

We build household robot manipulators that learn proficiently and efficiently like humans via **perceptual** and **motor abstractions**.



RSS Pioneers Program, 2023

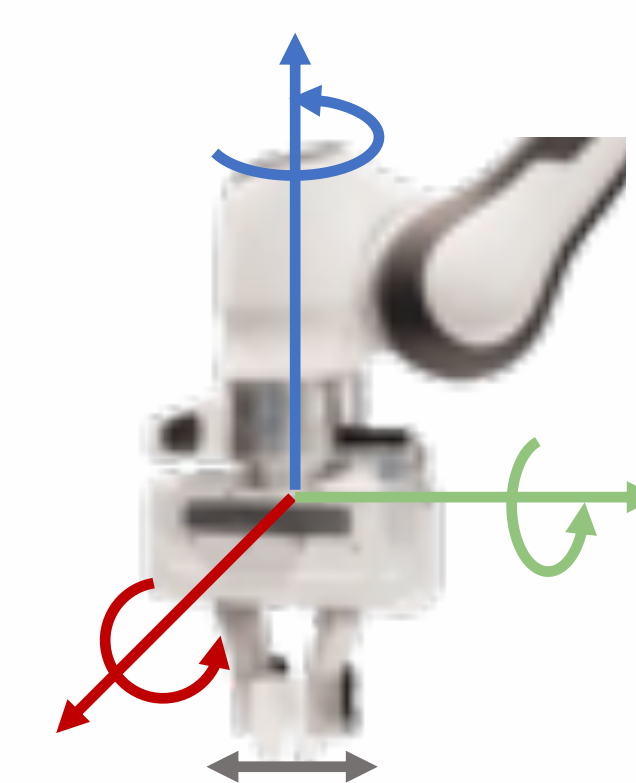
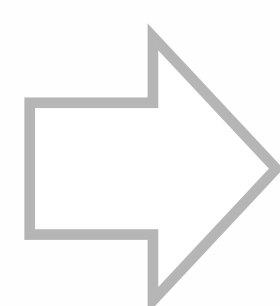
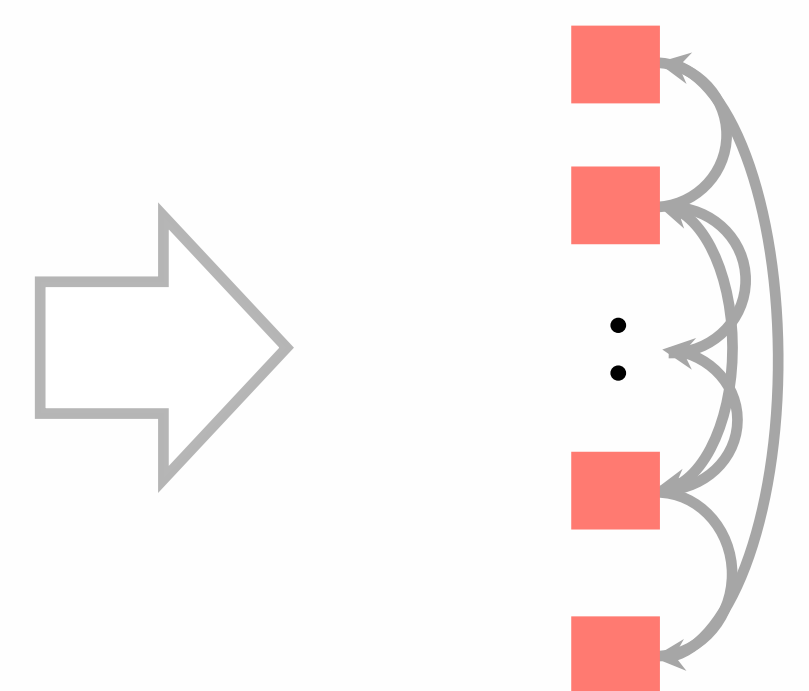
Building Human-Like Learning Household Robots via Perceptual and Motor Abstractions



Yifeng Zhu
UT Austin

Build Object-Centric Perception - VIOLA

Robots that know object concepts in RGB images can make you a coffee!



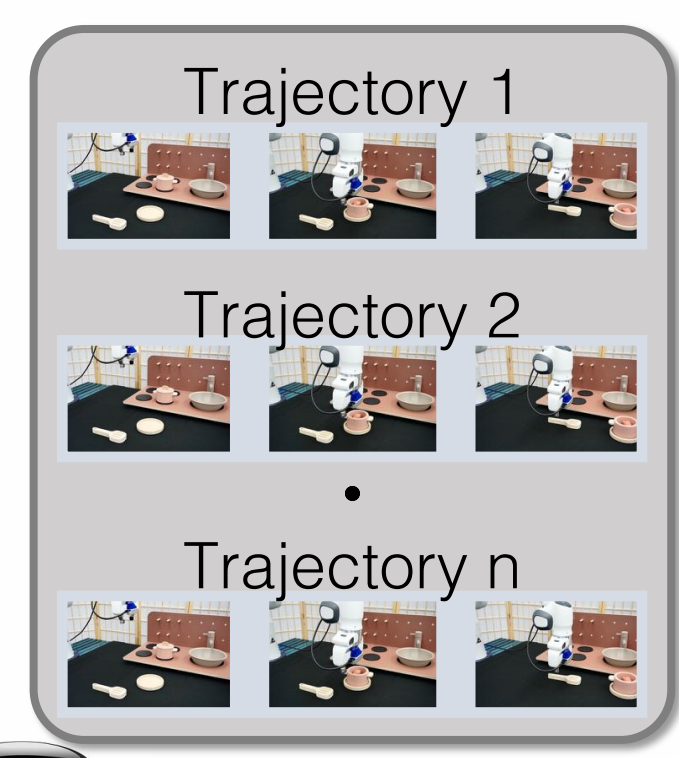
Transformer-Based Policy

Robot Commands

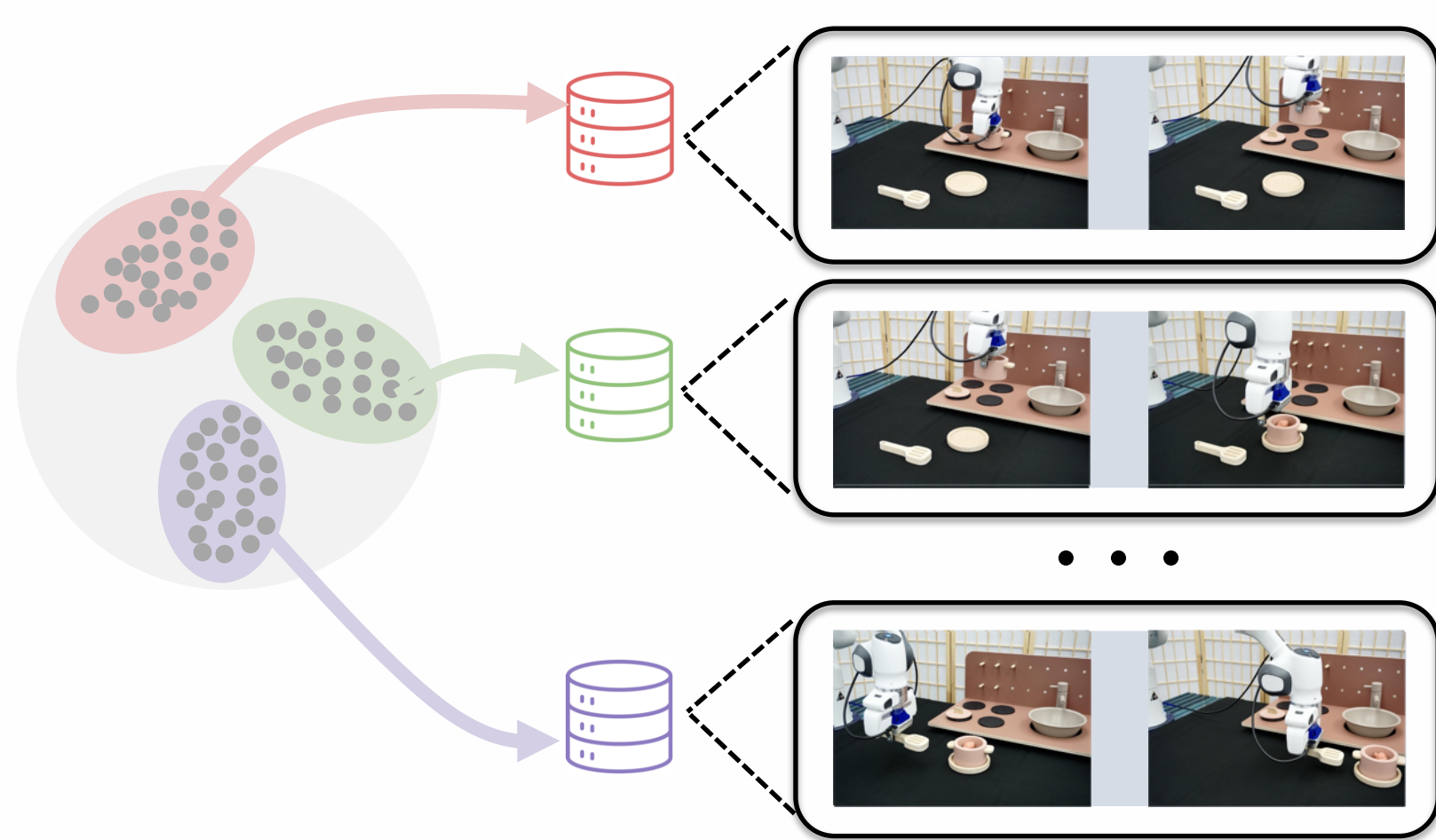
- Object-centric priors for images facilitate better visuomotor policy learning
- Pretrained vision models capture statistical priors of objects on images across various visual variations
- VIOLA policies can accomplish long-horizon, contact-rich manipulation tasks

Discover Motor Abstractions - BUDS

No need to write motor programs for your robots any more!

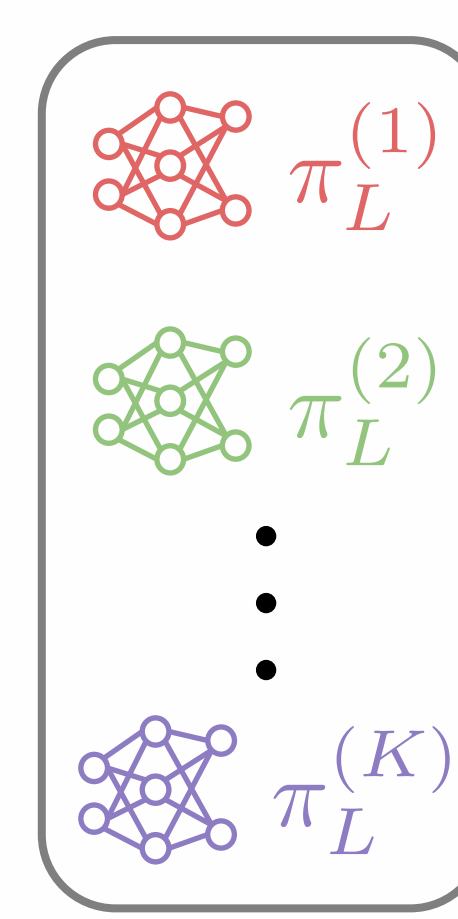


Hierarchical Clustering & Spectral Clustering



Recurring segments

Policy Learning



Skills

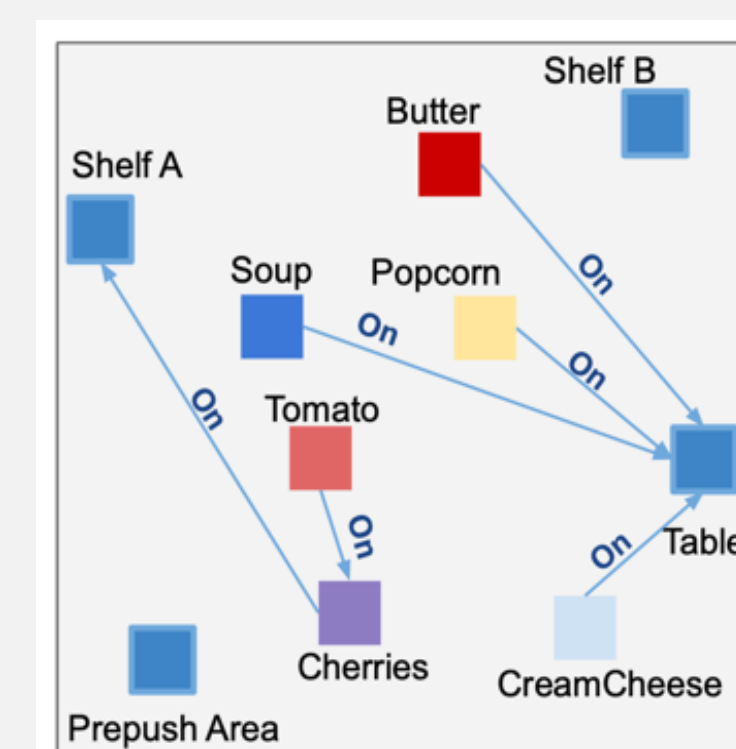
- BUDS can automatically discover skills (motor abstractions) from a small amount of unannotated prior experiences
- BUDS identifies recurring segments as skills based on multi-sensory coherence
- Semantically-meaningful skills emerge from the unsupervised discovery

Hierarchical Planning

Robots can solve tasks that you've never taught them to do!

Hierarchical Scene Graphs (HSGs)

Symbolic Scene Graph



Geometric Scene Graph

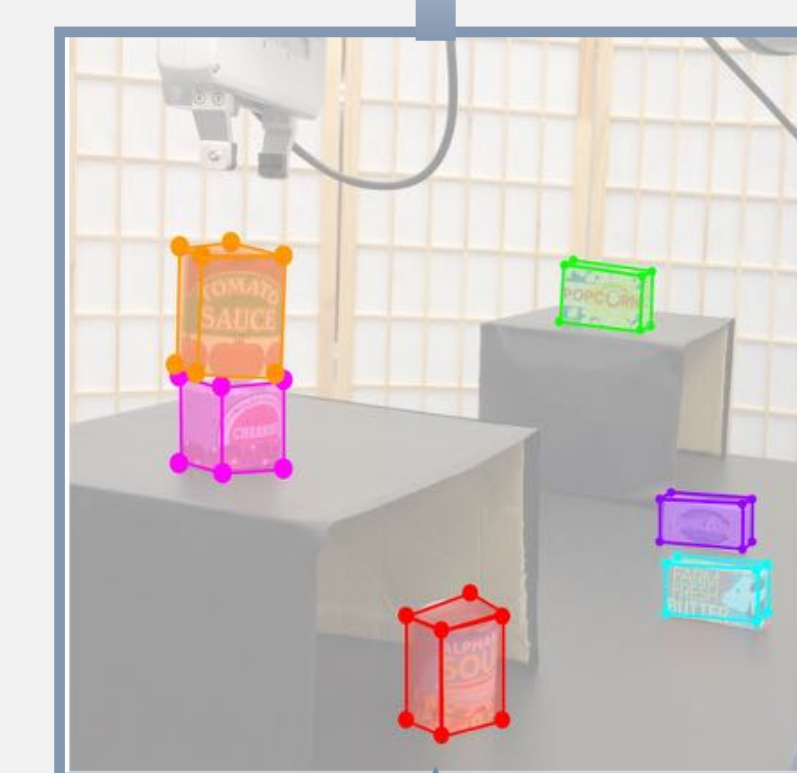
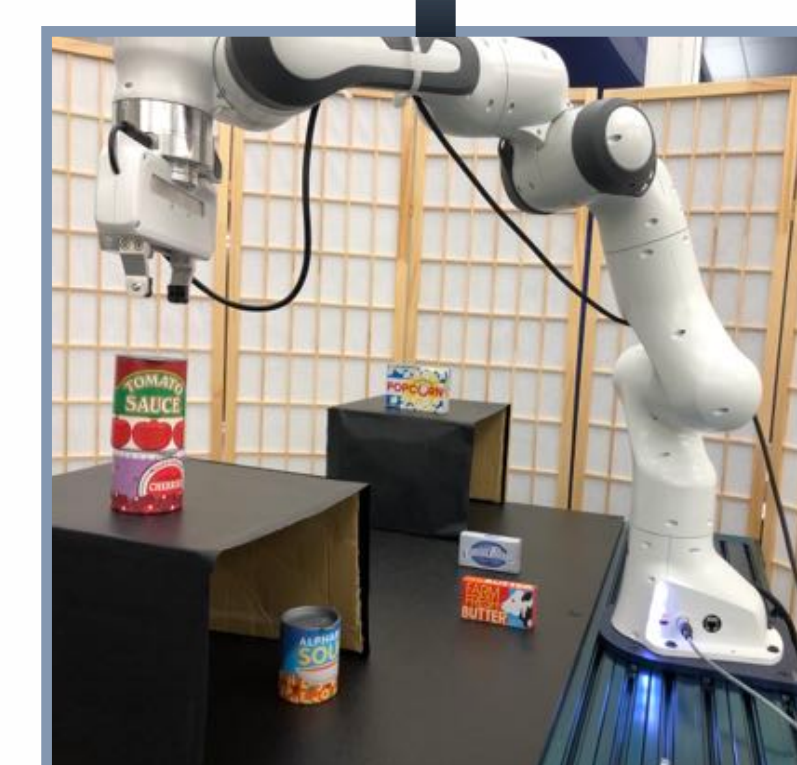


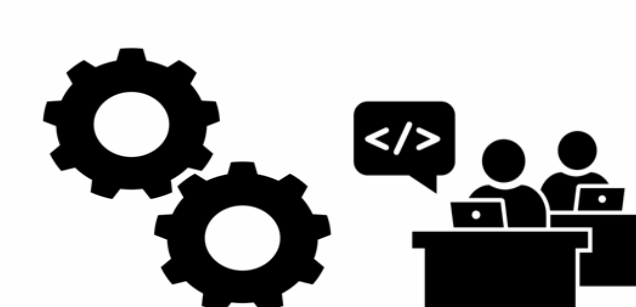
Image Observation



- HSGs leverage complementary strengths of object-centric abstractions and skills
- HSGs contain disentangled concepts for abstract semantic reasoning
- HSGs contain object locations for precise spatial reasoning
- HSGs allow compositional reasoning to generalize to new tasks with unseen goals

What comes next?

- We want a robot to continually improve over its lifespan, learning to solve unseen tasks
- We build a robot manipulation benchmark to support future research in lifelong robot manipulation



Procedural Generation



High-quality Demonstrations