ONLINE LEARNING IN THE MANIFOLD OF LOW-RANK MATRICES

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Matrix models in machine learning

- Similarity learning:
  \[ \text{similarity}_W(p, q) = p^T W q \]
- Multitask learning:
  \[ y_{pred} = W \cdot x \]

- Low-rank matrix models:
  Natural regularization and significant speedup and memory savings

- Online learning approach for tackling large scale problems
Low-rank Manifold and Online Learning

- Enforcing low-rank constraints is computationally hard.
- Low rank matrices form a manifold.
- Online learning: follow a path within the manifold. The ideal path follows geodesics down the gradient.
- Projected gradient approximates the ideal path, but requires SVD every step.
- Approximations to the geodesic are called retractions. We formulate a new retraction that is computed more efficiently.
**ALGORITHM**

**LORETA:** L0w-rank RETraction Algorithm

- Has *linear* runtime complexity
- Fully exploits the memory and computational complexity savings of low-rank models
- Achieves superior accuracy in two tasks: large scale document similarity and image labeling

*More details at poster W23*