1. Consider the following proposition:

$$(A \lor B) \land (\neg A \lor \neg B) \land (\neg B \lor \neg C \lor D)$$
$$\land (C \lor E) \land (\neg E \lor \neg A) \land (\neg D \lor E) \land (\neg E \lor \neg B)$$
$$\land (E \lor \neg F \lor G) \land (\neg F \lor G \lor \neg H) \land (\neg G \lor \neg H)$$
$$\land (F \lor \neg H) \land (\neg G \lor H \lor I) \land (\neg I \lor \neg J) \land (J \lor E \lor \neg A)$$

Determine whether the given propositional formula is satisfiable. If the formula is satisfiable, provide an assignment of truth values (a truth assignment) for variables $A, B, C, D, E, F, G, H, I$, and J that satisfies the formula. If it is unsatisfiable, explain why.

Answer The formula is satisfiable, as witnessed by the truth assignment

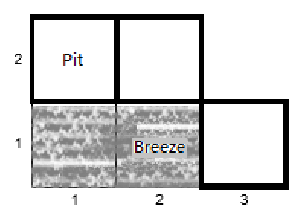
A	B	C	D	E	F	G	H	I	J
1	0	1	0	0	0	0	0	0	1

2. Consider the KB for wumpus world as described in the lectures. Suppose the agent has visited squares $(1,1)$ and $(2,1)$ and observed

$$\text{Percepts} = \{\neg S_{2,1}, B_{2,1}, \neg S_{1,1}, \neg B_{1,1}, OK_{1,1}, OK_{2,1}\}.$$

(a) Below is an illustration of an interpretation of the wumpus world. It only specifies information regarding locations $(1,2), (2,2), (3,1)$, which are the only locations affected by the percepts above. Information regarding the positions $(1,1)$ and $(2,1)$ is fixed by the percepts, while information regarding all other locations is ignored.

Draw all interpretations in this way (which only specifies the information regarding $(1,2), (2,2), (3,1)$) that satisfy Percepts:

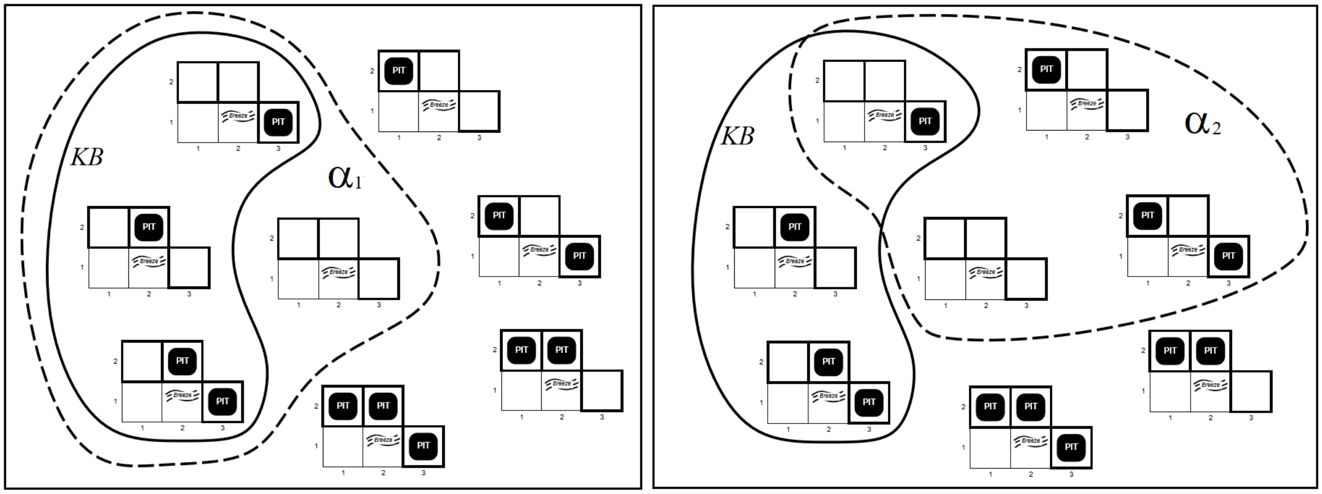


(b) Among the interpretations in (a), identify all models of KB.

(c) Consider propositions $\alpha_1 := \neg P_{1,2}$, and $\alpha_2 := \neg P_{2,2}$. Among the interpretations in (b), identify all models of α_1 and all models of α_2. From this, can you deduce the following?

$$(i).\ KB \cup \text{Percepts} \models \alpha_1$$
$$(ii).\ KB \cup \text{Percepts} \models \alpha_2$$

Answer. The following diagrams contain solutions to (a),(b),(c): The boxes contains all models of Percepts. The solid circle surrounds all models of KB. The dashed circles surrounds the models of α_1 and α_2 in the left and the right diagrams, respectively.



$KB \cup \text{Percepts} \models \alpha_1$ but $KB \cup \text{Percepts} \not\models \alpha_2$.

As illustrated in these diagrams, we can see that all models of KB also satisfy α_1. Therefore, α_1 is a logical consequence of $KB \cup \text{Percepts}$. However, there are two models of KB that do not satisfy α_2. Therefore, α_2 is not a logical consequence of $KB \cup \text{Percepts}$.

3. Suppose a definite clause KB contains the following propositions:

(1) $sam\_is\_happy \leftarrow night\_time \wedge no\_cloud$,
(2) $bird\_eats\_apple \leftarrow apple\_is\_red \wedge bird\_around$,
(3) $bird\_around \leftarrow no\_cloud$
(4) $apple\_is\_eaten \leftarrow bird\_eats\_apple$.

Percepts: (5) $apple\_is\_red$, (6) no_cloud.

Construct two proofs that $KB \cup \text{Percepts} \models apple\_is\_eaten$, one using forward chaining and another using SLD resolution.

Answer. Forward chaining produces the following proof:

$(7) bird\_around$	(Modus Ponens (3)(6))
$(8) bird\_eats\_apple$	(Modus Ponens (2)(5)(7))
$(9) apple\_is\_eaten$	(Modus Ponens (4)(8))

SLD resolution produces the following proof:

$yes \leftarrow apple\_is\_eaten$	(goal)
$yes \leftarrow bird\_eats\_apple$	(Resolution (4))
$yes \leftarrow apple\_is\_red \wedge bird\_around$	(Resolution (2))
$yes \leftarrow bird\_around$	(Resolution (5))
$yes \leftarrow no\_cloud$	(Resolution (3))
$yes \leftarrow$	(Resolution (6))

4. Consider the KB that contains $a \leftarrow b$, $a \leftarrow c \wedge f$, $b \leftarrow d$, $c \leftarrow d \wedge f$, $d \leftarrow f \wedge e$, $d \leftarrow g \wedge h$, $e \leftarrow g$,

The percept is Percepts $= \{f, g\}$.

The query is ask a.

Draw the search tree for SLD resolution.

Answer. The search tree