Topic 4.3 General Features of planning Problems

1) Representation of states using PDDL

Planning Domain Definition Language

a) Conjunction of function-free, positive and ground literals of FOL;

b) Closed world assumption: When fully specified, not mentioned is equivalent to False;

c) The goal state is usually partially specified;

d) If a current state contains the goal state, then the goal is considered achieved.

2) Representation of actions using PDDL

- An action schema is used to generate instances of the action.

- An action schema contains:

  - An action name with a parameter list;
  - A 'precondition' as a conjunction of function-free and positive literals, where the arguments of the predicates are taken from the parameter list;
  - An 'effect' as a conjunction of function-free literals, where also the arguments of the predicates are taken from the parameter list .

- The positive and negative literals of an 'effect' are stored in the 'Add list' and 'Delete list' respectively.

3) Execution of an action

✓ An action can be carried out on a state if the precondition holds on that state with appropriate substitutions;

✓ If an action is carried out, the Add-list elements are included in the state, while the Delete- list elements are deleted from the state;

✓ An action is carried out if it takes the process ‘closer’ to the goal.

4) Common concepts

- Plan: Sequence of actions taking from IS to GS;
- Planning: Process of generating a plan;
- Total order plan: No action can be executed in parallel to each other;
- Partial order plan: Some actions may be executed in parallel;
- Planner: System that generates plans;
- Solution to a planning problem: Plan.

5) Planner: An intelligent agent

✓ A planner is usually a goal-based agent;

✓A planner takes advantage of the structure and specific features of the problem domain to formulate the actions;

✓A planner follows the rule: Activities should be preconditioned;

✓ A planner decomposes a problem into independent subproblems, and it achieves the goal by satisfying subgoals.

6) Strategies for generating optimal plans

- Forward state space search [IS $\rightarrow$ GS]
- Backward state space search [IS $\leftarrow$ GS]
- Bidirectional search [IS $\rightarrow$ … $\leftarrow$ GS]