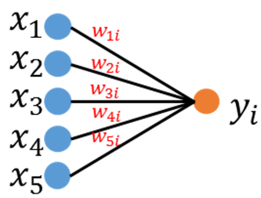
Supplementary Material for
Person Re-identification with Cascaded Pairwise Convolutions
(*Best Viewed in Color*)

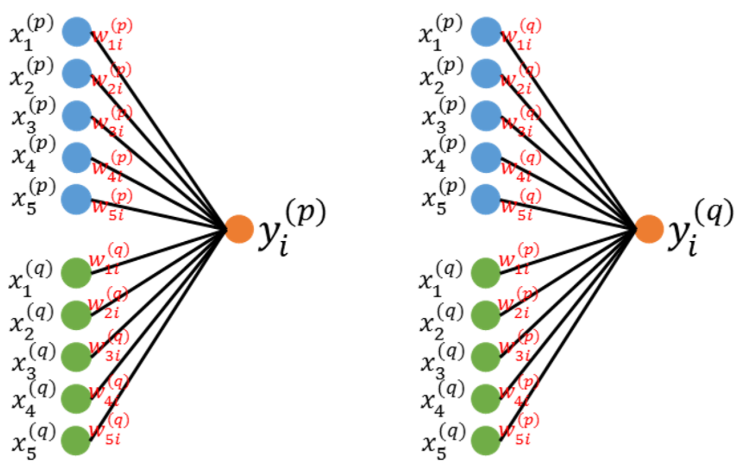
1. Detailed Explanations for Eq. 4 and Eq. 5 in Our Paper

1.1. Preparation

Graphical representation of Eq. 1 ($m = 5$ and the bias factor is omitted, the same below):



Graphical representation of Eq. 2:



Given a very small positive scalar ϵ, two categories of weight vector are defined and represented as:

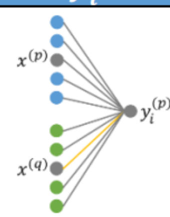
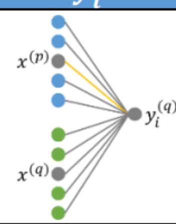
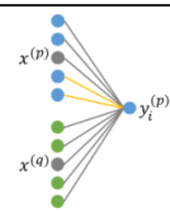
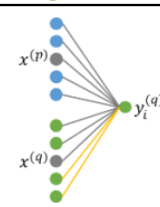
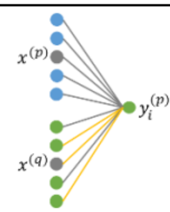
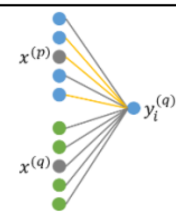
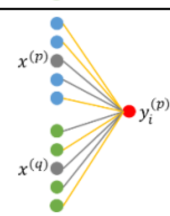
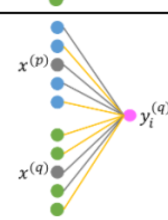
Condition	Category	Graphic Symbol
$\left\|w_{ji}^{(\cdot)}\right\|_2^2 \leq \varepsilon$	0	
$\left\|w_{ji}^{(\cdot)}\right\|_2^2 > \varepsilon$	1	

Five categories of channels in the cascaded WConv structure are defined and represented as:

Meaning	Category	Graphic Symbol
Meaningless channel, whose responses are always approximately zero	0	
The feature of I_A	1	
The feature of I_B	2	
The result of an asymmetric pattern matching in the combination case of $m^{(p)} - I_A, m^{(q)} - I_B$	3	
The result of an asymmetric pattern matching in the combination case of $m^{(q)} - I_A, m^{(p)} - I_B$	4	

1.2. Detailed Explanation for Eq. 4

Graphical representations of Eq. 4: (Graphics are examples)

ID	Condition	$y_i^{(p)}$	$y_i^{(q)}$
(a)	$\forall\, j\|_{t_j^{(p)} \neq 0}, c_{ji}^{(p)} = 0; \forall\, j\|_{t_j^{(q)} \neq 0}, c_{ji}^{(q)} = 0$		
(b)	$\exists\, j\|_{t_j^{(p)} = 1}, c_{ji}^{(p)} = 1; \forall\, j\|_{t_j^{(q)} \neq 0}, c_{ji}^{(q)} = 0$		
(c)	$\forall\, j\|_{t_j^{(p)} \neq 0}, c_{ji}^{(p)} = 0; \exists\, j\|_{t_j^{(q)} = 2}, c_{ji}^{(q)} = 1$		
(d)	$\exists\, j\|_{t_j^{(p)} = 1}, c_{ji}^{(p)} = 1; \exists\, j\|_{t_j^{(q)} = 2}, c_{ji}^{(q)} = 1$		

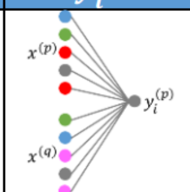
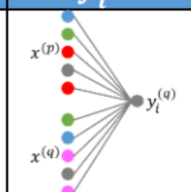
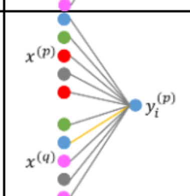
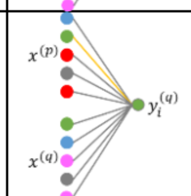
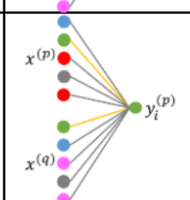
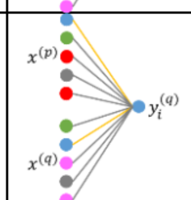
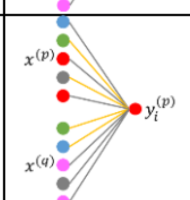
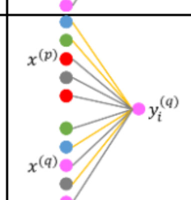
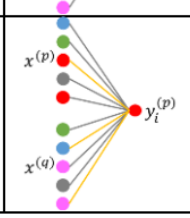
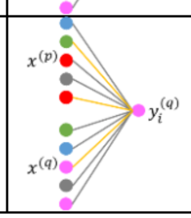
As $x^{(p)}$ and $x^{(q)}$ come from the same subnetwork but different images, $x_i^{(p)}$ and $x_i^{(q)}$ represent **the same type of single-image feature**, but correspond to different images.

In conditions (b) and (c), $y_i^{(p)}$ is extracted by the weight vectors from the features of one image, $y_i^{(q)}$ is extracted by the same weight vectors from the same type of features of the other image, so $y_i^{(p)}$ and $y_i^{(q)}$ represent **the same type of single-image feature**, but correspond to different images.

In condition (d), weight vectors marked with p are applied on features of one image, to discriminate whether subpattern $m_i^{(p)}$ exists in the location of this image; weight vectors marked with q are applied on the same type of features of the other image, to discriminate whether subpattern $m_i^{(q)}$ exists in the location of this image; the results of above two computations are added together to discriminate whether subpatterns $m_i^{(p)}$ and $m_i^{(p)}$ exists in the same location of two images, respectively. $y_i^{(p)}$ corresponds to the combination case of $m_i^{(p)}$-I_A, $m_i^{(q)}$-I_B; $y_i^{(q)}$ corresponds to the combination case of $m_i^{(q)}$-I_A, $m_i^{(p)}$-I_B. To summarize, $y_i^{(p)}$ and $y_i^{(q)}$ are the **results of the same asymmetric pattern matching**, but in different combination cases of subpatterns and images.

1.3. Detailed Explanation for Eq. 5

Graphical representations of Eq. 5: (Graphics are examples)

ID	Condition	$y_i^{(p)}$	$y_i^{(q)}$
(a)	$\forall\ (j,s)\|_{t_j^{(s)} \neq 0},\ c_{ji}^{(s)} = 0$		
(b)	$\exists\ (j,s)\|_{t_j^{(s)} = 1},\ c_{ji}^{(s)} = 1;\ \forall\ (j,s)\|_{t_j^{(s)} \neq 1},\ c_{ji}^{(s)} = 0$		
(c)	$\exists\ (j,s)\|_{t_j^{(s)} = 2},\ c_{ji}^{(s)} = 1;\ \forall\ (j,s)\|_{t_j^{(s)} \neq 2},\ c_{ji}^{(s)} = 0$		
(d)	$\exists\ (j,s)\|_{t_j^{(s)} = 1},\ c_{ji}^{(s)} = 1;\ \exists\ (j,s)\|_{t_j^{(s)} = 2},\ c_{ji}^{(s)} = 1$		
(e)	$\exists\ (j,s)\|_{t_j^{(s)} \in \{3,4\}},\ c_{ji}^{(s)} = 1$		

Note: Although condition (d) and condition (e) have intersection, for the convenience of description, we neither merge the two conditions into one condition, nor remove the intersection from one condition.

In conditions (b) and (c), $y_i^{(p)}$ is extracted by some weight vectors from the features of one image, $y_i^{(q)}$ is extracted by the same weight vectors from the same type of features of the other image, so $y_i^{(p)}$ and $y_i^{(q)}$ represent **the same type of single-image feature**, but correspond to different images.

In condition (d), some weight vectors are applied on features of one image, to discriminate whether subpattern $m_i^{(p)}$ exists in the location of this image; some other weight vectors are applied on the same type of features of the other image, to discriminate whether subpattern $m_i^{(q)}$ exists in the location of this image; the results of above two computations are added together to discriminate whether subpatterns $m_i^{(p)}$ and $m_i^{(q)}$ exist in the same location of two images, respectively. $y_i^{(p)}$ corresponds to the combination case of $m_i^{(p)}$-I_A, $m_i^{(q)}$-I_B; $y_i^{(q)}$ corresponds to the combination case of $m_i^{(q)}$-I_A, $m_i^{(p)}$-I_B. In conclusion, $y_i^{(p)}$ and $y_i^{(q)}$ are **the results of the same asymmetric pattern matching**, but in different combination cases of subpatterns and images.

In condition (e), results of previous asymmetric pattern matching (or results of previous asymmetric pattern matching and some single-image features) are further synthesized, which is also asymmetric pattern matching. As the values of $y_i^{(p)}$ and $y_i^{(q)}$ will be exchanged when the two input feature maps are exchanged (i.e., the two input images are exchanged), $y_i^{(p)}$ and $y_i^{(q)}$ are **the results of the same asymmetric pattern matching**, but in different combination cases of subpatterns and images.