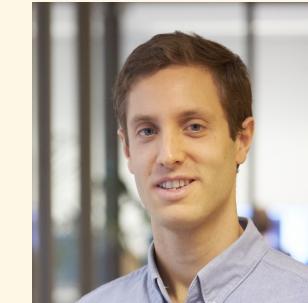


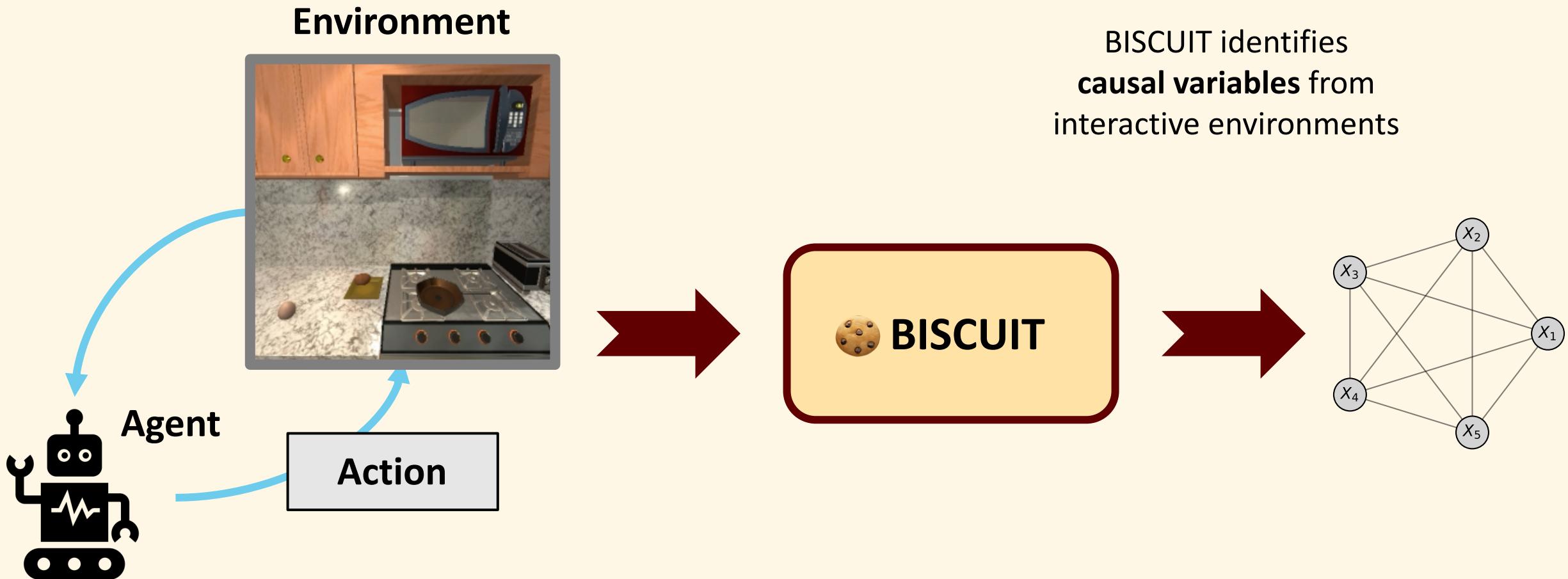


# BISCUIT: Causal Representation Learning from Binary Interactions

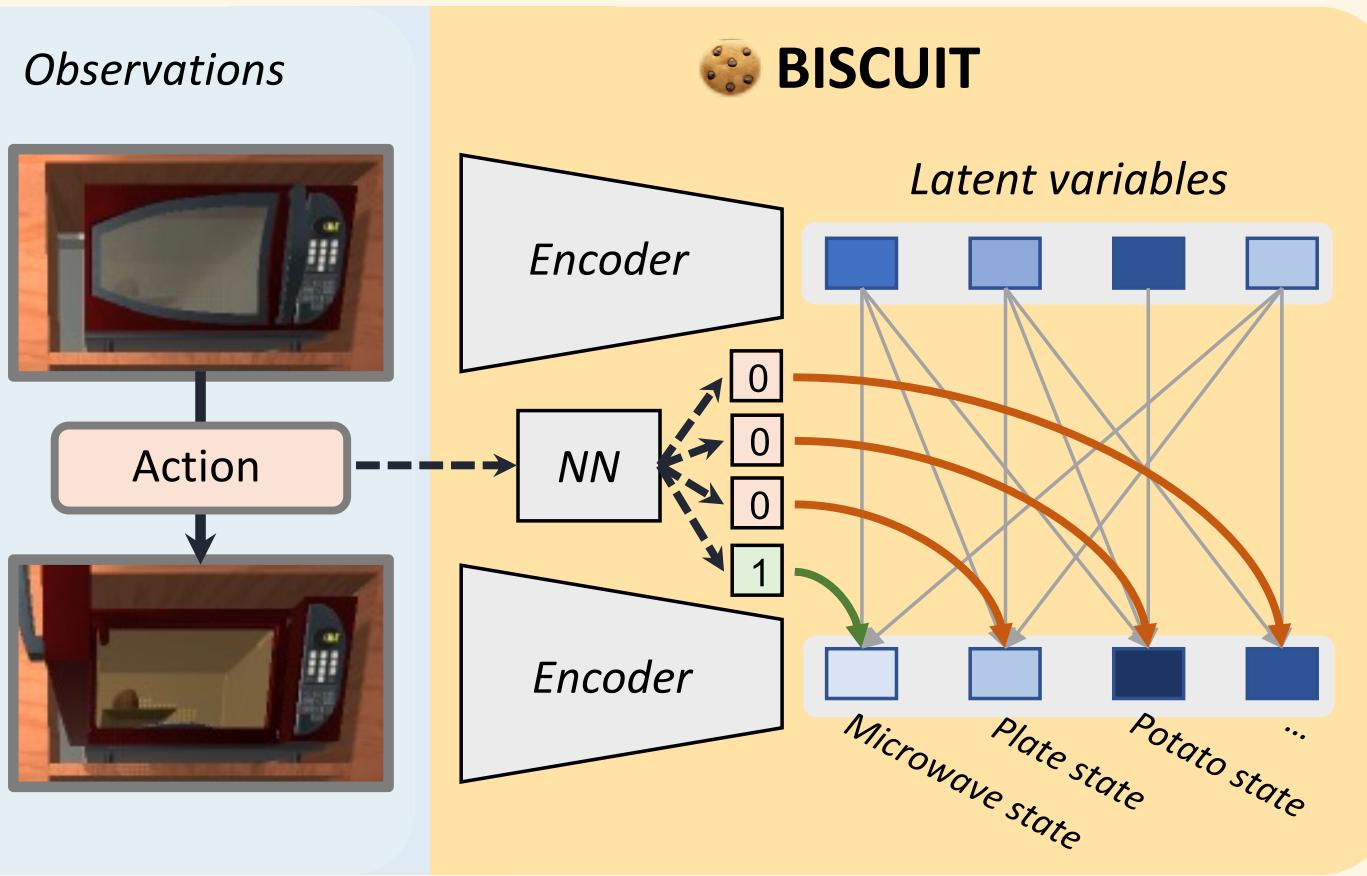
Phillip Lippe, Sara Magliacane, Sindy Löwe, Yuki M. Asano, Taco Cohen, Efstratios Gavves



# What is BISCUIT?



# How does BISCUIT work?



BISCUIT learns a **latent space** with **binary interaction variables** between agent and causal variables

# What can BISCUIT do?

BISCUIT can **simulate interventions** on causal variables by combining latent variables of two images

**Input image 1**



**Input image 2**



**Generated Output**



**Latents from image 2**

Microwave Active  
Stove (front-left)





# BISCUIT: Causal Representation Learning from Binary Interactions

Phillip Lippe, Sara Magliacane, Sindy Löwe, Yuki M. Asano, Taco Cohen, Efstratios Gavves

Visit our poster!

We identify causal variables from interactions, e.g. in Embodied AI.

**What is BISCUIT?**

- BISCUIT learns causal representations from videos of binary interactions.
- Example: identify the causal variables (e.g. microwave state, plate position, etc.) of the kitchen environment
- Key action: interaction variable can be caused by a binary intervention variable
- Interventional (e.g. open microwave) is observational

**How does BISCUIT work?**

- Temporal VAE with causal vars in latent space and MLPs learning interaction vars
- Alternative setup: normalizing flow applied on autoencoder representation

**Experiments**

- Evaluating accuracy of identifying causal variables from high-dimensional videos
- Action being clicks or robotic input

**Simulating Interventions in Latent Space**

- Latent interventions by (1) encoding two images, (2) replacing latents of first image by latents of second image for respective causal variables, (3) decoding new latents
- Achieves novel combinations of causal vars, e.g. uncooked egg on burning stove

**Interaction Maps**

- In iTHOR, an action is a random v-position of object interacted with
- Visualizing learned interaction variables for each causal variable segments objects

Paper and Demo

Project Website



[philippe.github.io/BISCUIT](http://philippe.github.io/BISCUIT)