Trajectory World Models for Heterogeneous Environments

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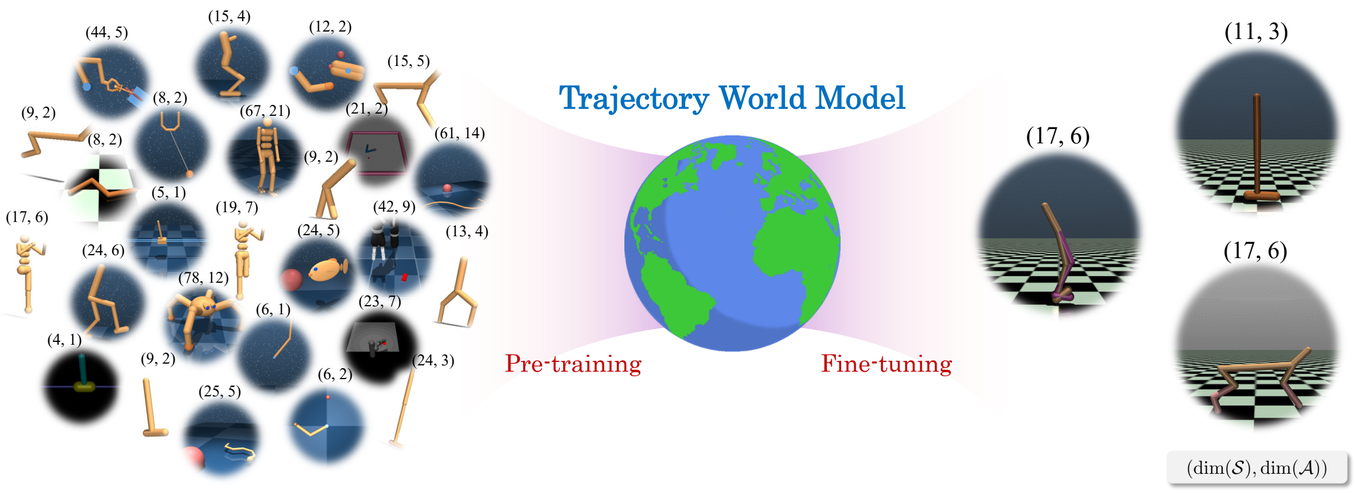
ICLR

Motivation: Heterogeneity inherent in sensor and actuator information



Motivation:

World models are all with videos or language?

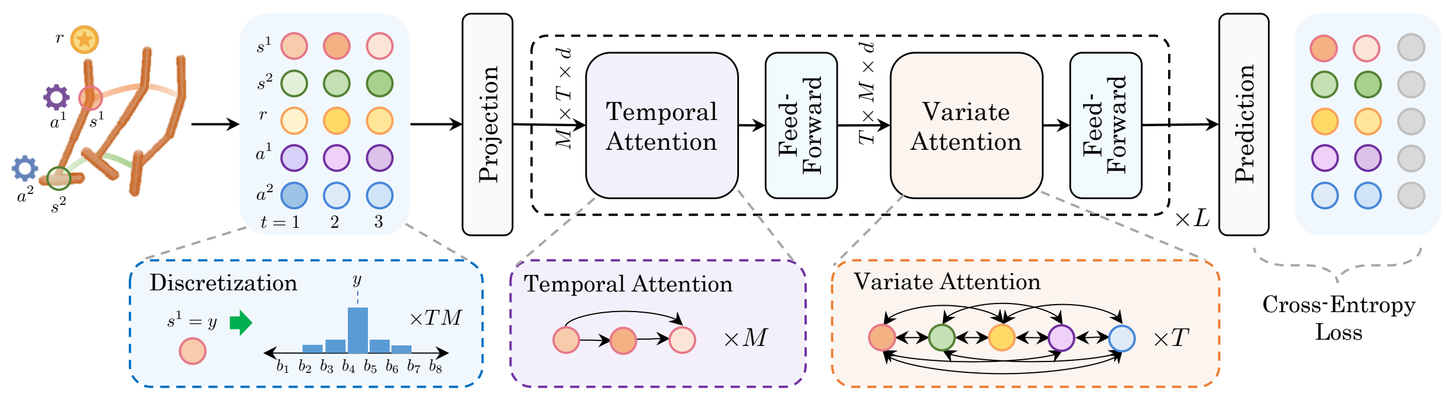
No modality in world models should be left behind, including essential sensor information represented as low-dimensional vectors!

How can we pre-train a world model to extract shared knowledge from trajectories across heterogeneous environments?

Method: TrajWorld (Trajectory World Models)

Overview:

TrajWorld, designed for flexibility in handling divergent state and action definitions, is capable of flexibly handling varying sensor and actuator information and capturing environment dynamics in-context.



Intuition:

1. Rediscovering homogeneity in scalars.
2. Identifying environment through historical context.
3. Inductive bias for two-dimensional representations.

Interleaved temporal-variate attentions:

1. temporal attention

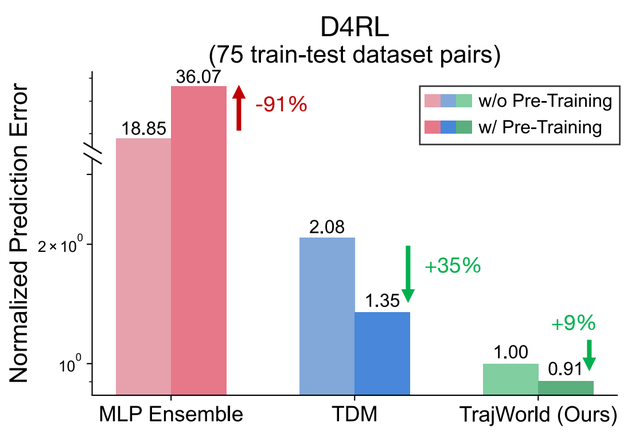
$$U^l_{1:T,j} = \text{CausalAttention}(Z^{l-1}_{1:T,j}), \quad \forall j \in [M],$$

2. variate attention

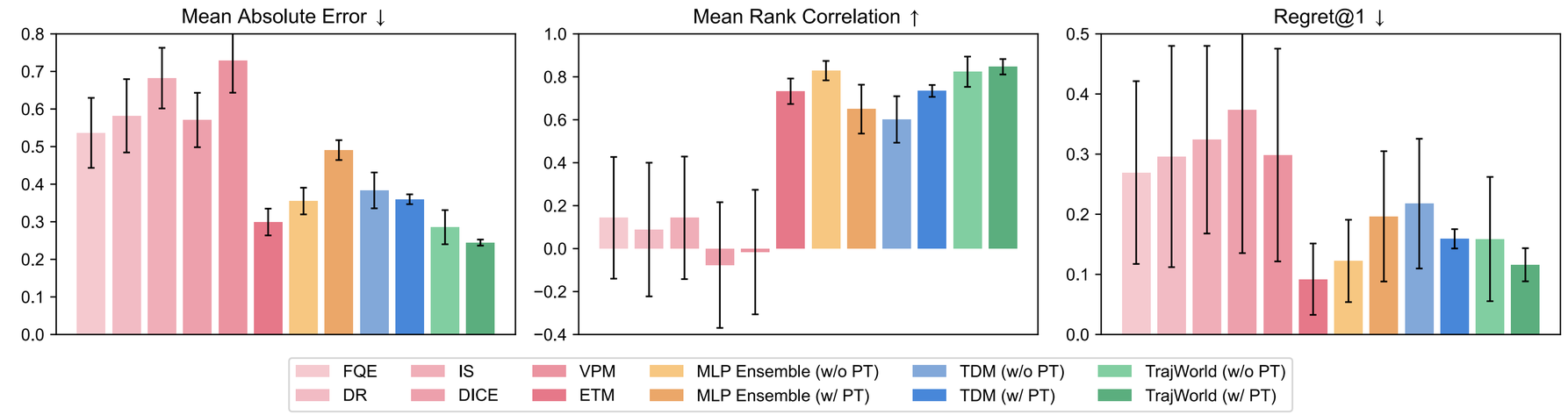
$$V^l_{i,1:M} = \text{Attention}(\hat{U}^l_{i,1:M}), \quad \forall i \in [T].$$

Experiments

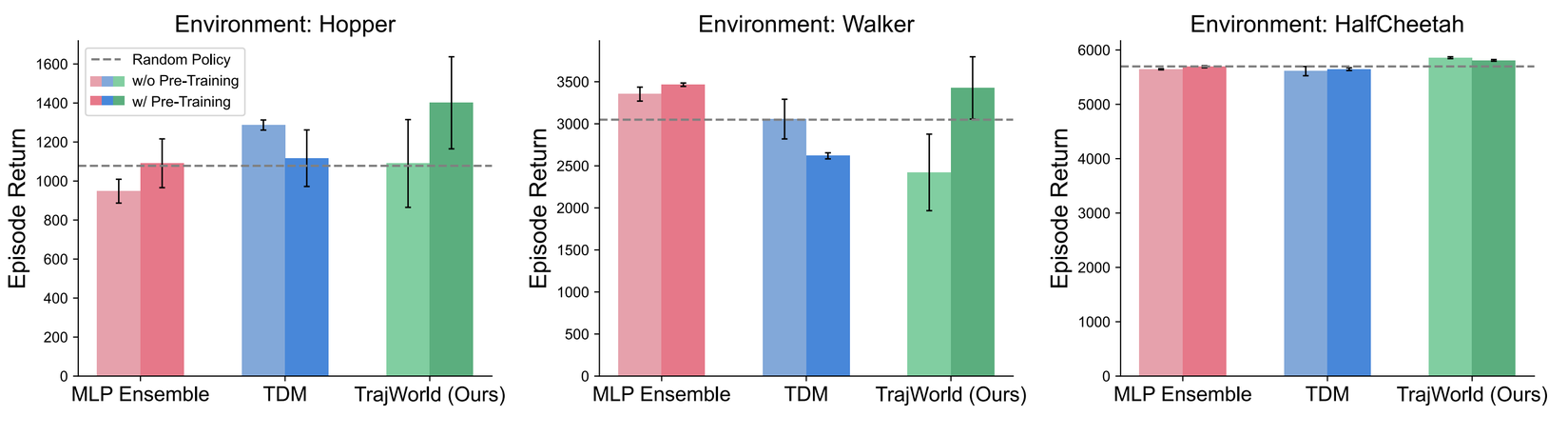
Transition Prediction



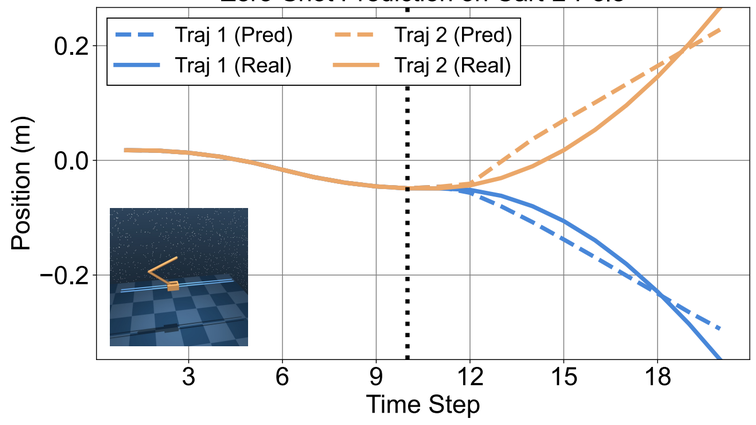
Off-Policy Evaluation (OPE)



Model Predictive Control (MPC)

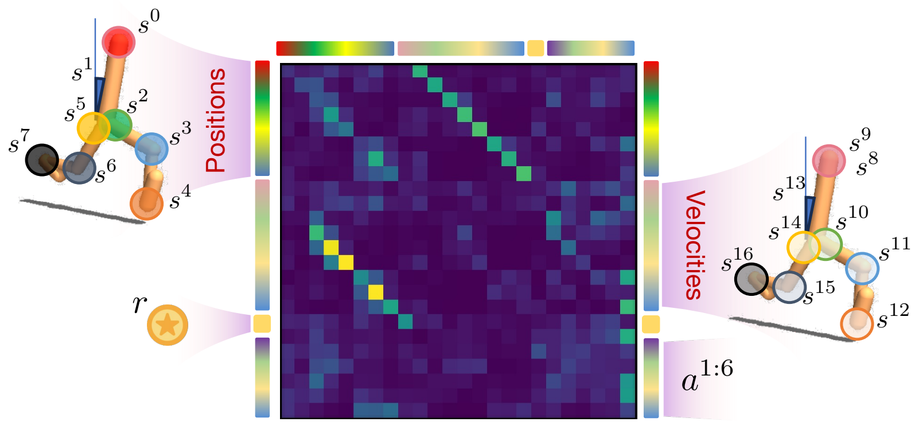


Zero-Shot Transfer



Vision of the future

Towards multimodal world models incorporating proprioceptive, visual and linguistical observations



Attention Analysis

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