HW1

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P1. 1. knowledge base:
$C \Rightarrow \neg B$
$\neg A \Rightarrow \neg C$
$C \wedge (B \vee A)$
2.

A	B	C	$C \Rightarrow \neg B$	$\neg A \Rightarrow \neg C$	$C \wedge (B \vee A)$
T	T	T	F	T	T
T	T	F	T	T	F
T	F	T	T	T	T
T	F	F	T	T	F
F	T	T	F	F	T
F	T	F	T	T	F
F	F	T	T	F	F
F	F	F	T	F	F

3.

Consistent, when A is T, B is F, C is T, all three testimonies are True.

4.

If all them are true, according to the truth table, A lied.

5.

If all testimonies are true, according to the truth table, A is innocent, B is guilty, C is innocent.
p2.

1.
First let's simplify the expression simply using resolution, by distribution's law, we can transform the original sentence to following:
$A \vee ((B \vee \neg C) \wedge \neg D)$

From the expression we can know that when A is true, any combination of BCD will be true. For an example :

A=1, B=1, C=0, D=0

2.

First lets simplity the expression using resolution,

$\neg(a \vee b) \wedge (\neg c \vee (c \wedge d)) \Rightarrow \neg c \vee d$

first we convert $(\neg c \vee (c \wedge d))$ to $((\neg c \vee c) \wedge (\neg c \vee d))$ which is equivalent to $T \wedge (\neg c \vee d)$ finally we have $\neg c \vee d$

then by implication we have

$\neg(\neg(a \vee b) \wedge (\neg c \vee d)) \vee (\neg c \vee d)$

then by negation we have

$(a \vee b) \wedge (\neg(\neg c \vee d)) \vee (\neg c \vee d)$

$(\neg c \vee d)$ can be considered as a unit clause, so the latter two parts combined is equivalent to True.

Finally we have $a \vee b$

In that case, the original expression is mainly determined by a and b. By basic DPLL, we consider when a=1, b can be 1 or 0, both are satisfiable.

So one scenario is:

a=1, b=0, c=1, d=1

3.

By Distribution, we can simplify the expression to

$((x \vee y) \vee (z \wedge \neg z)) \wedge ((x \vee \neg y) \vee (z \wedge \neg z)) \wedge ((\neg x \vee y) \vee (z \wedge \neg z)) \wedge ((\neg x \vee \neg y) \vee (z \wedge \neg z))$

$\Rightarrow$

$(x \vee y) \wedge (x \vee \neg y) \wedge (\neg x \vee y) \wedge (\neg x \vee \neg y)$

By distribution further,we can also simplify it to:

$(x \vee (y \wedge \neg y)) \wedge (\neg x \vee (y \wedge \neg y))$

$\Rightarrow$

$x \wedge \neg x$

Therefore, the simplified version tells us that the value of x will determine the expression.By DPLL, if the expression is satisfiable, then x is 1 and $\neg x$ is also 1 which means x need to be both 1 and 0. It is impossible, so the expression is not satisfiable.