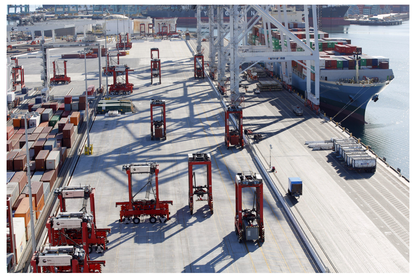
Planning and Acting with Hierarchical Input/Output Automata

INSTITUTE FOR SYSTEMS RESEARCH
A. JAMES CLARK SCHOOL OF ENGINEERING

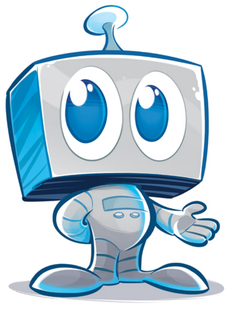
Sunandita Patra (CS and ISR), Advisor: Prof. Dana Nau (CS and ISR);
Collaborators: Paolo Traverso (FBK-ICT, Trento, Italy), Malik Ghallab (LAAS-CNRS, Toulouse, France)

Overview

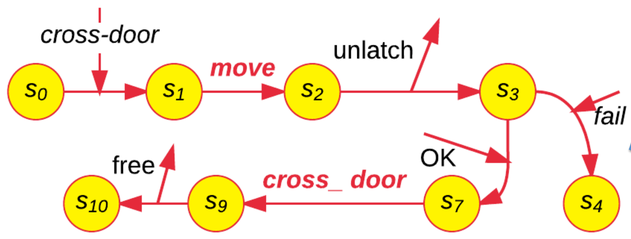
- We are building an original framework for hierarchical planning in systems defined by the parallel composition of the models of their components where the control component is an automaton.
- Typical applications are, for example, in harbor or warehouse automation.



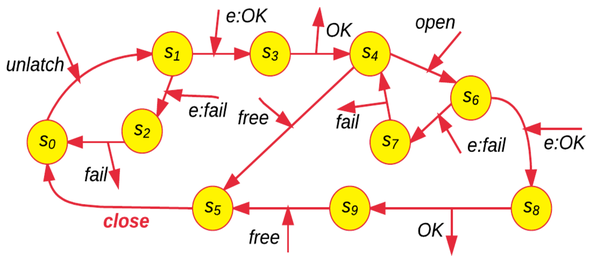
Example of a robot opening a door



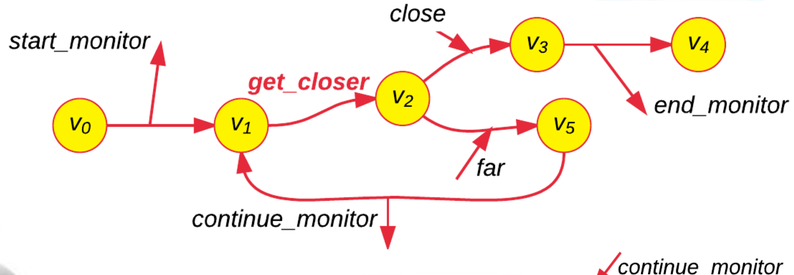
I/O automaton for robot (r)



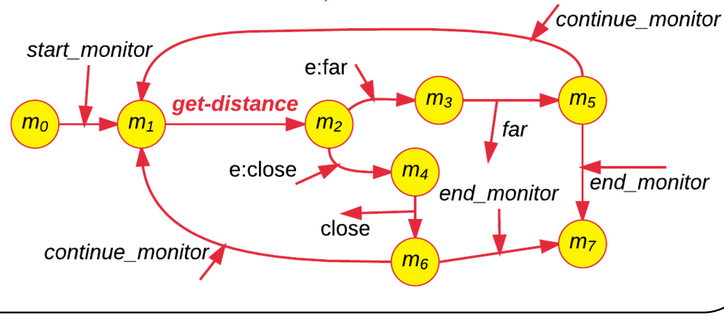
I/O automaton for door (d)



Refined robot r which can move



Monitoring agent (m)



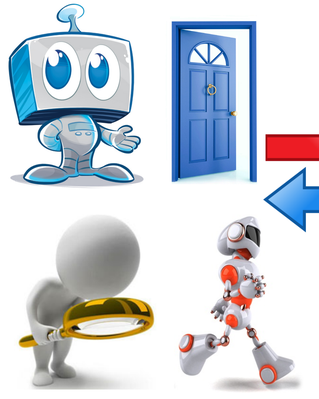
The operations of parallel composition and refinement are **distributive**, a critical feature needed for handling this representation and the planning algorithm.

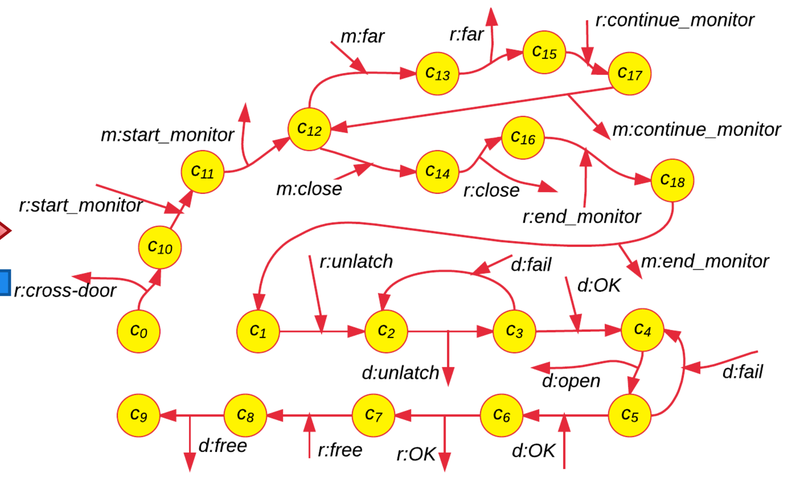
$$\mathfrak{R}(\sigma_1, s, \mu_t) = \mathfrak{R}(\sigma_1 \parallel \sigma_2, s^*, \mu_t)$$

Refinement — Parallel Composition

Planning Problem and Solution

$P = \langle \Sigma, \mathcal{M}, S_g \rangle$





Control automaton for refined robot (r), door (d) and the monitoring agent (m)

The solution is a control automaton which drives the refined robot, door and monitoring agent towards desired goal states via I/O interactions. We propose a new algorithm for solving this problem.

Interleaving Planning and Acting

- Having the choice of whether to refine a task or not at the planning stage
- Defer the decision of refinement till acting stage for some tasks
- Useful in a nondeterminstic environment where continuous monitoring is required.