02156 - Logical Systems and Logic Programming
Fall 2021

DTU - Technical University of Denmark

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Assignment 1

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Problem 1

Question 1.1

Truth table is constructed using semantics written in the assignment description.

A	B	$\neg A$	$A \wedge B$	$A \vee B$	$A \rightarrow B$	$A \leftrightarrow B$
T	T	F	T	T	T	T
T	F	F	F	T	F	F
T	X	F	X	T	X	X
F	T	T	F	T	T	F
F	F	T	F	F	T	T
F	X	T	F	X	T	¬ X
X	T	¬ X	X	T	T	X
X	F	¬ X	F	X	¬ X	¬ X
X	X	¬ X	X	X	T	T

The lack of semantics for X will make some cases just terminate with $\neg X$. An interesting observation from comparison is that some logical operations disregard or will work just fine without classical truth values. Like implication $X \rightarrow X$ will give True, as with implication it does not matter what value it is operating with.

Question 1.2

When p is T:

$$\neg T \wedge T = F \wedge T = \underline{\underline{F}}$$

When p is F:

$$\neg F \wedge F = T \wedge F = \underline{\underline{F}}$$
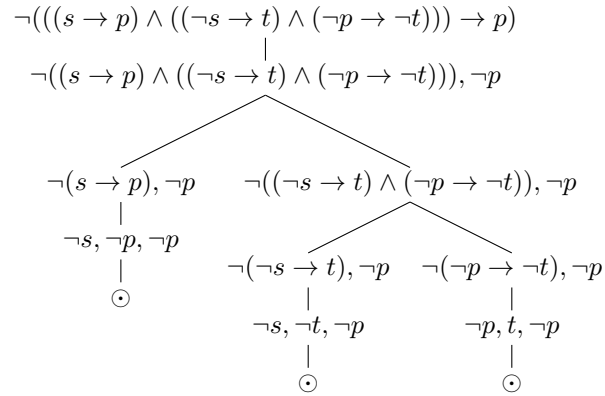
When p is X:

$$\neg X \wedge X = \underline{\underline{F}}$$

As there is no semantics for the negation of X, there is no better evaluation of ¬X. Hence we conclude the X case to be false, as the values is not equal and neither of them is T.

Problem 2

Question 2.1

Refuting the validity of the expression, we negate it and try to find counter example:

$$\neg(((s \to p) \land ((\neg s \to t) \land (\neg p \to \neg t))) \to p)$$
$$|$$
$$\neg((s \to p) \land ((\neg s \to t) \land (\neg p \to \neg t))), \neg p$$

$$\neg(s \to p), \neg p \qquad \neg((\neg s \to t) \land (\neg p \to \neg t)), \neg p$$
$$| $$
$$\neg s, \neg p, \neg p$$
$$| $$
$$\odot \qquad \neg(\neg s \to t), \neg p \qquad \neg(\neg p \to \neg t), \neg p$$
$$| \qquad\qquad\qquad |$$
$$\neg s, \neg t, \neg p \qquad \neg p, t, \neg p$$
$$| \qquad\qquad\qquad |$$
$$\odot \qquad\qquad\qquad \odot$$

From the first right branch, we can see that the expression is not valid. As if s is true, Watch week 4 solutions for inspiration about refutionation blabla

Question 2.2

Brug den logiske regl på udtrykket og se det giver mening:

Question 2.3