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CS-225: Discrete Structures in CS

Homework 1, Part 2

Exercise Set 2.2 of the Required Textbook- Problem #11, #15, #20(b, c, e, g), #38, #41, #43, #45, #48

Construct truth tables for the statement forms in 5–11.

11. $(p \rightarrow (q \rightarrow r)) \leftrightarrow ((p \wedge q) \rightarrow r)$

p	q	r	q→r	p∧q	p→(q→r)	(p∧q)→r	(p→(q→r))↔((p∧q)→r)
T	T	T	T	T	T	T	T
T	F	F	F	F	F	T	F
T	T	F	F	T	F	F	T
T	F	T	T	F	T	T	T
F	T	T	T	F	T	T	T
F	F	T	T	F	T	T	T
F	T	F	F	F	T	T	T
F	F	F	T	F	T	T	T

p→(q→r)	(p∧q)→r	(p→(q→r))↔((p∧q)→r)
T	T	T
T	F	F
F	T	F
F	F	T

15. Determine whether the following statement forms are logically equivalent:

$p \rightarrow (q \rightarrow r)$ and $(p \rightarrow q) \rightarrow r$

p	q	r	q→r	p→q	p→(q→r)	(p→q)→r
T	T	T	T	T	T	T
T	F	T	T	F	T	T
T	F	F	T	F	T	F
T	T	F	F	T	F	T
F	T	T	T	T	T	T
F	F	T	T	T	T	T
F	T	F	F	T	T	F

F	F	F	T	T	T	F

Conclusion: the statement forms, p → (q → r) and (p → q) → r, *are not logically equivalent based on the non-matching rows of the truth table.*

20. Write negations for each of the following statements. (Assume that all variables represent fixed quantities or entities, as appropriate.)

b. If today is New Year's Eve, then tomorrow is January.

Today is new year's eve and tomorrow is not January.

c. If the decimal expansion of r is terminating, then r is rational.

The decimal expansion of r is terminating and r is not rational.

e. If x is nonnegative, then x is positive or x is 0

X is nonnegative and X is not positive or 0.

g. If n is divisible by 6, then n is divisible by 2 and n is divisible by 3.

N is not divisible by 6, and n is not divisible by 2 or divisible by 3.

38. Ann will go unless it rains.

If it does not rain, then Ann will go.

Rewrite the statements in 40 and 41 in if-then form.

41. Having two 45° angles is a sufficient condition for this triangle to be a right triangle.

If there are two 45° angles then it is a right triangle.

Use the contrapositive to rewrite the statements in 42 and 43 in if-then form in two ways.

43. Doing homework regularly is a necessary condition for Jim to pass the course.

If-then: If Jim does homework regularly then Jim will pass the course

Contrapositive: If Jim does not pass the course then Jim does not do homework regularly.

Note that "a sufficient condition for s is r" means r is a sufficient condition for s and that "a necessary condition for s is r" means r is a necessary condition for s. Rewrite the statements in 44 and 45 in ifthen form.

45. A necessary condition for this computer program to be correct is that it not produce error messages during translation.

If it does not produce error messages during translation, then this computer program is correct.

48. $\sim(p \vee \sim q) \vee (r \vee q)$

a. Distributive

b. Cumulative

c. Negation

d. Identity

Therefore, $(p \wedge \sim q) \vee (p \wedge q) \equiv p$.