AI2 Module 4
Tutorial 4

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1 STRIPS Planning in the Blocks World

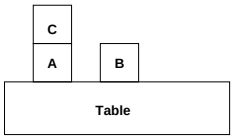
Imagine a Blocks World with 3 blocks: **A,B,C** and the STRIPS operators as introduced in the planning notes[2]:

- Pickup(x), which picks up block x from the table,
- Putdown(x), which puts block x on the table,
- Unstack(x, y) which picks up block x which is stacked on y, and
- Stack(x, y), which stacks block x on block y.

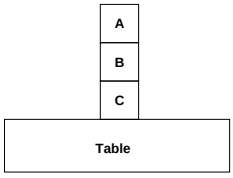
The operator Pickup(x), for instance, can be represented as:

act:	Pickup(x)
pre:	OnTable(x),Clear(x),Handempty
add:	Holding(x)
del:	OnTable(x),Clear(x),Handempty

We look at a planning problem where the initial state can be described with: **On(C,A), OnTable(A), OnTable(B), Clear(C), Clear(B)**:



The goal is: **On(A,B)**$\wedge$ **On(B,C)**:



(a) Represent the operator Unstack(x, y):

act:	Unstack(x, y)
pre:	
add:	
del:	

[1] In case of any question, do not hesitate to contact `jzimmer@mathweb.org`.
[2] Available at `http://www.informatics.ed.ac.uk/teaching/classes/ai2/module4/notes/planning.pdf`.

(b) Give the shortest possible plan, i.e. the shortest possible sequence of fully instantiated operators, that achieves the goal **On(A,B)** from the initial state.

(c) Give the shortest possible plan that achieves the goal **On(B,C)** from the initial state.

(d) Try to combine your plans from (b) and (c) to a single plan that achieves **On(A,B)**$\wedge$ **On(B,C)**.

2 Planning in the Wumpus World

Consider plan formation in the Wumpus World where the actions are: turning left (Left), turning right (Right), going forward (Forward), grabbing the gold (Grab), release the gold (Release), and shooting an arrow (Shoot). These actions can be represented by STRIPS operators, using (among others) the following predicates:

- $At(sq)$ means the agent is at square sq.
- $Heading(dir)$ means the agent is facing direction dir.
- $Next(sq_1, dir, sq_2)$ means that square sq_2 is adjacent to square sq_1 in direction dir.
- $Ninety(dir_1, dir_2)$ means that dir_2 is 90 degrees clockwise from dir_1.
- $OK(sq)$ means that square sq is safe.
- $Wumpus(sq)$ means the Wumpus is in square sq.

The initial state of our planning problem can be described with the knowledge base:

$$
\begin{array}{ll}
At(\langle 1,1\rangle), & Heading(West) \\
Ninety(West, North), & Ninety(North, East),\ ... \\
Next(\langle 1,1\rangle, North, \langle 1,2\rangle), & Next(\langle 1,2\rangle, North, \langle 1,3\rangle),\ ... \\
OK(\langle 1,1\rangle) & OK(\langle 1,2\rangle) \\
Wumpus(\langle 1,3\rangle) &
\end{array}
$$

(a) Represent the Shoot action with a STRIPS operator. The agent could Shoot an arrow if it is facing direction dir and the square adjacent to its current position in direction dir contains the Wumpus. The Wumpus will be killed by this action.

(b) Give a plan for killing the Wumpus in square $\langle 1,3\rangle$, i.e. give a sequence of fully instantiated operators that achieves the goal $\neg Wumpus(\langle 1,3\rangle)$.

(c) Describe how STRIPS could find this plan.

3 Qualification and Ramification

Consider the action of taking a train from Edinburgh to London with preconditions $At(Agent, Edinburgh)\wedge$ $At(Train, Edinburgh)$ and add list $At(Agent, London) \wedge At(Train, London)$.

(a) What additional preconditions might be required to guarantee that the action can be applied?

(b) What additional effects might be caused by the action?