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| **Algorithm** |  |
| **Input:**  *P* data matrices **X1**,**X2**,…,**XP**, parameters  **Output:**  *P* basis matrices **U1**,**U2**,...,**UP**,*P* relation matrices **W1**,**W2**,…,**WP**, factor matrices **V**, weight vector  1:**Begin**  2:Initialize **U1,U2,…,UP,W1,W2,…,WP,V**  3:Initialize  4:**loop**  5: **for** p=1 to *P* **do**  6: Fix **V**, update **UP,WP**  7: **end for**  8: Fix **U1**,**U2**,...,**UP**, update **Vl**  9: Fix **U1**,**U2**,...,**UP**, update **Vul**  10: **for** p=1 to *P* **do**  11: Fix **U**,**W**,**V**, compute  12: **end for**  13: **Update**  14:**break** loop if convergence  15:**End** | |



**We define:**



1. Fix V,W, update U

Lagrange function:



Using KKT condition, we get:



1. Fix U,V, update W

Lagrange function:



Using KKT condition, we get:



1. Fix U,W, update Vl

 Using KKT condition,



update Vul

 Using KKT condition,



1. Update ,using optimization tools

When U,V,W are fixed,minimization of is a convex optimization

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Graph Laplacian :



Prove:

