Report on Assignment 2

Results and Experimentation

Expected results were achieved after trying over and over again, changing small things and reconsidering the logic behind it. As is seen below, the program delivers acceptable outputs both for cases where there is a snake inside, and the treasure has to be hooked,

```
----------
Strips1
currrent state
warrior in W
snake in pit
ladder in L
rope in R
hook in H
chest in pit
goal state
chest in edge
working on goal chest in edge
----------
Strips2
working on chest in edge
calling Strips3 to apply operator
warrior goes using ladder to pit and get chest
back from Strips3
----------
Strips3
current state
warrior in W
snake in pit
ladder in L
rope in R
hook in H
chest in pit
attempting to use operator
warrior goes using ladder to pit and get chest
in context {}
```

precond not met- ladder in pit
calling Strips1 for goal ladder in pit

Strips1
currrent state
warrior in W
snake in pit
ladder in L
rope in R
hook in H
chest in pit
goal state
ladder in pit
working on goal ladder in pit

Strips2
working on ladder in pit
calling Strips3 to apply operator
warrior put ?obj into pit from edge
back from Strips3

Strips3
current state
warrior in W
snake in pit
ladder in L
rope in R
hook in H
chest in pit
attempting to use operator
warrior put ?obj into pit from edge
in context {?obj=ladder}
precond not met- warrior in edge
calling Strips1 for goal warrior in edge

Strips1
currrent state
warrior in W
snake in pit

ladder in L
rope in R
hook in H
chest in pit
goal state
warrior in edge
working on goal warrior in edge

Strips2
working on warrior in edge
calling Strips3 to apply operator
warrior moves from ?W to ?place
back from Strips3

Strips3
current state
warrior in W
snake in pit
ladder in L
rope in R
hook in H
chest in pit
attempting to use operator
warrior moves from ?W to ?place
in context {?place=edge}
Strips3: Applying op [warrior moves from W to edge]
[warrior in W]
[warrior in edge]
New state
snake in pit
ladder in L
rope in R
hook in H
chest in pit
warrior in edge

Strips1
currrent state
snake in pit

ladder in L
rope in R
hook in H
chest in pit
warrior in edge
goal state
warrior in edge
all goals met
---
precond not met- ?obj in edge
calling Strips1 for goal ladder in edge

Strips1
currrent state
snake in pit
ladder in L
rope in R
hook in H
chest in pit
warrior in edge
goal state
ladder in edge
working on goal ladder in edge

Strips2
working on ladder in edge
calling Strips3 to apply operator
warrior carry ?o from ?place1 to ?place2
back from Strips3

Strips3
current state
snake in pit
ladder in L
rope in R
hook in H
chest in pit
warrior in edge
attempting to use operator

warrior carry ?o from ?place1 to ?place2
in context {?o=ladder, ?place2=edge}
precond not met- warrior in ?place1
calling Strips1 for goal warrior in L

Strips1
currrent state
snake in pit
ladder in L
rope in R
hook in H
chest in pit
warrior in edge
goal state
warrior in L
working on goal warrior in L

Strips2
working on warrior in L
calling Strips3 to apply operator
warrior moves from ?W to ?place
back from Strips3

Strips3
current state
snake in pit
ladder in L
rope in R
hook in H
chest in pit
warrior in edge
attempting to use operator
warrior moves from ?W to ?place
in context {?place=L}
Strips3: Applying op [warrior moves from edge to L]
[warrior in edge]
[warrior in L]
New state
snake in pit

ladder in L
rope in R
hook in H
chest in pit
warrior in L

Strips1
currrent state
snake in pit
ladder in L
rope in R
hook in H
chest in pit
warrior in L
goal state
warrior in L
all goals met

Strips3: Applying op [warrior carry ladder from L to edge]
[ladder in L, warrior in L]
[warrior in edge, ladder in edge]
New state
snake in pit
rope in R
hook in H
chest in pit
warrior in edge
ladder in edge

Strips1
currrent state
snake in pit
rope in R
hook in H
chest in pit
warrior in edge
ladder in edge
goal state
ladder in edge

all goals met

Strips3: Applying op [warrior put ladder into pit from edge]

[ladder in edge]

[ladder in pit]

New state

snake in pit

rope in R

hook in H

chest in pit

warrior in edge

ladder in pit

Strips1

currrent state

snake in pit

rope in R

hook in H

chest in pit

warrior in edge

ladder in pit

goal state

ladder in pit

all goals met

---

precond not met- snake not in pit

calling Strips1 for goal snake not in pit

Strips1

currrent state

snake in pit

rope in R

hook in H

chest in pit

warrior in edge

ladder in pit

goal state

snake not in pit

working on goal snake not in pit

Strips2
working on snake not in pit
calling Strips3 to apply operator
pull chest from pit
back from Strips3

Strips3
current state
warrior in W
snake in pit
ladder in L
rope in R
hook in H
chest in pit
attempting to use operator
pull chest from pit
in context {}
precond not met- rope&hook in pit
calling Strips1 for goal rope&hook in pit

Strips1
currrent state
warrior in W
snake in pit
ladder in L
rope in R
hook in H
chest in pit
goal state
rope&hook in pit
working on goal rope&hook in pit

Strips2
working on rope&hook in pit
calling Strips3 to apply operator
warrior put ?obj into pit from edge
back from Strips3

Strips3
current state
warrior in W
snake in pit
ladder in L
rope in R
hook in H
chest in pit
attempting to use operator
warrior put ?obj into pit from edge
in context {?obj=rope&hook}
precond not met- warrior in edge
calling Strips1 for goal warrior in edge

Strips1
currrent state
warrior in W
snake in pit
ladder in L
rope in R
hook in H
chest in pit
goal state
warrior in edge
working on goal warrior in edge

Strips2
working on warrior in edge
calling Strips3 to apply operator
warrior moves from ?W to ?place
back from Strips3

Strips3
current state
warrior in W
snake in pit
ladder in L
rope in R
hook in H

chest in pit
attempting to use operator
warrior moves from ?W to ?place
in context {?place=edge}
Strips3: Applying op [warrior moves from W to edge]
[warrior in W]
[warrior in edge]
New state
snake in pit
ladder in L
rope in R
hook in H
chest in pit
warrior in edge

Strips1
currrent state
snake in pit
ladder in L
rope in R
hook in H
chest in pit
warrior in edge
goal state
warrior in edge
all goals met
---
precond not met- ?obj in edge
calling Strips1 for goal rope&hook in edge

Strips1
currrent state
snake in pit
ladder in L
rope in R
hook in H
chest in pit
warrior in edge
goal state

rope&hook in edge
working on goal rope&hook in edge

Strips2
working on rope&hook in edge
calling Strips3 to apply operator
attach rope to hook in ?place
back from Strips3

Strips3
current state
snake in pit
ladder in L
rope in R
hook in H
chest in pit
warrior in edge
attempting to use operator
attach rope to hook in ?place
in context {?place=edge}
precond not met- rope in ?place
calling Strips1 for goal rope in edge

Strips1
currrent state
snake in pit
ladder in L
rope in R
hook in H
chest in pit
warrior in edge
goal state
rope in edge
working on goal rope in edge

Strips2
working on rope in edge
calling Strips3 to apply operator
warrior carry ?o from ?place1 to ?place2

back from Strips3

Strips3
current state
snake in pit
ladder in L
rope in R
hook in H
chest in pit
warrior in edge
attempting to use operator
warrior carry ?o from ?place1 to ?place2
in context {?o=rope, ?place2=edge}
precond not met- warrior in ?place1
calling Strips1 for goal warrior in R

Strips1
currrent state
snake in pit
ladder in L
rope in R
hook in H
chest in pit
warrior in edge
goal state
warrior in R
working on goal warrior in R

Strips2
working on warrior in R
calling Strips3 to apply operator
warrior moves from ?W to ?place
back from Strips3

Strips3
current state
snake in pit
ladder in L
rope in R

hook in H
chest in pit
warrior in edge
attempting to use operator
warrior moves from ?W to ?place
in context {?place=R}
Strips3: Applying op [warrior moves from edge to R]
[warrior in edge]
[warrior in R]
New state
snake in pit
ladder in L
rope in R
hook in H
chest in pit
warrior in R

Strips1
currrent state
snake in pit
ladder in L
rope in R
hook in H
chest in pit
warrior in R
goal state
warrior in R
all goals met

Strips3: Applying op [warrior carry rope from R to edge]
[rope in R, warrior in R]
[warrior in edge, rope in edge]
New state
snake in pit
ladder in L
hook in H
chest in pit
warrior in edge
rope in edge

Strips1
currrent state
snake in pit
ladder in L
hook in H
chest in pit
warrior in edge
rope in edge
goal state
rope in edge
all goals met
---
precond not met- hook in ?place
calling Strips1 for goal hook in edge

Strips1
currrent state
snake in pit
ladder in L
hook in H
chest in pit
warrior in edge
rope in edge
goal state
hook in edge
working on goal hook in edge

Strips2
working on hook in edge
calling Strips3 to apply operator
warrior carry ?o from ?place1 to ?place2
back from Strips3

Strips3
current state
snake in pit
ladder in L
hook in H

chest in pit
warrior in edge
rope in edge
attempting to use operator
warrior carry ?o from ?place1 to ?place2
in context {?o=hook, ?place2=edge}
precond not met- warrior in ?place1
calling Strips1 for goal warrior in H

Strips1
currrent state
snake in pit
ladder in L
hook in H
chest in pit
warrior in edge
rope in edge
goal state
warrior in H
working on goal warrior in H

Strips2
working on warrior in H
calling Strips3 to apply operator
warrior moves from ?W to ?place
back from Strips3

Strips3
current state
snake in pit
ladder in L
hook in H
chest in pit
warrior in edge
rope in edge
attempting to use operator
warrior moves from ?W to ?place
in context {?place=H}
Strips3: Applying op [warrior moves from edge to H]

[warrior in edge]
[warrior in H]
New state
snake in pit
ladder in L
hook in H
chest in pit
rope in edge
warrior in H

Strips1
currrent state
snake in pit
ladder in L
hook in H
chest in pit
rope in edge
warrior in H
goal state
warrior in H
all goals met

Strips3: Applying op [warrior carry hook from H to edge]
[hook in H, warrior in H]
[warrior in edge, hook in edge]
New state
snake in pit
ladder in L
chest in pit
rope in edge
warrior in edge
hook in edge

Strips1
currrent state
snake in pit
ladder in L
chest in pit
rope in edge

warrior in edge
hook in edge
goal state
hook in edge
all goals met

Strips3: Applying op [attach rope to hook in edge]
[hook in edge, rope in edge]
[rope&hook in edge]
New state
snake in pit
ladder in L
chest in pit
warrior in edge
rope&hook in edge

Strips1
currrent state
snake in pit
ladder in L
chest in pit
warrior in edge
rope&hook in edge
goal state
rope&hook in edge
all goals met

Strips3: Applying op [warrior put rope&hook into pit from edge]
[rope&hook in edge]
[rope&hook in pit]
New state
snake in pit
ladder in L
chest in pit
warrior in edge
rope&hook in pit

Strips1
currrent state

snake in pit
ladder in L
chest in pit
warrior in edge
rope&hook in pit
goal state
rope&hook in pit
all goals met
---
precond not met- warrior in edge
calling Strips1 for goal warrior in edge

Strips1
currrent state
snake in pit
ladder in L
chest in pit
warrior in edge
rope&hook in pit
goal state
warrior in edge
all goals met

Strips3: Applying op [pull chest from pit]
[chest in pit]
[chest in edge]
New state
snake in pit
ladder in L
warrior in edge
rope&hook in pit
chest in edge

Strips1
currrent state
snake in pit
ladder in L
warrior in edge
rope&hook in pit

chest in edge
goal state
chest in edge
all goals met

Result is true
Plan is [warrior moves from W to edge, warrior moves from edge to R, warrior carry rope from R to edge, warrior moves from edge to H, warrior carry hook from H to edge, attach rope to hook in edge, warrior put rope&hook into pit from edge, pull chest from pit]

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and when the pit can be accessed with a ladder:

Strips1
currrent state
warrior in W
snake not in pit
ladder in L
rope in R
hook in H
chest in pit
goal state
chest in edge
working on goal chest in edge

Strips2
working on chest in edge
calling Strips3 to apply operator
warrior goes using ladder to pit and get chest
back from Strips3

Strips3
current state
warrior in W
snake not in pit
ladder in L
rope in R
hook in H

chest in pit
attempting to use operator
warrior goes using ladder to pit and get chest
in context {}
precond not met- ladder in pit
calling Strips1 for goal ladder in pit

Strips1
currrent state
warrior in W
snake not in pit
ladder in L
rope in R
hook in H
chest in pit
goal state
ladder in pit
working on goal ladder in pit

Strips2
working on ladder in pit
calling Strips3 to apply operator
warrior put ?obj into pit from edge
back from Strips3

Strips3
current state
warrior in W
snake not in pit
ladder in L
rope in R
hook in H
chest in pit
attempting to use operator
warrior put ?obj into pit from edge
in context {?obj=ladder}
precond not met- warrior in edge
calling Strips1 for goal warrior in edge

Strips1
currrent state
warrior in W
snake not in pit
ladder in L
rope in R
hook in H
chest in pit
goal state
warrior in edge
working on goal warrior in edge

Strips2
working on warrior in edge
calling Strips3 to apply operator
warrior moves from ?W to ?place
back from Strips3

Strips3
current state
warrior in W
snake not in pit
ladder in L
rope in R
hook in H
chest in pit
attempting to use operator
warrior moves from ?W to ?place
in context {?place=edge}
Strips3: Applying op [warrior moves from W to edge]
[warrior in W]
[warrior in edge]
New state
snake not in pit
ladder in L
rope in R
hook in H
chest in pit
warrior in edge

Strips1
currrent state
snake not in pit
ladder in L
rope in R
hook in H
chest in pit
warrior in edge
goal state
warrior in edge
all goals met
---
precond not met- ?obj in edge
calling Strips1 for goal ladder in edge

Strips1
currrent state
snake not in pit
ladder in L
rope in R
hook in H
chest in pit
warrior in edge
goal state
ladder in edge
working on goal ladder in edge

Strips2
working on ladder in edge
calling Strips3 to apply operator
warrior carry ?o from ?place1 to ?place2
back from Strips3

Strips3
current state
snake not in pit
ladder in L
rope in R

hook in H
chest in pit
warrior in edge
attempting to use operator
warrior carry ?o from ?place1 to ?place2
in context {?o=ladder, ?place2=edge}
precond not met- warrior in ?place1
calling Strips1 for goal warrior in L

Strips1
currrent state
snake not in pit
ladder in L
rope in R
hook in H
chest in pit
warrior in edge
goal state
warrior in L
working on goal warrior in L

Strips2
working on warrior in L
calling Strips3 to apply operator
warrior moves from ?W to ?place
back from Strips3

Strips3
current state
snake not in pit
ladder in L
rope in R
hook in H
chest in pit
warrior in edge
attempting to use operator
warrior moves from ?W to ?place
in context {?place=L}
Strips3: Applying op [warrior moves from edge to L]

[warrior in edge]
[warrior in L]
New state
snake not in pit
ladder in L
rope in R
hook in H
chest in pit
warrior in L

Strips1
currrent state
snake not in pit
ladder in L
rope in R
hook in H
chest in pit
warrior in L
goal state
warrior in L
all goals met

Strips3: Applying op [warrior carry ladder from L to edge]
[ladder in L, warrior in L]
[warrior in edge, ladder in edge]
New state
snake not in pit
rope in R
hook in H
chest in pit
warrior in edge
ladder in edge

Strips1
currrent state
snake not in pit
rope in R
hook in H
chest in pit

warrior in edge
ladder in edge
goal state
ladder in edge
all goals met

Strips3: Applying op [warrior put ladder into pit from edge]
[ladder in edge]
[ladder in pit]
New state
snake not in pit
rope in R
hook in H
chest in pit
warrior in edge
ladder in pit

Strips1
currrent state
snake not in pit
rope in R
hook in H
chest in pit
warrior in edge
ladder in pit
goal state
ladder in pit
all goals met
---
precond not met- ladder in pit
calling Strips1 for goal ladder in pit

Strips1
currrent state
snake not in pit
rope in R
hook in H
chest in pit
warrior in edge

ladder in pit
goal state
ladder in pit
all goals met
---
precond not met- warrior in edge
calling Strips1 for goal warrior in edge

Strips1
currrent state
snake not in pit
rope in R
hook in H
chest in pit
warrior in edge
ladder in pit
goal state
warrior in edge
all goals met

Strips3: Applying op [warrior goes using ladder to pit and get chest]
[chest in pit]
[chest in edge]
New state
snake not in pit
rope in R
hook in H
warrior in edge
ladder in pit
chest in edge

Strips1
currrent state
snake not in pit
rope in R
hook in H
warrior in edge
ladder in pit
chest in edge

goal state
chest in edge
all goals met

Result is true
Plan is [warrior moves from W to edge, warrior moves from edge to L, warrior carry ladder from L to edge, warrior put ladder into pit from edge, warrior goes using ladder to pit and get chest]

Even though now the problem is done the code seems rather logical, that is only now. During the development, the logic was regularly hard to understand.

Some problems were encountered, such as:

- The limited efficiency of the program. As STRIPS tries to solve the problem, it gets the goal and works backwards from it. Because of this, it would, directly from the beginning, try to get the chest. This was not possible in a beginning, as the Warrior had to be at the closest position to the pit to be able to retrieve it, and the necessary object(s) also had to be there. Because of this, the plan would be a plausible one, but not the most efficient one, as instead of picking up the object(s) and going to the pit, it would insist on moving to the edge, then back to the position where one of the necessary objects was, and then carried the object to the edge, and so would go back and forth for every necessary object. Even though I tried to see if changing the order of things helped, I didn't get any favorable results out of these.

Possible improvements

A suggestion that I think would be useful for problems like this and that this STRIPS version for Java lacked was part of the logic behind the statements used. A possible improvement would be for this problem solver to not rely so much on the order of the preconditions and operators, but for the problem solver to more intelligently read what had to be done in order for an action to be taken. This would have been quite useful in problems like this were my Warrior was constantly going back and forth between the edge and the positions of each object. By not having to put statements in such a specific order, it would've been possible to avoid this lack of efficiency. For example, the matching processor could not only read each statement in the preconditions and match it to one other specific goal and the actual situation, but to also try to find patterns within the statements in the preconditions. If, for example, STRIPS was able to read the fact that several entities needed to be at the edge for the treasure to be retrieved, it might intelligently decide to see what it can do to get them all to the edge in one go, instead of meeting each precondition individually. This could be coded by having the matching system not only comparing the actual state with each goal state but to have a separate method that

finds patterns within (in this case) the preconditions and compiles them, possibly, into an ArrayList of factors with the same goal.