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Investigating the Influence of Activation Functions on Image Classification Accuracy via Deep Convolutional Neural Network

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Abstract : Convolutional Neural Networks (CNNs) have emerged as powerful tools for image classification, and the choice of optimizers profoundly affects their performance. The study of optimizers and their adaptations remains a topic of significant importance in machine learning research. While numerous studies have explored and advocated for various optimizers, the efficacy of these optimization techniques is still subject to scrutiny. This work aims to address the challenges surrounding the effectiveness of optimizers by conducting a comprehensive analysis and evaluation. The primary focus of this investigation lies in examining the performance of different optimizers when employed in conjunction with the popular activation function, Rectified Linear Unit (ReLU). By incorporating ReLU, known for its favorable properties in prior research, the aim is to bolster the effectiveness of the optimizers under scrutiny. Specifically, we evaluate the adjustment of these optimizers with both the original Softmax activation function and the modified ReLU activation function, carefully assessing their impact on overall performance. To achieve this, a series of experiments are conducted using a well-established benchmark dataset for image classification tasks, namely the Canadian Institute for Advanced Research dataset (CIFAR-10). The selected optimizers for investigation encompass a range of prominent algorithms, including Adam, Root Mean Squared Propagation (RMSprop), Adaptive Learning Rate Method (Adadelta), Adaptive Gradient Algorithm (Adagrad), and Stochastic Gradient Descent (SGD). The performance analysis encompasses a comprehensive evaluation of the classification accuracy, convergence speed, and robustness of the CNN models trained with each optimizer. Through rigorous experimentation and meticulous assessment, we discern the strengths and weaknesses of the different optimization techniques, providing valuable insights into their suitability for image classification tasks. By conducting this in-depth study, we contribute to the existing body of knowledge surrounding optimizers in CNNs, shedding light on their performance characteristics for image classification. The findings gleaned from this research serve to guide researchers and practitioners in making informed decisions when selecting optimizers and activation functions, thus advancing the state-of-the-art in the field of image classification with convolutional neural networks.

Keywords : deep neural network, optimizers, RMsprop, ReLU, stochastic gradient descent
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