

CMSC 250 - Homework 2 - Summer 2006

Due Fri June 16th at the beginning of your discussion section.

You must write the solutions to the problems single-sided on your own lined paper, with all sheets stapled together, and with all answers written in sequential order or you will lose points. Please write your solutions in pencil.

1. Give in complete English sentences the negations of the following statements. Apply DeMorgan's Law so that the statements only have the smallest possible unit negated.
 - (a) Neither liberals nor conservatives are allowed here.
 - (b) Both poodles and dobermans make good pets.
 - (c) Either it doesn't fly or it is a bird.
 - (d) Either it is not a bird, it is a penguin or it flies
2. For each of the following statements, state "inverse," "converse," "contrapositive," or "none." I may have changed verb tenses to make so that the statements sound right, but tell if the form matches.
 - (a) If the bear is white, it must be a Polar Bear.
Since the bear is not white, it must not be a Polar Bear.
 - (b) You will be accepted only if you wear this hat.
If you wear this hat, then you will be accepted.
 - (c) Don't do that if it rains.
If it rains, do that.
3. Write the complete truth table for each of the following:
 - (a) $(p \rightarrow q) \rightarrow (\sim r \vee p)$.
 - (b) $(a \wedge b) \leftrightarrow (a \vee b)$
4. Use Theorem 1.1.1 and the definition of conditional and biconditional to prove the following:
 - (a) $(p \rightarrow r) \wedge (q \rightarrow r)$ and $(p \vee q) \rightarrow r$ are logically equivalent.
 - (b) $(p \vee q) \wedge (\sim p \vee r) \rightarrow (q \vee r)$ is a tautology.
5. For each of the following state the one single rule from Theorem 1.1.1 (page 14) or Table 1.3.1 (Page 39) that could be used to go directly from the statement(s) to the conclusion, or "none" if there is no one single rule. (note: the answer is "none" even if a series of rules can be applied)
 - (a) statement: $(p \vee q) \rightarrow r$ / $p \vee q$ / with conclusion: r .
 - (b) statements: $(p \vee q) \rightarrow r$ / $\sim r$ / with conclusion: $\sim p$.
 - (c) statements: $(p \wedge q) \rightarrow r$ / $p \wedge q$ / with conclusion: r .
 - (d) statements: $r \rightarrow (p \wedge q)$ / $\sim r$ / with conclusion: $\sim (p \wedge q)$.
 - (e) statements: $(p \wedge q) \rightarrow (r \vee s)$ / $\sim (r \vee s)$ / with conclusion: $\sim (p \wedge q)$.
 - (f) statements: $p \vee (s \wedge x)$ / $\sim p$ / with conclusion: $s \wedge x$.

- (g) statements: $p \vee (s \wedge t) / \sim s /$ with conclusion: p .
 (h) statements: $p \vee (s \vee x) / s \vee x /$ with conclusion: $\sim p$.

6. Use a truth table to determine if the following argument is valid or not. State whether or not it is valid, and give your reasons why it is valid or not.

P1	$p \vee q$
P2	$\sim r \rightarrow q$
P3	$\sim p \rightarrow \sim r$
Therefore	p

7. Use the rules of inference you were given to prove the following:

(a)

P1	$p \vee (q \wedge r)$
P2	$\sim s \rightarrow (\sim q \wedge \sim r)$
P3	$\sim p$
Therefore	$\sim s \rightarrow p$

(b)

P1	$p \vee ((\sim q) \wedge r)$
P2	$\sim (p \wedge s)$
P3	s
Therefore	$\sim (r \rightarrow q)$

(c)

P1	$p \vee q$
P2	$\sim p \vee r$
P3	$\sim r \vee s$
Therefore	$q \vee s$

(d)

P1	$p \wedge (q \vee r)$
P2	$s \rightarrow \sim p$
P3	$\sim q \rightarrow s$
Therefore	q

(e)

P1	$p \rightarrow r$
P2	$q \rightarrow s$
P3	$x \wedge y$
Therefore	$((p \wedge q) \rightarrow (r \wedge s)) \wedge (x \vee m)$

8. Write the following sentences in predicate logic. Use the predicates in parenthesis and the set of people P :

- (a) All judges are lawyers. ($J(x)$, $L(x)$)
 (b) Some lawyers are shysters. ($S(x)$)
 (c) Some judges are old but vigorous. ($O(x)$, $V(x)$)
 (d) Judge Jones is neither old nor vigorous. (j)
 (e) Some lawyers who are politicians are Congressmen. ($P(x)$, $C(x)$)
 (f) No Congressman is not vigorous.
 (g) Some women are both lawyers and Congressmen. ($W(x)$)
 (h) No woman is both a politician and a housewife. ($H(x)$)
 (i) All woman who are lawyers admire some judge. ($A(x,y)$)
 (j) Some lawyers admire only judges.
 (k) There are both lawyers and shysters who admire Judge Jones.
 (l) Only judges admire judges.
 (m) All judges admire only judges.