



RoboEarth

Workshop on Knowledge Engineering
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<http://www.roboearth.org>

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Overview

- RoboEarth
- RoboEarth language
- Representation of Action Recipes, Object Models, Semantic Maps
- **Capability Matching**

RoboEarth

- Problem: Let robots perform complex tasks in dynamic environments
- Strategy: Learning and Memorization
 - Share re-usable knowledge between robots
 - World-Wide-Web for and by robots
- Goal: Prove that using RoboEarth as a „global memory“ speeds up learning new tasks and adapting to new scenarios

RoboEarth Language

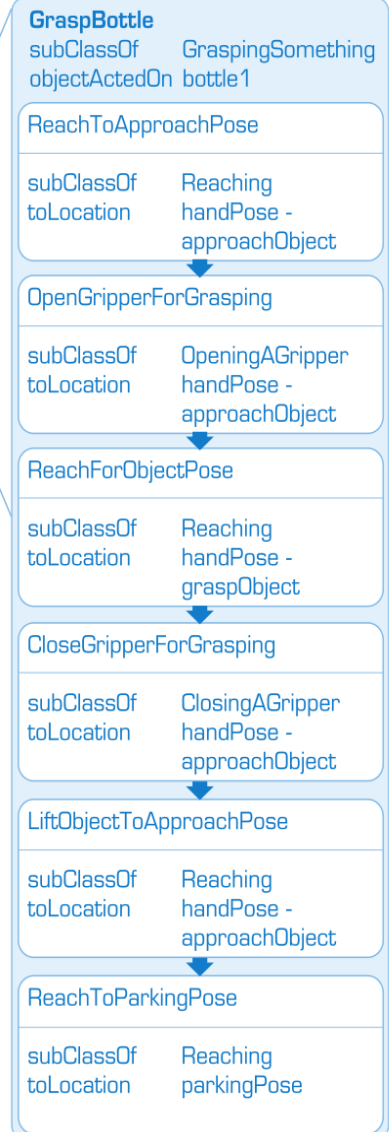
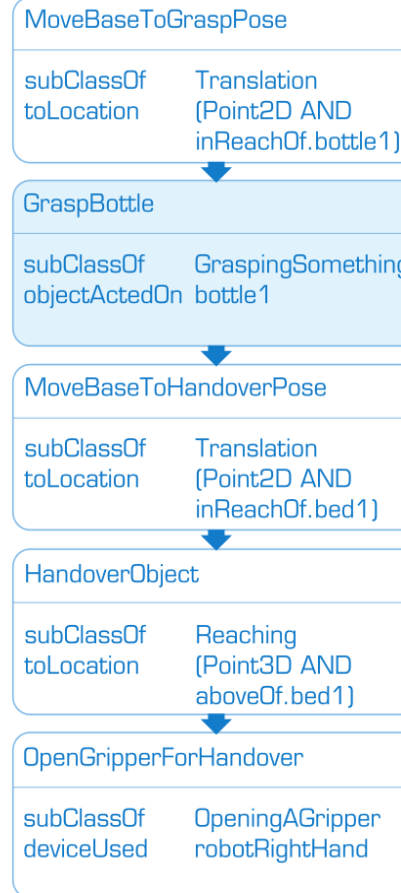
- Language to semantically represent action recipes (task descriptions), object models and environment maps
 - based on Description Logic (encoded in OWL)
 - describe sharable information and meta-data
 - link to binary files, if appropriate
- Reasoning methods to
 - check if an action recipe can be executed on a robot
 - find suitable information in the RoboEarth database
 - determine and retrieve missing information
 - ground abstract descriptions on the robot

Action Recipe

- Action ontology
 - specialization hierarchy
 - task composition
- Declarative and procedural descriptions
- Ordering of actions, pre- and postconditions
- Involved objects, locations
- Inherited dependencies

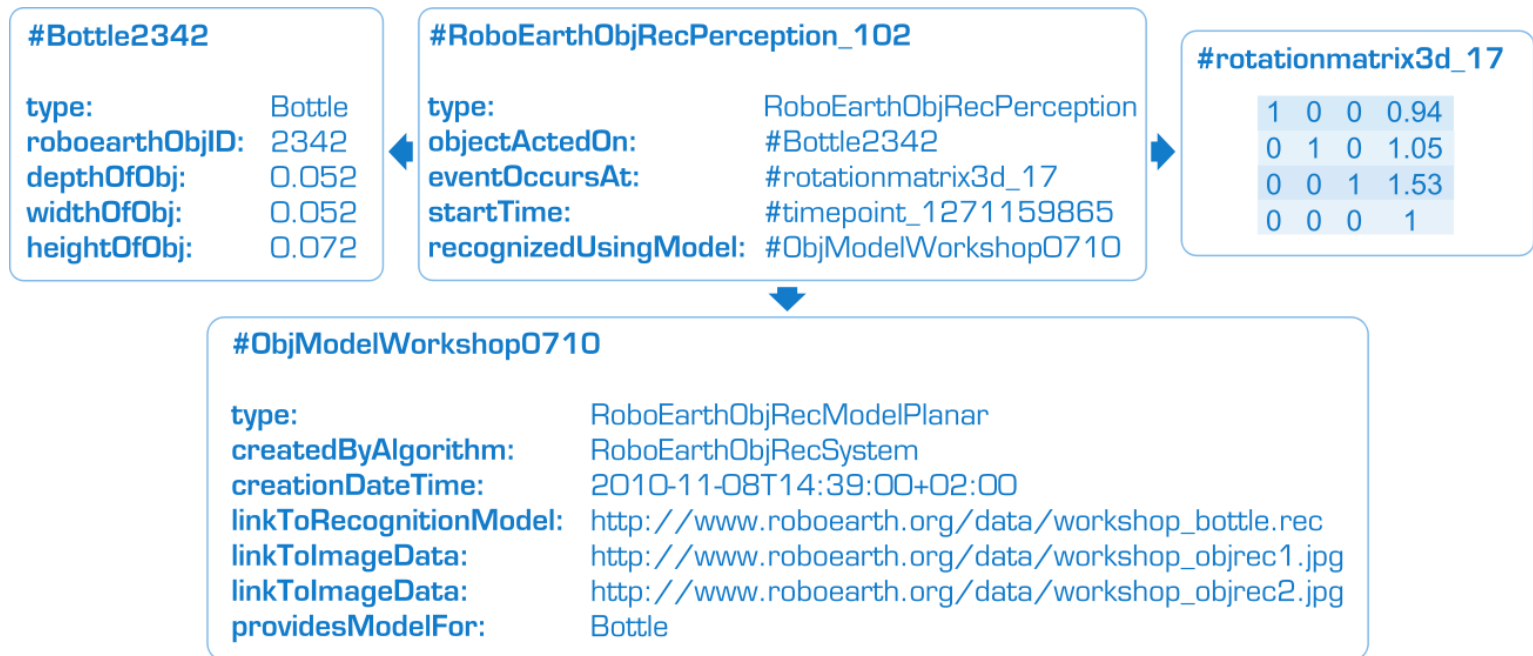
ServeADrink

dependsOnComponent ObjectRecognitionModel AND providesModelFor.Bottle
 dependsOnComponent ObjectRecognitionModel AND providesModelFor.Bed
 dependsOnComponent ObjectRecognitionModel AND providesModelFor.Cabinet



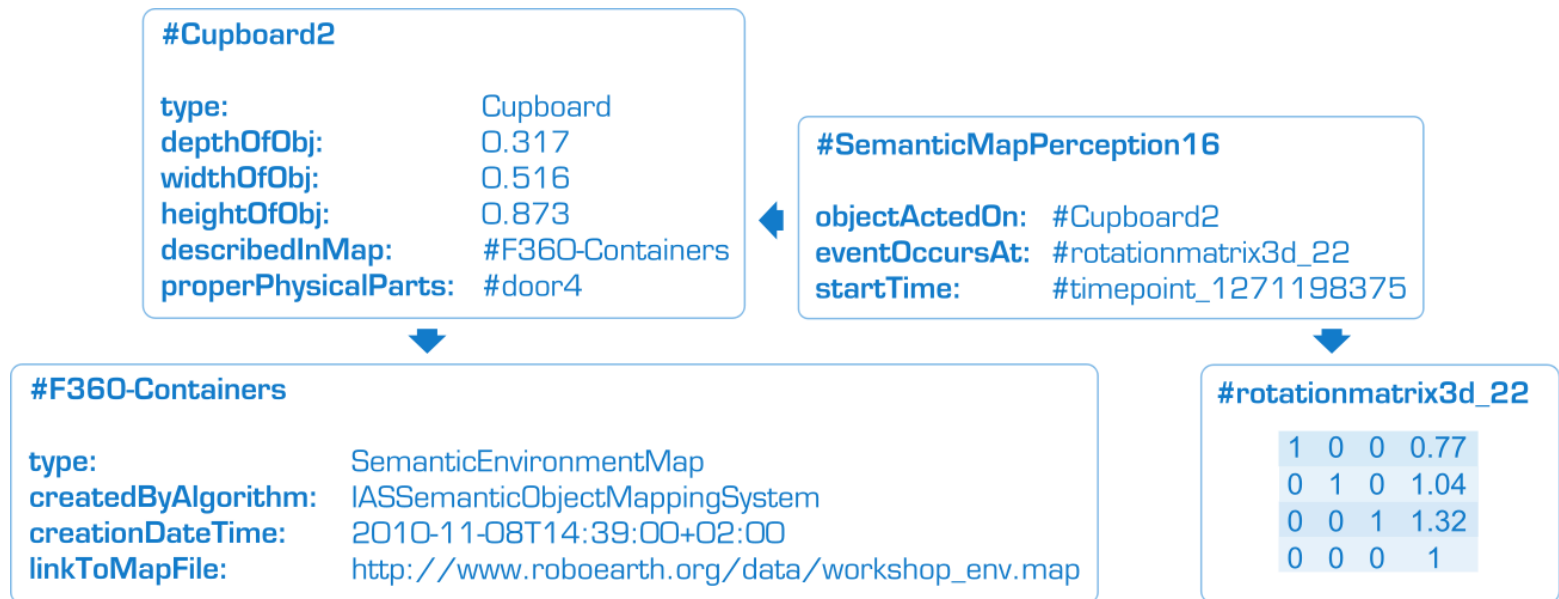
Object Model

- Classes of objects, their types, dimensions, states, ...
- Optionally: articulation model and link to recognition model
- Get grounded instances through perception system
- Reasoning: find actions to be performed on/with the object, ...

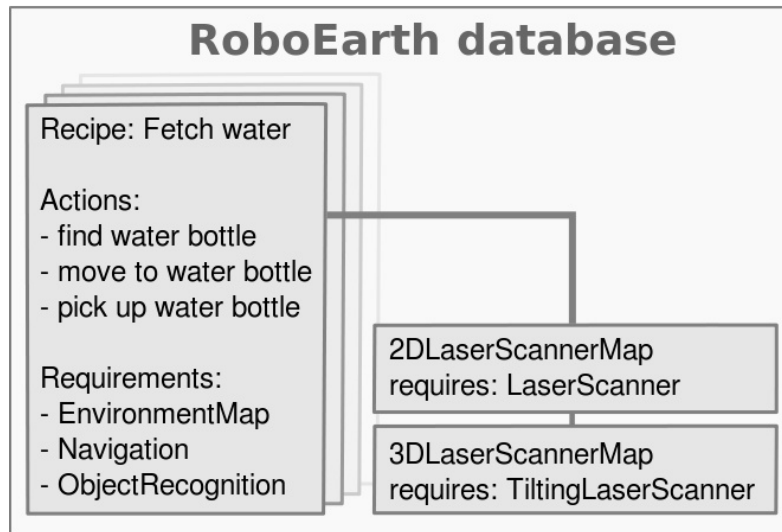


Semantic Map

- Consists of a map for localization (binary file) and a semantic description of contained object instances
- Object poses are described by latest perception instances
→ easy to incorporate newer detections
- Reasoning: determine position uncertainty, ...



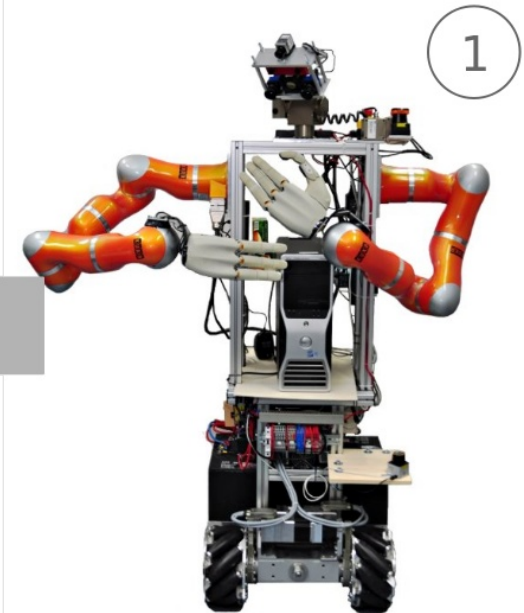
Matching Requirements to Capabilities



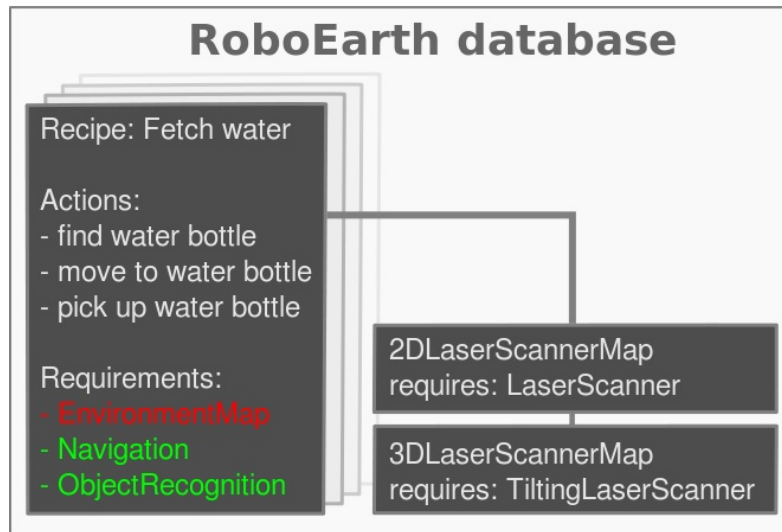
Request:
Recipe: Fetch water

Capabilities:
Navigation
ObjectRecognition

Sensors:
HokuyoLaser
StereoCamera



Matching Requirements to Capabilities

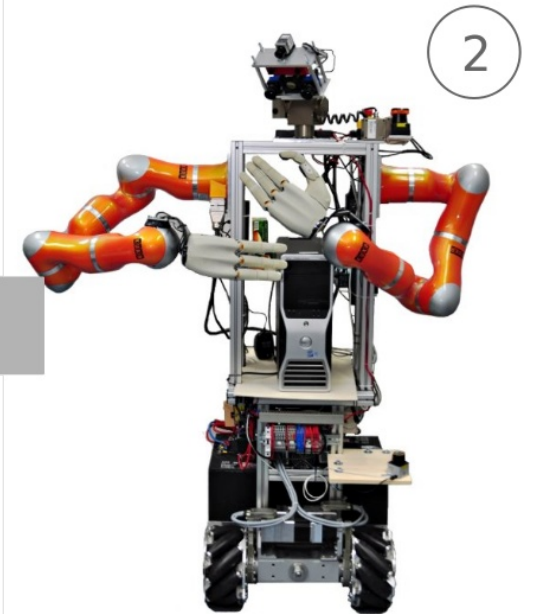


Request:
Recipe: Fetch water

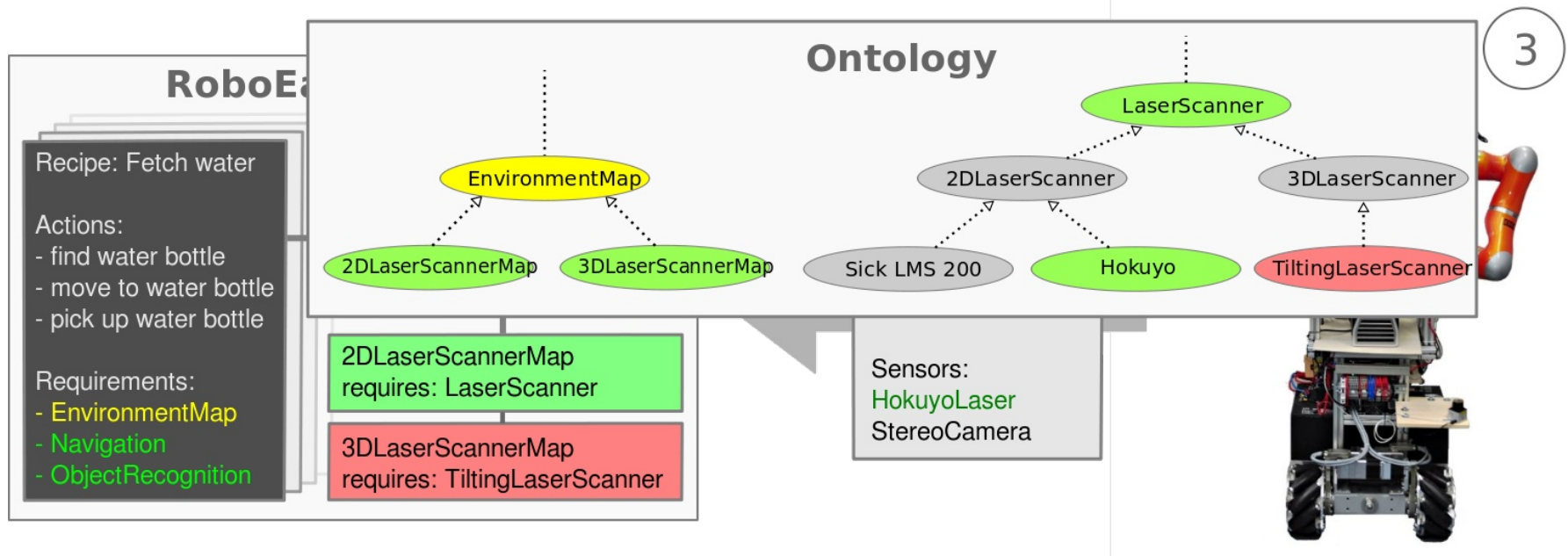
Capabilities:
Navigation
ObjectRecognition

Sensors:
HokuyoLaser
StereoCamera

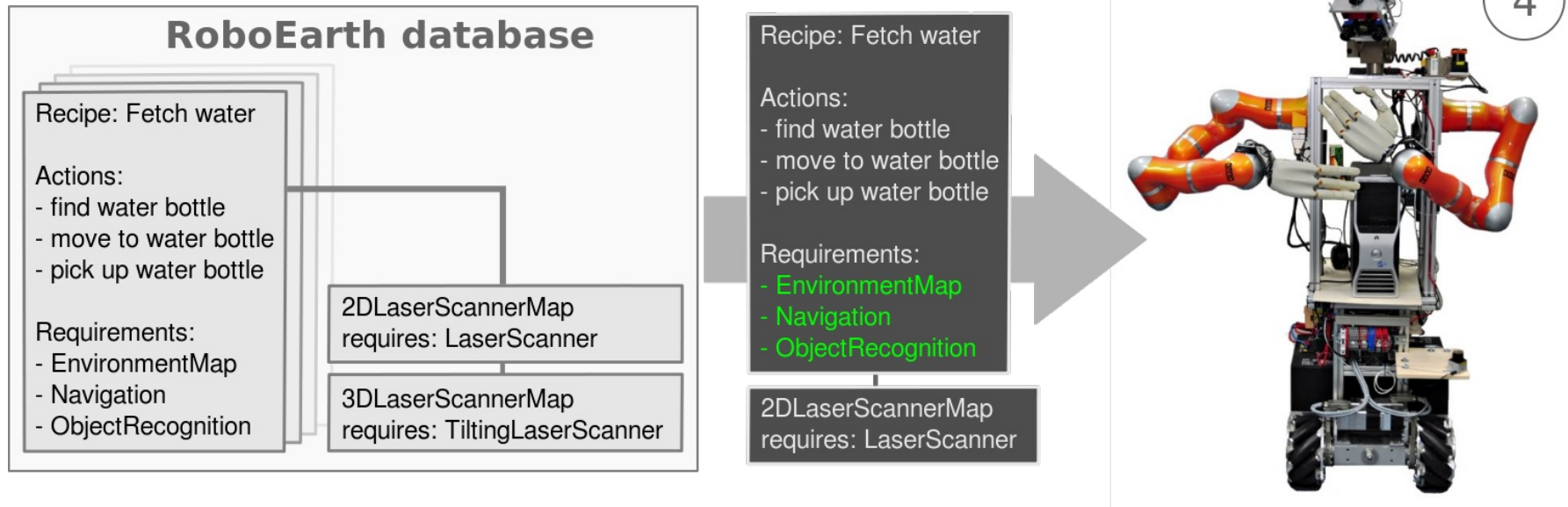
This diagram shows the robot's current state and requirements. It lists the 'Request' as 'Recipe: Fetch water'. Under 'Capabilities', it lists 'Navigation' and 'ObjectRecognition' in green. Under 'Sensors', it lists 'HokuyoLaser' and 'StereoCamera'. A large grey arrow points from the robot towards the database, indicating the matching process.



Matching Requirements to Capabilities



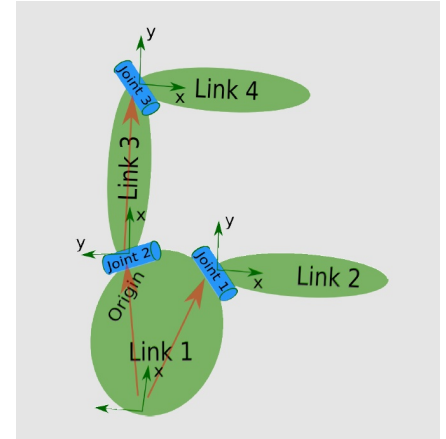
Matching Requirements to Capabilities



Matching Requirements to Capabilities

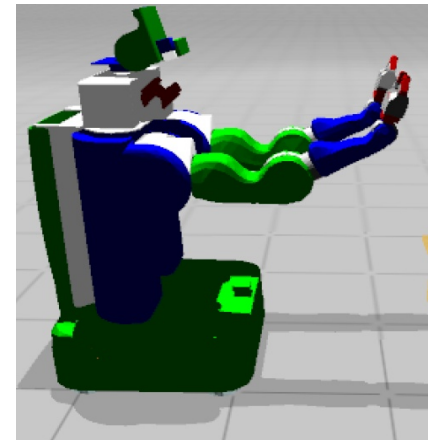
Robot description languages (URDF, ...)

- Robot kinematics
- Joints, links, surface meshes
- Used for motion planning, simulation, visualization

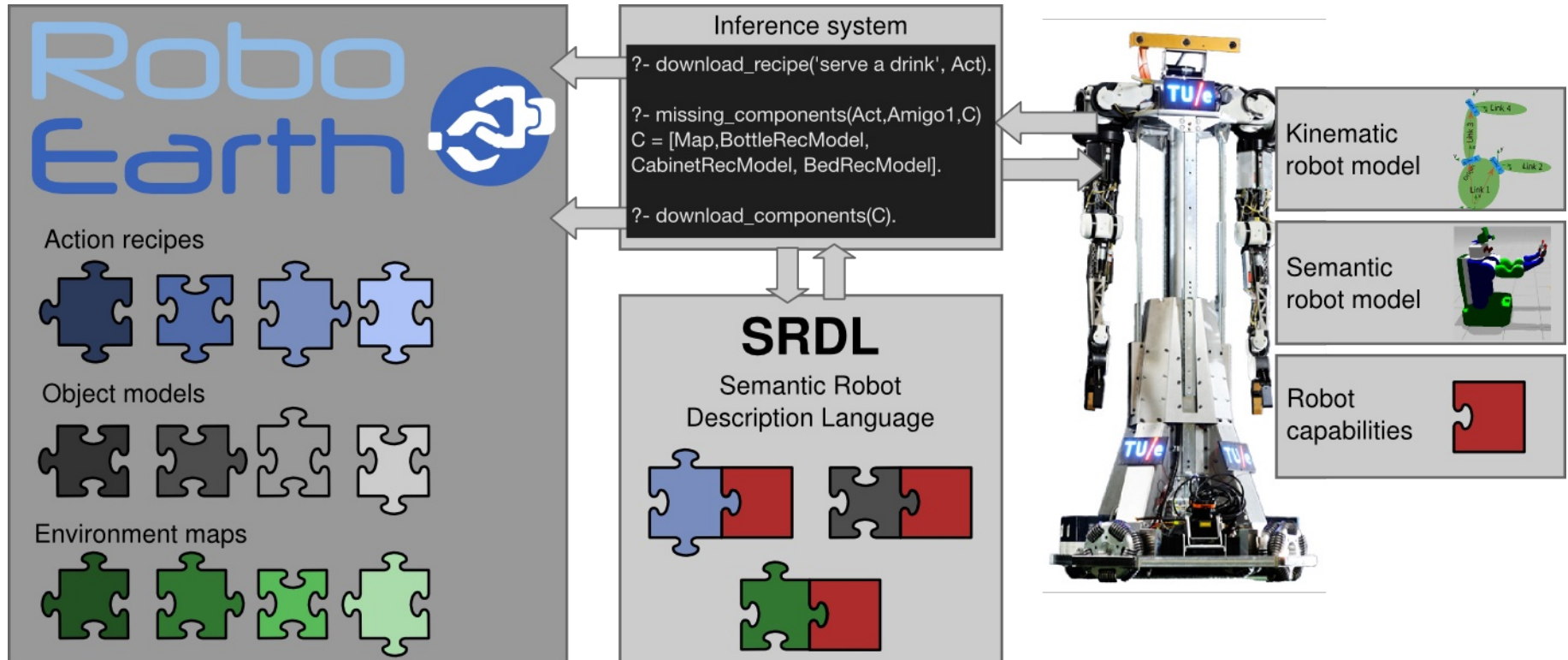


Semantic Robot Description Language

- Robot semantics
- Linked with kinematic model
- Assigns meaning to joints ('hand', 'arm', ...)



Matching Requirements to Capabilities



Thank you for your attention!