Early Stopping

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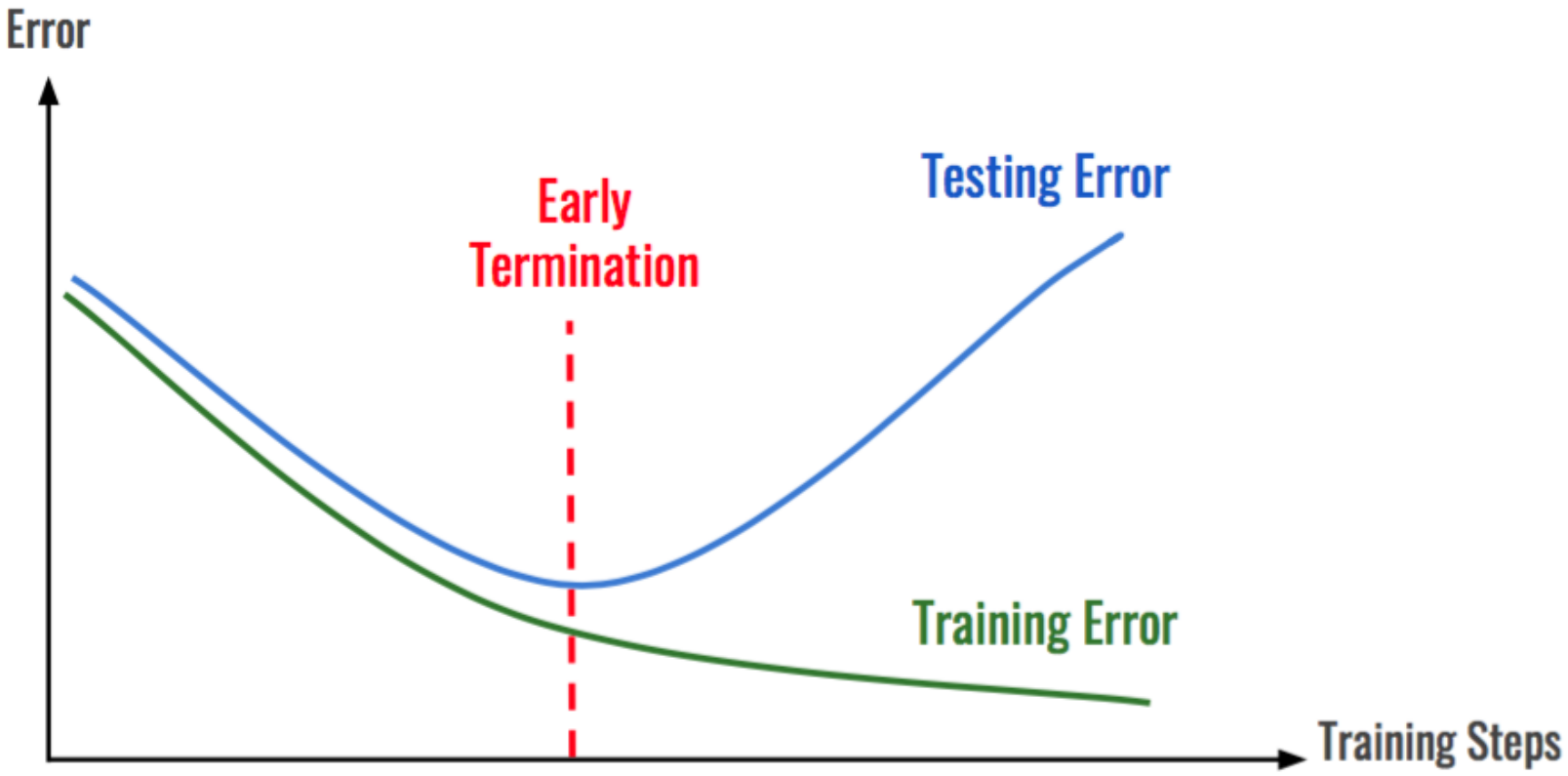
Error
Early
Termination
Testing Error
Training Error
Training Steps

Definition

- Early stopping is a regularization technique used in training neural networks to prevent overfitting.

- Overfitting occurs when a neural network learns the noise in the training data rather than the underlying pattern, leading to poor performance on unseen data.

How early stopping works:

- **Training with Validation**: During training, the dataset is typically split into training and validation sets. The model is trained on the training set, and its performance is periodically evaluated on the validation set.
- **Monitoring Performance**: The performance metric (such as accuracy or loss) on the validation set is monitored after each epoch (a full pass through the training data).
- **Stopping Criterion**: If the performance on the validation set stops improving for a certain number of consecutive epochs (known as the "patience" parameter), the training is halted. This suggests that further training would likely lead to overfitting.
- **Restore Best Model**: The weights of the model are reverted to the state that resulted in the best validation performance, ensuring that the best version of the model is used.

Benefits of Early Stopping

- **Prevents Overfitting**: By stopping the training process once the model starts to overfit, it ensures better generalization to new data.
- **Saves Time**: It can significantly reduce training time by stopping early rather than continuing for a pre-defined number of epochs.
- **Automatic**: It removes the need to manually choose the number of epochs for training, making the training process more efficient and less dependent on hyperparameter tuning.

Limitations of Early Stopping:

- If the model stops too early, there might be risk of underfitting
- It may not be beneficial for all types of models
- If validation set is not chosen properly, it may not lead to the most optimal stopping