Rectifying Shortcut Learning via Cellular Differentiation in Deep Learning Neurons

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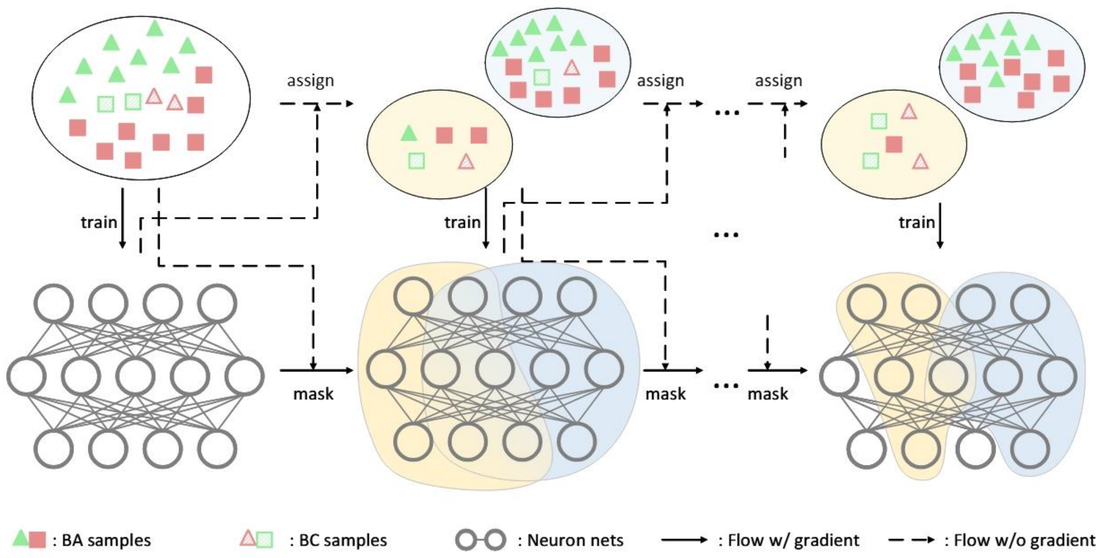
Overview

- The paper proposes a method for feature differentiation in models, which can learn more disentangled feature representations and enables the model to better adapt to complex task scenarios.
- The proposed method offers a new strategy to avoid excessive reliance on shortcut, which no longer requires prior knowledge of shortcut features.
- This work provides a new approach for debiasing tasks and achieves excellent performance without introducing additional priors or assumptions.

Framework



$$L_{GCE}(x,y;M) = \frac{1-p(M(x),y)^q}{q},$$

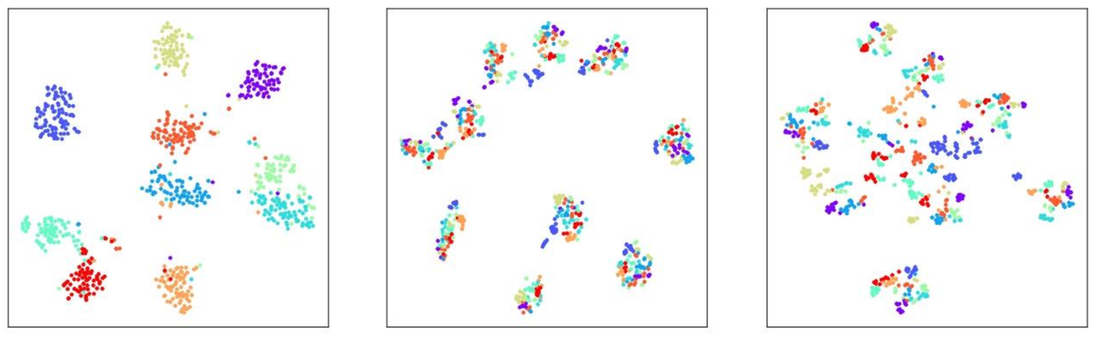
$$L_m = L_s(m_a,D_a) + L_s(m_b,D_b) + IoU(m_a,m_b).$$

$$L_s = GCE(x,y,M \circ m_a) + \lambda \sum_{m_a} |\theta_i|.$$

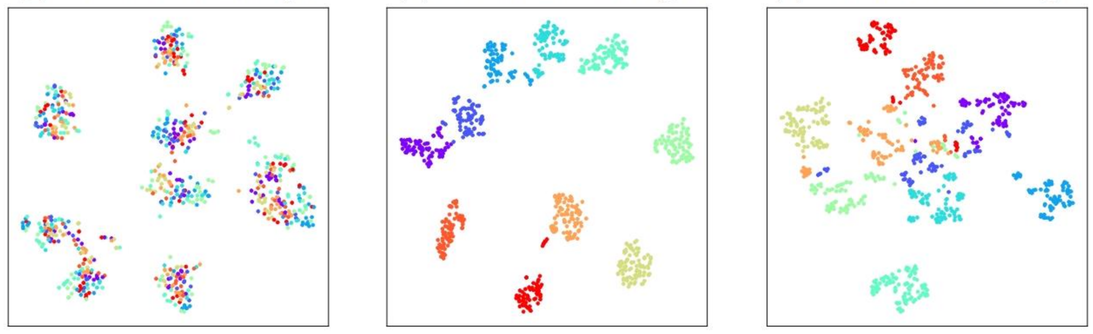
Experiments.

Dataset	Ratio (%)	Vanilla‡	EnD‡	ReBias‡	LFF‡	DFA‡	DCWP‡	Ours
		✓	×	×	✓	✓	✓	✓
CMNIST	0.5	62.36	84.32	69.12	83.73	86.74	93.41	**93.68**$_{\pm 0.47}$
	1.0	81.73	94.98	84.65	88.44	93.15	95.98	**96.15**$_{\pm 0.16}$
	2.0	89.33	97.01	91.96	92.67	95.15	97.16	**97.23**$_{\pm 0.16}$
	5.0	95.22	98.00	96.74	94.90	96.76	**98.02**	97.86$_{\pm 0.04}$
CIFAR10-C	0.5	22.02	23.93	21.73	27.02	27.86	35.90	**38.60**$_{\pm 0.39}$
	1.0	28.00	27.61	28.09	31.44	34.62	41.56	**45.53**$_{\pm 1.58}$
	2.0	34.63	36.62	35.57	38.49	41.95	49.01	**51.78**$_{\pm 0.61}$
	5.0	45.66	43.67	48.22	46.16	49.15	56.17	**59.04**$_{\pm 0.90}$
BFFHQ	0.5	52.25	59.80	54.90	56.50	55.50	60.35	**60.70**$_{\pm 1.30}$

The proposed method achieves better performs on most of the tested o.o.d. dataset. And the method can be used on other datasets.

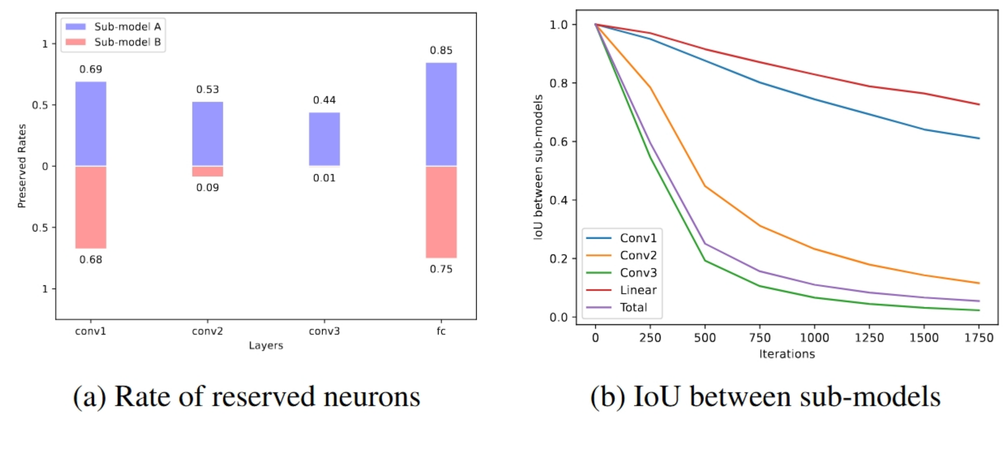


(a) sub-model A, target (b) sub-model B, target (c) vanilla model, target



(d) sub-model A, shortcut (e) sub-model B, shortcut (f) vanilla model, shortcut

t-SNE results show that different sub-models in out method can learn different features.



(a) Rate of reserved neurons (b) IoU between sub-models

The experiments show that sub-models share some features in low level layer. And the IOU between sub-models decreases.

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