Visual Perception Module

Input Video Frames

Frame 0 - 35   Frame 35 - 70

Object Trajectories & Features

Object and Interactive Features

Object 1   Object 2   Object 3

Obj1×Obj2   Obj1×Obj3   Obj2×Obj3

Object Detector

Physical Parameters

	Shape	Color	Mass	Restitution	Location	Velocity	
Obj1	Cylinder	Cyan	0.94	0.61	(-2.3, -1.7)	(1.9, 1.8)	
Obj2	Sphere	Green	0.76	0.73	(-1.2, 1.1)	(0.0, 0.0)	
Obj3	Cylinder	Green	1.25	0.90	(-2.2, 2.3)	(1.8, -2.0)	
Obj4	Cube	Purple	Unkwn.	Unkwn.	(-6.7, 4.1)	(2.6, -1.3)	

Radius	0.21		Damping Coeff.	0.06		Frictional Coeff.	0.03

Simulate & Get Events

Physics Model

Predictive Simulation:
Frame 70 - 150

Counterfactual Simulation:
Remove the green sphere
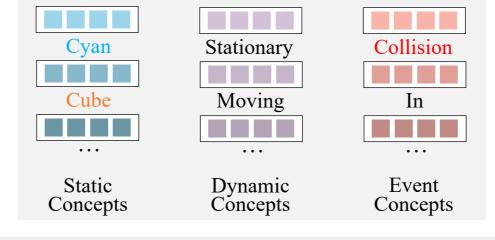
Concept Learner

Input Questions

➤ **Predictive Question:** What will happen next?

Choice: The green cylinder collides with the cube.

➤ **Counterfactual Question:** Without the green sphere, what would happen?

Choice: The green cylinder and the cyan object collide.

Question Parser

Concept Embeddings & Programs

Cyan   Stationary   Collision

Cube   Moving   In

Static Concepts   Dynamic Concepts   Event Concepts

Program 1: Filter(Unseen Events) ↳
Filter(Collision, (Filter(Green, Cylinder), Filter(Cube)))

Program 2: Filter(Counterfact, Filter(Green, Sphere)) ↳
Filter(Collision, (Filter(Green, Cylinder), Filter(Cyan)))

Execute programs to get answers
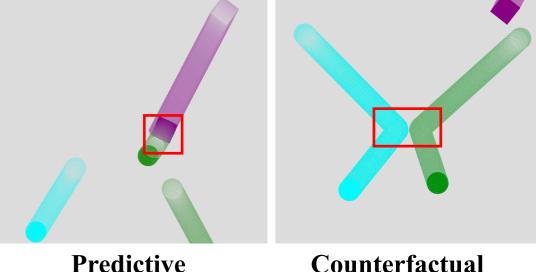
Predictive: True ✓   Counterfactual: True ✓

update