GCAN:
Graph Convolutional Adversarial Network for **Unsupervised Domain Adaptation**

(X. Ma, T. Zhang, and C. Xu. In CVPR 2019)

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Quick Explanation on UDA & Prev. Work

Labeled source data D_S → Unlabeled target data D_T

Covariate shift!

One way to solve it is to do these things (MSTN, ICML'18):

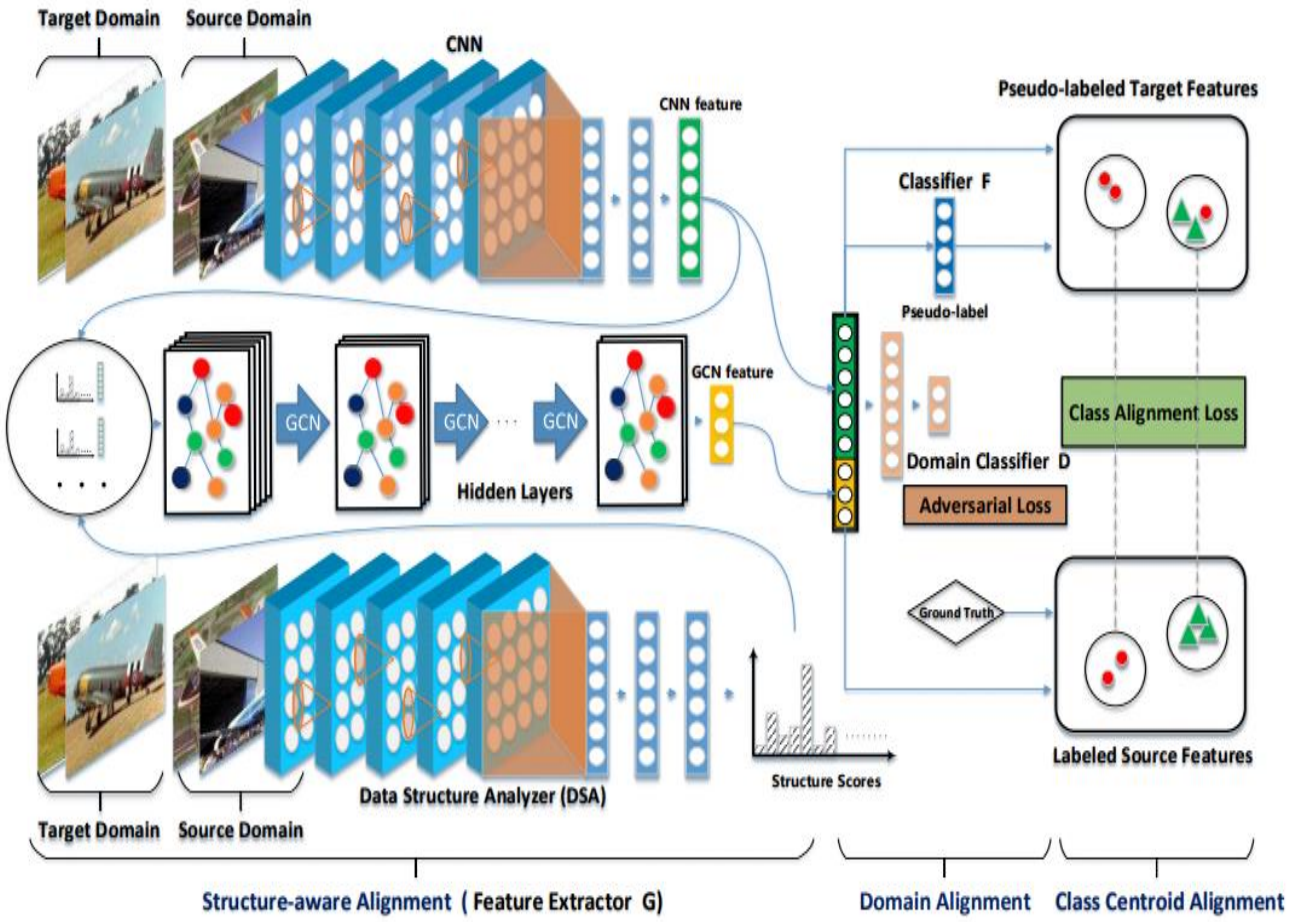
1. Make features domain invariant (**discriminator**)
2. Align cluster centroids (for **each class**, **btw source & target**)

However, it has a problem:

the structure among features (instances) are ignored → **noisy decision boundary**

So, the authors adopted **GCN** to put **instance relation** into the scene

GCAN Architecture & Loss Functions



1. $\mathcal{L}_C = \mathbb{E}_{(x,y)\sim D_S}[cross\_entropy(F(G(x)), y)]$
2. $\mathcal{L}_{DA} = \mathbb{E}_{x\in D_S}[\log(1 - D(G(x))] + \mathbb{E}_{x\in D_T}[\log(D(G(x))]$
3. $\mathcal{L}_{CA} = \sum_{k=1}^{K} \phi(C_S^k, C_T^k)$
4. $\mathcal{L}_{SA} = \max(\left\| X_{C_a} - X_{C_p} \right\|^2 - \left\| X_{C_a} - X_{C_n} \right\|^2 + m, 0)$

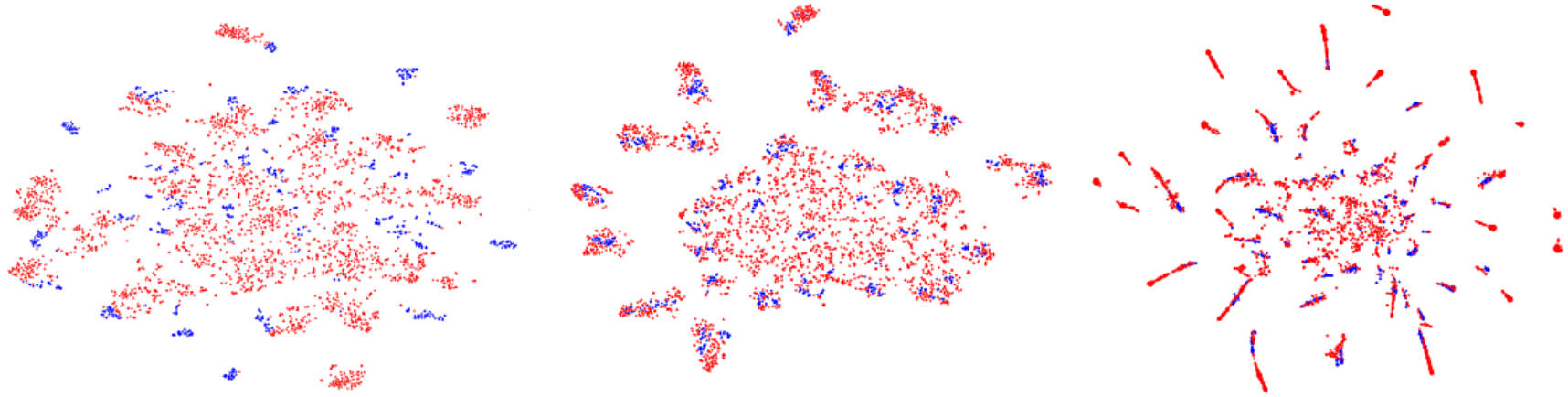
Linear combination to get the total loss

$$\mathcal{L}_{total} = \mathcal{L}_C + \lambda\mathcal{L}_{DA} + \gamma\mathcal{L}_{CA} + \eta\mathcal{L}_{SA}$$

Experimental Results

Table 1. Classification accuracy (%) on the Office-31 dataset.

Method	$A \rightarrow W$	$D \rightarrow W$	$W \rightarrow D$	$A \rightarrow D$	$D \rightarrow A$	$W \rightarrow A$	Avg
AlexNet	61.6±0.5	95.4±0.3	99.0±0.2	63.8±0.5	51.1±0.6	49.8±0.4	70.1
DDC [74]	61.8±0.4	95.0±0.5	98.5±0.4	64.4±0.3	52.1±0.6	52.2±0.4	70.6
DRCN [27]	68.7±0.3	96.4±0.3	99.0±0.2	66.8±0.5	56.0±0.5	54.9±0.5	73.6
RevGrad [22]	73.0±0.5	96.4±0.3	99.2±0.3	72.3±0.3	53.4±0.4	51.2±0.5	74.3
RTN [52]	73.3±0.3	96.8±0.2	99.6±0.1	71.0±0.2	50.5±0.3	51.0±0.1	73.7
JAN [53]	74.9±0.3	96.6±0.2	99.5±0.2	71.8±0.2	58.3±0.3	55.0±0.4	76.0
AutoDIAL [50]	75.5	96.6	99.5	73.6	58.1	59.4	77.1
MSTN [77]	80.5±0.4	96.9±0.1	**99.9±0.1**	74.5±0.4	62.5±0.4	60.0±0.6	79.1
GCAN	**82.7±0.1**	**97.1±0.1**	99.8±0.1	**76.4±0.5**	**64.9±0.1**	**62.6±0.3**	**80.6**



(d) AlexNet: $W \rightarrow A$ (e) RevGrad: $W \rightarrow A$ (f) GCAN: $W \rightarrow A$

Thank you!