Going Beyond Nouns With Vision & Language Models Using Synthetic Data

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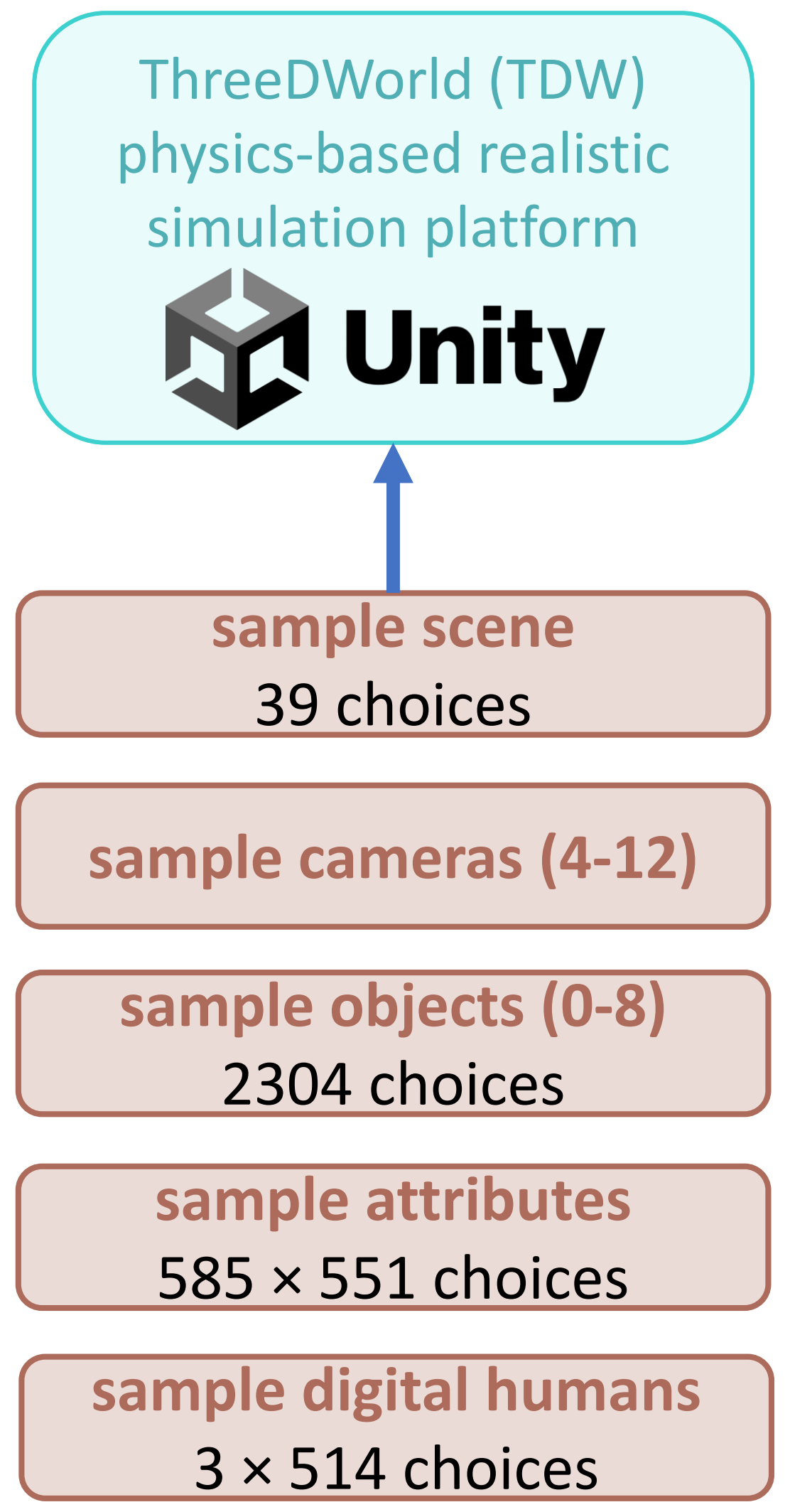
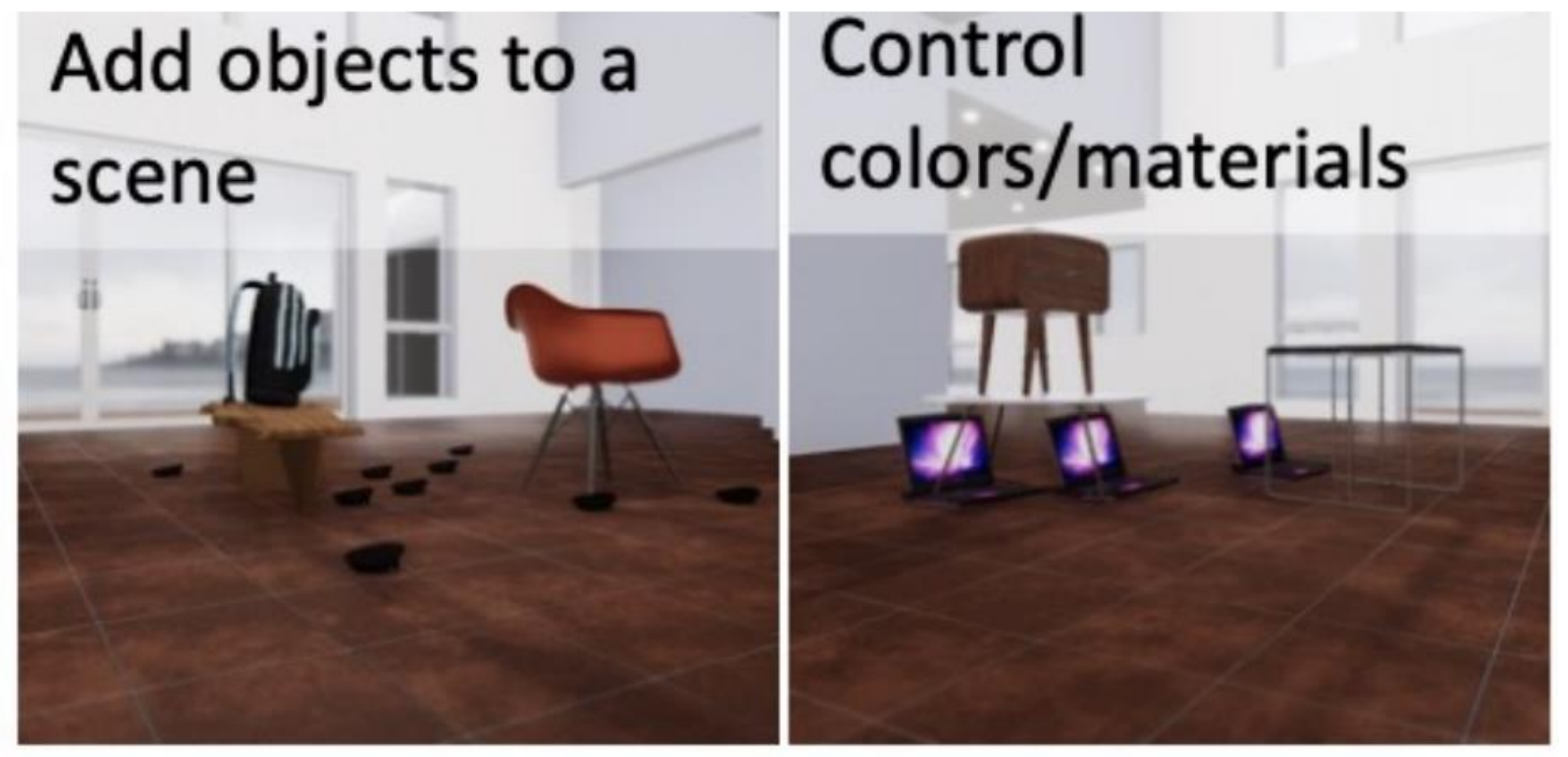
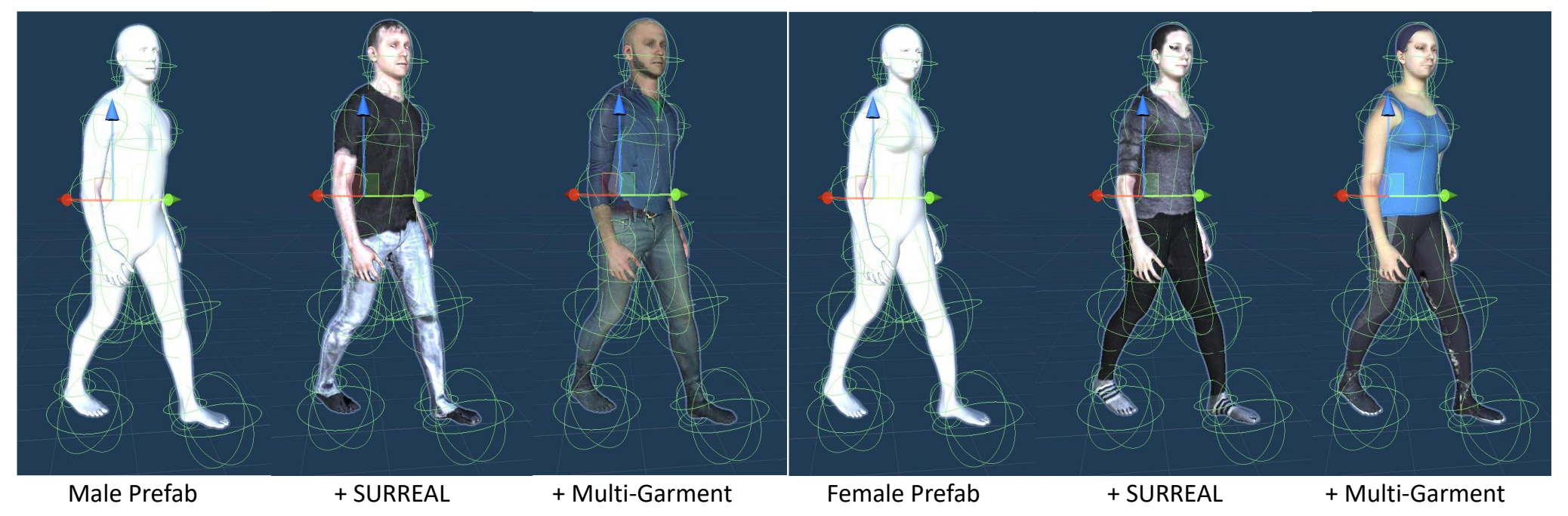
Synthetic data is cheap to produce and comes automatically labeled; it sidesteps many ethical and privacy issues that come with natural images.





An image of a *chair* next to a *backpack*

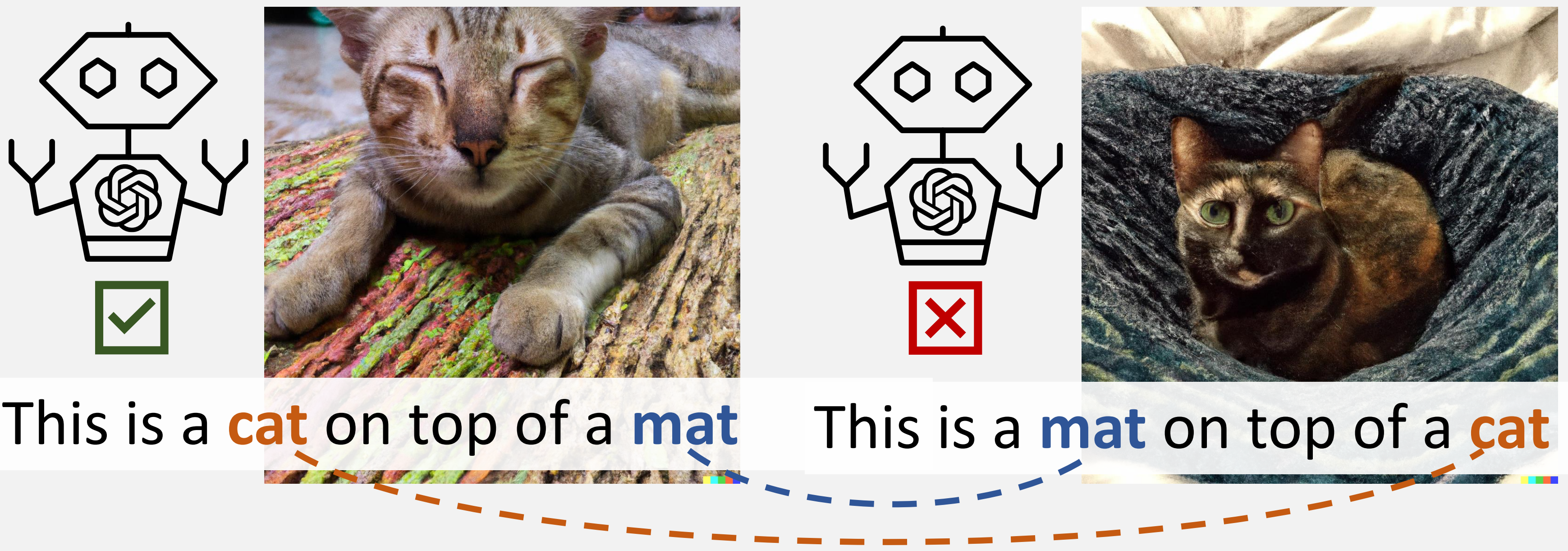
An image of a brown *table* on top of a white *table*



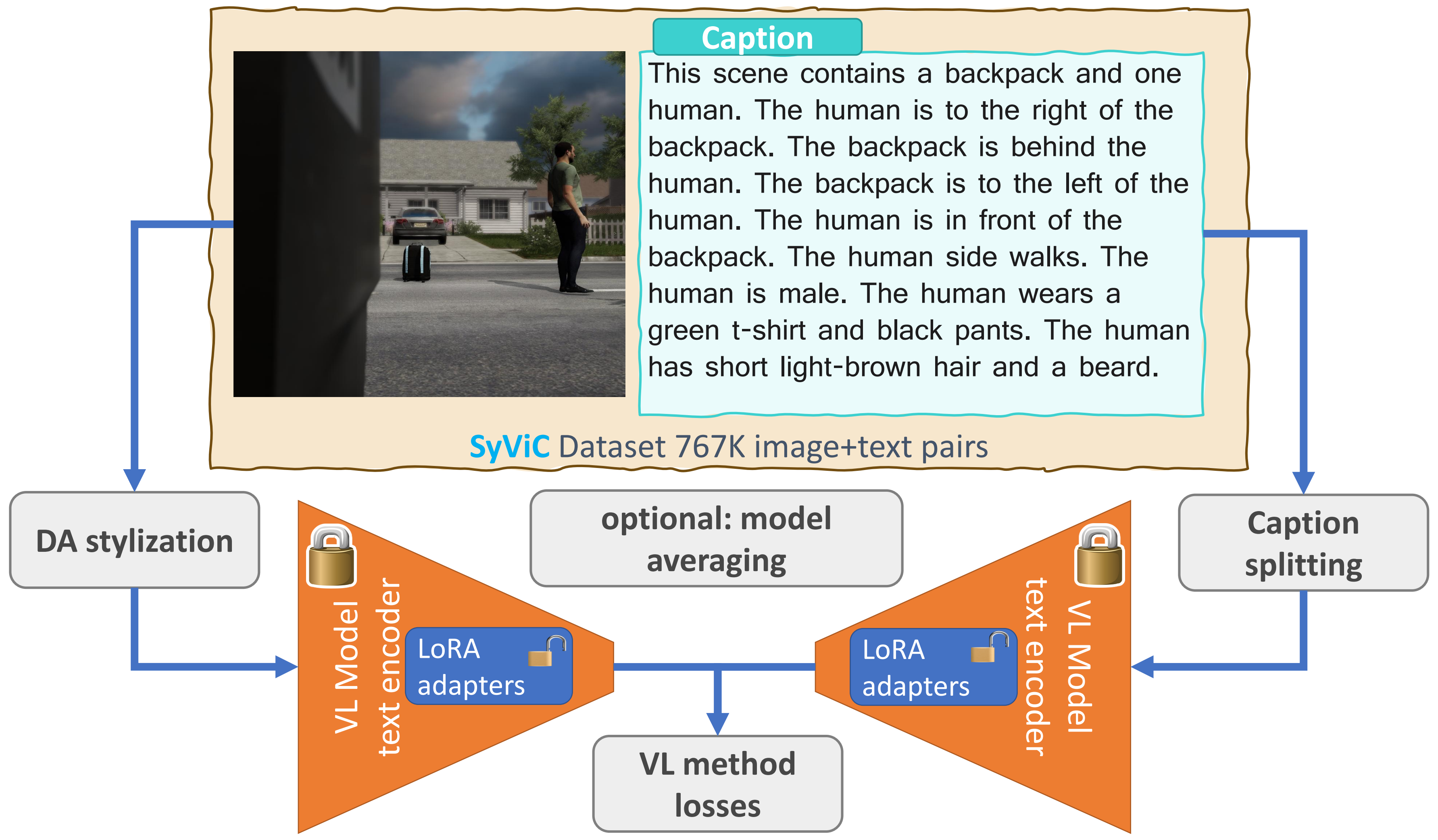
We propose **SyViC**, a million-scale synthetic dataset, and data generation codebase. By adding **digital humans** and enabling **physics,** we aim to cover transitive and intransitive **human actions**.

This scene contains a shirt, a stool, a fire hydrant, and two humans. They are in a room with blue floor and white walls. The first human is to the right of the fire hydrant. The second human wears a green football jersey and blue jeans pants (...)

Large-scale vision & language models struggle with **compositional reasoning**



We finetune a large-scale pre-trained VL model using our **SyViC** dataset. Our proposed methodology includes **domain adaptation** and **avoiding forgetting** through parameter-efficient finetuning (**LoRA**) and **model averaging**.



Caption

This scene contains a backpack and one human. The human is to the right of the backpack. The backpack is behind the human. The backpack is to the left of the human. The human is in front of the backpack. The human side walks. The human is male. The human wears a green t-shirt and black pants. The human has short light-brown hair and a beard.

Results

We evaluate our finetuned model on 3 benchmarks: *VL-Checklist*, *ARO*, and *Winoground*. The compositional reasoning evaluation includes understanding the meaning of the sentence after changing the **word order**, **attributes,** and **relations** of humans/objects.

	VL Checklist			Zero-Short
	Relation	Attribute	**Average**	(21 tasks)
CLIP	63.57	67.51	65.54	56.07
CyCLIP	61.15	66.96	64.06	55.99
syn-CLIP	69.39 (+5.82)	70.37 (+2.86)	69.88 (+4.34)	55.27 (-0.8)
syn-CyCLIP	65.73 (+4.58)	68.06 (+1.1)	66.89 (+2.83)	55.40 (-0.6)

	ARO				
	VG-Rel.	VG-Att.	Flickr30k	COCO	**Average**
CLIP	58.84	63.19	47.20	59.46	57.17
CyCLIP	59.12	65.41	20.82	29.54	43.72
syn-CLIP	71.40 (+12.56)	66.94 (+3.75)	59.06 (+11.86)	70.96 (+11.5)	67.09 (+9.9)
syn-CyCLIP	69.02 (+9.9)	63.65 (-1.76)	49.17 (+28.35)	59.36 (+29.82)	60.30 (+16.58)

	Winoground			Winoground†		
	Text	Image	**Group**	Text	Image	**Group**
CLIP	31.25	10.50	8.00	31.58	10.53	8.19
syn-CLIP	30.00	11.50	9.50 (+1.50)	29.82	12.28	9.94 (+1.75)

Project Page

https://synthetic-vic.github.io/

Let's place the mat where it should be.