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Review of AlexNet for Medical Image Classification

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Abstract

In recent years, the rapid development of deep learning has led to a wide range of applications in medical image classification. The variants of neural network models with ever-increasing performance share some commonalities: to try to mitigate overfitting, improve generalization, avoid gradient vanishing and exploding, etc. AlexNet first utilizes the dropout technique to ease overfitting and the ReLU activation function to prevent vanishing gradient. Therefore, we focus on AlexNet, which initially contributed significantly to Convolutional Neural Networks (CNNs) research in 2012. After reviewing over 100 papers, including those from journals and conferences, we give a narrative on the technical details, advantages, and application areas of AlexNet.

Keywords: Medical Image Classification, ReLU, Neural Networks, Gradient Vanishing, CNNs

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1. Early Development of Deep Learning

During the development of Deep Learning (DL), artificial neural networks and machine learning techniques have made great strides, leading to the emergence of powerful deep neural networks. The evolvement of DL has gone through four stages:

Early Developments: The concept of artificial neural networks dates back to the 1940s and 1950s, with the development of perceptrons by Frank Rosenblatt [1]. However, early neural networks had limitations, and research stagnated. The perceptron, a single-layer neural network, could only model linearly separable functions, limiting its practical applications.

Revival with Backpropagation: In the 1980s, the field of neural networks experienced a resurgence with the development of the backpropagation (BP) algorithm, which allowed for efficient training of multi-layer neural networks [2]. Researchers such as Geoffrey Hinton and Yann LeCun contributed significantly during this period. However, due to the disappearance of gradients, deep networks still face challenges in training and scaling, where gradients become weaker and weaker as they propagate layer by layer until they eventually disappear, no longer contributing to the learning process [3].

DL Renaissance: The DL Renaissance, occurring primarily in the 2010s, marked a transformative period in the field. Breakthroughs in neural network architectures, increased computational power, the availability of large datasets, and the introduction of deep learning frameworks fueled significant advancements. Section 2 will present detailed content related to the DL Renaissance.

Breakthroughs and Applications: The content related to breakthroughs in DL will be introduced in Section 3. The success of AlexNet demonstrated the power of deep convolutional neural networks (CNNs) for image recognition. In the following years, DL methods have achieved remarkable results in many areas such as natural language processing, speech recognition, robotics, and self-driving cars. This led to the widespread adoption of DL techniques and advanced deep neural network architectures.

Our paper is structured as follows: Section 2 focuses on two essential innovations in DL and describes the reasons

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