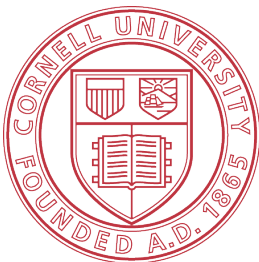


# Sorry Dave, I'm Afraid I Can't Do That: Explaining Unachievable Robot Tasks Using Natural Language

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## High-Level Tasks:

Carrying meals to patients  
Delivering medical records  
Patrolling patient rooms

- 
- 
-



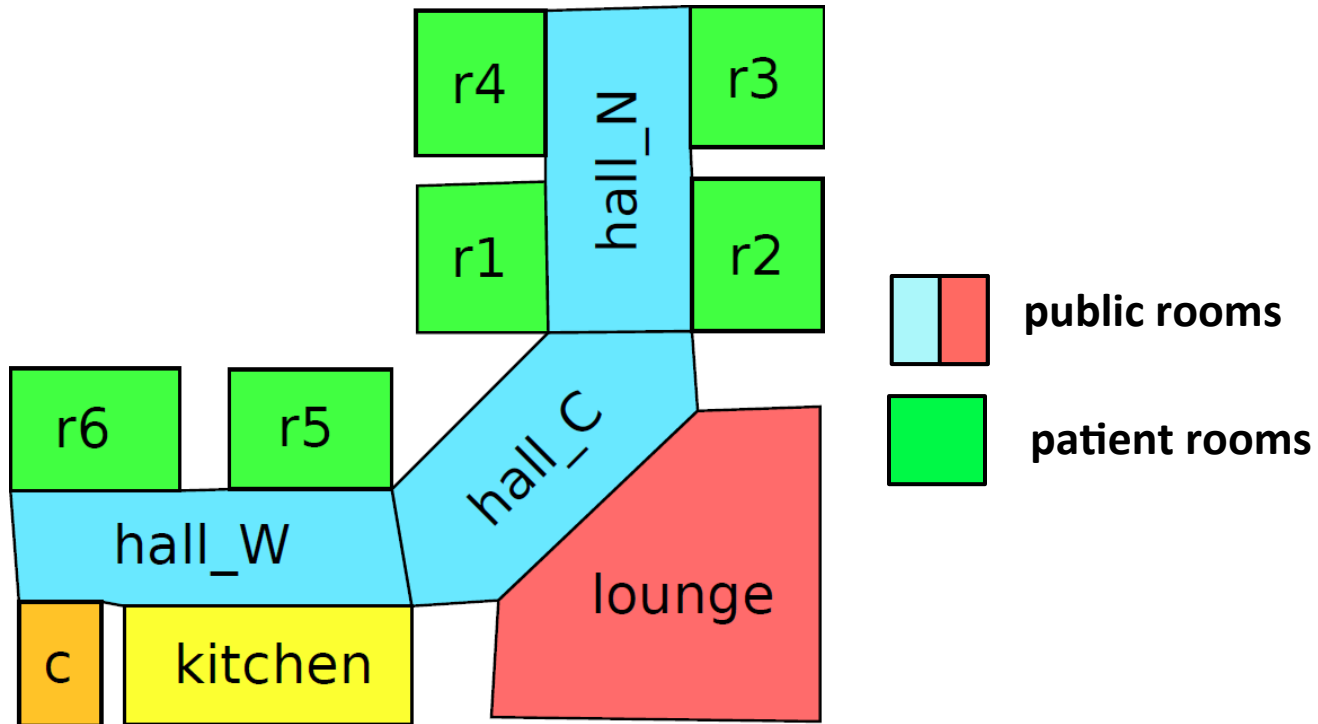
## High-Level Tasks:

Carrying meals to patients  
Delivering medical records  
Patrolling patient rooms

## Challenges:

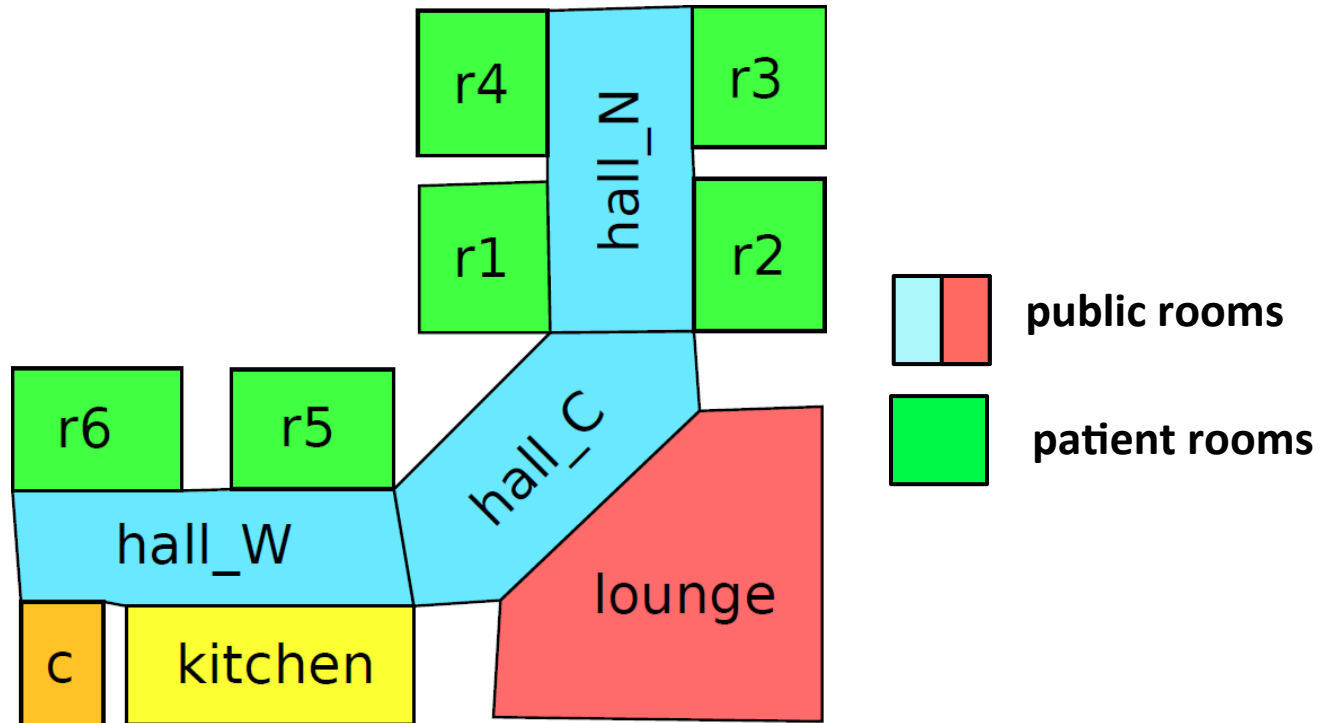
Easy to instruct  
Does as it is told\*

# Example



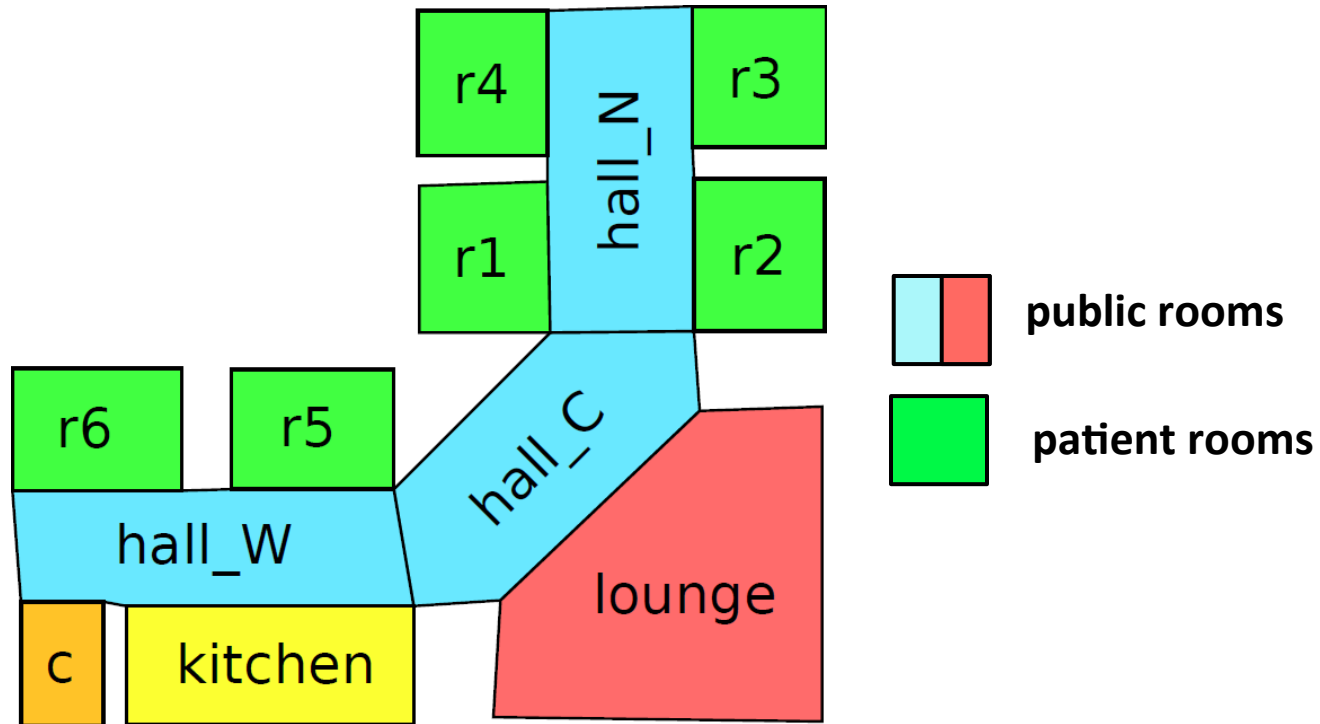
Carry meals from the kitchen to all patient rooms.

# Example



Start in the closet. Carry meals from the kitchen to all patient rooms. Don't go into any public rooms.

# Example



~~Start in the closet. Carry meals from the kitchen to all patient rooms. Don't go into any public rooms.~~

# Approach (Highlights)

# Approach (Highlights)

- Natural language pipeline





# Approach (Highlights)



The image displays two windows from a simulation. The 'Simulation Status' window shows a top-down view of a robot's environment. The robot is a small white circle located in the 'hall\_c' area. The environment consists of several rooms: 'hall\_n' (yellow), 'hall\_w' (orange), 'kitchen' (green), 'lounge' (blue), 'hall\_c' (purple), and 'close' (yellow). Rooms are surrounded by walls (r1-r6) and doors (d1-d6). The 'Dummy Sensor Handler' window shows a similar view but with sensor data points (p1-p11) overlaid on the environment. A large red rectangle is visible at the bottom of this window.

User: What are you doing?  
System: I'm currently trying to "Follow the target to 'hall\_n'."  
User: What are you doing?  
System: I'm currently trying to "Follow the target to 'kitchen'."  
User: What are you doing?  
System: I'm currently trying to "Follow the target to 'hall\_c'."  
User: What are you doing?  
System: I'm currently trying to "Follow the target to 'hall\_n'."

# Approach (Highlights)

- Natural language pipeline
- Provably correct controller via synthesis  
(when one exists)

# Approach (Highlights)

- Natural language pipeline
- Provably correct controller via synthesis
- Minimal cause of unsynthesizability
  - Unsatisfiable core (using PicoSAT)
  - Explained in natural language

## Analysis Output:

The problematic goal is 'Carry meals from the kitchen to all patient rooms.'. The system cannot achieve the sub-goal "Deliver 'meal' to 'r1'.".

The statements that cause the problem are:

'Carry meals from the kitchen to all patient rooms.' because of item(s): "Deliver 'meal' to 'r1'.".

"Don't go into any public rooms." because of item(s): "Do not go to 'hall\_c'.".

No further analysis available.

## SLURP Traceback:

- ▶ Start in the closet.
- ▼ Carry meals from the kitchen to all patient rooms.
  - ▼ Action: 'carry', Argument: 'meal', Source: 'kitchen', Destination: 'rooms'
    - ▶ Nothing is carried or delivered at the start.
    - ▶ Only pick up if you can carry more.
    - ▶ Only drop if you are carrying something.
    - ▶ Stay where you are when picking up and dropping.
    - ▶ Pick up 'meal' in 'kitchen'.
    - ▼ Deliver 'meal' to 'r1'.

```
(([]((next(s.mem_deliver_r1) <-> (s.mem_deliver_r1 | (next(s.r1) & next(s.drop))))))
```

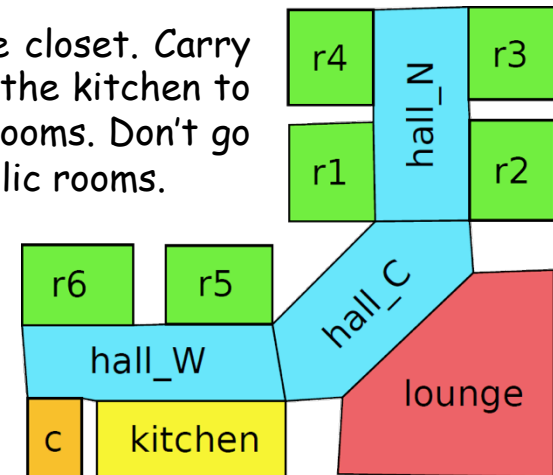
```
(([]<>(s.mem_deliver_r1))
```

- ▶ Deliver 'meal' to 'r2'.
- ▶ Deliver 'meal' to 'r3'.
- ▶ Deliver 'meal' to 'r4'.
- ▶ Deliver 'meal' to 'r5'.
- ▶ Deliver 'meal' to 'r6'.
- ▼ Don't go into any public rooms.
  - ▼ Action: do not 'go', Location: 'rooms'
    - ▼ Do not go to 'hall\_c'.

```
(([](!s.hall_c))
```

- ▶ The robot does not begin in 'hall\_c'.
- ▶ Do not go to 'lounge'.
- ▶ The robot does not begin in 'lounge'.

Start in the closet. Carry meals from the kitchen to all patient rooms. Don't go into any public rooms.



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**15:30—18:00 Interactive Presentation (#3), Lichthof**

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