AI2 Module 4
Tutorial 5

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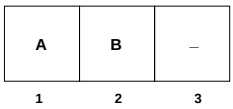
1 Partial Order Planning and Register Swap

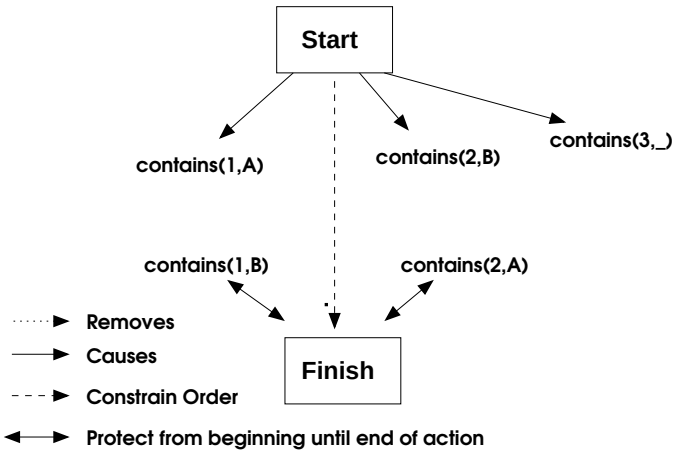
Consider the simple register swap problem in which we have a register with three cells: 1,2, and 3, and data items **A** and **B**:



The above situation can be described with: **Contains(1,A)**∧**Contains(2,B)**∧ **Contains(3,_)**, where _ denotes the empty cell.
The only action available is copying a data item from cell i to another cell j: Copy(i,j). The original content of cell j is overwritten by this action.

(a) Represent the action Copy(i,j) as a STRIPS operator.

(b) Consider the the partial order planning algorithm introduced in lecture. Describe, on an abstract level, how the planner would proceed to find a plan for swapping the contents of cell 1 and cell 2 in the above example, i.e. to achieve the goal **Contains(1,B)** ∧ **Contains(2,A)**, until the first threats occur. Also describe how the threats can be resolved. The initial plan is:



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2 The Event Calculus in the Wumpus World

Let us assume that there are two agents, b and c in the Wumpus World. Furthermore, actions in the Wumpus World are now continuous and we use $T(a, i)$ to indicate that the event of performing the action a occurs over exactly the interval i. In the following, $Move(x, sq_1, sq_2)$ is the action of agent x moving from square sq_1 to square sq_2 and $Stay(x, sq)$ is the passive action of agent x staying at square sq. Thus, $T(Move(x, sq_1, sq_2), i)$ means that the event of agent x moving from square sq_1 to square sq_2 occurs over exactly the interval i.
Assume that the initial location of agent b is the square sq_b and the initial location of agent c is sq_c. Formalise the following statement in the event calculus:

> If Agent b and agent c both move from their initial square to a square sq, then they always wait long enough to meet, i.e. there is some time interval in which they are both present at square sq.

3 Modal Logics and World Politics

Try to formalise the following quotation of Donald Rumsfeld as a modal logic formula. Represent "we know φ" as $\boxed{\mathsf{K}_{we}}\,\varphi$.

> *As we know,*
> *There are known knowns.*
> *There are things we know we know.*
> *We also know*
> *There are known unknowns.*
> *That is to say*
> *We know there are some things*
> *We do not know.*
> *But there are also unknown unknowns.*
> *The ones we don't know we don't know.*
>
> (*The Guardian*, Saturday May 3, 2003, p. 13)

[Hint: You will need to quantify over propostitions, e.g. $\exists\varphi$]