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International Journal of Artificial Intelligence & Applications (IJAIA)

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ISSN: 0975-900X (Online); 0976-2191 (Print)

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HARDWARE DESIGN FOR MACHINE LEARNING

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ABSTRACT

Things like growing volumes and varieties of available data, cheaper and more powerful computational processing, data storage and large-value predictions that can guide better decisions and smart actions in real time without human intervention are playing critical role in this age. All of these require models that can automatically analyse large complex data and deliver quick accurate results – even on a very large scale. Machine learning plays a significant role in developing these models. The applications of machine learning range from speech and object recognition to analysis and prediction of finance markets. Artificial Neural Network is one of the important algorithms of machine learning that is inspired by the structure and functional aspects of the biological neural networks. In this paper, we discuss the purpose, representation and classification methods for developing hardware for machine learning with the main focus on neural networks. This paper also presents the requirements, design issues and optimization techniques for building hardware architecture of neural networks.

KEYWORDS

Artificial intelligence (AI), application specific integrated circuit (ASIC), artificial neural network (ANN), central processing unit (CPU), field programmable gate array (FPGA), graphics processing unit (GPU), machine learning (ML), neurochip

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FORGED CHARACTER DETECTION DATASETS: PASSPORTS, DRIVING LICENCES AND VISA STICKERS

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ABSTRACT

Forged documents specifically passport, driving licence and VISA stickers are used for fraud purposes including robbery, theft and many more. So detecting forged characters from documents is a significantly important and challenging task in digital forensic imaging. Forged characters detection has two big challenges. First challenge is, data for forged characters detection is extremely difficult to get due to several reasons including limited access of data, unlabeled data or work is done on private data. Second challenge is, deep learning (DL) algorithms require labeled data, which poses a further challenge as getting labeled is tedious, time-consuming, expensive and requires domain expertise. To end these issues, in this paper we propose a novel algorithm, which generates the three datasets namely forged characters detection for passport (FCD-P), forged characters detection for driving licence (FCD-D) and forged characters detection for VISA stickers (FCD-V). To the best of our knowledge, we are the first to release these datasets. The proposed algorithm starts by reading plain document images, simulates forging simulation tasks on five different countries' passports, driving licences and VISA stickers. Then it keeps the bounding boxes as a track of the forged characters as a labeling process. Furthermore, considering the real world scenario, we performed the selected data augmentation accordingly. Regarding the stats of datasets, each dataset consists of 15000 images having size of 950 x 550 of each. For further research purpose we release our algorithm code 1 and, datasets i.e. FCD-P 2 , FCD-D 3 and FCD-V 4 .

KEYWORDS

Character detection dataset, Deep learning forgery, Forged character detection

For More Details: https://aircconline.com/ijaia/V13N2/13222ijaia02.pdf

Volume Link: https://www.airccse.org/journal/ijaia/current2022.html

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SOFTWARE TESTING: ISSUES AND CHALLENGES OF ARTIFICIAL INTELLIGENCE & MACHINE LEARNING

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ABSTRACT

The history of Artificial Intelligence and Machine Learning dates back to 1950's. In recent years, there has been an increase in popularity for applications that implement AI and ML technology. As with traditional development, software testing is a critical component of an efficient AI/ML application. However, the approach to development methodology used in AI/ML varies significantly from traditional development. Owing to these variations, numerous software testing challenges occur. This paper aims to recognize and to explain some of the biggest challenges that software testers face in dealing with AI/ML applications. For future research, this study has key implications. Each of the challenges outlined in this paper is ideal for further investigation and has great potential to shed light on the way to more productive software testing strategies and methodologies that can be applied to AI/ML applications

KEYWORDS

Artificial Intelligence (AI), Machine Learning (ML), Software Testing

For More Details: https://aircconline.com/ijaia/V12N1/12121ijaia07.pdf

Volume Link: https://www.airccse.org/journal/ijaia/current2021.html

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ARTIFICIAL NEURAL NETWORK CONTROLLER FOR PERFORMANCE OPTIMIZATION OF SINGLE PHASE INVERTER

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ABSTRACT

Thyristorised Power control provides high efficiency. However, generated harmonics cause a nuisance in power system operation. The work presented here, deals with reduction of harmonics (3rd-11th) by using Multiple Pulse Modulation technique. Traditional numerical methods do not yield accurate pulse-positions as non-linearity is involved in computation. In this paper, a continuous Hopfiled Neural Network is designed for Harmonic minimization in a 1Φ inverter output voltage. Results show considerable improvement in voltage spectrum if trigger pulses are generated at the ANN positions as harmonic contents are reduced with significant improvement in fundamental voltage resulting in reduction in device ratings. The ANN controlled voltage is used to drive a 1Φ Induction motor in MATLAB simulation and is compared with SPWM controlled VSI driving the same motor load. The quantitative analysis is given in tabular form. This shows feasibility of design of a controller for optimized performance of a single phase VSI.

KEYWORDS

Neural Network controller, Harmonic minimization, Performance optimization, Inverter, Motor control

For More Details: https://aircconline.com/ijaia/V3N1/3112ijaia05.pdf

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ESTIMATION OF REGRESSION COEFFICIENTS USING GEOMETRIC MEAN OF SQUARED ERROR FOR SINGLE INDEX LINEAR REGRESSION MODEL

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ABSTRACT

Regression models and their statistical analyses is one of the most important tool used by scientists and practitioners. The aim of a regression model is to fit parametric functions to data. It is known that the true regression is unknown and specific methods are created and used strictly pertaining to the problem. For the pioneering work to develop procedures for fitting functions, we refer to the work on the methods of least absolute deviations, least squares deviations and minimax absolute deviations. Today's widely celebrated procedure of the method of least squares for function fitting is credited to the published works of Legendre and Gauss. However, the least squares based models in practice may fail to provide optimal results in nonGaussian situations especially when the errors follow distributions with the fat tails. In this paper an unorthodox method of estimating linear regression coefficients by minimising GMSE(geometric mean of squared errors) is explored. Though GMSE(geometric mean of squared errors) is used to compare models it is rarely used to obtain the coefficients. Such a method is tedious to handle due to the large number of roots obtained by minimisation of the loss function. This paper offers a way to tackle that problem. Application is illustrated with the 'Advertising' dataset from ISLR and the obtained results are compared with the results of the method of least squares for single index linear regression model.

KEYWORDS

Linear Regression, Geometric Mean of Squared Errors, Geometric regression

For More Details: https://aircconline.com/ijaia/V7N6/7616ijaia06.pdf

Volume Link: https://www.airccse.org/journal/ijaia/current2016.html

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PREDICTING STUDENT ACADEMIC PERFORMANCE IN BLENDED LEARNING USING ARTIFICIAL NEURAL NETWORKS

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ABSTRACT

Along with the spreading of online education, the importance of active support of students involved in online learning processes has grown. The application of artificial intelligence in education allows instructors to analyze data extracted from university servers, identify patterns of student behavior and develop interventions for struggling students. This study used student data stored in a Moodle server and predicted student success in course, based on four learning activities - communication via emails, collaborative content creation with wiki, content interaction measured by files viewed and self-evaluation through online quizzes. Next, a model based on the Multi-Layer Perceptron Neural Network was trained to predict student performance on a blended learning course environment. The model predicted the performance of students with correct classification rate, CCR, of 98.3%.

KEYWORDS

Artificial Neural Networks, Blended Learning, Student Achievement, Learning Analytics, Moodle Data

For More Details:https://aircconline.com/ijaia/V7N5/7516ijaia02.pdf

Volume Link: http://www.airccse.org/journal/ijaia/current2016.html

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DIFFERENT MACHINE LEARNING ALGORITHMS FOR BREAST CANCER DIAGNOSIS

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ABSTRACT

Breast cancer affects many people at the present time. The factors that cause this disease are many and cannot be easily determined. Additionally, the diagnosis process which determines whether the cancer is benign or malignant also requires a great deal of effort from a doctors and physicians . When several tests are involved in the diagnosis of breast cancer, such as clump thickness, uniformity of cell size, uniformity of cell shape,…etc, the ultimate result may be difficult to obtain, even for medical experts. This has given a rise in the last few years to the use of machine learning and Artificial Intelligence in general as diagnostic tools. We aimed from this study to compare different classification learning algorithms significantly to predict a benign from malignant cancer in Wisconsin breast cancer dataset. We used the Wisconsin breast cancer dataset to compare five different learning algorithms , Bayesian Network, Naïve Bayes, Decision trees J4.8 , ADTree, and Multi-layer Neural Network along with t-test for the best algorithm in terms of prediction accuracy. The experiment, has shown that Bayesian Network is significantly better than the other algorithms.

KEYWORDS

reastcancer , Bayesian Network , K2 algorithm

For More Details:https://aircconline.com/ijaia/V3N6/3612ijaia03.pdf

Volume Link: https://www.airccse.org/journal/ijaia/current2012.html

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DESIGN AND ANALOG VLSI IMPLEMENTATION OF ARTIFICIAL NEURAL NETWORK

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ABSTRACT

Nature has evolved highly advanced systems capable of performing complex computations, adoption and learning using analog computations. Furthermore nature has evolved techniques to deal with imprecise analog computations by using redundancy and massive connectivity. In this paper we are making use of Artificial Neural Network to demonstrate the way in which the biological system processes in analog domain.

We are using 180nm CMOS VLSI technology for implementing circuits which performs arithmetic operations and for implementing Neural Network. The arithmetic circuits presented here are based on MOS transistors operating in subthreshold region. The basic blocks of artificial neuron are multiplier, adder and neuron activation function.

The functionality of designed neural network is verified for analog operations like signal amplification and frequency multiplication. The network designed can be adopted for digital operations like AND, OR and NOT. The network realizes its functionality for the trained targets which is verified using simulation results. The schematic, Layout design and verification of proposed Neural Network is carried out using Cadence Virtuoso tool.

KEYWORDS

Neural Network Architecture (NNA), Artificial Neural Network (ANN), Back Propagation Algorithm (BPA), Artificial Intelligence (AI), Neuron Activation Function (NAF).

For More Details: https://aircconline.com/ijaia/V2N3/0711ijaia09.pdf

Volume Link: https://www.airccse.org/journal/ijaia/current2011.html

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INTELLIGENT PORTFOLIO MANAGEMENTVIA NLP ANALYSIS OF FINANCIAL 10-K STATEMENTS

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ABSTRACT

The paper attempts to analyze if the sentiment stability of financial 10-K reports over time can determine the company's future mean returns. A diverse portfolio of stocks was selected to test this hypothesis. The proposed framework downloads 10-K reports of the companies from SEC's EDGAR database. It passes them through the preprocessing pipeline to extract critical sections of the filings to perform NLP analysis. Using Loughran and McDonald sentiment word list, the framework generates sentiment TF-IDF from the 10-K documents to calculate the cosine similarity between two consecutive 10-K reports and proposes to leverage this cosine similarity as the alpha factor. For analyzing the effectiveness of our alpha factor at predicting future returns, the framework uses the alphalens library to perform factor return analysis, turnover analysis, and for comparing the Sharpe ratio of potential alpha factors. The results show that there exists a strong correlation between the sentiment stability of our portfolio's 10-K statements and its future mean returns. For the benefit of the research community, the code and Jupyter notebooks related to this paper have been open-sourced on Github1.

KEYWORDS

Natural language Processing, stock market, textual analysis, TF-IDF, cosine similarity, intelligentportfolio management.

For More Details: https://aircconline.com/ijaia/V11N6/11620ijaia02.pdf

Volume Link: http://www.airccse.org/journal/ijaia/current2020.html

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Reviewing Process Mining Applications and Techniques in Education

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ABSTRACT

Process Mining (PM) emerged from business process management but has recently been applied to educational data and has been found to facilitate the understanding of the educational process. Educational Process Mining (EPM) bridges the gap between process analysis and data analysis, based on the techniques of model discovery, conformance checking and extension of existing process models. We present a systematic review of the recent and current status of research in the EPM domain, focusing on application domains, techniques, tools and models, to highlight the use of EPM in comprehending and improving educational processes.

KEYWORDS

Process Mining, Educational Process Mining, educational applications, process model.

For More Details: https://aircconline.com/ijaia/V13N1/13122ijaia06.pdf

Volume Link: https://www.airccse.org/journal/ijaia/current2022.html

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