COMP232 - Mathematics for Computer Science

Tutorial 2

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Exercise 5

Use the truth table to verify the distributive law
$p \wedge (q \vee r) \equiv (p \wedge q) \vee (p \wedge r)$.

T	T	T	T	T	T	T	T
T	T	F	T	T	T	F	T
T	F	T	T	T	F	T	T
T	F	F	F	F	F	F	F
F	T	T	T	F	F	F	F
F	T	F	T	F	F	F	F
F	F	T	T	F	F	F	F
F	F	F	F	F	F	F	F

Exercise 6

Use the truth table to verify the first De Morgan law
$\neg(p \wedge q) \equiv \neg p \vee \neg q$.

T	T	T	F	F	F	F
T	F	F	T	F	T	T
F	T	F	T	T	F	T
F	F	F	T	T	T	T

Exercise 8

Use De Morgan's laws to find the negation of each of the following statements.

- a) Kwame will take a job in industry or go to graduate school.
  Kwame will not take a job in industry and will not go to graduate school.
- b) Yoshiko knows Java and calculus.
  Yoshiko doesn't know Java or doesn't know calculus.
- c) James is young and strong.
  James is not young or is not strong
- d) Rita will move to Oregon or Washington
  Rita will not move to Oregon and will not move to Washington

Exercise 9.a

Show that each of these conditional statements is a tautology by using truth table $(p \wedge q) \rightarrow p$.

T	T	T	T
T	F	F	T
F	T	F	T
F	F	F	T

Exercise 9.b

Show that each of these conditional statements is a tautology by using truth table $p \to (p \vee q)$.

T	T	T	T
T	F	T	T
F	T	T	T
F	F	F	T

Exercise 9.c

Show that each of these conditional statements is a tautology by using truth table $\neg p \rightarrow (p \rightarrow q)$.

T	T	T	T
T	F	F	T
F	T	T	T
F	F	T	T

Exercise 9.d

Show that each of these conditional statements is a tautology by using truth table $(p \wedge q) \rightarrow (p \rightarrow q)$.

T	T	T	T
T	F	F	T
F	T	T	T
F	F	T	T

Exercise 9.e

Show that each of these conditional statements is a tautology by using truth table $\neg(p \rightarrow q) \rightarrow p$.

T	T	T	T
T	F	F	T
F	T	T	T
F	F	T	T

Exercise 9.f

Show that each of these conditional statements is a tautology by using truth table $\neg(p \to q) \to \neg q$.

T	T	T	T
T	F	F	T
F	T	T	T
F	F	T	T

Exercise 18

Show that $p \to q$ and $\neg q \to \neg P$ are logically equivalent.

T	T	T	T
T	F	F	F
F	T	T	T
F	F	T	T

Exercise 20

Show that $\neg(p \oplus q)$ and $p \leftrightarrow q$ are logically equivalent.

T	T	T	T
T	F	F	F
F	T	F	F
F	F	T	T

Exercise 26

Show that $\neg p \rightarrow (q \rightarrow r)$ and $q \rightarrow (p \vee r)$ are logically equivalent.

T	T	T	T	T	T	T
T	T	F	F	T	T	T
T	F	T	T	T	T	T
T	F	F	T	T	T	T
F	T	T	T	T	T	T
F	T	F	F	F	F	F
F	F	T	T	T	T	T
F	F	F	T	T	F	T

Exercise 41

Find a compound proposition involving the propositional variables p, q and r that is true when exactly two of p, q and r are true and is false otherwise.
Hint: Form a disjunction of conjunctions.
Hint: Include a conjunction for each combination of values for which the compound proposition is true.
Hint: Each conjunction should include each of three propositional variables or its negations.
Answer:

$$(p \land q \land \neg r) \lor (p \land \neg q \land r) \lor (\neg p \land q \land r)$$