilizing the graph-dependent global-state value rather than relying on the effect of each action for each state. This approach provides a more accurate approximation of the Q-value. With better Q-value approximation, the network can deal with the problem of massive state space with sparse rewards and significantly achieve higher learning efficiency without imposing any change to the underlying reinforcement learning algorithm. The proposed method was introduced into an automated ICT system design model. The automated ICT system design model faces a fundamental challenge characterized by prolonged learning times, primarily attributable to the tendency to overestimate particular configurations owing to the scarcity of rewards despite the vast exploration space encompassing numerous possible combinations of ICT system components. The results reveal that the proposed architecture effectively improves the learning efficiency of the DRL model without imposing any changes to the underlying reinforcement learning algorithm.
26-ANSP-DL-012	**Enhancing Mobile App Recommendations With Crowdsourced Educational Data Using Machine Learning and Deep Learning** In the rapidly evolving digital landscape, personalized recommendations have become essential for enhancing user experience. Machine learning models analyze user behavior patterns to suggest relevant entertainment, education, or e-commerce content. Mobile devices make it easier to gather educational data through crowdsourcing, which opens new possibilities for improving app recommendation algorithms. This paper provides valuable methodologies for scalable student recommendation and educational systems, highlighting DL's advantages over CF in handling sparse, time-sensitive datasets. The objective of this study is to recommend apps to university students by category based on app usage patterns. Data was used to evaluate these 806 university students to train the Collaborative Filtering (CF) and Contemporary Deep Learning (DL) models. The results demonstrate that Gated Recurrent Units (GRU) are the best option for real-time, customized suggestions because of their capacity to simulate successive interactions and adjust to changing user behavior. The GRU yields the lowest mean errors MAE of 0.2246, RMSE=0.2516, and superior short-term predictions k=4 MAE of 0.1319 and RMSE of 0.1319. Other techniques, i.e., Stacked Auto-Encoder, exhibit the sign of overfitting with an MAE of 0.0001, whereas the LSTM and Graph Auto-Encoder perform below GRU with an MAE of 0.3453 and 0.8992. Although the CF techniques suffer from temporal dynamics and data sparsity, even the KNN Basic stands out among all CF algorithms with the lowest MAE of 0.548 and RMSE of 0.754, demonstrating the highest predictive accuracy.

26-ANSP-DL-013	**Enhancing Phishing Detection: A Machine Learning Approach With Feature Selection and Deep Learning Models** With the rise in cybercrime, phishing remains a significant concern as it targets individuals with fake websites, causing victims to disclose their private information. The effective implementation of phishing detection relies on cost efficiency, with the increased feature extraction factor contributing to these costs. This research analyzes a dataset containing 58,645 URLs, examining 111 features of the latest phishing websites dataset to identify the differences between phishing sites and legitimate sites. Astonishingly, using only 14 characteristics, the feedforward model achieved a remarkable accuracy of 94.46%, confirming the efficiency of Machine Learning in phishing detection. Through the exploitation of a multiple classifier collection, including Deep Neural Network (DNN), Wide and Deep, and TabNet, this research advances ongoing efforts to improve the accuracy and efficiency of phishing detection mechanisms and enhance cybersecurity defenses against malicious activities. The methodology introduces a new metric called the 'anti-phishing score,' which evaluates performance based on false positives and negatives, beyond traditional model accuracy. The model was trained through a robust design of extensive experimentation and hyperparameter-sensitive grid search, ensuring an optimized configuration for phishing detection. Furthermore, the trained model was validated on a new dataset to evaluate its generalizability, enhancing its practical applicability. Through the integration of feature selection principles, advanced algorithmic techniques, and comprehensive evaluation approaches, this research offers a robust approach to phishing detection, considering the evolving nature of cyber threats. The findings provide a beneficial framework for cybersecurity specialists and researchers, enabling more effective preventive measures against phishing attacks.
26-ANSP-DL-014	**Exploring the Effectiveness of Machine Learning and Deep Learning Techniques for EEG Signal Classification in Neurological Disorders** Neurological disorders are among the leading causes of both physical and cognitive disabilities worldwide, affecting approximately 15% of the global population. This study explores the use of machine learning (ML) and deep learning (DL) techniques in processing Electroencephalography (EEG) signals to detect various neurological disorders, including Epilepsy, Autism Spectrum Disorder (ASD), and Alzheimer's disease. We present a detailed workflow that begins with EEG data acquisition using a headset, followed by data preprocessing with Finite Impulse Response (FIR) filters and Independent Component Analysis (ICA) to eliminate noise and artifacts. Furthermore, the data is segmented, allowing the extraction of key features such as Bandpower and Shannon entropy, which improve classification accuracy. These features are stored in an offline database for easy access during analysis, to be then applied for both ML and DL models, systematically testing their performance and comparing the results to prior studies. Hence, our findings show impressive accuracy, with the random forest model achieving 99.85% accuracy in classifying autism vs. healthy subjects and 100% accuracy in distinguishing healthy individuals from those with dementia using Support Vector Machines (SVM). Moreover, deep learning models, including Convolutional Neural Networks (CNN) and ChronoNet, demonstrated accuracy rates ranging from 92.5% to 100%. In conclusion, this research highlights the effectiveness of ML and DL techniques in EEG signal processing, offering valuable contributions to the field of brain-computer interfaces and advancing the potential for more accurate neurological disease classification and diagnosis.

26-ANSP-DL-015	**Federated Deep Reinforcement Learning for ENDC Optimization** 5G New Radio (NR) network deployment in Non- Stand Alone (NSA) mode means that 5G networks rely on the control plane of existing Long Term Evolution (LTE) modules for control functions, while 5G modules are only dedicated to the user plane tasks, which could also be carried out by LTE modules simultaneously. The first deployments of 5G networks are essentially using this technology. These deployments enable what is known as E-UTRAN NR Dual Connectivity (ENDC), where a user establish a 5G connection simultaneously with a pre-existing LTE connection to boost their data rate. In this paper, a single Federated Deep Reinforcement Learning (FDRL) agent for the optimization of the event that triggers the dual connectivity between LTE and 5G is proposed. First, single Deep Reinforcement Learning (DRL) agents are trained in isolated cells. Later, these agents are merged into a unique global agent capable of optimizing the whole network with Federated Learning (FL). This scheme of training single agents and merging them also makes feasible the use of dynamic simulators for this type of learning algorithm and parameters related to mobility, by drastically reducing the number of possible combinations resulting in fewer simulations. The simulation results show that the final agent is capable of achieving a tradeoff between dropped calls and the user throughput to achieve global optimum without the need for interacting with all the cells for training.
26-ANSP-DL-016	**FFDL: Feature Fusion-Based Deep Learning Method Utilizing Federated Learning for Forged Face Detection** The widespread adoption of advanced technologies may be responsible for the extensive dissemination of forged photographs and videos on the Internet. This could potentially result in the proliferation of fraudulent identities online, raising safety concerns in society. The traditional method for detecting forgery, commonly referred to as the classical forgery method, lacks the capability to accurately identify such fraudulent activities. This limitation arises because these algorithms are trained on publicly available centralized datasets and do not prioritize privacy and security considerations. Consequently, they adversely affect the ability to detect counterfeit content. As a potential solution to this problem, we employed a highly effective deep learning methodology rooted in federated learning. We introduced a novel deep learning approach that combines features to assess the authenticity of photographs and videos shared on social media platforms. The proposed model was trained using three widely recognized forensic datasets: FaceForensics++, Deepforensic-1.0, and WildDeepfake. Visual features were extracted using two widely recognized deep learning approaches, namelyInception and Xception. These features were then combined into a feature vector using Canonical Correlation Analysis, and Convolutional Neural Networks were trained on these features to identify manipulated images and videos. The experiments were carried out with publicly available datasets and involved changing several parameters. Finally, the proposed model's performance was compared with other deep learning models within federated learning environments to identify forgeries. Our proposed approach demonstrated exceptional performance, achieving an accuracy rate of 98.99% when evaluated on the merged dataset.
26-ANSP-DL-017	**Machine Learning and Deep Learning Approaches for Fake News Detection: A Systematic Review of Techniques, Challenges, and Advancements** In response to the escalating threat of fake news on social media, this systematic literature review analyzes the recent advancements in machine learning and deep learning approaches for automated detection. Following the PRISMA guidelines, we

	examined 90 peer-reviewed studies published between 2020 and 2024 to evaluate the model effectiveness, identify limitations, and highlight emerging trends. Our analysis shows that deep learning models, particularly transformer-based architectures such as BERT, consistently outperform traditional machine learning methods, often achieving a high accuracy (Acc), precision (P), recall (R), and F1-score (F1). For instance, a BERT-based model reported up to 99.9% accuracy on the Kaggle fake news dataset and above 98% accuracy on other public datasets, including ISOT, Fake-or- Real, and D3. Similarly, the GANM model demonstrated robust performance on the FakeNewsNet dataset by integrating text and social features. Transfer learning and multimodal models that incorporate user behaviour and network information significantly improve detection in diverse, low-resource environments. However, challenges persist in terms of the dataset quality, model interpretability, domain generalisability, and real- time deployment. This review also underscores the limited adoption of few-shot and zero-shot learning techniques, highlighting a promising direction for future research on handling emerging misinformation using minimal training data. To support practical deployment, we advocate the development of explainable, multilingual, and lightweight models with greater emphasis on human-centred evaluation and ethical consid- erations. Our findings provide a foundation for researchers and practitioners to build scalable, trustworthy, and context-aware fake news detection systems for global use.
26-ANSP-DL-018	**Neural-XGBoost: A Hybrid Approach for Disaster Prediction and Management Using Machine Learning** Effective disaster prediction is essential for disaster management and mitigation. This study addresses a multi-classification problem and proposes the Neural-XGBoost disaster prediction model (N- XGB), a hybrid model that combines neural networks (NN) for feature extraction with XGBoost for classification. The NN component extracts high-level features, while XGBoost uses gradient-boosted decision trees for accurate predictions, combining the strengths of deep learning and boosting techniques for improved accuracy. The N-XGB model achieves an accuracy of 94.8% and an average F1 score of 0.95 on a real-world dataset that includes wildfires, floods and earthquakes, significantly outperforming baseline models such as random forest, Support vector machine and logistic regression 85% accuracy. The balanced F1 scores for wildfires 0.96, floods 0.93, and earthquakes 0.96 demonstrate the model's robustness in multi-class classification. The Synthetic Minority Oversampling Technique (SMOTE) balances datasets and improves model efficiency and capability. The proposed N-XGB model provides a reliable and accurate solution for predicting disasters and contributes to improving preparedness, resource allocation and risk management strategies.

26-ANSP-DL-019	**Performance Evaluation of Hybrid Bio-Inspired and Deep Learning Algorithms in Gene Selection and Cancer Classification** Cancer classification based on gene expression data is a critical challenge in modern bioinfor- matics, requiring efficient and accurate feature selection methods. This study explores the performance of hybrid bio-inspired algorithms and deep learning techniques for gene selection and cancer classification. Hybrid bio-inspired methods, inspired by natural optimization processes, have demonstrated significant advantages in navigating high-dimensional genomic data. Meanwhile, deep learning models excel in pattern recognition and automated feature extraction, offering a complementary approach to traditional gene selection techniques. This paper systematically evaluates both approaches, highlighting their strengths and limitations in terms of classification accuracy, computational efficiency, and feature selection effectiveness. Our findings reveal that hybrid bio-inspired methods, such as Grey Wolf Optimizer and Harris Hawks

	Optimization, achieve high classification accuracy with minimal selected genes, making them computa- tionally efficient for clinical applications. Conversely, deep learning models, including convolutional neural networks and autoencoders, demonstrate superior feature extraction but often require larger datasets and higher computational resources. By providing a comparative analysis, this study aims to guide researchers and clinicians in selecting the most suitable approach for cancer classification tasks. The results underscore the potential of hybrid methodologies in advancing precision oncology while identifying opportunities for future improvements in deep learning-based feature selection.
26-ANSP-DL-020	**Reweighted Partial Least Squares and Deep Learning-Based RDOA/AOA Estimation for Seismic Epicenter** In this study, we proposed an innovative approach to accurately estimate the location of a seismic epicenter using a combination of reweighted partial least squares and deep learning- based range-difference-of-arrival and angle-of-arrival models. Our method enhances existing P- and S-wave estimation techniques by employing a short-time Fourier transform to analyze the seismic signals detected at the four nearest stations. The resulting spec- trogram images were used to develop a deep learning model that accurately distinguishes P-waves, S-waves, and noise. By classifying images according to the time variation, we defined the new onset time with the highest probability as the P- and S-wave arrival times. The reweighted partial least squares method significantly improved the accuracy and robustness of the range-difference-of-arrival and angle-of-arrival models for epicenter localization. The proposed method demonstrated an improved epicenter localization accuracy in the simulation of real and ideal cases. The proposed process of epicenter localization is a potential solution for various seismic monitoring and early warning systems.
26-ANSP-DL-021	**Simple Yet Powerful: Machine Learning-Based IoT Intrusion System With Smart Preprocessing and Feature Generation Rivals Deep Learning** With the rapid advancements in deep learning, IoT intrusion detection systems have increasingly adopted deep learning models as the state-of-the-art solution due to their ability to handle complex data patterns. However, these solutions introduce the risk of overengineering, in which the complexity of the model outweighs its practical benefits. In contrast, classical machine learning techniques offer a more efficient alternative but are often overlooked due to a lack of focus on data pre-processing, which is critical for achieving optimal performance. Here we propose a classical machine learning system, built around a Random Forest classifier paired with a novel feature extraction algorithm adapted from Explainable Boosted Linear Regression (EBLR). Our workflow emphasizes the importance of well- structured preprocessing pipelines missing data handling, categorical feature encoding, and multicollinearity reduction, paired with classical machine learning models. We evaluated our method on the ToN-IoT dataset, which contains various network traffic data sets and various types of attacks. Experimental results show that our model achieves an area under the curve (AUC) score of 0.99 on both training and test sets with high performance in a variety of attack categories. Finally, we show that our method outperforms existing deep learning models, thus providing a novel and effective solution for intrusion detection in IoT environments. Experimental results show that our model achieves an area under the curve (AUC) score of 0.99 in both the training and test sets. Furthermore, the classifier achieves precision, recall and F1 score values of 0.999, 0.988, and 0.994, respectively, for normal traffic detection, while maintaining strong performance for other attack categories, such as denial of service (precision: 0.985, recall: 0.977, F1 score: 0.981) and

	scanning (precision: 0.984, recall: 0.992, F1 score: 0.988). Injection and ransomware attack types also demonstrate precision and recall scores above 0.90. These results highlight that, when paired with appropriate preprocessing and feature engineering, classical machine learning models still can provide an effective solution for intrusion detection in IoT environments.
26-ANSP-DL-022	**SLEEP-SAFE: Self-Supervised Learning for Estimating Electroencephalogram Patterns With Structural Analysis of Fatigue Evidence** Recently, deep learning frameworks have gained increasing attentions from electroencephalogram (EEG)-based driver's fatigue estimation, thanks to their unprecedented feature extraction calibre. However, it is still challenging to develop session- and/or subject-independent system, because of the complex structural characteristics of EEG signals. In this regard, this work proposes a novel deep convolutional neural network architecture that can learn spectro-spatio-temporal representation of the vigilance EEG signals, thereby achieving a powerful mental status recognition ability. Specifically, the proposed network pretrained via two novel self-supervision pretext tasks. Further, both differential entropy and EEG signal itself are exploited to acquire rich features. To demonstrate the validity of the proposed methods, this work conduct intra- and inter-subject classification experiments using a publicly available dataset. In the exhaustive experiments, we observed that our proposed framework has practical availability. Specifically, our proposed multiple path structure improved the model's performance by 3 ~ 7 percentage points (%p) in the session-independent setting and by 6 ~ 9 %p in the subject-independent setting. Besides, the novel self-supervised learning strategy enhanced the performance by 10 ~ 17 and 12 ~ 16 %p in the session- and subject-independent case, respectively. Furthermore, this work also investigate strengths and society-friendliness of our proposed framework.
26-ANSP-DL-023	**The More, the Better? Evaluating the Role of EEG Preprocessing for Deep Learning Applications** The last decade has witnessed a notable surge in deep learning applications for electroencephalog- raphy (EEG) data analysis, showing promising improvements over conventional statistical techniques. However, deep learning models can underperform if trained with bad processed data. Preprocessing is crucial for EEG data analysis, yet there is no consensus on the optimal strate- gies in deep learning scenarios, leading to uncertainty about the extent of preprocessing required for optimal results. This study is the first to thoroughly investigate the effects of EEG preprocessing in deep learning applications, drafting guidelines for future research. It evaluates the effects of varying preprocessing levels, from raw and minimally filtered data to complex pipelines with automated artifact removal algorithms. Six classification tasks (eye blinking, motor imagery, Parkinson's, Alzheimer's disease, sleep deprivation, and first episode psychosis) and four established EEG architectures were considered for the evaluation. The analysis of 4800 trained models revealed statistical differences between preprocessing pipelines at the intra-task level for each model and at the inter-task level for the largest model. Models trained on raw data consistently performed poorly, always ranking last in aver- age scores. In addition, models seem to benefit more from minimal pipelines without artifact handling methods. These findings suggest that EEG artifacts may affect the perfor- mance and generalizability of deep neural networks.

26-ANSP-DL-024	**Toward Deep Semi-Supervised Continual Learning: A Unified Survey for Scalable and Adaptive AI** The integration of Deep Semi-Supervised Learning (DSSL) with Continual Learning (CL) holds significant promise for advancing artificial intelligence systems capable of learning from limited labeled data while continuously adapting to new tasks. This review explores recent progress in combining DSSL and CL, referred to as Deep Semi-Supervised Continual Learning (DSCL), focusing on the potential to develop models capable of learning efficiently in dynamic environments through both labeled and unlabeled data while mitigating catastrophic forgetting. Our analysis highlights several critical applications including image classification, cybersecurity, and natural language processing, while also identifying key challenges that prevent its broader adoption in real-world scenarios. Integration challenges such as catastrophic forgetting, handling noisy, unlabeled, and imbalanced data, and managing the stability-plasticity trade-off are discussed in detail. Moreover, the importance of open-world learning, lightweight architectures for on- device learning, enhanced scalability, and interpretable models is emphasized to ensure DSCL's applicability in real-world, high-stakes domains. However, the current reliance on benchmark datasets, while valuable for evaluation, may limit generalization to complex tasks like medical imaging. To address these challenges, future research should prioritize leveraging domain-specific datasets to enhance real-world applicability, integrating transfer learning for better adaptability, and developing domain-agnostic frameworks and task- free continual learning. Additionally, exploring techniques like Reinforcement Learning from Human Feedback (RLHF) could enhance interpretability and trustworthiness. By addressing these gaps, DSCL can evolve to provide more flexible, scalable, and reliable solutions, contributing significantly to the development of adaptable and intelligent systems across diverse domains.
26-ANSP-DL-025	**VGG-16, VGG-16 With Random Forest, Resnet50 With SVM, and EfficientNetB0 With XGBoost-Enhancing Bone Fracture Classification in X-Ray Using Deep Learning Models** Millions of cases of bone fractures are reported every year, and accuracy in classification is crucial to help with proper management and treatment. The recently developed techniques of Machine Learning, particularly Deep Learning, have been effective in increasing diagnosis precision and efficiency. We utilized a diverse dataset comprising 10 different classes of fracture types captured in X-Ray images. This paper makes a comparison of different machine learning models on classifying bone fractures: VGG-16, VGG-16 with Random Forest, ResNet-50 with Support Vector Machine, and EfficientNetB0 with XGBoost. Model performances were evaluated with respect to parameters of precision, recalls, and F1-scores. According to results, VGG-16 and its variant ensemble with Random Forest outperformed with an accuracy of 0.95 when compared to others on every parameter for different classes of fractures. Results indicate that models based on VGG16 are quite effective for bone fracture classification.