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Dataset Condensation with Contrastive Signals

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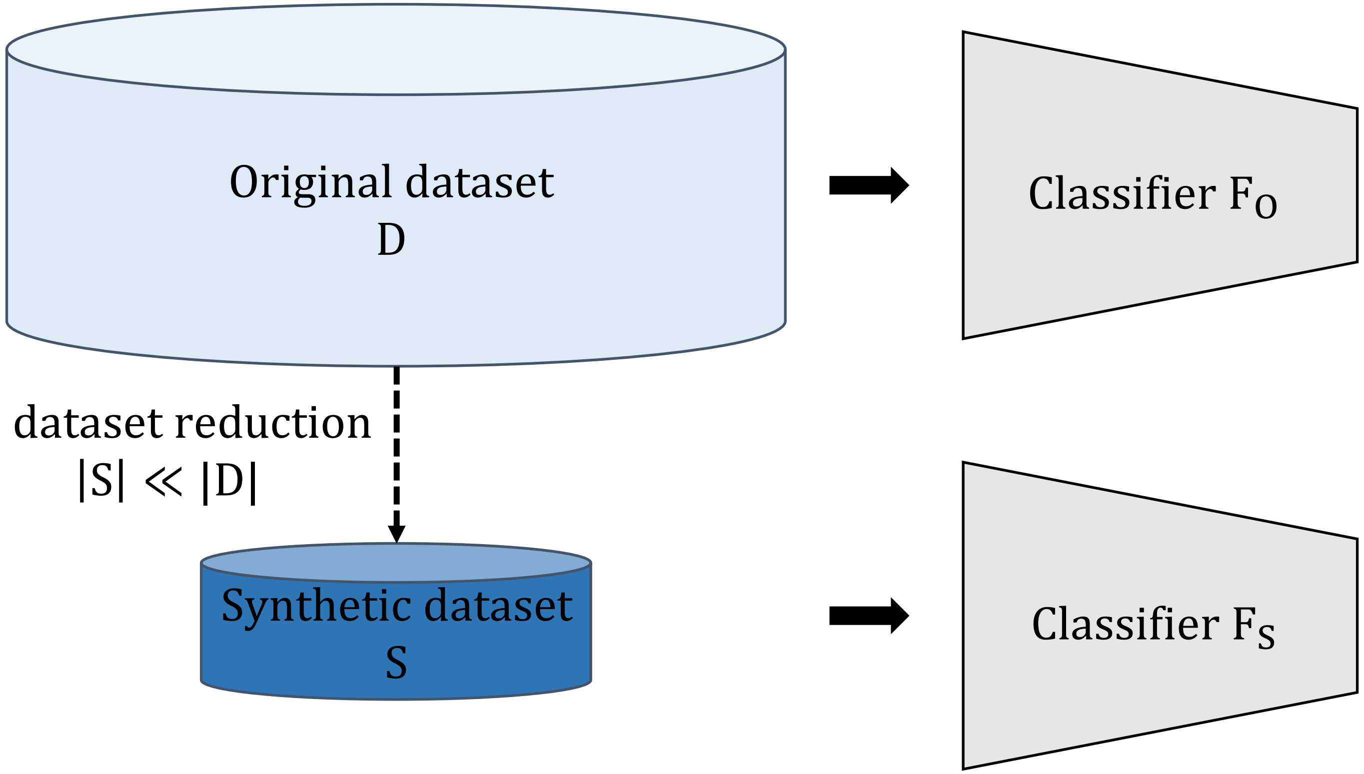
Introduction



Minimize the performance gap between F_O *and* F_S

Introduction

(a) Trailer Truck

(b) Police Van

Task-irrelevant features: {Wheels, Head lights, Roads, Trees, ...}

Task-relevant features: {Logo, Police sign, Trailers, ...}

Source: Deng, J., Dong, W., Socher, R., Li, L.-J., Li, K., and FeiFei, L. ImageNet: A Large-Scale Hierarchical Image Database. In CVPR09, 2009.

Class-Wise Gradient Matching (DC)

$$\mathcal{L} = \sum_{c=0}^{C-1} D\left(\nabla_{\theta_t} L(\mathcal{X}^c; \theta_t), \nabla_{\theta_t} L(\mathcal{S}^c; \theta_t)\right),$$

$\mathcal{X}^c$: a set of real images for class c

$\mathcal{S}^c$: a set of synthetic images for class c

θ_t: the model parameter at time t

C: the number of classes

$D(\cdot, \cdot)$: a distance function

$L(\cdot;)$: the cross-entropy loss function

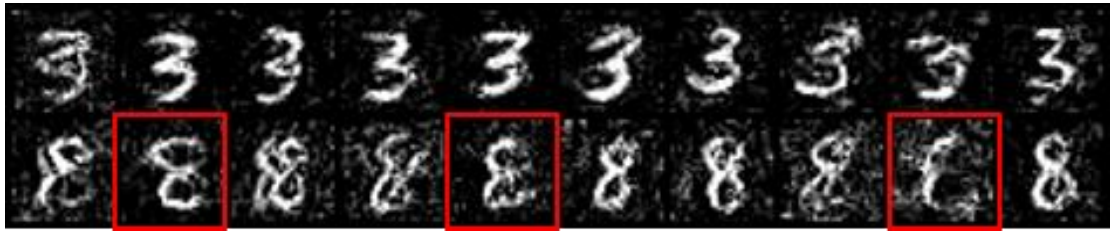
Our Gradient Matching (DCC)

$$\mathcal{L} = \sum_{c=0}^{C-1} D\left(\nabla_{\theta_t} L(\mathcal{X}^c; \theta_t), \nabla_{\theta_t} L(\mathcal{S}^c; \theta_t)\right)$$

$$\mathcal{L} = D\left(\frac{\boxed{\sum_{c=0}^{C-1}} \nabla_{\theta_t} L(\mathcal{X}^c;\theta_t)}{\sum_{c=0}^{C-1} \|\mathcal{X}^c\|}, \frac{\boxed{\sum_{c=0}^{C-1}} \nabla_{\theta_t} L(\mathcal{S}^c;\theta_t)}{\sum_{c=0}^{C-1} \|\mathcal{S}^c\|}\right)$$

Comparison

3 vs. 8 class-wise gradient matching



3 vs. 8 our gradient matching

Flipped 3 vs. 8 our gradient matching

Comparison

Dataset	Img/cls	Random	Selection-based C-score	GraNd	EL2N	Synthesis-based DC	DSA	Ours DCC	DSAC	Ω
SVHN	1	14.6±1.6	-	19.6±0.5	19.1±0.6	34.6±2.0	36.0±2.0	34.3±1.6	**47.5±2.6**	92.1±0.2
	10	35.1±4.1	-	37.5±1.6	32.5±1.2	76.2±0.6	78.9±0.5	76.2±0.8	**80.5±0.6**	
	50	70.9±0.9	-	69.1±0.7	68.7±0.7	82.7±0.3	84.4±0.4	83.3±0.2	**87.2±0.3**	
CIFAR-10	1	14.4±2.0	21.7±0.6	21.8±0.5	20.9±0.6	28.2±0.7	28.7±0.7	32.9±0.8	**34.0±0.7**	81.6±0.3
	10	26.0±1.2	31.6±0.4	32.3±0.4	32.3±0.4	44.7±0.6	52.1±0.6	49.4±0.5	**54.5±0.5**	
	50	43.4±1.0	39.8±0.4	41.2±0.3	40.7±0.3	54.8±0.5	60.6±0.4	61.6±0.4	**64.2±0.4**	
CIFAR-100	1	4.2±0.3	8.0±0.3	8.8±0.3	8.8±0.3	12.8±0.3	13.9±0.4	13.3±0.3	**14.6±0.3**	52.5±0.3
	10	14.6±0.5	18.1±0.2	17.8±0.2	17.3±0.2	26.6±0.3	32.4±0.3	30.6±0.4	**33.5±0.3**	
	50	29.7±0.4	30.4±0.3	27.6±0.2	27.7±0.2	32.1±0.3	38.6±0.3	**40.0±0.3**	39.3±0.4	

Conclusion

- We show that DC primarily focuses on the class-wise gradient while overlooking **contrastive signals**.
- To address this issue, we propose the **Dataset Condensation with Contrastive signals (DCC)** method.
- In our experiments, we demonstrate that the proposed DCC **outperforms** DC in fine-grained classification tasks and general benchmark datasets

Thank you!

https://github.com/Saehyung-Lee/DCC