Topic 2.2 Limitations of Logical Inference: An example

A goal based logical agent for simplified 'Treasure Hunt: A Risky Business' [Find Gold avoiding Monsters]

a) Problem

1,4			
1,3			
1,2			
1,1	2,1	3,1	4,1

Environment: 4x4 grid; Probability of a monster at a cell except [1,1] is > 0, and independent; Gold is hidden in some cells.

ShoutWow, CryAhh, ...

Actions: MoveToRight, MoveUp,

b) Assumptions

$$A_{i,i}$$
 – the agent is in [i,j]

$$\neg M_{i,i}$$
 – no monster is in [i,j]

$$S_{i,j}$$
 – smell of a monster is perceived in [i,j]

Example of a percept:
$$S_{i,j} \land \neg M_{i,j} \land \neg G_{i,j}$$

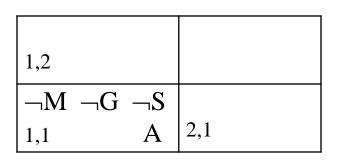
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c) Initial KB

$$\textbf{1.} \ S_{i,\,j} \! \Longleftrightarrow M_{i\text{-}1,\,j} \lor M_{i\text{+}1,\,j} \lor M_{i,\,j\text{-}1} \lor M_{i,\,j\text{+}1}$$

2.
$$(i \ge 1) \land (j \ge 1) \land (i \le 4) \land (j \le 4)$$

3.
$$\neg M_{1,1} \land \neg S_{1,1} \land \neg G_{1,1}$$



d) Reasoning

T1.
$$\neg S_{1,1}$$
 [Similarly, $\neg M_{1,1}$, $\neg G_{1,1}$]

T2.
$$S_{1, 1} \Leftrightarrow M_{2, 1} \vee M_{1, 2}$$

T3.
$$(S_{1,1} \Rightarrow M_{2,1} \lor M_{1,2}) \land (M_{2,1} \lor M_{1,2} \Rightarrow S_{1,1})$$

[Elimination of
$$\Leftrightarrow$$
]

T4.
$$M_{2,1} \lor M_{1,2} \Rightarrow S_{1,1}$$

T5.
$$\neg S_{1,1} \Rightarrow \neg (M_{2,1} \lor M_{1,2})$$

T6.
$$\neg (M_{2,1} \lor M_{1,2})$$

T7.
$$\neg M_{2,1} \land \neg M_{1,2}$$

So, we get $\neg M_{2,1}$ and $\neg M_{1,2}$ by Simplification of T7.

Useful addition to KB after reasoning:

5.
$$\neg M_{2, 1}$$
 6. $\neg M_{1, 2}$

¬M 1,2	
	¬M 2,1

Decision: Safe to move to right or up

Action taken, say: MoveToRight

Important Changes:

4.
$$A_{1,1}$$
; $A_{2,1}$

New percept, suppose:
$$S_{2,1} \land \neg M_{2,1} \land \neg G_{2,1}$$

$\neg M$		
1,2		
$\neg M \neg G \neg S$	$\neg M \neg G$	S
1,1	2,1	A

Result of further reasoning [Self study]:

$$M_{2,2} \vee M_{3,1}$$

Actions taken, say:

MoveToLeft, MoveUp

New percept, suppose: $S_{1,2} \land \neg M_{1,2} \land \neg G_{1,2}$

$\neg M \neg G$	S		
1,2	A		
$\neg M \neg G$	$\neg S$	$\neg M \neg G$	S
1,1		2,1	

Result of further reasoning:

$$S_{1,2}$$
 $M_{2,2} \lor M_{1,3}$

So, $M_{1,3}$ or $M_{2,2}$ or $M_{3,1}$ may hold, but the combination is uncertain!!!

?M				
1,3				
$\neg M \neg G$	S	?M		
1,2	A	2,2		
$\neg M \neg G -$	$_{1}S$	$\neg M \neg G$	S	?M
1,1		2,1		3,1

What to do next?