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Chapter 1

Introduction

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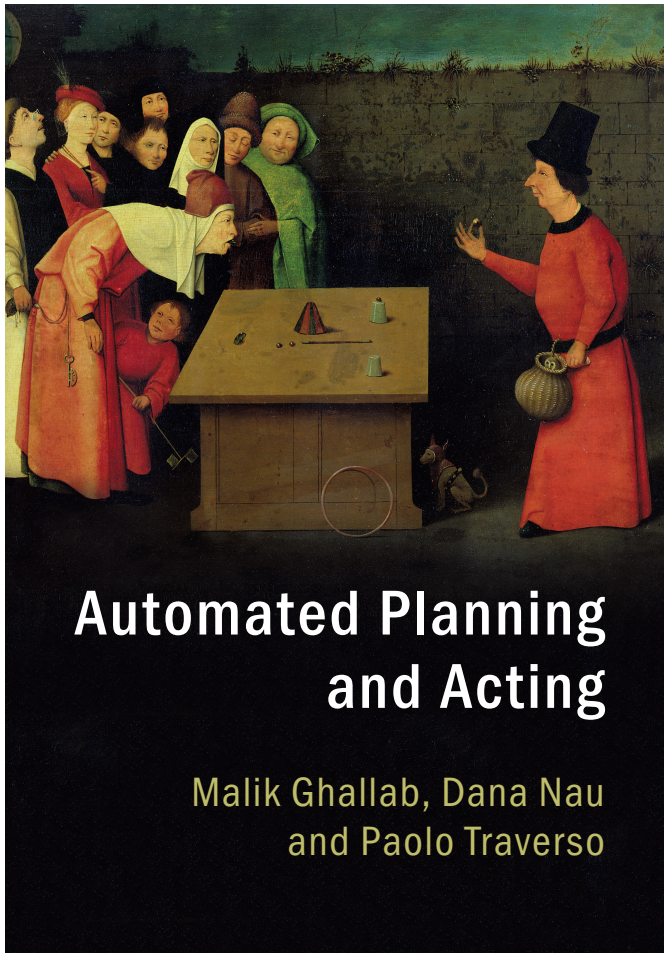


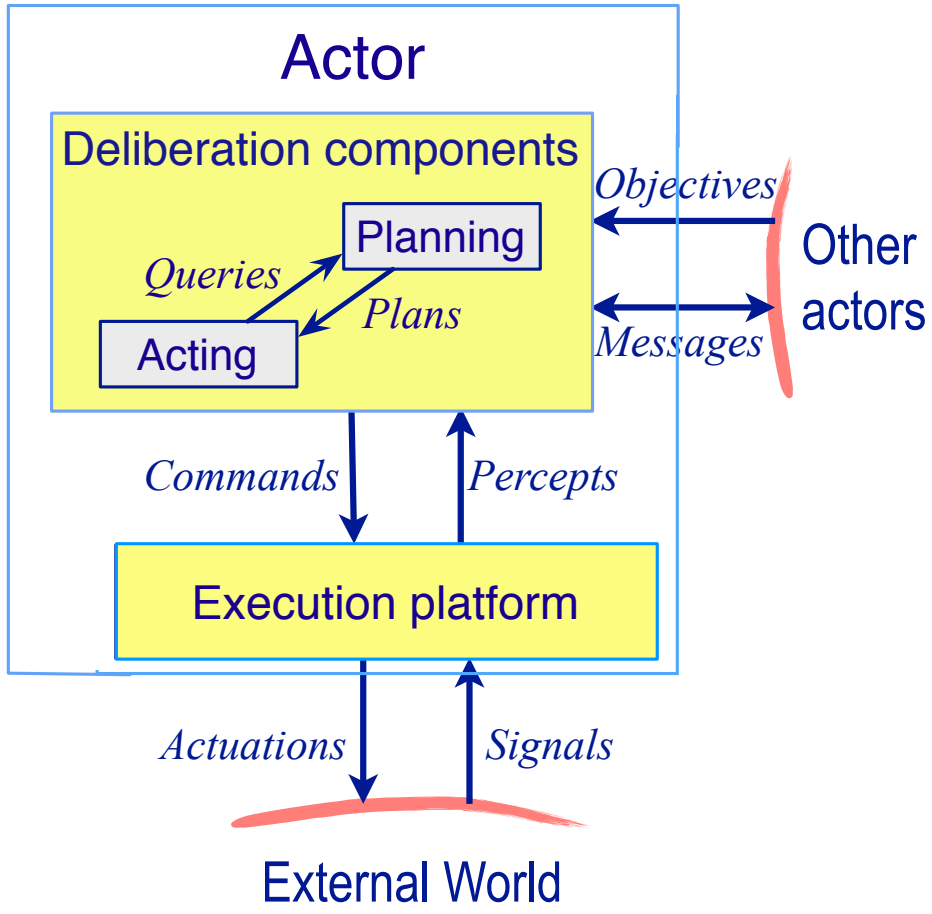
http://www.laas.fr/planning

Motivation

- *Actor*: agent that performs actions
- Deliberation functions
  - Planning

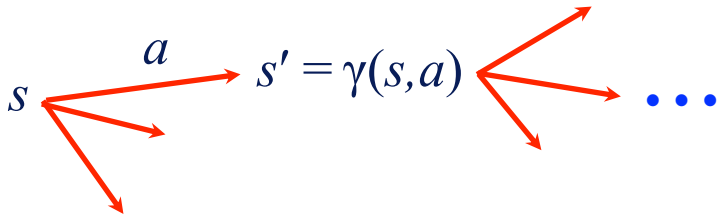
    What actions to perform
  - Acting

    How to perform them



Planning

- Relies on *prediction* + *search*
- Uses *descriptive models* of the actions
  - Predict *what* the actions will do
  - Don't tell *how* to do them
- Search over *predicted states* and possible organizations of feasible actions



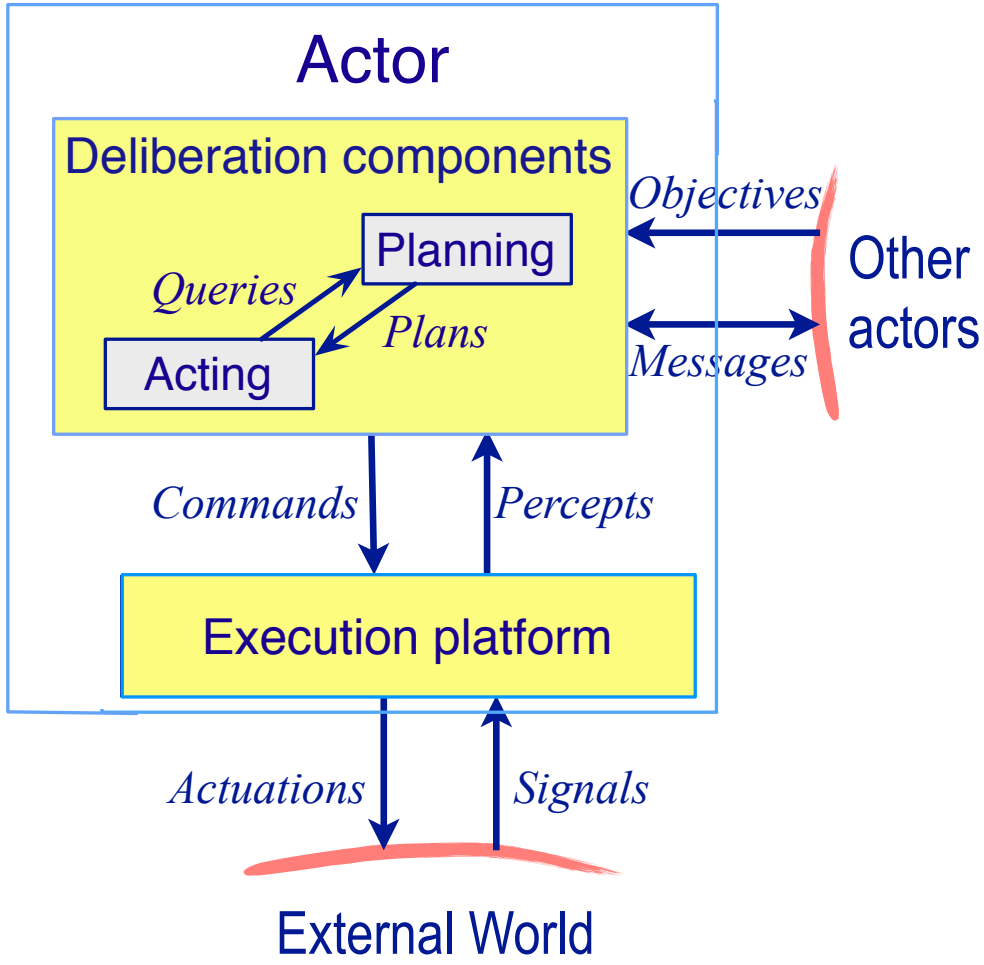
- Different types of actions ⇒
  - Different predictive models
  - Different planning problems and techniques

  - Motion and manipulation planning
  - Perception planning
  - Navigation planning
  - Communication planning
  - **Task planning**

Most AI planning

Acting

- Traditional "AI planning" view:
  - Carrying out an action is just execution
  - Can ignore how it's done
- *Sometimes* that's OK
  - If the environment has been engineered to make actions predictable
  - Example on next slide
- Usually acting is more complicated
  - Example later



Acting as Execution

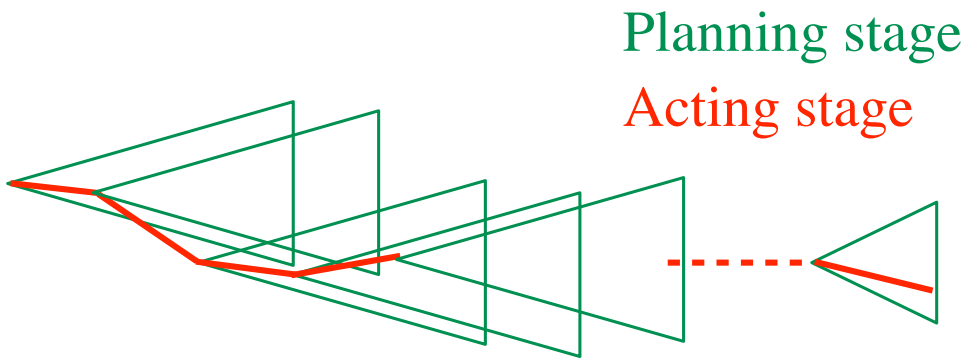
Video: https://www.cs.umd.edu/~nau/apa/kiva.mp4

Deliberative Acting

Video: https://www.cs.umd.edu/~nau/apa/crow.mov

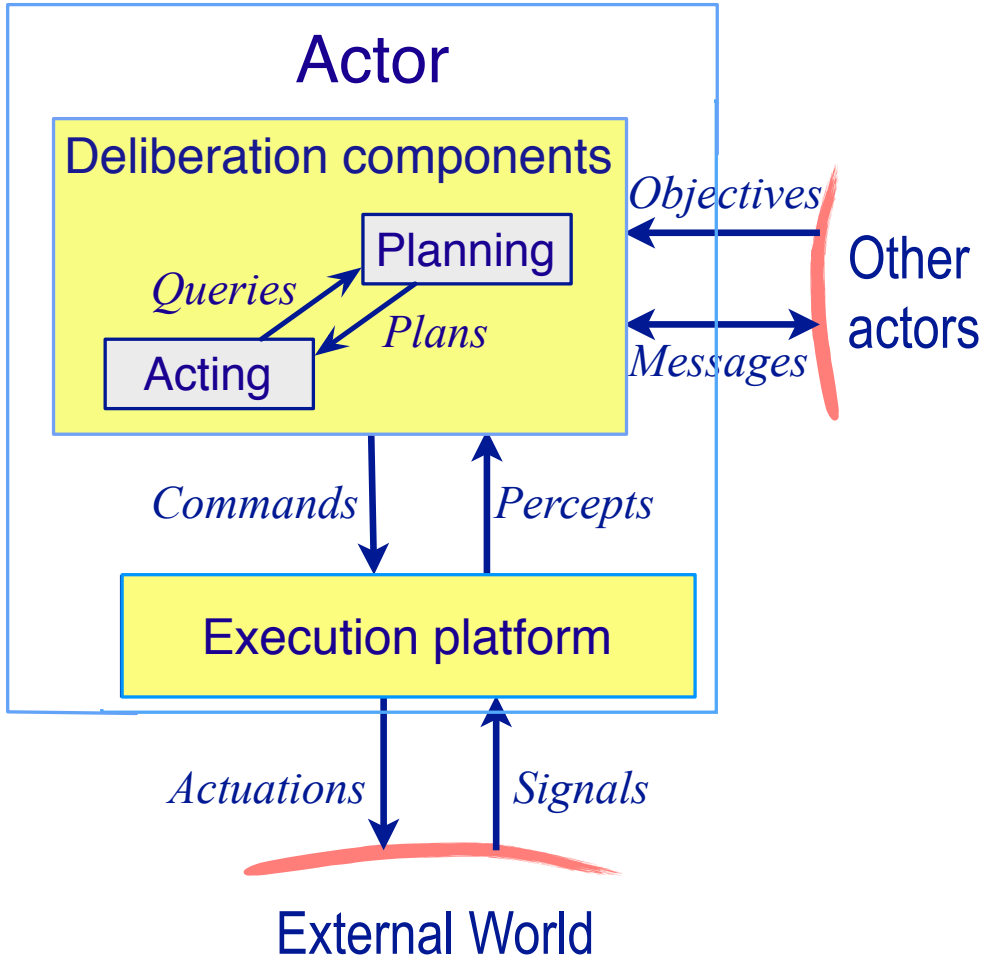
Deliberative Acting

- Actor is in a dynamic unpredictable environment
  - Adapt actions to current context
  - React to events
- Relies on
  - *Operational models* telling *how* to perform the actions
  - Observations of *current state*



Planning and Acting

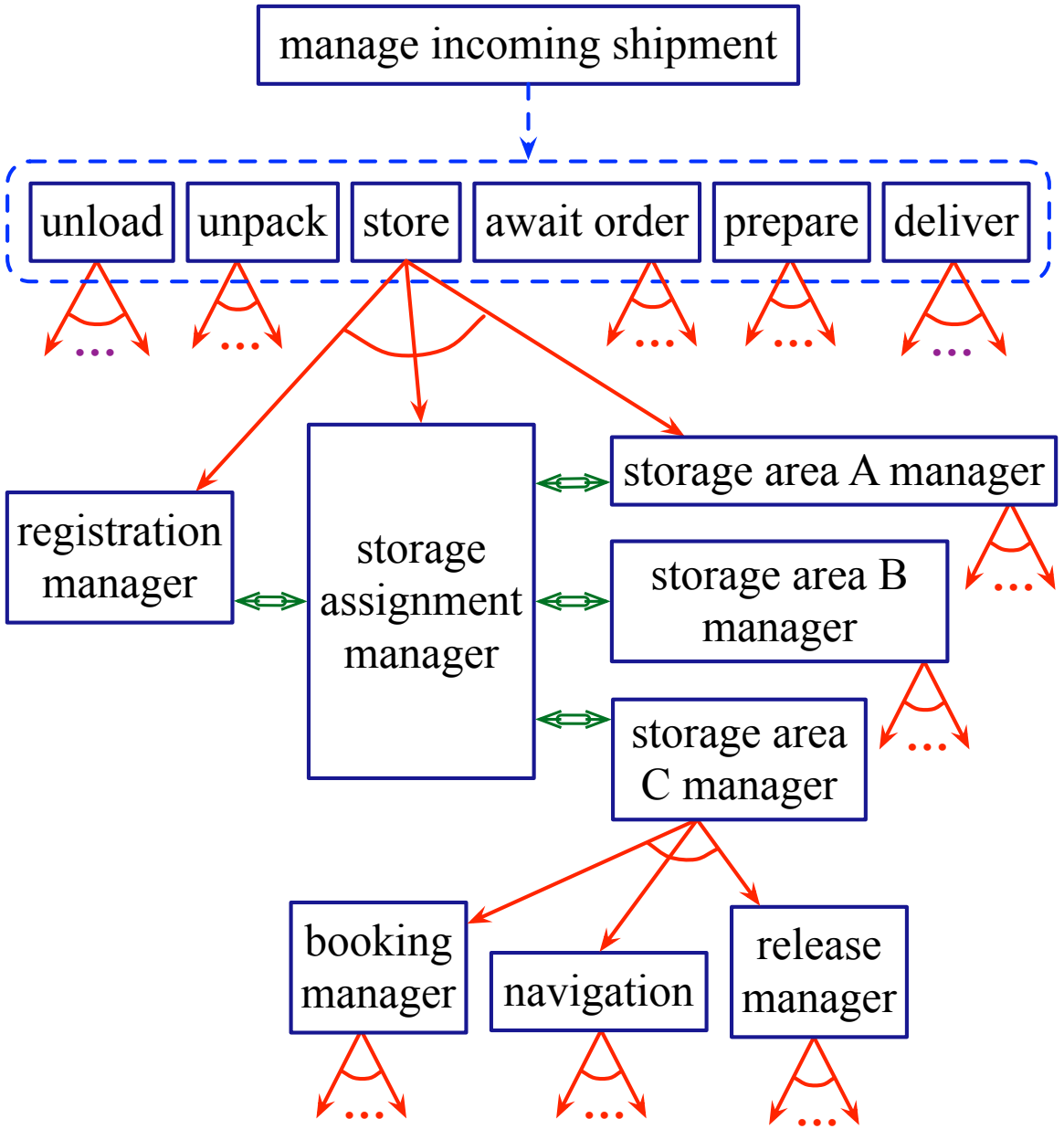
- *Multiple levels of abstraction*
  - Actors are organized into physical subsystems
  - Deliberation reflects this
- *Heterogeneous reasoning*
  - Different techniques
    - at different levels
    - different subsystems at same level
- *Continual online planning*
  - Can't plan everything in advance
  - Plans are abstract and partial until more detail is needed



Bremen Harbor

Example: Harbor Management

- Importing/exporting cars
  - Based on Bremen Harbor
- *Multiple levels of abstraction*
  - Reflect physical organization of harbor
- *Continual online planning*
  - Top level can be planned offline
  - The rest is online, based on current conditions
- *Heterogeneous reasoning*
  - Different components work in different ways
  - Online synthesis of automata to control their interactions

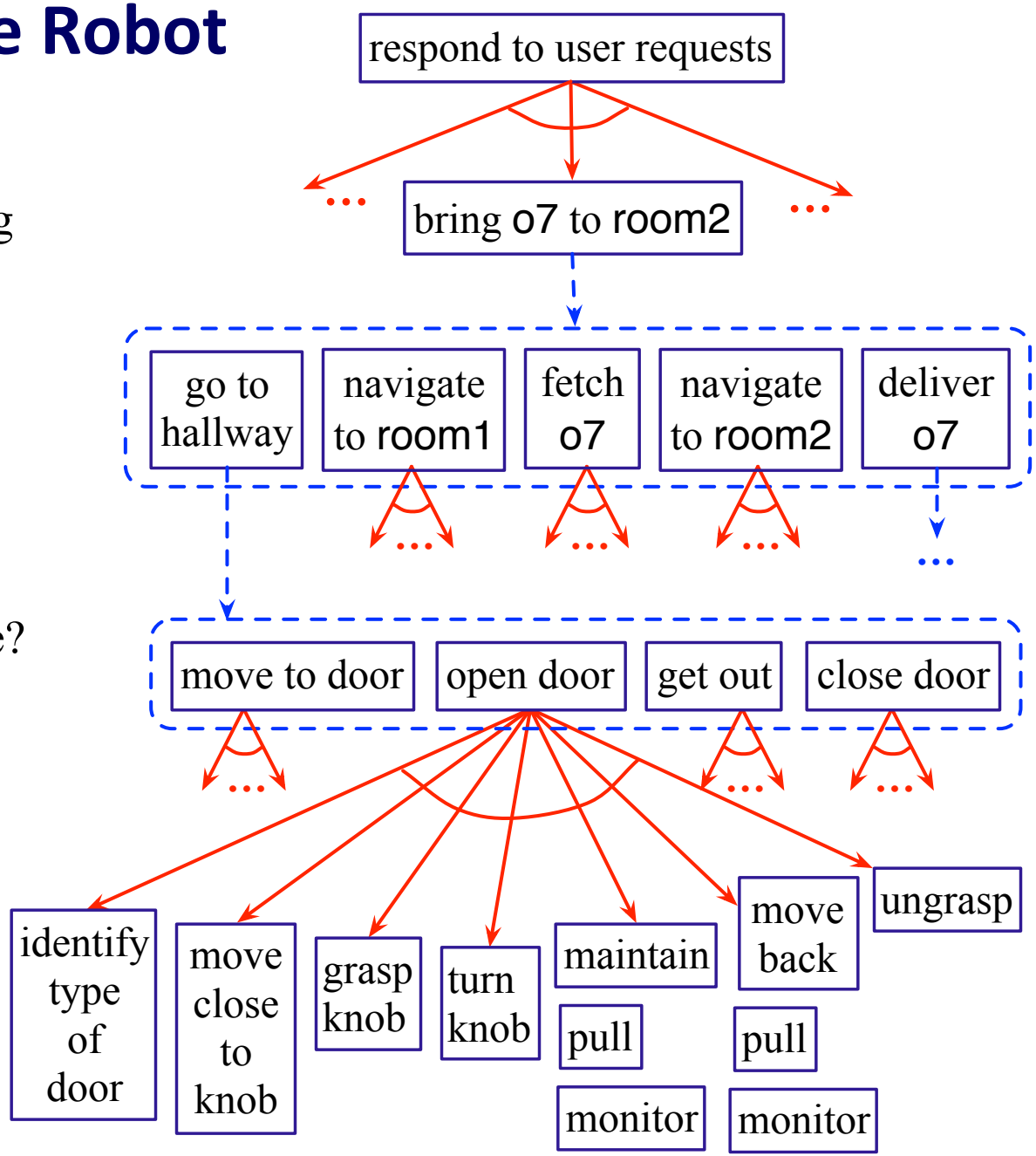


Planning

Acting

Example: Service Robot

- *Multiple levels of abstraction*
  - Higher levels: more planning
  - Lower levels: more acting
- *Continual online planning*
  - What room is o7 in?
  - What route?
  - What kind of door?
  - Close enough to door handle?
- *Heterogeneous reasoning*
  - planning abstract tasks
  - path planning
  - reactive (e.g., open door)



Planning

Acting

Outline of Book

1: *Introduction* (this lecture)

2: *Deterministic models*

- Conventional (*classical*) AI planning
- Integrating it with acting

3: *Refinement methods*

- Acting and planning by refining abstract activities into less-abstract activities

4: *Temporal models*

- Reasoning about time constraints

5: *Nondeterministic models*

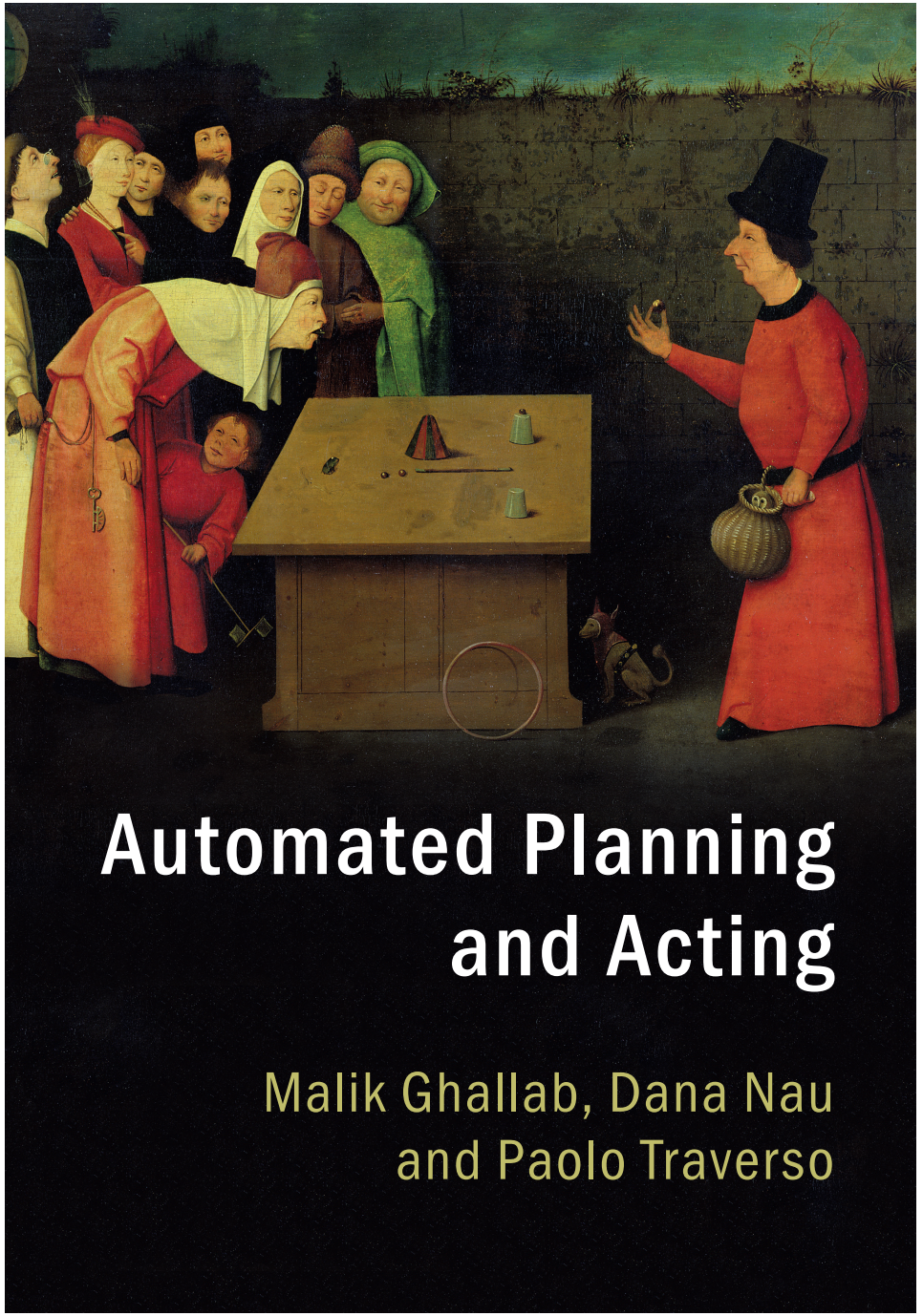
- Actions with multiple possible outcomes

6: *Probabilistic models*

- Multiple possible outcomes, with probabilities

7: *Other*:

- perceiving, monitoring, goal reasoning, learning, hybrid models, ontologies



Cover image: *The Conjuror.* Hieronymus Bosch (c.1450–1516)