Deadline: Nov. 11, 5pm. Please upload your assignment to Moodle by this time, and also bring a paper copy to class on next day. 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, content, and convention of assignments are set by lectures, instead of any specific textbook. Please beware that different textbooks may use different symbolism or definitions.

Assignments are meant to be challenging! You are encouraged to discuss your answers with other students (but write up your own answers individually).

1. Give, for each of the following implication claims, a top-down derivation or a counterexample, using the implication laws we have learned. You can also use substitutions of equivalents. Please label each step (as well as number each step, unless you're using the tree structure).

   (1) $\models A \vee (\neg A \wedge C) \rightarrow (\neg A \rightarrow C)$

   (2) $A \wedge B, B \rightarrow (C \vee \neg D), D \rightarrow \neg C \models C$

   (3) $A \leftrightarrow B, B \vee C, A \rightarrow \neg C \models A \vee (C \wedge \neg B)$

   (4) $A \rightarrow (B \wedge C), (B \vee C) \rightarrow D \models (D \rightarrow A) \rightarrow (B \leftrightarrow C)$

   (5) $(B \wedge C) \rightarrow A, (A \vee B) \rightarrow C \models B \rightarrow A$

2. Using the proof-by-contradiction method, check which of the following implications is valid. Give in each case either a top-down derivation or a counterexample.

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

   (2) $A \vee B, B \rightarrow C, C \rightarrow \neg A \models \bot$

3. Translate the following sentences, using predicates, individual constants and connectives.

   (1) The universe is immense.

   (2) If Alan and Tom are tired, Grace leads the way.

   (3) My computer turns off only if its battery runs out.