A survey on trajectory representation learning methods

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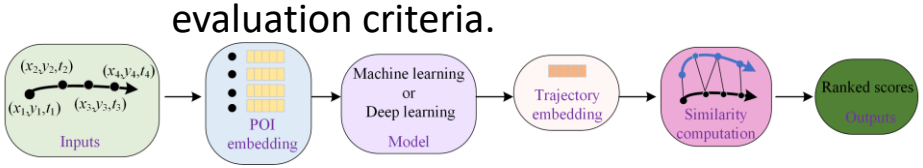
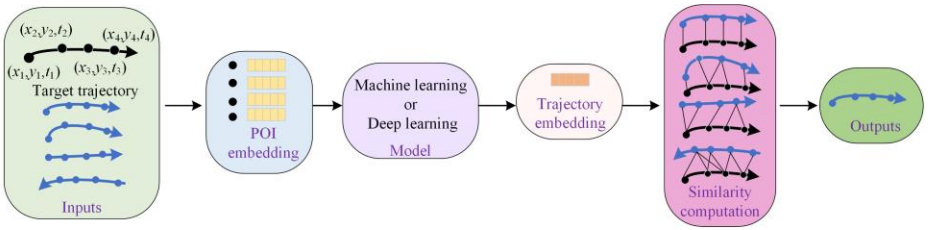
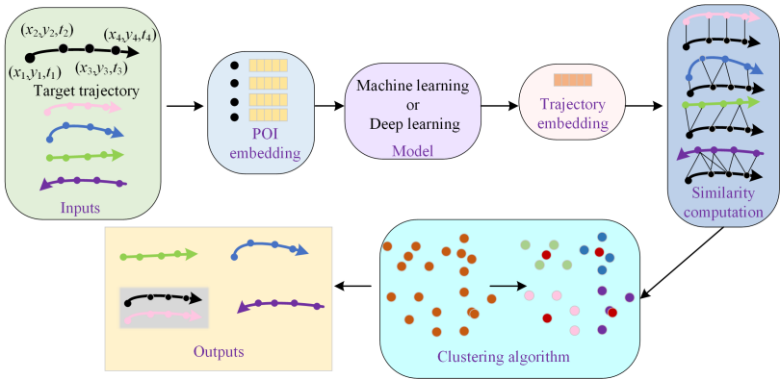
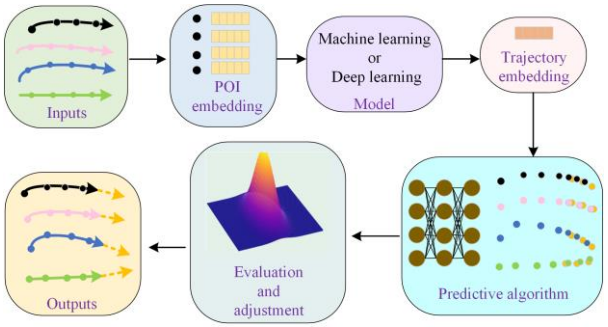
Problems & Ideas

- **Problems of conventional trajectory representation learning approaches:**
  - Traditional trajectory processing methods require fixed-length input vectors, which necessitates the conversion of inherently variable-length trajectory data into low-dimensional embeddings, potentially losing semantic richness.
  - Existing works often overlook detailed model comparisons and are not structured to analyze the task-dependent nature of trajectory representation.
- **Ideas: A task-driven taxonomy and comparative study of trajectory representation learning methods:**
  - This paper proposes a task-oriented framework to organize and analyze trajectory representation learning methods according to four core downstream tasks: **trajectory similarity computation(Top-left), similar trajectory search(Top-right), trajectory clustering(Bottom-left), and trajectory prediction(Bottom-right).**
  - Emphasis is placed on aligning the learning strategy with the task's unique characteristics and evaluation criteria.









Main Contributions

- Contributions:
  - A comprehensive literature review connecting trajectory representation methods to specific downstream applications.
  - A task-driven classification of existing methods, revealing the distinct design philosophies behind trajectory similarity, clustering, search, and prediction.
  - Comparative analysis of representative models in each task, including architectural principles, strengths, and limitations.
  - Identification of critical challenges such as data sparsity, multimodality, and privacy, with proposed research directions for addressing them.