Revisiting Pool-based Prompt Learning for Few-shot Class-incremental Learning

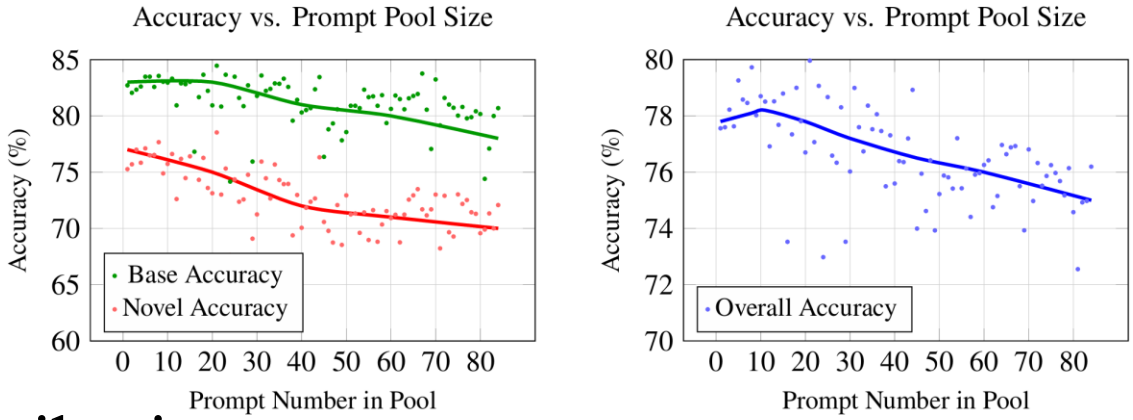
Yongwei Jiang, Yixiong Zou*, Yuhua Li, Ruixuan Li
School of Computer Science and Technology, Huazhong University of Science and Technology
{jiangyongwei, yixiongz, idcliyuhua, rxli}@hust.edu.cn

Few-shot Class-incremental Learning (FSCIL)

- Setting
  - Base session: abundant samples
  - Novel sessions: *N*-way *K*-shot
  - Minimal samples and incrementally adaptation
- Task
  - Classification incrementally on all encountered classes
- Difficulty
  - Overfitting
  - Catastrophic forgetting

Phenomenon

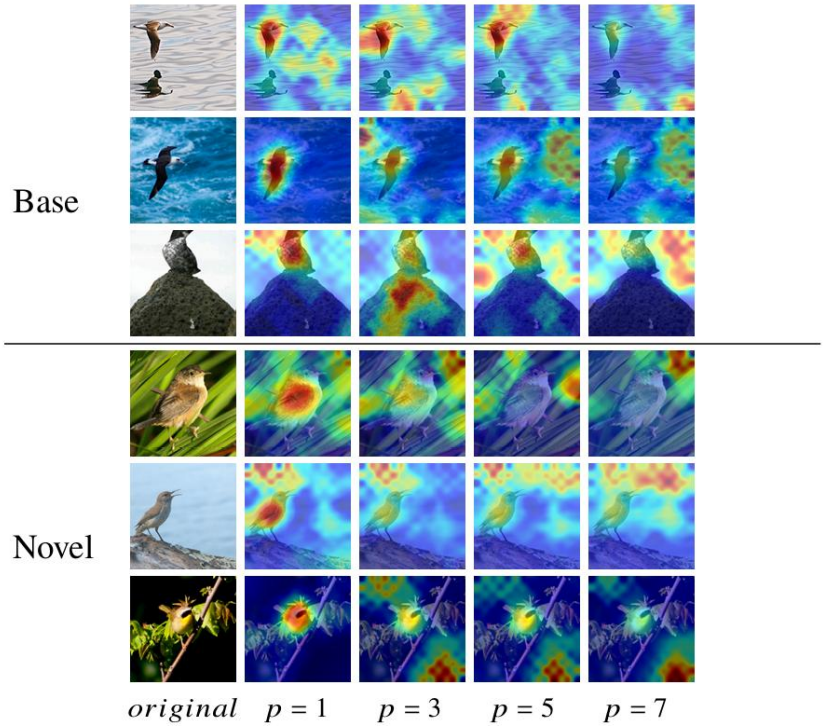
- Base session accuracy improves with the increase of prompt number, while novel session decreases



- Contribution
  - Study pool-based prompt learning methods for FSCIL
  - Reveal the token-dimension saturation in pool-based learning
  - Propose a method that leverages spatial information while avoiding token dimension saturation

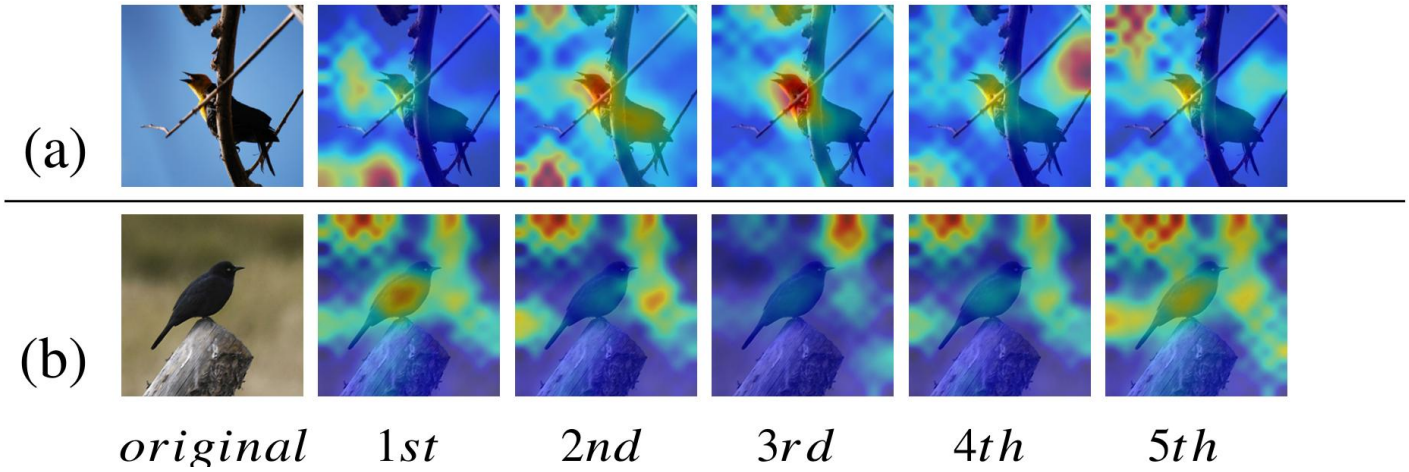
Interpretion

- Global Attention of the CLS token
  - Information that prompt pool contains is limited by the training data size



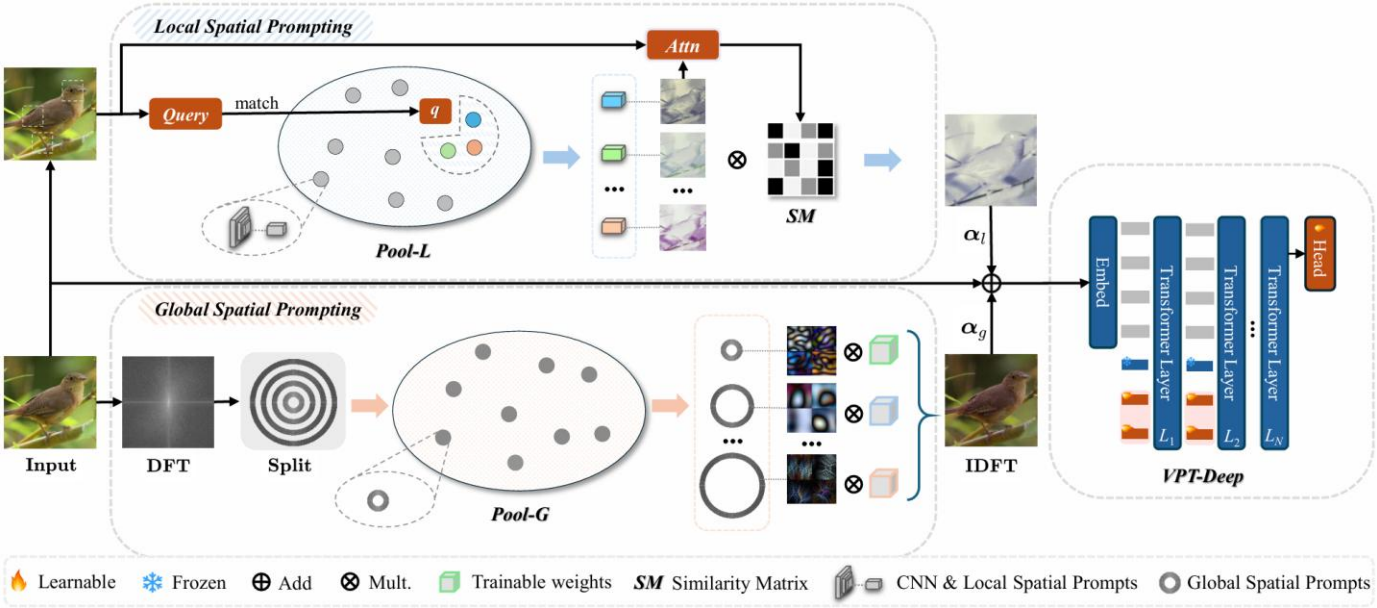
Interpretion

- Individual Attention of Each Prompt in the Pool
  - Each prompt in the pool competes with each other to encode the task-relevant information



- Limited Training Samples Lead to Token Dimension Conflict and Saturation

Method



- Local Spatial Prompting
  - Capture fine-grained spatial features while preventing catastrophic forgetting
- Global Spatial Prompting
  - Enable holistic pattern learning while avoiding token-dimension saturation

Experiments

State-of-the-art performance

Method	Venue	S0	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	Avg. ↑
Fine-Tuning + Proto	N/A	84.21	66.43	25.00	25.44	16.19	4.58	1.42	1.49	3.62	5.50	3.79	21.60
iCaRL [30]	CVPR'17	82.43	79.32	68.74	59.93	61.62	59.91	57.83	57.34	55.42	52.73	55.92	63.83
RDI [51]	IJCAI'24	80.13	76.55	73.21	69.37	67.83	65.74	64.91	63.37	61.43	61.41	60.20	67.65
CEC [46]	CVPR'21	81.82	79.53	78.42	75.54	76.31	74.83	74.41	74.62	74.23	73.91	73.84	76.13
FOSTER [37]	ECCV'22	85.02	83.43	77.41	71.52	69.93	66.34	65.52	63.07	62.92	62.03	60.42	69.78
FACT [49]	CVPR'22	84.32	81.23	79.14	75.13	75.42	73.31	72.43	72.52	71.41	71.12	70.91	75.18
CLOM [53]	NIPS'22	83.28	81.85	79.61	77.79	76.34	74.64	73.62	72.82	71.24	71.33	70.50	75.73
NC-FSCIL [45]	ICLR'23	83.52	80.92	80.14	77.83	77.81	76.96	76.72	74.78	74.18	73.92	73.80	77.32
WaRP [15]	ICLR'23	82.74	80.21	79.06	77.80	77.78	76.81	76.82	74.61	74.13	74.02	73.36	77.03
TEEN [39]	NIPS'23	84.03	81.52	80.91	78.34	78.32	77.24	77.13	75.42	75.51	75.13	75.61	78.11
Comp-FSCIL [57]	ICML'24	83.67	81.73	79.03	78.04	77.73	75.52	74.32	74.55	73.35	73.15	72.80	76.72
Yourself [33]	ECCV'24	82.31	80.65	79.85	76.96	77.08	74.85	74.99	75.40	74.29	74.69	74.38	76.86
PriViLege [26]	CVPR'24	82.21	81.25	80.45	77.76	77.78	75.95	75.69	76.00	75.19	75.19	75.08	77.50
L2P† [43]	CVPR'22	82.47	81.23	79.01	76.89	76.21	74.73	74.19	74.11	72.73	73.02	73.67	76.21
DualPrompt† [42]	ECCV'22	83.51	82.27	80.93	79.57	78.63	77.09	76.31	77.03	75.79	76.17	76.53	78.53
CODA-Prompt† [32]	CVPR'23	79.61	78.12	76.42	75.68	75.02	73.19	72.58	72.81	72.07	72.49	72.97	74.63
LGSP-Prompt	Ours	**85.72**	**84.31**	**83.21**	**81.33**	**81.80**	**80.33**	**79.89**	**80.09**	**79.18**	**79.74**	**79.72**	**81.39**

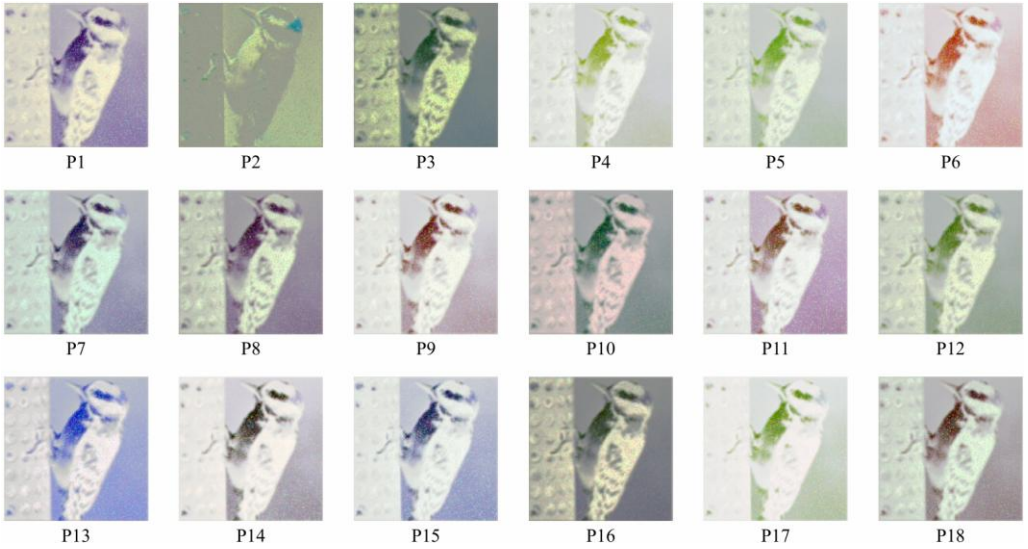
Experiments

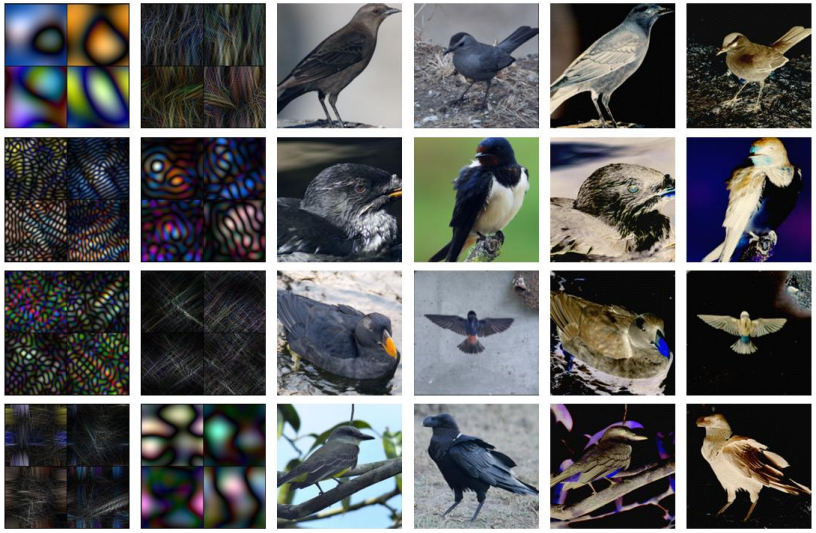
Ablation Study

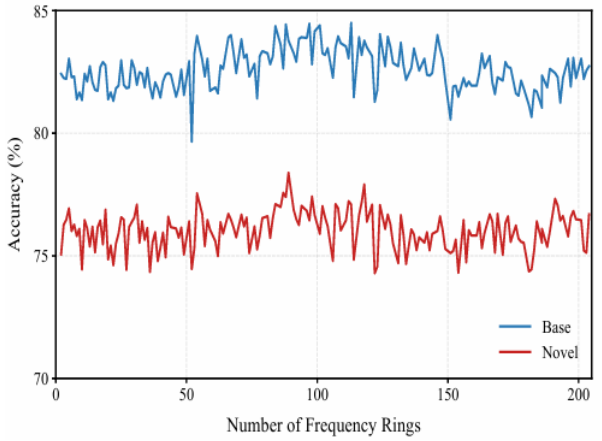
Methods	CUB200			FGVC			iNF200		
	O	B	N	O	B	N	O	B	N
Vanilla ViT	61.66	68.26	61.00	15.93	16.93	15.84	30.51	35.40	30.02
VPT	79.26	83.49	78.84	20.41	24.91	19.96	51.48	60.60	50.68
VPT+LSP*	79.49	84.01	79.30	20.85	25.62	20.35	52.94	62.15	51.89
VPT+LSP	80.16	84.64	79.71	21.58	28.27	20.92	56.87	67.40	55.82
VPT+GSP	79.89	83.59	79.52	22.18	27.43	21.66	56.51	65.60	55.60
Ours	**81.39**	**85.72**	**80.96**	**25.82**	**27.67**	**25.64**	**57.62**	**67.00**	**56.68**

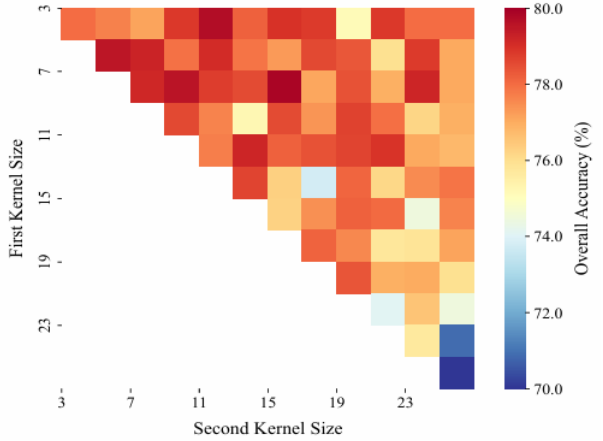
Experiments

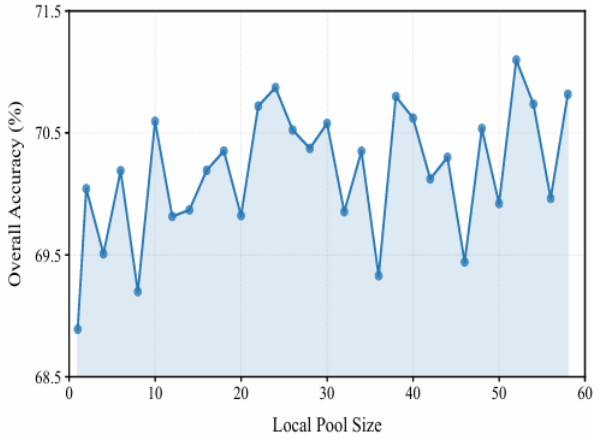
- Verification and Visualization Results





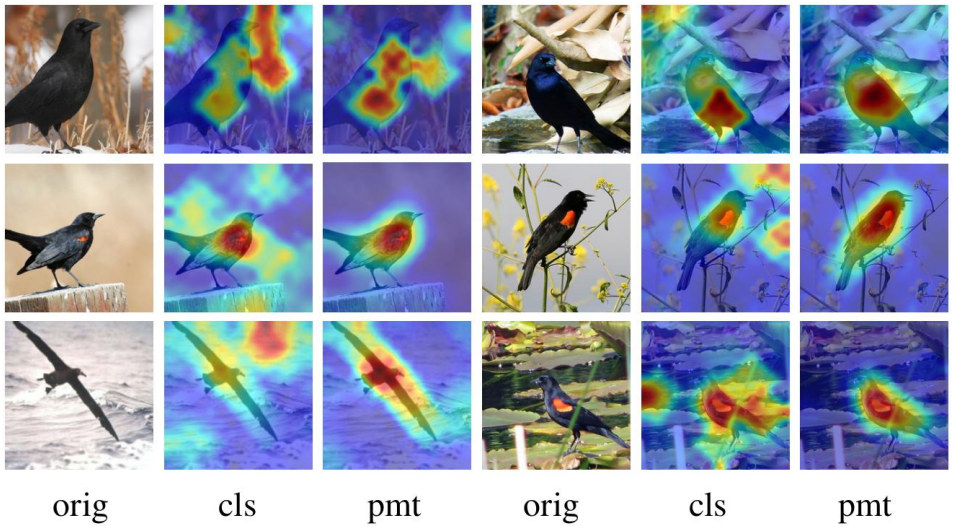


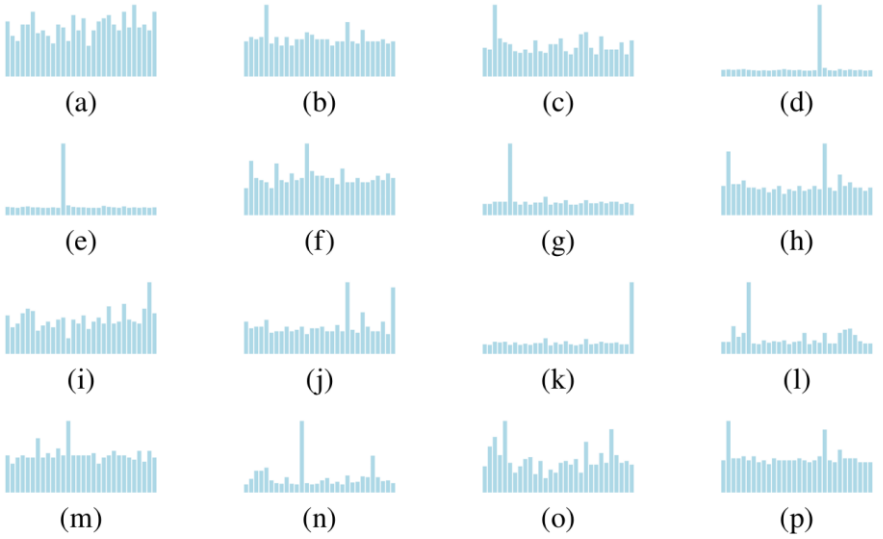




Experiments

- Verification and Visualization Results





Thanks!