

Classical planning

Definition

- $[S, I, A, G]$
 - S is a finite set of states
 - I (belongs to S) is an initial state
 - A is a set of actions
 - G (subset of S) is a finite set of goal states
- The task of coming up with a sequence of actions that will achieve a goal

Overview

- **Features:**
 - discrete (in time, action, objects and effects)
 - finite
 - deterministic
- **Representation of a problem**
 - Representation of states
 - Representation of actions

Representation of states (FDR)

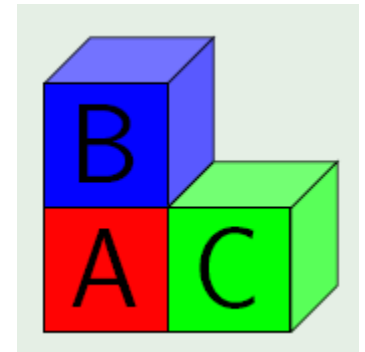
- The state of the world is described in terms of a finite set of finite-valued **state variables**.
 - hour: $\{0; \dots; 23\} = 13$
 - minute: $\{0; \dots; 59\} = 55$
 - location: $\{51; 52; 82; 101; 102\} = 101$
 - weather: $\{\text{sunny}; \text{cloudy}; \text{rainy}\} = \text{cloudy}$
 - holiday: $\{\text{dT}; \text{dF}\} = \text{dF}$
- Can have different domains

Example

- Blocks-world
- State variables:
 - location-of-A: {B;C;table}
 - location-of-B: {A;C;table}
 - location-of-C: {A;B;table}

- state

$s = \{$
 location-of-A = Table,
 location-of-B = A,
 location-of-C = Table
 $\}$



Example ctd. (BDR)

- boolean variables

$s = \{$

A-on-B = 0

A-on-C = 0

A-on-table = 1

B-on-A = 1

B-on-C = 0

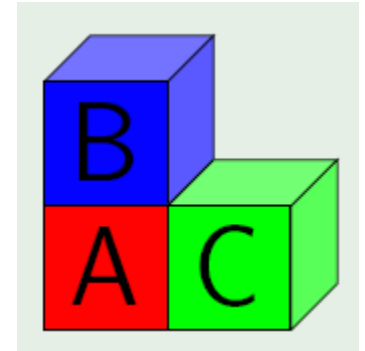
B-on-table = 0

C-on-A = 0

C-on-B = 0

C-on-table = 1

$\} = \{ \text{A-on-table, B-on-A, C-on-table} \}$



Representation of actions

- **Applicable actions**
 - actions that can be applied on current state
 - their **preconditions**, defined as evaluated state variables, match the current state values
- Each action, when applied, changes (**effects**) the current state variables' values,
- it causes the move to another state

Example (BDR)

- move-B-A-C

- preconditions: {

- B-on-A = 1,

- B-clear = 1,

- C-clear = 1

- }

- effect: {

- B-on-C = 1,

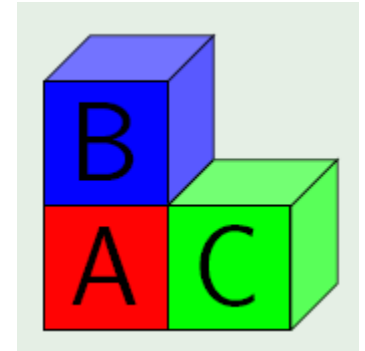
- A-clear = 1,

- B-on-A = 0,

- C-clear = 0

- }

-> s' = { A-on-table, A-clear, B-on-C, C-on-table, B-clear }



STRIPS

- based on FOL (first order predicate logic)
- world objects as constants
- state variables - ground FOL literals (**atoms**)
- action preconditions and effects -
conjunctions of function-free FOL literals that
instantiates their body by concrete constants

Example

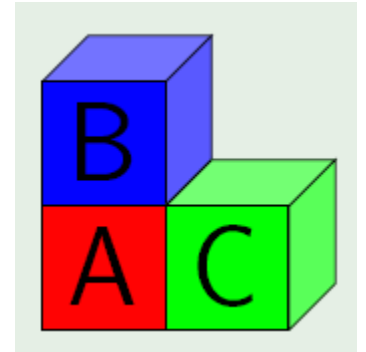
FOL literals:

Objects:

Init:

Goal:

Actions:



Example

FOL literals: On, Clear

Objects: a, b, table

Init: {On(a,table), On(b,a), On(c,table),

Clear(b), clear(C)}

Goal: {On(b,c)}

Actions: [_board_]

