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Robotic manipulation of multiple objects as a POMDP

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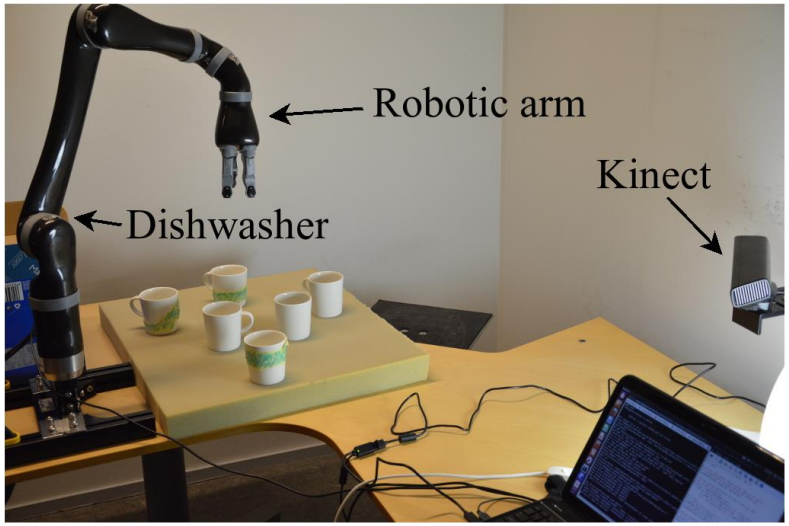
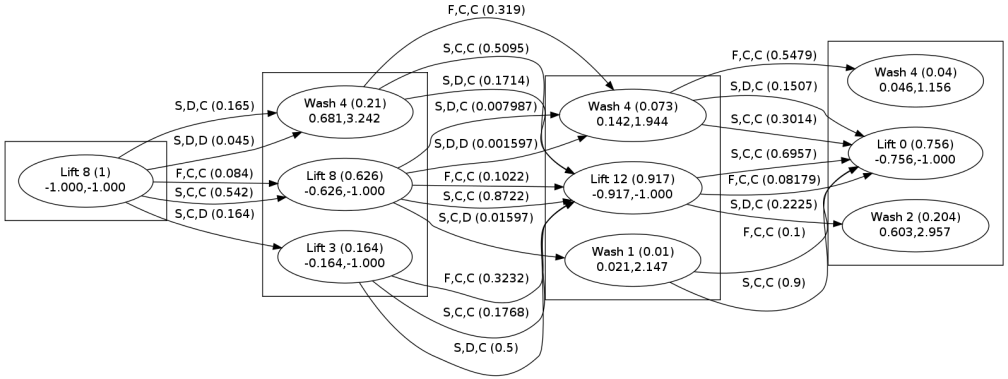


- Setting: Unknown objects in a crowded environment
- Challenges: Occlusion, imperfect observations, and uncertain action success
- Objective: perform sequential task, such as moving dirty objects into dishwasher or cleaning up toys

Belief

→

Probability

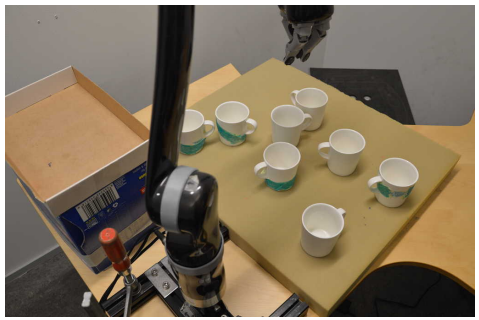


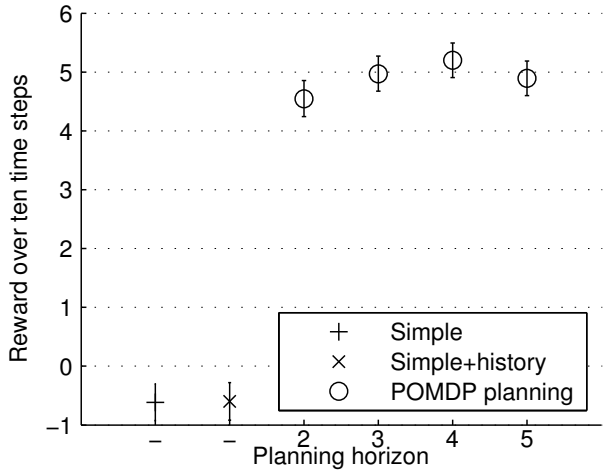
Approach: We model the problem as a partially observable Markov decision process (POMDP)

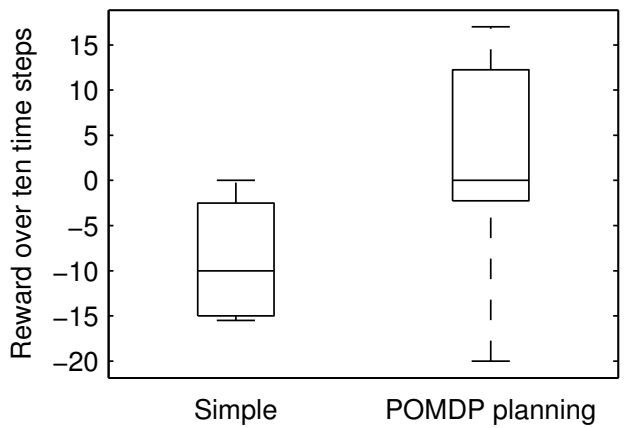
1. Estimate *belief* over object attributes (e.g. color), estimate semantic locations (e.g. on table) and occlusions
2. Estimate object probabilities
   - Probability for observing and grasping an object depends on a model-free occlusion measure
   - Our model adapts automatically object grasp probabilities according to previous grasp successes
3. Compute compact POMDP plan and execute action

Example application: dirty objects into dishwasher

- Robot may move an object into dishwasher (blue box) or lift an object to see behind the object
- Objective is to quickly move dirty but not clean objects into dishwasher







POMDP approach vs. simple heuristic approach

Thank you for your attention