Assignment 1

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**Question 1**

(a) 3 (b) 3 (c) 2

**Question 2**

(a)valid (b) neither (c) neither (d) valid (e) valid (f) valid (g) valid (h) neither

**Question 3**

is satisfiable if and only if in models in whichis true, andis true. And the statement is unsatisfiable means that is valid.

( ( This exactly equals tois valid, thus is satisfiable if and only if is unsatisfiable.

**Question 4**

a.

(P→Q)∩(P→R)|=P→(Q∩R)

(¬P∪Q)∩(¬P∪R)|=¬P∪(Q∩R)

(¬P∪Q)∩(¬P∪R)|=(¬P∪Q)∩(¬P∪R)

， Unsatisfiable

Therefore (P→Q)∩(P→R)|=P→(Q∩R)

b.

(P→ (Q∪R))∩(P→(Q∪¬R)))|=P→Q

(¬P∪(Q∪R))∩(¬P∪(Q∪¬R))|=¬P∪Q

.

, Unsatisfiable

Therefore (P→(Q∪R))∩(P→(Q∪¬R))|=P→Q

c.

(P→Q)∩((Q∩R)→S)|=(P∩R)→S

(¬P∪Q)∩(¬(Q∩R)∪S)|=¬(P∩R)∪S

(¬P∪Q)∩((¬Q∪S)∩(¬R∪S))|=(¬P∪S)∩(¬R∪S)

.

, Unsatisfiable

Therefore(¬P→Q)∩((Q∩R)→S)|=(P∩R)→S

**Question 5**

If M stands for models and A stands for assignments of the relevant variables which causes a conflict, M∩A is unsatisfiable.

Because M∩A is unsatisfiable and ¬(M∩A)↔(¬M∪¬A) ,therefore (¬M∪¬A) is satisfiable.

(¬M∪¬A)↔(M→¬A) , so (M→¬A) is satisfiable. And ¬A is exactly the clause we can get from a conflict.

Therefore, each of these candidate clauses, if not already existing, can be derived from the models, that is, by resolution.

Take one example in the lecture.

1: A∪B 2: B∪C 3: ¬A∪¬X∪Y 4: ¬A∪X∪Z 5: ¬A∪¬Y∪Z 6: ¬A∪X∪¬Z

7: ¬A∪¬Y∪¬Z

The two cuts are:

Cut1: {A,X} → ¬A∪¬X

Cut2: {A,Y} → ¬A∪¬Y

For cut1, it can be derived as below:

3 and 5 → ¬A∪¬X∪Z

¬A∪¬X∪Z and 7 → ¬A∪¬X∪¬Y

¬A∪¬X∪¬Y and 3 → ¬A∪¬X

For cut 2, it can be derived as below:

5 and 7 → ¬A∪¬Y

**Question 6**

UIP is a node at the current decision level such that any path from the decision variable at this level to the conflict variable as well as its negation must go through it. And first-UIP is the node that is closest to the conflict variable. It backtracks to the lowest decision level and its clause can be minimized locally by resolving out a literal, which has other literals in its antecedent already in the first-UIP clause. And in addition, if first-UIP is already exist, the conflict will be found before it and this doesn`t make sense.

**Question 7**

1.d-DNNF B∪(A∩C∩¬B)

or

B and

A C ¬B

2.DNNF B∪(A∩C)

or

B and

A C

3.d-NNF ((A∩¬B)∪B)∩(C∪(B∩¬C))

and

or or

and B C and

A ¬B B ¬C

4.sd-DNNF (A∩B∩C)∪(A∩B∩¬C)∪(¬A∩B∩C)∪(¬A∩B∩¬C)∪(A∩¬B∩C)

or

and and and and and

A B C A B ¬C ¬A B C ¬A B ¬C A ¬B C