1. Proving equivalence

Suppose $P$, $Q$, $R$, and $S$ are statements.

1. Prove that $P \implies (Q \implies (R \implies S))$ is equivalent to $(P \land Q \land R) \implies S$.

2. Prove that $((P \implies Q) \implies R) \implies S$ is equivalent to $(\neg P \land \neg R) \lor (Q \land \neg R) \lor S$.

2. Negation

Negate the following sentences:

1. Every dog has its day, or perhaps its cat.

2. $\forall x \in X, \exists y \in Y, x > y \land y > x$

3. Guarantees

Consider the statement:

$(S1)$ A and B are both guarantees that C is true.

1. Write $(S1)$ symbolically. Use parentheses "(" and ")" to make your answer precise.

2. Choose some appropriate phrases to replace A, B and C. Use these to write $(S1)$ in English. Does this cause you to reconsider your answer to (1)?

3. Suppose $(S1)$ is true and A is false. What, if anything, can be determined about B and C? Briefly justify.