INSTITUTO
DE INFORMÁTICA
UFRGS

# DISCOVERING AND LEARNING PREFERRED OPERATORS FOR CLASSICAL PLANNING WITH NEURAL NETWORKS

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Defesa de Mestrado — Julho de 2023

# AGENDA

*Planning* has the goal of finding a sequence of actions from a initial state that satisfy the goal condition.

## Example: *Classical* Planning

environment:

- static vs. dynamic
- deterministic vs. non-deterministic vs. stochastic
- fully observable vs. partially observable vs. not observable
- discrete vs. continuous
- single-agent vs. multi-agent

problem solving method:

- problem-specific vs. general vs. learning

Definition 1 (A planning problem in STRIPS). $\Pi = \langle F, O, I, G \rangle$ *where*

- $F$ *is a set of boolean variables (facts),*
- $O$ *is a set of operators or actions over* $F$*, where* $\langle Pre(o), Add(o), Del(o) \rangle \subseteq F$*,*
- $I \subseteq F$ *is the initial state, and*
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*Finally,* $\pi = a_0, a_1, \ldots, a_n$ *is called a plan for* $\Pi$ *where* $a_i$ *is an applicable action.*

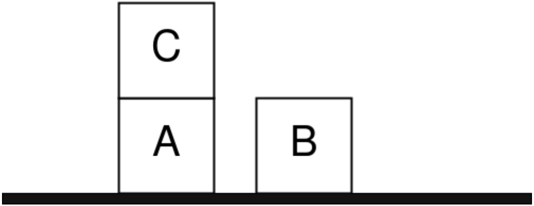



Figura: A task of the Blocksworld domain.

## Example: Blocksworld

$\Pi = \langle F, O, I, G \rangle$

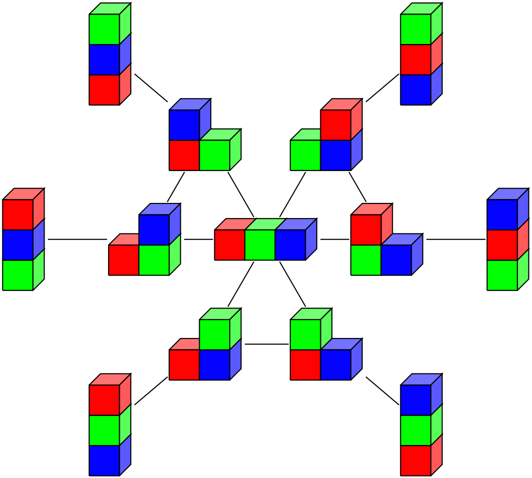
- $F$ = {on(a,b), on(a,c), on(b,a), on(b,c), on(c,a), on(c,b), on-table(a), on-table(b), on-table(c), clear(a), clear(b), clear(c)}
- $O$ = {move(a,b,c), move(a,c,b), move(b,a,c), move(b,c,a), move(c,a,b), move(c,b,a), to-table(a,b), to-table(a,c), to-table(b,a), to-table(b,c), to-table(c,a), to-table(c,b), from-table(a,b), from-table(a,c), from-table(b,a), from-table(b,c), from-table(c,a), from-table(c,b)}
- $I$ = {on(c,a), on-table(a), on-table(b), clear(c), clear(b)}
- $G$ = {on(a,b), on(b,c)}

## Example: Blocksworld

- *move*: move a block from one block to another.
  - Pre(move(a,b,c)) = {on(a,b), clear(a), clear(c)}
  - Add(move(a,b,c)) = {on(a,c), clear(b)}
  - Del(move(a,b,c)) = {on(a,b), clear(c)}
  - From the initial state, is this action applicable?
- *to-table*: move a block from a block to the table.
- *from-table*: move a block from the table to a block.

# STATE SPACE OF BLOCKSWORLD WITH 3 BLOCKS





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  - Etc.
- We have answers to these questions and, to the best of our knowledge, the best coverage results with a learned heuristic in a model-free setting.