

Feb 6, 2020

Kangbo OIT: Rhodes 405

Mon 2:30

Dimensionality reduce / latent factor models

$$\begin{matrix} n \\ \boxed{A} \\ m \end{matrix} \approx \begin{matrix} k \\ \boxed{L} \\ m \end{matrix} \begin{matrix} k \\ \boxed{M} \\ k \end{matrix} \begin{matrix} n \\ \boxed{R} \\ k \end{matrix}$$

Goal:

- generative models
- think in smaller dims
- factors say something meaningful
- denoising

k-means:  $A = LR$

TSVD:  $A = U_k \Sigma_k V_k^T$

$$\begin{matrix} n \\ \boxed{A} \\ m \end{matrix} \approx \begin{matrix} \boxed{U} \\ \boxed{\Sigma} \\ \boxed{V^T} \end{matrix}$$

$$\min_Z \|A - Z\|_F$$

$$\text{s.t. } \text{rank}(Z) = k$$



















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||  $\arg \min_S$

$$\beta \gamma \|S\|_1 + \frac{1}{2} \|(A - Z^k) - S\|_F^2 + \langle \beta \Lambda^k, Z^k + S - A \rangle$$
$$\beta \gamma \|S\|_1 + \frac{1}{2} \|A - Z^k - \beta \Lambda^k - S\|_F^2$$

Alternate  $S/Z/\Lambda$

$$s^{k+1} = \arg \min_S \beta \gamma \|S\|_1 + \frac{1}{2} \|(A - Z^k) - S\|_F^2 + \langle \beta \Lambda^k, Z^k + S - A \rangle$$

$$= \arg \min_S \beta \gamma \|S\|_1 + \frac{1}{2} \|A - Z^k - \beta \Lambda^k - S\|_F^2$$

$$= S_{\beta \gamma} (A - Z^k - \beta \Lambda^k)$$

$$z^{k+1} = \arg \min_z \beta \|z\|_* + \frac{1}{2} \|(A - S^{k+1}) - z\|_F^2 + \langle B \wedge^k, z + S^{k+1} - A \rangle$$

$$= \arg \min_z \beta \|z\|_* + \frac{1}{2} \|A - S^{k+1} + B \wedge^k - z\|_F^2$$

$$\text{prox}_{\beta \|\cdot\|_*} (A - S^{k+1} + B \wedge^k)$$