Online Learning in The Manifold of Low-Rank Matrices

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Matrix models in machine learning

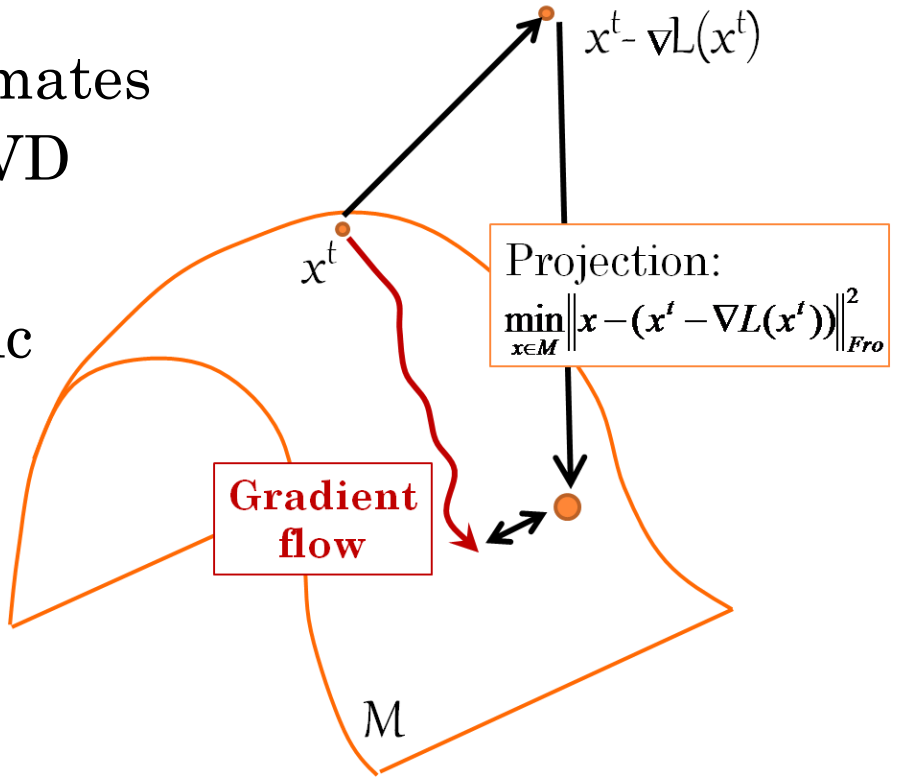
- Similarity learning:
  $similarity_W(p,q) = p^T W q$

  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: LOw-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***