Khrystian Clark

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 → (q → r)) ↔ ((p ∧ q) → 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 → (q → r) and (p → q) → 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. ∼(p ∨ ∼ q) ∨ (r ∨ q)

*a. Distributive*

*b. Cumulative*

*c. Negation*

*d. Identity*

Therefore, (p ∧ ∼q) ∨ (p ∧ q) ≡ p.