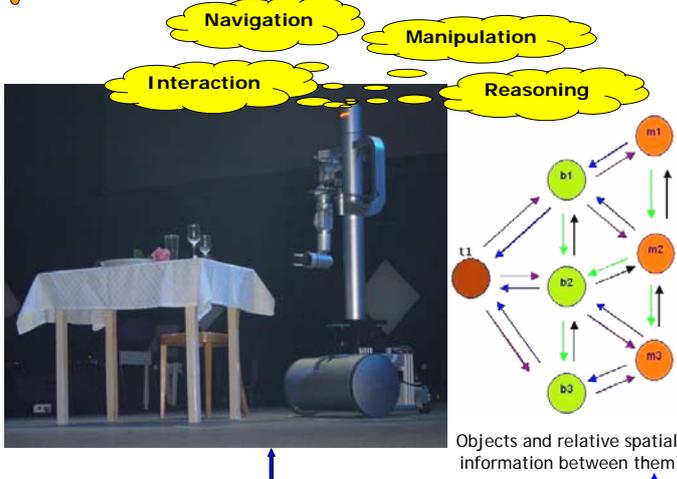


# Cognitive Probabilistic Representation of Space for Mobile Robots

## Motivation

### Cognitive Robot Companions of the future



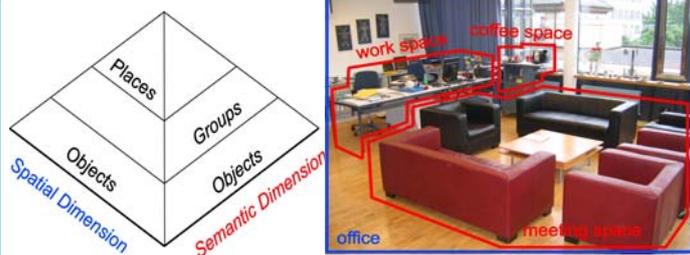
**Our Work** → **REPRESENTATION FOR ROBOT**  
Hierarchical Probabilistic Representation of Space

Scalable Multi-modal Multi-purpose probabilistic representation of space  
Increase in SEMANTICS in a robot representation  
Increase in SPATIAL AWARENESS (understanding) of Robot

## Objectives

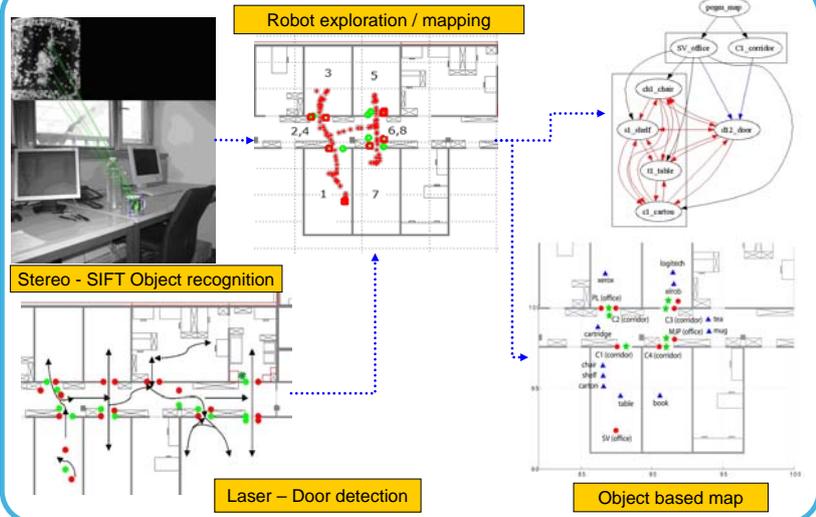
- Perception
  - High level features like objects, doors and walls.
- Representation / Mapping
  - Hierarchical Cognitive Probabilistic representation of space based on high-level features - human compatible representation of space.
- Cognition (probabilistic methods for cognitive competences)
  - Conceptualization of places.
  - Place Classification
  - Place recognition
- User Studies (Cognitive Validation of thesis)

## Approach

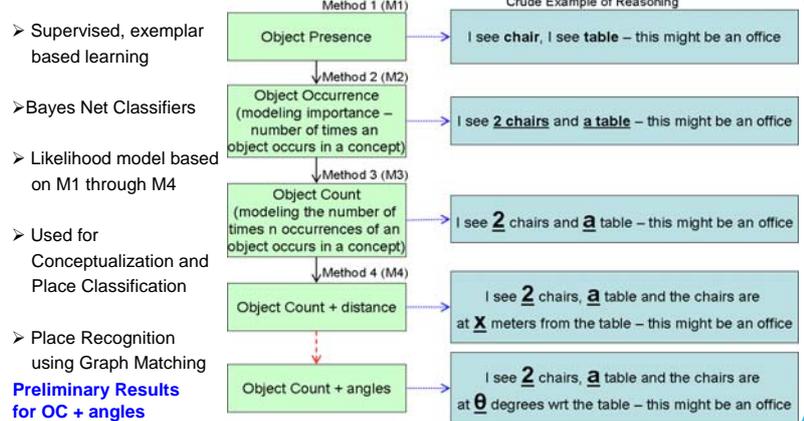


- 1. Enhance the feature set !**
  - Move from low-level features such as lines, corners etc. to high-level ones such as objects, doors and walls.
- 2. Graph based representation**
  - Develop a representation that encodes space in terms of objects and spatial relationships between them.
  - Represent relationships using a metric basis.
- 3. Abstract space to develop the hierarchical representation**
  - Develop a mapping from sensory abstractions to increasingly abstract concepts - both spatial and semantic.
  - Semantic abstractions (groups): capture spatial semantics (common purpose, functionality or due to spatial arrangement) between a cluster of objects.
  - Spatial abstractions (places): collection of groups of objects, formed due to the occurrence of boundary elements such as doors and walls.

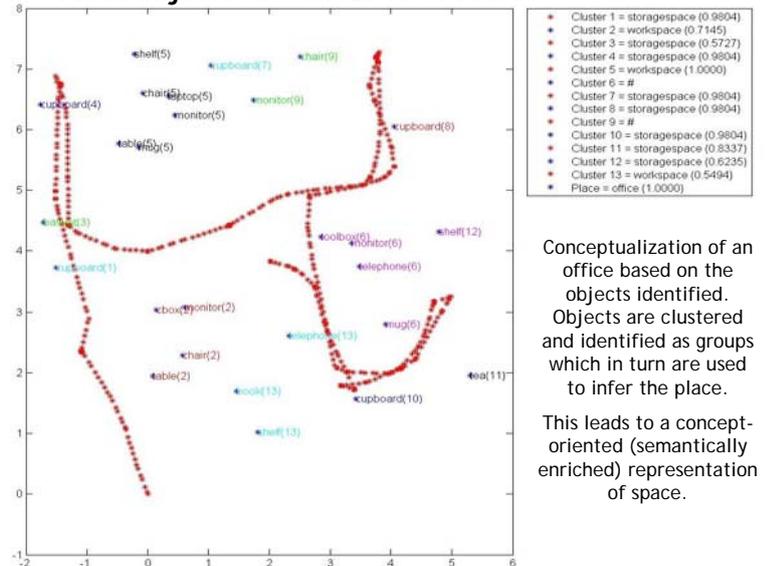
## From Objects to Places



## Overview of Conceptualization Methods



## From Objects to CONCEPTS to Places



Conceptualization of an office based on the objects identified. Objects are clustered and identified as groups which in turn are used to infer the place. This leads to a concept-oriented (semantically enriched) representation of space.

