# Semantic Object Maps for Household Tasks

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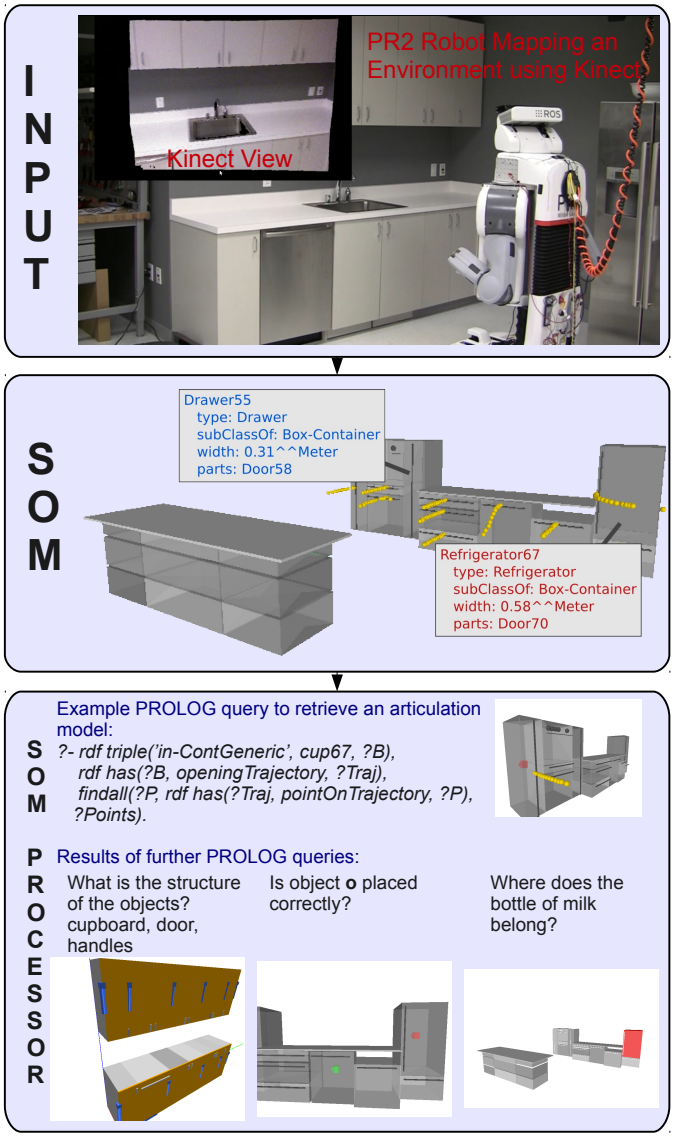
## Introduction

We present the representation and acquisition of semantic objects maps (SOMs) that can serve as information resources for autonomous service robots performing everyday manipulation tasks in kitchen environments. These maps provide the robot with information about its operation environment that enable it to perform fetch and place tasks more efficiently and reliably. To this end, the semantic object maps can answer queries such as the following ones: "What do parts of the kitchen look like?", "How can a container be opened and closed?", "Where do objects of daily use belong?", "What is inside of cupboards/drawers?", etc.




## Open-source Software

Acquisition:

ROS Stacks: bosch_registration, bosch_surface_reconstruction, bosch_texture_reconstruction

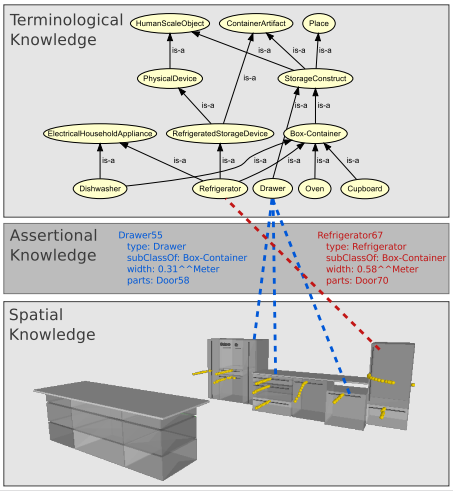
Representation:

`http://www.ros.org/wiki/knowrob`

## Representation

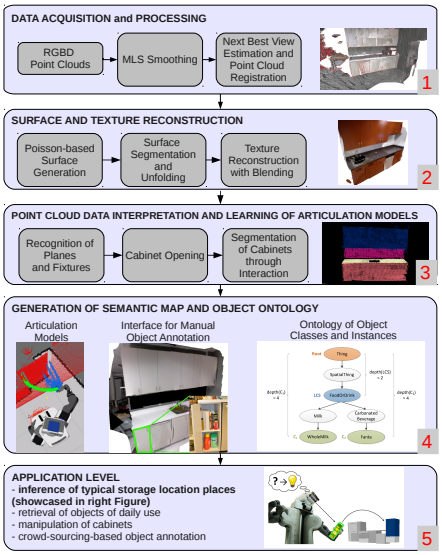
We consider a SOM map to be a pair SOM = $\langle \mathcal{SOMKB}, \mathcal{C} \rangle$, where $\mathcal{SOMKB}$ is the knowledge base representing the environment and $\mathcal{C}$ is a set of inference methods that can be used to infer knowledge that is implied by the knowledge base but not directly stored. For example, the set of inference methods $\mathcal{C}$ includes a method to infer whether two positions $p_1$ and $p_2$ satisfy the qualitative spatial relationship "left of".

The knowledge base $\mathcal{SOMKB}$ itself is formalized as a triple $\langle \mathcal{T}, \mathcal{A}, \mathcal{S} \rangle$ where $\mathcal{T}$ is an encyclopedic or terminological knowledge base that specifies the concepts or categories of objects that are used to represent the environment. For example, $\mathcal{T}$ defines the concept of cupboards as box-shaped containers that have a hinge and a door with a handle. $\mathcal{A}$ denotes the assertional knowledge which states for example that *cb23* is a physical object in the environment and an instance of concept *Cupboard*. Finally, $\mathcal{S}$ is the spatial knowledge that asserts the pose of the cupboard *cb23* in the respective environment.




## Acquisition

Acquisition process consists of 5 steps. In steps 1 and 2 we generate an explicit texture mesh model, in step 3 we semantically intrepret the given mesh and in step 4 we export the interpreted data into the above presented SOM format. Step 5 is an application level and depicts the robot making use of such generated SOM by e.g. inferring where does the bottle of milk belong.

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