



# A DEMONSTRATION OF COMPOSITIONAL HIERARCHICAL INTERACTIVE TASK LEARNING

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## DEMO SUMMARY

Rosie (an interactive task learning agent) learns how to patrol a simulated barracks environment from natural language instruction, involving:

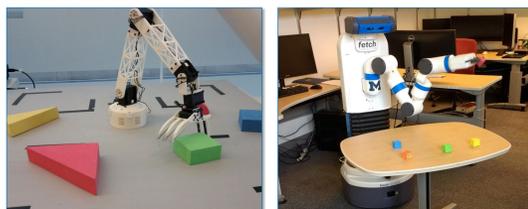
- Inspecting rooms
- Tidying up
- Reporting any fires
- Stopping when relieved

Rosie builds up a sizeable task hierarchy from a single training session

## RESEARCH GOALS

Create agents that learn new tasks from scratch through natural interaction.

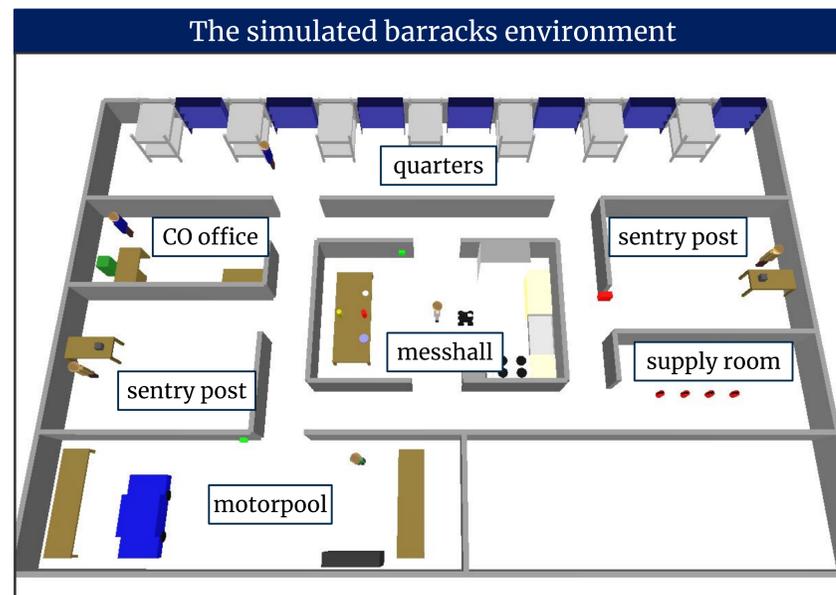
- **Instructive:** Teaching is through natural language and demonstration.
- **Mixed-Initiative:** Both the instructor and agent can initiate further dialog.
- **Situated:** Teaching occurs through a shared experience.
- **Comprehensive:** Agent learns all aspects of a task.
- **One-Shot:** Agent learns a task after a single teaching interaction.
- **Generalizable:** What is learned is transferred to other tasks.



## APPROACH

- Uses the Soar cognitive architecture.
- Processes natural language instructions and creates internal task representation.
- Uses general task interpretation and reasoning to perform task and learn efficient procedural task execution knowledge.
- If missing or ambiguous knowledge, requests information from instructor.
- Generalizes knowledge learned in one problem to similar problems.

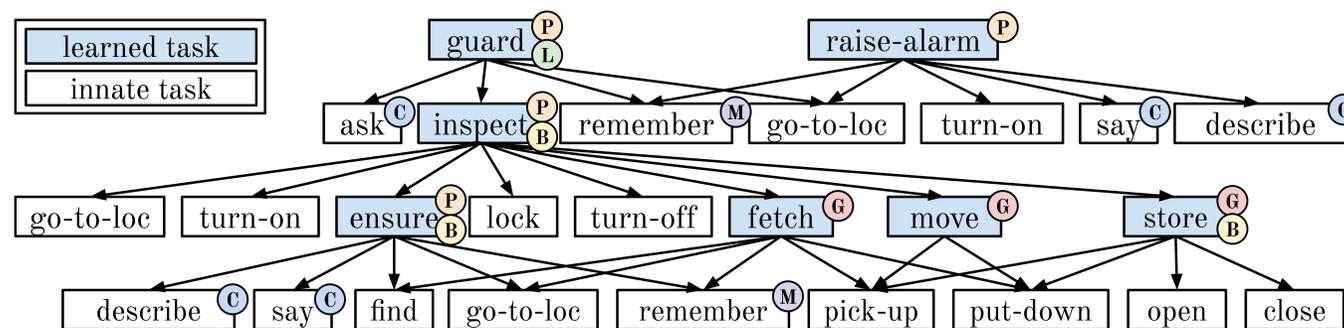
## BARRACKS ENVIRONMENT



## EXAMPLE SCRIPT

Guard the barracks.  
 Ask "Who is my relieving officer?"  
 Remember the answer as the relieving officer.  
 Repeat the following tasks until the relieving officer is present.  
 Inspect the messhall.  
 Inspect the eastern SP.  
 Inspect the motorpool.  
 Repeat.

## LEARNED TASK HIERARCHY



A key contribution of Rosie is learning a compositional task hierarchy (above) that includes an extensive and diverse set of tasks. We highlight the following task features:

- (G) Goal-Based Task**  
Represented as satisfying some goal predicates
- (B) Branching Task**  
The task contains conditional steps/subtasks
- (C) Communicative Task**  
The task involves using language (ask/say)
- (P) Procedural Task**  
Represented as following a procedure (set of steps)
- (L) Looping Task**  
The task contains looping subtasks
- (M) Mental Task**  
The task involves using mental ops (remember/recall)

## DEMO TIMELINE

### 1 Learn the Inspect Task

"Inspect the eastern sentry post"

- Go to the sentry post
- Turn on the lights
- Fetch an extinguisher
- Ensure there is a sentry
- Turn off the lights

### 2 Learn to Raise a Fire Alarm

"Raise a fire-alarm."

- Remember the location with the fire
- Turn on the alarm in the eastern hallway
- Tell the CO about the fire and where it is

### 3 Learn to Guard the Barracks

"Guard the barracks."

- Ask about the relieving officer and remember them
- Inspect the messhall, eastern sentry post, and motorpool in a loop

#### 3.1 Extending Inspect - Messhall

- Store any condiments into the fridge [Teach the Store Task]
- Move plates on the table into the sink [Teach the Move Task]
- Finish the task when the relieving officer is present

### 4 Verifying the Guard Task

Rosie successfully performs the guard task again without needing further instruction, despite variations in the environment