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Question 1

Sally will write if and only if she wants to publish it:	t ↔ q	≡ (¬ t v q) ^ (¬ q v t)
If it is Tuesday, Sally wants to rest.	a → s	≡ ¬ a v s
If Sally is reading, she either wants to rest or publish:	p → (s v q)	≡ ¬ p v s v q
If Sally is not reading, then it is not Tuesday.	¬ p → ¬ a	≡ p v ¬ a
Sally is reading.	p	

(¬ t v q) ^ (¬ q v t) ^ (¬ a v s) ^ (¬ p v s v q) ^ (p v ¬ a) ^ (p)

The numbers in the first row of the truth table indicate the order of computation. The green column indicates the final outcome.

					1	3=1^2	2	5=3^4	4	7=5^6	6	9=7^8	8	9^10	10
a	p	q	s	t	(¬ t v q)	^	(¬ q v t)	^	(¬ a v s)	^	(¬ p v s v q)	^	(p v ¬ a)	^	(p)
0	0	0	0	0	1	1	1	1	1	1	1	1	1	0	0
0	0	0	0	1	0	0	1	0	1	0	1	0	1	0	0
0	0	0	1	0	1	1	1	1	1	1	1	1	1	0	0
0	0	0	1	1	0	0	1	0	1	0	1	0	1	0	0
0	0	1	0	0	1	0	0	0	1	0	1	0	1	0	0
0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0
0	0	1	1	0	1	0	0	0	1	0	1	0	1	0	0
0	0	1	1	1	1	1	1	1	1	1	1	1	1	0	0
0	1	0	0	0	1	1	1	1	1	0	0	0	1	0	1
0	1	0	0	1	0	0	1	0	1	0	0	0	1	0	1
0	1	0	1	0	1	1	1	1	1	1	1	1	1	1	1
0	1	0	1	1	0	0	1	0	1	0	1	0	1	0	1
0	1	1	0	0	1	0	0	0	1	0	1	0	1	0	1
0	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1
0	1	1	1	0	1	0	0	0	1	0	1	0	1	0	1
0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	0	0	0	0	1	1	1	0	0	0	1	0	0	0	0
1	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0
1	0	0	1	0	1	1	1	1	1	1	1	0	0	0	0
1	0	0	1	1	0	0	1	0	1	0	1	0	0	0	0
1	0	1	0	0	1	0	0	0	0	0	1	0	0	0	0
1	0	1	0	1	1	1	1	0	0	0	1	0	0	0	0
1	0	1	1	0	1	0	0	0	1	0	1	0	0	0	0
1	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0
1	1	0	0	0	1	1	1	0	0	0	0	0	1	0	1
1	1	0	0	1	0	0	1	0	0	0	0	0	1	0	1
1	1	0	1	0	1	1	1	1	1	1	1	1	1	1	1
1	1	0	1	1	0	0	1	0	1	0	1	0	1	0	1
1	1	1	0	0	1	0	0	0	0	0	1	0	1	0	1
1	1	1	0	1	1	1	1	0	0	0	1	0	1	0	1
1	1	1	1	0	1	0	0	0	1	0	1	0	1	0	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Based on the results of the final outcome the statements provided are not a tautology but also do not provide a contradiction. So any line for which 1 in the green column can be deemed a satisfactory model.

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Question 2

1. Michelle, Sheryl and Berne are the members of WiCS.

$$\text{WiCS(Michelle), WiCS(Sheryl), WiCS(Berne)}$$

2. Each member of WiCS is either a Physics major, CS major or both.

$$\forall x\ \text{WiCS}(x) \Rightarrow ((\text{Phy}(x) \wedge \neg\text{Com}(x)) \vee (\neg\text{Phy}(x) \wedge \text{Com}(x)) \vee (\text{Phy}(x) \wedge \text{Com}(x)))$$

$$\forall x\ \text{WiCS}(x) \Rightarrow (\text{Phy}(x) \vee \text{Com}(x)$$

3. None of the CS majors study Mechanics and all the Physics majors take Scientific computing.

$$\neg\exists x\ (\text{Com}(x) \wedge \text{enroll}(x, \text{Mechanics})) \wedge \forall x\ \text{Phy}(x) \Rightarrow \text{enroll}(x, \text{Scientific Computing})$$

4. Michelle is enrolled in courses that Sheryl is not, and is not in the courses that Sheryl is enrolled in.

$$\forall y\ \text{enroll}(\text{Sheryl}, y) \Rightarrow \neg\text{enroll}(\text{Michelle}, y) \wedge \neg\text{enroll}(\text{Sheryl}, y) \Rightarrow \text{enroll}(\text{Michelle}, y)$$

5. Sheryl is not enrolled in Mechanics and Scientific Computing.

$$\neg\text{enroll}(\text{Sheryl}, \text{Mechanics}) \wedge \neg\text{enroll}(\text{Sheryl}, \text{Scientific Computing})$$

6. There is a WiCS member, who is a CS major but not a Physics major

$$\exists x\ \text{WiCS}(x) \wedge \text{Com}(x) \wedge \neg\text{Phy}(x)$$

First to convert to CNF:

WiCS(Michelle), WiCS(Sheryl), WiCS(Berne)

$\forall x\ \neg\text{WiCS}(x) \vee \text{Phy}(x) \vee \text{Com}(x)$

$\forall x\ (\neg\text{Com}(x) \vee \neg\text{enroll}(x, \text{Mechanics})) \wedge (\neg\text{Phy}(x) \vee \text{enroll}(x, \text{Scientific Computing}))$

$\forall y\ (\neg\text{enroll}(\text{Sheryl}, y) \vee \neg\text{enroll}(\text{Michelle}, y)) \wedge (\text{enroll}(\text{Sheryl}, y) \vee \text{enroll}(\text{Michelle}, y))$

$\neg\text{enroll}(\text{Sheryl}, \text{Mechanics}) \wedge \neg\text{enroll}(\text{Sheryl}, \text{Scientific Computing})$

Finally negate the target statement

$\forall x\ \neg\text{WiCS}(x) \vee \neg\text{Com}(x) \vee \text{Phy}(x)$

Dropping the Universal quantifiers

1. WiCS(Michelle)
2. WiCS(Sheryl)
3. WiCS(Berne)
4. $\neg\text{WiCS}(i) \vee \text{Phy}(i) \vee \text{Com}(i)$
5. $\neg\text{Com}(j) \vee \neg\text{enroll}(j, \text{Mechanics})$
6. $\neg\text{Phy}(k) \vee \text{enroll}(k, \text{Scientific Computing})$
7. $\neg\text{enroll}(\text{Sheryl}, m) \vee \neg\text{enroll}(\text{Michelle}, m)$
8. $\neg\text{enroll}(\text{Michelle}, n) \vee \neg\text{enroll}(\text{Sheryl}, n)$
9. $\neg\text{enroll}(\text{Sheryl}, \text{Mechanics})$
10. $\neg\text{enroll}(\text{Sheryl}, \text{Scientific Computing})$
11. $\neg\text{WiCS}(x) \vee \neg\text{Com}(x) \vee \text{Phy}(x)$ *** Negated Target statement**

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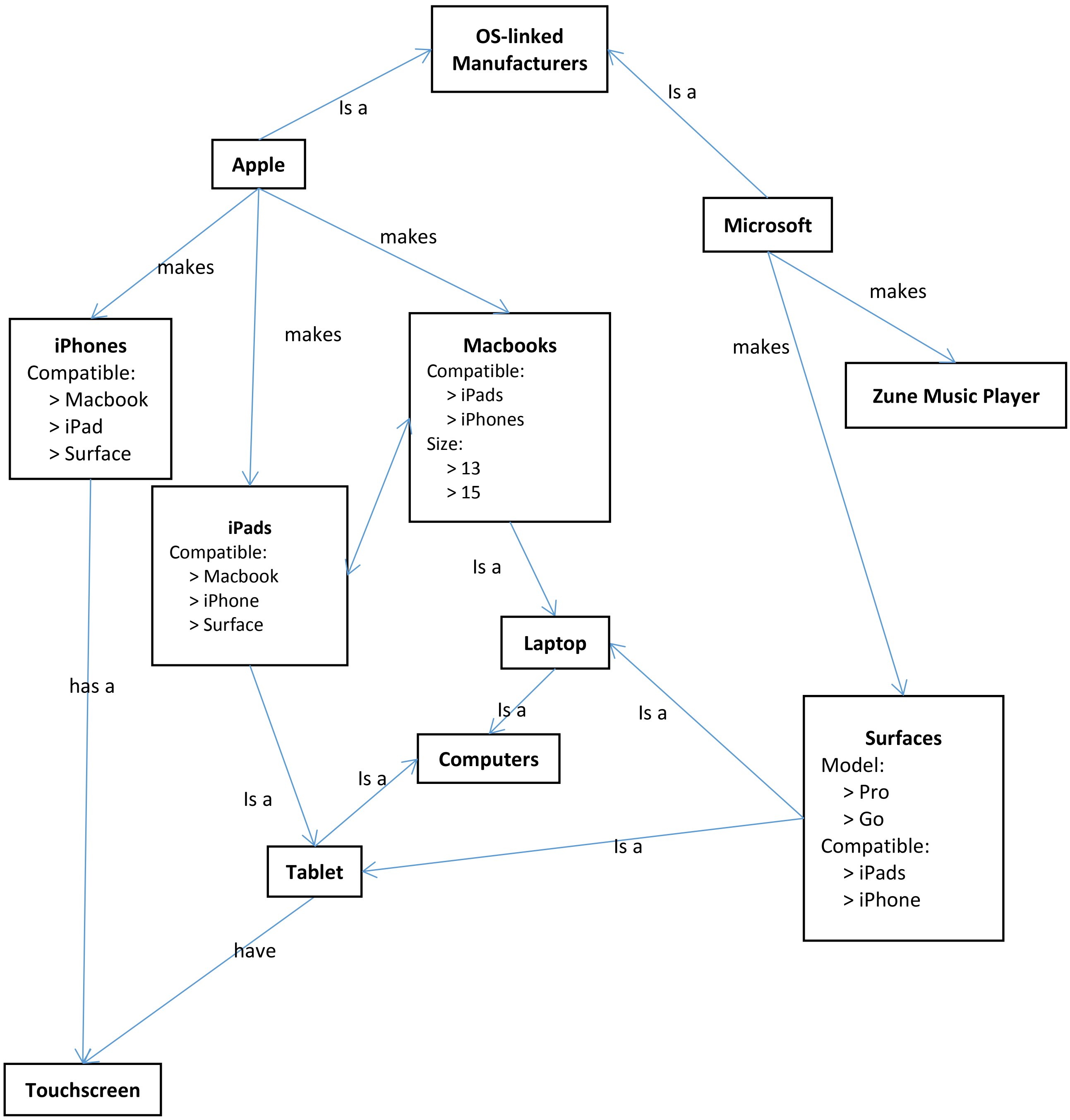
Question 3

The frame representation is shown below and the code is located in q3.pl file with instruction on usage of the code along with examples in the file README.



Question 4

1. c ([a , [a] , b] ,X).
   X = 2.
2. Step-by-Step:

Subgoal List	Matched Clause	Substitutions
c([a, [a], b], X)	1	{a/H, [[a], b]/T}
c(a, N1), c([[a], b], M1), X is N1 + M1	2	{1/N1}
c(a, N2), c([], M2), X1 is N2 + M2	2	{1/N2}
c(a, N2), **c([], M2)**, X1 is N2 + M2	3	{0/M2}
c(a, N2), c([], M2), **X1 is N2 + M2**	1	{1/X1}
c([a], N3), c(b, M3), X2 is N3 + M3	1	{1/N3}
c(b, N4), c([], M4), X3 is N4 + M4	3	{0/N4}
c(b, N4), **c([], M4)**, X3 is N4 + M4	3	{0/M4}
c(b, N4), c([], M4), **X3 is N4 + M4**	1	{1/X3}
c([a], N3), **c(b, M3)**, X2 is N3 + M3	1	{0/M3}
c([a], N3), c(b, M3), **X2 is N3 + M3**	1	{1/X2}
c(a, N1), **c([[a], b], M1)**, X is N1 + M1	2	{1/M1}
c(a, N1), c([[a], b], M1), **X is N1 + M1**	2	{2/X}

3. Removing the cut term makes no difference in this case is because of what the cut term does; it always succeeds and prevents any backtracking. But in this case this is the bottom of the ‘recursion’ so there will be no backtracking for this clause hence the answer does not change.
4. If the cut from first line is removed then there will be multiple results:

c ([a , [a] , b] ,X).
X = 2
X = 2
X = 1
X = 1
X = 1
X = 0

This happens because even after c(H, N), c(T, M), X is N+M succeed in finding bindings due to backtracking. After the first bindings have been processed, because queries ‘c([b],M).’, ‘c([[a],b],M).’ can be satisfied by ‘c(_,0)’ clause multiple values for X are returned.

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Question 5

The program is provided in the file q5.pl and the use instructions are provided in the README file.

Question 6

The program is provided in the file q6.pl and the use instructions are provided in the README file.