

OUTLINE

Introduction

Challenges of Building UFMs

Overview of UFMs

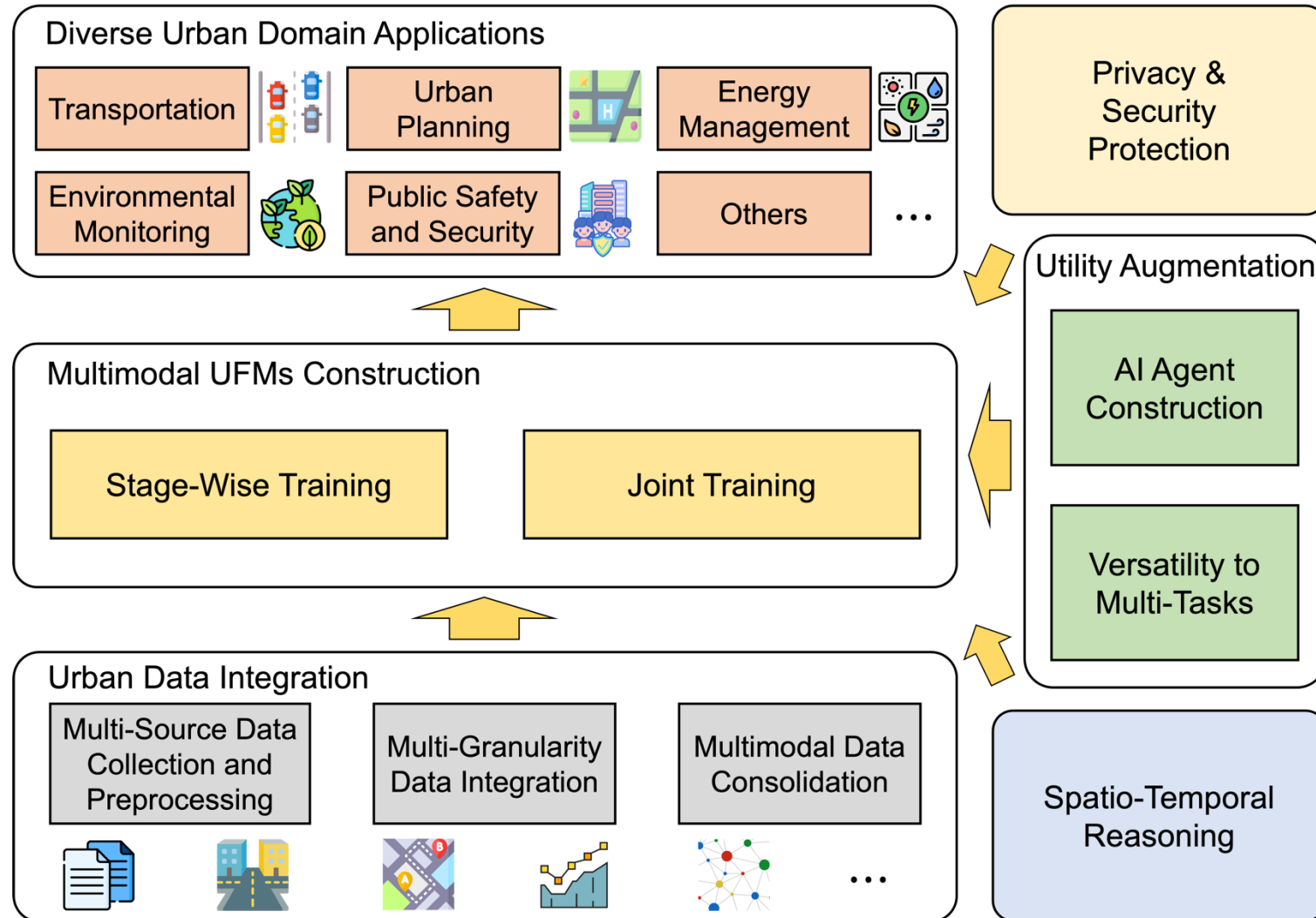
 **Prospects of UFMs**

Summary

Prospective Framework of UFM



- Future UFM may be a multi-agent system with a world simulator



A prospective framework for building versatile multimodal UFM.



➤ Multi-source Data Collection and Preprocessing

- Collect, select, augment multi-source urban data
- Preprocess and transform multi-source urban data

➤ Multi-granularity Data Integration

- Data standardization
- Hierarchical data structuring
- Data cross-referencing

➤ Multimodal Data Consolidation

- Data encoding
- Data alignment
- Multimodal data fusion



Stage-wise Training

Constructing unimodal
FMs separately



Aligning unimodal FMs
using multimodal
urban data

V.S.

Joint Training

Optimizing the entire
multimodal UFM jointly
using multimodal
urban data



Stage-wise Training

Pros:

- 1) Flexibility in integrating more modalities;
- 2) Can leverage established FMs.

urban data

V.S.

Joint Training

Pros:

- 1) End-to-end training;
- 2) Mutual enhancement among multimodal data.

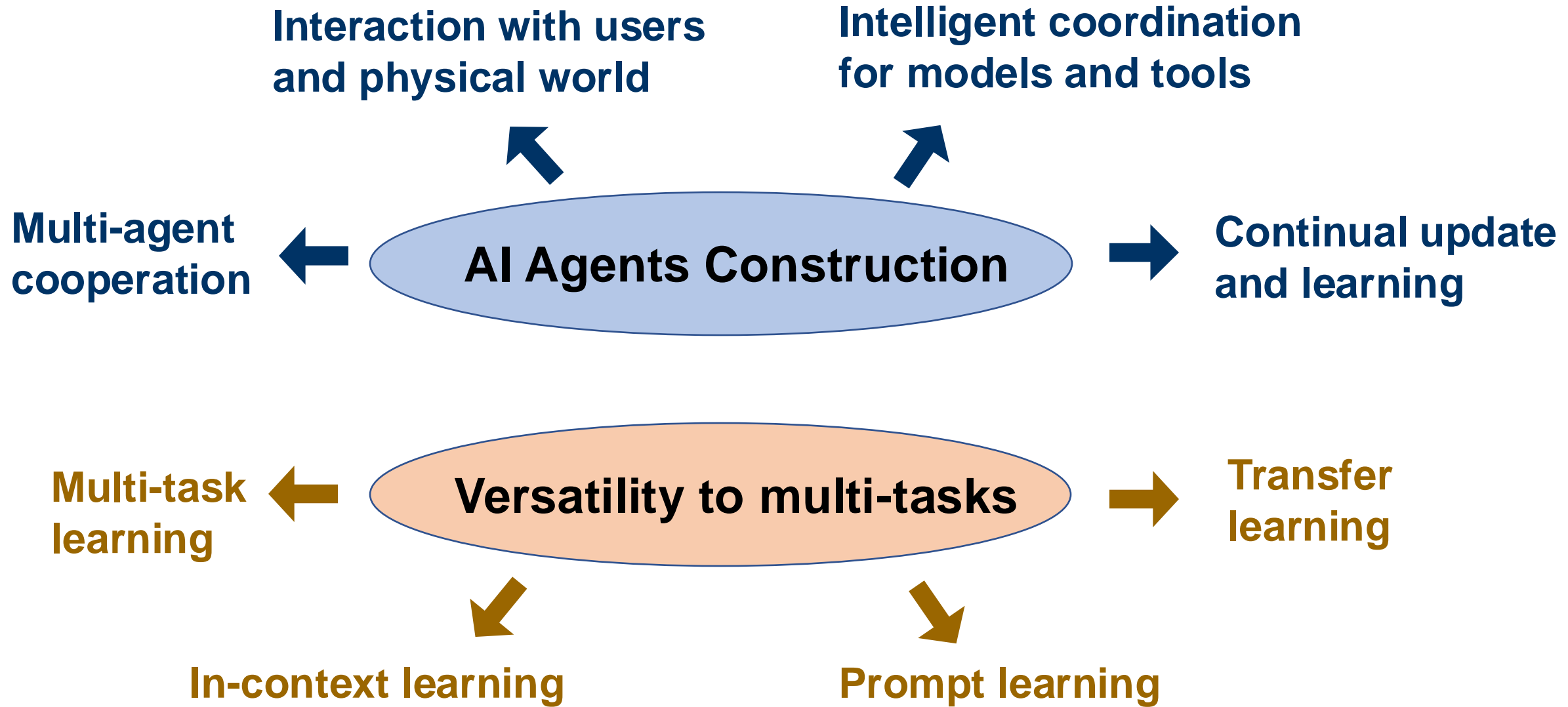


Spatial Reasoning

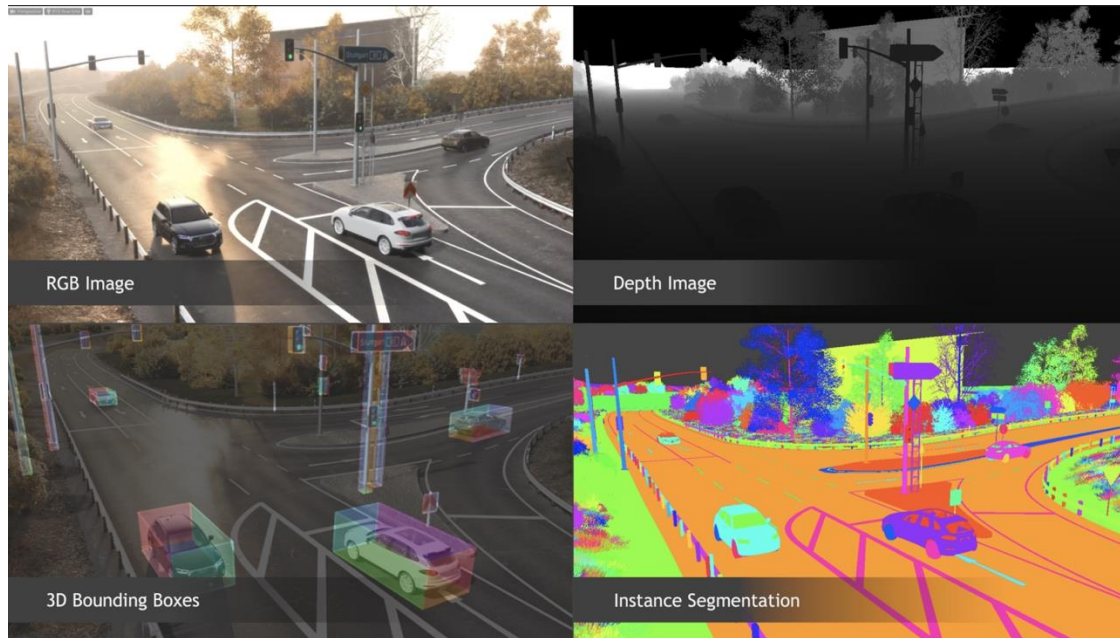
- Tool invocation (GIS tool, GeoKG, database)
- Universal location embeddings
- Cross-modal geospatial alignment
- High-level geospatial capability learning

Temporal Reasoning

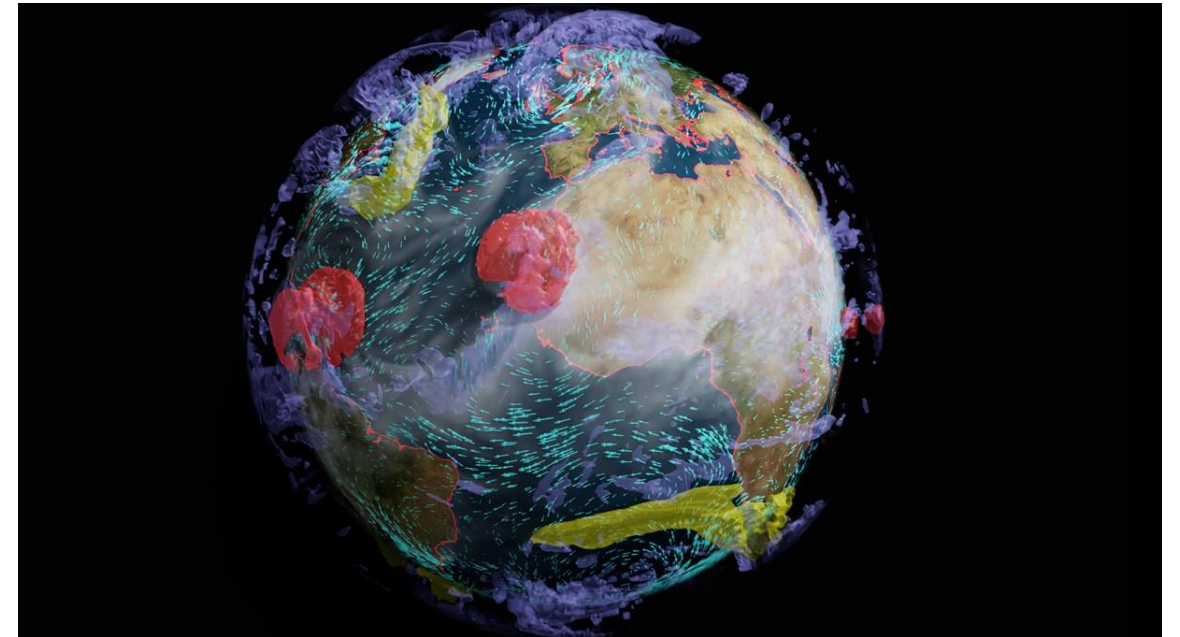
- Time embedding
- Temporal contextualization
- Sequence modeling



- Latest generative models, e.g., Nvidia Earth-2, Sora, opens a new window to nexus the physical and cyber world.



NVIDIA DRIVE Sim powered by Omniverse



Earth-2 used to predict weather



Privacy preservation

- Federated learning of UFM s based on isolated and private data
- Prevention of user privacy leakage in user-UFM interactions
- Privacy-preservation of large model parameters



Security protection

- System and model level protection of malicious attacks
- Alignment of UFM s to human preference
- Defending generation of harmful, disruptive, and hallucinate outputs



Data and model pricing

- Data pricing: contribution measurement and incentive for collaborative learning
- Model pricing: incentive for UFM development

OUTLINE

Introduction

Challenges of Building UFM's

Overview of UFM's

Prospects of UFM's



Summary



■ Summary

- Definition of *Urban Foundation Models (UFMs)*
- Challenges of constructing UFMs
- Taxonomy of existing UFM studies
- A systematic review of Urban Foundation Models
- Prospects of UFM studies

■ Future Work

- Integration of multi-source, multi-granularity and multimodal urban data
- Enhancing spatiotemporal reasoning capabilities
- Understanding urban dynamics and providing timely urban insights

The ultimate question: What are the ideal form of cities and societies?

We cannot achieve what we cannot imagine.



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Thank you!
Q & A



Tutorial Website



Survey Paper



Github