Neural Collaborative Subspace Clustering

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Subspace Clustering

- Cluster data points drawn from a union of low-dimensional subspaces

- Applications: image clustering, motion segmentation, etc.

Subspace Clustering Methods

- STOA methods consist of two steps:

    1. Construct an affinity matrix for the whole dataset,

    2. Apply normalized cuts or spectral clustering.

Scalability Issue!!

- Affinity matrix construction is expensive:
  - Large memory footprint;
  - High complexity in optimization.

- Spectral clustering is expensive:
  - Computing SVD on large matrices is demanding.

Can we avoid the construction of huge affinity matrices and bypass the spectral clustering?

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Our Idea

- Construct affinity matrix in a batch;
- Train a classifier using affinity matrices.

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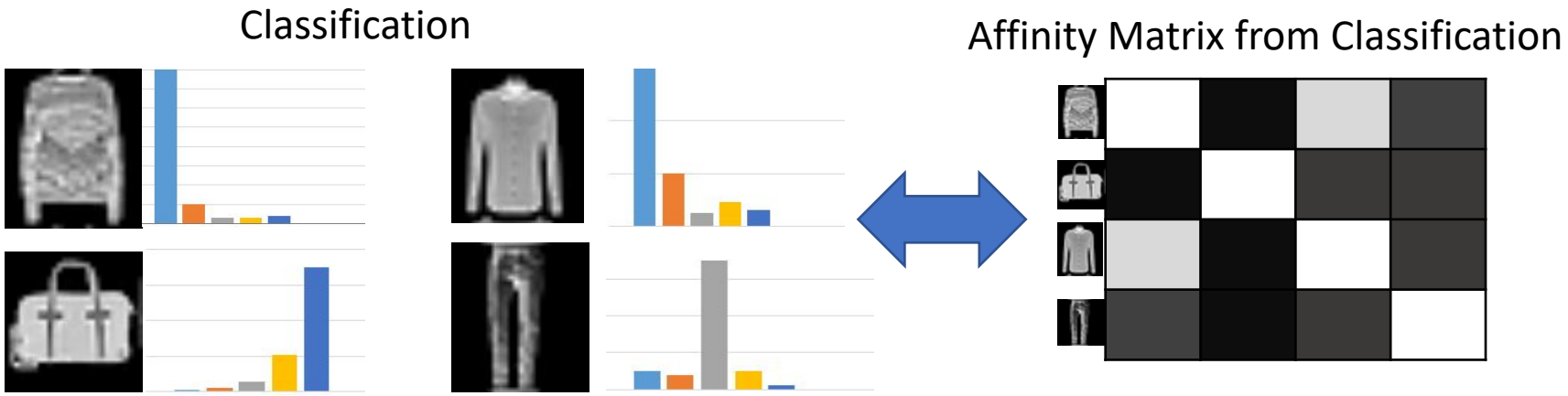
- **How?**

Affinity from Classification

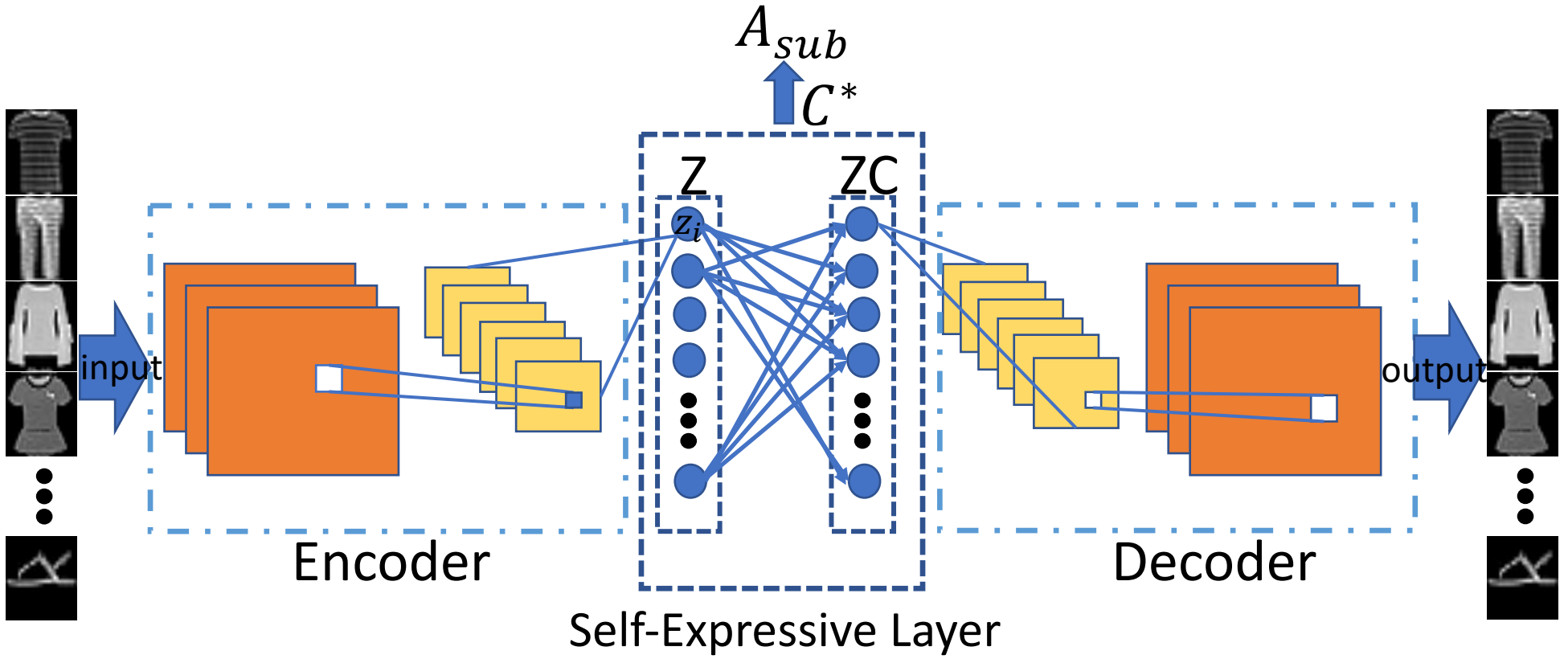
- Build connection between clustering and classification via affinity matrices



$$A_{cla}(i,j) = f_i f_j^T$$

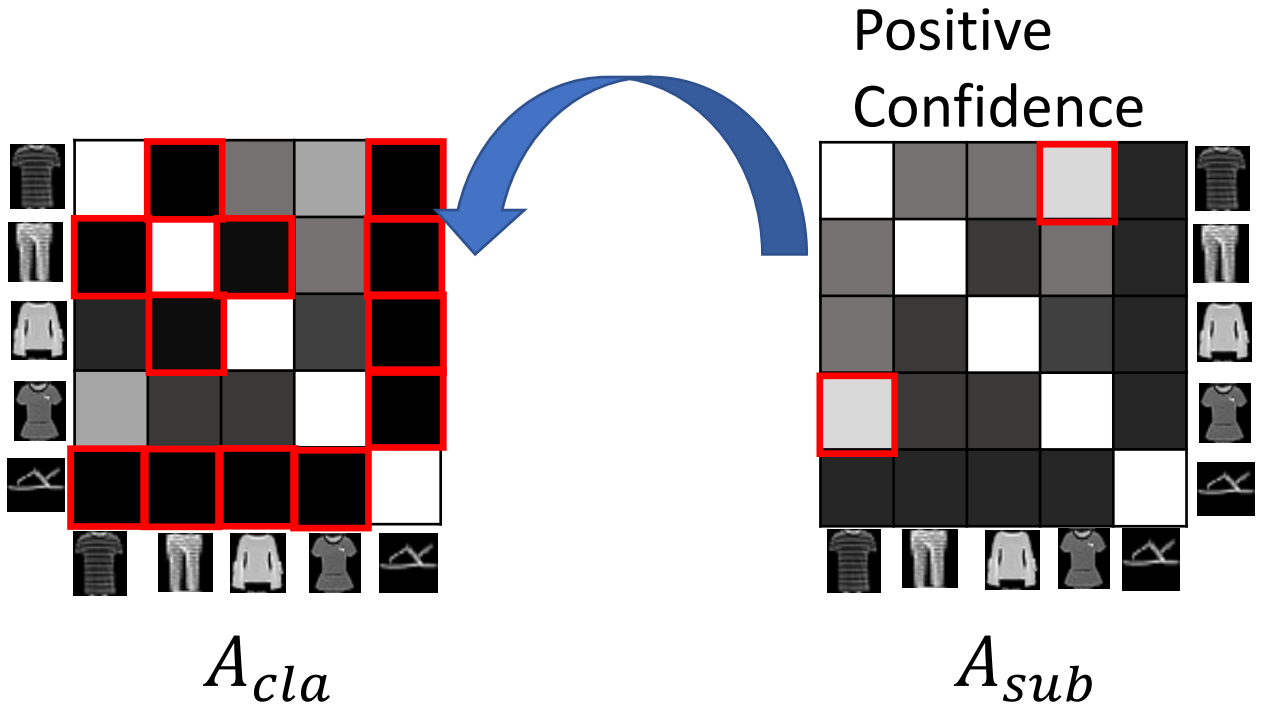
Affinity from Subspace

- Subspace affinity A_{sub} from self-expressiveness



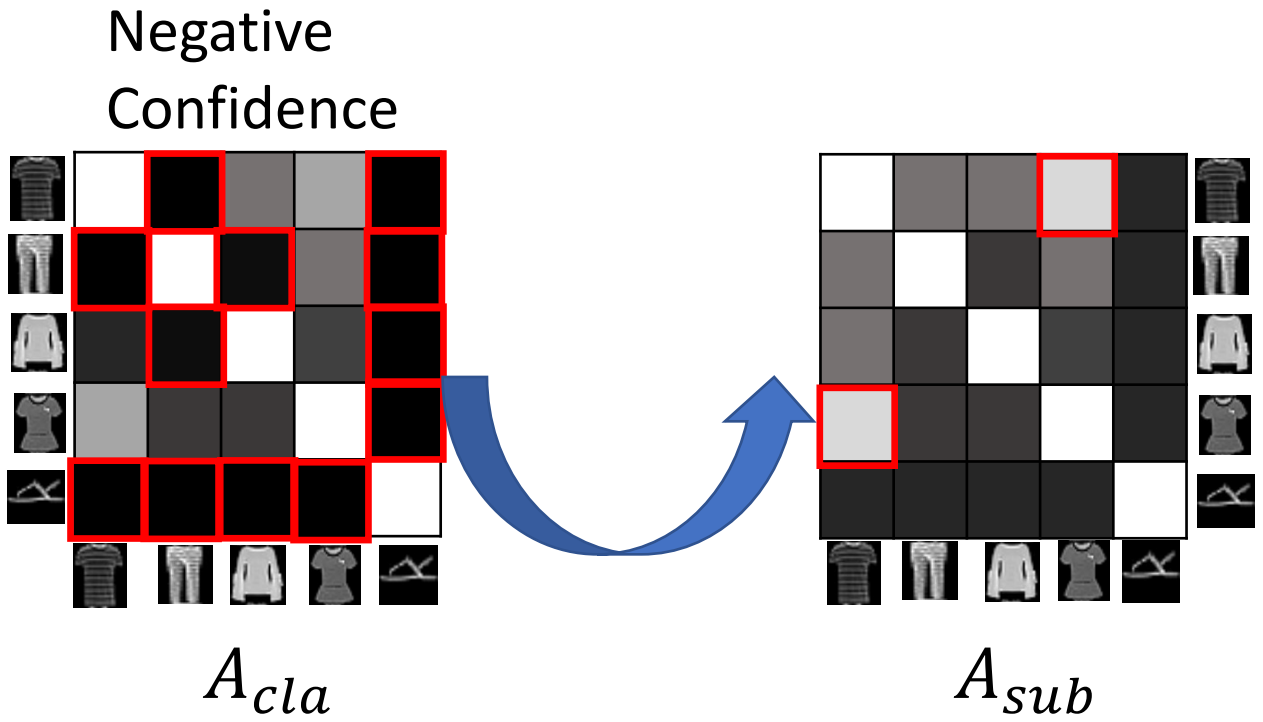
Collaborative Learning

- Subspace affinity is more confident of identifying samples from the same class.

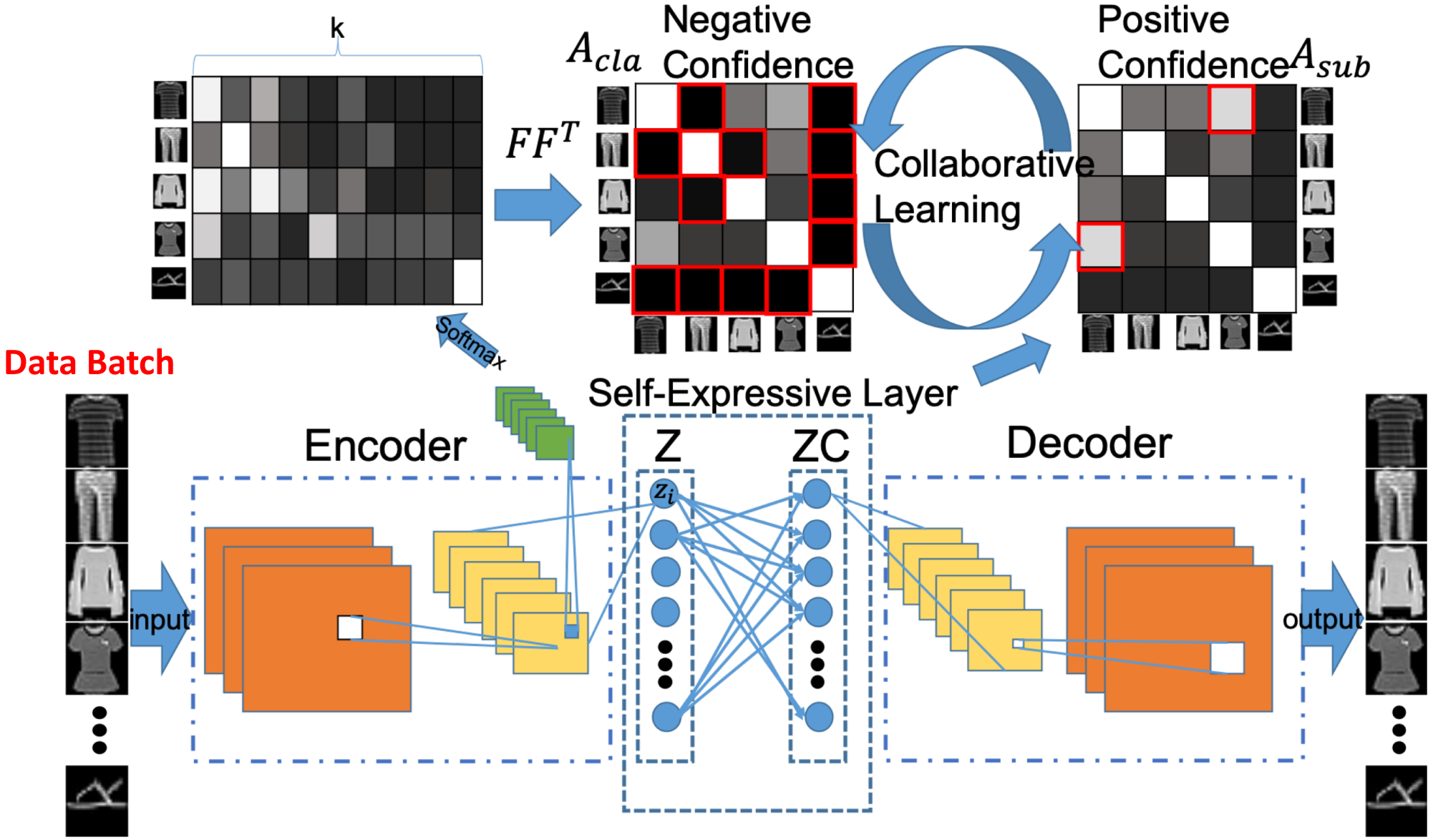


Collaborative Learning (cont'd)

- Classification affinity is more confident of identifying samples from different classes.



Our Framework: Collaborative Learning



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Clustering via Classifier

- Output the clustering simply through the classification part (bypass the spectral clustering):

$$s_i = argmax_h(f_{ih}), h = 1, \cdots, k,$$

where k is number of clusters.

Experiments:

- MNIST

	ACC(%)	NMI(%)	ARI(%)
SAE-KM	81.29	73.78	67
CAE-KM	51	44.87	33.52
K-means	53	50	37
PCA-KS	68.53	64.17	54.17
DEC	84.3	80	75
DCN	83.31	80.86	74.87
kSCN	87.14	78.15	
Ours	**94.09**	**86.12**	**87.52**

- Fashion-MNIST

	ACC(%)	NMI(%)	ARI(%)
SAE-KM	54.35	58.53	41.86
CAE-KM	39.84	39.80	25.93
K-means	47.58	51.24	34.86
PCA-KS	53.41	57.5	41.17
DEC	59	60.1	44.6
DCN	58.67	59.4	43.04
kSCN	63.78	62.04	48.04
ClusterGAN	63.0	64.0	50.0
InfoGAN	61.0	59.0	44.0
DAC	61.5	63.2	50.2
Ours	**72.14**	**68.60**	**59.17**

Conclusion

- Subspace is a powerful tool to represent data in high-dimensional space.
- Introduced a *collaborative learning* paradigm for clustering.
- Made subspace clustering scalable through batch-wise training.

Thank You

Poster time: Room Pacific Ballroom
06:30-09:00 pm, June 13th

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