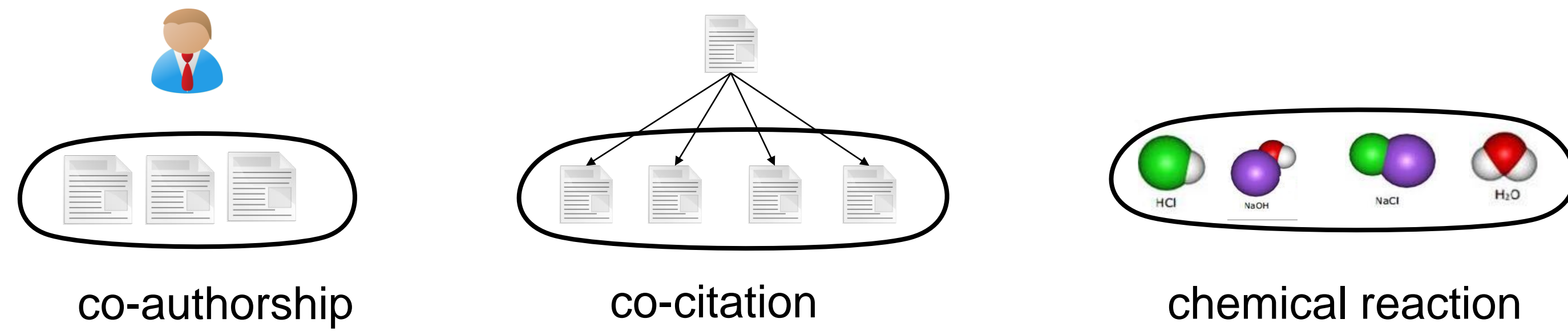


Motivation

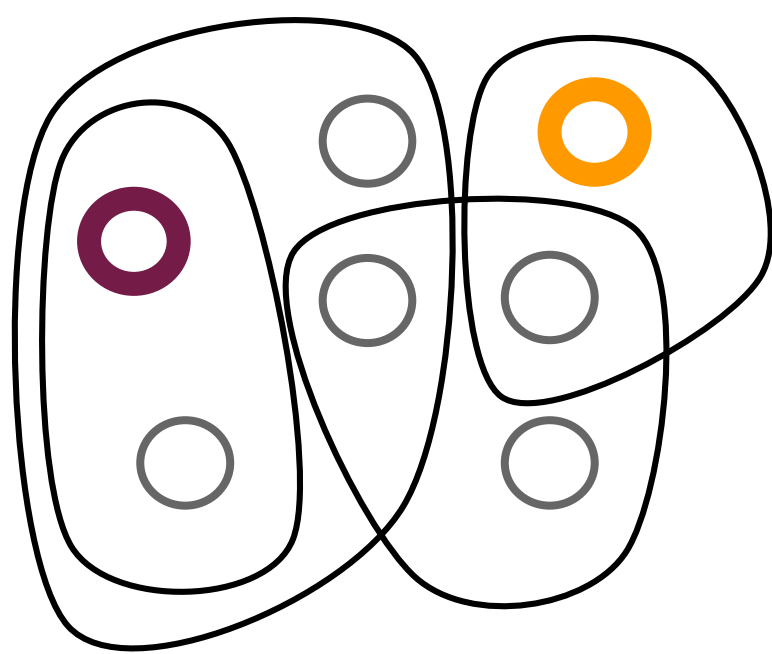
Networks have complex relationships



Modelled flexibly by hypergraphs

Hypergraph Semi-Supervised Learning

Label vertices in U given labelled vertices in $V - U$



$$\mathcal{H} = (V, E)$$

Challenges

- Arbitrary size $E \subseteq 2^V$
- Low supervision $|V - U| \ll |U|$
- Noisy edges $|y_v : v \in e| > 1, e \in E$

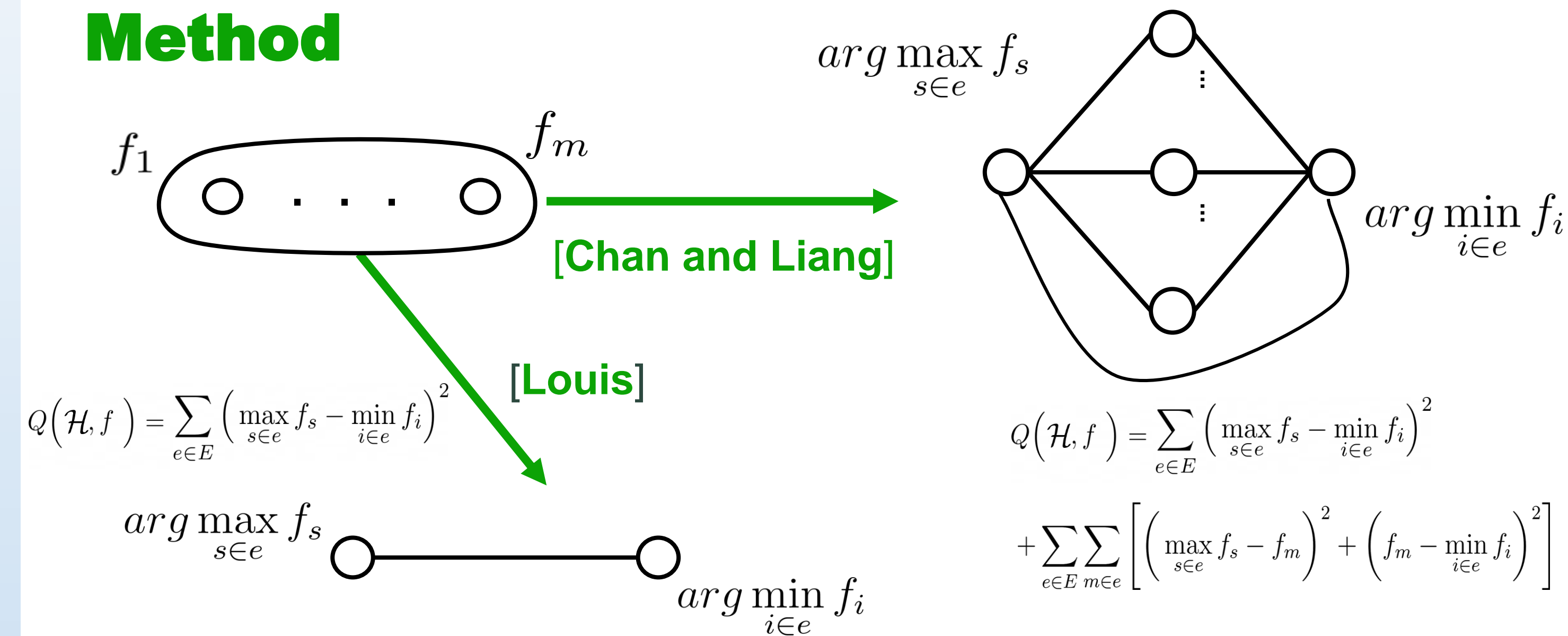
- Explicit regularisation [Zhou et al., Hein et al.]

$$\mathcal{L} = \mathcal{L}_S + \lambda \cdot Q(\mathcal{H}, f) \quad \text{✗ hyperedges encode similarity}$$

- Implicit regularisation [Feng et al.]

$$f_{\text{Neural}}(\mathcal{H}, X) = ? \quad \mathcal{L} = \mathcal{L}_S \quad \text{✓ need not encode similarity}$$

Method



GCN [Kipf and Welling]

$$H^{\{l\}} = \sigma \left(A \cdot H^{\{l-1\}} \cdot W^{\{l\}} \right)$$

HyperGCN

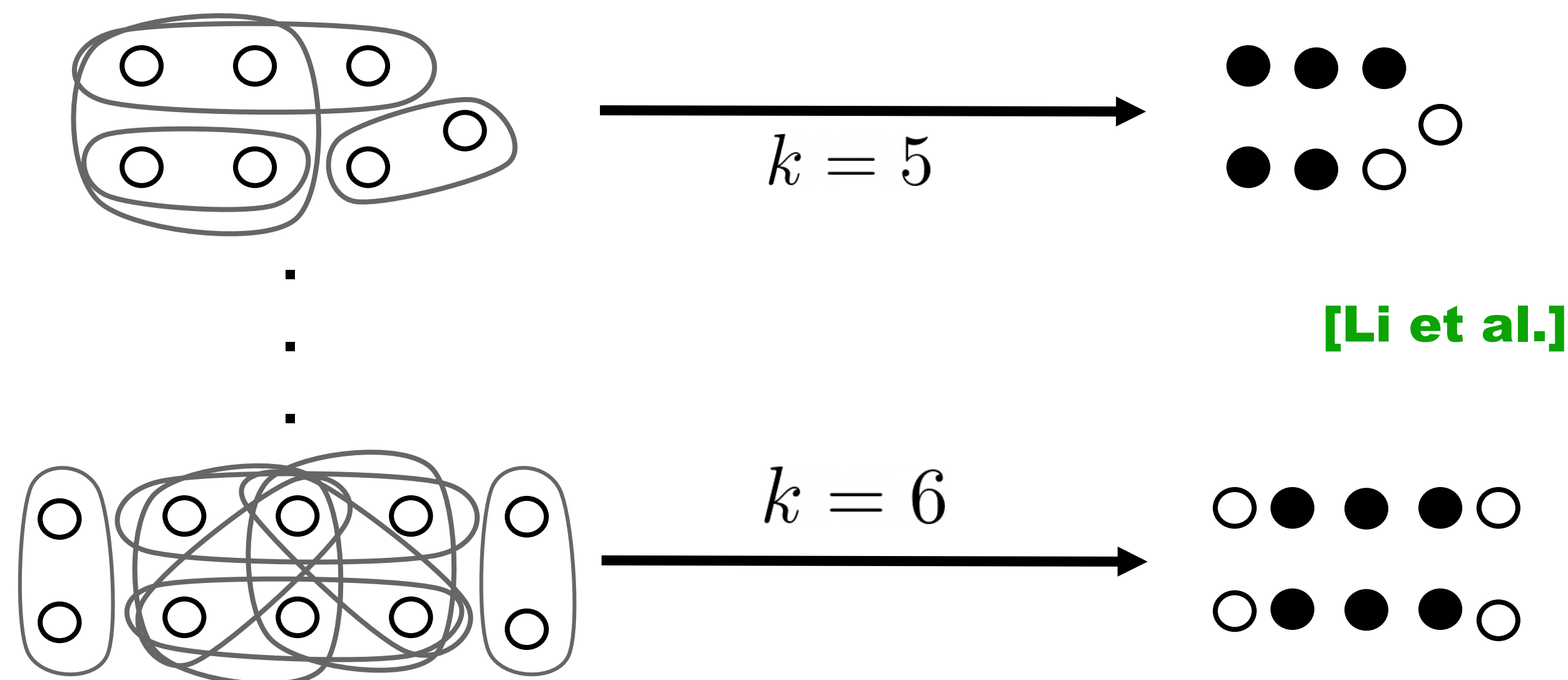
$$f = H^{\{l-1\}} \cdot W^{\{l\}}$$

FastHyperGCN

$$f = H^{\{0\}} = X$$

Densest k-Subhypergraph

$$W \subseteq V, |W| = k, \text{ maximise } |e \in E : e \subseteq W|$$



Results

Simple, strong baseline: HGNN



test error (lower is better)

Avg. size	8.5 ± 8.8	4.3 ± 5.7
Dataset	DBLP	Pubmed
HGNN	45.27 ± 2.48	29.41 ± 1.5
HyperGCN	41.64 ± 2.6	25.56 ± 1.6
FastHyperGCN	41.79 ± 2.8	29.48 ± 1.6

comparable on small hyperedges

Avg. size	3.0 ± 1.1	3.2 ± 2.0
Dataset	Cora	Citeseer
HGNN	32.41 ± 1.8	37.40 ± 1.6
HyperGCN	32.37 ± 1.7	37.35 ± 1.6
FastHyperGCN	32.42 ± 1.8	37.42 ± 1.7

training time (lower is better)

Dataset	DBLP	Pubmed
HGNN	0.115s	0.019s
FastHyperGCN	0.035s	0.016s

more accurate, faster on large noisy hyperedges

density for $k = 0.75 \cdot |V|$ (higher is better) and training time (lower is better)

Dataset	DBLP	Pubmed	Cora	Citeseer
HGNN	6274	7865	437	969
HyperGCN	7720	7928	504	971
FastHyperGCN	7342	7893	452	969

Type	Training Time	Density
HGNN	170s	337
FastHyperGCN	143s	352

What NeurIPS Reviewers Liked

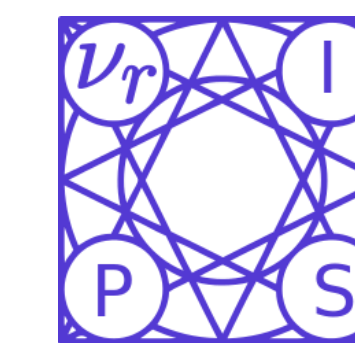
- Linking two different fields
- Quadratic to Linear Approx.
- Extensive experiments



Going Forward

- Unsupervised learning
- Label correlation
- Hypergraph pooling

Acknowledgement



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