CS 261

Assignemnt 3

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* 1. Proposition, False
  2. Proposition, False
  3. Proposition, True
  4. Proposition, True
  5. Proposition, False
  6. Not a proposition
  7. If you have the flu, then you miss the final exam.
  8. You pass the course if and only if you make it to the final exam.
  9. If you miss the final exam, then you fail the course.
  10. If you have the flu or you miss the final exam, then you fail the course.
  11. If you make it to the final exam, then you don’t have the flu.

|  |  |  |
| --- | --- | --- |
| p | ¬p | p∧¬p |
| T | F | F |
| F | T | F |

|  |  |  |
| --- | --- | --- |
| p | ¬p | p∨¬p |
| T | F | T |
| F | T | T |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| p | q | ¬q | p∨¬q | (p∨¬q)→q |
| T | T | F | T | T |
| T | F | T | T | F |
| F | T | F | F | T |
| F | F | T | T | F |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| p | q | ¬p | ¬q | p→q | ¬q→¬p | (p→q)↔(¬q→¬p) |
| T | T | F | F | T | T | T |
| T | F | F | T | F | F | T |
| F | T | T | F | T | T | T |
| F | F | T | T | T | T | T |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| p | q | p→q | q→p | (p→q)→(q→p) |
| T | T | T | T | T |
| T | F | F | T | T |
| F | T | T | F | F |
| F | F | T | T | T |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| p | q | p∨q | p⊕q | (p∨q)→(p⊕q) |
| T | T | T | F | F |
| T | F | T | T | T |
| F | T | T | T | T |
| F | F | F | F | T |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| p | q | p∧q | p⊕q | (p⊕q)→(p∧q) |
| T | T | T | F | T |
| T | F | F | T | F |
| F | T | F | T | F |
| F | F | F | F | T |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| p | q | p∧q | p∨q | (p∨q)⊕(p∧q) |
| T | T | T | T | F |
| T | F | F | T | T |
| F | T | F | T | T |
| F | F | F | F | F |

1. To show logical equivalence, must show both directions of the implication. If we know p→q and q→r, then p→r from hypothetical syllogism. Conversely, if r→q and q→p, then r→q. Because p↔q and q↔r, p↔r.
   1. p→(q∨r)
   2. (q∨r)→p
   3. non-CS students are not smart or not happy
   4. If you are not good at math and not good at programming, you do not get into CS.
   5. Yes

|  |  |  |  |
| --- | --- | --- | --- |
| p | q | p∧q | (p∧q)→p |
| T | T | T | T |
| T | F | F | T |
| F | T | F | T |
| F | F | F | T |

* 1. Yes

|  |  |  |  |
| --- | --- | --- | --- |
| p | q | p∨q | p→(p∨q) |
| T | T | T | T |
| T | F | T | T |
| F | T | T | T |
| F | F | F | T |

* 1. Yes

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| p | q | ¬p | p→q | ¬p→(p→q) |
| T | T | F | T | T |
| T | F | F | F | T |
| F | T | T | T | T |
| F | F | T | T | T |

* 1. Yes

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| p | q | p∧q | p→q | (p∧q)→(p→q) |
| T | T | T | T | T |
| T | F | F | F | T |
| F | T | F | T | T |
| F | F | F | T | T |

* 1. Yes

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| p | q | p→q | ¬(p→q) | ¬(p→q)→p |
| T | T | T | F | T |
| T | F | F | T | T |
| F | T | T | F | T |
| F | F | T | F | T |

* 1. Yes

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| p | q | ¬q | p→q | ¬(p→q) | ¬(p→q)→¬q |
| T | T | F | T | F | T |
| T | F | T | F | T | T |
| F | T | F | T | F | T |
| F | F | T | T | F | T |

* 1. P(orange) = True
  2. P(lemon) = False
  3. P(true) = False
  4. P(false) = True
  5. ∃x (P(x)∧Q(x))

P(x) = x has lived in florida

Q(x) = x is in discrete math

* 1. ∃x (P(x)∧Q(x))

P(x) = x got a perfect grade

Q(x) = x is in discrete math

* 1. ∀x (P(x)→Q(x))

P(x) = x is in our class

Q(x) = loves discrete math

* 1. ∃x (P(x)∧Q(x))

P(x) = x has been to every state

Q(x) = x is in discrete math

* 1. ∃x,y (P(x)∧Q(x,y))

P(x) = x is in discrete math

Q(x,y) = x has been to every city in state y

* 1. ∀x (P(x)→Q(x))

P(x) = x is in our class

Q(x) = x has been to at least one state in the country

1. For the statement ∃x (P(x)∧Q(x)), this implies that there exists an x, such that both P and Q are true. Note that this x is the same for both P and Q. The statement (∃xP(x))∧(∃xQ(x)) implies that there is an x such that P and Q are true, however this does not have to be the same x.
   1. Addition
   2. Simplification
   3. Modus Ponens
   4. Modus Tollens
   5. Hypothetical Syllogism
   6. Simplification
   7. Disjunctive Syllogism
   8. Modus Ponens
   9. Addition
   10. Hypothetical Syllogism

p = “it rains”

q = “it is foggy”

r = “sailing race is held”

s = “lifesaving demonstration will go on”

t = “trophy was awarded”

|  |  |
| --- | --- |
| 1. (¬p∨¬q)→(r∧s) |  |
| 2. r→t |  |
| 3. ¬t |  |
| 4. (¬p∨¬q)→r | simplification of 1 |
| 5. (¬p∨¬q)→t | hypothetical syllogism of 4 & 2 |
| 6. ¬(¬p∨¬q) | modus Tollens of 3 & 5 |
| 7. p∧q | equivalent of 6 |
| 8. p | simplification of 7 |

P(x) = “x is a man”

Q(x) = “x is an island”

¬∃x (P(x)→Q(x))

∀x ¬(P(x)→Q(x))

∀x (P(x)∧¬Q(x))

P(Manhattan)∧¬Q(Manhattan)

Q(Manhattan)

therefore ¬P(Manhattan)

Modus Tollens

* 1. correct, this uses universal instantiation and modus ponens
  2. incorrect, the implication cannot be reversed
  3. incorrect, this is not modus ponens
  4. correct, modus Tollens
  5. incorrect, this is not an if and only if statement, so you cannot conclude the reverse implication
  6. correct, modus Tollens
  7. incorrect, wrong form of modus Tollens since it is using the negation of p instead of q.

P(x) = “x is a baby”

Q(x) = “x is logical”

R(x) = “x is despised”

T(x) = “x can manage a crocodile”

|  |  |
| --- | --- |
| 1. P(x)→¬Q(x) |  |
| 2. T(x)→¬R(x) |  |
| 3. ¬Q(x)→R(x) |  |
| 4. P(x)→R(x) | Hypothetical Syllogism of 1 & 3 |
| 5. R(x)→¬T(x) | Logical equivalence of 2 |
| 6. P(x)→ ¬T(x) | Hypothetical Syllogism of 4 and t |

It is valid