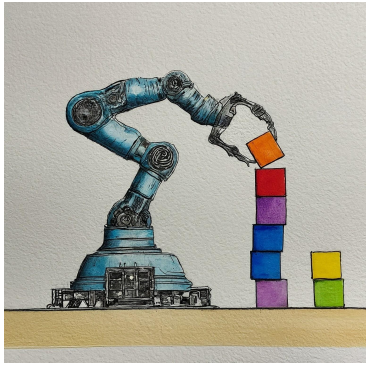
Learning for Integrated Task and Motion Planning

2025 AAAI Bridge Program



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TECHNION | The Henry and Marilyn Taub Faculty of Computer Science

Our github links

https://github.com/CLAIR-LAB-TECHNION/AAAI_25_Bridge_TMP

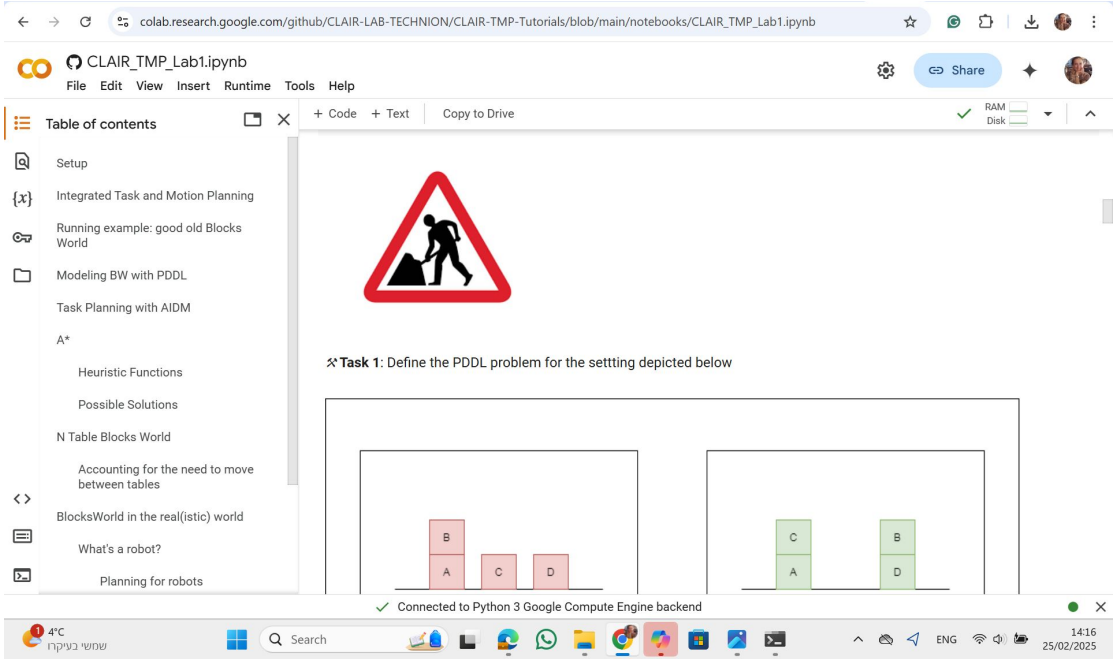
https://github.com/CLAIR-LAB-TECHNION/CLAIR-TMP-Tutorials

Technical Details

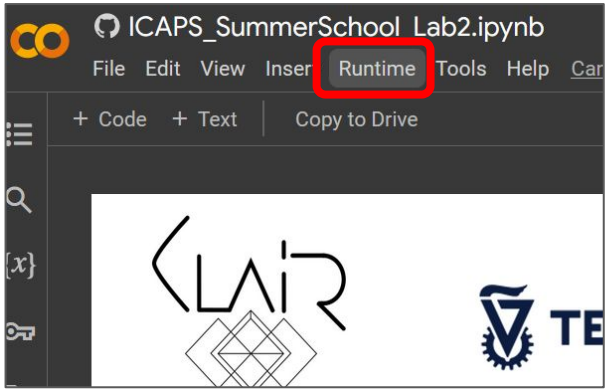
- The tutorials are provided in the form of Jupyter notebooks, suitable for running online via Google Colab.
- Basic knowledge of Python and PDDL is required.
- At the beginning of each notebook, there is a link to run it on Colab.
- If you would like to run the notebooks locally on your machine, you can download them, but some installations may be required (e.g., numpy).

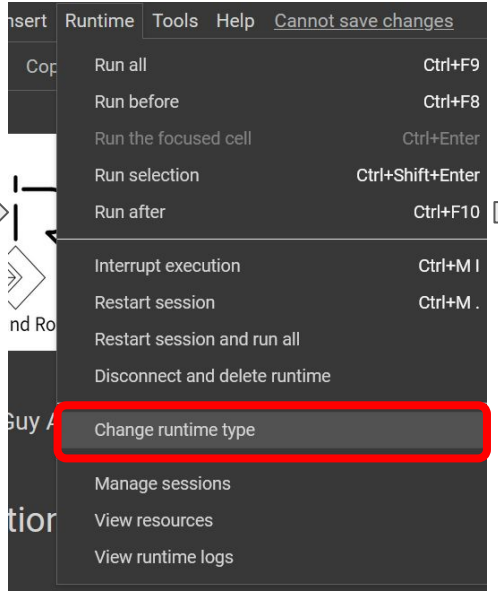
https://github.com/CLAIR-LAB-TECHNION/CLAIR-TMP-Tutorials

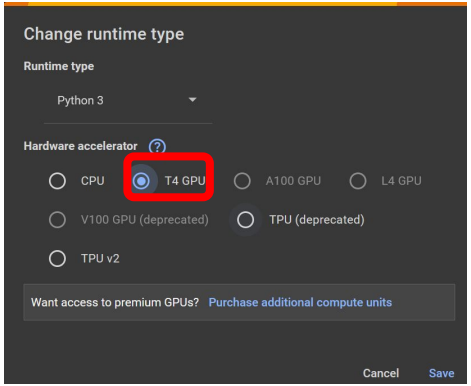
Technical Details



Activating GPU Runtime in Colab

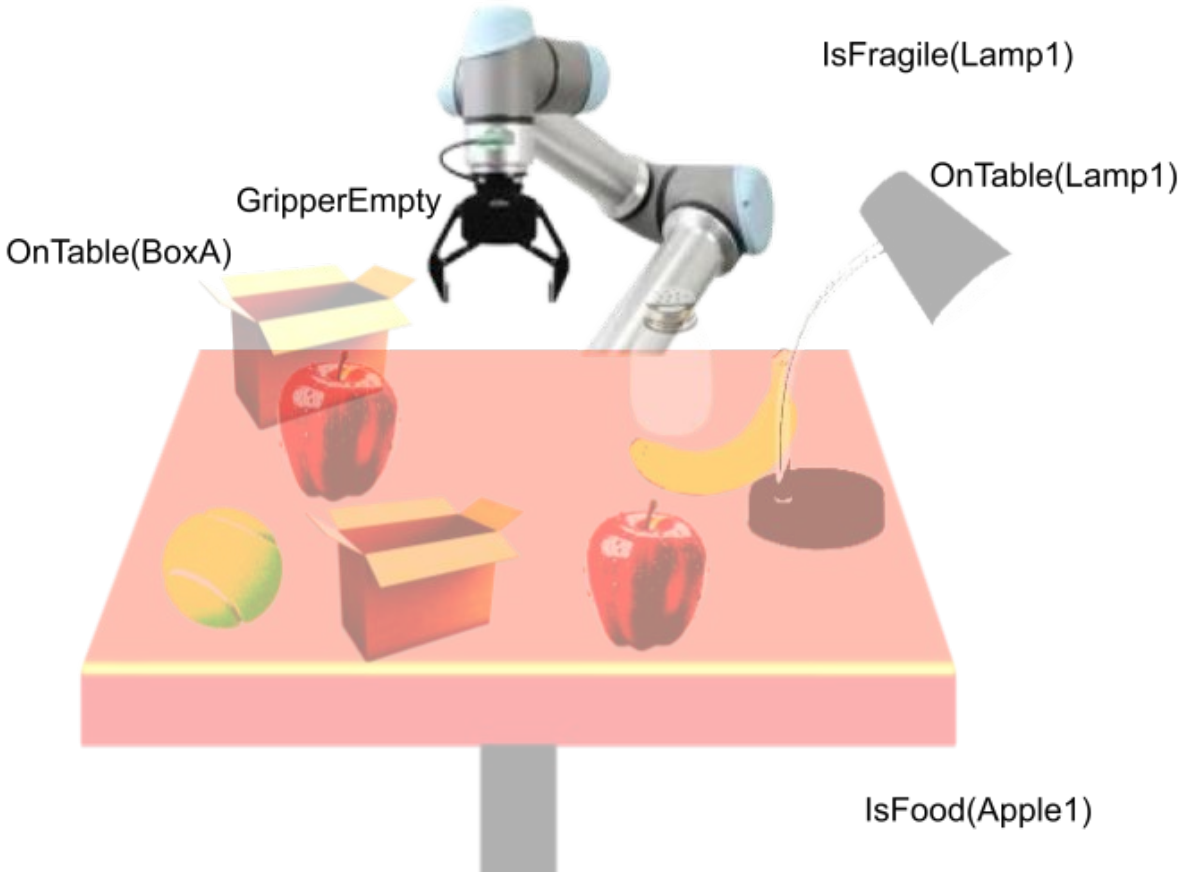


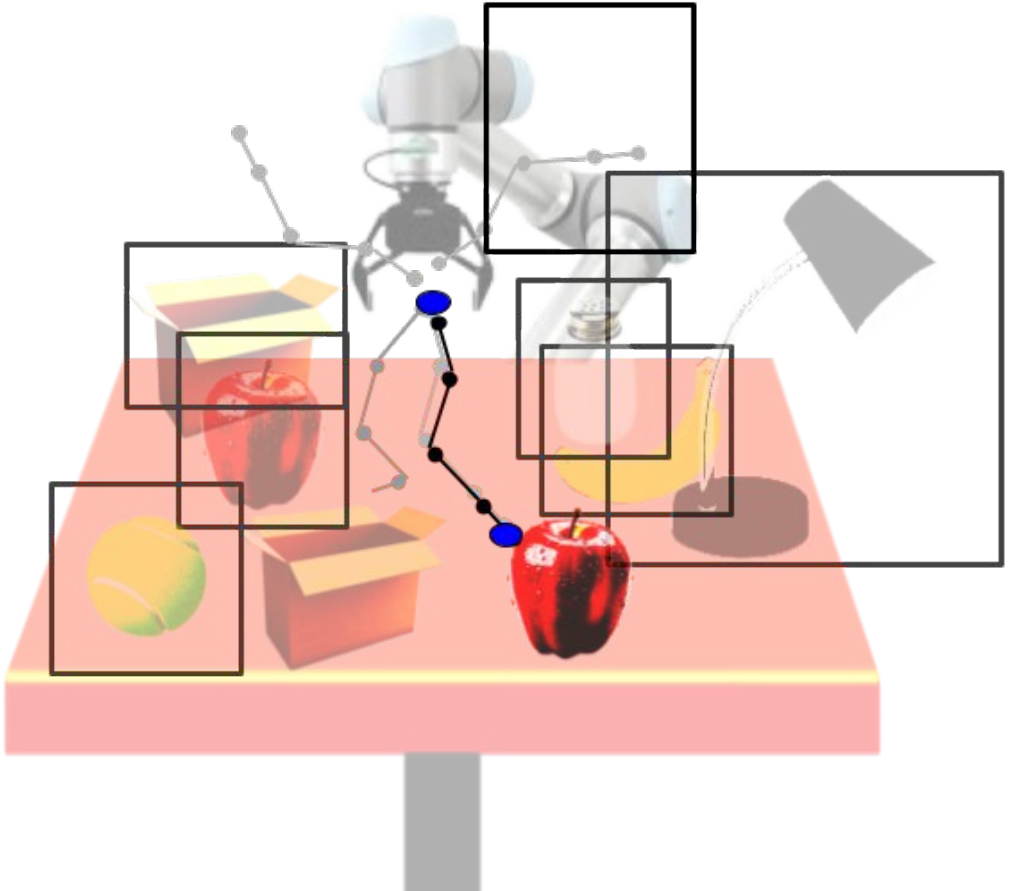


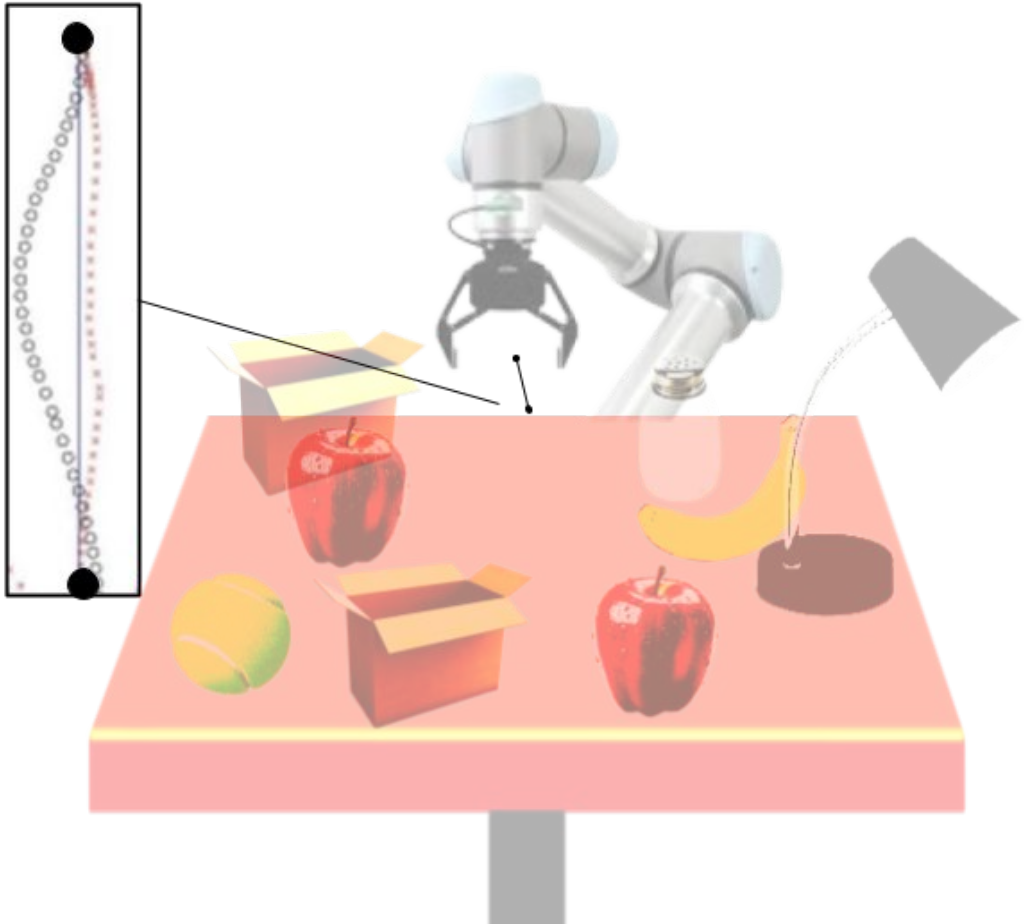


Example

“I am hungry”


IsFragile(Lamp1)
OnTable(Lamp1)
GripperEmpty
OnTable(BoxA)
IsFood(Apple1)

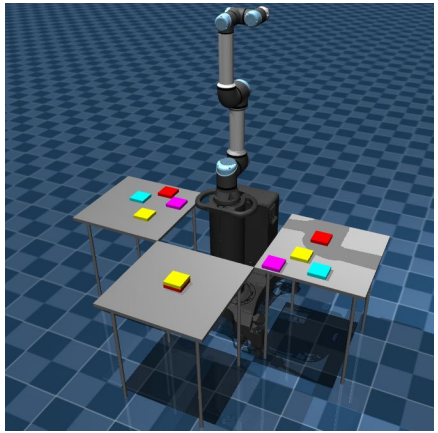


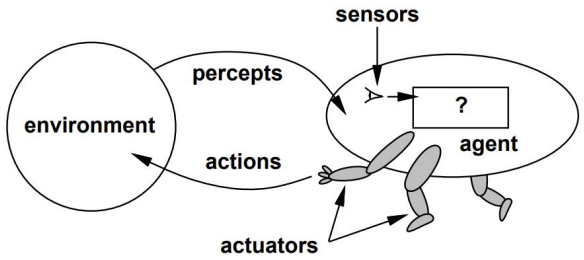


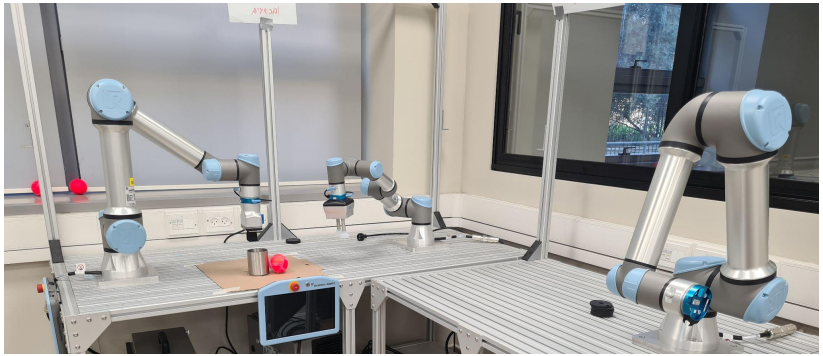
Lab 1 - Task Planning

Lab 1 - Objectives

- Getting to know the complexities of task planning for robotic settings
- Understanding the limitations of PDDL in representing complex settings
- Understanding the need to integrate task and motion planning



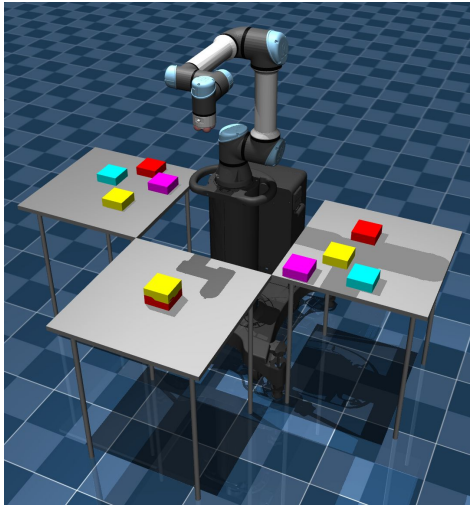


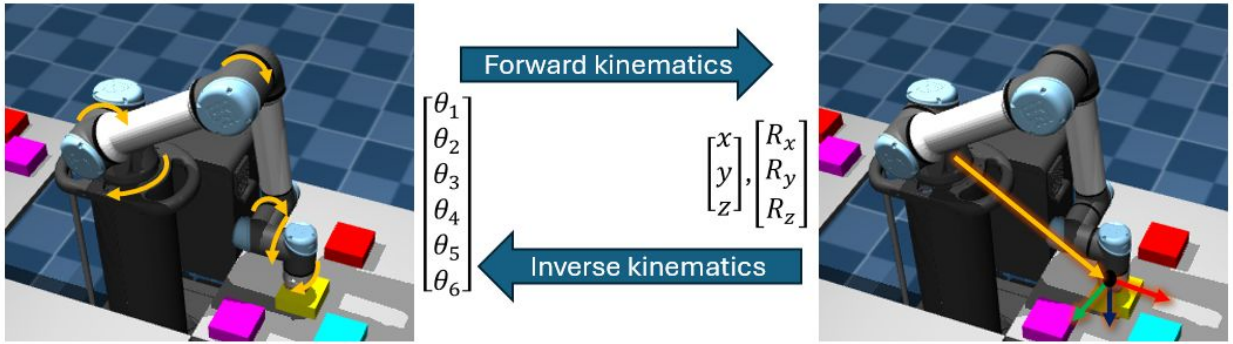


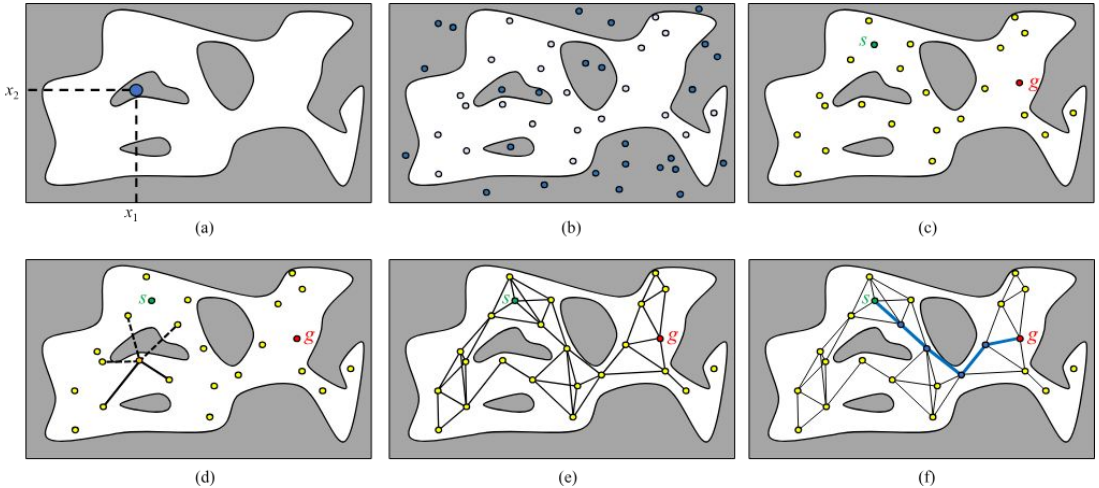
```
function BEST-FIRST-SEARCH(problem, f) returns a solution node or failure
  node ← NODE(STATE=problem.INITIAL)
  frontier ← a priority queue ordered by f, with node as an element
  reached ← a lookup table, with one entry with key problem.INITIAL and value node
  while not IS-EMPTY(frontier) do
    node ← POP(frontier)
    if problem.IS-GOAL(node.STATE) then return node
    for each child in EXPAND(problem, node) do
      s ← child.STATE
      if s is not in reached or child.PATH-COST < reached[s].PATH-COST then
        reached[s] ← child
        add child to frontier
  return failure
```

N-table Blocks World

Lab 2 - Motion Planning

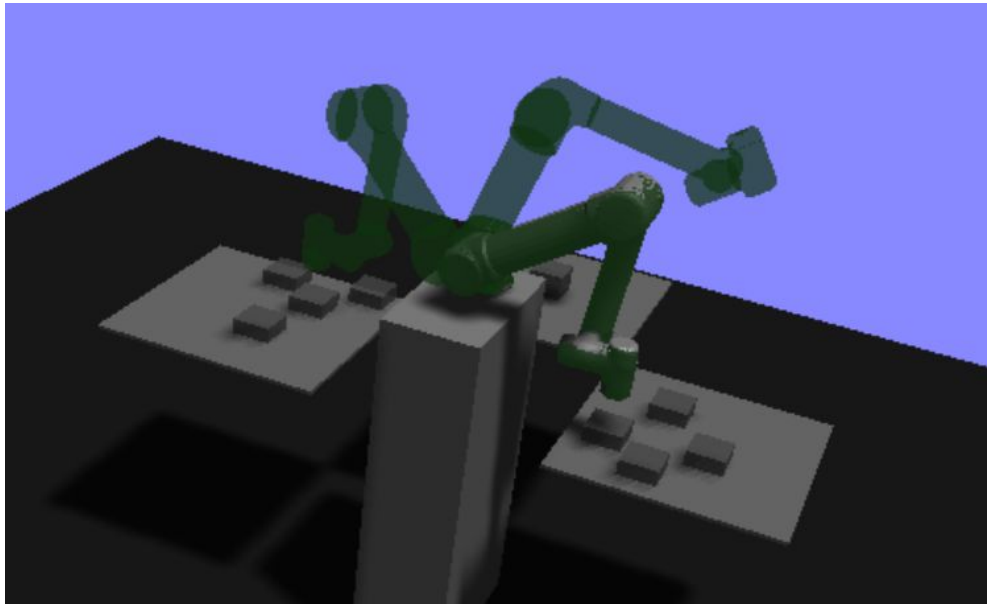



Forward kinematics
$\begin{bmatrix}\theta_1\\ \theta_2\\ \theta_3\\ \theta_4\\ \theta_5\\ \theta_6\end{bmatrix}$
$\begin{bmatrix}x\\ y\\ z\end{bmatrix}, \begin{bmatrix}R_x\\ R_y\\ R_z\end{bmatrix}$
Inverse kinematics

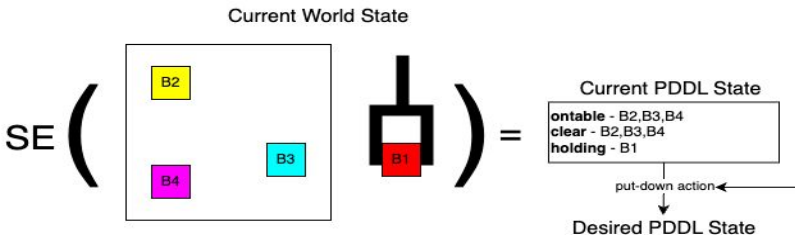

x_2
x_1
(a)
(b)
s
g
(c)
s
g
(d)
s
g
(e)
s
g
(f)

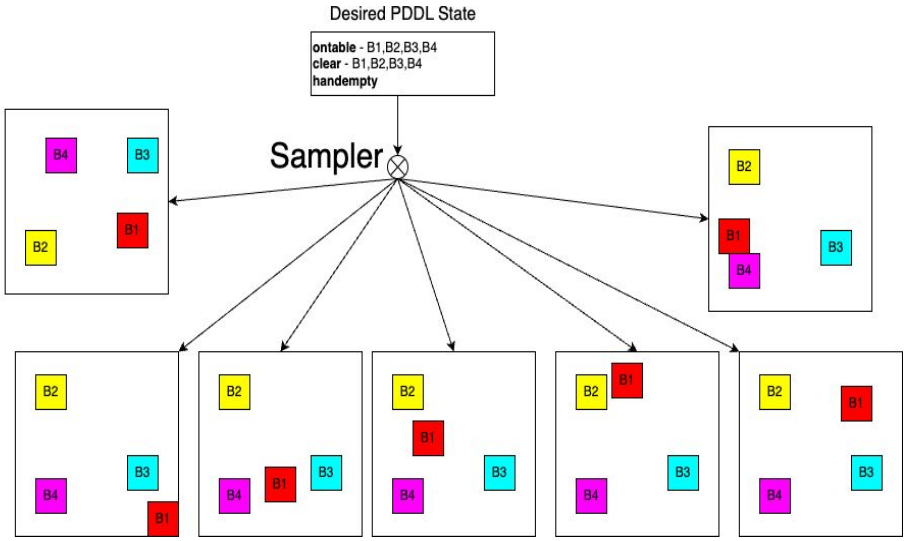
Motion Planning Example

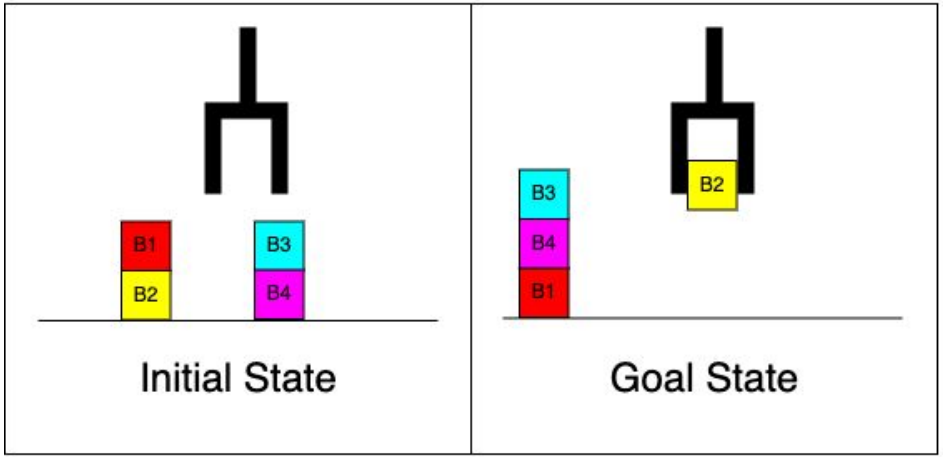
How to get from one position to another ?



Lab 3 - Integration


Current World State
SE
B2
B3
B4
B1
=
Current PDDL State
ontable - B2,B3,B4
clear - B2,B3,B4
holding - B1
put-down action
Desired PDDL State


Desired PDDL State
ontable - B1,B2,B3,B4
clear - B1,B2,B3,B4
handempty
Sampler
B4
B3
B2
B1
B2
B1
B4
B3
B2
B3
B4
B1
B2
B1
B3
B4
B2
B1
B3
B4
B2
B1
B3
B4
B2
B1
B3
B4


B1
B2
B3
B4
Initial State
B3
B4
B1
B2
Goal State