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SymSkill.

Symbol and Skill Co-Invention for Data-Efficient and and Reactive Long-Horizon Manipulation.

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Figueroa

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Reactive Long Horizon Manipulation

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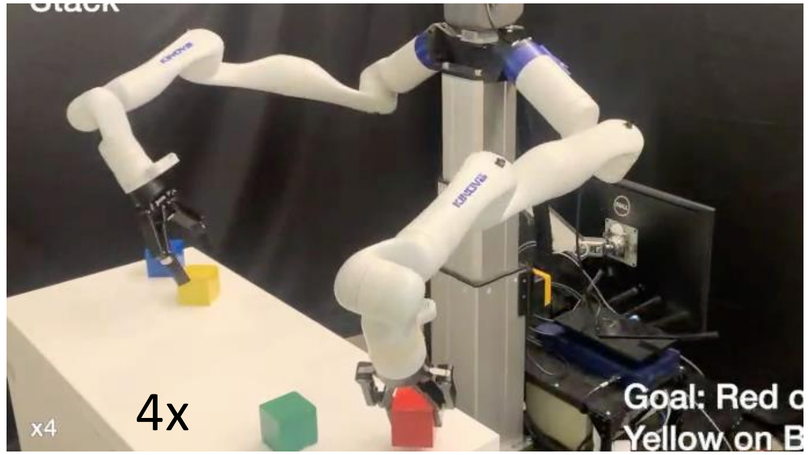
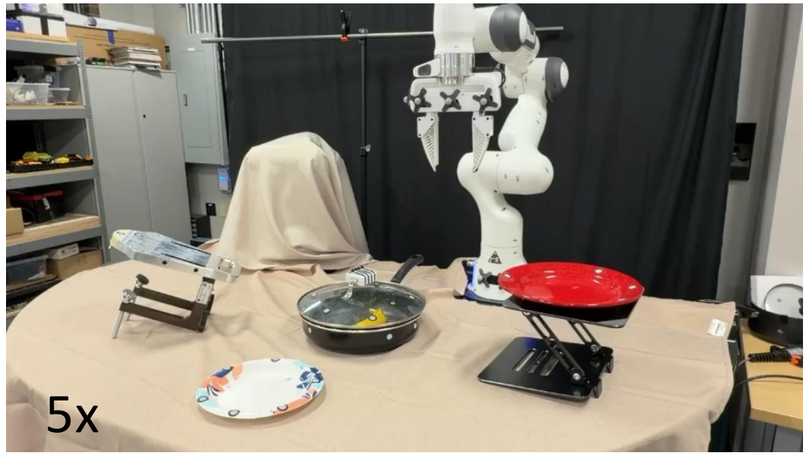
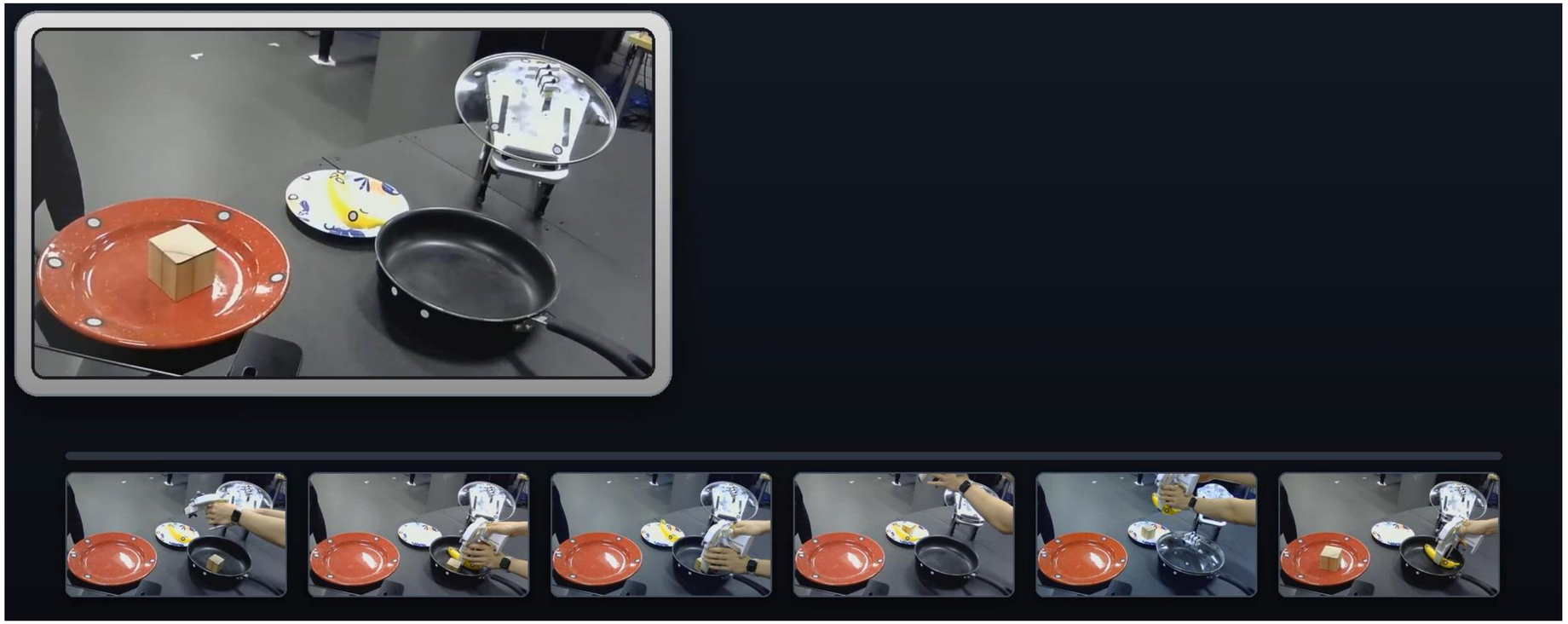




	Generalist VLA, VAM, etc [Physical Intelligence, '26]	**Task and Motion Planning** [Garrett & Ramos, ICRA '26]	**SymSkill (Symbol & Skill Co-Invention)** [Shao et al., ICRA '26]
COMPOSITIONAL GENERALIZATION	✗	✓	✓
CERTIFIABLE	✗	✓	✓
REACTIVE	✓	✗	✓
EFFORT	😭 **Data Collection**	😭 **Manual Definition**	😃 **5 min of Play Data**

1

Demonstration by Play



Type: $\lambda \in \Lambda$ Pose Trajectory: $\tau = \{\boldsymbol{T}_t\}_{t=0}^{n}, \boldsymbol{T}_t \in SE(3)$

2A A Segmentation

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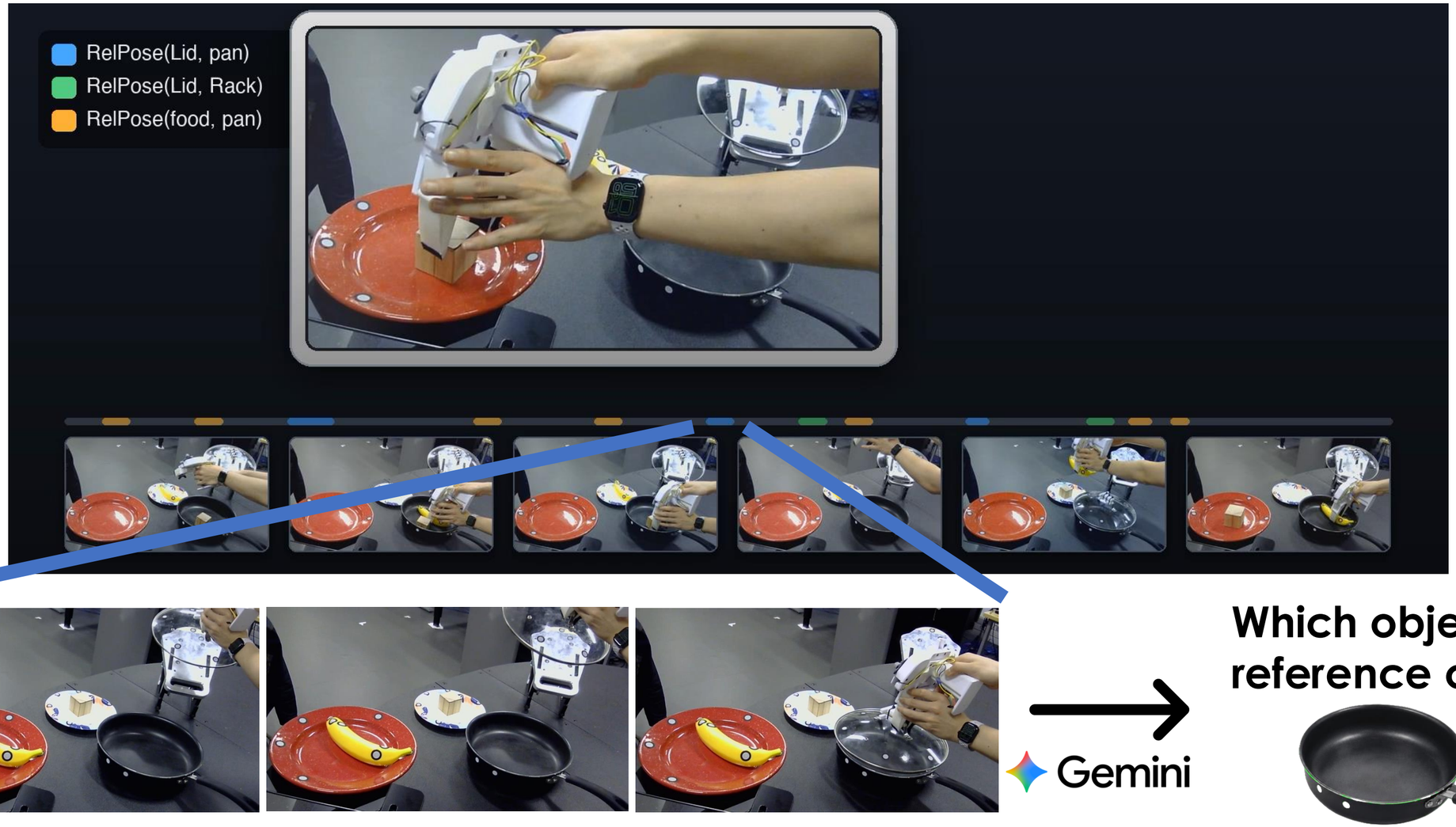
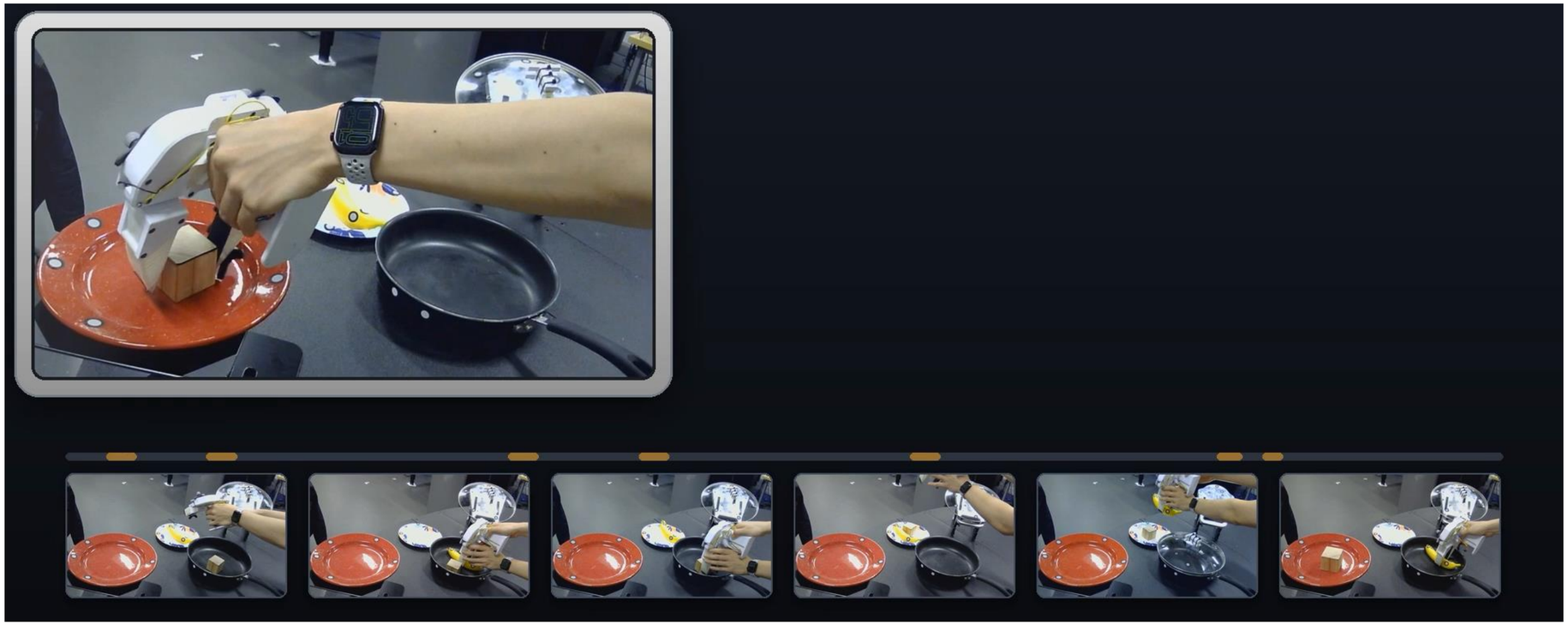


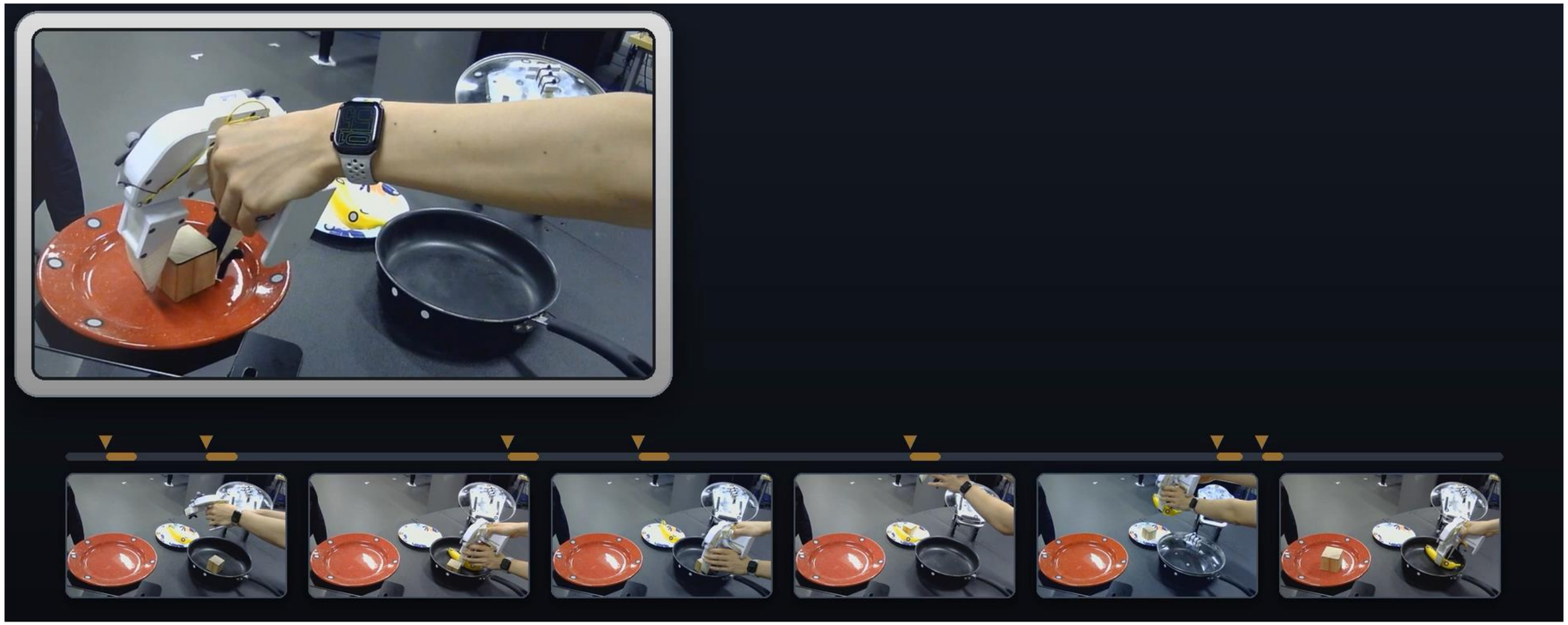
2A Action Learning



Action: Add Food to Pan

Effect: ψ(Food, Pan)

2A Action Learning



Action: Add Food to Pan

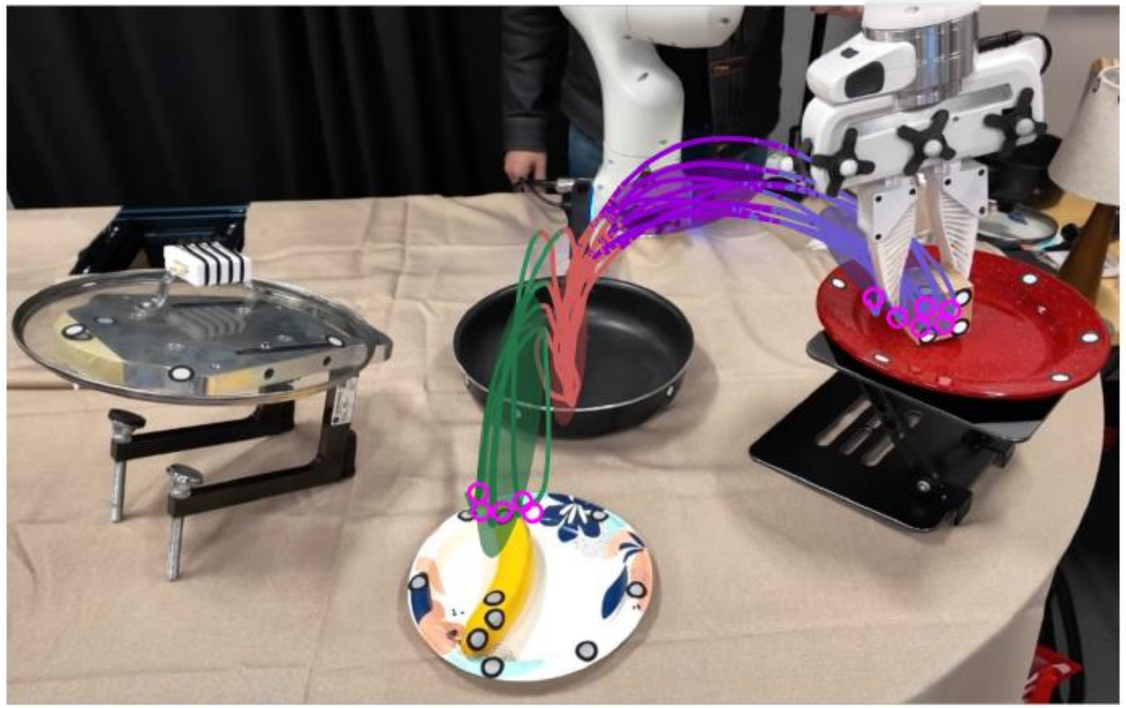
Precondition: ψ(Lid, Rack) Effect: ψ(Food, Pan)

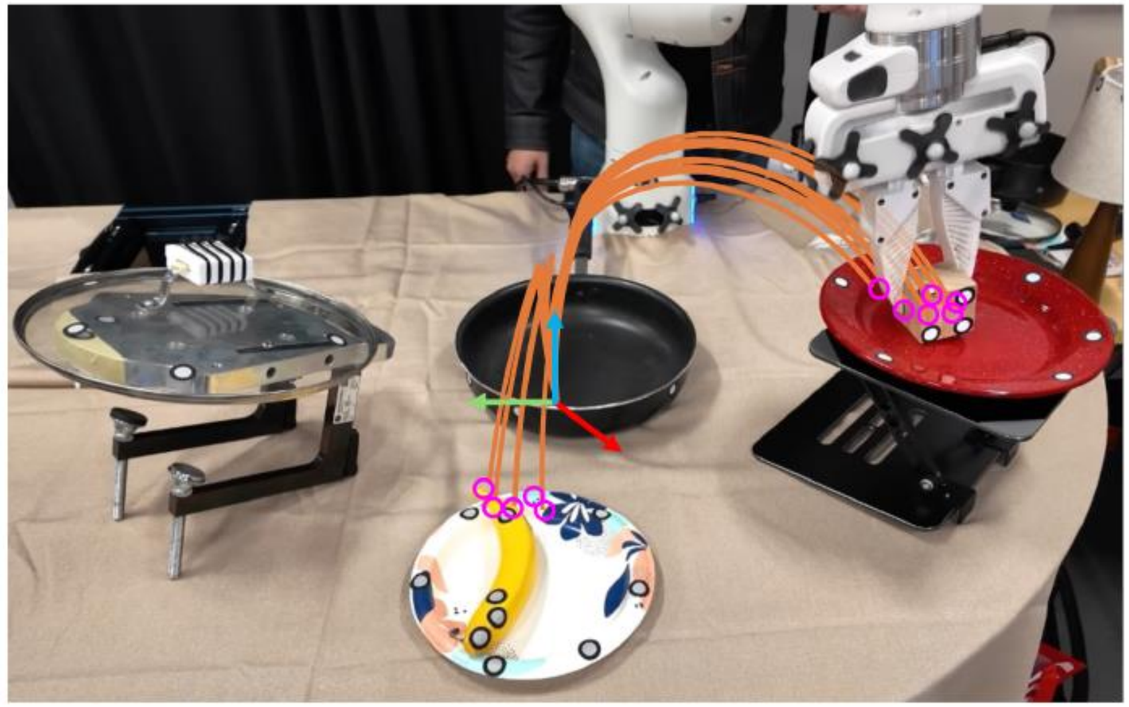
2B Skill Learning

SE(3) LPV-DS

[Sun and Figueroa, IROS'26]

Control policy on SE(3) to enforce convergence to goal pose and stability





Translation: $$\dot{x} = \sum_{k=1}^{K} \gamma_k(x) \mathbf{A}_k (x - x^*)$$

Rotation: $$(\hat{\mathbf{q}}_{att})^{des} = \sum_{k=1}^{K} \gamma_k(\mathbf{q}) \mathbf{A}_k \log_{\mathbf{q}_{att}} \mathbf{q}$$

3 Online Planning, Execution and Monitoring of Closed-Loop Policy

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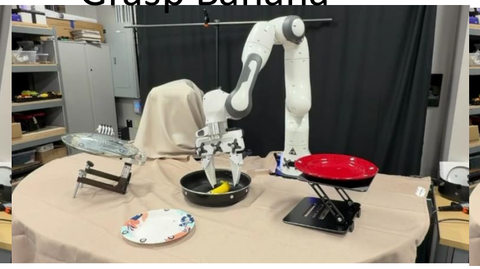
Goal:

Move Banana to Plate

ψ(banana, plate)

Action Plan:



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Move Banana to Plate

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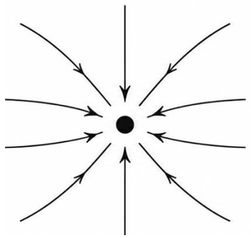
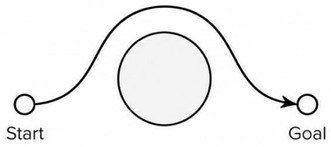
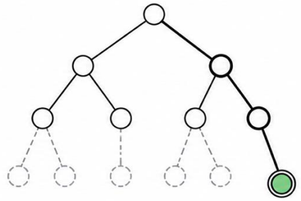




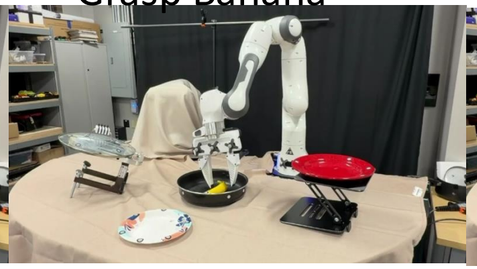


Action Plan:

Grasp Lid

Place Lid on Rack

Grasp Banana



Place Banana

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Goal:

Lid Closed

Move All Food to Pan

- ψ(lid, pan)
- ψ(banana, pan)
- ψ(tofu, pan)

Action Plan:

Grasp Lid → Place Lid on Rack → Grasp Tofu → Place in White Plate

↓

Place in pan ← Grasp Tofu ← Place in Pan ← Grasp Banana

↓

Grasp Lid → Place on Pan

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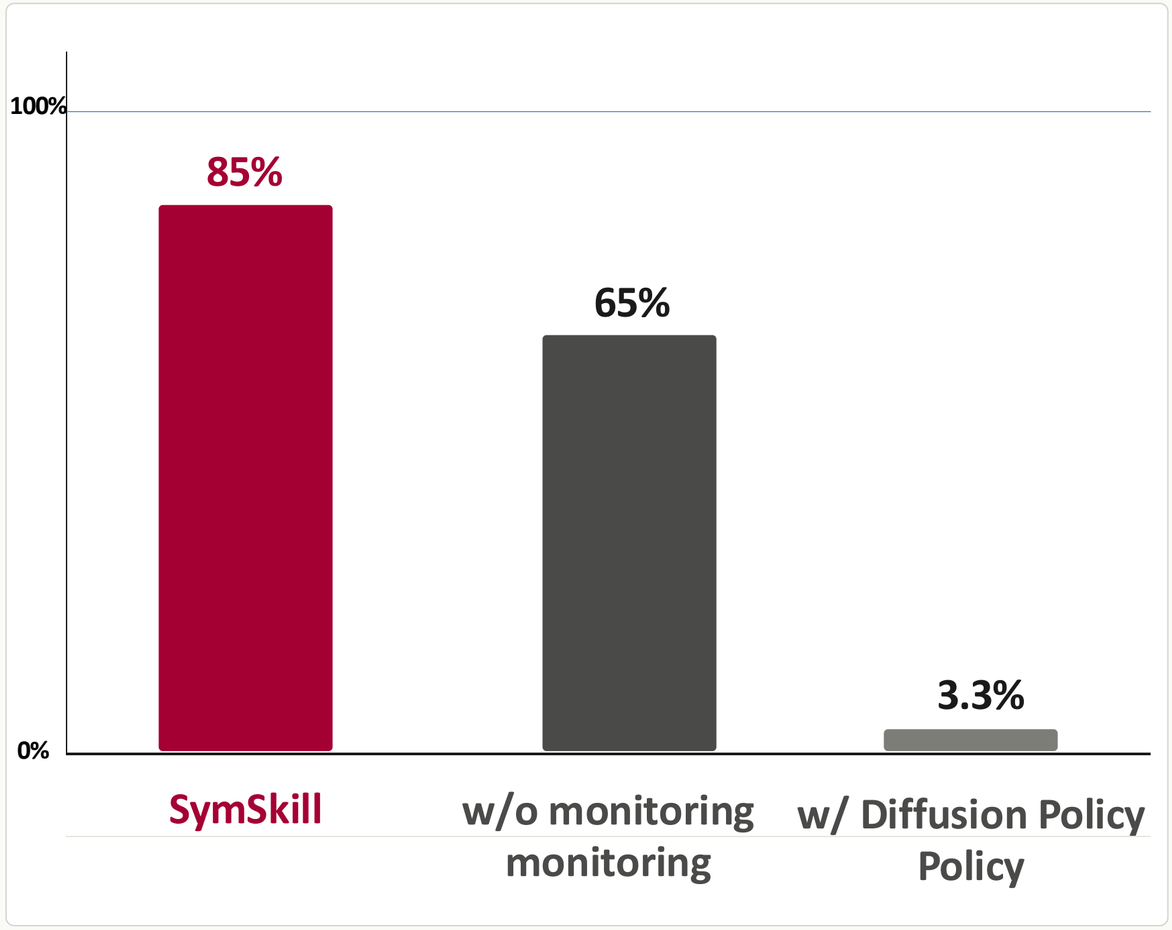
85% on 12 tasks in Robocasa. Learn from single tasks then combine zero-shot



Learning: Open Cabinet
Pick and Place
Close Cabinet

Goal: Put Cheese In Cab & Close Door
ψ(cheese, cabinet)
ψ(door, cabinet)

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SymSkill — co-invent symbols and skills from play

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- Compositional like TAMP
- Reactive like VLA
- Certifiable in both Planning and Skill Levels
- Data Efficient

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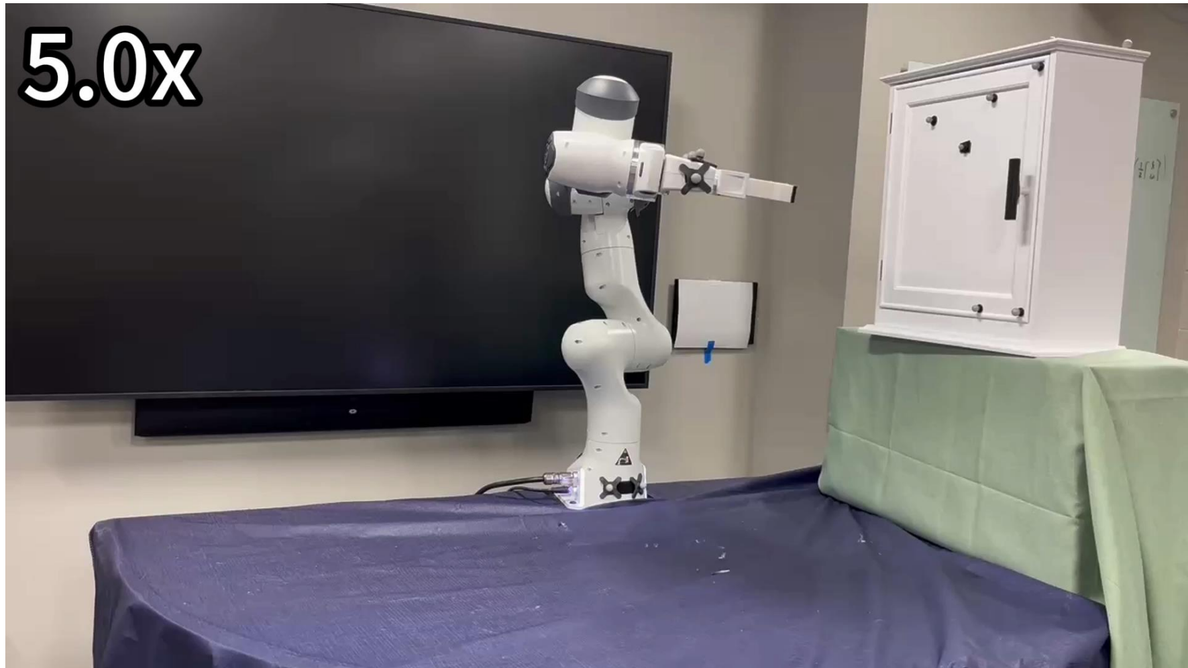

Website

Arxiv 2510.01661

Code github.com/shaoyifei96/Symskill

github.com/shaoyifei96/Symskill