1. (a) For truth table enumeration

time complexity: $O(2^n)$

space complexity: $O(n)$

n is the # of symbols

(b) forward chaining

time complexity: $O(n)$

space complexity: $O(n)$

n is the # of horn clause

(C) Resolution

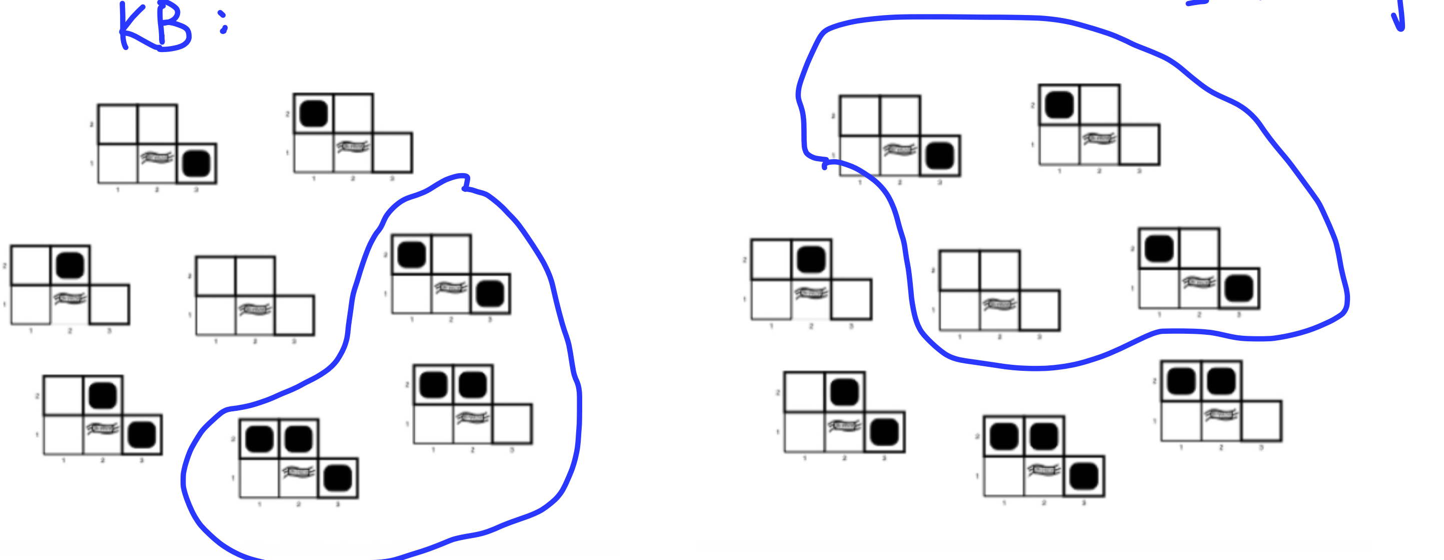
time complexity: $O(n^2)$

space complexity: $O(n^2)$

n is the # of clauses

2. KB:

α: [2,2] is safe



breeze in [1,1] and [2,1]

conclusion: KB do not entail α

3.

$(A \land B \Rightarrow C) \land -C$ $\qquad$ $-A \land -B$

A	B	C	-A	-B	-C	A∧B=>C	KB	α
true	true	true	false	false	false	true	false	false
true	false	true	false	true	false	true	false	true
false	true	true	true	false	false	true	false	true
true	true	false	false	false	false	false	false	false
false	false	true	true	true	true	true	false	true
false	true	false	true	false	false	true	true	true
true	false	false	false	true	true	true	true	true
false	false	false	true	true	true	true	true	true

When KB is true α is true

$\therefore KB \models \alpha$

4.

(a) Rules:

$B(1,1) \Rightarrow P(2,1) \lor P(1,2)$

$B(1,2) \Rightarrow P(1,1) \lor P(2,2)$

$B(2,1) \Rightarrow P(1,1) \lor P(2,2)$

$B(2,2) \Rightarrow P(2,1) \lor P(1,2)$

Observation:

$B(2,1)$ $\qquad$ $-P(2,1)$

$-B(1,1)$

$-P(1,1)$

(b)

1 $B(1,1) \Leftrightarrow (P(2,1) \vee P(1,2))$

$\Rightarrow (B(1,1) \rightarrow (P(2,1) \vee P(1,2))) \wedge (P(2,1) \vee P(1,2) \rightarrow B(1,1))$

– by conditional elimination

$\Rightarrow (\neg B(1,1) \vee (P(2,1) \vee P(1,2)) \wedge \neg((P(2,1) \vee P(1,2)) \vee B(1,1)$

– de Morgan law

$\Rightarrow (-B(1,1) \vee P(2,1) \vee P(1,2)) \wedge (\neg P(2,1) \wedge \neg P(1,2)) \vee B(1,1)$

– distribution law

$\Rightarrow -B(1,1) \vee P(2,1) \vee P(1,2) \wedge \neg P(2,1) \vee B(1,1) \wedge \neg P(1,2) \vee B(1,1)$

$\Downarrow$ $(\wedge -P(2,1) \wedge -B(1,1))$ from observation

$-B(1,1) \vee P(1,2) \wedge \neg P(2,1) \wedge \neg P(1,2)$

$\Rightarrow -B(1,1) \wedge \neg P(2,1) \wedge \neg P(1,2)$ ①

By the same process, ② will be

$-B(1,2) \cancel{\vee P(1,1)} \vee P(2,2) \wedge \neg P(1,1) \vee B(1,2) \wedge -P(2,2) \vee B(1,2)$

from observation: $\wedge \neg P(1,1)$

$\Rightarrow -B(1,2) \vee P(2,2) \wedge -P(1,1) \vee B(1,2) \wedge -P(2,2) \vee B(1,2)$ ②

By the same process as ①, ③ will be

$\cancel{-B(2,1)} \vee \cancel{P(1,1)} \vee P(2,2) \wedge -P(1,1) \vee B(2,1) \wedge \neg P(2,2) \vee B(2,1)$

from observation $(B(2,1) \wedge -P(1,1))$

So $P(2,2)$ must be true

5. $G: \neg R \wedge I$

$KB: \neg L \Rightarrow \neg R \quad \rightarrow \quad L \vee \neg R$

$\qquad D \Rightarrow \neg L \quad \rightarrow \quad \neg D \vee \neg L$

$\therefore KB: \underline{L \vee \neg R} \wedge \underline{\cancel{\neg D} \vee \neg L} \wedge \underline{D} \wedge \underline{A} \wedge \underline{I} \wedge \underline{A}$

$\Rightarrow \cancel{L} \vee \neg R \wedge \neg L \wedge D \wedge A \wedge I$

$\Rightarrow \neg R \wedge \neg L \wedge D \wedge A \wedge I$

$\therefore KB \models G$