Early Stopping

Early stopping is a form of regularization used to prevent overfitting in machine learning and deep learning models. It involves stopping the training process before the model starts to overfit. The idea is to monitor the model's performance on a validation set during the training process and stop training when the performance starts to degrade, which is an indication that the model is beginning to overfit the training data.
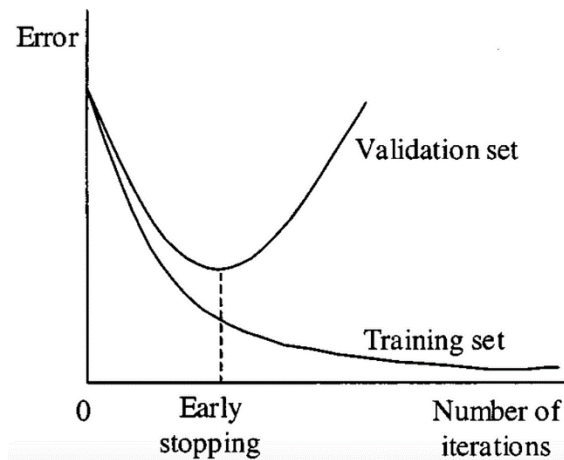
How Early Stopping Works:

- Validation Set: During training, a portion of the training data is set aside as a validation set. This set is used to evaluate the model's performance at each epoch (iteration over the entire dataset).
- Performance Monitoring: The model's performance on the validation set is monitored at each epoch. Common metrics used for this purpose include accuracy, loss, or any other metric relevant to the problem at hand.
- Early Stopping Criterion: If the performance on the validation set starts to degrade (e.g., the loss increases or the accuracy decreases), it's an indication that the model is beginning to overfit the training data. At this point, early stopping is triggered, and the training process is halted.
- Model Selection: Since the training is stopped before overfitting occurs, the model at the point of early stopping is typically the best model, as it has not yet learned the noise in the training data.

Early Stopping class:

```python
keras.callbacks.EarlyStopping(
    monitor="val_loss",
    min_delta=0,
    patience=0,
    verbose=0,
    mode="auto",
    baseline=None,
    restore_best_weights=False,
    start_from_epoch=0,
)
```

- **monitor**: Quantity to be monitored. Defaults to "val_loss".
- **min_delta**: Minimum change in the monitored quantity to qualify as an improvement, i.e. an absolute change of less than min_delta, will count as no improvement. Defaults to 0.
- **patience**: Number of epochs with no improvement after which training will be stopped. Defaults to 0.
- **verbose**: Verbosity mode, 0 or 1. Mode 0 is silent, and mode 1 displays messages when the callback takes an action. Defaults to 0.
- **mode**: One of {"auto", "min", "max"}. In min mode, training will stop when the quantity monitored has stopped decreasing; in "max" mode it will stop when the quantity monitored has stopped increasing; in "auto" mode, the direction is automatically inferred from the name of the monitored quantity. Defaults to "auto".
- **baseline**: Baseline value for the monitored quantity. If not None, training will stop if the model doesn't show improvement over the baseline. Defaults to None.
- **restore_best_weights**: Whether to restore model weights from the epoch with the best value of the monitored quantity. If False, the model weights obtained at the last step of training are used. An epoch will be restored regardless of the performance relative to the baseline. If no epoch improves on baseline, training will run for patience epochs and restore weights from the best epoch in that set. Defaults to False.
- **start_from_epoch**: Number of epochs to wait before starting to monitor improvement. This allows for a warm-up period in which no improvement is expected and thus training will not be stopped. Defaults to 0.