

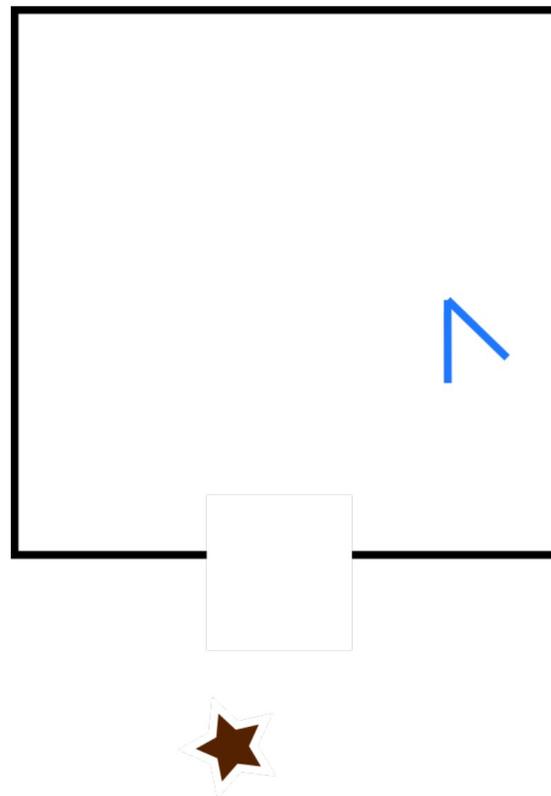
A “Simple” Action Model Learning Example

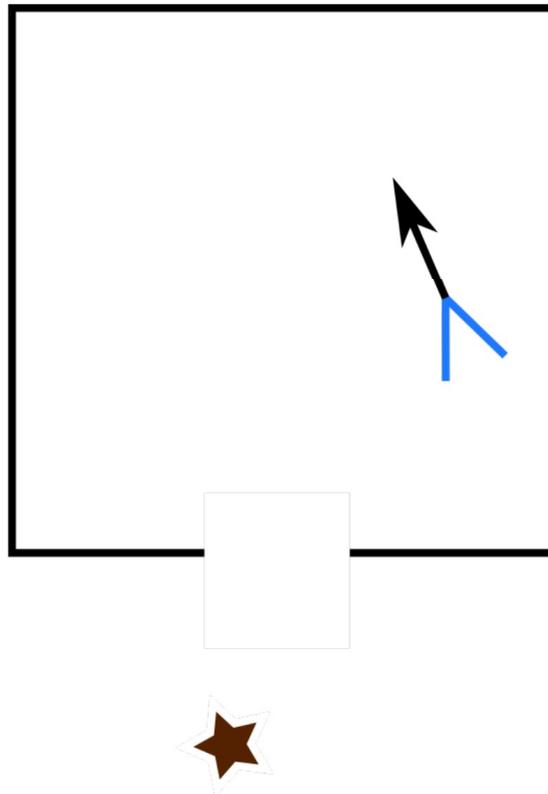
Steven J. Jones

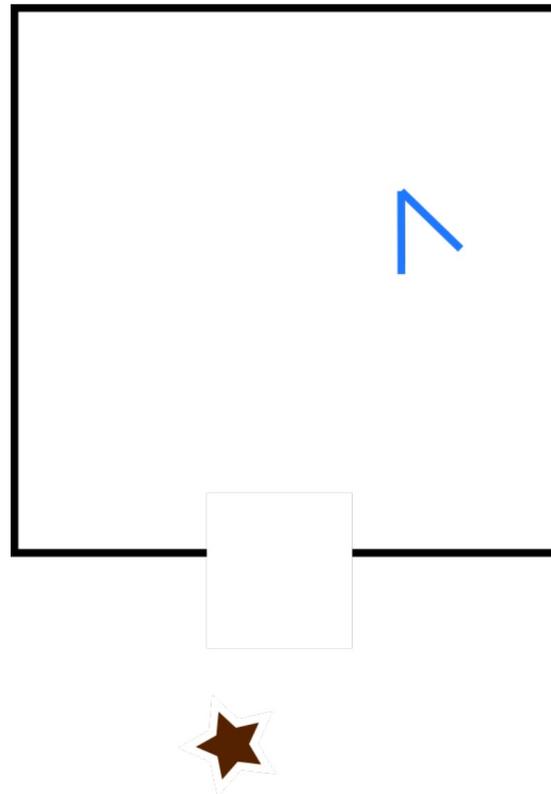
Computer Science and Engineering, University of Michigan, Ann Arbor

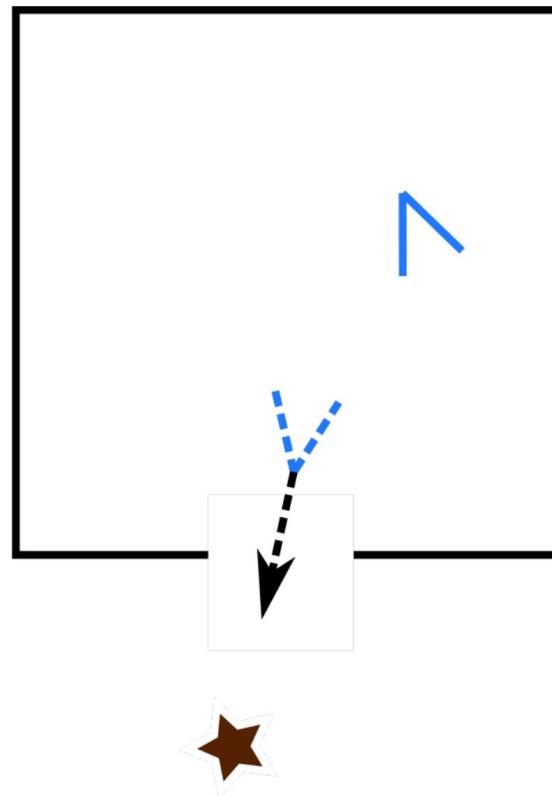
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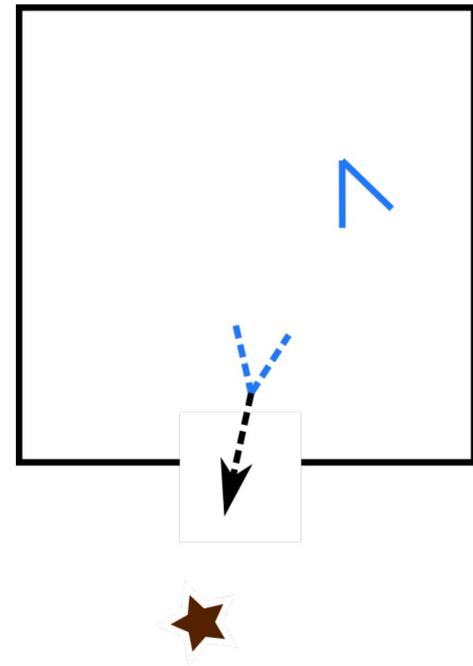




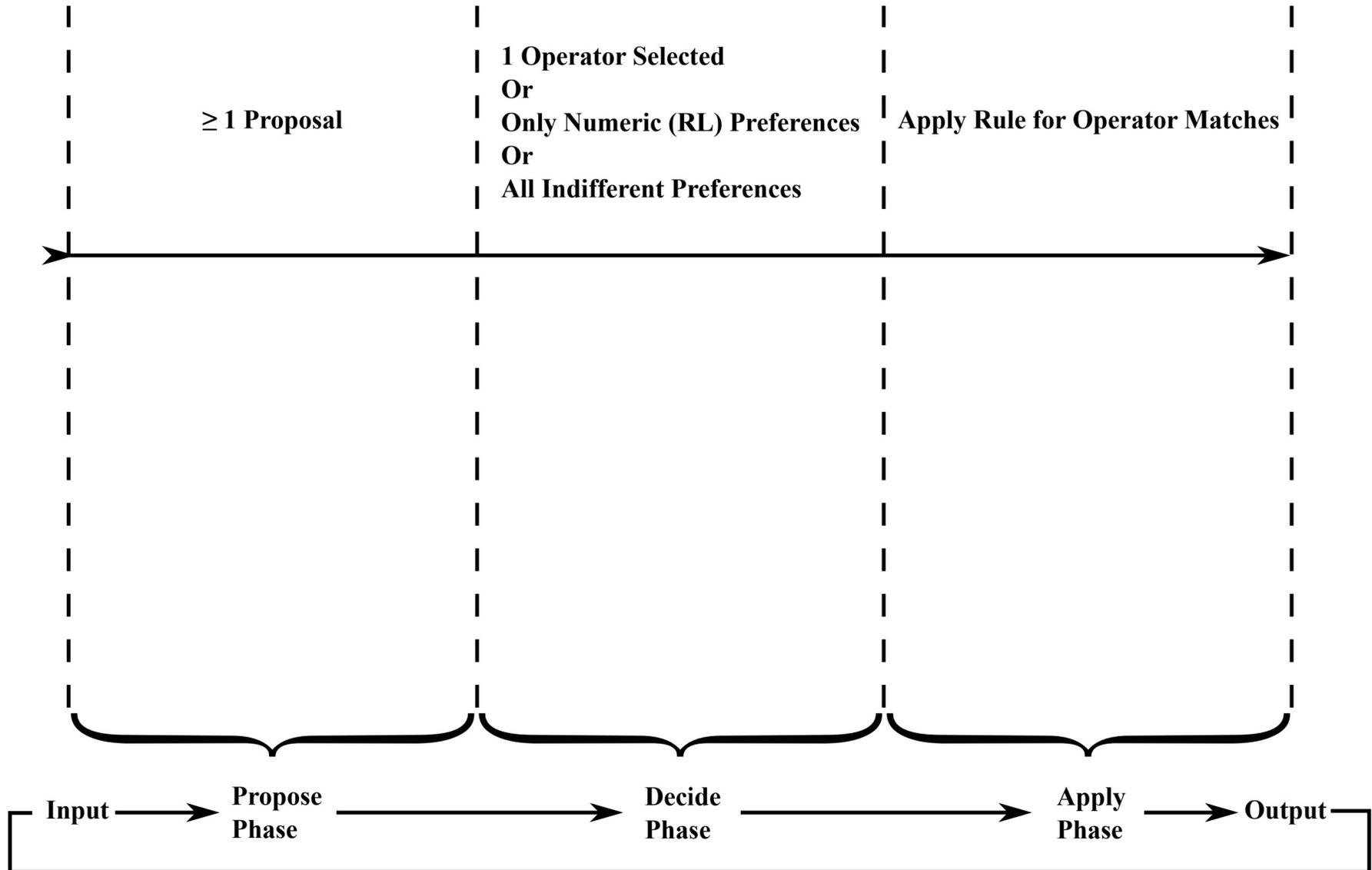
What's an Action Model?

Declarative representation of:

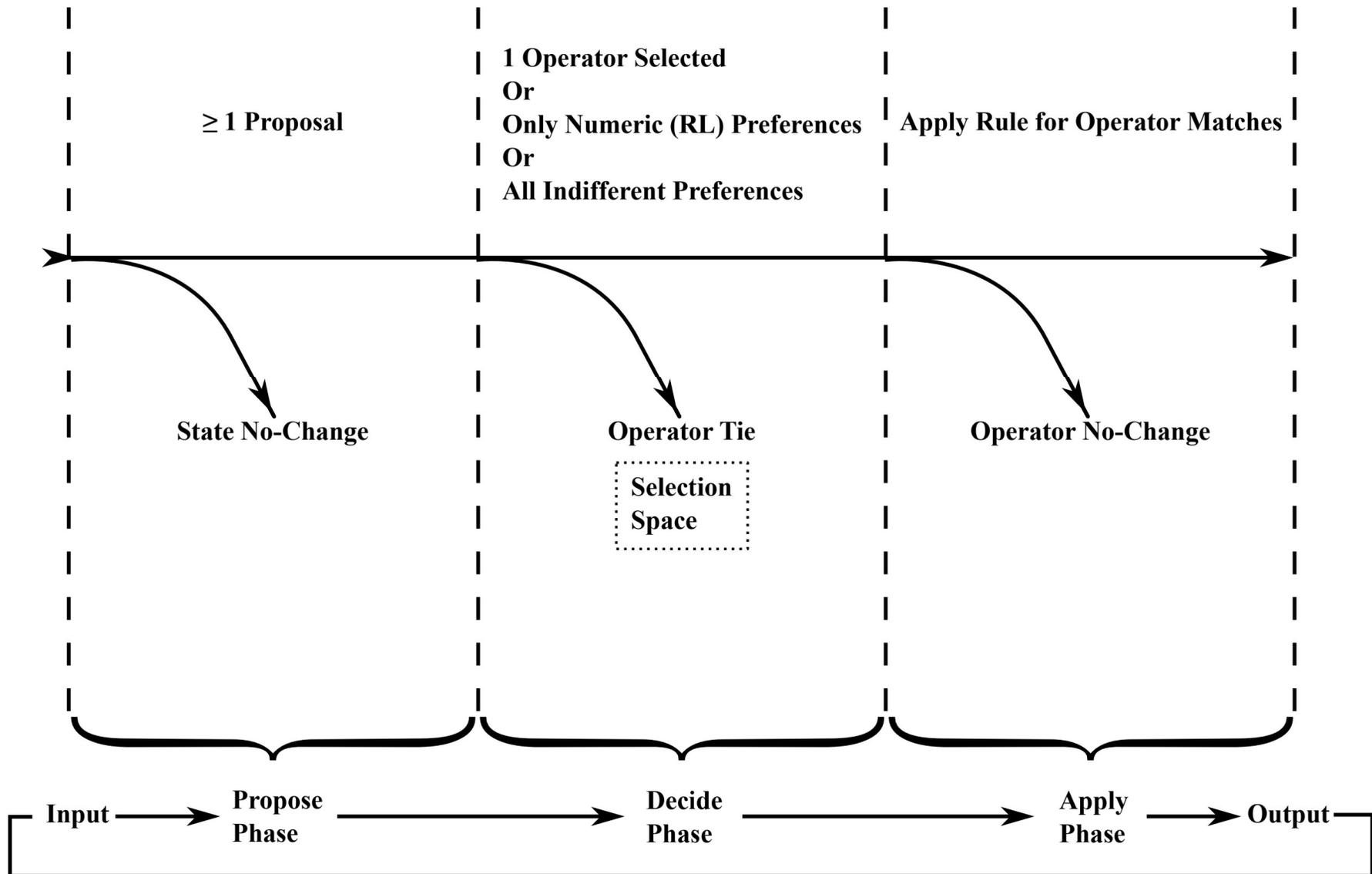
- Effect(s):
 - What will happen?
- Action(s):
 - What makes it happen?
- Precondition(s):
 - When does that make it happen?



The Decision Cycle



The Decision Cycle



State No-Change Impasse

The Problem:

- No operators to propose in the current situation

The solution:

- Make one from an *action model*

Resolving State No-Change Impasse with an Action Model

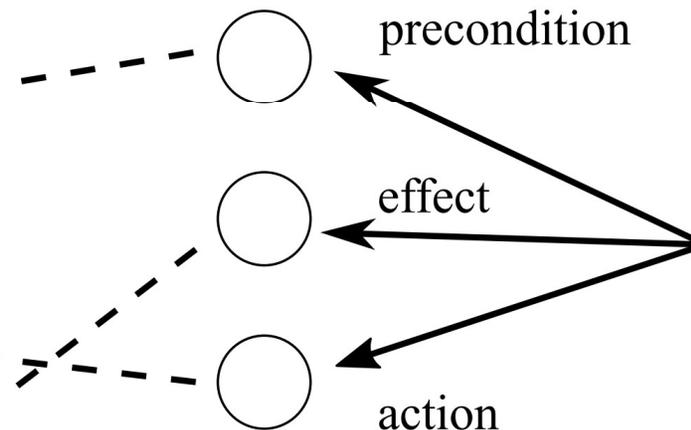
How to propose

```

sp {typical-proposal
  (state <s> ???)
  (<s> -^ ???)
-->
  (<s> ^operator <o>)
  (<o> ^action ???)
  (<o> ^expected ???)}

```

Knowledge in action model



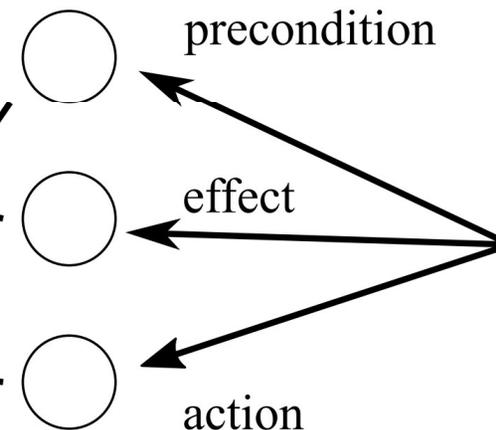
Resolving State No-Change Impasse (MEA)

How to propose

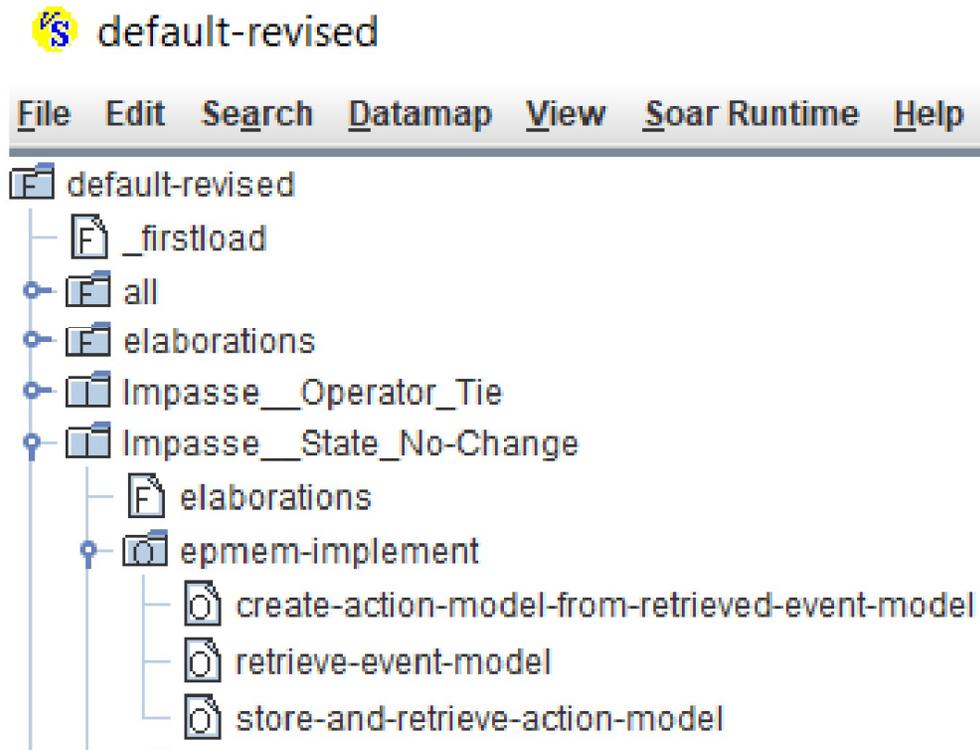
```

sp {MEA-proposal
  (state <s>
    ^desired <goal>)
-->
(<s> ^operator <o>)
(<o> ^action ???)
(<o> ^preconditions ???)}
  
```

Where it comes from



Where does that helpful action model come from?



Easy State No-Change:

Already have preconditions and goal effect

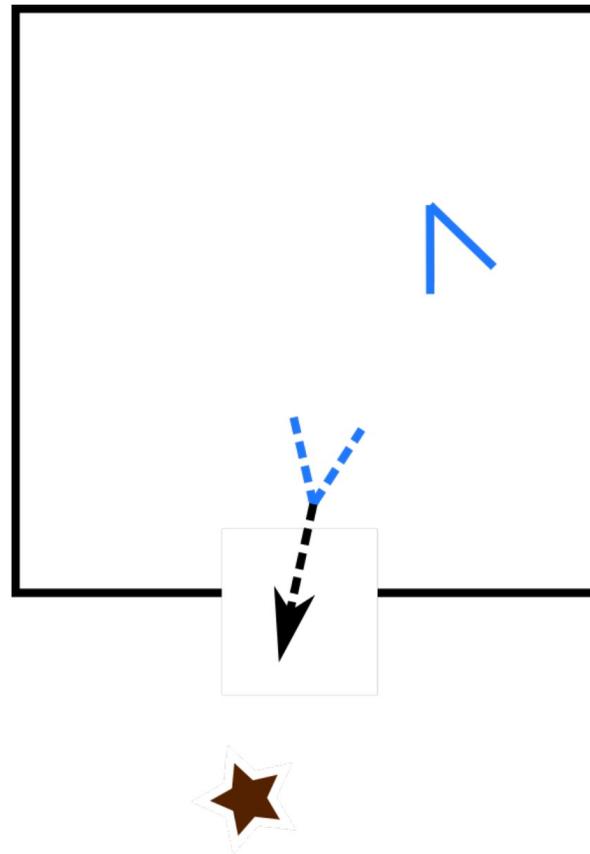
```

Impasse__State_No-Changeepmem-implement
File Edit Search Soar Insert Template Runtime
#When in a state no-change that is under an operator no-change,
#look for whether the operator that induced the no-change
#has true preconditions.
#If so, the agent does epmem-based implementation.

sp {propose*type-of-SNC-epmem
  (state <s> ^choices none
    ^attribute state
    ^superstate.superstate.preconditions true
    -^retrieved-action-model <am>)
-->
  (<s> ^operator.name epmem-implement)
}

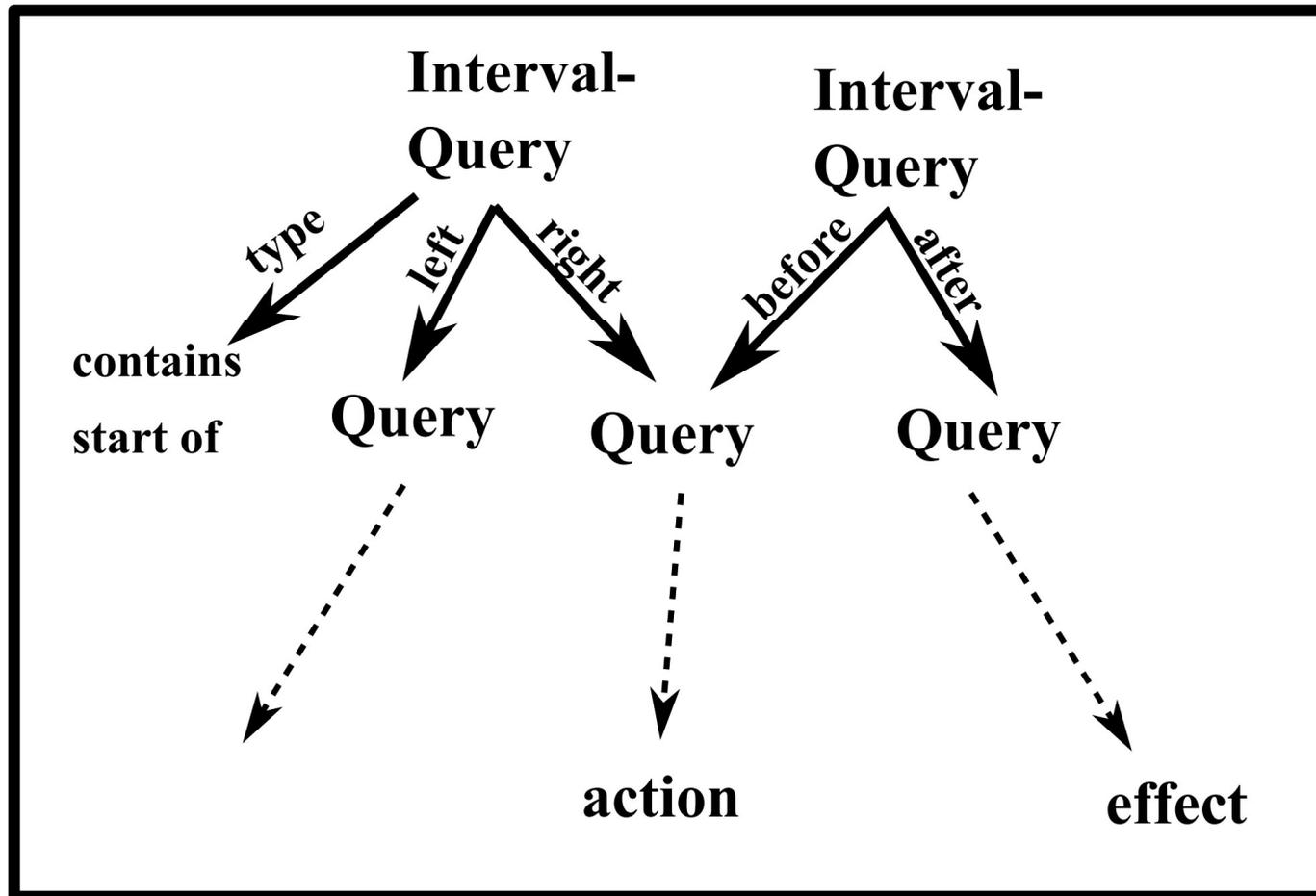
```

Querying Episodic Memory Without Known Preconditions



Querying Episodic Memory Without Known Preconditions

Working Memory



Inspecting Interval-based Event Representation

Effect:

- Trivial: if the query succeeds, direct match

Action:

- Trivial: if the query succeeds, some action was present

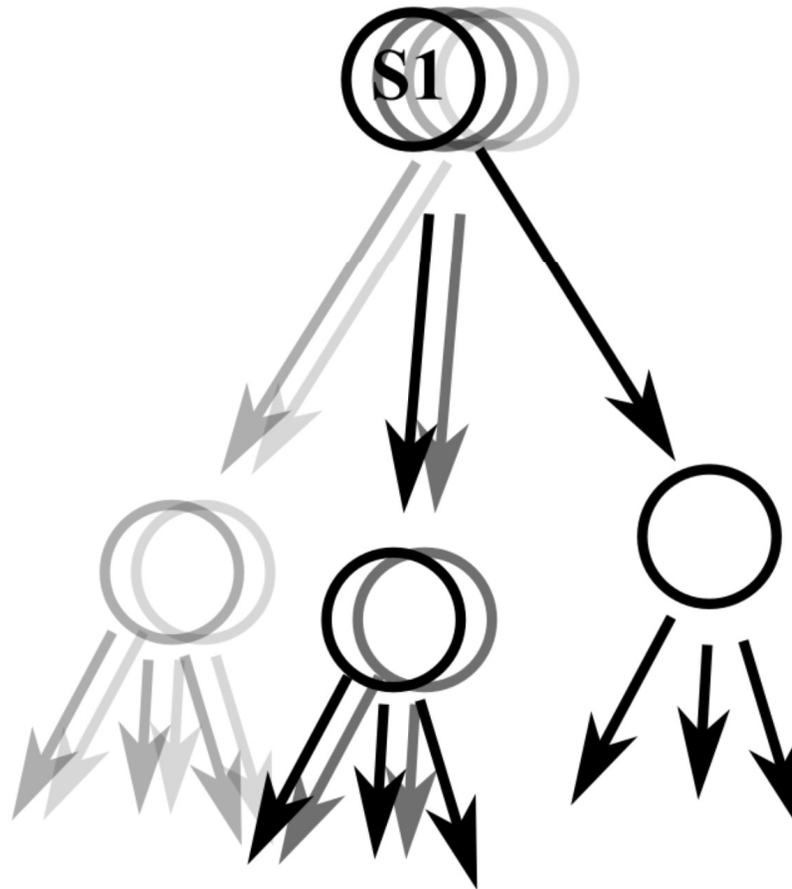
Precondition:

- ... potentially any state features present during the action???

Preconditions: Potentially a big problem

Interval-based queries and event representations aren't magic

$$\mathbf{T} = \mathbf{t}, \mathbf{t}-1, \mathbf{t}-2, \mathbf{t}-3$$



Preconditions: a heuristic approach

- effects of previous action are convenient (replicable)
- if possible, prefer surprising state feature
- for a guess at a precondition, check there isn't already a counter example in EpMem
- *bias towards some state features based on statistical transition data learned in SMem*
- *worst case: search over all temporal interval logic predicates true in historical state during/before action*

Nuggets:

- New default rules?!
- Demonstrates utility of EpMem changes
- Provides non-instruction task-general declarative → procedural learning
- preconditions often easy and simple in practice (with good state features)

Coal:

- not a real example: couldn't make running code in time for workshop
- space of hypothetically possible preconditions is huge