# LegoTron: An Environment for Interactive Structural Understanding

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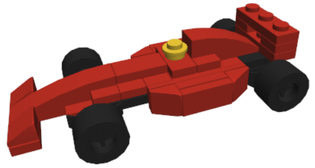
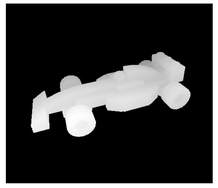
## Overview:



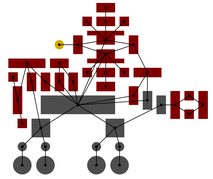
Full Color

Exploded To Show Detail

Part Mask

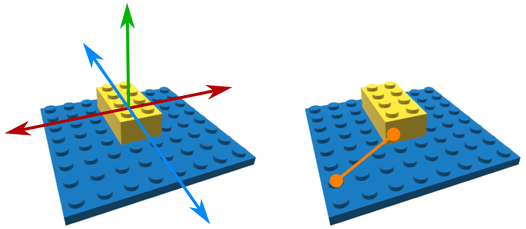


Depth



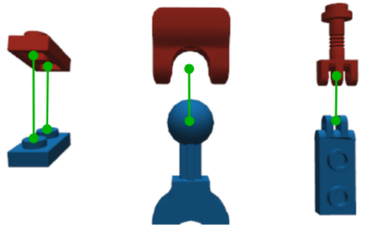
Connection Graph

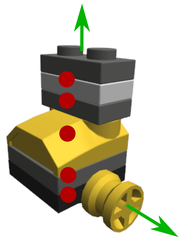
LegoTron is an interactive simulator for manipulating 3D Lego models. LegoTron supports a variety of action and observation modalities designed to provide a rich environment for interactive machine learning agents. LegoTron comes bundled 1,491 fan-made Lego models (examples below), providing a rich source of natural training data.



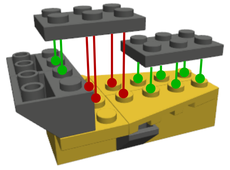
LegoTron supports manipulation of individual bricks using a number of action primitives. Bricks may be translated and rotated in a local axis-aligned coordinate system and can also be dragged from one location to another. Bricks may be specified using 2D screen coordinates or an ID.

LegoTron supports reasoning over not just individual bricks, but also the connections between them. A variety of connection types are supported including stud-hole, ball-socket and interlocking finger/hinge connectors. These are used for snapping drag-and-drop actions. Connection points are also used to reason about the graphical structure of a model by determining which bricks are connected to each other.





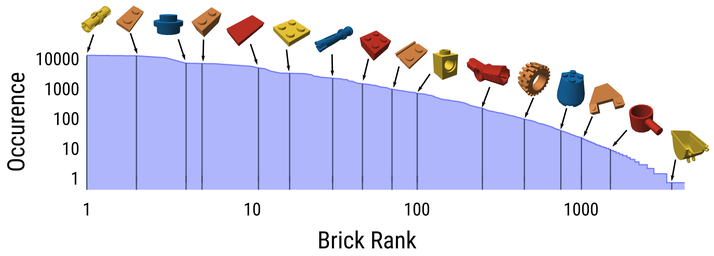
Removability



Insertability

LegoTron supports basic feasibility checking when placing and removing bricks. On the left, the wheel and the top brick are removable while all others are stuck. On the right, the bricks can be placed into the locations specified by the green dots, but not the red dots because of collisions.

## Dataset:




The models that are bundled with LegoTron are extremely diverse, ranging in size from 5 to 5197 bricks, and use over four thousand distinct brick shapes. The graph above plots the number of times each is used on a log-log scale. This reveals a long tail of rare items that is a common feature of many natural datasets. There are more than 100 bricks shapes with at least 1000 instances, but around half of all brick types are occur less than 10 times.

Many models in the dataset contain manually labelled subcomponents that can be broken out into separate models. For example the model shown at left contains five cars and a garage. LegoTron supports loading each of these individual components in addition to the entire model.