AI Image Recognition Challenge - Weather Image Classification

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1 Introduction

Weather image classification is a significant task in meteorology and computer vision, with applications ranging from weather forecasting to environmental monitoring and disaster management. Generally, traditional classification methods of weather phenomena rely on human observation. However, the traditional artificial visual distinction between weather phenomena takes a lot of time and is prone to errors. Hence, there is an urgent need to develop high-precision, efficient, and automated technologies for weather phenomena classification. In recent years, Convolutional Neural Networks (CNNs) have emerged as powerful tools for image classification, demonstrating remarkable performance in various domains.

Convolutional Neural Network (CNN) is one of the deep learning algorithms. It can provide powerful feature representations for images because of the use of deep structure, local receptive fields, spatial sub-sampling, shared weights, and so.

2 Dataset

The weather image dataset chosen contains 6862 images of different types of weather. There are 11 classes dew, fog/smog, frost, glaze, hail, lightning , rain, rainbow, rime, sandstorm and snow

3 Methodology

CNNs consist of interconnected layers of neurons that resemble the organization of neurons in the visual cortex. The key concept behind CNNs is to take advantage of the spatial correlation in images by using convolutional layers.

Convolutional layers extract spatial features from input images by applying learnable filters to the image through convolution operations. The filters detect patterns and features like edges or shapes. Multiple filters can be used simultaneously.

Pooling layers come after convolutional layers and downsample the feature maps to reduce their size. Max pooling, a common operation, extracts the maximum value within local regions. Pooling makes the representation more invariant to small changes and reduces parameters.

Activation functions, like ReLU, introduce non-linearities into the network, enabling it to learn complex relationships in the data.

Fully connected layers transform high-level features into predictions or class probabilities. They resemble traditional neural network layers.

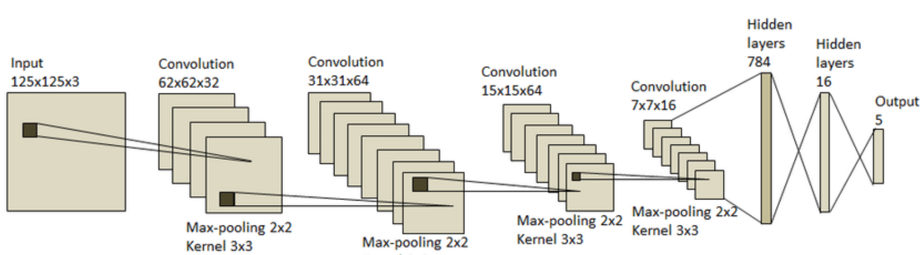

Figure 1: CNN architecture

CNNs are trained using backpropagation, where the network's parameters are updated based on computed gradients of a loss function. Labelled images are used to compute the discrepancy between predicted and true labels, and parameters are adjusted to minimize this loss.

CNNs excel at learning hierarchical representations. Initial layers learn low-level features, while deeper layers learn more abstract and complex features. This hierarchical feature extraction contributes to CNNs' success in image classification and other visual tasks.

4 Conclusion

Weather image classification using Convolutional Neural Networks (CNNs) has emerged as a promising and effective approach in meteorology and computer vision. Traditional methods relying on human observation for weather classification are time-consuming and prone to errors. Therefore, the development of high-precision, efficient, and automated technologies for weather phenomena classification is crucial. CNNs provide a powerful and efficient approach for weather image classification. By leveraging their ability to extract spatial features, learn hierarchical representations, and optimize parameters through training, CNNs have the potential to significantly enhance automated weather phenomena classification systems, enabling accurate and timely analysis for weather forecasting, environmental monitoring, and disaster management.

5 References

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