StyleAlign은 parent, child인 styleGAN에 대해 연구

* Introduction.

Transfer Learning (TL)은 pre-trained된 teacher와 child가 있다.

Teacher를 init으로, target domain에서 전체 또는 일부 훈련.

논문에서는 이에 대한 shared knowledge에 대해 분석.

같은 architecture에서 fine-tune된 것을 aligned model이라고 함.

논문에서는 이런 model align에 대해 연구 (styleGAN2 기준)

↳ 어떤 부분이 변형, 상속되는지.

↳ domain 간에 유사성이 어느정도 dependent 한지

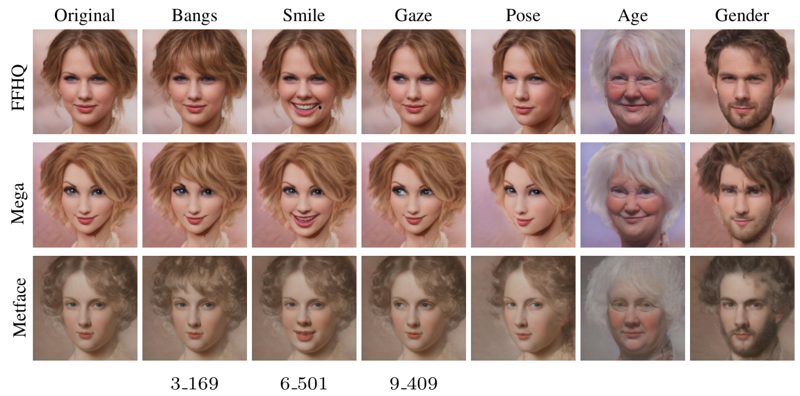

Figure 2: Semantic controls discovered for a parent FFHQ model retain their function in the children models (Mega and Metface). This holds for individual channels in $\mathcal{S}$ (bangs, smile, gaze), as well as for directions in $\mathcal{W}$ (pose, age, gender).

↳ StyleGAN2의 W space는 fine-tune의 영향을 많이 받지 않음

↳ Child에서 사용하지 않는 knowledge는 손실되는지, 복구 가능한지. → 복구 가능

↳ 다른 application은 어떤것이 있는지

그리고, 여러 vision에 대해 적용

* Analysis of Aligned StyleGAN Models

StyleGAN2의 동일한 W space에서 생성된 teacher와 child가 유사함.

- Which parts of nework change. during transfer

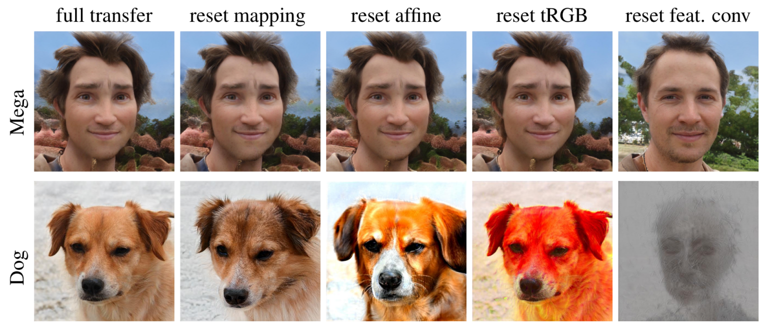

Figure 1: Effect of resetting the weights of different components in child models (Mega, Dog) to their initial values, which come from the parent model (FFHQ). Resetting the feature convolution weights causes the most drastic changes. Also see Figure 8.

Mapping($Z \to W$), Affine($W \to S$), feature conv, RGB → tRGB 등.

feature Conv가 가장 큰 영향을 받음

그리고 Affine 과 tRGB layer의 경우, domain 간 거리가 클수록 많이 바뀜 → Fig.8.

Mapping의 경우, domain이 변하지 않으면, 모다 w에 유사하게 mapping됨.

└ 전이가 잘 이뤄짐.

- Semantic alignment for similar domain.

parent의 latent semantic은 child에 많은 영향을 끼침.

Figure 10: Semantic alignment of multiple channels: semantically meaningful directions in StyleSpace discovered in the parent model (FFHQ), detected using StyleCLIP (Patashnik et al., 2021), still control the same attributes in children models (Mega and Metface).

- Semantic Alignment for more distant domain.

두 domain 간에 연관성이 적은 부분은 transfer 되지 않고 숨겨짐

ㄴ 나중에 복구 가능.

Figure 14: Some degree of semantic alignment is present even when the source and target domains are very dissimilar. In the top two rows, we show that the latent direction that controls pose in the parent FFHQ model still controls pose in the child LSUN church model. In the bottom two rows, we examine a double transfer, with FFHQ as parent, AFHQ dog as child and LSUN bedroom as grandchild. The pose direction in FFHQ still controls the pose in the grandchild bedroom model.

- Are latent semantic forgotten or hidden?

ㄴ hidden.

		eyebrow 19	eye 5	ear 41	nose 21	mouth 32	neck 46	cloth 34	hair 62
eyebrow	29	8			1		1		
eye	9		3						
ear	45			20					
nose	23				8				
mouth	55					11			
neck	61				1		15		
cloth	65							19	
hair	70								33

Table 3: The number of localized StyleSpace controls for various semantic regions for an FFHQ parent model and an FFHQ grandchild model, with training flow from FFHQ (parent) to AFHQ dog (child) then back to FFHQ (grandchild). Each column corresponds to a semantic region for parent and each row to a semantic region for grandchild. The number of localized channels shared between two models is indicated for each pair of semantic regions.

		eyebrow	eye	ear	nose	mouth	neck	cloth	hair
		19	5	41	21	32	46	34	62
eyebrow	22					1	1		
eye	5								1
ear	44					1	1	1	
nose	19								
mouth	28			1	1	1			
neck	43			1		1	1		1
cloth	32			2	1			1	
hair	85					1	2		2

Table 4: The number of localized StyleSpace controls for various semantic regions for two randomly initialized FFHQ models. Each column corresponds to a semantic region in one model and each row to a semantic region in the other model. The number of localized channels shared between two models is indicated for each pair of semantic regions. It is evident that the two models only have a small number of overlap channels across unrelated semantic regions (for example, hair and eye). This experiment serves as a negative control to show that a large number of overlap channels only occurs when the two models have parent and child relation, as is the case in Table 1