Learning to Distinguish Samples for Generalized Category Discovery

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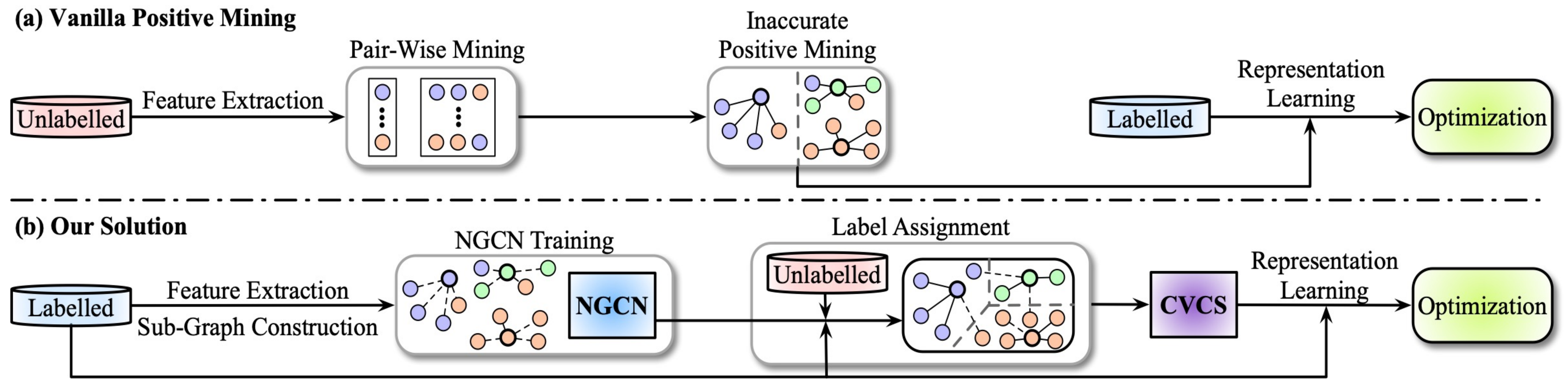
Problem Formulation

Definition: Using partially labelled data to optimize model and recognize known / unknown categories [a].

Approach: Assigning pseudo-labels for representation learning.

Contributions



■ Background

(1) Concurrent methods [a,b] predict pseudo-labels based on pairwise similarities, while the overall relationships within each instance's neighbors are largely overlooked.

(2) Moreover, the inaccurate pseudo labels may hinder the further improvement of GCD accuracies.

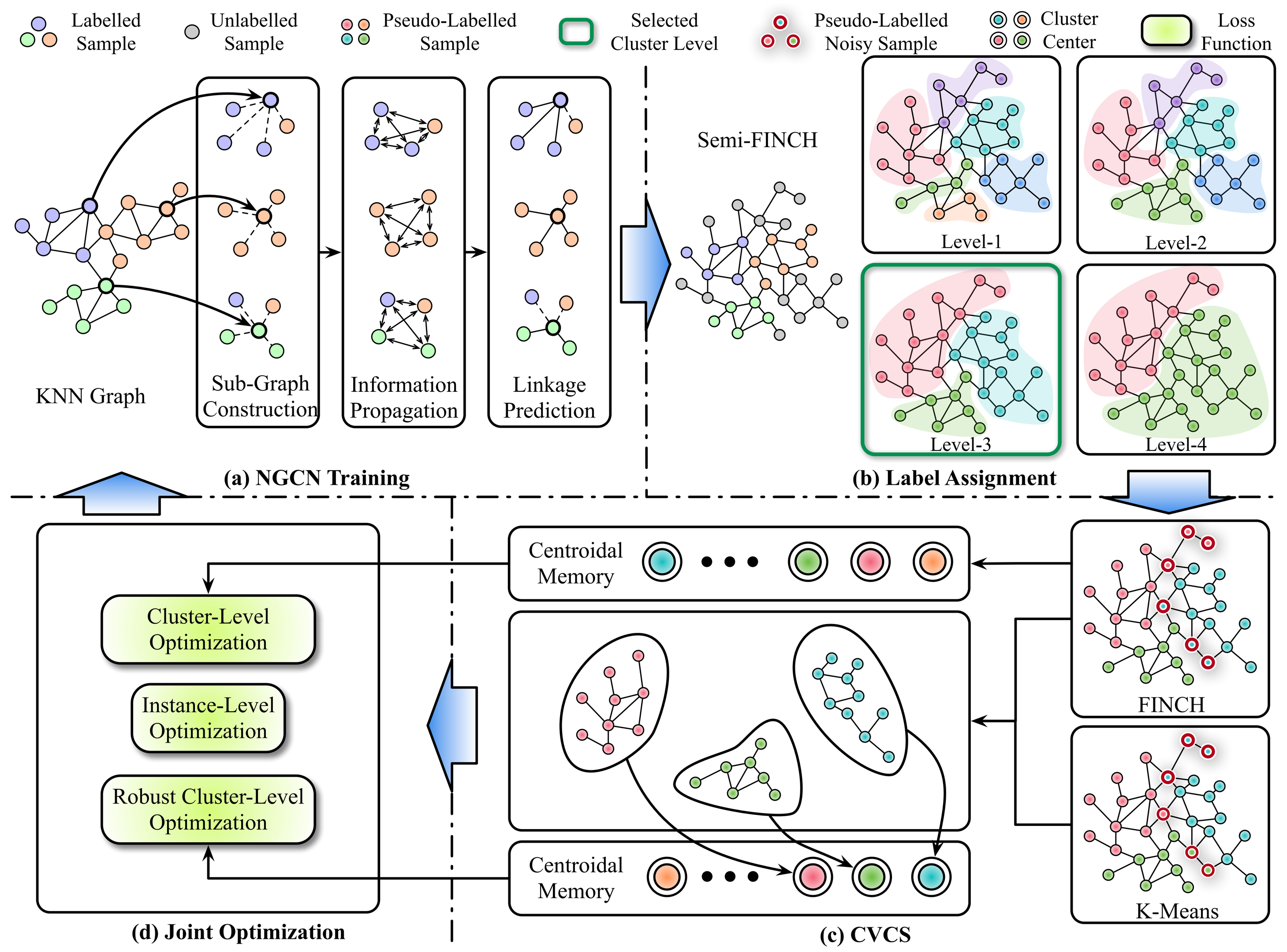
■ Contributions

(1) We construct sub-graphs based on each labelled instance's k-nearest neighbors and optimize Neighbor Graph Convolutional Network (NGCN) to extract neighbor-wise relations for pseudo labelling. NGCN is then used to predict pseudo labels of unlabelled data.

(2) We propose Cross-View Consistency Strategy (CVCS) to locate and exclude noisy labels from training, which is achieved by comparing clusters from two different clustering algorithms.

(3) NGCN and CVCS are plug-and-play modules, which can be easily incorporated into other GCD methods for better accuracies.

Framework



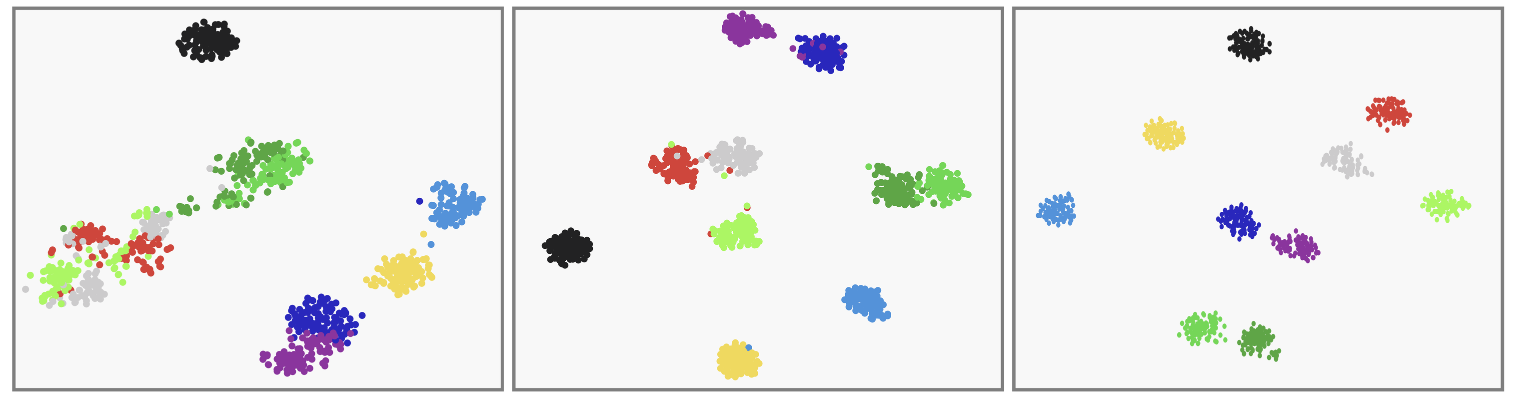
Step 1: Optimizing NGCN with kNN of labelled data.

Step 2: Adopting NGCN to predict linkage of unlabelled data for clustering.

Step 3: Using CVCS and another clustering method to exclude noisy labels.

Step 4: Optimizing GCD model to recognize known / unknown categories.

Visualization



(a) DINO (b) GCD (c) Ours

Conclusion: Features learned with our method is more discriminative and shows clear inter-class boundary than others.

Contact Us

If you have any problem, please send an email to us **(yangfx@stu.xmu.edu.cn)** or ask in Github.

Scan QR code for code and other resources.

Experiments

Methods	CF10			CF100			IN100		
	All	Old	New	All	Old	New	All	Old	New
UNO+ [10]	68.6	**98.3**	53.8	69.5	80.6	47.2	70.3	95.0	57.9
RankStats+ [13]	46.8	19.2	60.5	58.2	77.6	19.3	37.1	61.6	24.8
GCD [35]	91.5	97.9	88.2	73.0	76.2	66.5	74.1	89.8	66.3
XCon [9]	96.0	97.3	95.4	74.2	81.2	60.3	77.6	93.5	69.7
DCCL [28]	96.3	96.5	**96.9**	**75.3**	**76.8**	**70.2**	**80.5**	90.5	**76.2**
This Work	**96.5**	97.6	94.4	74.6	76.5	69.4	78.1	**91.3**	70.5
Methods	**Pets**			**CUB**			**SCars**		
	All	Old	New	All	Old	New	All	Old	New
UNO+ [10]	-	-	-	35.1	49.0	28.1	35.5	**70.5**	18.6
RankStats+ [13]	-	-	-	33.3	51.6	24.2	28.3	61.8	12.1
GCD [35]	80.2	85.1	77.6	51.3	56.6	48.7	39.0	57.6	29.9
XCon [9]	86.7	91.5	84.1	52.1	54.3	51.0	40.5	58.8	31.7
DCCL [28]	**88.1**	88.2	88.0	**63.5**	60.8	**64.9**	43.1	55.7	36.2
This Work	87.2	**91.2**	**89.6**	61.3	**60.8**	62.1	**44.3**	58.2	**39.1**

Tab. 1 Results under "k-unknown" Scenario

Methods	CF100			IN100		
	All	Old	New	All	Old	New
SimGCD [37]	80.1	81.2	77.8	83.0	93.1	77.9
PromptCAL [41]	81.2	84.2	75.3	83.1	92.7	78.3
Ours + PromptCAL	**82.5**	**86.6**	**78.2**	**83.8**	**93.2**	**79.0**
Methods	**CUB**			**SCars**		
	All	Old	New	All	Old	New
SimGCD [37]	60.3	65.6	57.7	53.8	**71.9**	45.0
PromptCAL [41]	62.9	64.4	62.1	50.2	70.1	40.6
Ours + PromptCAL	**63.8**	**68.4**	**63.7**	**54.7**	69.6	**45.5**

Tab. 2 Results under "k-known" Scenario

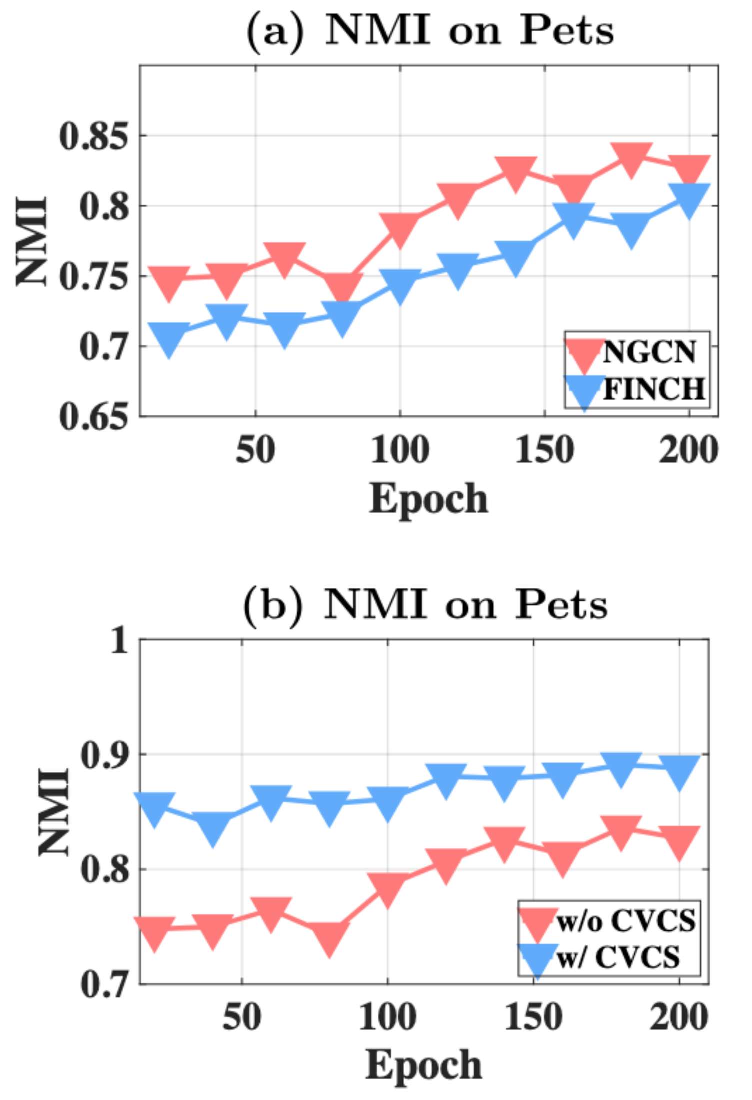


Fig. 1 Quantitative results for (a) NGCN prediction accuracy (b) NMI for clusters before and after using CVCS

Method	Attributes		CUB-200			Pets		
	NGCN	CVCS	All	Old	New	All	Old	New
Baseline (L_{ins})	×	×	51.3	56.6	48.7	80.2	85.1	77.6
NGCN (L_{ins} and L_{ccl})	✓	×	58.3	56.4	59.2	83.3	82.3	83.8
CVCS (L_{ins} and L_{rcl})	×	✓	53.5	57.2	52.8	82.6	80.2	83.7
Ours (L_{ins}, L_{ccl}, and L_{rcl})	✓	✓	**61.3**	**60.8**	**62.1**	**87.2**	**91.2**	**86.8**

Tab. 3 Ablation Study

Conclusions:

- Our method achieves competitive results and can be further incorporated into SoTA methods for better accuracies under both "k-konwn" and "k-unknown" scenario.
- Ablation study show the efficacy of each component. Moreover, visualization of NMI show the efficacy of NGCN and CVCS in terms of clustering.

References

[a] Vaze et al. Generalized Category Discovery. CVPR'22.

[b] Pu et al. Dynamic Conceptional Contrastive Learning for Generalized Category Discovery. CVPR'23.