

Problem: Generate 3D shapes from latent vectors

Motivation

- Template-based methods cannot generate novel shapes
- Shapes synthesized by earlier deep nets are not as realistic
- Adversarial learning provides novel and high-res shapes

Advantages

- Generator synthesizes realistic objects with high resolution
- Discriminator offers a powerful 3D shape descriptor for recognition
- Latent shape space encodes semantic information



Learning a Probabilistic Latent Space of Object Shapes via 3D Generative-Adversarial Modeling Jiajun Wu^{*1} Chengkai Zhang^{*1} Tianfan Xue¹ William T. Freeman^{1,2} Joshua B. Tenenbaum¹ 1 Massachusetts Institute of Technology 2 Google Research 3D-GAN **Classification Accuracy** Model

Latent

vector

Generated

shape

Real shape

Discriminator

Generator

Generated or real?	Supervision	Methods	Classification (
		MVCNN [Su et al., 2015]	90.1%			
	Category labels	MVCNN-MultiRes [Qi et al., 2016]	91.4%			
		VoxNet [Maturana et al., 2015]	83.0%			
		ORION [Sedaghat et al., 2016]	-			
		T-L Network [Girdhar et al., 2016]	74.4%			
	Unsupervised	Vconv-DAE [Sharma et al., 2016]	75.5%			
		3D-GAN (ours)	83.3%			
			Rec			
	Input \\ image Im y	Variational Variational vector $C(\cdot)$ $E(\cdot)$ Latent vector $C(\cdot)$ $E(\cdot)$	$\frac{1}{2}$			
	$L = L_{C}$ $L_{KL} = D_{K}$ $L_{recon} = G $	$\begin{aligned} & F_{AN} + \alpha L_{KL} + \beta L_{recon} \\ & F_L(q(z y) p(z)) \\ & F(E(y)) - x ^2 \end{aligned}$				

 $L_{GAN} = log D(x) + log(1 - D(G(z)))$

Average Precision of Reconstruction on IKEA

	Bed	Bookcase	Chair	Desk	Sofa	Table	Mean
AlovNot_fc8 [Girdbar et al 2016]	29.5	17 3		19.7	38.8	16.0	23.6
AlexNet conv() [Cirdbar at al. 2016]	2J.J 20 1		20.4		50.0	10.0	25.0
AlexNet-Conv4 [Girdnar et al., 2016]	38.2	20.0	31.4	20.0	09.3	19.1	35.Z
I-L Network [Girdhar et al., 2016]	56.3	30.2	32.9	25.8	/1./	23.3	40.0
Our 3D-VAE-GAN (jointly trained)	49.1	31.9	42.6	34.8	79.8	33.1	45.2
Our 3D-VAE-GAN (separately trained)	63.2	46.3	47.2	40.7	78.8	42.3	53.1





