NeF-GPT: Autoregressive Generation of Neural Field Weights

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Code and Additional Information available under: https://github.com/nef-gpt/adl4cv

Motivation

- Increasing popularity of **Neural Fields** for 3D Reconstruction tasks
- **Autoregressive** Generation has seen rapid development in the last few years
- Two papers important for our research are **HyperDiffusion** and **MeshGPT**
- **Hyperdiffusion** demonstrates the possibity to generate **novel MLP-weights** for **NeF** using a Diffusion Pipeline
- **MeshGPT** employed an autoregressive transformer-based approach for novel **3D triangle mesh generation**
- In our work we aim to adapt the general transformer architecture from MeshGPT to a **different domain**, namely from polygon meshes to MLP-weights

Dataset

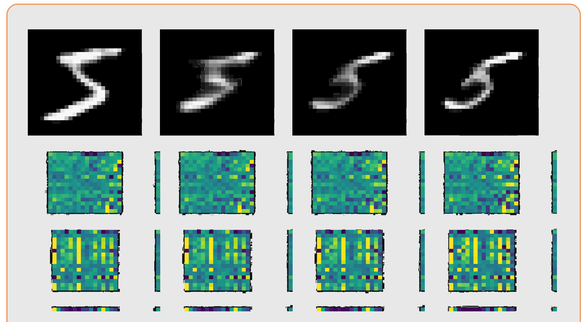
- MNIST Dataset: 60.000 examples of handwritten digits
- ShapeNet Dataset: 4.046 meshes of planes

Our Contribution

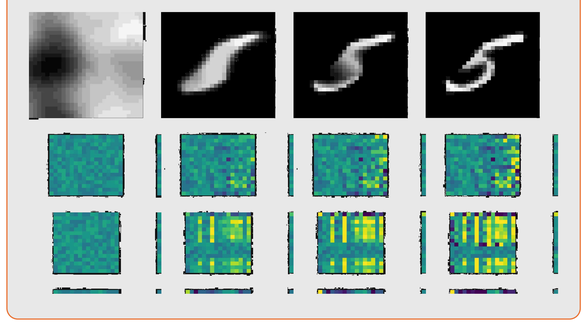
- Pipeline to **train** Neural Fields from meshes or point clouds
- Modules to convert **Neural Fields to Sequences and Tokens**
- **Transformer** Model to generate Tokens **unconditionally**
- Modules to **reconstruct** MLP and Point Clouds **from predicted tokens**

Overfitting

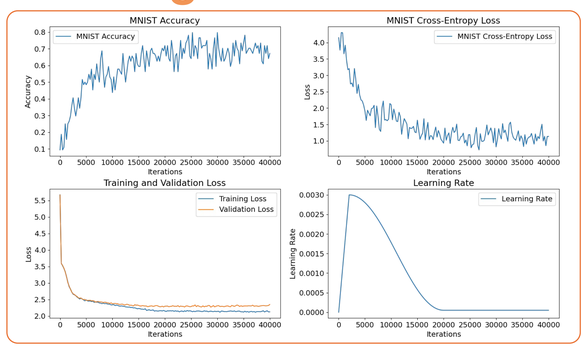
Unconditioned



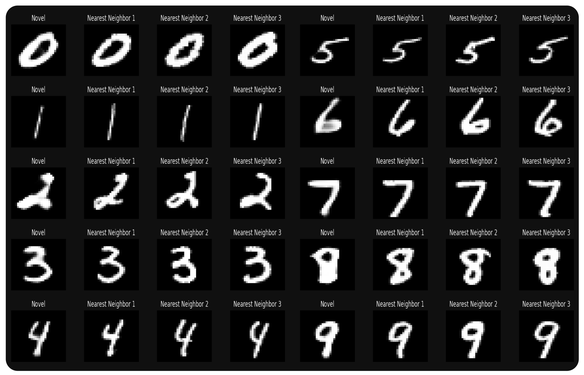
Conditioned



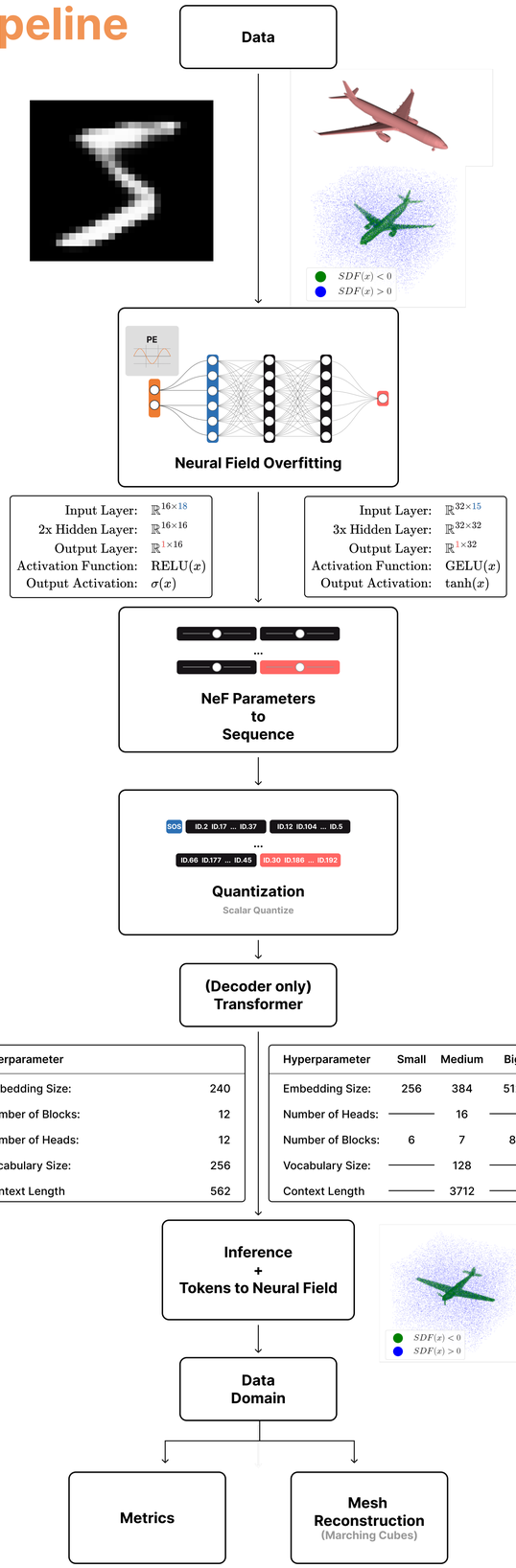
Training



Generation



Pipeline

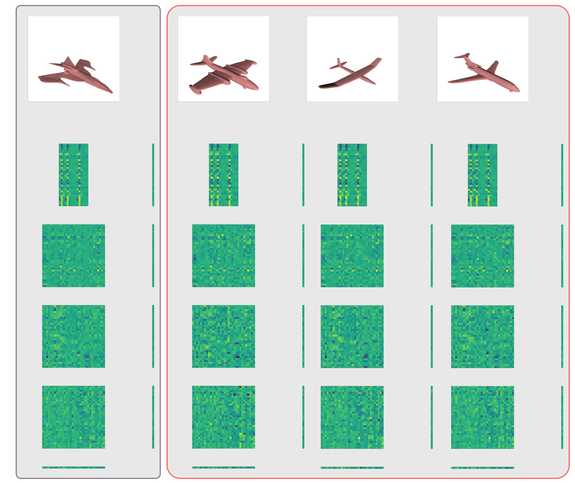


Hyperparameter	
Embedding Size:	240
Number of Blocks:	12
Number of Heads:	12
Vocabulary Size:	256
Context Length	562

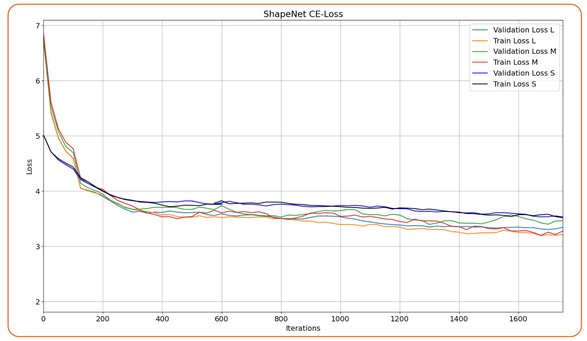
Hyperparameter	Small	Medium	Big
Embedding Size:	256	384	512
Number of Heads:	——	16	——
Number of Blocks:	6	7	8
Vocabulary Size:	——	128	——
Context Length	——	3712	——

Overfitting

Condition Conditioned



Training



Metrics

Method	COV % ↑	1-NNA % ↓	FPD ↓
Diffusion Voxel Baseline	28	94.1	38.9
PVD	39	76.3	5.8
DPC	46	74.7	18.7
HyperDiffusion	49	69.3	3.5
Ours [3, 0.8]	**38.77**	90.77	**31.34**
Ours [3, 1]	34.57	91.31	36.78
Ours [5, 0.8]	37.50	**90.43**	35.21
Ours [5, 1]	35.64	91.36	31.87

Generation