Implicit Neural Representations with Levels-of-Experts

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Motivation

- Coordinate-based networks, usually in the forms of MLPs, are difficult to scale to high-resolution signals or large datasets due to prohibitive computational cost.
- Levels-of-Experts (LoE) brings hierarchical, input-dependent weights to MLPs, allowing a coordinate-based network to scale up without increasing computation.
- Compared to other hybrid networks, LoE does not require extra networks, retains a compact latent representation, and achieves good parameter efficiency.

What is Levels-of-Experts (LoE)?

- LoE can generalize to 2D and 3D easily by using 2D or 3D grids for the weights.
- A wide range of grid patterns and interpolation methods are possible. The grids do not need to be axis-aligned or follow any specific order.
- Drop-in replacement for coordinate-based MLP, achieving better model capacity without the extra computation.

Levels-of-Experts in Higher Dimensions

Coarse-to-fine  Coarse-to-fine + bilinear  Fine-to-coarse  Random scale
Gray code  Random affine

High-resolution Image Fitting

- LoE achieves the best performance at the same computational cost.
- Having hierarchical weight grids is crucial for the performance of LoE.
- LoE does not require smooth interpolation of weights to perform well.

Video Fitting

- LoE performs the best under the same computational cost and parameter count.

Novel View Synthesis

- LoE performs well even when supervised indirectly (3D to 2D supervision).
- Hierarchical arrangement of weight grids encourages smooth results.

Conditional-independent Generation

- LoE supports a compact latent space – output is controlled by a single latent variable z.
- It can be used directly as a generator without the need of any auxiliary networks.