Viewpoint-Conditioned Legible Motion Planning with Imitation and Reinforcement Learning

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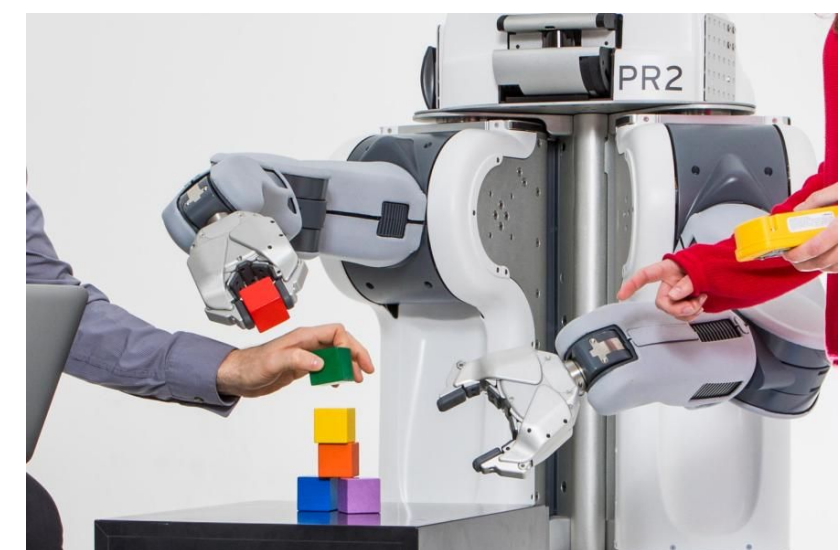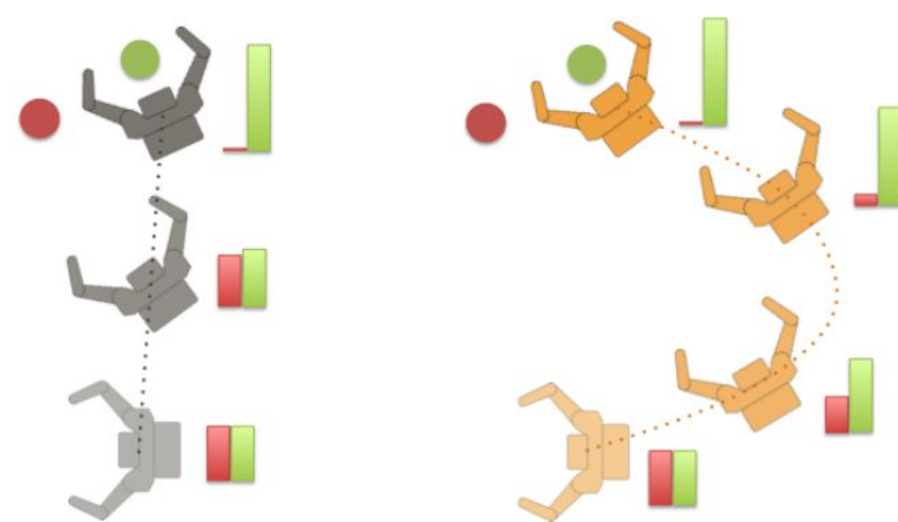
Legible motion planning: the key to effective human-robot collaboration
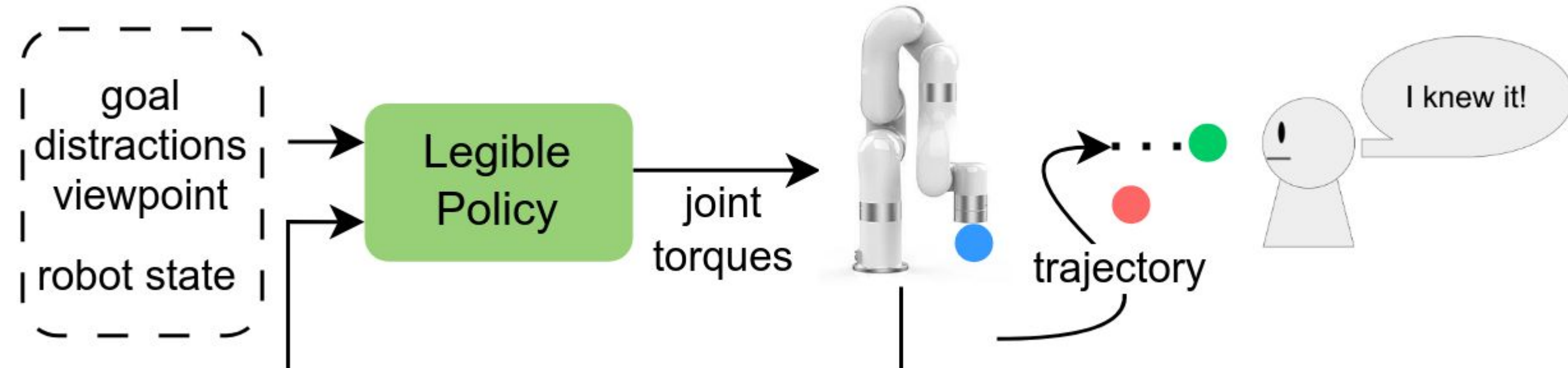

Legible motion is crucial for efficiency and trust in assistive robotics and cooperative tasks
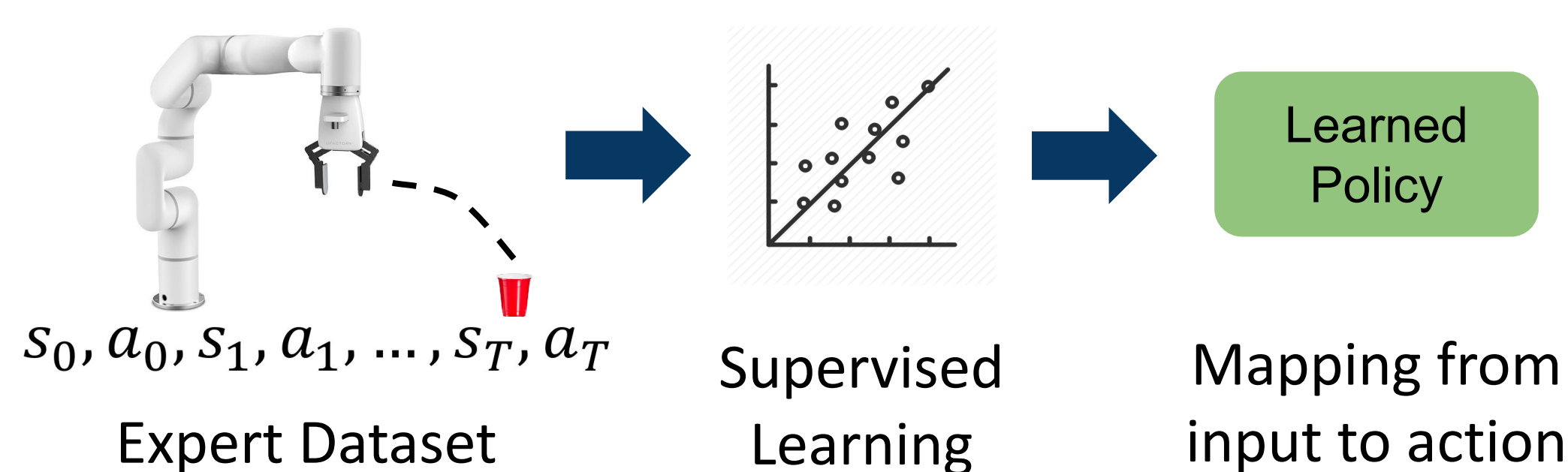
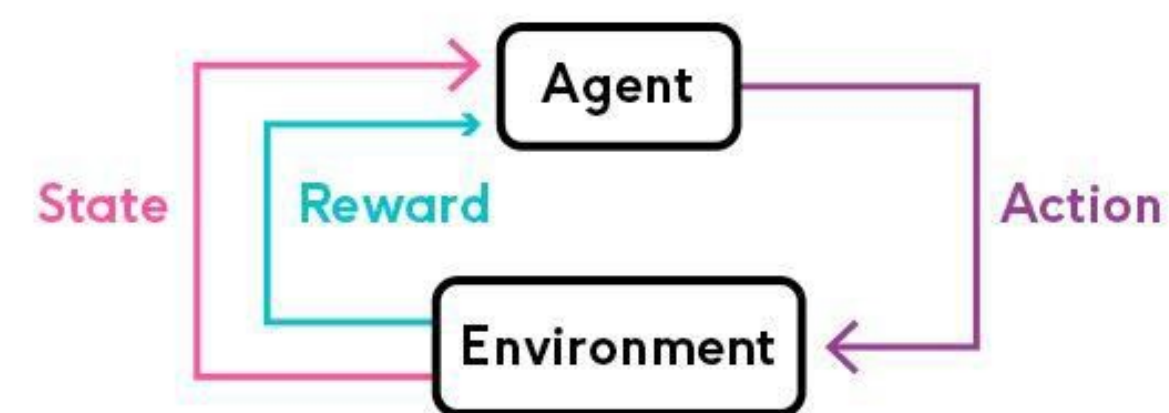Robots that behave in an understandable manner boost human experience

A unified system for learning-based legible motion planning

IL performs supervised learning on legible expert demonstrations

$s_0, a_0, s_1, a_1, \ldots, s_T, a_T$

Expert Dataset — Supervised Learning — Mapping from input to action

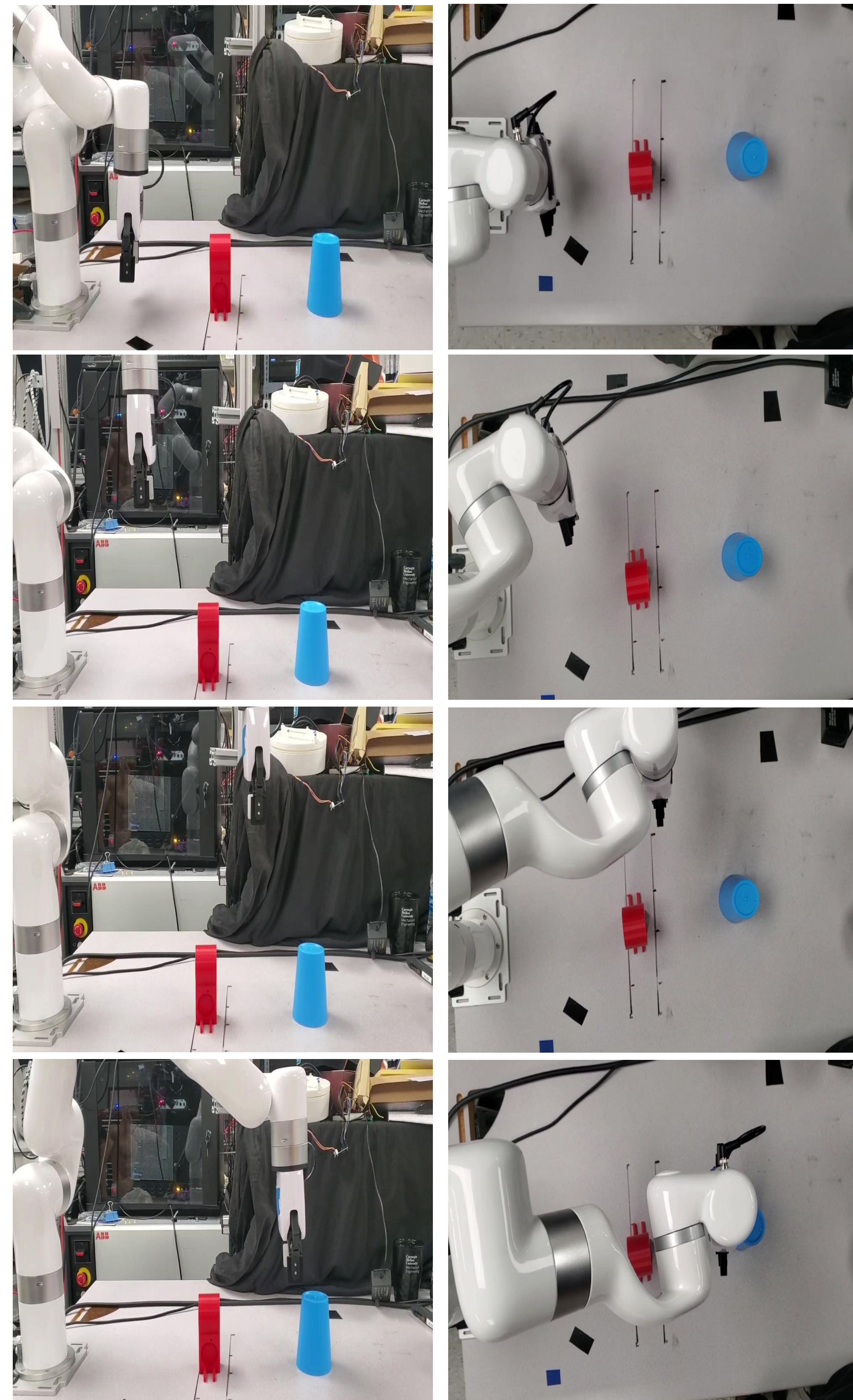## RL maximizes a legibility reward by interacting with the environment

Algorithm:
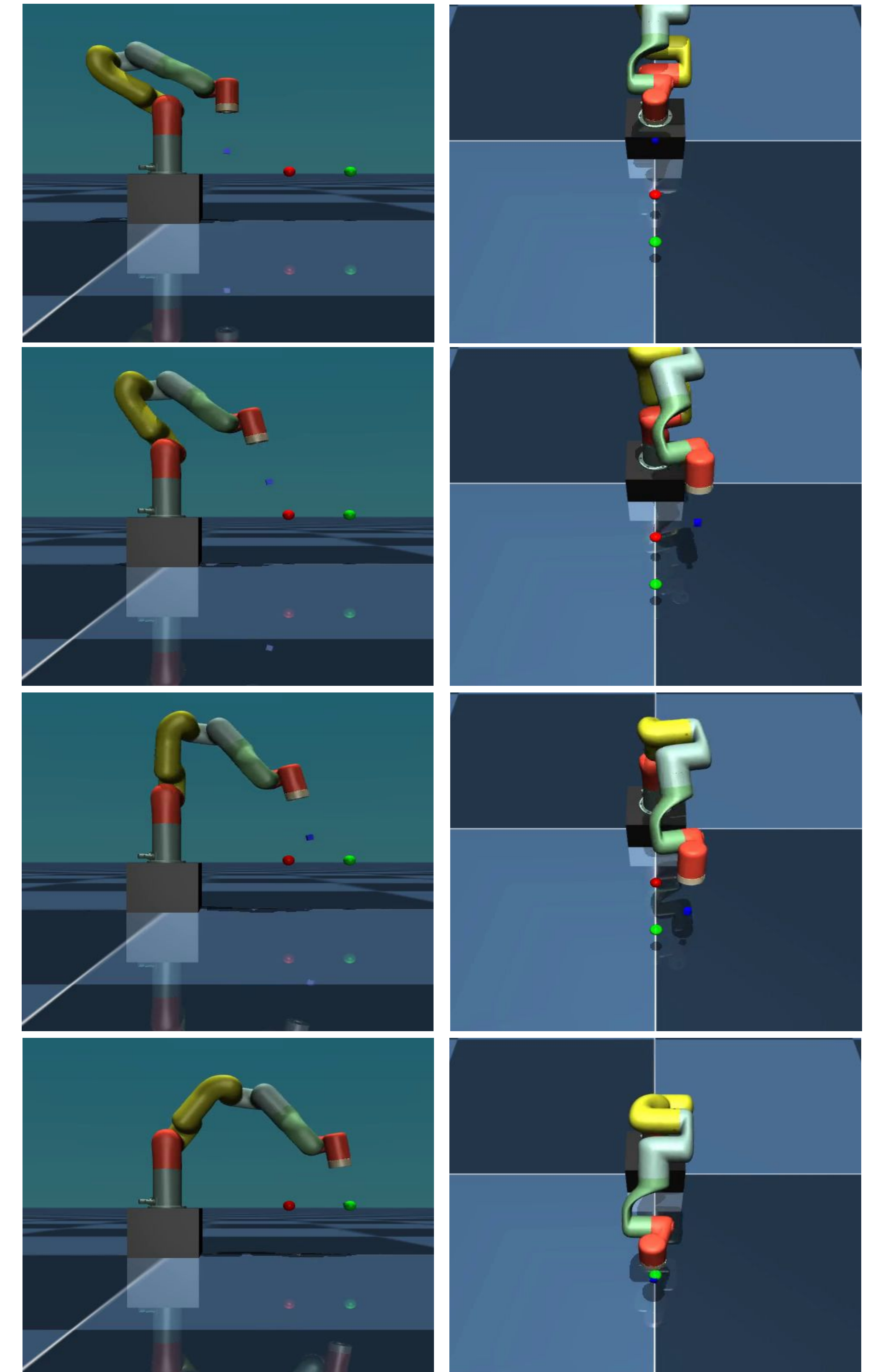soft actor-critic + hindsight exp. replay

Reward:

$$r = -\alpha_1 d_{goal} + \alpha_2 g(d_{distract}, \beta_1) - \alpha_3 e_{rot} + \alpha_4 g(z, \beta_2)$$
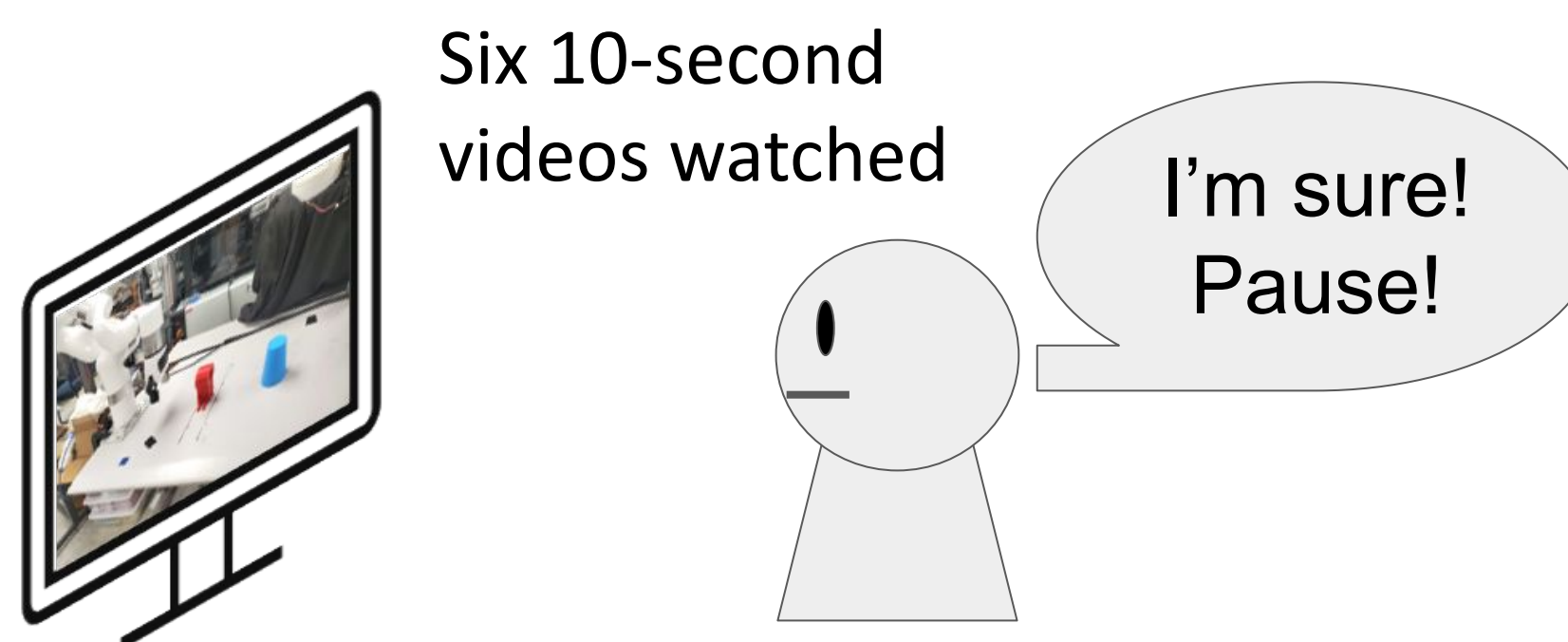
$g(x, y) = -1$ if $x \leq y$, otherwise 0

Results of Imitation Learning Policy

We asked our friends for evaluation

Six 10-second videos watched

I'm sure! Pause!

Expert	0.65
IM policy	0.64
RL policy	0.75

$\text{correct} \cdot \left(1 - \dfrac{t_{pause}}{t_{total}}\right)$

Results of Reinforcement Learning Policy

Conclusions and Future Work

✅ Accomplished goal-oriented tasks with legible motion plans considering observer's viewpoint

✅ Evaluated two learning-based methods with humans and compared with expert baseline

🦾 Future Work: Integrate multi-modal sensory inputs for adaptive and dynamic legible motion

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