Developing deep transfer and machine learning models of chest X-ray for diagnosing COVID-19 cases using probabilistic single-valued neutrosophic hesitant fuzzy

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ABSTRACT

This study presents a novel Dynamic localization-based Decision (DLBD) with fuzzy weighting with zero inconsistency (PWZIC) under a probabilistic single-valued neutrosophic hesitant fuzzy set (PSVNHFS) environment to benchmark Hybrid Multi Deep Transfer and Machine Learning (HMDTML) models. The novel DLBD method is proposed to generate a dynamic localization decision matrix based on the upper and lower boundaries and the length of the scale. The superiority of DLBD derives from its ability to manage dynamic changes with boundary value consequences. In addition, the utilization of PSVNHFS in conjunction with DLBD and PWZIC has proven to effectively address the challenges posed by vagueness, uncertainty and hesitancy in the benchmarking procedure. The proposed methodology consists of three primary three steps: i) the adaptation of 40 HMDTML models, including 4 deep transfer learning models and 12 machine learning models trained on a dataset of 936 chest X-ray images obtained from both COVID-19 patients and individuals without the disease. Then, these models were evaluated based on seven evaluation criteria, and a decision matrix was proposed. ii) The development of a PSVNH–PWZIC to assign weights to the evaluation criteria. iii) The formulation of a PSVNH–DLBD for the purpose of benchmarking HMDTML models. Results of the PSVNH–PWZIC revealed that AUC and time were the most important evaluation criteria, while precision was the least important. Furthermore, the results from PSVNH–DLBD, reveal that Model M24 (Painters-Decision Tree) earned the highest rank when λ = 2, 3, 4, 5 and 6, followed by Model M25 (SqueezeNet-AdaBoost) and Model M34 (DeepLoc-LNN), while Model M39 (DeepLoc-SVM) had the lowest rank (rank = 40) across all λ values. The proposed method underwent sensitivity and comparison analyses to confirm its reliability and robustness.

1. Introduction

Early diagnosis is an essential public health strategy in all situations because it allows for treatment at the earliest stage possible, increasing the likelihood of a positive outcome (Roop et al., 2020). Mortality rates can be dramatically lowered through detection and treatment at an early

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Table of Contents Developing Expert Syst Busi

1. Understanding the eBook Developing Expert Syst Busi
    - The Rise of Digital Reading Developing Expert Syst Busi
    - Advantages of eBooks Over Traditional Books
2. Identifying Developing Expert Syst Busi
    - Exploring Different Genres
    - Considering Fiction vs. Non-Fiction
    - Determining Your Reading Goals
3. Choosing the Right eBook Platform
    - Popular eBook Platforms
    - Features to Look for in an Developing Expert Syst Busi
    - User-Friendly Interface
4. Exploring eBook Recommendations from Developing Expert Syst Busi
    - Personalized Recommendations
    - Developing Expert Syst Busi User Reviews and Ratings
    - Developing Expert Syst Busi and Bestseller Lists
5. Accessing Developing Expert Syst Busi Free and Paid eBooks
    - Developing Expert Syst Busi Public Domain eBooks
    - Developing Expert Syst Busi eBook Subscription Services

- Integration of Multimedia Elements
- Interactive and Gamified eBooks

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