Memory Replay with Unlabeled Data for Semi-Supervised Class-Incremental Learning via Temporal Consistency

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Frontiers of Computer Science, DOI: 10.1007/s11704-025-40828-0

Problems & Ideas

- Problems of current continual learning approaches:
  - Obtaining labeled samples can be difficult and tedious as it may require expert knowledge.
  - Labeled and unlabeled samples exist simultaneously, with more unlabeled than labeled samples in streaming data.
- Ideas: A more challenging scenario: Semi-Supervised Class-Incremental Learning (SSCIL) is proposed, aiming to leverage unlabeled data to alleviate catastrophic forgetting in classification tasks.

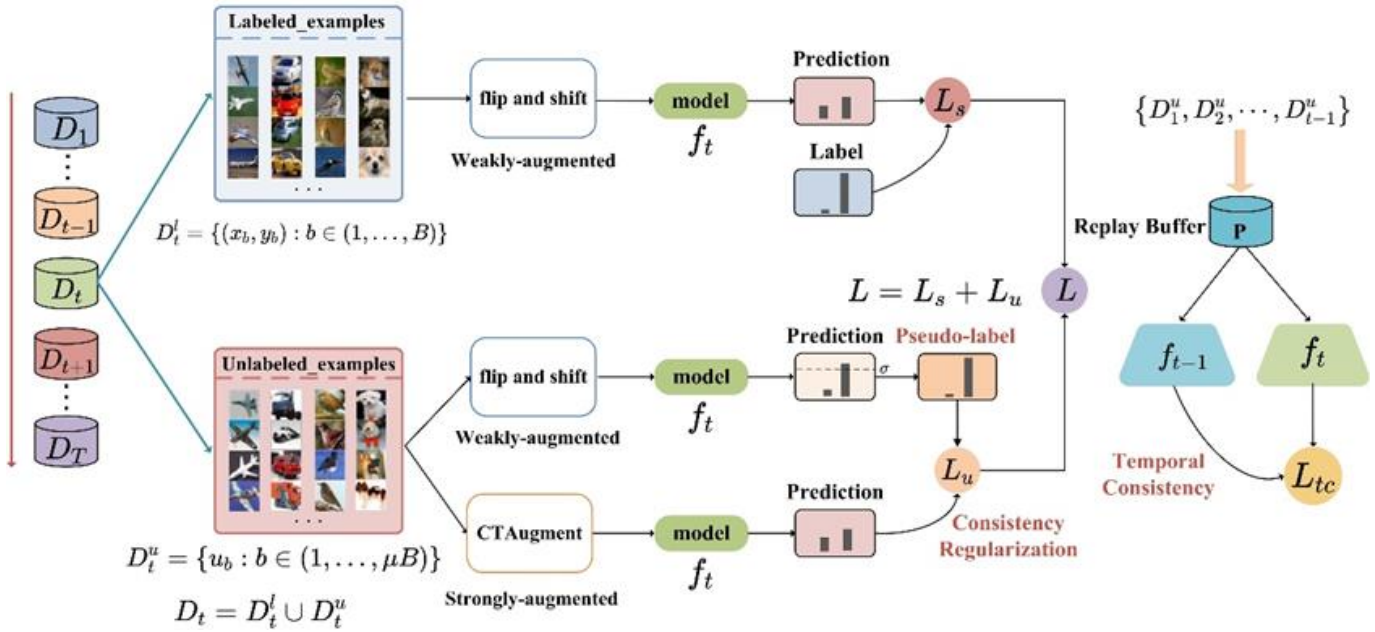

Fig. 1 The illustration for our proposed SSCIL framework.

Main Contributions

- Contributions:
  - We propose a novel SSCIL framework tailored to classification tasks, which facilitates the gradual acquisition of new class knowledge while maintaining a balance between the stability and plasticity on previously learned classes.
  - We propose a novel strategy for measuring the temporal consistency with the unlabeled data memory replay.
  - We conduct extensive experiments on two benchmark datasets and experimental results showcase notable performance advantages over other competing methods.

Method	Task ID									
	1	2	3	4	5	6	7	8	9	10
semi-Finetune	90.20	39.85	30.63	21.68	18.72	14.82	13.19	10.98	10.21	8.57 (89.22)
Finetune	92.40	40.80	30.52	22.24	18.89	17.64	16.58	13.98	12.23	10.27 (-)
semi-LwF	90.20	58.20	48.97	36.58	27.08	18.73	15.54	13.1	10.14	8.29 (50.29)
LwF	92.40	70.58	56.42	42.84	39.82	32.42	30.18	24.16	23.18	21.17 (-)
semi-Replay	90.20	62.00	61.90	56.40	51.12	40.78	42.46	27.34	31.38	27.35 (44.80)
Replay	92.40	78.24	72.18	62.24	58.84	52.48	49.87	44.43	42.36	40.23(-)
semi-iCaRL	90.20	73.15	67.27	54.82	50.06	44.13	41.44	35.11	32.17	28.31 (35.58)
iCaRL	92.40	79.16	73.21	67.89	63.22	60.02	58.56	52.17	50.24	48.23 (-)
semi-WA	90.20	73.15	65.60	54.98	47.18	43.52	38.96	34.99	30.73	27.22 (35.47)
WA	92.40	79.78	76.43	71.23	67.89	63.24	61.34	58.67	54.56	52.24 (-)
semi-DER	90.20	70.35	67.23	63.22	57.92	45.65	39.17	40.70	37.92	32.79 (26.13)
DER	92.40	79.80	78.47	77.56	72.47	69.80	65.45	62.09	60.78	58.86 (-)
semi-COIL	90.60	51.75	40.90	28.92	26.82	23.27	22.59	19.24	19.23	17.16 (74.84)
COIL	92.40	78.89	74.56	68.67	64.69	61.23	59.80	54.34	53.24	49.84 (-)
Pseudo Labeling	90.20	72.45	69.87	63.39	60.32	55.57	50.10	49.89	47.10	44.95(-)
Non-Exemplar	95.48	83.27	80.87	76.42	72.57	71.21	70.03	68.36	65.26	64.23 (-)
Ours	**90.20**	**73.80**	**69.63**	**63.12**	**56.80**	**55.00**	**51.94**	**46.74**	**44.26**	**41.19** (26.67)

Table 1: The classification average accuracy (%) and forgetting (%) of CIFAR-100 with 1000 labeled samples for each task. The red font indicates the average forgetting of the model for each task.