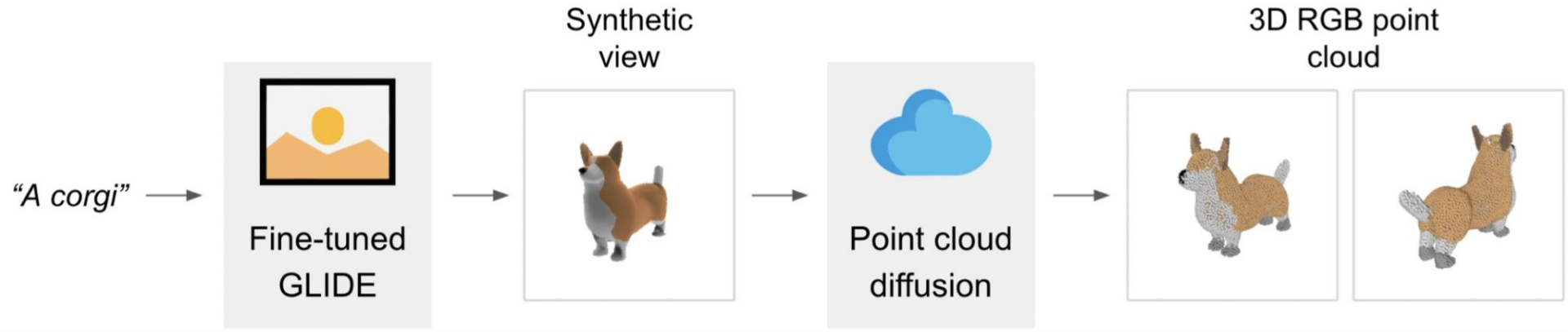
Point·E: A System for Generating 3D Point Clouds from Complex Prompts



Reviewer-researcher: Pirogov Slava

Authors

Alex Nichol*

Dalle-2
Glide
Diffusion beat GANs
IDDPM

Prafulla Dhariwal

Heewoo Jun*

CV
Generation
Code solve problems

Pamela Mishkin

Dalle
Glide
Code solve problems

Mark Chen

Zero-shot text-to-
-image generation
Dalle-2
Glide
Diffusion beat Gans
IDDPM

Pros and cons

Pros

- OpenAI
- Github
- Different approach
- P-IS and P-FID
- Simple objects

Cons

- Small research
- Dataset
- Speed

"a 3D printable gear, a single gear 3 inches in diameter and half inch thick"

Method	ViT-B/32	ViT-L/14	Latency
DreamFields	78.6%	82.9%	$\sim$ 200 V100-hr†
CLIP-Mesh	67.8%	74.5%	$\sim$ 17 V100-min*
DreamFusion	75.1%	79.7%	$\sim$ 12 V100-hr†
Point·E (40M, text-only)	15.4%	16.2%	16 V100-sec
Point·E (40M)	36.5%	38.8%	1.0 V100-min
Point·E (300M)	40.3%	45.6%	1.2 V100-min
Point·E (1B)	41.1%	46.8%	1.5 V100-min
Conditioning images	69.6%	86.6%	-

Diffusion models

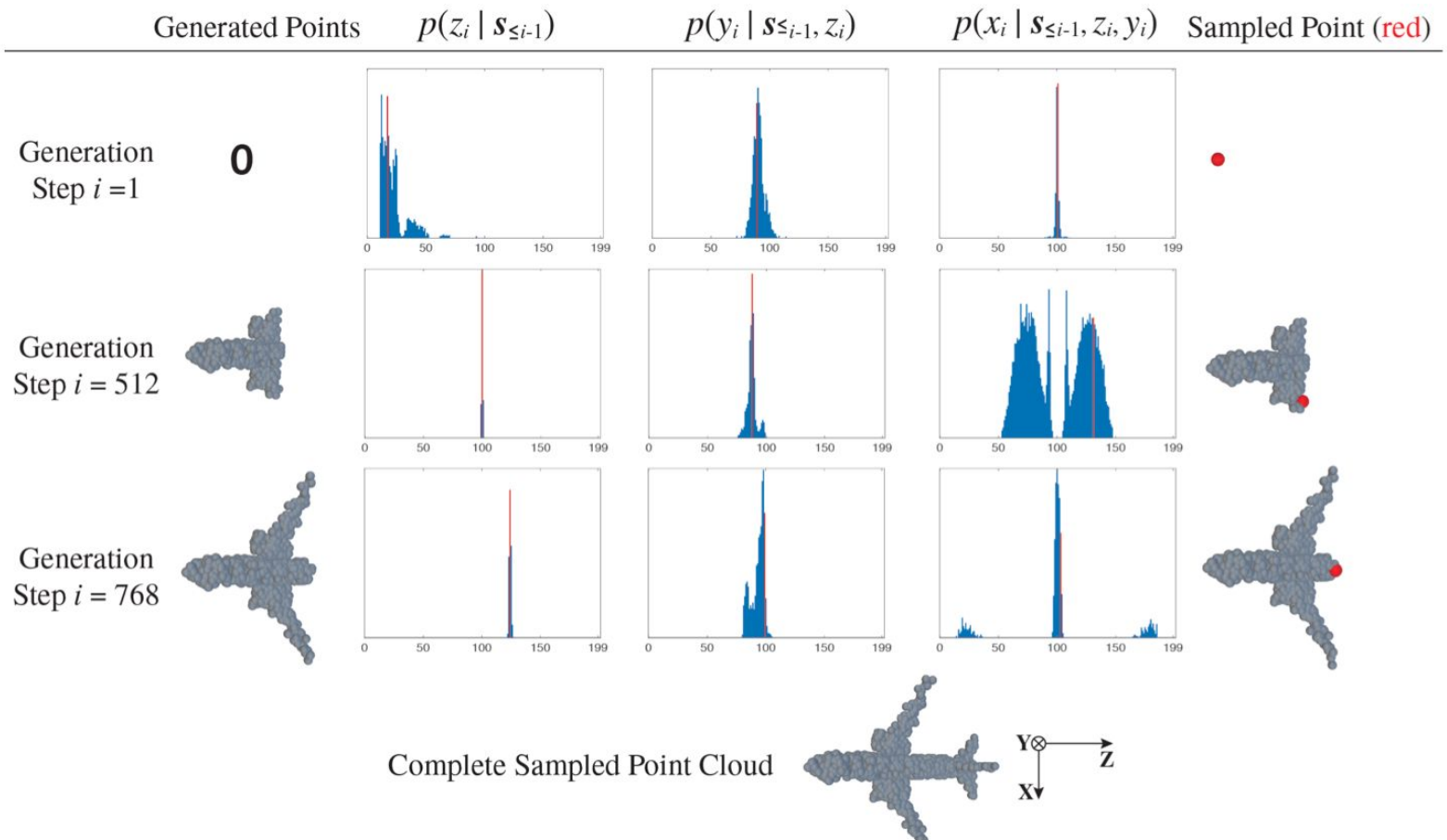
- Deep unsupervised learning using nonequilibrium thermodynamics - 2015
- Score-based generative modeling through stochastic differential equations - 2020
- Denoising diffusion probabilistic models - 2020
- Score-based generative modeling through stochastic differential equations - 2020
- Improved denoising diffusion probabilistic models - 2021
- Diffusion models beat gans on image synthesis - 2021
- Classifier-free diffusion guidance - 2021

- Elucidating the Design Space of Diffusion-Based Generative Models - 2022
- Glide: Towards photorealistic image generation and editing with text-guided diffusion models - 2021
- 3d shape generation and completion through point-voxel diffusion - 2021
- Towards zero-shot text-to-shape generation - 2021
- …

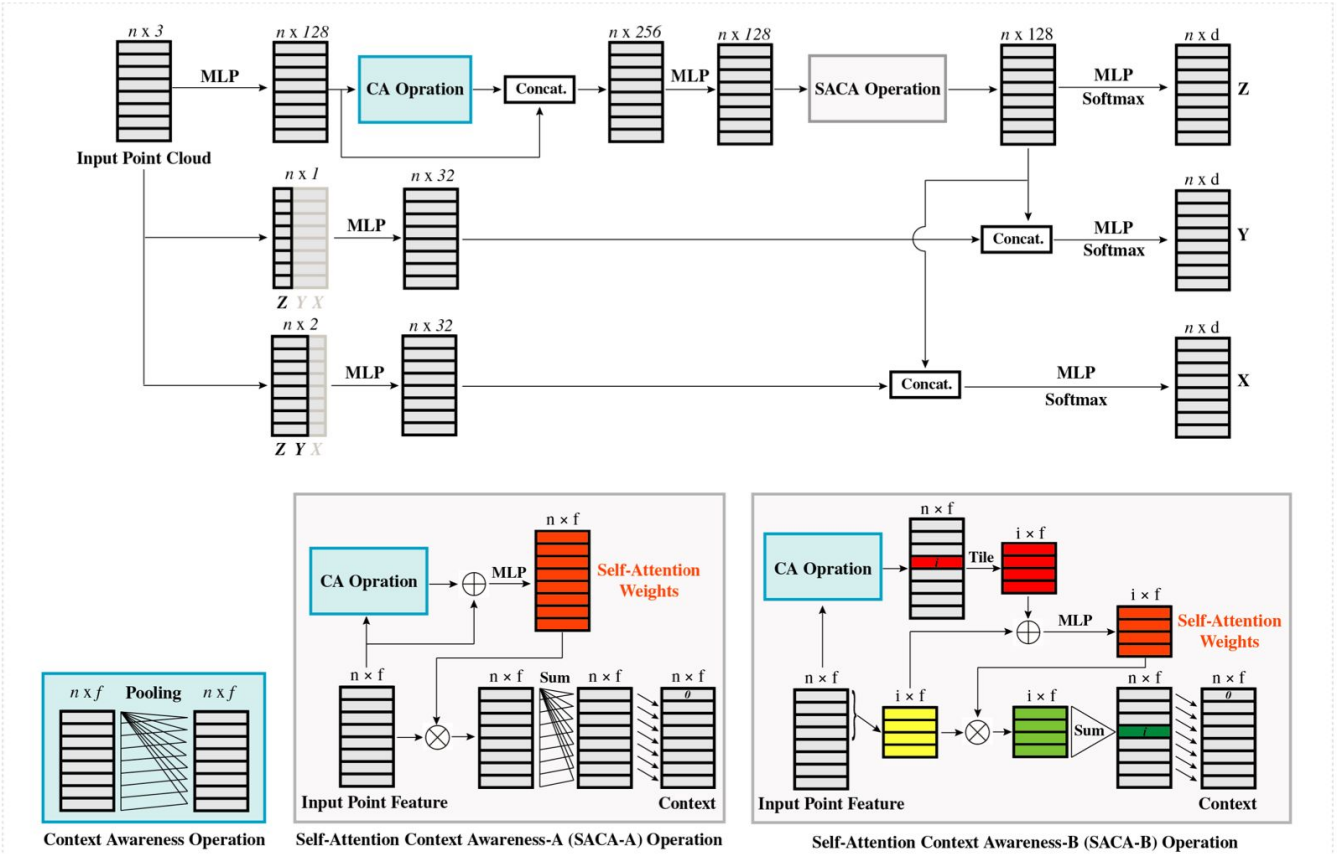
3D modeling

- Learning representations and generative models for 3d point clouds - 2017
  - Train point-cloud autoencoders and fit generative priors (GAN)
- Hierarchical graph networks for 3d shape generation
  - Generate point clouds using a VAE on hierarchical graph representations of 3D objects
- Pointflow: 3d point cloud generation with continuous normalizing flows.
  - Train a two-stage flow model for point cloud generation: first, a prior flow model produces a latent vector, and then a second flow model samples points conditioned on the latent vector.
- Diffusion probabilistic models for 3d point cloud generation
- Learning gradient fields for shape generation
  - Train two-stage models where the second stage is a diffusion model over individual points in a point cloud, and the first stage is a latent flow model or a latent GAN, respectively.

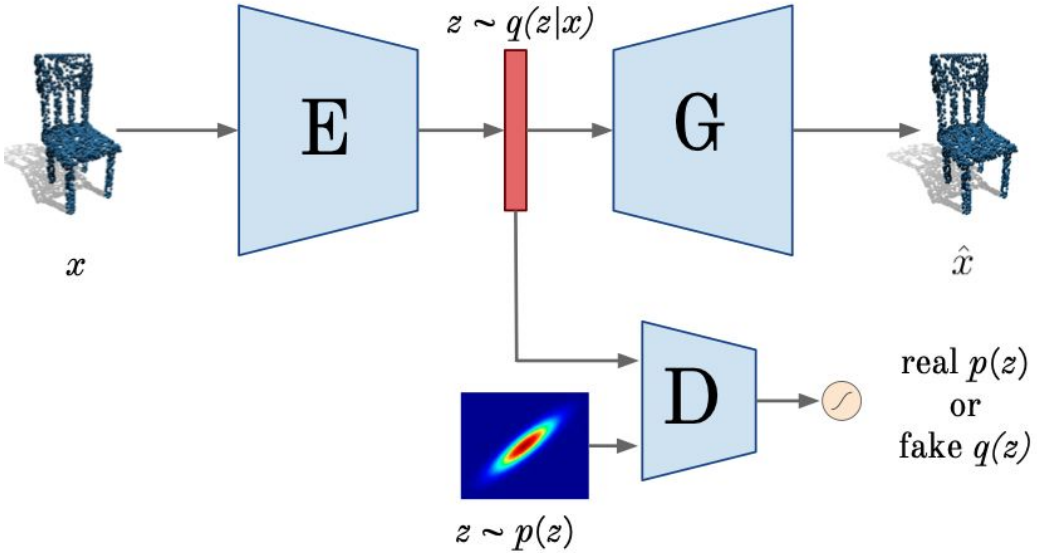
3D modeling - PointGrow(2018)



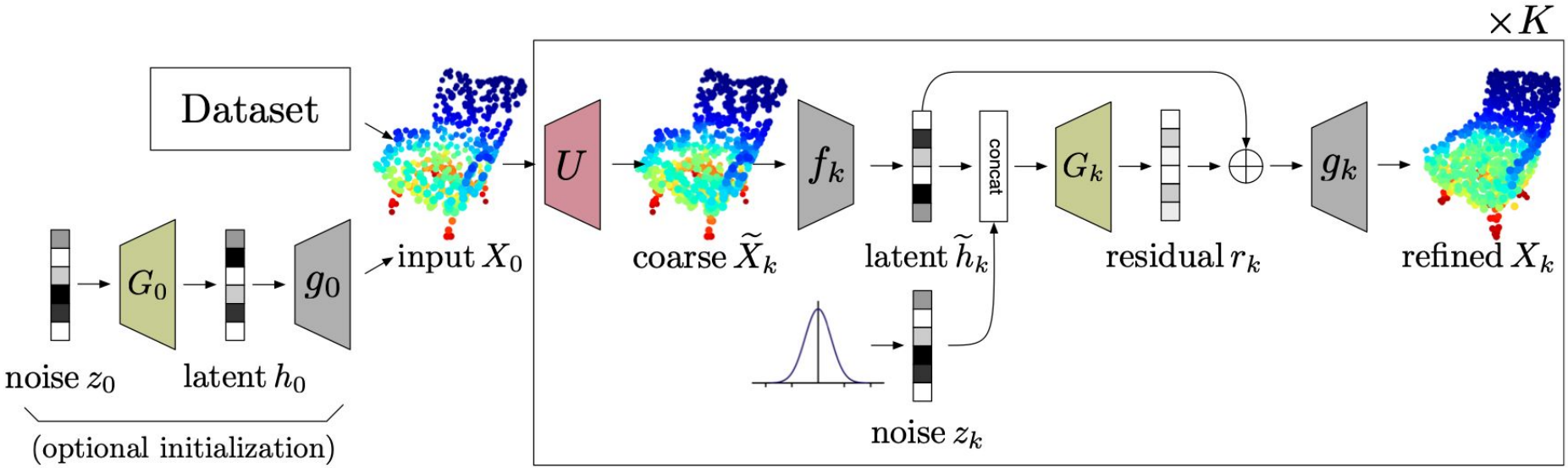
3D modeling - PointGrow(2018)



Adversarial Autoencoders (2018)



Latent-Space Laplacian Pyramids for Adversarial Representation Learning with 3D Point Clouds (2019)



Latent-Space Laplacian Pyramids for Adversarial Representation Learning with 3D Point Clouds (2019)

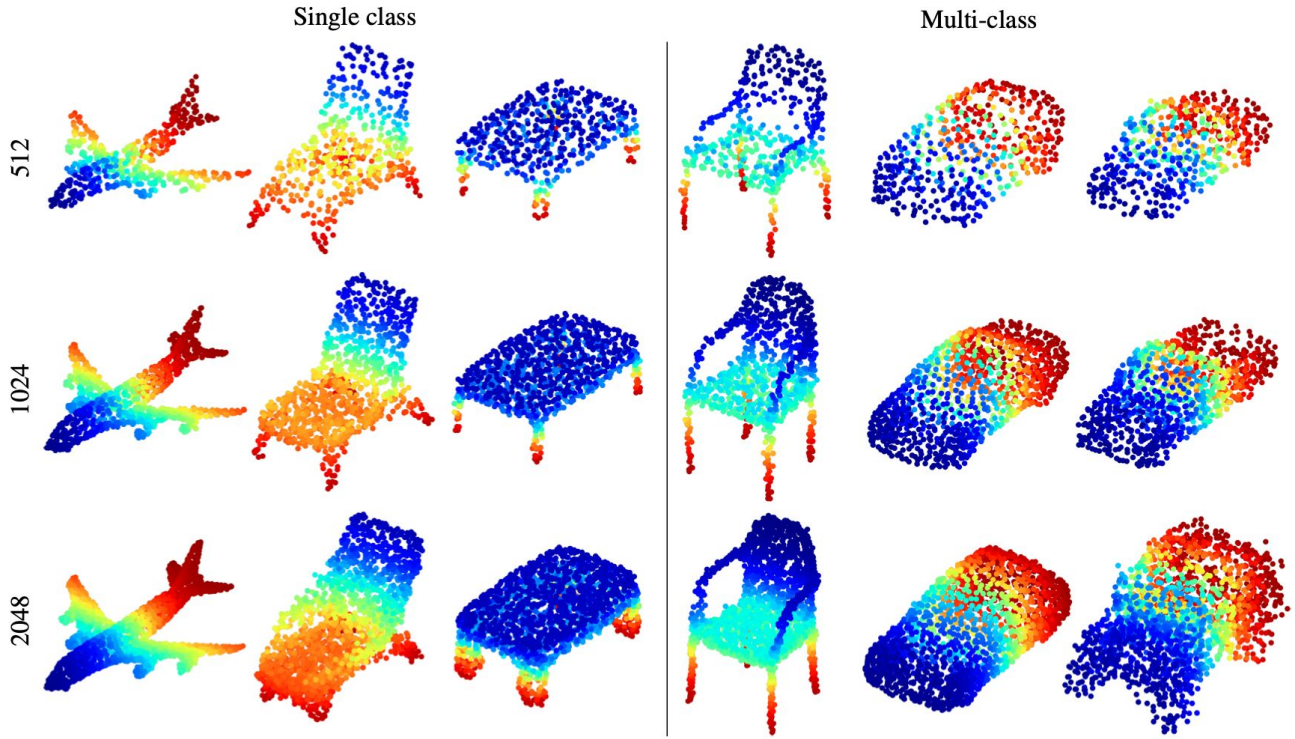
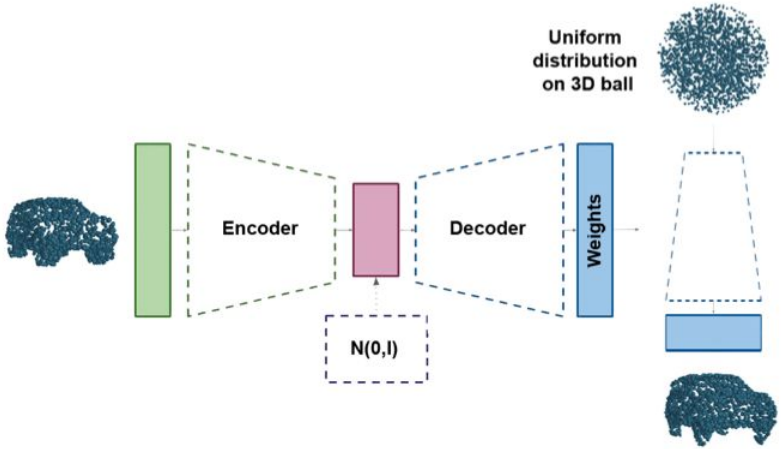
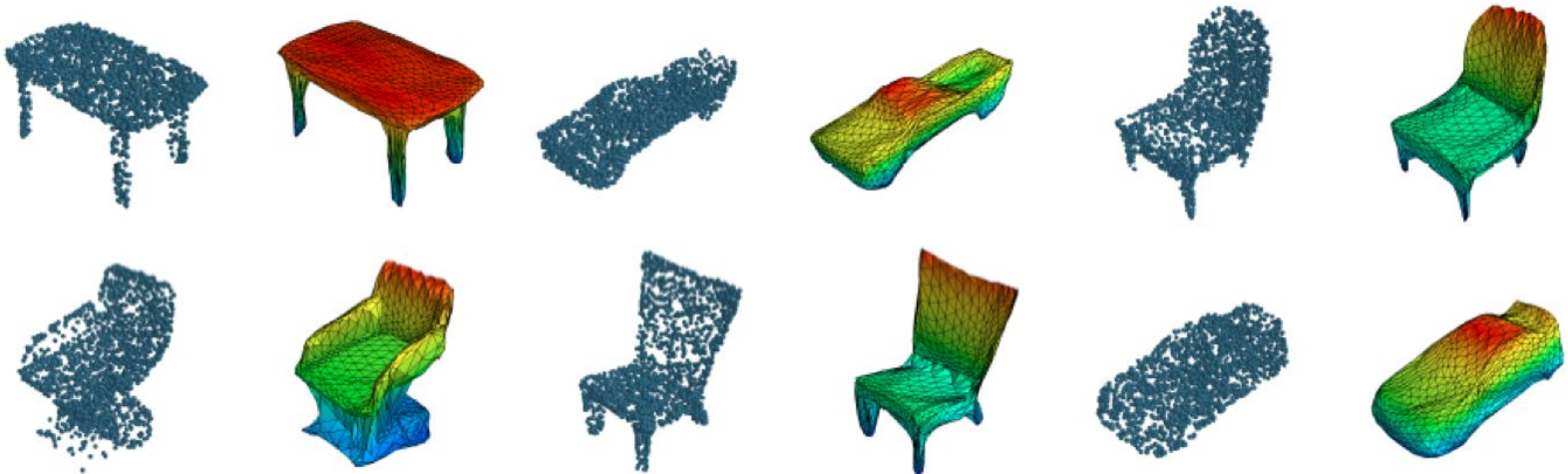


Figure 5: Examples of shapes synthesised using our LSLP-GAN model. *Left:* airplanes, chairs, and tables synthesised using our single-class models. *Right:* samples of 3D shapes synthesised using our multi-class model, note that the overall geometry of the shape changes slightly due to averaging over many classes. The rightmost figure displays a failure mode for our model.

Hypernetwork approach to generating point clouds (2020)





DreamFusion

https://dreamfusion3d.github.io/

Rodin: A Generative Model for Sculpting 3D Digital Avatars Using Diffusion - 12 Dec 2022

Blogpost