Truth Table

p	**q**	**p∨q**	**¬(p∧q)**	**(p∨q)∧¬(p∧q)**
T	T	T	F	F
T	F	T	T	T
F	T	T	T	T
F	F	F	T	F

We want to find the inverse of this **(p∨q)∧¬(p∧q)** which would be finding the inverse of the "exclusive or".

I believe **¬(p∨q)∨(p∧q)** works but I'm wondering if it's the simplest possible case.

Is there a way to go from conjunctions (∧) to disjunctions (∨) using nots (**¬**)?

(p∨q)∧¬(p∧q)	**¬(p∨q)∨(p∧q)**

¬(p∨q)	**p∧q**	**¬(p∨q)∨(p∧q)**
F	T	T
F	F	F
F	F	F
T	F	T

What happens when we bring recursion into this? i.e. we plug entire statements in as p or q recursively. What happens to the truth tables?

$\neg(p \wedge q)$	$p \vee q$	$\neg(p \vee q)$	$p \wedge q$
F	T	F	T
T	T	F	F
T	T	F	F
T	F	T	F

Original	¬ Distributed	∨ -> ∧	Both
$\neg(p \vee q) \vee (p \wedge q)$	$(p \vee q) \vee \neg(p \wedge q)$	$\neg(p \vee q) \wedge (p \wedge q)$	$(p \vee q) \wedge \neg(p \wedge q)$
T	T	F	F
F	T	F	T
F	T	F	T
T	T	F	F

Is it true that if you distribute and alternate between conjunction and disjunction all truth table values will alternate?

So, let's say you have an implication statement $p \rightarrow q$, if p is always false then this statement is true. If you have a contradiction in p, then this statement is always true. This is nonsense, no? Can the two really be connected? What's the use of such a statement?

Apparently yes, these are called Demorgan's laws. Look at it visually.