Positive Pair Distillation Considered Harmful:
Continual Meta Metric Learning for Lifelong Object Re-Identification

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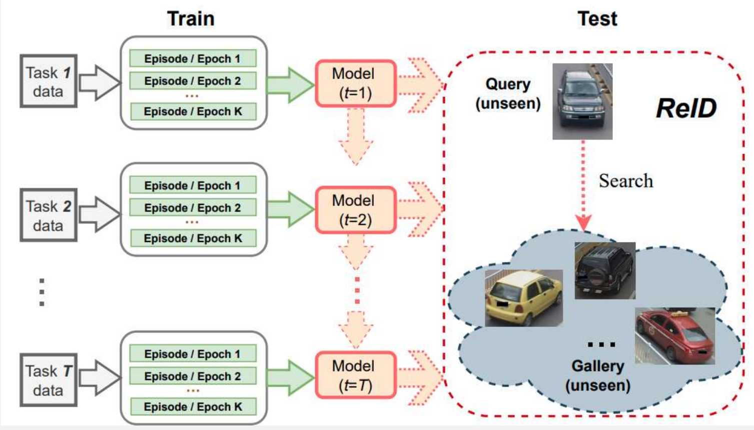
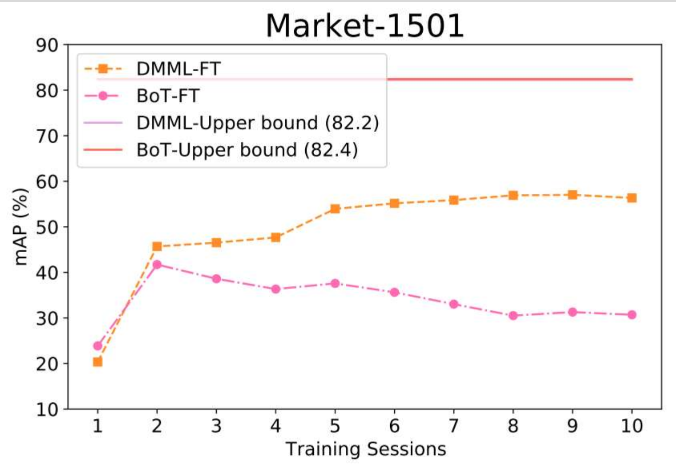
Problem setup: Lifelong Object ReID



- Data are presented sequentially in discrete tasks of disjoint classes.
- Data from previous tasks are unavailable in successive ones.
- The learner must incrementally update.
- The test identities are not seen during training.

Continual meta-metric learning *vs.* Continual metric learning

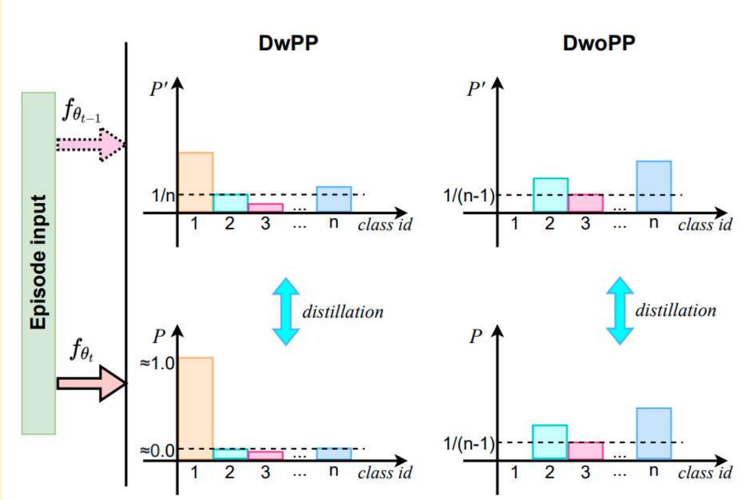


- Continual metric learning is quickly surpassed by continual meta-metric learning.
- Re-identification aims to recognize *unseen* objects. This is the characteristic of *few-shot* recognition.
- Continual metric learning focus on current task.
- The DMML loss tends to learn a better representation.
- DMML is a more principled approach for continual metric learning.

Conclusions

- We demonstrate that meta learning approaches perform better than those based on global metric loss optimization for Object ReID.
- We propose Distillation without Positive Pairs (DwoPP) as an approach that eliminates positive samples from distillation.
- Extensive experiments on newly proposed intra-task object re-identification datasets and the existing LReID benchmark demonstrate the effectiveness of our approach.

DwPP *vs.* DwoPP



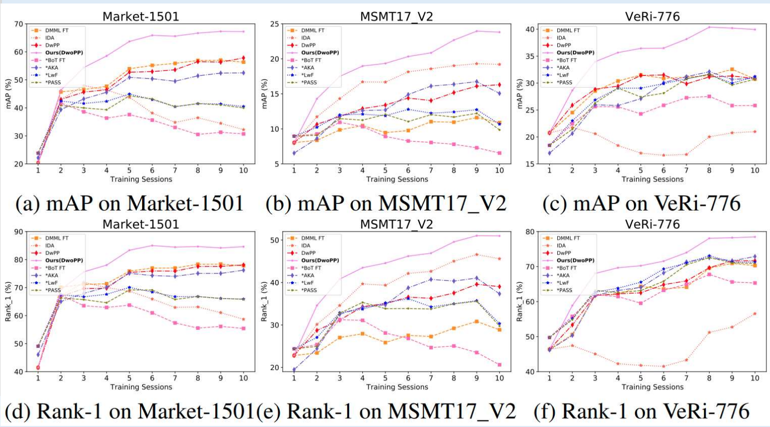
- The old model has never seen class 1 and so likely produces an output less than 1.
- the dominance of the positive class inhibits distillation of negative pair information

DwPP prediction:

$$g_c(S_k^t, \hat{x}; \theta) = \frac{[\exp(-d(f_\theta(\hat{x}), \mathbf{u}_c))]^{1/T}}{\sum_{c' \in \mathbb{C}} [\exp(-d(f_\theta(\hat{x}), \mathbf{u}_{c'}))]^{1/T}}$$

DwoPP prediction:

$$g'_c(S_k^t, \hat{x}, \hat{y}; \theta) = \frac{[\exp(-d(f_\theta(\hat{x}), \mathbf{u}_c))]^{1/T}}{\sum_{c' \in \mathbb{C} \setminus \{\hat{y}\}} [\exp(-d(f_\theta(\hat{x}), \mathbf{u}_{c'}))]^{1/T}}$$



(a) mAP on Market-1501 (b) mAP on MSMT17_V2 (c) mAP on VeRi-776

(d) Rank-1 on Market-1501 (e) Rank-1 on MSMT17_V2 (f) Rank-1 on VeRi-776

mAP and Rank-1 performance on ***intra-domain*** benchmarks

	mAP						Rank-1 Accuracy					
	market	sysu	msmt17	cuhk03	*seen avg.*	*unseen*	market	sysu	msmt17	cuhk03	*seen avg.*	*unseen*
BoT-FT	11.6	54.6	0.8	31.2	24.6	32.4	31.6	61.6	2.8	35.1	32.8	32.8
LwF	21.0	58.0	1.7	48.0	32.2	43.3	46.5	64.7	5.8	53.8	42.7	42.9
AKA	18.7	56.3	1.6	48.6	31.3	43.6	42.3	63.1	5.8	53.9	41.3	43.6
DMML-FT	22.5	56.8	2.3	67.0	37.2	42.8	47.3	62.6	8.4	**73.8**	48.0	42.6
DwPP	23.2	56.7	2.2	**67.9**	37.5	44.7	49.1	63.2	7.5	72.4	48.0	44.2
Ours (DwoPP)	**34.4**	**67.3**	**4.1**	53.5	**39.8**	**48.5**	**58.6**	**73.0**	**12.3**	59.6	**50.9**	**47.8**

***Inter*-domain benchmark (LReID)**