Pattern Recognition and Machine Learning: Homework 3, Zhengzuo Liu

Problem 1

Task 1

Answer:

Denote the objective function of LapRLS as S.

Let $\nabla_W S = 0$, get

$$-2(JK)^T(Y - JKW^*) + \gamma_A l(KW^* + K^T W^*) + \frac{\gamma_I l}{(u+l)^2}((KLK)W^* + (KLK)^T W^*) = 0$$

$$\xrightarrow{J^2=J} -2KY + 2KJKW^* + 2\gamma_A lKW^* + \frac{2\gamma_I l}{(u+l)^2}KLKW^* = 0$$

$$\xrightarrow{\frac{1}{2}K^{-1}\times} JKW^* + \gamma_A lIW^* + \frac{\gamma_I l}{(u+l)^2}LKW^* = Y$$

$$W^* = (JK + \gamma_A lI + \frac{\gamma_I l}{(u+l)^2}LK)^{-1}Y$$

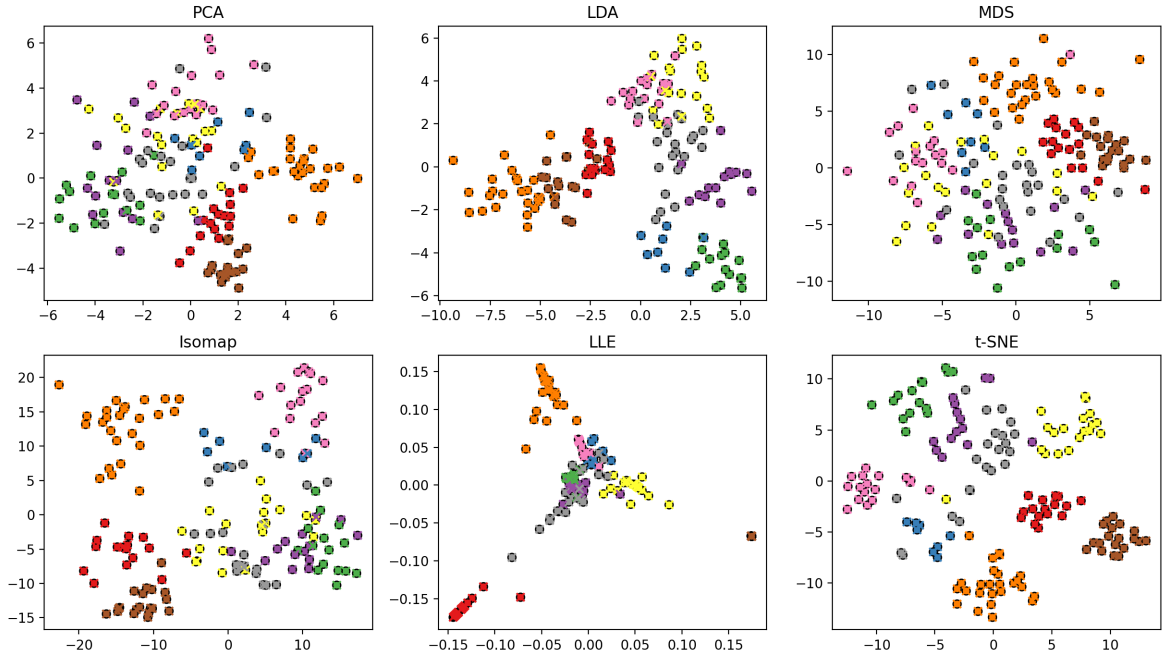
Task 2

The accuracy result on data set "digits" is: RLS: 0.818±0.0695; LapRLS: 0.896±0.0186.

While using data set "usps", the result could not be obtained due to the following error ValueError: ('Lengths must match to compare', (930,), (1, 930))

Task 3

The prediction results of the two methods are as follows (LapRLS and RLS):


PCA
LDA
MDS
Isomap
LLE
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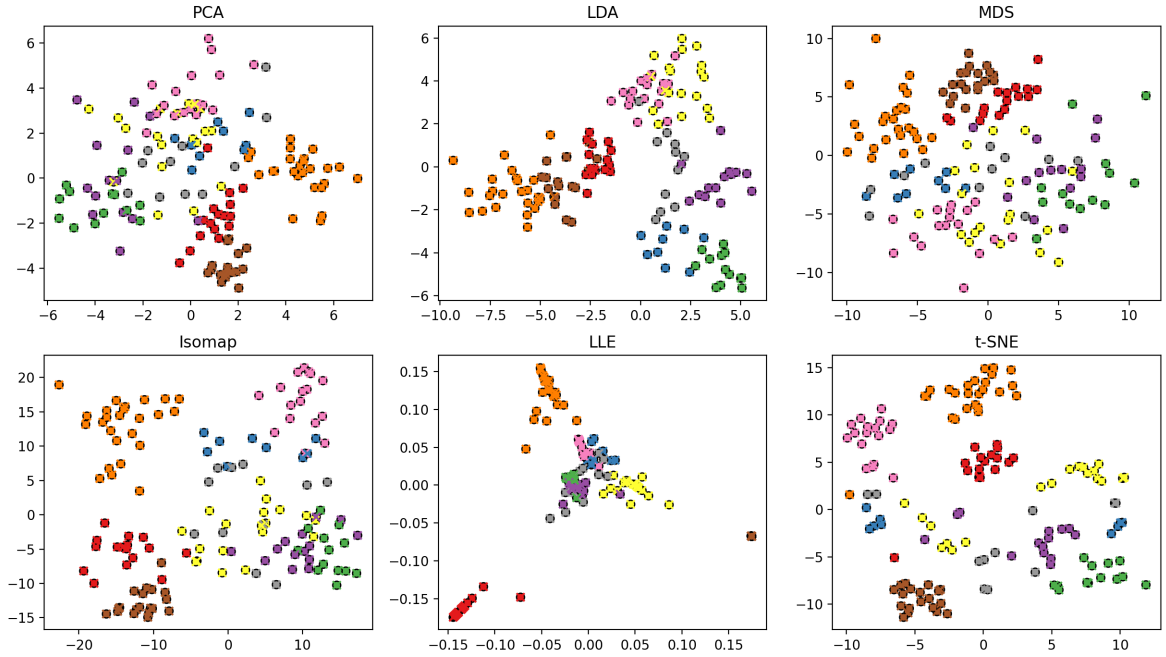
PCA
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