**CS 225 Assignment 1 - Part 2**
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**11)** ∧ ( ~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 | T | F | F | T | F | F | T |
| T | F | T | T | F | T | T | T |
| T | F | F | T | F | T | T | T |
| F | T | T | T | F | T | T | T |
| F | T | F | T | F | T | T | T |
| F | F | T | T | F | T | T | T |
| F | F | F | T | F | T | T | T |

**13b)** The statements prove logical equivalence. I basically just built the chart and found the truth values for (p -> q) and tested ~(p -> q) against (p -> q) which is just the opposite values of the former. I then tested the (p ∧ ~q) against ~(p -> q). It essentially looks at the truth values of p and ~q and checks to see if both values evaluate to T. If not, then the cell is F because both values need to evaluate to T.

| p | q | ~q | (p -> q) | ~(p -> q) | (p ∧ ~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 |

**15)** Not Logically Equivalent - refer to last two columns to see why.

| p | q | r | (q -> r) | (p -> q) | **p -> (q -> r)** | **(p ->q) -> 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 |

**20a)** p is a square and p is not a rectangle.

**20b)** Today is NYE and tomorrow isn’t January

**20c)** The decimal expansion of r is terminating, and r is not rational.

**20d)** n is prime and n is neither odd nor 2.

**20e)** x is non-negative and x is neither positive nor 0.

**20f)** Tom is Ann’s father, and either Jim is not her Uncle or Sue is not her Aunt.

**20g)** n is divisible by 6 and either n is not divisible by 2 or n is not divisible by 3.

**43)** If Jim wants to pass the course, then he needs to do his homework regularly.

**45)** If this computer program is correct, then it will not produce errors messages during translation.