Unsupervised Domain Adaptation for open-set person re-identification

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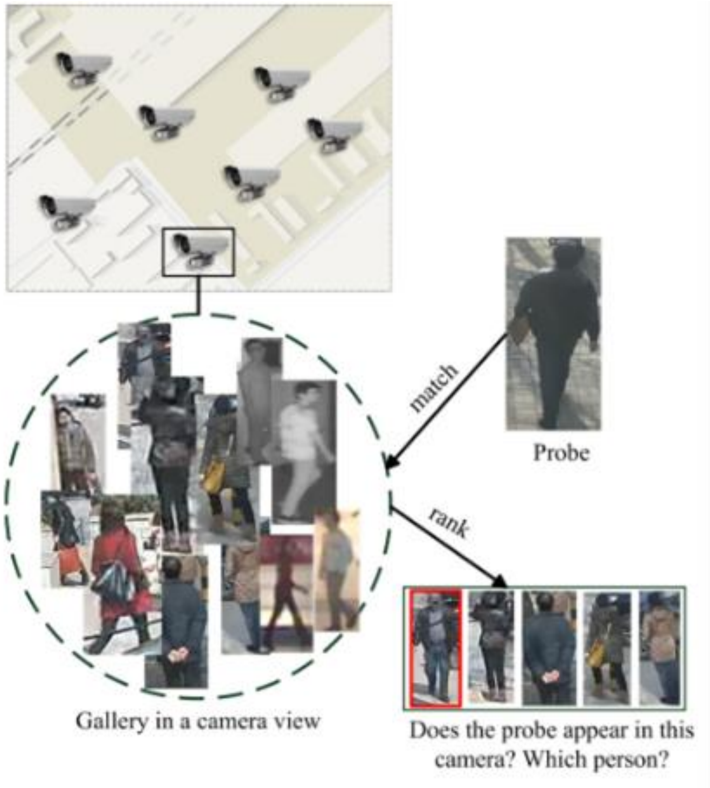
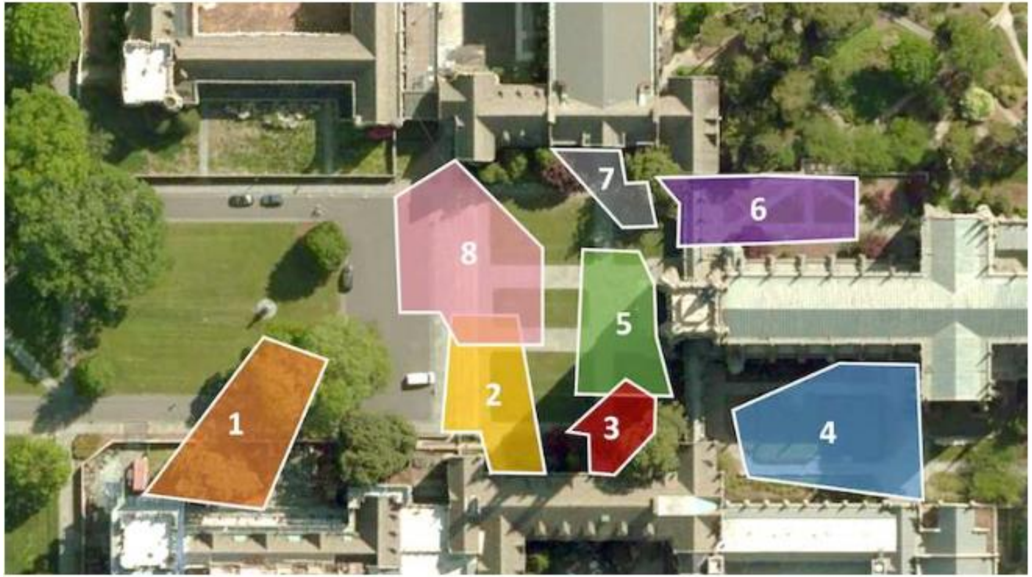
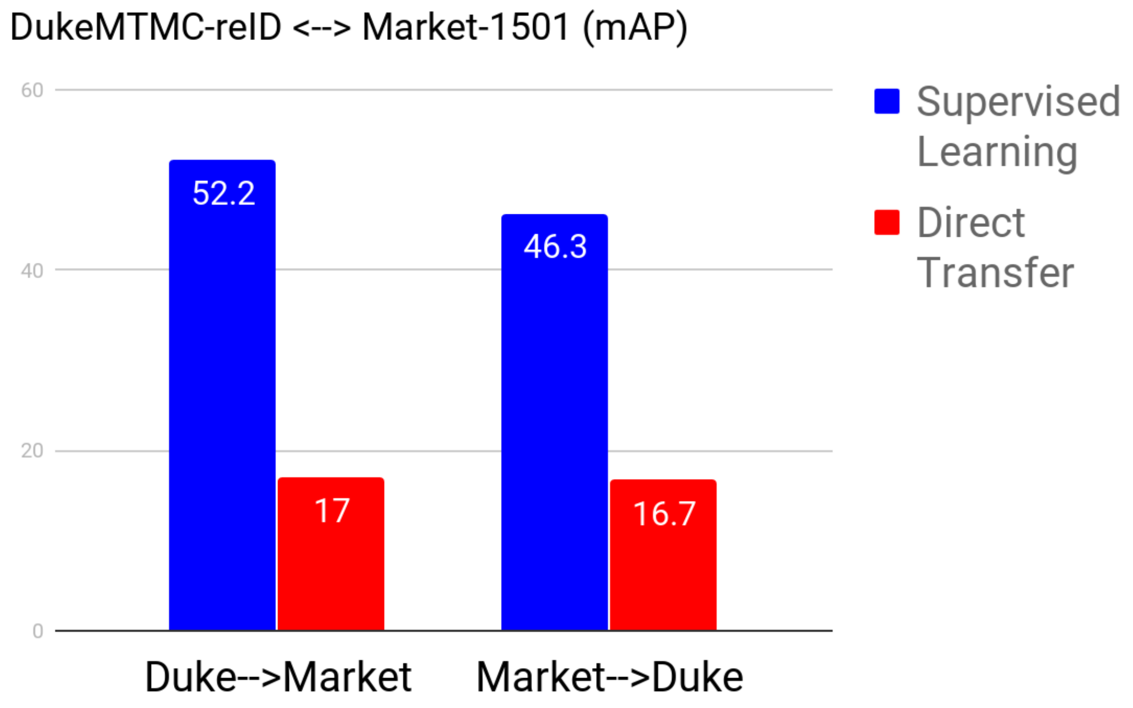
person re-identification





layout of the cameras in the DukeMTMC dataset

problem of domain shifts



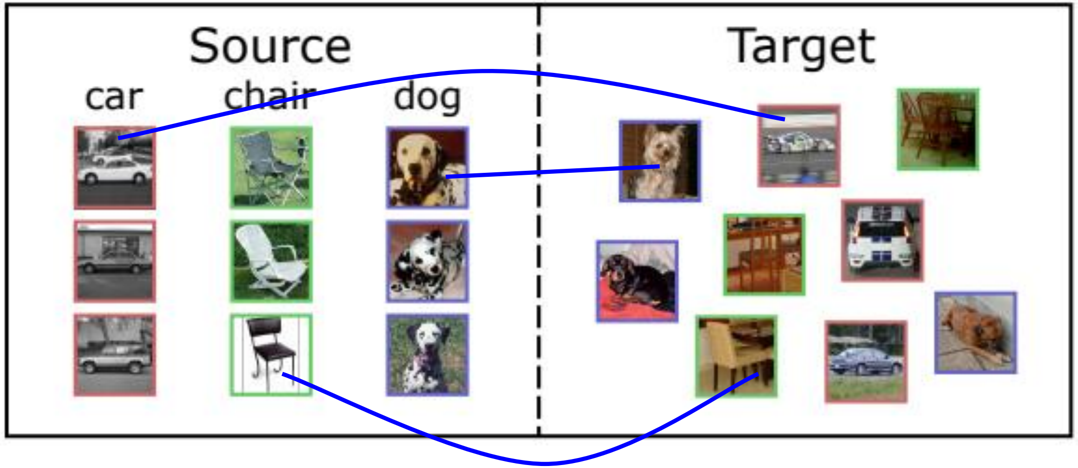
create new dataset?

1. prohibitive manual effort for annotation ?
2. time-consuming
3. hard to reuse
4. privacy

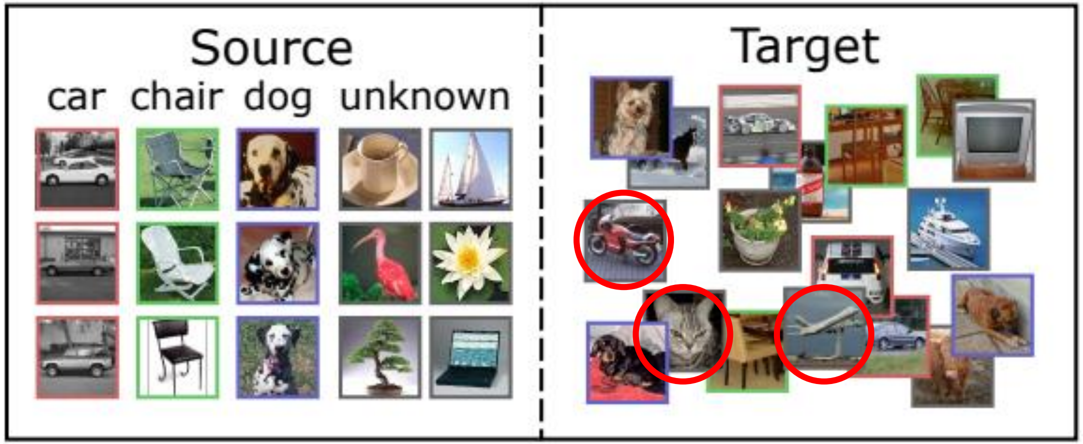
transfer learning/ domain adaptation ☑

Unsupervised Domain Adaptation for closed-/open-set scenarios

close-set assumption: source and target domains share the same classes

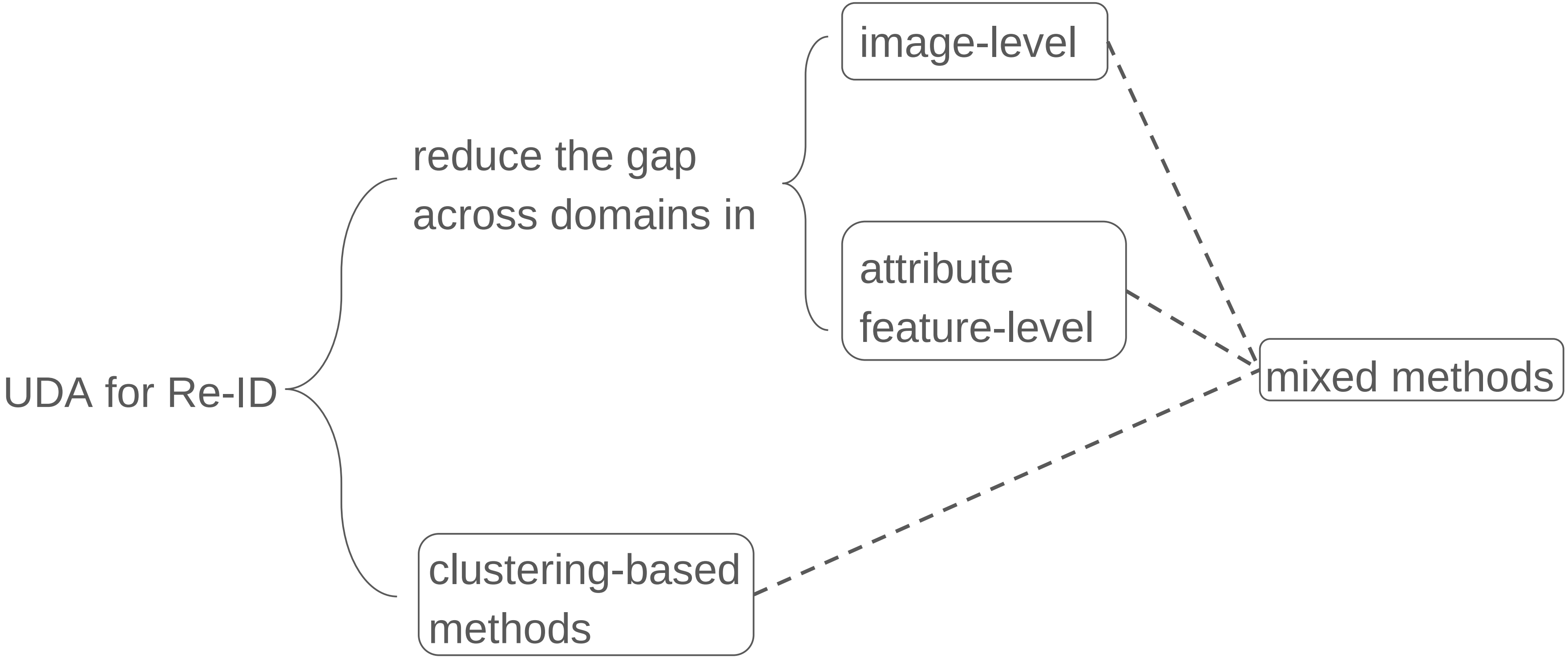


open-set assumption: classes from 2 domains are different



→ **re-ID scenario**

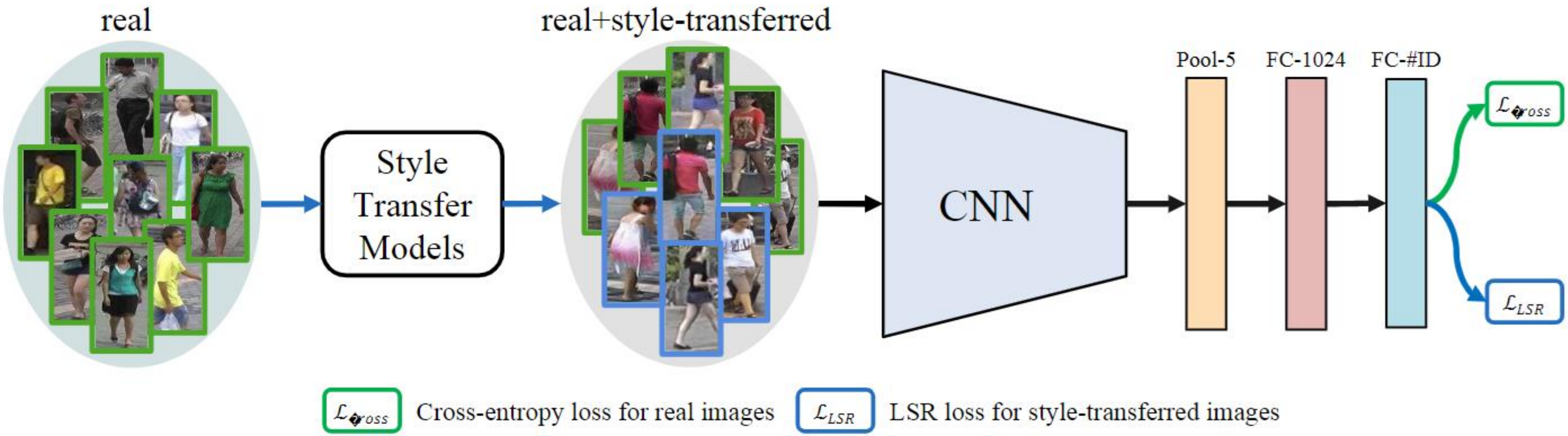
Current methods of UDA for open-set re-ID



1.reduce the gap across domains on the **image-level**

image-level gap reduction

- SPGAN[CVPR 18], HHL methods [ECCV 18], PTGAN[CVPR 18]
- <u>CamStyle</u>[TIP 19], <u>ATNet</u>[CVPR 19]

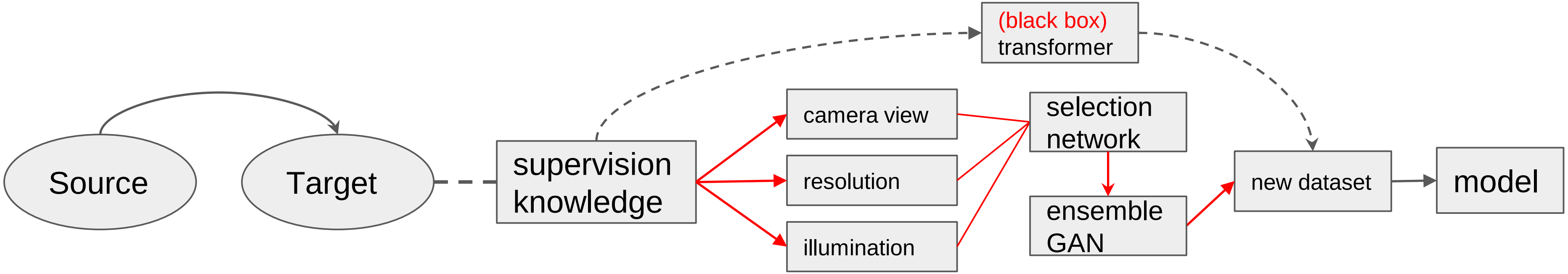


ATNet

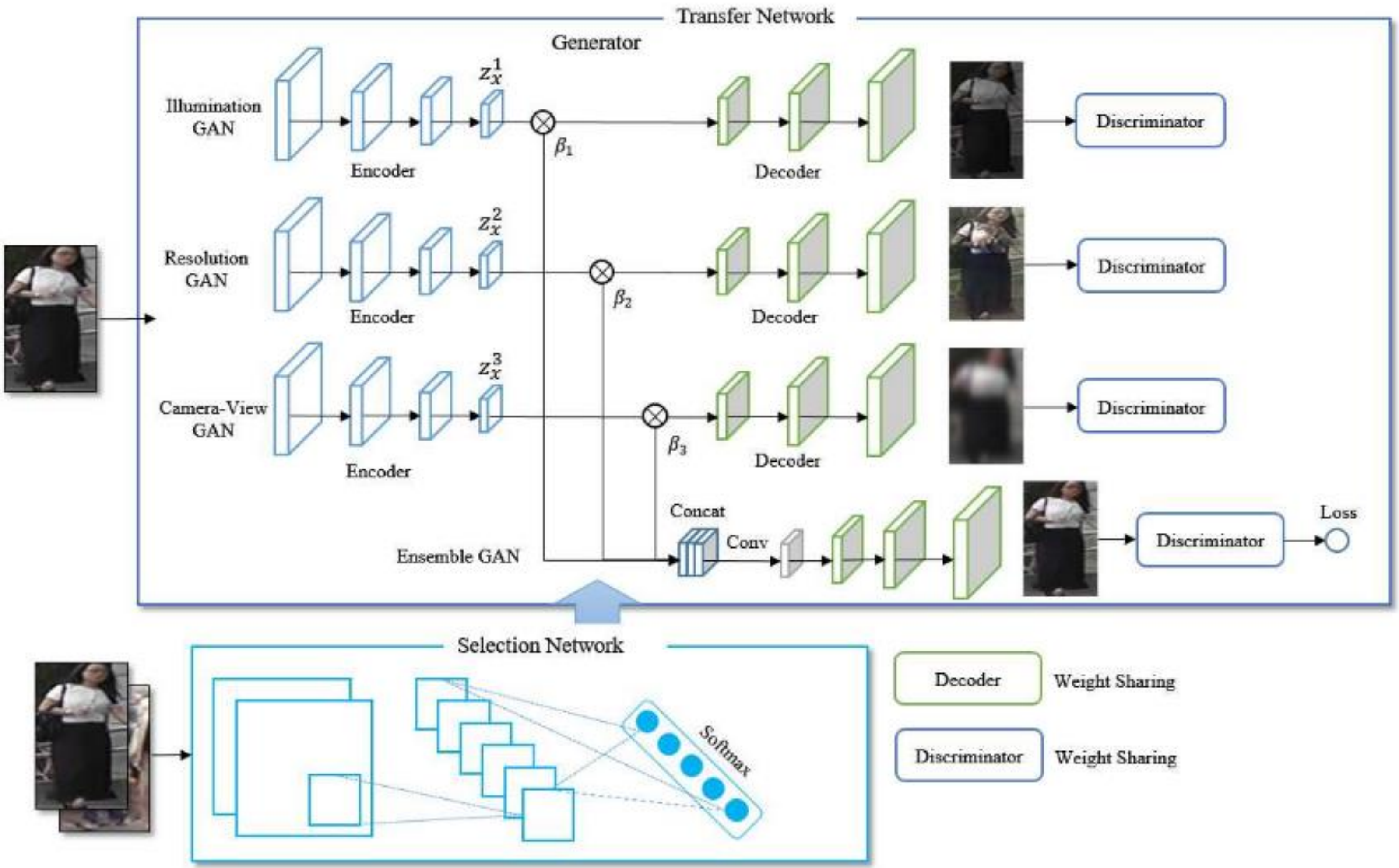
Adaptative Transfer Network for Cross-Domain Person Re-Identification (CVPR 2019)

What are the main factors of DA for re-id?

- Illumination
- Resolution
- Camera view



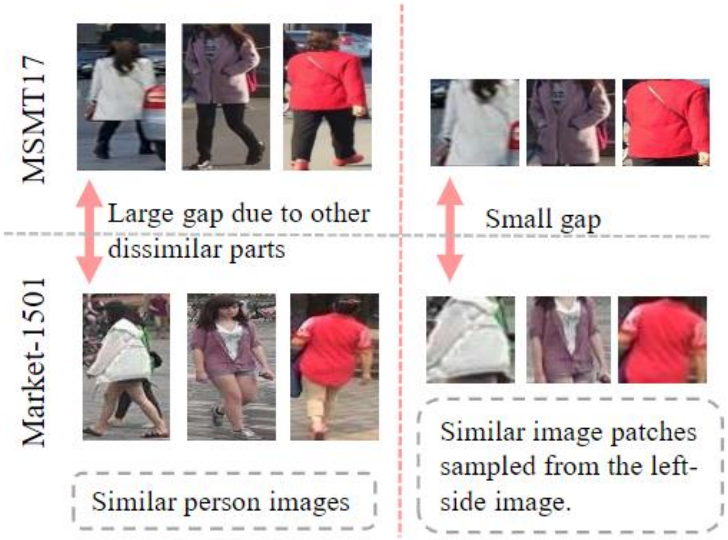
ATNet

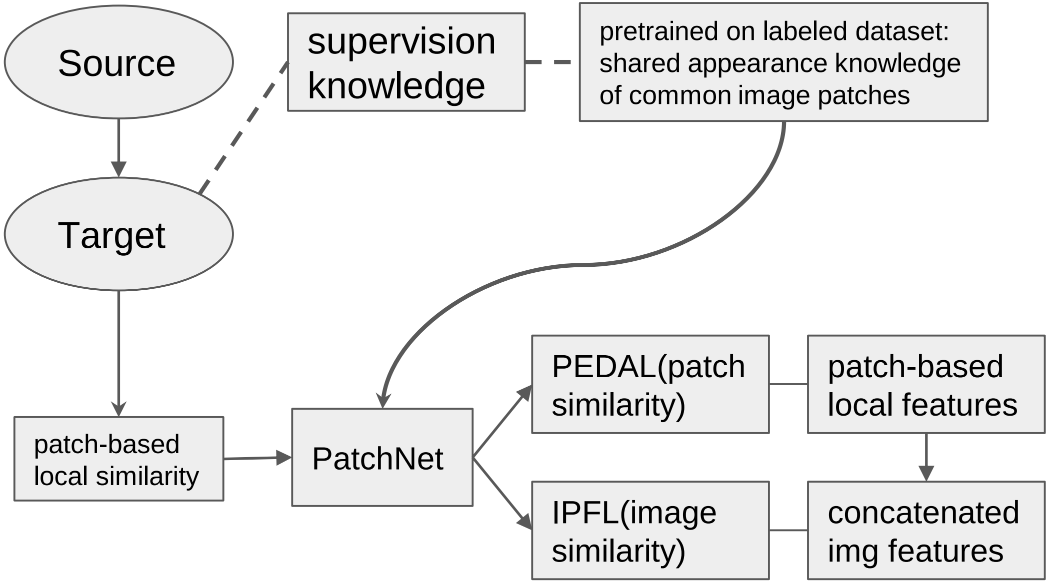


Transfer Network
Generator
Illumination GAN
Encoder
z_x^1
β_1
Decoder
Discriminator
Resolution GAN
Encoder
z_x^2
β_2
Decoder
Discriminator
Camera-View GAN
Encoder
z_x^3
β_3
Decoder
Discriminator
Concat
Conv
Ensemble GAN
Discriminator
Loss
Selection Network
Softmax
Decoder
Weight Sharing
Discriminator
Weight Sharing

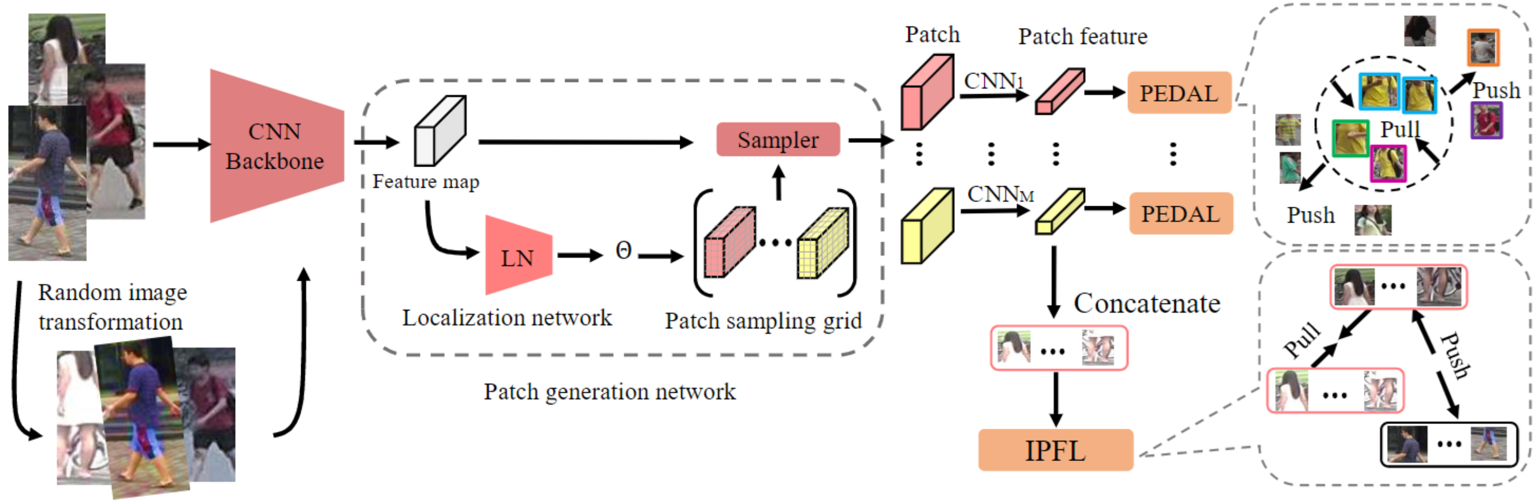
PAUL

Patch-based Discriminative Feature Learning for Unsupervised Person Re-identification (CVPR 2019)





PAUL



Source	DukeMTMC-reID		Market-1501	
Target	Market-1501		DukeMTMC-reID	
Methods	Rank-1	mAP	Rank-1	mAP
PUL [7]	45.5	20.5	30.0	16.4
PTGAN [40]	38.6	-	27.4	-
TJ-AIDL [37]	58.2	26.5	44.3	23.0
HHL [55]	62.2	31.4	46.9	27.2
PAUL (Ours)	**66.7**	**36.8**	**56.1**	**35.7**

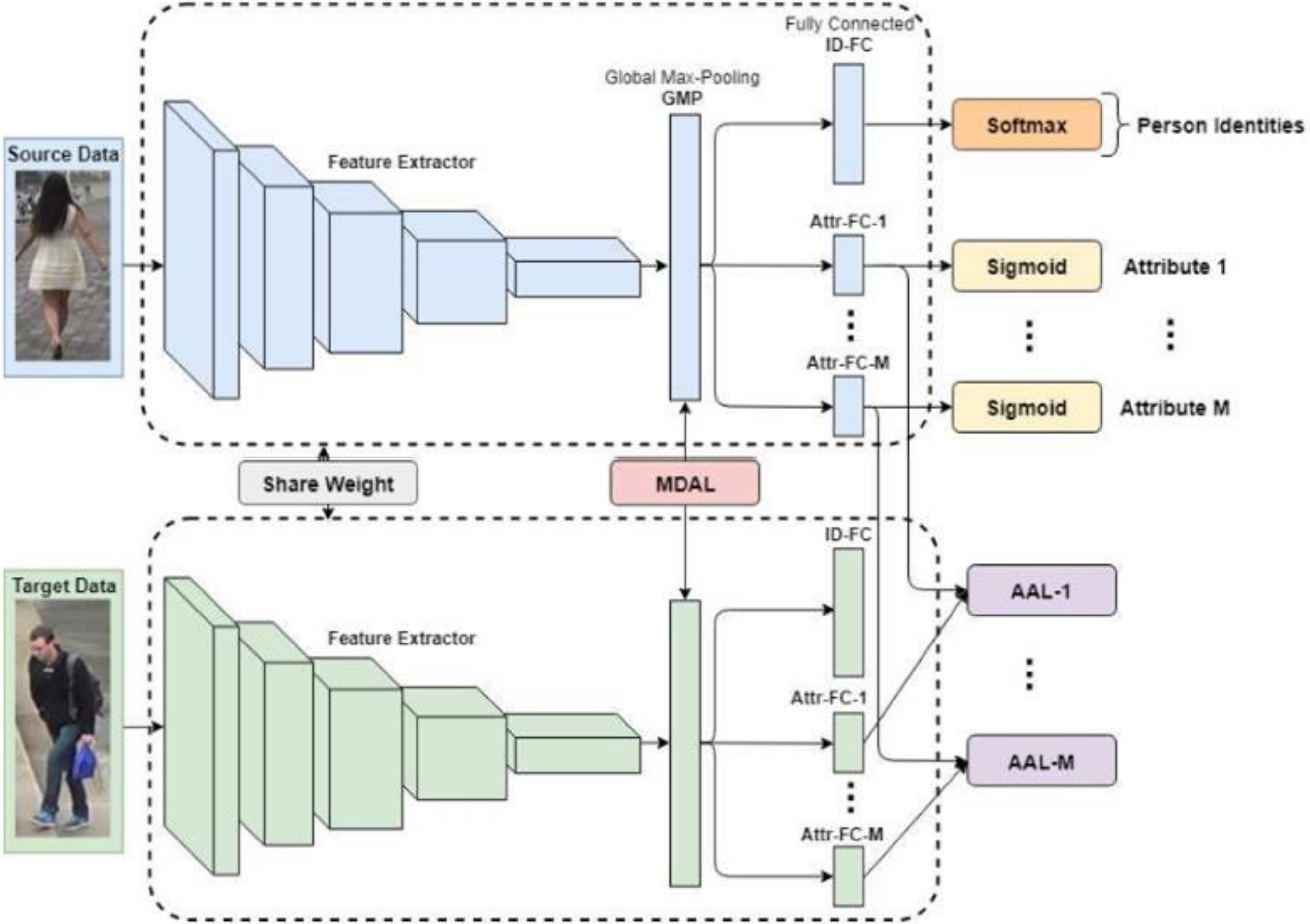
2.reduce the gap across domains on the **attribute feature-level**

attribute feature-level
gap reduction

TJ-AIDL[CVPR 18]

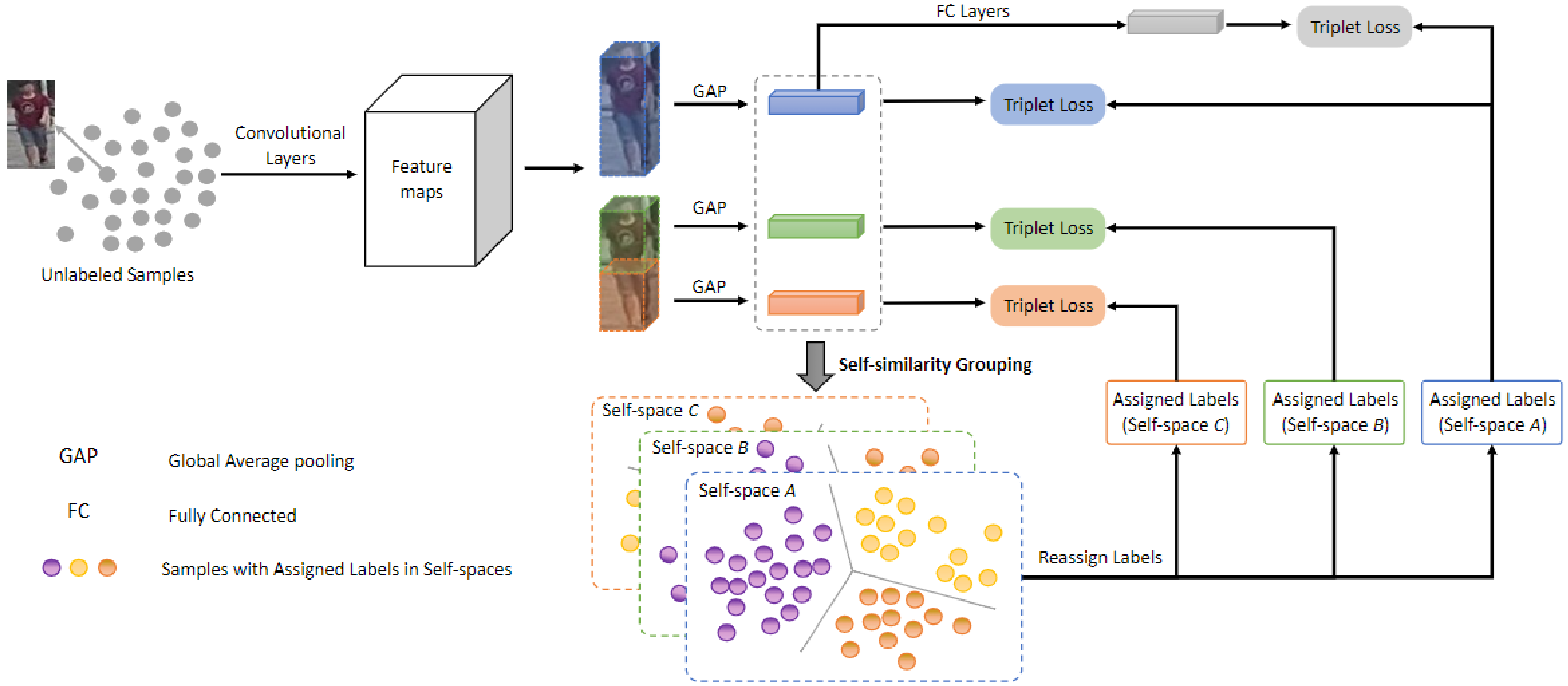
UCDA & CCE
[CVPR 19]

<u>MMFA</u>[BMVC 18]



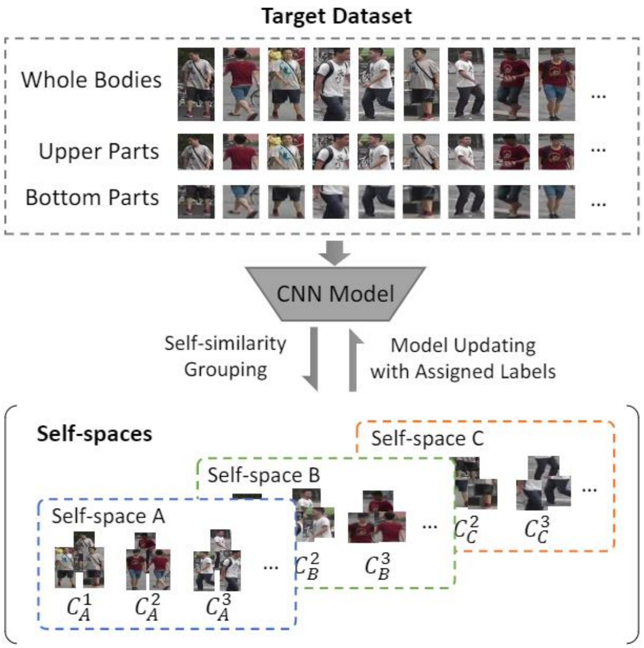
3.clustering-based methods

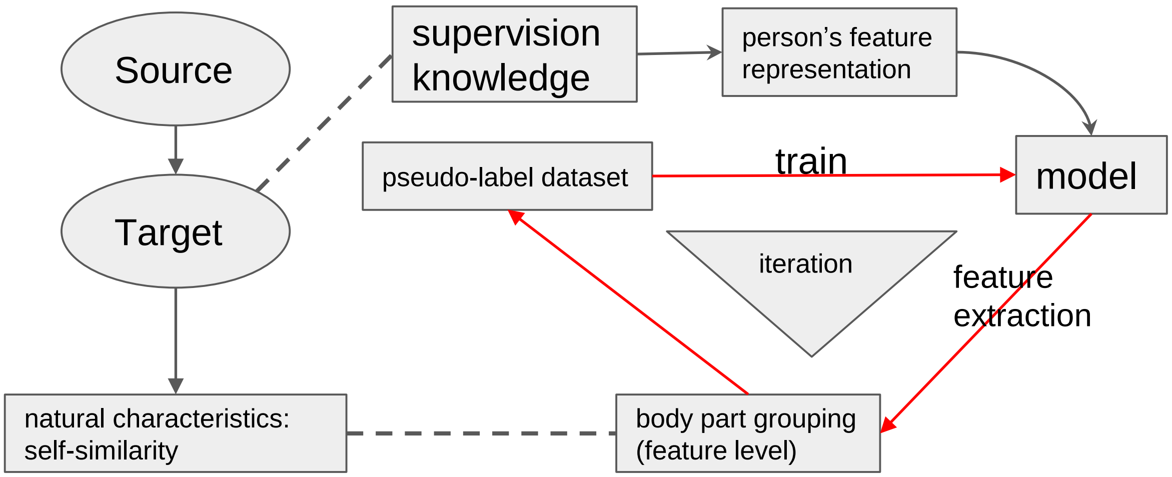
clustering-based
- ECN[CVPR 19], PAUL[CVPR 19], SSG[ICCV 19], PAST[ICCV 19]
- UDA Re-Identification: Theory and Practice(arxiv)



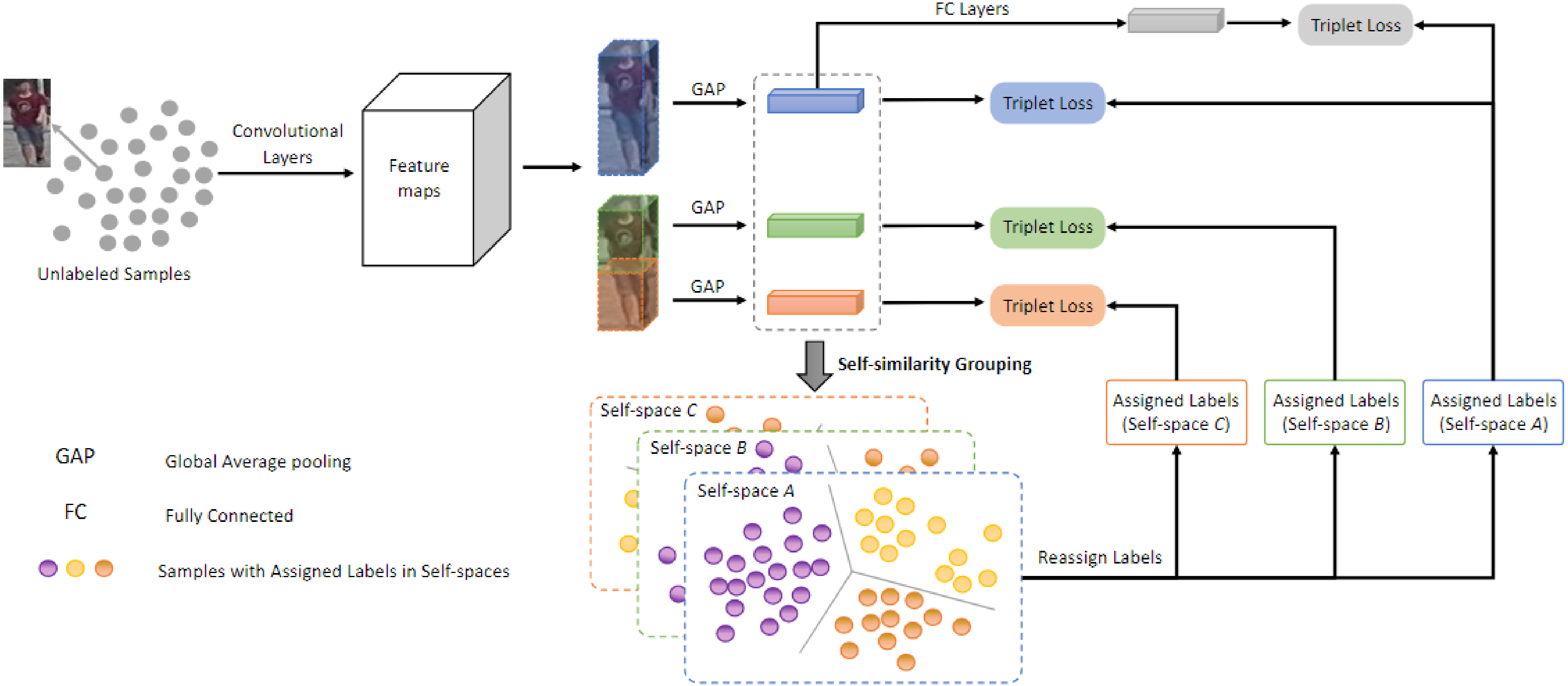
SSG

Self-similarity Grouping: A Simple Unsupervised Cross Domain Adaptation Approach for Person Re-identification (ICCV 2019)



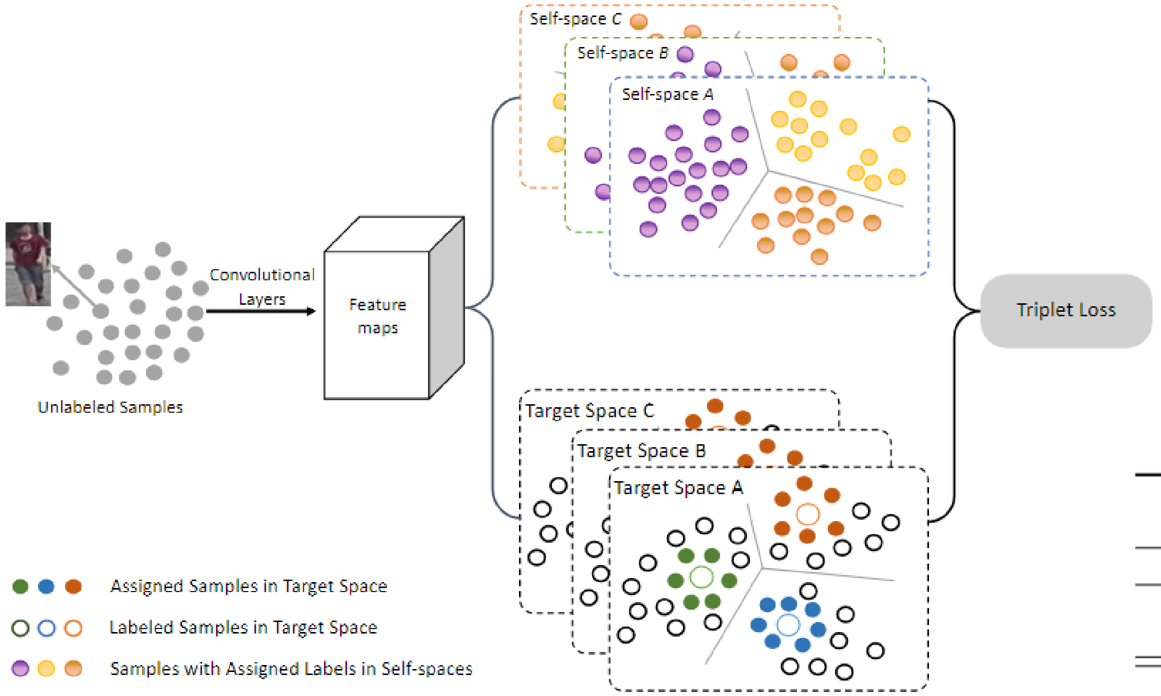


SSG



step-wise learning approach: use pseudo-labeled dataset generated by clustering for training

SSG



Source	DukeMTMC-reID
Target	Market-1501

Methods	mAP	R1	R5	R10
SSG	**58.3**	**80.0**	**90.0**	**92.4**
SSG++	**68.7**	**86.2**	**94.6**	**96.5**

Source	Market-1501
Target	DukeMTMC-reID

Methods	mAP	R1	R5	R10
SSG	**53.4**	**73.0**	**80.6**	**83.2**
SSG++	**60.3**	**76.0**	**85.8**	**89.3**

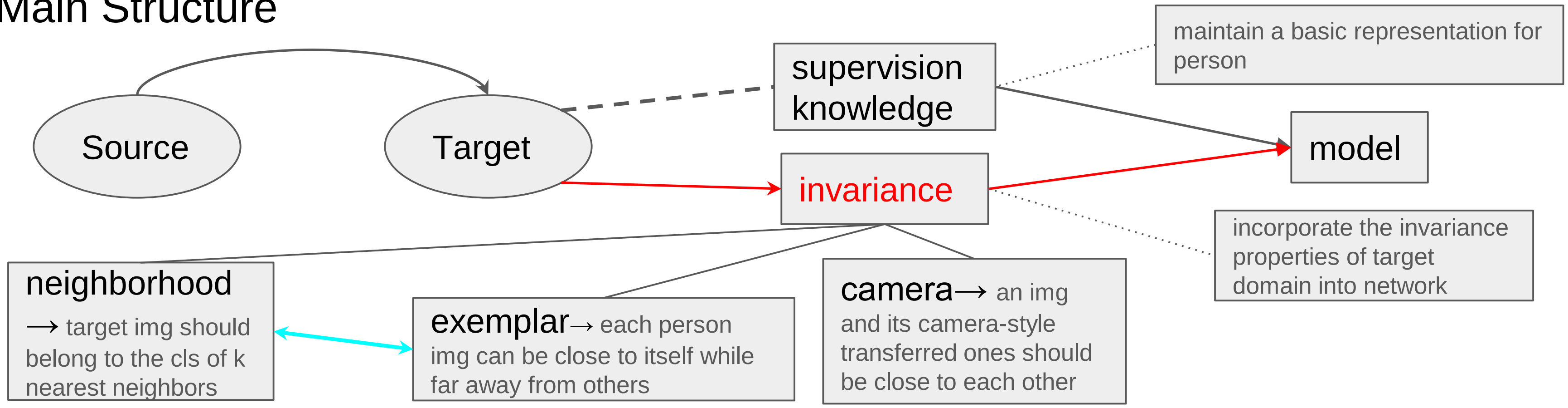
Methods	DukeMTMC-reID→ MSMT17		
	mAP	R1	R10
PTGAN [40]	3.3	11.8	27.4
SSG	**13.3**	**32.2**	**51.2**
SSG++	**18.3**	**41.6**	**62.2**

Methods	Market1501→ MSMT17		
	mAP	R1	R10
PTGAN [40]	2.9	10.2	24.4
SSG	**13.2**	**31.6**	**49.6**
SGG++	**16.6**	**37.6**	**57.2**

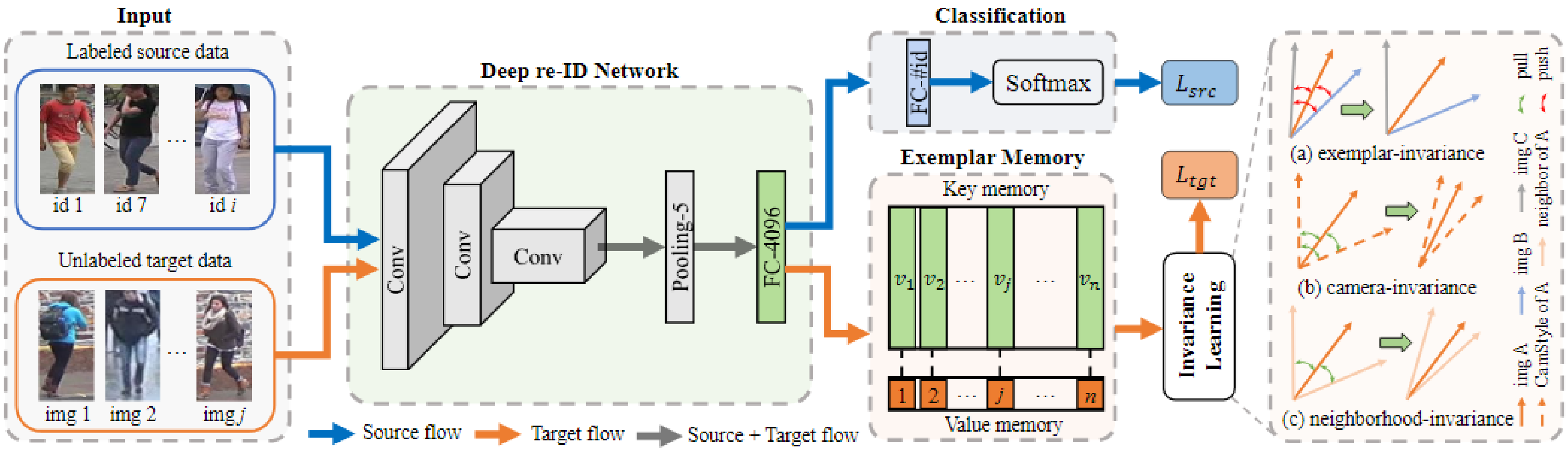
ECN

Invariance Matters: Exemplar Memory for Domain Adaptative Person Re-identification (CVPR 2019)

Main Structure



ECN

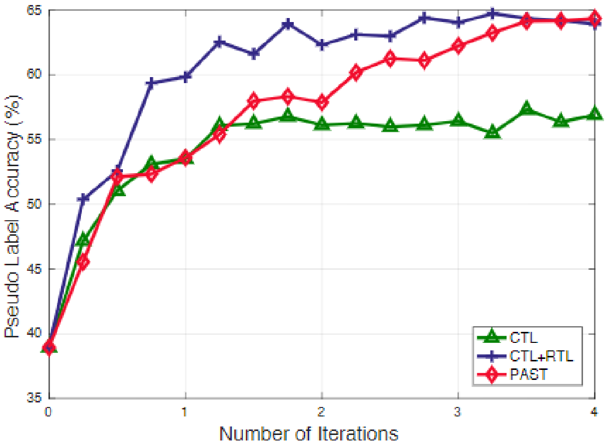


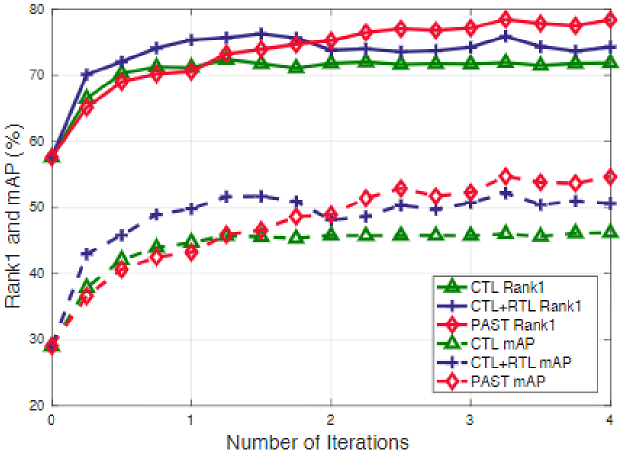
Methods	Market-1501				DukeMTMC-reID			
	R-1	R-5	R-10	mAP	R-1	R-5	R-10	mAP
LOMO [15]	27.2	41.6	49.1	8.0	12.3	21.3	26.6	4.8
Bow [37]	35.8	52.4	60.3	14.8	17.1	28.8	34.9	8.3
UMDL [20]	34.5	52.6	59.6	12.4	18.5	31.4	37.6	7.3
PTGAN [30]	38.6	-	66.1	-	27.4	-	50.7	-
PUL [9]	45.5	60.7	66.7	20.5	30.0	43.4	48.5	16.4
SPGAN [7]	51.5	70.1	76.8	22.8	41.1	56.6	63.0	22.3
CAMEL [36]	54.5	-	-	26.3	-	-	-	-
MMFA [16]	56.7	75.0	81.8	27.4	45.3	59.8	66.3	24.7
SPGAN+LMP [7]	57.7	75.8	82.4	26.7	46.4	62.3	68.0	26.2
TJ-AIDL [29]	58.2	74.8	81.1	26.5	44.3	59.6	65.0	23.0
CamStyle [45]	58.8	78.2	84.3	27.4	48.4	62.5	68.9	25.1
HHL [43]	62.2	78.8	84.0	31.4	46.9	61.0	66.7	27.2
Ours (ECN)	**75.1**	**87.6**	**91.6**	**43.0**	**63.3**	**75.8**	**80.4**	**40.4**

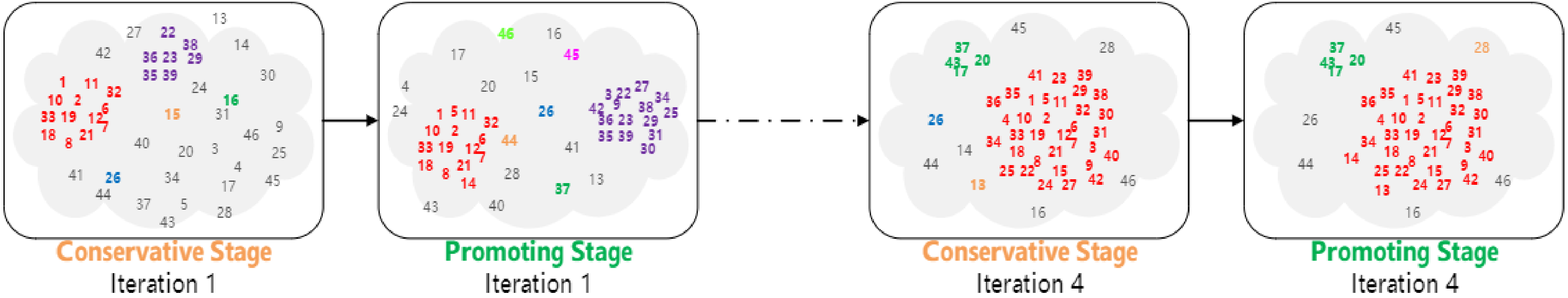
Methods	Src.	MSMT17			
		R-1	R-5	R-10	mAP
PTGAN [30]	Market	10.2	-	24.4	2.9
Ours (ECN)	Market	**25.3**	**36.3**	**42.1**	**8.5**
PTGAN [30]	Duke	11.8	-	27.4	3.3
Ours (ECN)	Duke	**30.2**	**41.5**	**46.8**	**10.2**

PAST

Self-training with progressive augmentation for unsupervised cross-domain person re-identification (ICCV 2019)

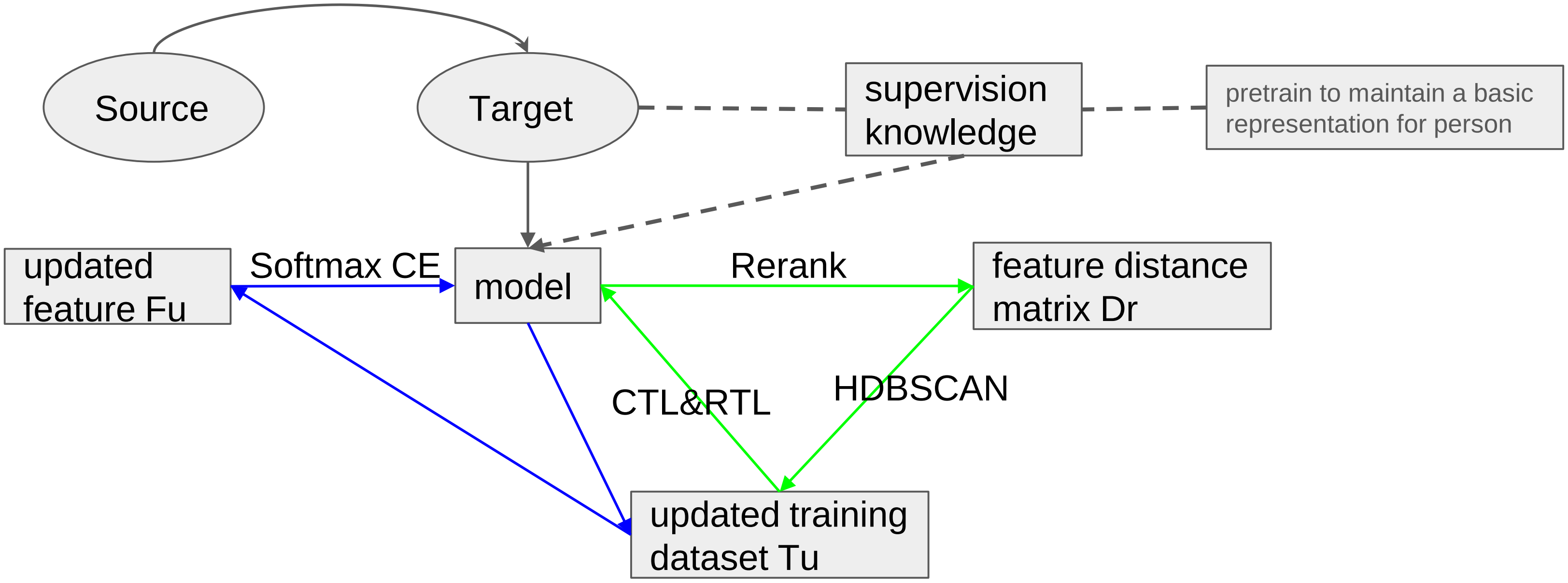






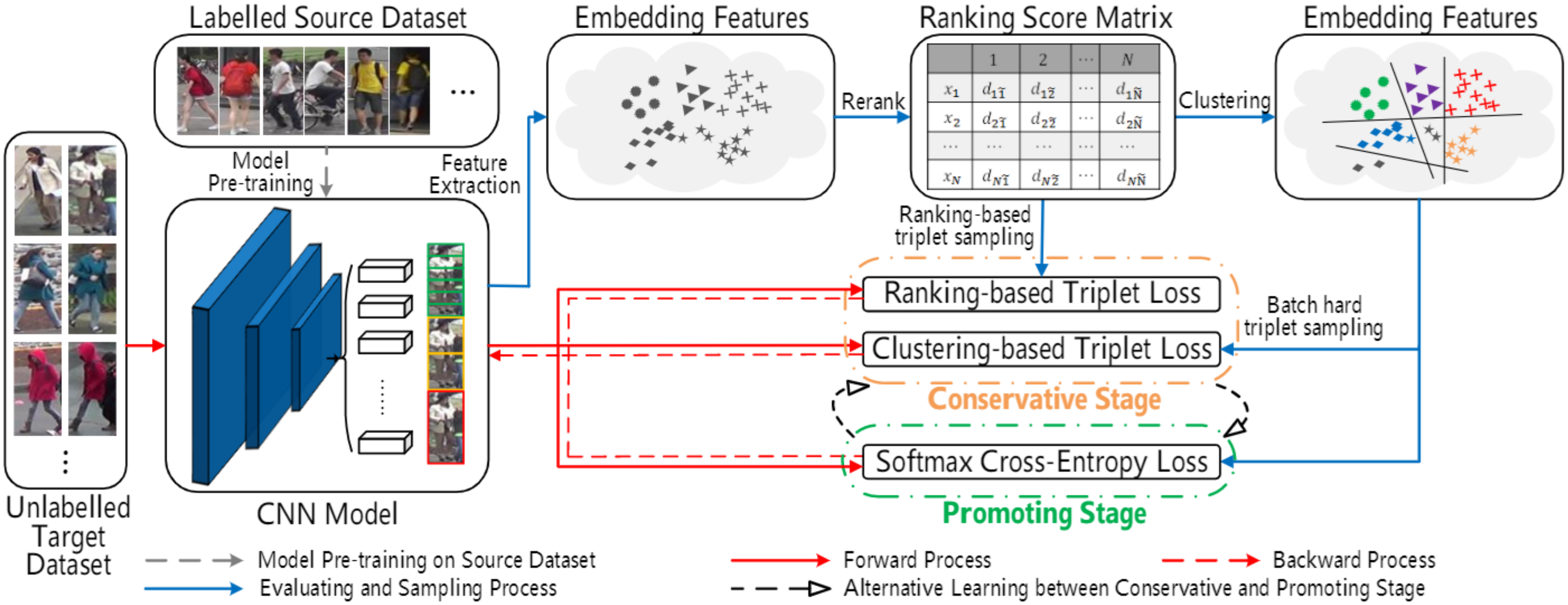
PAST

Main Structure



PAST

Progressive augmentation framework



PAST

Design of loss function

1. Clustering-based Triplet Loss(C-Stage)

$$L_{CTL} = \sum_{a=1}^{PK} [m + ||\mathrm{f}(x_a) - \mathrm{f}(x_p)||_2 - ||\mathrm{f}(x_a) - \mathrm{f}(x_n)||_2]_+$$

$$= \sum_{i=1}^{P}\sum_{a=1}^{K}[m + \overbrace{\max_{p=1\ldots K} ||\mathrm{f}(x_{i,a}) - \mathrm{f}(x_{i,p})||_2}^{\text{hardest positive}}$$

$$\underbrace{- \min_{\substack{n=1\ldots K\\ j=1\ldots P\\ j\neq i}} ||\mathrm{f}(x_{i,a}) - \mathrm{f}(x_{j,n})||_2}_{\text{hardest negative}}]_+,$$

2. Ranking-based Triplet Loss(C-Stage)

$$L_{RTL} = \sum_{a=1}^{PK}[\frac{|P_p - P_n|}{\eta} m +$$

$$||\mathrm{f}(x_a) - \mathrm{f}(x_p)||_2 - ||\mathrm{f}(x_a) - \mathrm{f}(x_n)||_2]_+$$

Total loss(C-Stage)

$$L_C = L_{RTL} + \lambda L_{CTL}$$

CE loss(P-Stage)

$$L_P = -\sum_{i=1}^{PK} \log \frac{e^{W_{\hat{y}_i}^T x_i}}{\sum_{c=1}^{C} e^{W_c^T x_i}}$$

Result of UDA

Methods	D --> Market-1501				M --> DukeMTMC-re-ID			
	R-1	R-5	R-10	**mAP**	**R-1**	R-5	R-10	**mAP**
LOMO(CVPR 2015)	27.2	41.6	49.1	8	12.3	21.3	26.6	4.8
UMDL(CVPR 2016)	34.5	52.6	59.6	12.4	18.5	31.4	37.6	7.3
Bow(ICCV 2015)	35.8	52.4	60.3	14.8	17.1	28.8	34.9	8.3
PTGAN(CVPR 2018)	38.6		66.1		27.4		50.7	
PUL(ACM TOMM 2018)	45.5	60.7	66.7	20.5	30	43.4	48.5	16.4
SPGAN(CVPR 2018)	51.5	70.1	76.8	22.8	41.1	56.6	63	22.3
CAMEL(ICCV 2017)	54.5			26.3				
ATNet(CVPR 2019)	55.7	73.2	79.4	25.6	45.1	59.5	64.2	24.9
MMFA(BMVC 2018)	56.7	75	81.8	27.4	45.3	59.8	66.3	24.7
SPGAN+LMP(CVPR 2018)	57.7	75.8	82.4	26.7	46.4	62.3	68	26.2
TJ-AIDL(CVPR 2018)	58.2	74.8	81.1	26.5	44.3	59.6	65	23
CamStyle(TIP 2019)	58.8	78.2	84.3	27.4	48.4	62.5	68.9	25.1
HHL(ECCV 2018)	62.2	78.8	84	31.4	46.9	61	66.7	27.2
BUC(AAAI 2019)	66.2	79.6	84.5	38.3	47.4	62.6	68.4	27.5
PAUL(CVPR 2019)	68.5	82.4	87.4	40.1	72	82.7	86	53.2
DBC(arxiv 2019)	69.2	83	87.8	41.3	51.5	64.6	70.1	30
E-cluster(arxiv 2019)	70.2		88.6	42.8	52.7		70.6	31.4
ECN(CVPR 2019)	75.1	87.6	91.6	43	63.3	75.8	80.4	40.4
theory&practice(arxiv 2018)	75.8	89.5	93.2	53.7	68.4	80.1	83.5	49
PAST(ICCV 2019)	**78.38**			**54.62**	**72.35**			**54.26**
SSG(ICCV 2019)	80	90	92.4	58.3	73	80.6	83.2	53.4
SSG++	86.2	94.6	96.5	68.7	76	85.8	89.3	60.3