

Hyperparameter Tuning in CNNs

Optimizing the performance of a CNN model often involves carefully tuning its hyperparameters. These parameters are not learned from the data but are set prior to the training process. Key hyperparameters that significantly impact model accuracy and efficiency include:

Number of Convolutional Layers: The depth of the network, typically ranging from 1 to 3 or more layers, influencing the complexity of features the model can learn.

Example Range: 1, 2, or 3 layers.

Number of Filters in Each Convolutional Layer: Determines the number of feature maps produced by each convolutional layer. A higher number allows the model to learn more diverse features.

Example Range: 32 to 128 filters, with a step size of 16 (e.g., 32, 48, 64, 80, 96, 112, 128).

Number of Dense Layers: The number of fully connected layers at the end of the network, which perform high-level reasoning based on the extracted features.

Example Range: 1, 2, or 3 layers.

Number of Units in Each Dense Layer: The width of the fully connected layers, impacting the model's capacity to learn complex non-linear relationships. The last dense layer typically corresponds to the number of output classes (e.g., 10 units for CIFAR-10).

Example Range: 32 to 128 units, with a step size of 16 (e.g., 32, 48, 64, 80, 96, 112, 128).

Dropout Rate: A regularization technique applied to dense layers to prevent overfitting by randomly setting a fraction of input units to zero at each update during training.

Example Range: 0.0 to 0.5, with a step size of 0.1 (e.g., 0.0, 0.1, 0.2, 0.3, 0.4, 0.5).

Learning Rate: The step size for the optimization algorithm (e.g., Adam), controlling the rate of convergence during training. An appropriate learning rate is crucial for efficient and stable training.

Example Choices: 0.01, 0.001, 0.0001.

Tuning these hyperparameters systematically, often through techniques like grid search or random search, is essential to optimize the model's performance on the validation set and ensure robust generalization to unseen data.