Advanced Computational Techniques for Seepage Analysis and Slope Stability using the Python Programming Language

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Abstract
This study addresses seepage issues in earth dams, focusing on constant flow in porous media and slope stability. The Monte Carlo method is employed to solve permanent flow problems, comparing results with the finite element method. Circular slides are analyzed to determine factor of safety, and overall stability is assessed using the Monte Carlo method, specifically the random walking approach. A Python program, based on the Bishop method, iteratively calculates the factor of safety against sliding. This technique proves valuable for seepage analysis, offering a powerful tool for estimating hydraulic head in dam bodies. The study establishes theoretical foundations, providing a practical application and comparative analysis with the finite element method, drawing meaningful conclusions.

Keywords: Earth dam, Stationary, Random walk, Python, Stability, Seepage, Flow

Comparative Analysis of First-Order Optimizers for Neural Network Training: A Study on Gradient Descent Variants

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Abstract

This is a comprehensive study evaluating the performance of various first-order optimization algorithms commonly employed in training neural networks. The algorithms under investigation include traditional methods such as Gradient Descent, Stochastic Gradient Descent (SGD), Momentum, Nesterov Momentum, Adagrad, RMSProp, Adadelta, and Adam. The primary objective of this research is to analyze and compare the strengths and weaknesses of these optimization techniques in the context of a multilayer perceptron. To conduct this study, a neural network with one hidden layer consisting of 10 neurons is utilized alongside with a synthetic dataset for training and testing. The neural network is trained with each optimization algorithm individually, and performance metrics such as convergence speed, final loss values, and accuracy are measured. The findings of our study reveal intriguing insights into the efficacy of these optimization algorithms. Notably, Adadelta demonstrated suboptimal performance, exhibiting poor convergence and accuracy. Conversely, RMSProp exhibited remarkable proficiency, showcasing improved convergence and overall better performance in comparison to other algorithms.

Keywords: deep learning, artificial neural networks, optimizers, gradient descent.

Comparison Between Optimization Algorithms for Deep Learning

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Keywords: deep learning, artificial neural networks, optimizers, gradient descent.

Cyber Attacks Management in IoT Networks: A State-of-the-Art

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Abstract

This work presents a condensed state-of-the-art on the management of cyber-attacks in IoT networks. Addressing the escalating threats to IoT ecosystems, the survey categorizes and analyzes various cyber risks, from conventional vulnerabilities to emerging challenges across diverse sectors. Focusing on methodologies and frameworks, the article evaluates current cybersecurity strategies, including traditional measures and cutting-edge technologies such machine learning. It also explores regulatory frameworks and compliance standards shaping the landscape of IoT security.

Keywords: IoT Security, Cyber Attacks, State-of-the-Art, Cybersecurity Frameworks .

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Deep Galerkin method for the Landau–Lifshitz equation in micromagnetism

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Abstract
The temporal evolution of magnetization in continuous ferromagnets is described by the Landau-Lifshitz equation (LL). This equation, characterized by a non-convex constraint, exhibits strong nonlinearity. In this work, we employ the deep learning-based approximation method, specifically the Deep Galerkin Method, to solve this nonlinear equation in high dimensions. Computational trials and comparisons with various numerical methods are provided to substantiate the effectiveness of the proposed approach.

Keywords: Ferromagnetism, Deep Galerkin method, magnetization dynamics, Landau, Lifshitz equation.

Deep Neural Classifiers as Computational Graphs

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Abstract
This paper addresses the problem of explainability of deep neural networks (DNNs). Due to their complex architecture, DNNs are indeed often seen as opaque models, which make it difficult to understand how they learn from data, and how they use the learned knowledge to make predictions and take decisions. We show how computational graphs can help in mitigating this problem by visually representing the mathematical operations that a DNN performs during both its training and inference phases. We illustrate the applicability of this method for logistic and softmax regressions, and provide insight on its extension to deeper architectures..

Keywords: Deep Learning, Explainability, Computational Graphs, Classification, Logistic Regression, Softmax Regression.

Enhancing University Orientation with an AI-Powered Automatic Recommendation System

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Abstract
This paper investigates the potential of AI-based recommendation systems within university orientation programs. It explores how these systems could revolutionize the delivery of personalized guidance to incoming students, reshaping the landscape of higher education orientation. By harnessing advanced AI algorithms, these systems aim to provide tailored recommendations, resource suggestions, and support mechanisms to facilitate students' transition into university life. The study examines the advantages, challenges, and ethical considerations surrounding the integration of AI in orientation programs, with a focus on its implications for student success, engagement, and well-being. Through an analysis of current research and case studies, this paper contributes to a deeper understanding of the evolving role of AI in optimizing university orientation experiences.

Keywords: Artificial Intelligence, Recommendation System, Higher Education.

Exploring Word Embeddings for Sentiment Analysis in Moroccan Dialect

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Abstract

This project investigates sentiment analysis on Moroccan dialect comments, focusing on the impact of various word embedding techniques and emphasizing the critical role of each, rather than solely relying on traditional algorithms.

The study systematically evaluates the impact of varied word embedding methodologies on sentiment classification accuracy by implementing a spectrum of techniques, ranging from established methods to cutting-edge approaches, offering insights for optimizing sentiment analysis models in dialectal languages.

The research aims to unravel the nuanced dynamics of sentiment expression within the unique linguistic nuances of Moroccan dialect.
The paper also provides a comparative evaluation of these methods, demonstrating their respective effectiveness.

Keywords: NLP, SA, ASA, Machine Learning, Word Embeddings, Moroccan dialect.

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Leveraging Bayesian Networks for Causal Analysis in Early Diabetes Diagnosis and Management

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Abstract

Background: This study explores the application of causal inference methods combined with Machine Learning to enhance early diagnosis and management of diabetes.

Method: We employed causal analysis methods, including Bayesian networks, created new features, and optimized hyperparameters. Data preprocessing involved the removal of variables, imputation of missing values, elimination of outliers, and data balancing. Models such as RandomForestClassifier, LASSO, XGBClassifier, and the ensemble Stacking approach were used for analyzing significant variables and predicting diabetes.

Results: After the creation of new variables with weighting and interaction among causal variables, the results showed a significant improvement, shifting from an accuracy of 0.70 and an AUC of 0.7744 to an accuracy of 0.73 and an AUC of 0.7984.

Conclusions: The integrated methods demonstrated substantial efficacy in predicting and managing diabetes, highlighting the importance of causal analysis in the medical field.

Keywords: Causal Inference, Bayesian Networks, Machine Learning, Diabetes Diagnosis

On the use of cross-entropy in the training process of artificial neural networks

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Abstract
This paper addresses some questions related to the use of cross-entropy in the process of training artificial neural networks (ANNs). We discuss the conceptual origin of cross-entropy, its connection to entropy, the specific quantity it evaluates, its role as an objective function for optimizers during the training process of neural network classifiers, its relationship with the notion of likelihood, and the reason behind minimizing it. Typical examples of commonly used classifiers will be discussed to clarify these questions and mitigate any potential ambiguities they may cause for users of this technology.

Keywords: Machine Learning, Artificial Neural Networks, Deep Learning, Classification, Entropy, Cross-Entropy.

Physics-informed neural networks methodology for the resolution of some Turing's type models

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Abstract
The mathematical modeling of pattern formation in developmental biology results in non-linear reaction-diffusion systems, which are typically highly stiff in both diffusion and reaction terms. In this paper, we will use a machine learning technique, called physics-informed neural network (PINN), to solve some non-linear time dependent reaction–diffusion systems such as Schnakenberg model, FitzHugh–Nagumo model and Gray–Scott model.
PINN has succeeded in many scientific and engineering disciplines by encoding physical laws into the loss functions of the neural network, so that the network not only conforms to measurements, initial and boundaries, but also satisfies the governing equations. The performance of the method is verified by solving one-dimensional and two-dimensional test problems and comparing the results with those from numerical or analytical approaches. Validation of results is examined in terms of absolute error. The result showed that the PINN performed well in producing good accuracy on benchmark problems.

Keywords: Physics informed neural networks, Reaction-diffusion models, Turing's model, Gray-Scott model, Schnakenberg model, FitzHugh-Nagumo model.

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Revolutionizing Cybersecurity: A Proactive and Adaptive SIEM Framework with Predictive Analytics

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Abstract

Given the evolving cybersecurity landscape, this proposal presents the design of a Security Information and Event Management (SIEM) framework. The envisaged framework aims to redefine and enhance the capabilities of SIEM systems by incorporating mechanisms for analysis, real-time threat detection and adaptive response. Drawing on state-of-the-art technologies, this architecture establishes a modular infrastructure that can be flexibly deployed in organizational environments. The proposed SIEM framework not only addresses security issues, but also predicts future threats through the use of machine learning and predictive analytics algorithms. By taking a proactive approach to security monitoring, this architecture sets a benchmark for SIEM solutions, enabling organizations to effectively protect their digital assets.

Keywords: SIEM, IA, Framework

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Smart Learning: A Bibliometric Analysis

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Abstract
In recent years, the educational ecosystem has undergone radical transfor- mations, emerging as a central theme in the evolution of education at a time when technology wields a transformative influence. The integration of these technological advances into the educational domain has acted as a pivotal driver to enhance the quality of life by optimizing teaching and learning methods. In the era of information technologies, synchronized evolution with contemporary technological advancements has become cru- cial, incorporating elements such as Big Data, the Internet of Things (IoT), and artificial intelligence into the recent innovations integrated into online learning platforms.
This article, based on a thorough bibliometric analysis, presents a compre- hensive overview of research and the application of new technologies in the context of Smart Learning. It relies on an in-depth bibliometric study and examines the deployment of information and communication technologies (ICT) in the field of intelligent learning over time.

Keywords: Smart Learning, ICT, Big Data, Internet of Things (IoT), Artificiel intelligence (AI), Bibliometric analysis,

Introduction

In today's context, there is a strong emphasis on the impact of Information and Communication Technologies (ICT) on current education, highlight- ing the benefits of ubiquitous technology, especially in the realm of online learning [1]. The use of technology in teaching enables dynamic interac-

tion between learners and instructors, thereby facilitating real-time online assessments. Advantages include a focus on essential learning tasks, eliminating the need for paper and pen [2]. Institutions can leverage various technologies such as cloud computing, ICT, RFID, and sensor networks to gather data and enhance educational performance [3]. The primary goal of these technologies is to make institutions smarter and more efficient, transforming interactions among students, teachers, and administrators through smart devices to improve learning outcomes and reduce costs [4]. These technologies introduce innovative solutions such as smart whiteboards, energy efficiency sensors, smart student cards, access control, wireless door locks, network surveillance cameras, and facial recognition systems to enhance security in the educational ecosystem. The aim of these technological advancements is to create safer, more efficient educational environments tailored to the needs of learners and educators [5].

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