This assignment will be graded anonymously, so please don't list your name, but only your MAC ID.

As noted by the syllabus as well as in class, the scope and content of assignments are set by lectures, instead of any specific textbook. Please beware that different textbooks may use different symbolism or definitions. Lemmon's as a very old textbook, for example, uses soundness and validity differently from the lectures.

Assignments are meant to be challenging! It's okay if you don't know the answers right away. In that case, **first look at your class notes, notes posted in the shared folder, or textbooks**. Try different answers to see if anything works. You are encouraged to discuss your answers with other students (but write up your own answers individually).

1. (1 point) Using the three implication laws (Conditional Proof, Disjoining, and Conjunction Premise—we learned the last one in class but only named it in Assignment 7), prove, via top-down derivations, the following five implications. The goal should be reduced in the end to an obvious implication in which the conclusion is one of the premises. You can use substitution-of-equivalents based on simple equivalences laws as we did in class.

(1) $A \to (A \wedge B), B \to C \models A \to C$

(2) $(B \wedge C) \to (A \leftrightarrow D), C \models B \to (A \leftrightarrow D)$

2. (3 points) Translate the following sentences, using predicates, **individual constants**, and connectives. The translation is to be based on the assumption that the sentences are interpreted in a universe consisting of six people: Jack, David, and Harry are American; Claire, Ann, and Edith are Canadian. (Please do **not use quantifiers** yet.)

When you find a sentence ambiguous, give its possible translations and explain their non-equivalence by showing the existence of interpretations under which they get different truth-values.

(1) Everyone is happy.

(2) Every American is happy and every Canadian is happy.

(3) Every American is happy or every Canadian is happy.

(4) Someone is happy.

(5) Some American is happy and some Canadian is happy.

(6) Some American is happy or some Canadian is happy.

(7) Some Canadian is happy and some is not.

(8) Exactly one of Ann, Edith and Claire is happy.

(9) If Jack is not happy, none of the Canadians is.

(10) All Canadians are not happy, but all Americans are.

(11) If Americans are happy so are Canadians.

(12) Every Canadian is liked by some American.

(13) Some American likes every Canadian.

(14) Some Canadian likes herself, and some American does not.

(15) Nobody is happy who does not like himself/herself.

3. (1 point) Translate the following sentences, using predicates, universal or existential quantifier, and connectives.

(1) Some bunnies are fluffy, and all cats are cute.

(2) Every werewolf is afraid of the Moon.

(3) Everyone wants to be happy, but some people want to be rich.

(4) "Some are born great, some achieve greatness, and some have greatness thrust upon them." (Shakespeare, *Twelfth Night*)