A Review on Multi-View Learning

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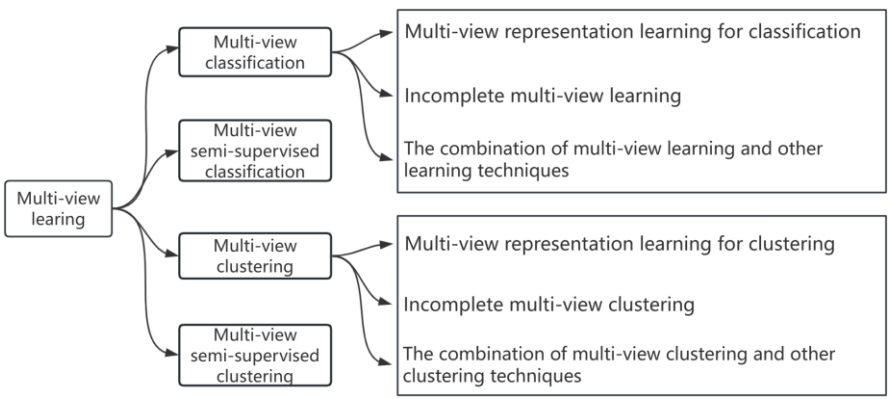
Problems & Ideas

- Problems of existing reviews on multi-view learning:
  - Existing reviews only focus on a specific task, such as classification or clustering task, or on a specific methodology, such as representation learning or deep learning.
  - Few reviews comprehensively encompassing almost all works and systematically elucidate existing methods based on learning paradigms.
- Ideas: A review from the perspective of learning paradigms, covering the basic concepts, technologies, methods and categorizations, applications and challenges.

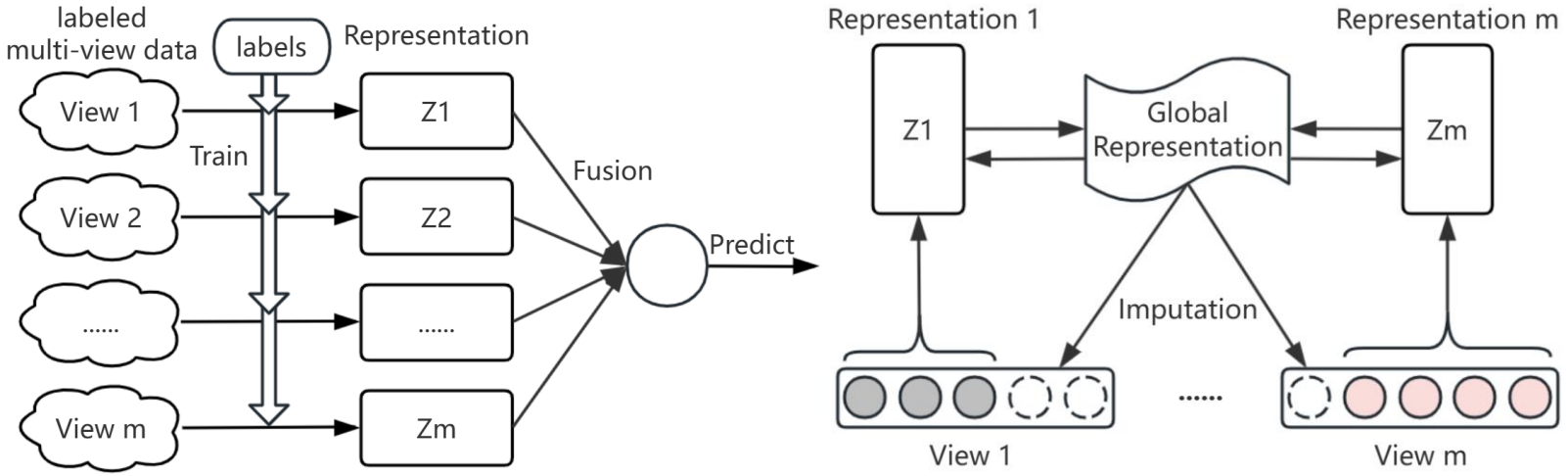
References	Task	Categories
Xu et al. [6]	Multi-view classification	co-training, multiple kernel learning, subspace learning
Li et al. [10]	Multi-view classification	multi-view representation alignment, multi-view representation fusion(multi-modal topic learning, multi-view sparse coding, multi-view latent space Markov networks, multi-modal autoencoders, multi-view convolutional neural networks, and multi-modal recurrent neural networks)
Li et al. [11]	Multi-view classification	multi-view construction methods, interactivity enhancement methods, multi-view fusion methods
Zhao et al. [12]	Multi-view classification	co-training, co-regularization, margin-consistency
Yan et al. [13]	Multi-view classification	multi-view auto-encoder, multi-view conventional neural networks, multi-view deep brief networks, deep multi-view canonical correlation analysis, deep multi-view matrix factorization, deep multi-view information bottleneck
Yang et al. [14]	Multi-view clustering	co-training, multi-kernel learning, graph clustering, subspace clustering, multi-task clustering
Fu et al. [15]	Multi-view clustering	graph based model, space learning based model, binary code learning based model
Wen et al. [16]	Multi-view clustering	matrix factorization-based incomplete multi-view clustering (IMC), kernel learning-based IMC, graph learning-based IMC, deep learning-based IMC
Chao et al. [17]	Multi-view clustering	generative methods, discriminative methods (five groups: common eigenvector matrix, common coefficient matrix, common indicator matrix, direct combination, combination after projection)
Fang et al. [18]	Multi-view clustering	heuristic-based approaches, neural network-based approaches
Ours	Multi-view classification Multi-view clustering	multi-view classification methods, multi-view semi-supervised classification methods, multi-view clustering methods, multi-view semi-supervised clustering methods



Left: The overview of different surveys for multi-view learning; Right: The categorizations of the survey on multi-view learning.

Main Contributions

- Contributions:
  - This survey provides a review of multi-view learning from a novel perspective of machine learning paradigms(i.e. the task level), systematically categorizing existing multi-view learning methods by considering different supervised scenarios and types of tasks;
  - Further categorizations and discussions have been conducted on multi-view representation learning and incomplete multi-view learning from both technical level and data level;
  - The existing applications, future developments, and challenges of multi view learning have also been discussed deeply.



Further categorizations and discussions on multi-view learning. Left: The scheme of multi-view representation learning (technical level); Right: The scheme of incomplete multi-view learning (data level);