Multi-view classifier based on Probabilistic Collaborative Representation and Latent Representation

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Abstract:

Key Words:

1 Introduction

(13).

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2 ProCRC-MV and LProCRC-MV

2.1 Probabilistic Collaborative Representation based Classifier (ProCRC)

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$X = [X_1, \cdots, X_K]$, X_k, $k \in \{1, \cdots, K\}$ k, X_k , l_X X. S X, X fi , x S, $x = X\alpha$, α , x $l(x)$. $X\alpha$ S, , $l(x)$, . $P(l(x) \in l_X)$, α. $P(l(x) \in l_X)$ α .

$$P(l(x) \in l_X) \propto \exp(-c \|\alpha\|_2^2) \quad (1)$$

c . y . S, . X , y , . $l(x)$.

$X\alpha$ k x. y, fi
x S .

$$P(l(y) \in l_X) = P(l(y) = l(x)|l(x) \in l_X) \cdot P(l(x) \in l_X) \tag{2}$$

k $P(l(y) = l(x)|l(x) \in l_X)$
x x.

$$\begin{bmatrix} y_{1,n_y} \\ y_{2,n_y} \\ \vdots \\ y_{m,n_y} \\ \vdots \\ y_{M,n_y} \end{bmatrix} = [x_1, x_2, \cdots, x_{n_X}, \cdots, x_{N_X}] \begin{bmatrix} \hat{\alpha}_{1,n_y} \\ \hat{\alpha}_{2,n_y n_y} \\ \vdots \\ \hat{\alpha}_{n_X,n_y} \\ \vdots \\ \hat{\alpha}_{N_X,n_y} \end{bmatrix}$$
$$= \hat{\alpha}_{1,n_y} \begin{bmatrix} x_{1,1} \\ x_{2,1} \\ \vdots \\ x_{m,1} \\ \vdots \\ x_{M,1} \end{bmatrix} + \cdots + \hat{\alpha}_{n_X,n_Y} \begin{bmatrix} x_{1,n_X} \\ x_{2,n_X} \\ \vdots \\ x_{m,n_X} \\ \vdots \\ x_{M,n_X} \end{bmatrix} + \cdots + \hat{\alpha}_{N_X,n_y} \begin{bmatrix} x_{1,N_X} \\ x_{2,N_X} \\ \vdots \\ x_{m,N_X} \\ \vdots \\ x_{M,N_X} \end{bmatrix} \tag{15}$$

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$$\min_Z L(X, XZ) + \lambda \Omega(Z) \tag{16}$$

$L(\cdot)$ $\Omega(\cdot)$

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X, X -

$X = \{[x_i^1, \cdots, x_i^V]\}_{i=1}^{N_X}$ N_X

V $Y = \{[y_i^1, \cdots, y_i^V]\}_{i=1}^{N_Y}$

N_Y V . , -

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. $X = \{[x_i^1, \cdots, x_i^V]\}_{i=1}^{N}$,

N V .

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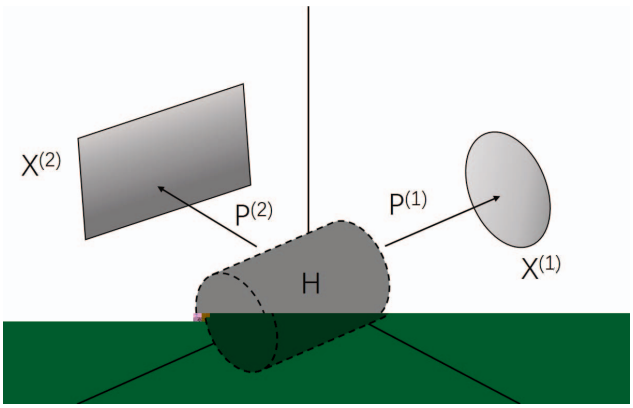
, . 1. $P = \{p^1, \cdots, p^V\}$



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$$x_i^{(v)} = P^{(v)} h_i + e_i^{(v)} \tag{1 }$$

$e_i^{(v)}$ 03( )- (8.32 80 8 3 81 .601 0 51)25(

$$\min_{P,H,Z,E_V,E_S} \|E_V\|_{2,1} + \lambda_1 \|E_S\|_{2,1} + \lambda_2 \|Z\|_2 \quad s.t. X = PH + E_V, H = HZ + E_S, PP^T = I \tag{21}$$

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$$\begin{aligned} &L(P,H,Z,E_V,E_S,J) \\ &= \|E\|_{2,1} + \lambda \|J\|_2 + (W_1, X - PH - E_V) \\ &+ (W_2, H - HZ - E_S) + (W_3, J - Z) \\ &s.t. E = [E_V; E_S];\ PP^T = I \end{aligned} \tag{22}$$

J . Z - . W_1, W_2, W_3 . . 20 fi $(C,D) = \frac{\mu}{2}\|D\|_F^2 + \langle C, D\rangle$, $\langle A,B\rangle = tr(A^TB)$, $\mu > 0$, C - . 11 , - , . - - (-)

(1) P

$$P^* = \arg\min_P (W_1, X - PH - E_V) \quad s.t. PP^T = I \tag{23}$$

1 16 , $\min_R \|Q - GR\|_F^2, s.t. R^TR = RR^T = I,$. $R = UV^T$, U V . . G^TQ. (23)

$$\begin{aligned} P^* &= \arg\min_P (W_1, X - PH - E_V) \\ &= \arg\min_P \tfrac{\mu}{2}\|X - PH - E_V + W_1/\mu\|_F^2 \\ &= \arg\min_P \tfrac{\mu}{2}\|(X + W_1/\mu - E_V) - PH\|_F^2 \\ &= \arg\min_P \tfrac{\mu}{2}\left\|(X + W_1/\mu - E_V)^T - H^TP^T\right\|_F^2 \end{aligned} \tag{24}$$

. 1 16 , . $(P^*)^T = UV^T$, U V . . $H(X + W_1/\mu - E_V)^T$.

(2) H

$$H^* = \arg\min_H (W_1, X - PH - E_V) + (W_2, H - HZ - E_S) \tag{25}$$

. H, 0, -

$$AH + HB = C \tag{26}$$

$$A = \mu P^TP \tag{2 }$$

$$B = \mu(ZZ^T - Z - Z^T + I) \tag{28}$$

$$\begin{aligned} C &= (P^TW_1 + W_2(Z^T - I)) \\ &+ \mu(P^TX + E_S^T - P^TE_V - E_SZ^T) \end{aligned} \tag{2 }$$

. (26) . 22 , - . (26) , H^*.

(3) . . Z . Z

$$Z^* = \arg\min_Z (W_3, J - Z) + (W_2, H - HZ - E_S) \tag{30}$$

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$$Z^* = (H^TH + I)^{-1}[(J + H^TH - H^TE_S) + (W_3 + H^TW_2)/\mu] \tag{31}$$

(4) . . E

$$\begin{aligned} E^* &= \arg\min_E \|E\|_{2,1} + (W_1, X - PH - E_V) \\ &+ (W_2, H - HZ - E_S) \\ &= \arg\min_E \tfrac{1}{\mu}\|E\|_{2,1} + \tfrac{1}{2}\|E - G\|_F^2 \end{aligned} \tag{32}$$

G . $X - PH - W_1/\mu$ $H - HZ + W_2/\mu$.

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(5) . J

$$\begin{aligned} J^* &= \arg\min_J \lambda\|J\|_* + (W_3, J - Z) \\ &= \tfrac{\lambda}{\mu}\|J\|_* + \tfrac{1}{2}\|J - (Z - W_3/\mu)\|_F^2 \end{aligned} \tag{33}$$

k , 2 .

(6) .

$$\begin{aligned} W_1 &= W_1 + \mu(X - PH - E_V) \\ W_2 &= W_2 + \mu(H - HZ - E_S) \\ W_3 &= W_3 + \mu(J - Z) \end{aligned} \tag{34}$$

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Algorithm 1

Input: . - $X = \{[x_i^1, \cdots, x_i^V]\}_{i=1}^N$, - k H λ

1 $P = 0$, $E_V = 0$, $E_S = 0$, $J = Z = 0$, $W_1 = 0$,$W_2 = 0$, $W_3 = 0$, $\mu = 10^{-6}$, $\rho = 1.2$, $\varepsilon = 10^{-4}$, $\max_\mu = 10^6$, H . .

2 **repeat**

3 P, H, Z, E_V, E_S, J

4 W_1, W_2, W_3

5 μ $\mu = \min(\rho\mu; \max_\mu)$

6 k $\|X - PH - E_V\|_\infty <$ ε, $\left\|H - PH - E_{\setminus S}\right\|_\infty < \varepsilon$ $\|J - Z\|_\infty < \varepsilon$

until

Output: P, H, Z E

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3 Experimental results

3.1 ProCRC-MV

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. $X = \{[x_i^1, \cdots, x_i^V]\}_{i=1}^{N_X}$
x_i ,
$X^{M \times N_X} = [x_1, \cdots, x_{n_X}, \cdots, x_{N_X}]$, $n_X \in \{1, \cdots, N_X\}$. $Y = \{[y_i^1, \cdots, y_i^V]\}_{i=1}^{N_Y}$
y_i, $Y^{M \times N_Y} = [y_1, \cdots, y_{n_Y}, \cdots, y_{N_Y}]$,
$n_Y \in \{1, \cdots, N_Y\}$, M . -
. , $X^{M \times N_X}, Y^{M \times N_Y}$
$\{l_i\}_{i=1}^{N_X}$, $\{l_i\}_{i=1}^{N_Y}$ -
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3.2 LProCRC-MV

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$X = \{[x_i^1, \cdots, x_i^V]\}_{i=1}^{N_X}$ $Y = \{[y_i^1, \cdots, y_i^V]\}_{i=1}^{N_Y}$. - . .
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2 . (%)

	88. ±3.4	.6±2.3	2.6±5.4	0.4±2.0	2.5±5.5	6. ±5.4	85.0±4.
.	63.8±4.0	5.0±0.2	8 .2±1.	2.8±0.5	4 .5± .4	6 .2±4.3	51.4±3.8
	50.1±2.6	5.4±0.1	5 .5±0	3 .8±1.2	41.4±1.	58.0±1.	53.0±1.5
	33.5± .0	100±0	81.8±1.	5.5±2.8	60. ±5.1	65.1±5.0	64.5±2.5
	8.6±1.3	100±0	8.6±1.3	6.1±1.	.5±6.4	.3±6.1	8.5±5.0

3 1- (%)

	8 . ±3.8	. ±2.6	2.65±4.2	8 .1±2.3	5 .4±8.	61.8±11.5	6 .4± .
.	62.5±4.	3. ±1.3	8 .0±3.0	1.2±0.1	32. ±6.2	4 .1±5.0	3 .8±3.
	50. ±2.5	6.1±0.1	55.5±0	32.3±3.2	26.1±1.5	51.1±1.4	40.0±2.5
	32.2±5.	100±0	84.2±2.2	3.4±6.4	42.8±4.6	53.6±8.5	.8±2.
	8. ±1.2	100±0	8. ±1.2	6.0±2.0	66.0±8.4	60.3± .5	66.0±8.4

4 . (%)

	88. ±3.4	.6±2.3	2.6±5.4	0.4±2.0	2.5±5.5	6. ±5.4	85.0±4.
.	63.8±4.0	5.0±0.2	8 .2±1.	2.8±0.5	4 .5± .4	6 .2±4.3	51.4±3.8
	50.1±2.6	5.4±0.1	5 .5±0	3 .8±1.2	41.4±1.	58.0±1.	53.0±1.5
	33.5± .0	100±0	81.8±1.	5.5±2.8	60. ±5.1	65.1±5.0	64.5±2.5
	8.6±1.3	100±0	8.6±1.3	6.1±1.	.5±6.4	.3±6.1	8.5±5.0
-	5.5± .0	100±0	8.8±0.5	4. ±1.5	80.8±4.4	.6±5.1	86.8±4.8

5 1- (%)

	8 . ±3.8	. ±2.6	2.65±4.2	8 .1±2.3	5 .4±8.	61.8±11.5	6 .4± .
.	62.5±4.	3. ±1.3	8 .0±3.0	1.2±0.1	32. ±6.2	4 .1±5.0	3 .8±3.
	50. ±2.5	6.1±0.1	55.5±0	32.3±3.2	26.1±1.5	51.1±1.4	40.0±2.5
	32.2±5.	100±0	84.2±2.2	3.4±6.4	42.8±4.6	53.6±8.5	50.8±2.
	8. ±1.2	100±0	8. ±1.2	6.0±2.0	66.0±8.4	60.3± .5	66.0±8.4
-	5.4± .	100±0	8.0±0.8	5.0±0.3	6 .6±6.1	65.5±4.	63.8±6.3

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4 Conclusions and Discussion

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