STRIPS Planner

- Divide and conquer: to create a plan to achieve a conjunction of goals, create a plan to achieve one goal, and then create a plan to achieve the rest of the goals.
- To achieve a list of goals:
  - choose one of them to achieve.
  - If it is not already achieved
    - choose an action that makes the goal true
    - achieve the preconditions of the action
    - carry out the action
  - achieve the rest of the goals.

STRIPS Planner Code

% *achieve_all*(*Gs*, W_1, W_2) is true if W_2 is the world resulting
% from achieving every element of the list *Gs* of goals from
% the world W_1.

achieve_all([ ], W_0, W_0).

achieve_all(*Goals*, W_0, W_2) $\leftarrow$

remove(*G*, *Goals*, *Rem_Gs*) $\wedge$

achieve(*G*, W_0, W_1) $\wedge$

achieve_all(*Rem_Gs*, W_1, W_2).

% $achieve(G, W_0, W_1)$ is true if W_1 is the resulting world

% after achieving goal G from the world W_0.

$$achieve(G, W, W) \leftarrow$$

$$holds(G, W).$$

$$achieve(G, W_0, W_1) \leftarrow$$

$$clause(G, B) \wedge$$

$$achieve\_all(B, W_0, W_1).$$

$$achieve(G, W_0, do(Action, W_1)) \leftarrow$$

$$achieves(Action, G) \wedge$$

$$preconditions(Action, Pre) \wedge$$

$$achieve\_all(Pre, W_0, W_1).$$

Undoing Achieved Goals

Example: consider trying to achieve

$$[carrying(rob, parcel), sitting\_at(rob, lab2)]$$

Example: consider trying to achieve

$$[sitting\_at(rob, lab2), carrying(rob, parcel)]$$

- The STRIPS algorithm, as presented, is unsound.
- Achieving one subgoal may undo already achieved subgoals.

Fixing the STRIPS Algorithm

Two ideas to make STRIPS sound:

- Protect subgoals so that, once achieved, until they are needed, they cannot be undone. Let *remove* return different choices.
- Reachieve subgoals that have been undone.
  - Protecting subgoals makes STRIPS incomplete.
  - Reachieving subgoals finds longer plans than necessary.

Does protecting always work?

- Example Suppose the robot can only carry one item at a time. Consider the goal:

$$sitting\_at(rob, lab2) \wedge carrying(rob, parcel)$$

- We cannot consider the subgoals in isolation!