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CS-225: Discrete Structures in CS

Homework 1, Part 2

Exercise Set 2.1: Problem # 22, 42, 45

Exercise Set 2.2: Problem # 11, 13.b, 15, 20, 38, 41, 43, 45

● HW 1, part 2: Set 2.1 – Q#22

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

$p \wedge (q \vee r)$  and  $(p \wedge q) \vee (p \wedge r)$  always have the same truth value, so they are logically equivalent.

● HW 1, part 2: Set 2.1 – Q#42

p	q	r	$\sim p$	$\sim p \wedge q$	$q \wedge r$	$(\sim p \wedge q) \wedge (q \wedge r)$	$\sim q$	$((\sim p \wedge q) \wedge (q \wedge r)) \wedge \sim q$
T	T	T	F	F	T	F	F	F
T	T	F	F	F	F	F	F	F
T	F	T	F	F	F	F	T	F
T	F	F	F	F	F	F	T	F
F	T	T	T	T	T	T	F	F
F	T	F	T	T	F	F	F	F
F	F	T	T	F	F	F	T	F
F	F	F	T	F	F	F	T	F

The truth values of  $((\sim p \wedge q) \wedge (q \wedge r)) \wedge \sim q$  are all F's, so  $((\sim p \wedge q) \wedge (q \wedge r)) \wedge \sim q$  is a contradiction.

● HW 1, part 2: Set 2.1 – Q#45

Let "p" be the statement "Bob is a double math and computer science major", "q" the statement "Ann is a math major", and "r" the statement "Ann is a double math and computer science major". Then statement a expressed in symbolic notation is " $p \wedge q \wedge \sim r$ ", statement b is " $\sim(p \wedge r) \wedge (q \wedge p)$ ".

Then make a truth table to determine whether these two statements are logically equivalent or not.

p	q	r	$\sim r$	$p \wedge q$	$p \wedge r$	$\sim(p \wedge r)$	$q \wedge p$	$p \wedge q \wedge \sim r$	$\sim(p \wedge r) \wedge (q \wedge p)$
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T	T	T	F	T	T	F	T	F	F
T	T	F	T	T	F	T	T	T	T
T	F	T	F	F	T	F	F	F	F
T	F	F	T	F	F	T	F	F	F
F	T	T	F	F	F	T	F	F	F
F	T	F	T	F	F	T	F	F	F
F	F	T	F	F	F	T	F	F	F
F	F	F	T	F	F	T	F	F	F

$p \wedge q \wedge \sim r$  and  $\sim(p \wedge r) \wedge (q \wedge p)$  always have the same truth value, so they are logically equivalent. So statement a and statement b are logically equivalent.

● HW 1, part 2: Set 2.2 – Q#11

p	q	r	$p \wedge q$	$q \rightarrow r$	$p \rightarrow (q \rightarrow r)$	$(p \wedge q) \rightarrow r$	$p \rightarrow (q \rightarrow r) \leftrightarrow ((p \wedge q) \rightarrow r)$
T	T	T	T	T	T	T	T
T	T	F	T	F	F	F	T
T	F	T	F	T	T	T	T
T	F	F	F	T	T	T	T
F	T	T	F	T	T	T	T
F	T	F	F	F	T	T	T
F	F	T	F	T	T	T	T
F	F	F	F	T	T	T	T

● HW 1, part 2: Set 2.2 – Q#13.b

p	q	$\sim q$	$p \rightarrow q$	$\sim(p \rightarrow q)$	$p \wedge \sim q$
T	T	F	T	F	F
T	F	T	F	T	T
F	T	F	T	F	F
F	F	T	T	F	F

$\sim(p \rightarrow q)$  and  $p \wedge \sim q$  always have the same truth value, so they are logically equivalent.

● HW 1, part 2: Set 2.2 – Q#15

p	q	r	$q \rightarrow r$	$p \rightarrow q$	$p \rightarrow (q \rightarrow r)$	$(p \rightarrow q) \rightarrow r$
T	T	T	T	T	T	T
T	T	F	F	T	F	F
T	F	T	T	F	T	T
T	F	F	T	F	T	T
F	T	T	T	T	T	T
F	T	F	F	T	T	F
F	F	T	T	T	T	T
F	F	F	T	T	T	F

$p \rightarrow (q \rightarrow r)$  and  $(p \rightarrow q) \rightarrow r$  are not logically equivalent because they have different truth values in row 6 and 8 in the truth table.

- HW 1, part 2: Set 2.2 – Q#20

- a. P is a square and P is not a rectangle.
- b. Today is New Year's Eve and tomorrow is not January.
- c. The decimal expansion of  $r$  is terminating and  $r$  is not rational.
- d.  $n$  is prime and  $n$  is not odd and  $n$  is not 2.
- e.  $x$  is nonnegative and  $x$  is not positive and  $x$  is not 0.
- f. Tom is Ann's father and Jim is not her uncle or Sue is not her aunt.
- g.  $n$  is divisible by 6 and  $n$  is not divisible by 2 or  $n$  is not divisible by 3.

- HW 1, part 2: Set 2.2 – Q#38, 41, 43, 45

- 38. If it doesn't rain, then Ann will go.
- 41. If this triangle has two  $45^\circ$  angles, then this triangle is a right triangle.
- 43. If this number is divisible by 9, then this number is divisible by 3.
- 45. If this computer program does not produce error messages during translation, then this computer program is correct.