FIL1006 - oblig 1

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1 Negate statements

(a) The gloves and the hat are black.

- p = the gloves are black
- q = the hat is black
- $\neg(p \wedge q) = \neg p \vee \neg q$
- The gloves are not black, or the hat is not black.

(b) Some exercises are not difficult

- E = exercise that is easy
- $\neg(\exists x.E(x)) = \forall x.\neg E(x)$
- All exercises are difficult.

(c) The postman is either kind or stupid.

- p = postman is kind
- q = postman is stupid
- $\neg(p \oplus q) = (\neg p \wedge \neg q) \vee (p \wedge q)$
- The postman is either both kind and stupid or neither.

(d) She is rarely late.

- She is often late.

2 Are the statements truth-functions

(a) Yes, the statement is a truth-function. It's a truth-function because the consequence value is dependent the antecedent value. In this case, if Trump had lost, then Clinton would have won.

(b) This is not a truth-function because the constituent statements do not depend on each other. The statement is just two facts, she got a job, and that she is satisfied.

3 Formalize the statements

(a) John is helpful if you ask him to do something.

- p = you ask John to do something
- q = John is helpful
- $\underline{p \supset q}$

(b) The government will sign the agreement only if doing so involves a financial benefit.

- p = the agreement is financially beneficial
- q = the government will sign the agreement
- $\underline{p \supset q}$

(c) Peter cannot help the patient, unless either John or Harry relieves him of his desk duty.

- p = John relieves Peter of his desk duty
- q = Harry relieves Peter of his desk duty
- r = Peter can help the patient
- $\underline{(p \vee q) \supset r}$

(d) If John and Peter are neighbours, then Harry and Peter must be neighbours too.

- p = John and Peter are neighbours
- q = Harry and Peter are neighbours
- $\underline{p \supset q}$

4 Explain

p iff q is true if both p and q are either true or false. If you negate one of the operands, then the expression is true if one of them is false and the other true. In other words, you've negated the whole expression. It may seem a little strange, but it's because $p \equiv q$ is actually a compound expression $(p \supset q) \wedge (q \supset p)$ and negating it isn't intuitive (you have to use DeMorgan's Law).

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

5 Truth table

p	q	r	$p \supset (q \vee r)$	$(p \wedge q) \equiv (q \wedge r)$	$((p \vee q) \wedge r) \supset p$
T	T	T	T	T	T
T	T	F	T	F	T
T	F	T	T	T	T
T	F	F	F	T	T
F	T	T	T	F	F
F	T	F	T	T	T
F	F	T	T	T	T
F	F	F	T	T	T