Membership Representation for Detecting Block-diagonal Structure in Low-rank or Sparse Subspace Clustering
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1. Overview of subspace clustering

Subspace clustering divides data into groups, each of which forms a linear subspace. There are many examples that are adequate for subspace clustering, such as motion, face, and texture.

2. Proposal: Membership representation / normalized membership representation

Properties of membership matrix
1. Each element is either zero or one.
2. It can be transformed into a block-diagonal matrix, by permuting the same indices of rows and columns.
3. It is positive semidefinite (PSD).
4. It has integral eigenvalues.
5. For an ideal \( W \), that has the same block-diagonal structure with \( W \) satisfy:

Properties of normalized membership matrix
1. It is doubly stochastic, i.e., \( F F^T = I \).
2. It can be transformed into a block diagonal matrix, by permuting the same indices of rows and columns.
3. These optimization problems are complex. Auxiliary variables (e.g., \( M = M_1 = M_2 \))
4. Sets of membership / normalized membership matrices are discrete.

3. Procedure

1. \( W \) is not ideal. Minimize the errors.
2. Solutions become trivial. Regularization terms.

4. Results

Compared methods: Normalized cut (Shi and Malik, TPAMI 2000)

5. Conclusion

• We propose the membership representation (MR), which detects the block-diagonal structure in the output of subspace clustering.
• MR is a self-expressive system based on a Hadamard product.
• The final output is a normalized membership matrix, which is a doubly stochastic normalization of \( M \). It has eigenvalues in between zero and one.
• A simple eigenvalue-counting method showed competitive results in the experiments.

Any questions, comments, or suggestions are welcome! (Email: mileepaper@hanyang.ac.kr)