FAITH: Few-Shot Graph Classification with Hierarchical Task Graphs

Song Wang[1] , **Yushun Dong**[1] , **Xiao Huang**[2] , **Chen Chen**[1] , **Jundong Li**[1]

[1]University of Virginia
[2]Hong Kong Polytechnic University

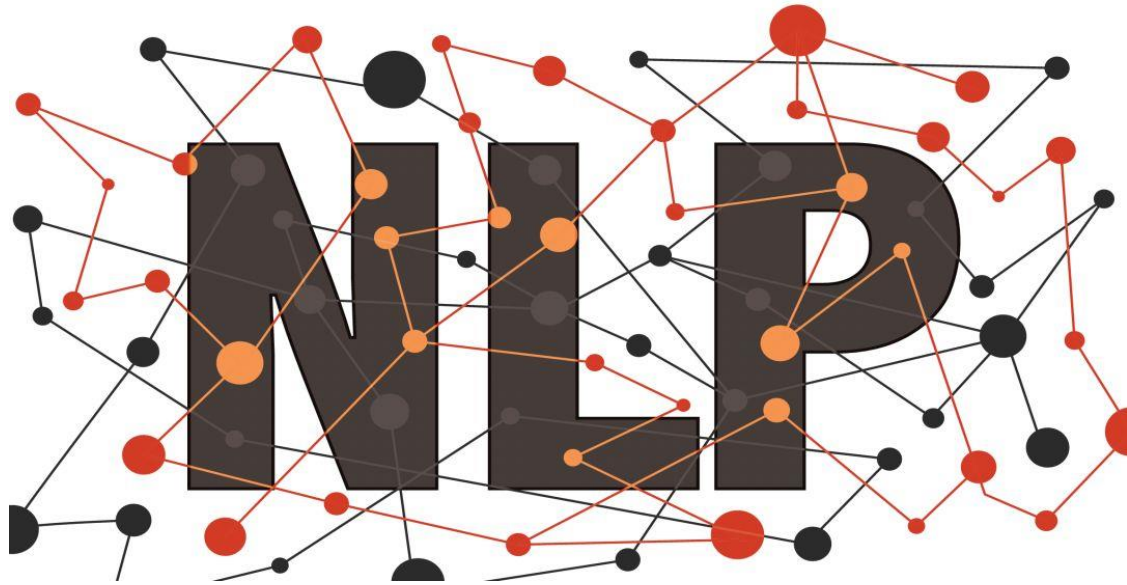{sw3wv, yd6eb, zrh6du, jundong}@virginia.edu, xiaohuang@comp.polyu.edu.hk,

Code:https://github.com/SongW-SW/FAITH

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NATURAL LANGUAGE PROCESSING

1.Introduction

2.Method

3.Experiments

Introduction

existing few-shot graph classification methods treat different meta-training tasks independently without considering task correlations.

For example, the target task of the toxicity property prediction with the meta-training task of the chemical activity prediction has stronger task correlations.

Method
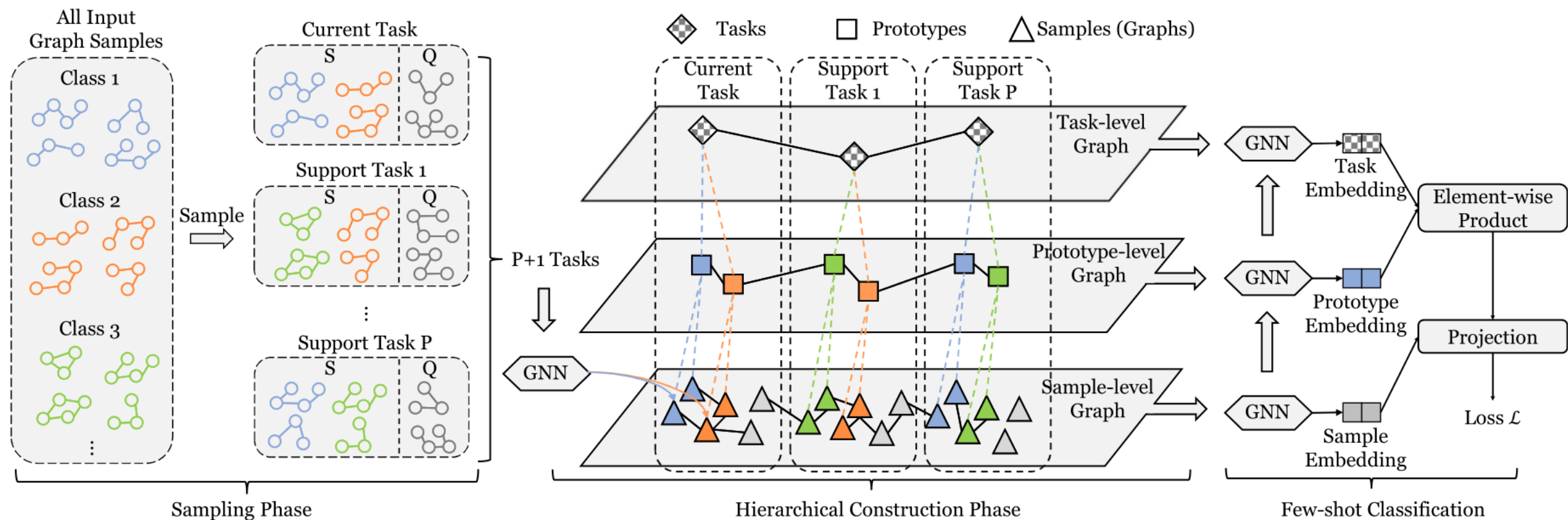
Method
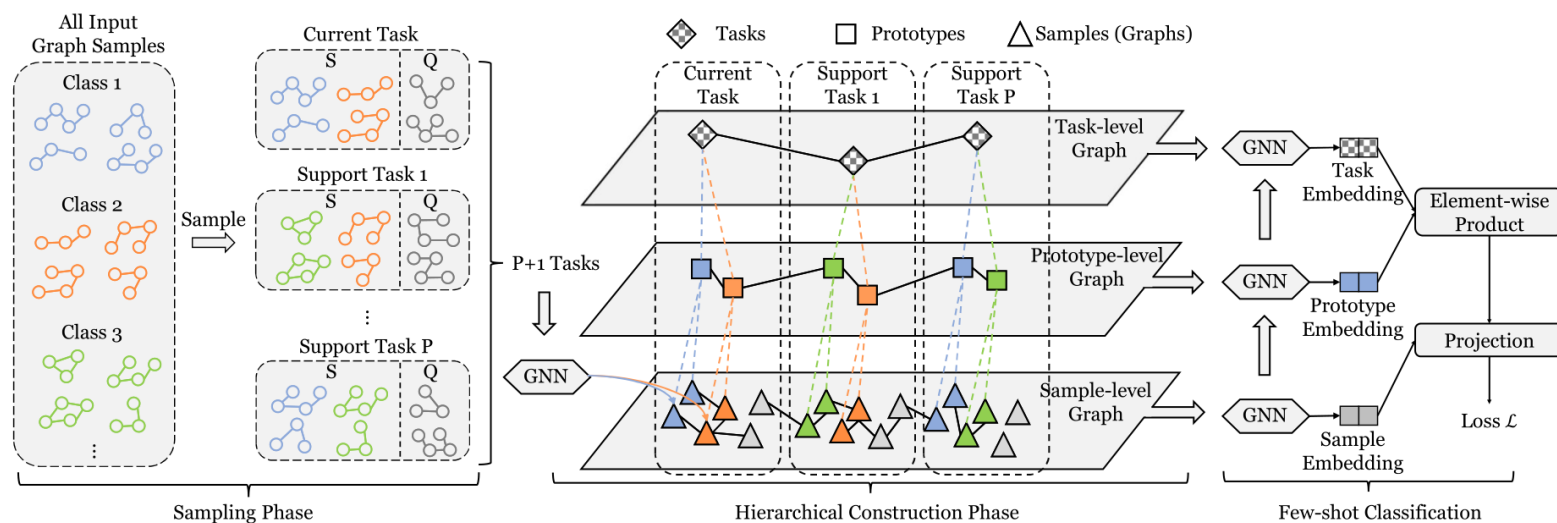
Loss-based Sampling for Support Tasks

$$\mathbf{p}_i = \mathrm{softmax}(\mathrm{MLP}(\frac{1}{K}\sum_{j=1}^{K}\mathbf{z}_i^j)), \qquad (1)$$

$$\mathcal{L}_{sample} = -\frac{1}{N}\sum_{i=1}^{N}\sum_{j=1}^{C}y_{i,j}\log p_{i,j}, \qquad (2)$$

Constructing Hierarchical Task Graphs

$$\mathbf{A}_s = \mathbf{A}'_s + \mathbf{A}''_s,$$

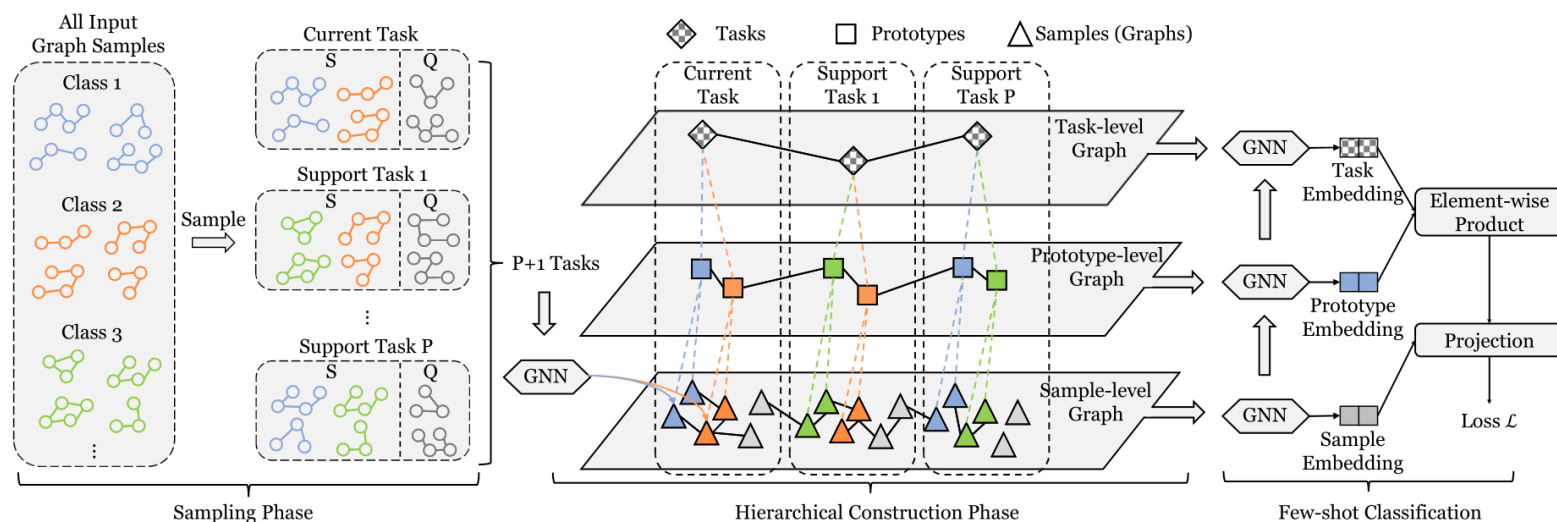$$\mathbf{A}'_s(i,j) = \cos(\mathbf{Z}_s(i), \mathbf{Z}_s(j))$$

$$\mathbf{A}''_s(i,j) = \begin{cases} 1, & \text{if } y_i = y_j \\ 0, & \text{otherwise} \end{cases}, \qquad (3)$$

$$\mathbf{H}_s = \mathrm{GNN}_h^{(s)}(\mathbf{Z}_s, \mathbf{A}_s), \qquad (4)$$

$$\mathbf{G}_s = \mathrm{GNN}_g^{(s)}(\mathbf{Z}_s, \mathbf{A}_s), \qquad (5)$$

$$\mathbf{Z}_p(i) = \mathrm{softmax}((\mathbf{G}_s^i)^\top \mathbf{H}_s^i), \qquad (6)$$

Method

Task-specific Few-shot Classification

$$z_{i,j}^k = (\mathbf{s}_i^k)^\top \mathbf{W}(\mathbf{p}_j^k \circ \mathbf{t}^k), \qquad (7)$$

$$\bar{z}_{i,j}^k = \exp(z_{i,j}^k)/(\textstyle\sum_{j=1}^N \exp(z_{i,j}^k)) $$

$$\mathcal{L}_{class} = -\frac{1}{(P+1)Q} \sum_{k=1}^{(P+1)} \sum_{i=1}^{Q} \sum_{j=1}^{N} y_{i,j}^k \log \bar{z}_{i,j}^k, \qquad (8)$$

$$\mathcal{L} = \mathcal{L}_{class} + \alpha \mathcal{L}_{sample}, \qquad (9)$$

Experiment

Table 1: Results of all methods with different few-shot settings on four benchmark datasets. The best results are shown in bold.

Methods	Letter-high		ENZYMES		TRIANGLES		Reddit-12K	
	5-shot	10-shot	5-shot	10-shot	5-shot	10-shot	5-shot	10-shot
WL	65.27 ± 7.67	68.39 ± 4.69	55.78 ± 4.72	58.37 ± 3.84	51.25 ± 4.02	53.26 ± 2.95	40.26 ± 5.17	42.57 ± 3.69
Graphlet	33.76 ± 6.94	37.59 ± 4.60	53.17 ± 5.92	55.30 ± 3.78	40.17 ± 3.18	43.76 ± 3.09	33.76 ± 6.94	37.59 ± 4.60
PN	68.48 ± 3.28	72.60 ± 3.01	53.72 ± 4.37	55.79 ± 3.95	69.56 ± 3.97	73.12 ± 3.64	42.31 ± 2.32	43.23 ± 2.01
Relation	51.14 ± 4.21	52.54 ± 4.04	41.39 ± 4.73	43.27 ± 3.49	46.09 ± 3.10	49.15 ± 3.49	34.89 ± 3.76	37.76 ± 3.09
GSM	69.91 ± 5.90	73.28 ± 3.64	55.42 ± 5.74	60.64 ± 3.84	71.40 ± 4.34	75.60 ± 3.67	41.59 ± 4.12	45.67 ± 3.68
AS-MAML	69.44 ± 0.75	75.93 ± 0.53	49.83 ± 1.12	52.30 ± 1.43	78.42 ± 0.67	80.39 ± 0.56	36.96 ± 0.74	41.47 ± 0.83
FAITH	$\mathbf{71.55 \pm 3.58}$	$\mathbf{76.65 \pm 3.26}$	$\mathbf{57.89 \pm 4.65}$	$\mathbf{62.16 \pm 4.11}$	$\mathbf{79.59 \pm 4.05}$	$\mathbf{80.79 \pm 3.53}$	$\mathbf{42.71 \pm 4.18}$	$\mathbf{46.63 \pm 4.01}$

Experiment

Table 2: Detailed statistics of used datasets.

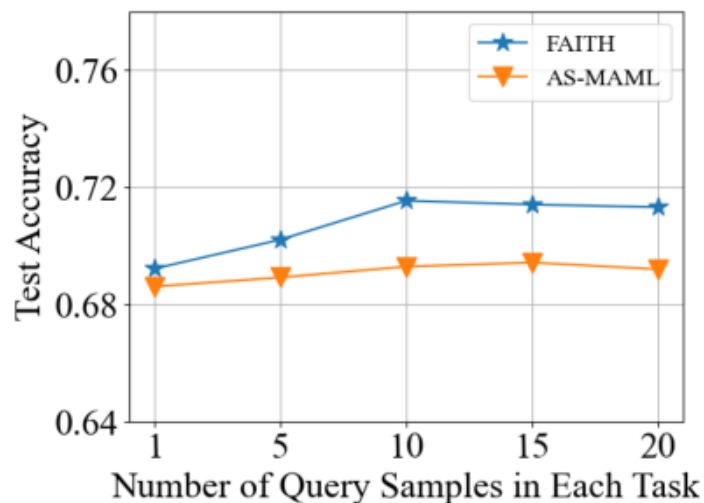| Dataset	$|\mathcal{Y}_f|/|\mathcal{Y}_t|$	# Graphs	# Nodes	# Edges
Letter-high	4/11	2,250	4.67	4.50
ENZYMES	2/4	600	32.63	62.14
TRIANGLES	3/7	2,000	20.85	35.50
Reddit-12K	4/7	1,111	391.41	456.89

Experiment
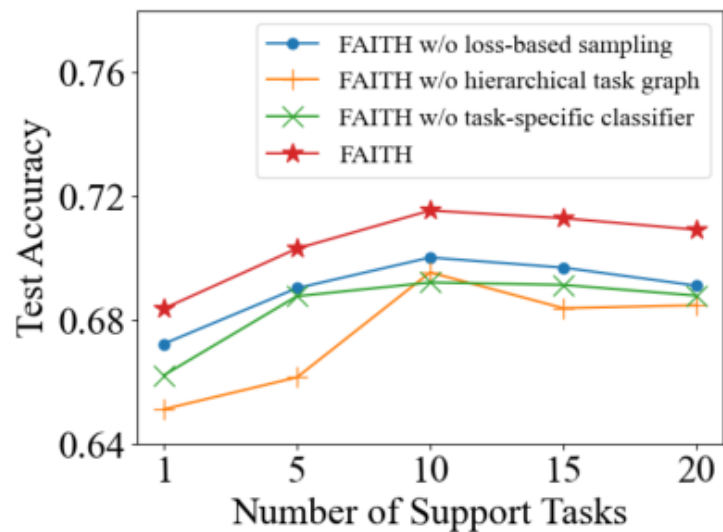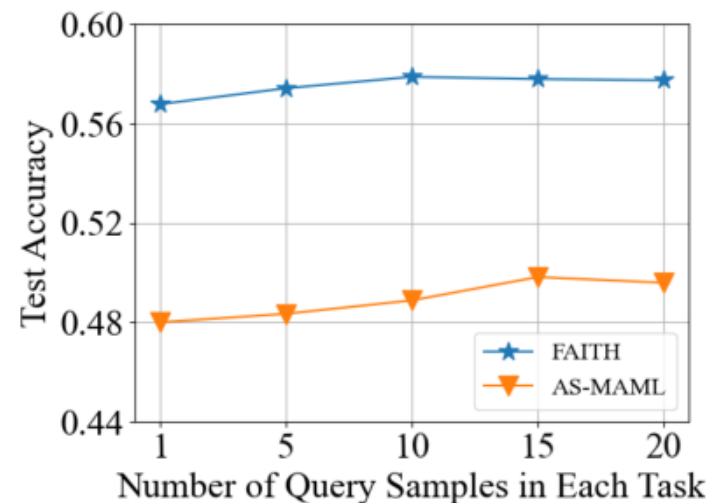

(a) Results on Letter-high
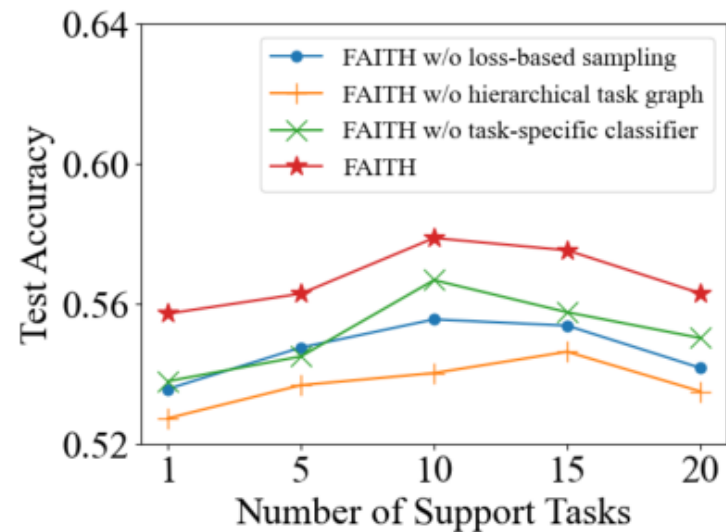
(b) Results on ENZYMES

Figure 2: Ablation study on Letter-high and ENZYMES.

Experiment

(a) Results on Letter-high

(b) Results on ENZYMES

Figure 3: Accuracy with respect to the number of query samples of FAITH and AS-MAML on two datasets.

Thank you!