Dynamically Managing a Prompt Pool via Self-Enhancement in Continual Learning

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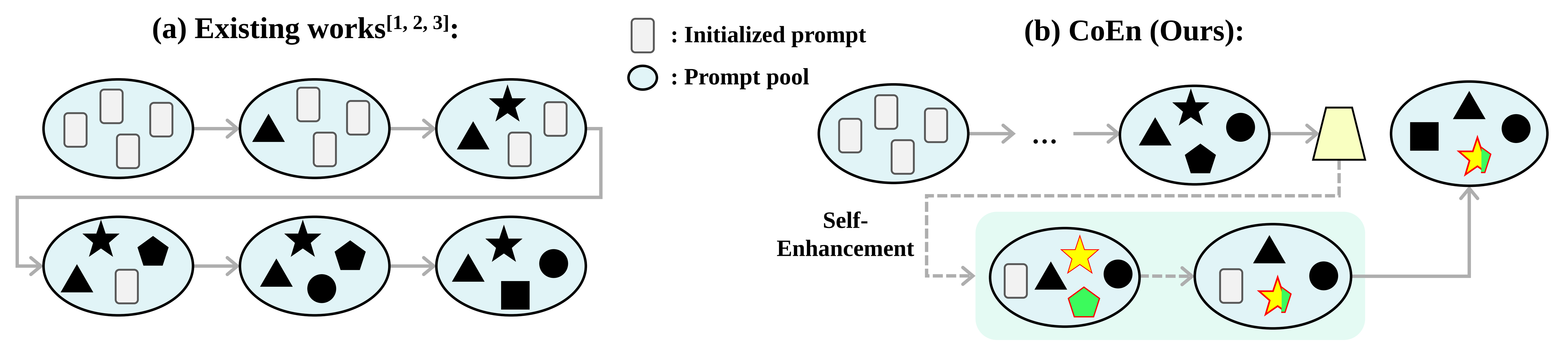
Introduction & Motivation



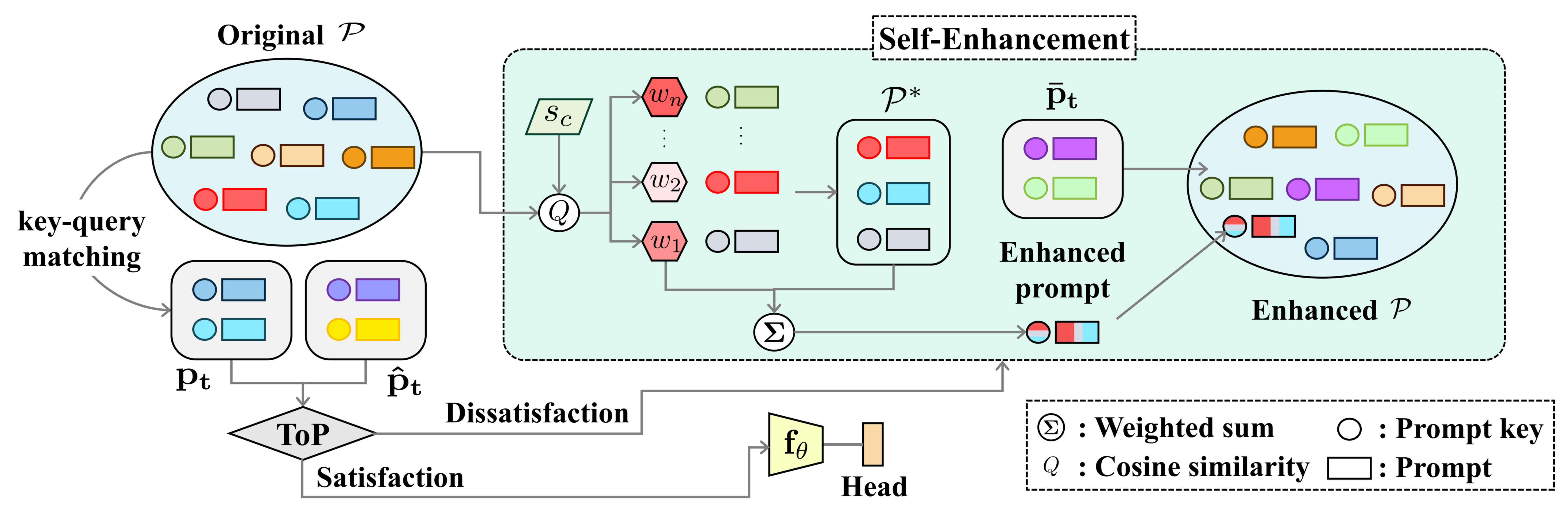
Existing prompt-based continual learning (a)

- Select similar prompt via key-query matching; uncertainty in positive knowledge transfer.

Dynamic prompt pool management of CoEn (b)

- Self-Enhancement mechanism; better new knowledge integration and enhanced knowledge retention.

CoEn: Continual Enhanced prompt pool



Transferability of the prompt pool (ToP)

$$\text{ToP}^{(t)}[p_t] = \begin{cases} 1, & \text{if } \underset{(x^t,y^t)}{\mathbb{E}}[\mathcal{L}(f_\theta(x^t,p_t),y^t)] > \underset{(x^t,y^t)}{\mathbb{E}}[\mathcal{L}(f_\theta(x^t,\hat{p}_t),y^t)], \\ 0, & \text{otherwise}, \end{cases}$$

- Assess positive knowledge transfer via statistical risk; enhance prompt pool if ToP fails.

Enhanced prompt

$$w_i = \frac{1}{C}\sum_{c=1}^{C} sim(k_i, s_c), i \in \{0, \ldots, N\},$$

$$k_{enh} = \sum_{i=1}^{h} \frac{w_{\rho(i)} k_{\rho(i)}}{\sum_{i=1}^{h} w_{\rho(i)}}, \quad p_{enh} = \sum_{i=1}^{h} \frac{w_{\rho(i)} p_{\rho(i)}}{\sum_{i=1}^{h} w_{\rho(i)}}.$$

- Low-relevance k and p are aggregated to enhanced one.

Experimental Results

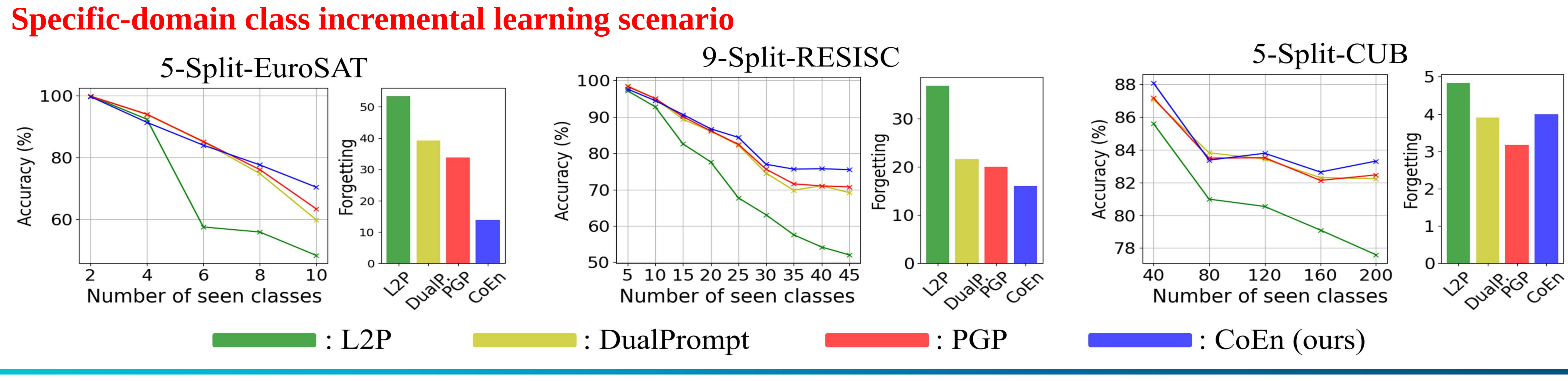
General-domain class incremental learning scenario

Method	10-Split-CIFAR100		20-Split-CIFAR100		10-Split-ImageNet-R		20-Split-ImageNet-R	
	Acc	F	Acc	F	Acc	F	Acc	F
L2P[1]	83.5	6.9	81.6	9.4	65.1	5.1	57.0	9.5
Dual.P[2]	86.1	5.8	83.5	7.8	69.2	4.7	65.7	7.1
PGP[3]	86.7	5.5	83.5	8.1	69.1	5.8	65.9	7.1
CoEn	86.8	4.9	84.3	6.4	69.6	5.6	64.9	8.0

Results

- CoEn: 3.8% accuracy boost.
- Superior to existing methods.
- Enhanced knowledge transfer.
- Dynamic prompt management.

Specific-domain class incremental learning scenario



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