

Few-Shot Task Learning through Inverse Generative Modeling

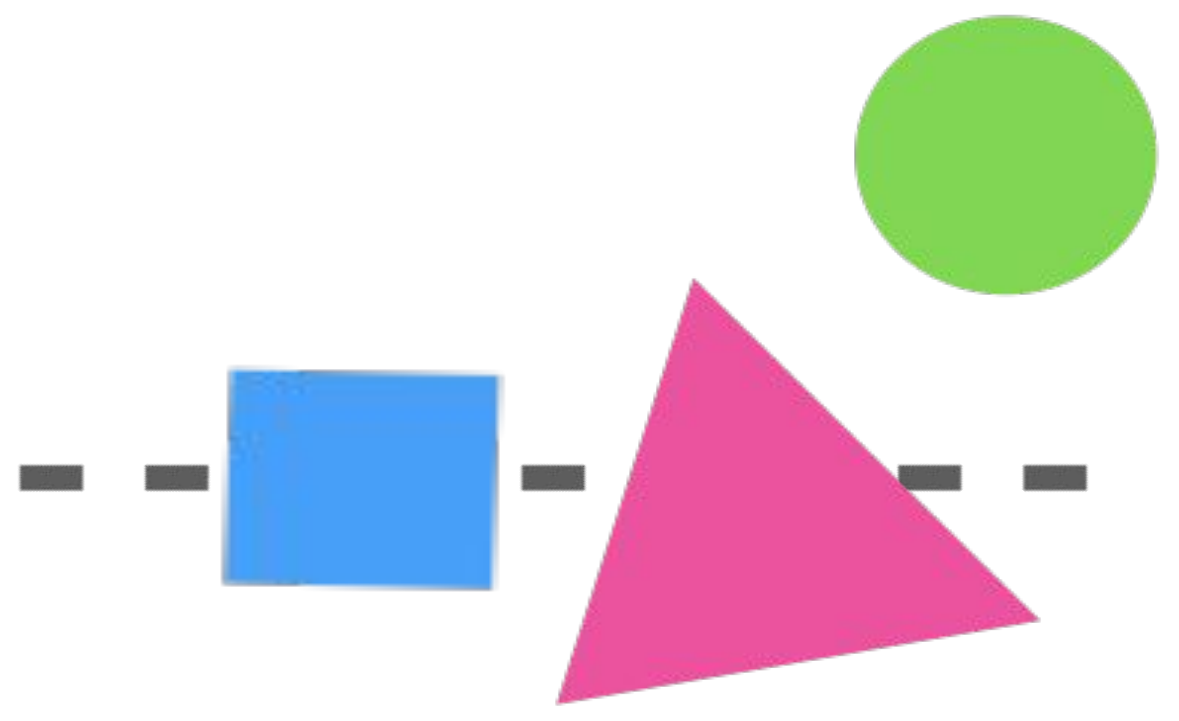
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Joshua Tenenbaum, Tianmin Shu and Pulkit Agrawal

NeurIPS 2024



Learn a Task (Goal/Motion) from Demonstrations

Object
Rearrangement



MoCap



Goal-Oriented Navigation

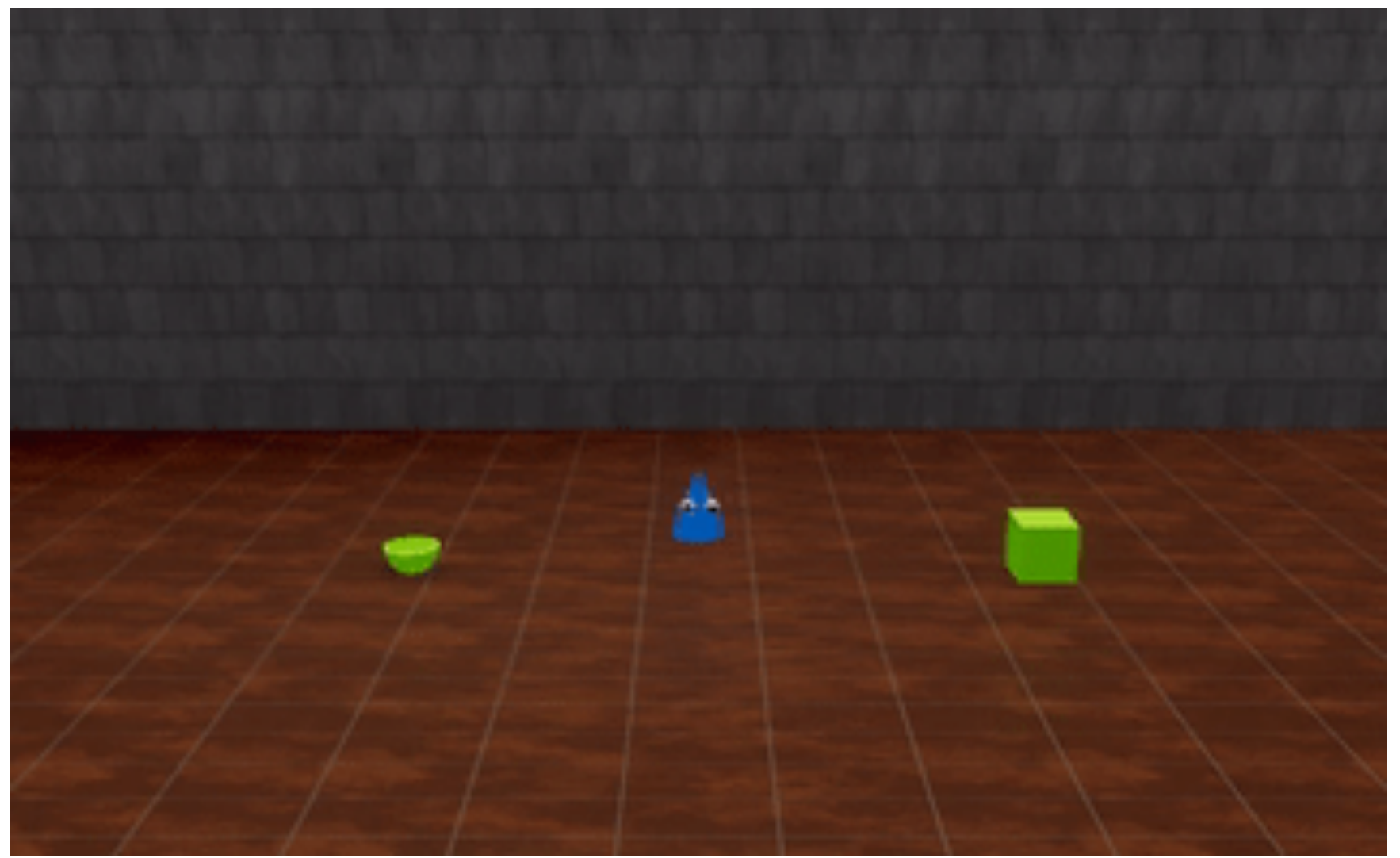
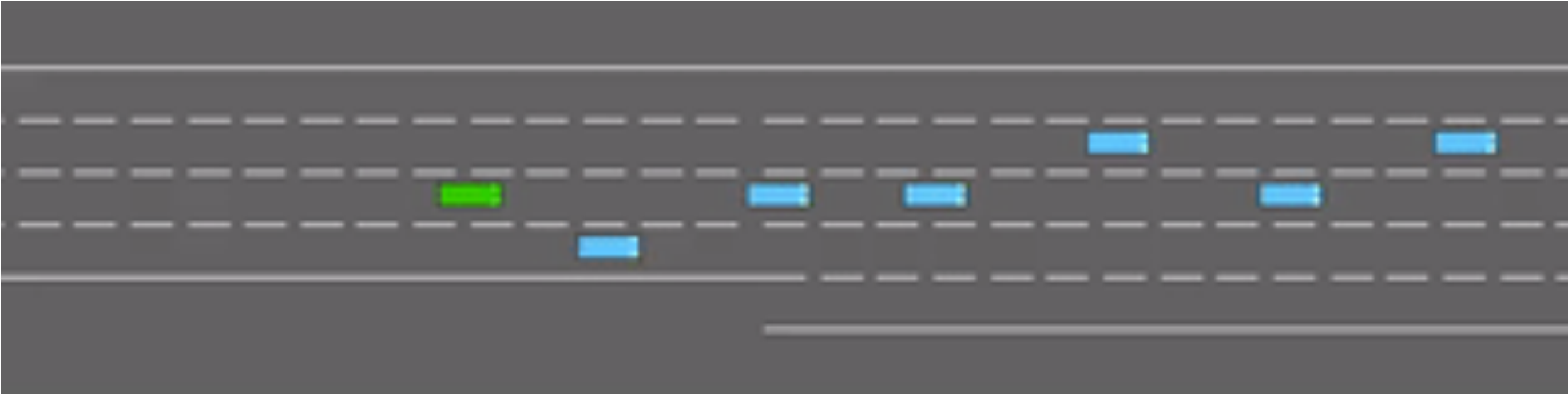


Table-Top Manipulation



Driving



Task Representation

BC — Policy π_θ

Requires learning a new policy model mimicking the demos

IRL — Reward R_θ

Requires learning a reward model for the new task

In-Context — Trajectories $\{\tau\}_i$

Ours — Latent c

Training Tasks



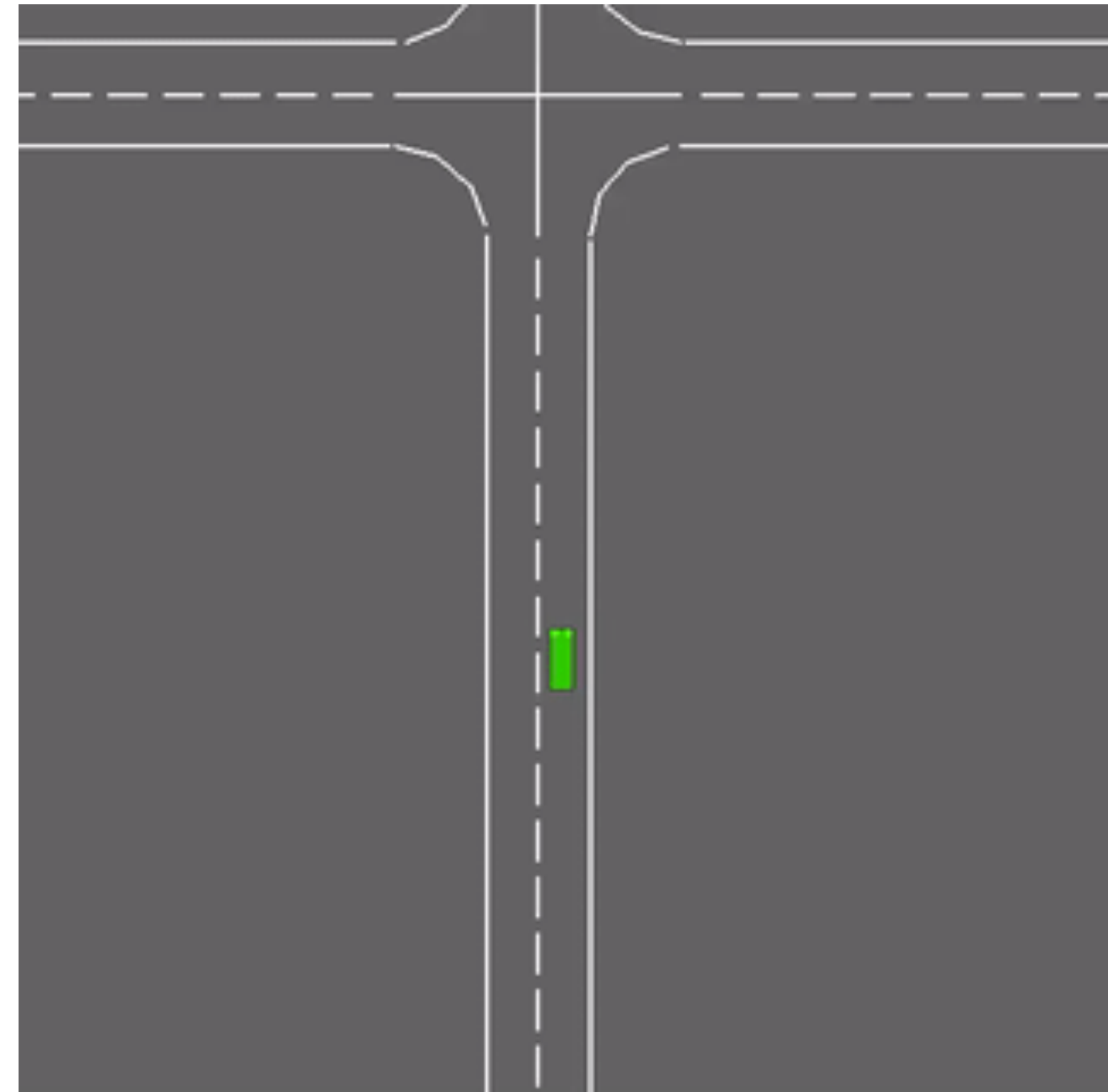
merge



exit

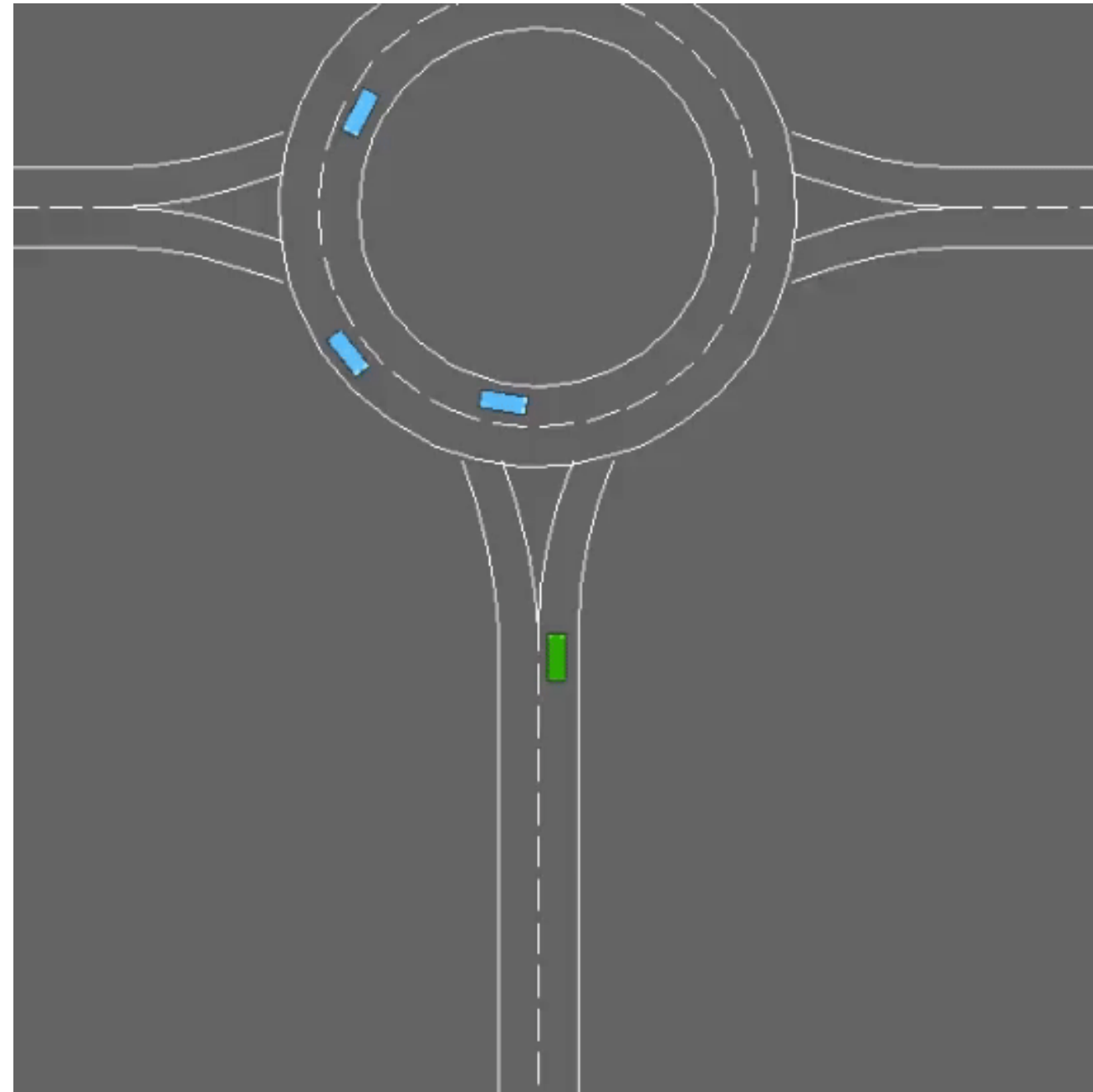


highway



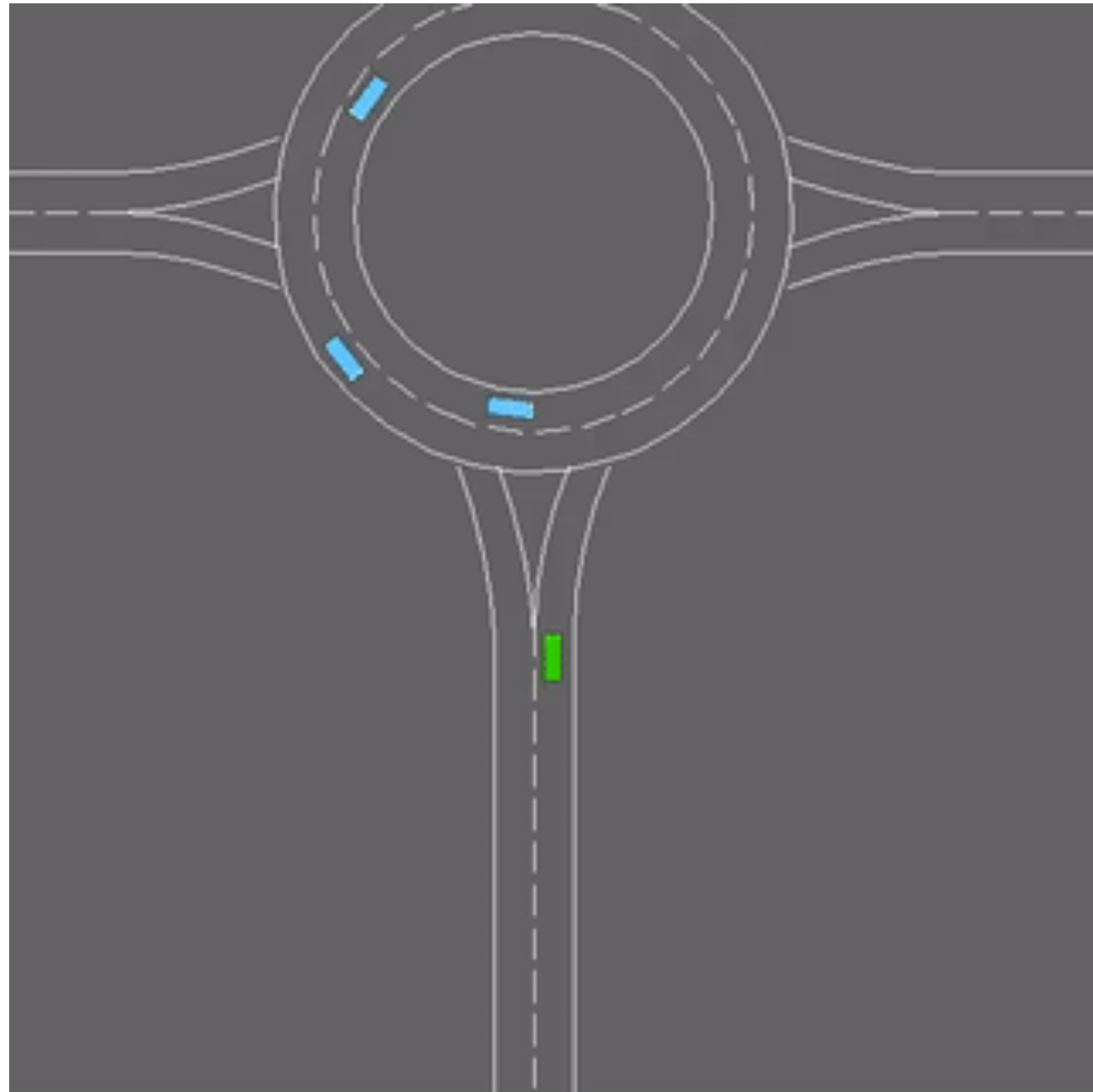
intersection

Learn a New Task from Few Demonstrations

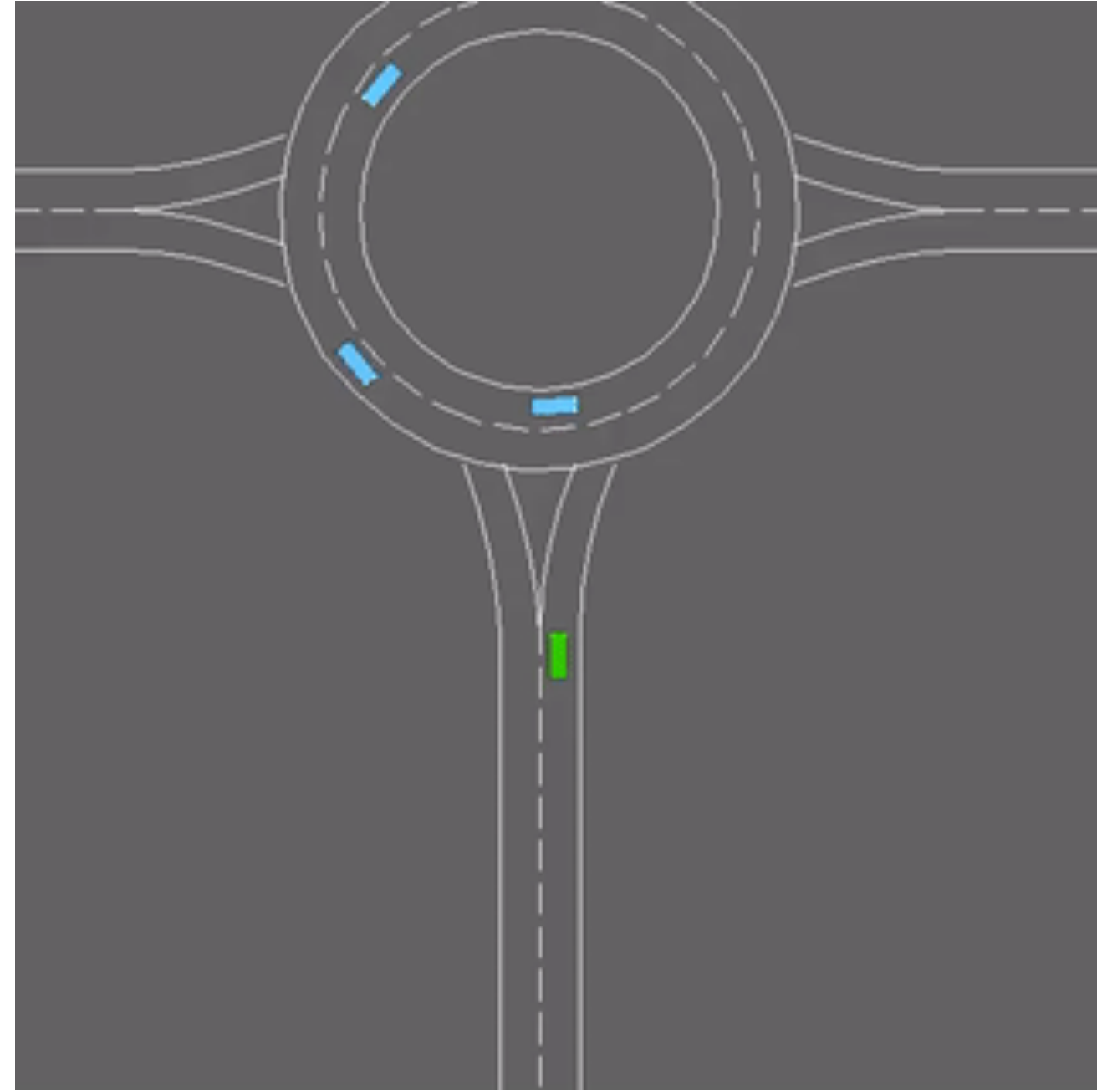


?

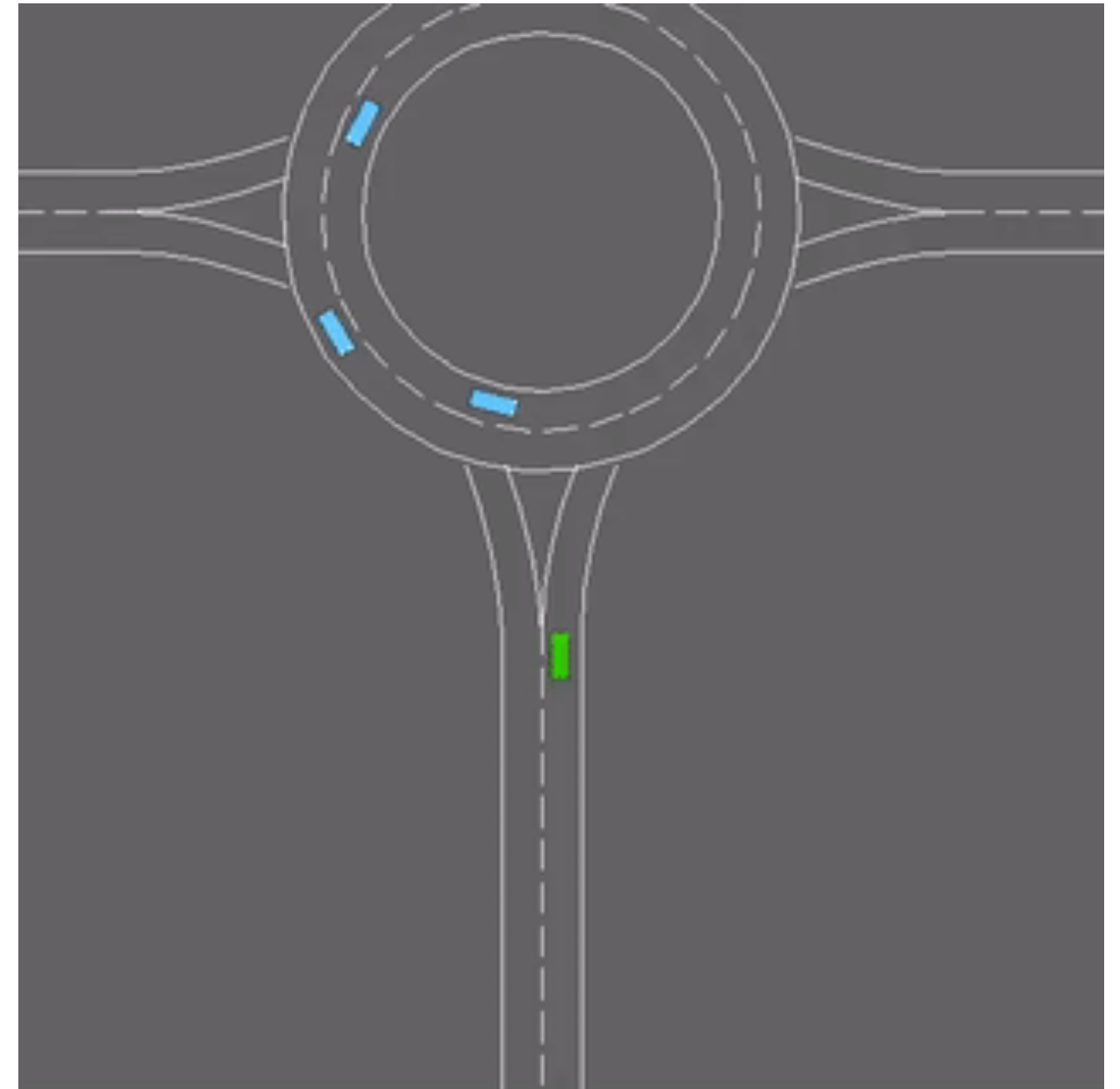
Learn a New Task from Few Demonstrations



Behavioral Cloning



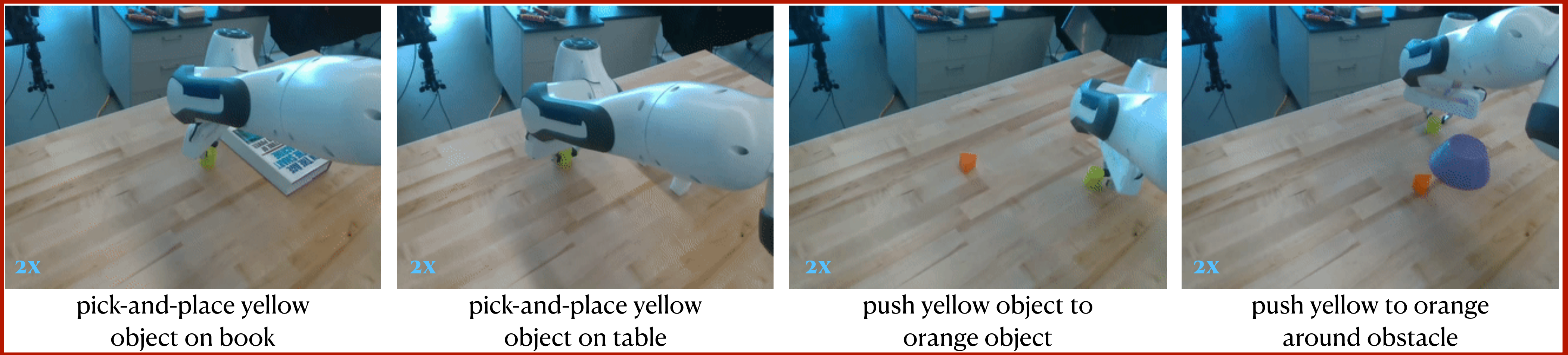
In-Context Learning



Ours

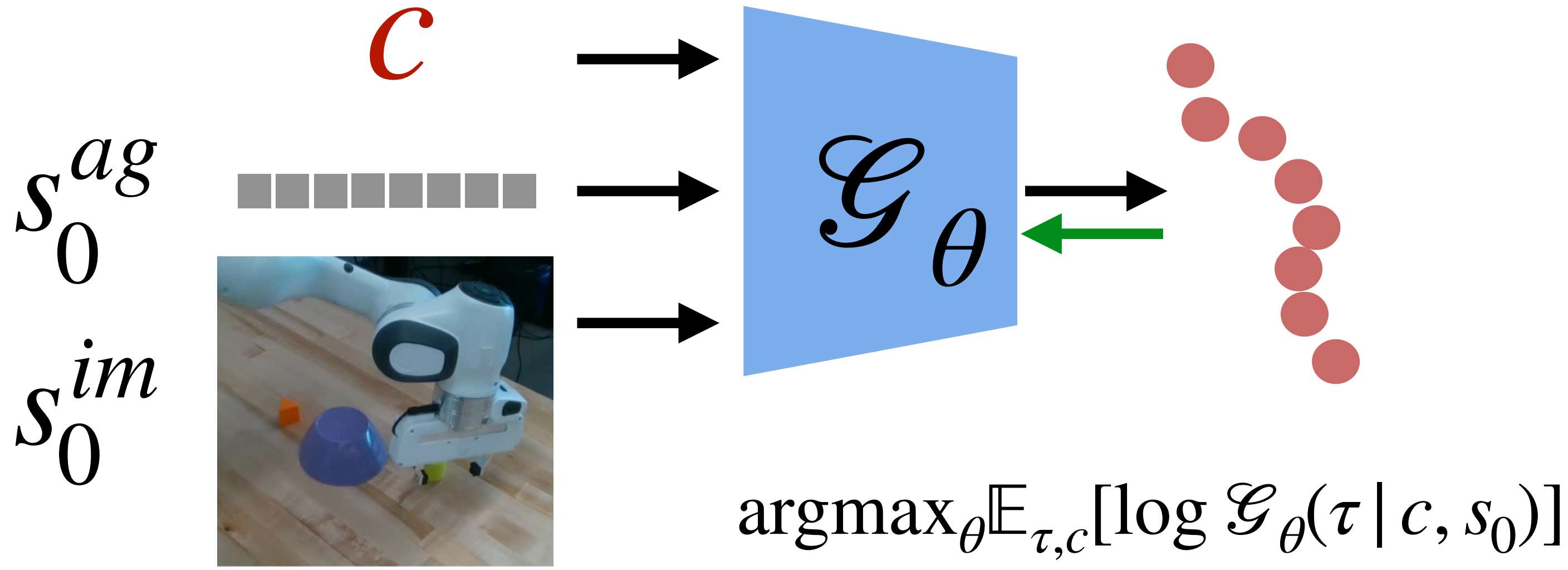
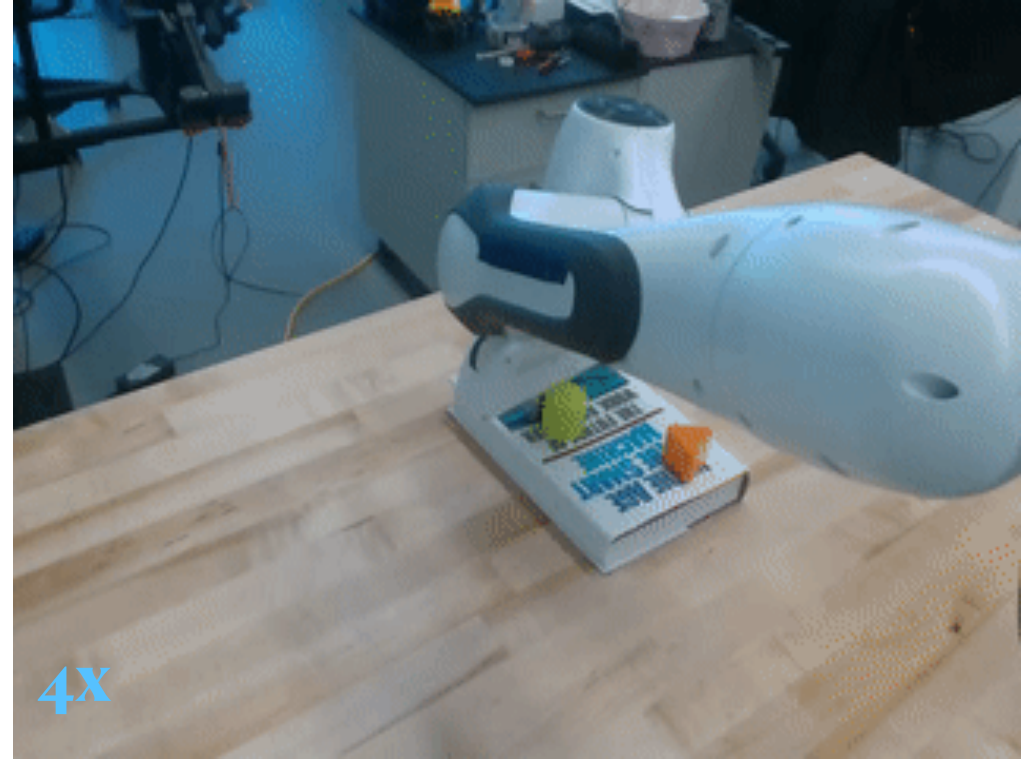
Few-Shot Task Learning through Inverse Generative Modeling

Given paired task representations c (T5 embeddings) and demonstrations τ



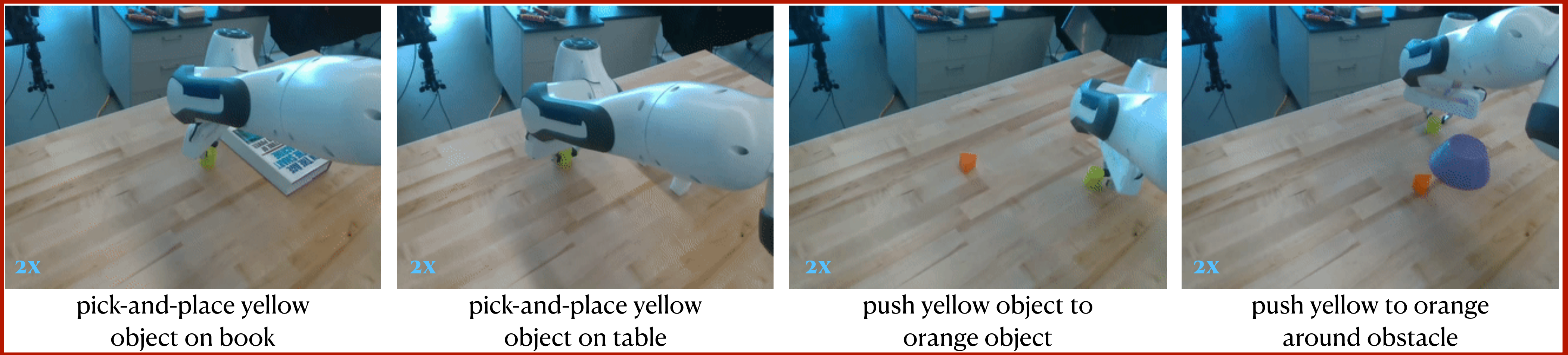
and a few demonstrations of a new task $\tilde{\tau}$

→ learn its representation \tilde{c}



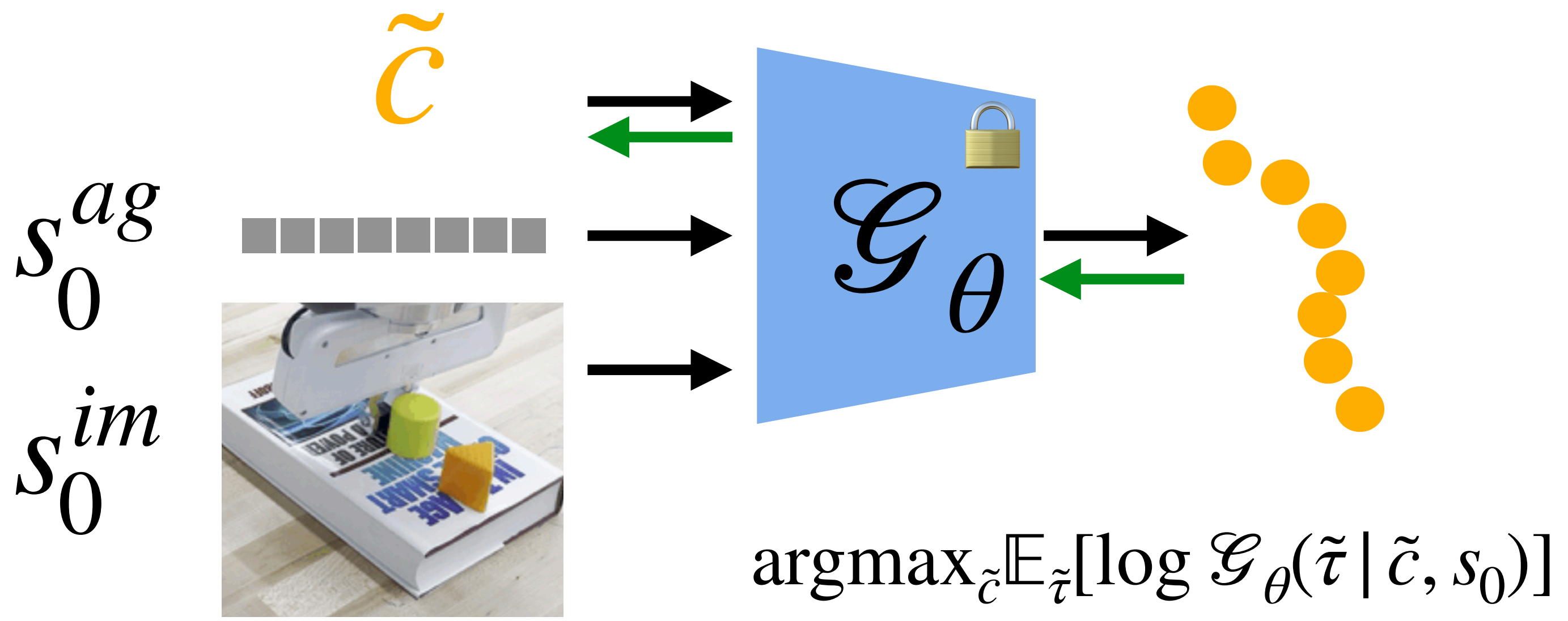
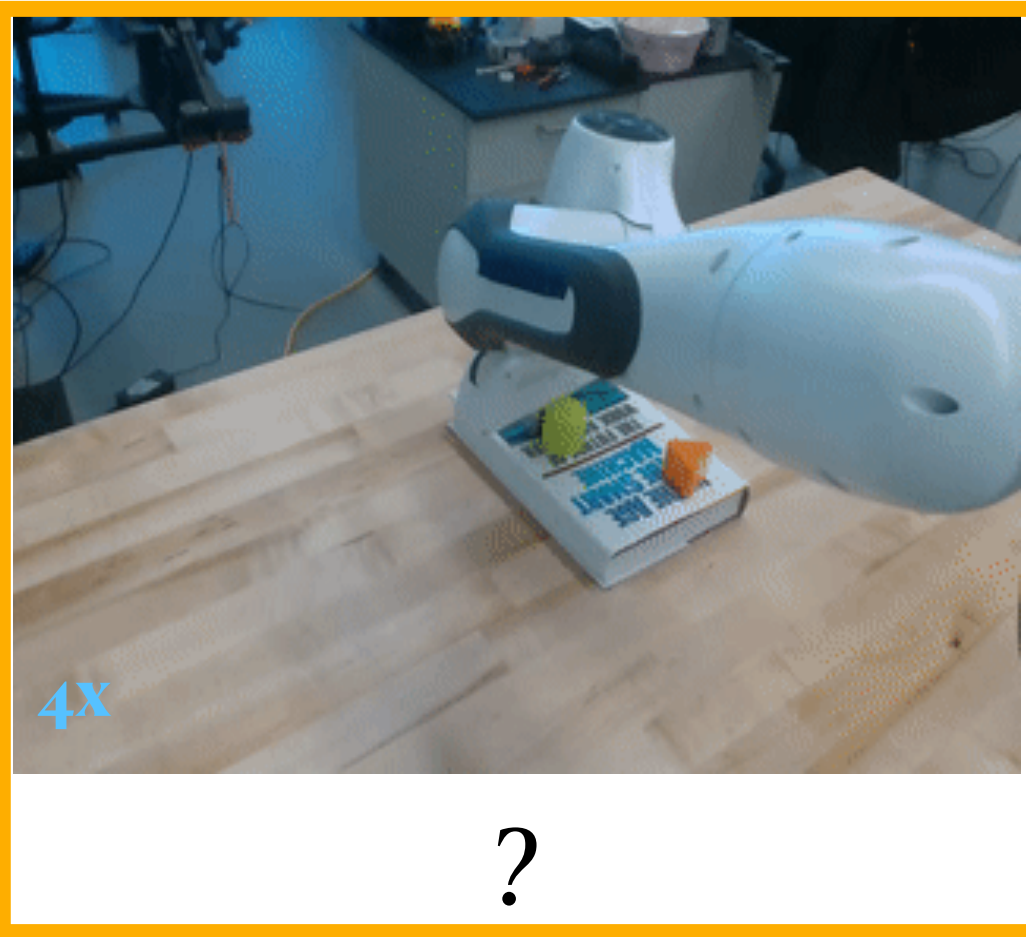
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Given paired task representations c (T5 embeddings) and demonstrations τ



and a few demonstrations of a new task $\tilde{\tau}$

→ learn its representation \tilde{c}



Real-World Table-Top Manipulation Evaluation



Ours
push on **surface**
conditioned on **training** push

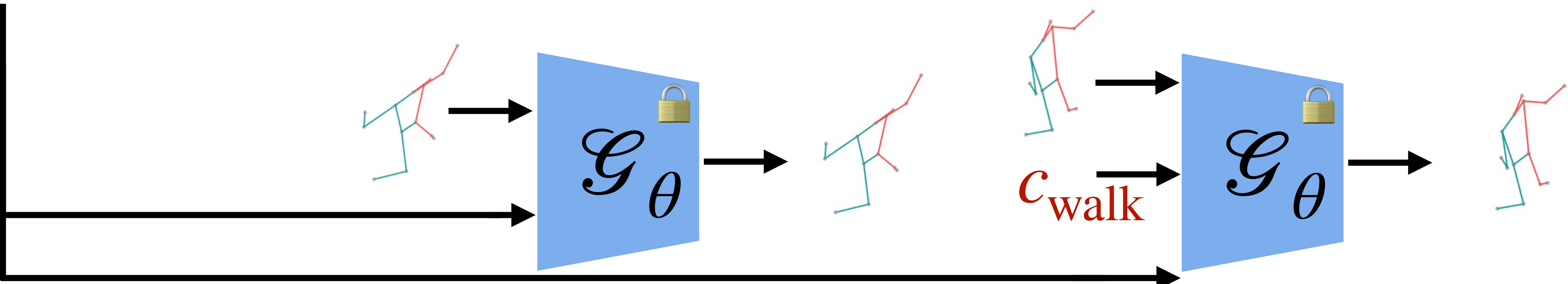
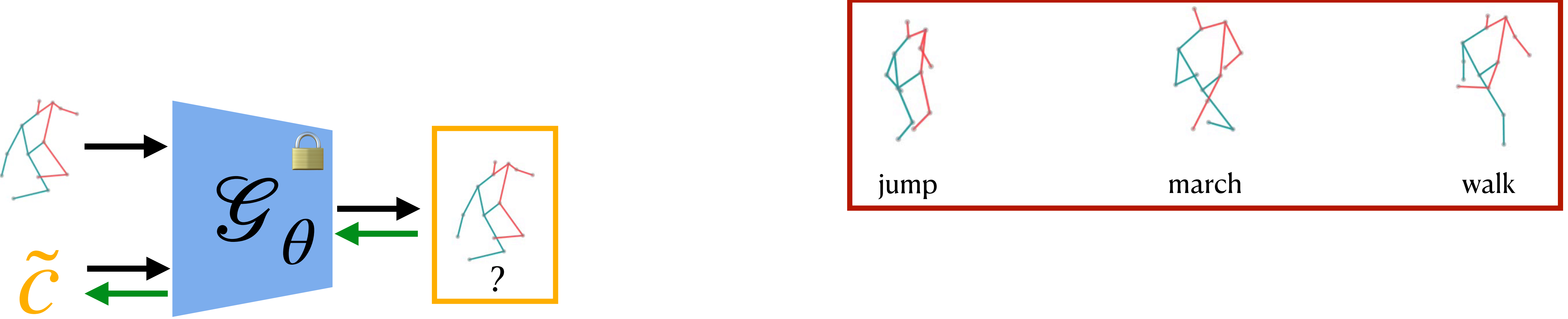


Baseline
push on **elevated** surface
conditioned on **training** push



Ours
push on **elevated** surface
conditioned on **learned** test push

Generative Models Enable Generalization



New initial states

In composition with other tasks

Few-Shot Task Learning through Inverse Generative Modeling

Formulate task learning from few demonstrations as

“Few-Shot Task Learning through Inverse Generative Modeling”

Adapt a method for inverting generative models to our
formulation → strong generalization

Extensively demonstrate applicability of approach



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