COMP90054 Workshop 4

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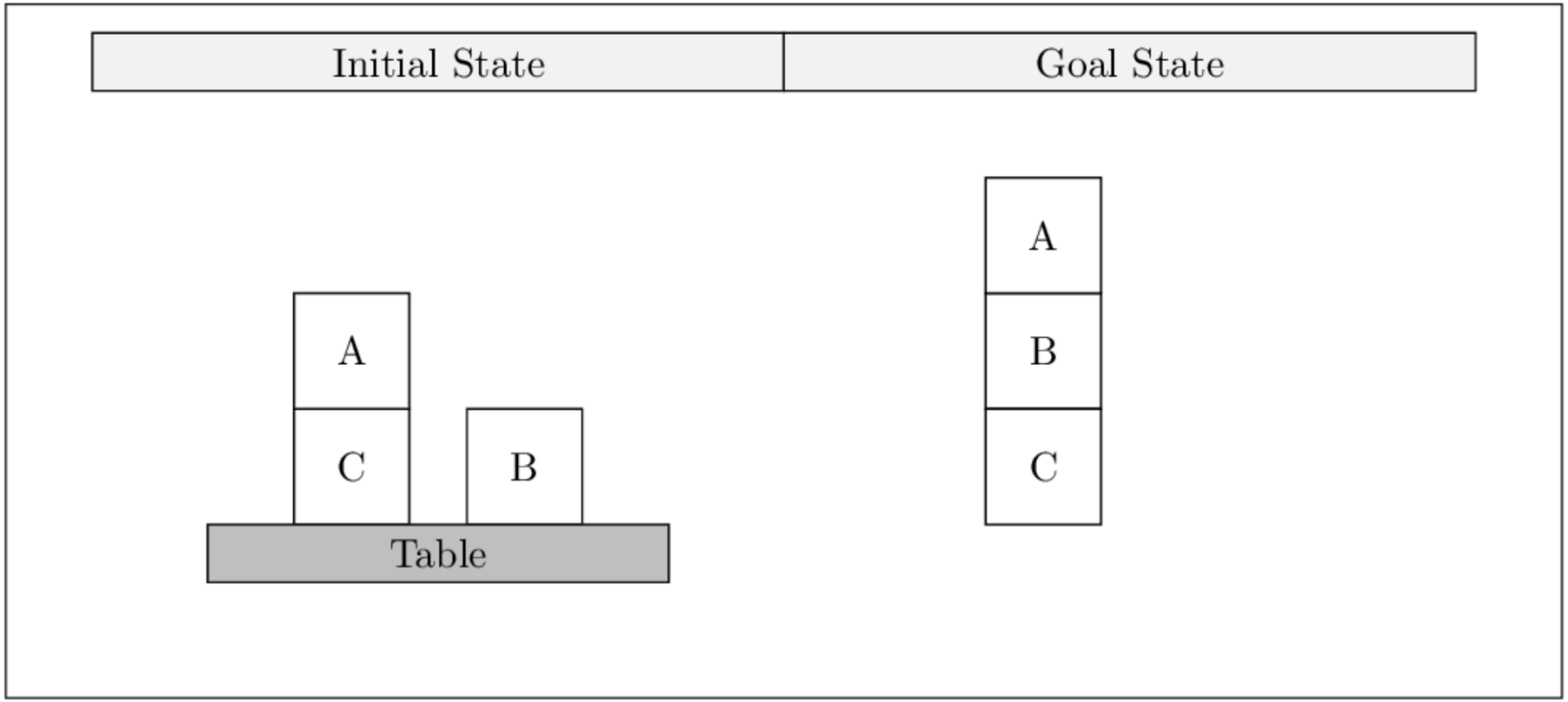
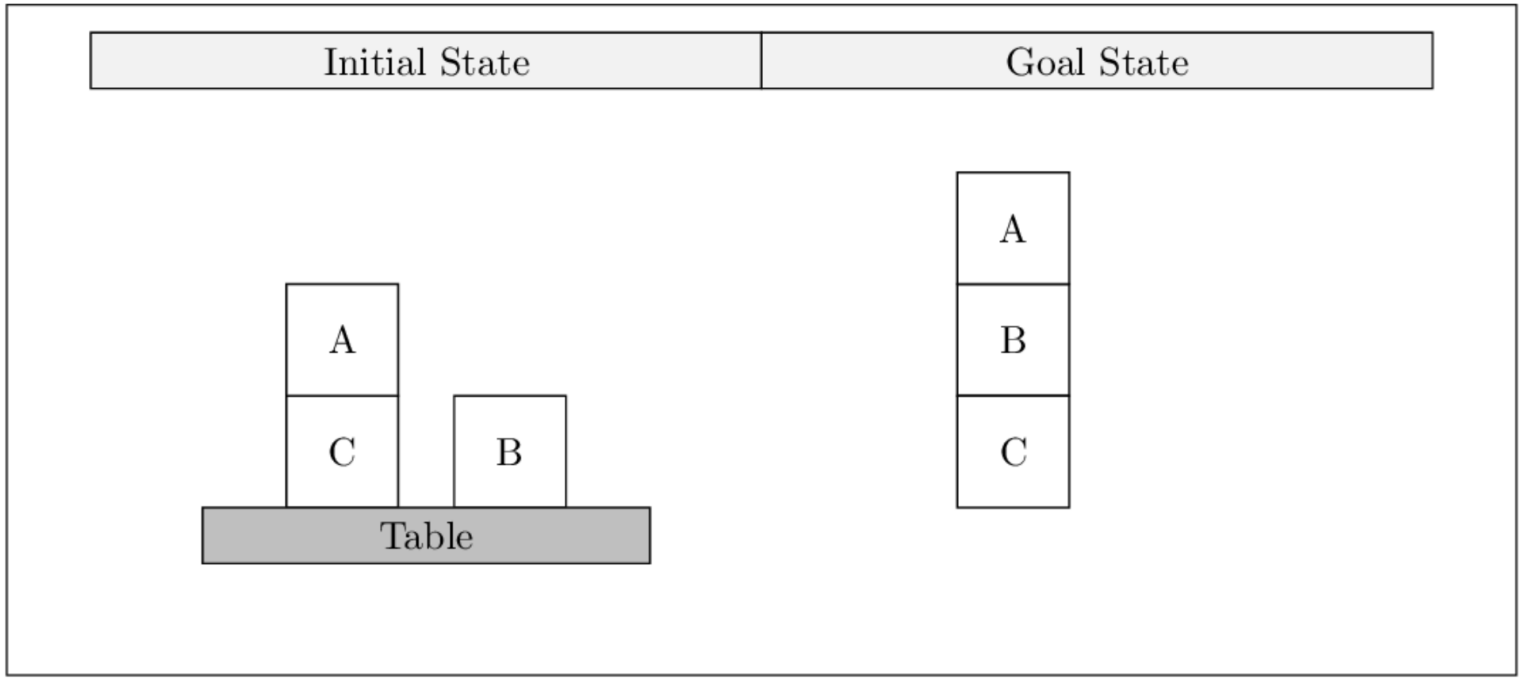
Problem 1

Model Blocks-World as a STRIPS problem $P=\langle F,O,I,G\rangle$.
You need to define the set of facts F, the set of operators O,
the goal facts G and the initial facts I.
You must also define the pre, add, and del functions.



STRIPS model

- F:={on(x, y), onTable(x), clear(x), holding(x), armFree}
- I:={on(A, C), onTable(C), onTable(B), clear(A), clear(B), armFree}
- G:={on(A, B), on(B, C)}



Operators (Stack & Unstack)

O:=

{ stack(x,y): =

prec:= {holding(x), clear(y)}

add:= {clear(x), on(x,y), armFree}

del:= {clear(y), holding(x)}

| x, y ∈ {A, B, C} and $x \neq y$

}

^ {unstack(x,y): =

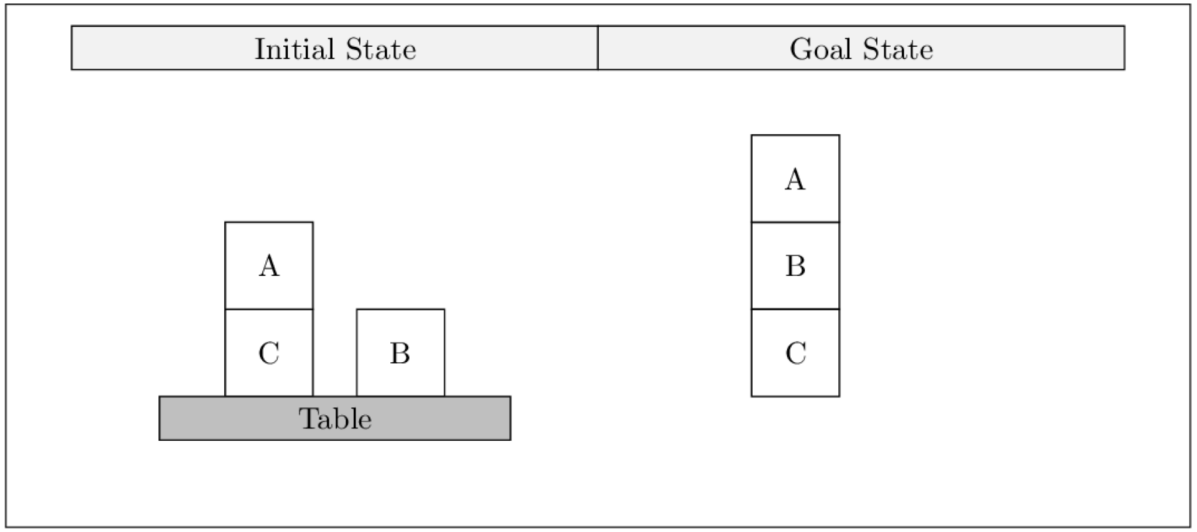
prec:= {on(x,y), clear(x), armFree}

add:= {holding(x), clear(y)}

del:= {clear(x), on(x,y), armFree}

| x, y ∈ {A, B, C} and $x \neq y$

}



Operators (putdown & pickup)

^ { putdown(x): =

prec:= {holding(x) }

add:= {clear(x), onTable(x), armFree}

del:= {holding(x)}

| x, y ∈ {A, B, C}

}

^ {pickup(x): =

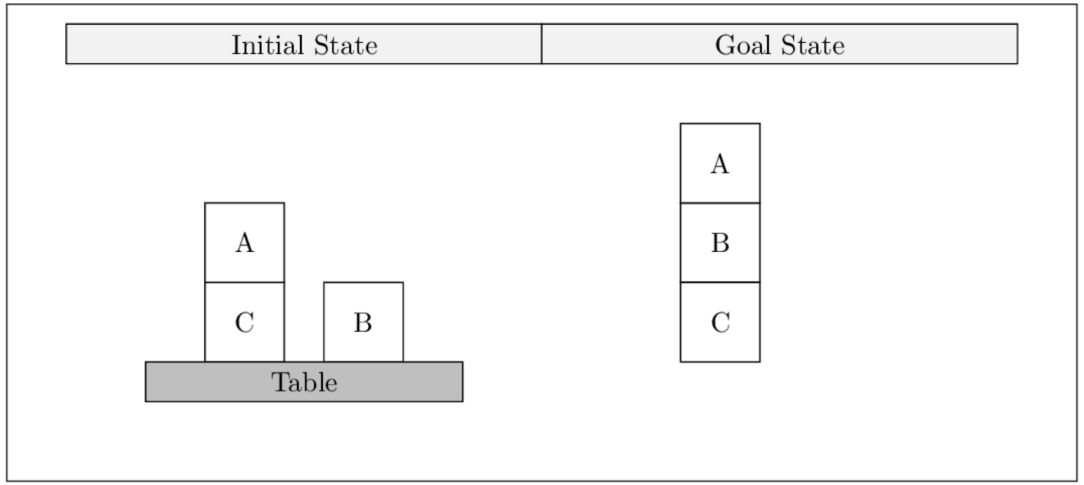
prec:= {onTable(x), clear(x), armFree}

add:= {holding(x)}

del:= {clear(x), onTable(x), armFree}

| x, y ∈ {A, B, C}

}



Does $x \neq y$ constraint matter?

How many operators in total?

|O| without $x \neq y$**:**

Stack(x,y), Unstack(x,y):
Putdown(x), Pickup(x):
In total:

|O| with $x \neq y$**:**

Stack(x,y), Unstack(x,y):
Putdown(x), Pickup(x):
In total:

How many operators in total

|O| without $x \neq y$**:**

Stack(x, y), Unstack(x, y): 3*3 each

Putdown(x), Pickup(x): 3 each

In total: 3*3 + 3*3 + 3 + 3 = 24

|O| with $x \neq y$**:**

Stack(x, y), Unstack(x, y): 2*3 each

Putdown(x), Pickup(x): 3 each

In total: 2*3 + 2*3 + 3 + 3 = 18

Stack(x, x)- Prec: holding(x), clear(x)

{putdown(x): =

prec:= {holding(x) }

add:= {**clear(x),** onTable(x), armFree}

del:= {**holding(x)}**

| x, y ∈ {A, B, C} }

{pickup(x): =

prec:= {onTable(x), clear(x), armFree}

add:= {**holding(x)}**

del:= {**clear(x),** onTable(x), armFree}

| x, y ∈ {A, B, C} }

Unstack(x, x)- Prec: on(x, x), clear(x)

{ stack(x,y): =

prec:= {holding(x), clear(y)}

add:= {clear(x), **on(x,y),** armFree}

del:= {**clear(y),** holding(x)}

| x, y ∈ {A, B, C} }

^ {unstack(x,y): =

prec:= {on(x,y), clear(x), armFree}

add:= {holding(x), **clear(y)}**

del:= {clear(x), **on(x,y)**, armFree}

| x, y ∈ {A, B, C} }

Problem 2

Implement your STRIPS model in PDDL.

Remember that a PDDL implementation is split between two files: a domain file (also known as an “operator” file) and a problem file (also known as a “fact” file).

PDDL

PDDL is not a propositional language:

- Representation is lifted, using object variables to be instantiated from a finite set of objects. (Similar to predicate logic)
- Action schemas parameterized by objects.
- Predicates to be instantiated with objects.

A PDDL planning task comes in two pieces:

- The domain file and the problem file.
- The problem file gives the objects, the initial state, and the goal state.
- The domain file gives the predicates and the operators; each benchmark domain has *one* domain file.

Platform to run PDDL

- With python and notebook
- Online platform: http://editor.planning.domains/
- VS Code, (Sublime) with PDDL extensions

Problem 3

- Blockworld can be modeled with only 2 actions instead of 4.
- The robot can **pick up a block** and **put it down on another block (or the table)** **in a single action**.
- You've got actions Move(Block, FromTable, ToBlock) and Move(Block, FromBlock, ToTable).
- You now no longer need to keep track of what the robot is holding or if the hand is empty.
- Implement a STRIPS model of this "2-operation" blocks-world in PDDL.

Sample solution

- https://editor.planning.domains/#edit_session=dUczpZb1KtUMSos