ELDEN: Exploration via Local Dependencies

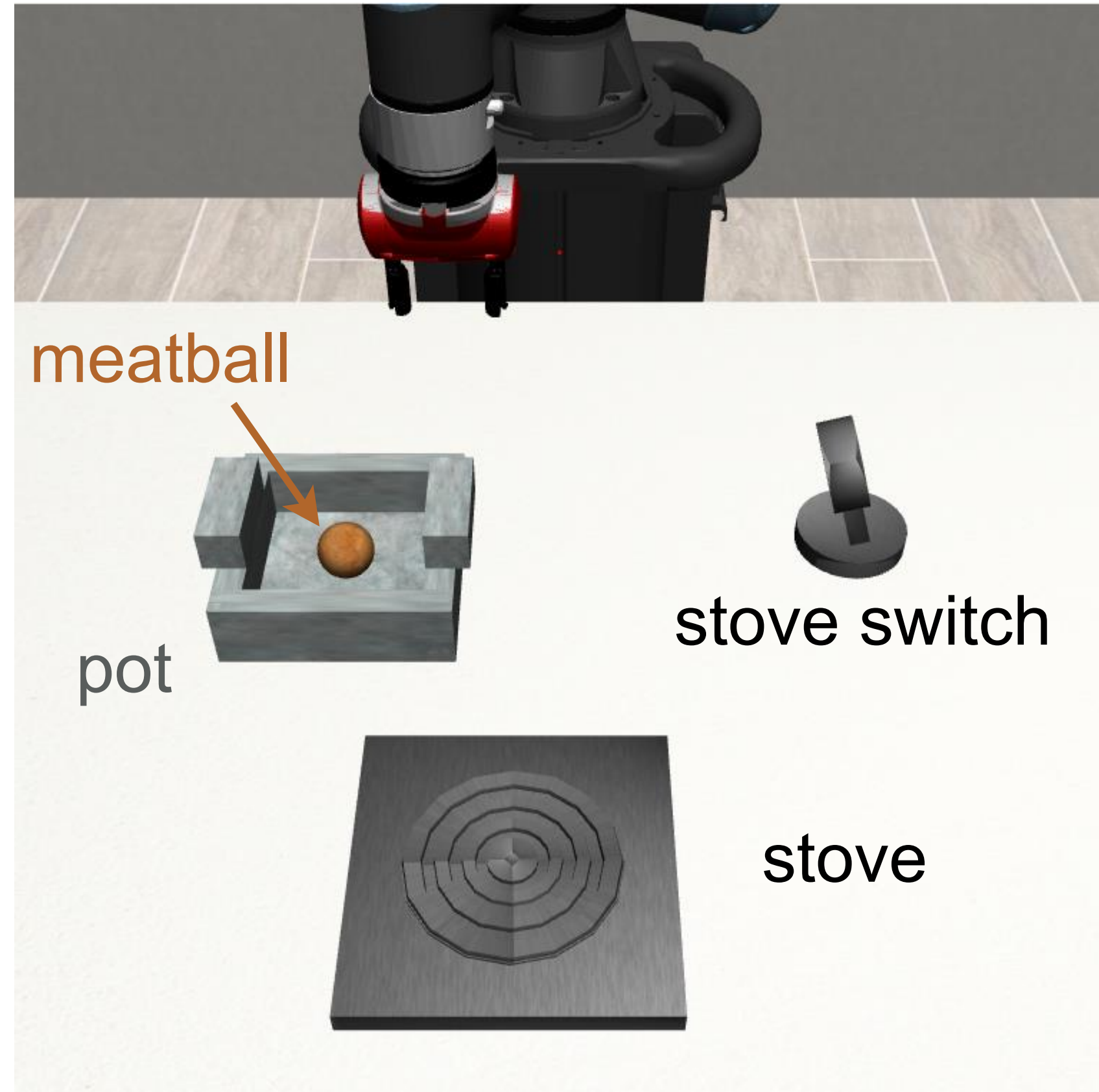**Zizhao Wang*, Jiaheng Hu*, Peter Stone+, Roberto Martin-Martin+**

the task requires turning on the stove 🔲 to cook the meatball ⚪ in the pot 🍲
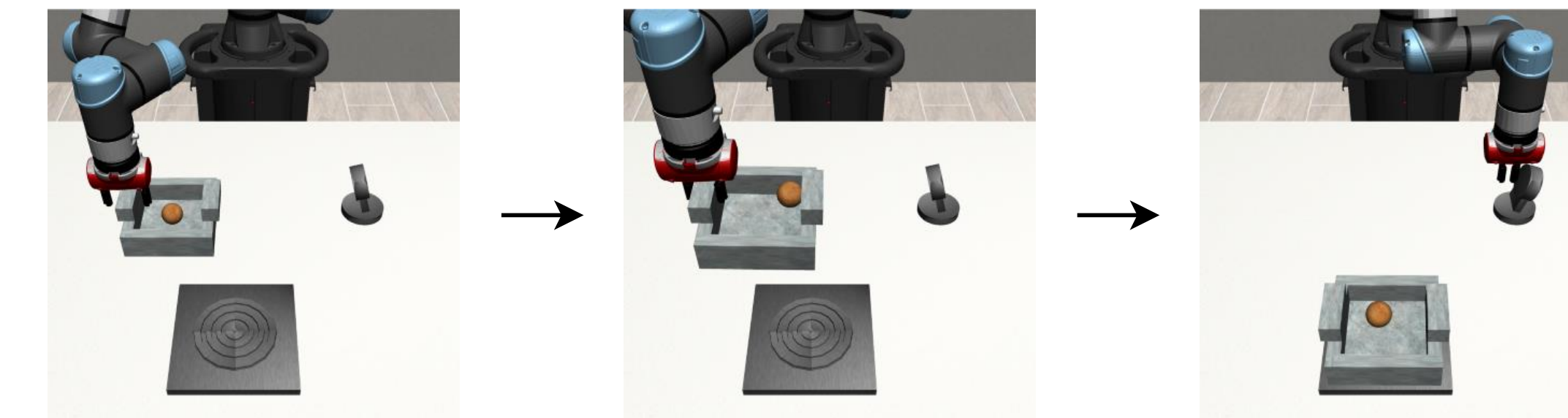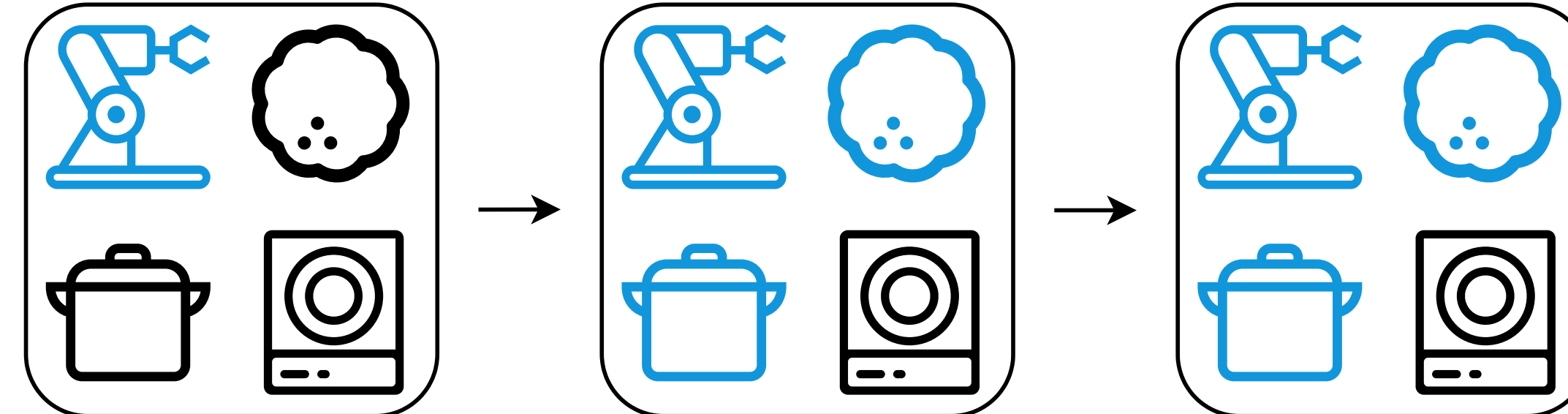
meatball

pot

stove switch

stove

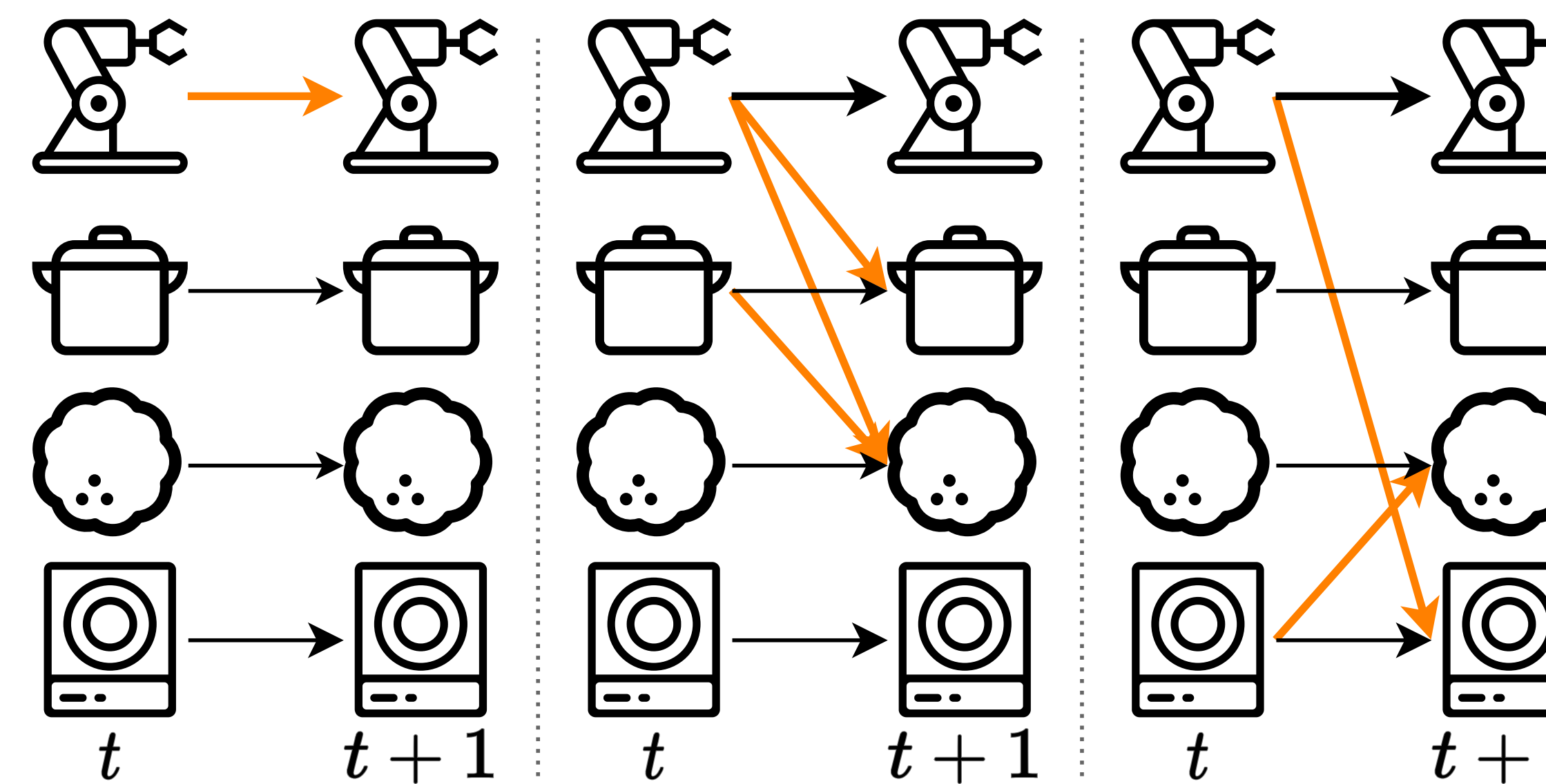behaviors of different agents at different learning stages

Curiosity: interested in **high prediction errors** in entity movements
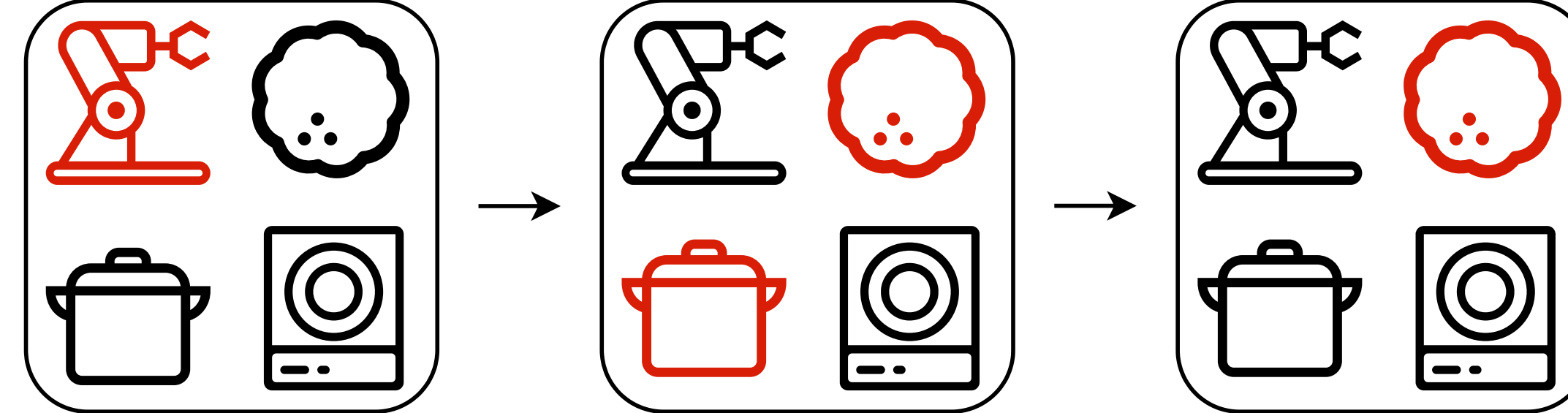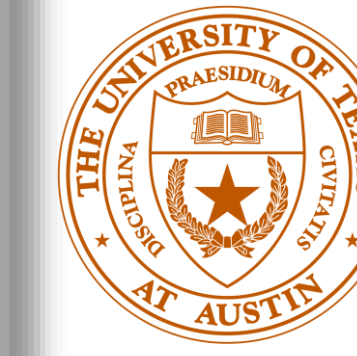
Empowerment: interested in maximizing the **action's influence on environment entities**
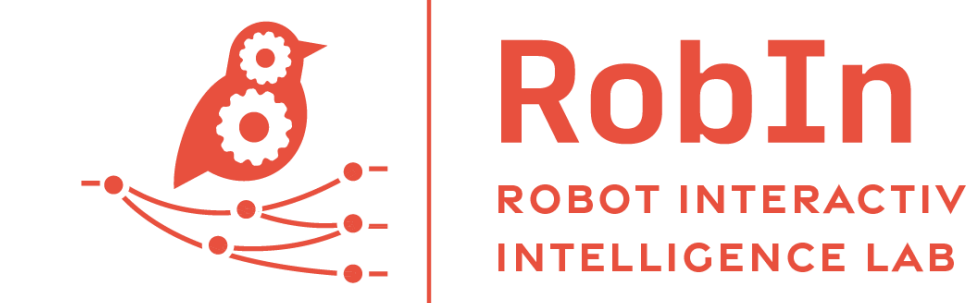
ELDEN (ours): interested in **novel local dependencies** between entities

t $t+1$ t $t+1$ t $t+1$

ELDEN makes RL exploration efficient by reasoning about local dependencies between objects.

Method

ensembled dynamics model

dynamics model **training**

$$L_f = ||s_{t+1}^j - \hat{s}_{t+1}^j|| + \lambda \left\| \frac{\partial \hat{s}_{t+1}}{\partial [s_t, a_t]} \right\|$$

prediction error   regularization

s_t

a_t

f^1

$\hat{s}_{t+1}$

$\left| \frac{\partial \hat{s}_{t+1}}{\partial [s_t, a_t]} \right|$

$\begin{bmatrix} 0.85 & \cdots & 0.12 \\ \vdots & \ddots & \vdots \\ 0.13 & \cdots & 0.62 \end{bmatrix}$

$\begin{bmatrix} 1 & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & 1 \end{bmatrix}$

variance across

r_t^{int}

$\geq \epsilon$? local dependencies

intrinsic reward **inference**

Results

technology tree

craft @

apply to

Crafter

Kitchen

butter

meatball

initial state   goal state

Disagreement   Dynamics Curiosity   CAI   Vanilla PPO   ELDEN (ours)

Mini-Behavior: Thawing

Mini-Behavior: Car Wash

Crafter

Kitchen

task progress

episodes