Constructive Logic (15-317), Spring 2022
Assignment 1: Say hi to logic!

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Due: Thursday, 27 January, 2022, 23:59

Welcome to 15-317, Spring 2022 edition! In this homework assignment, you will practice some basic principles you'll need for the rest of the course.

We require that you typeset your written solutions. Most students use LaTeX, but other software is acceptable. Please put each task on its own page to speed up grading.

The assignments in this course must be submitted electronically through Gradescope. Each assignment can have both a written and programming assignment. Weeks with both will split the assingment in two on Gradescope.

Links to the course's Gradescope can be found on Piazza. For this homework, submit two files: `hw1.pdf` (your written solutions), and `hw1.deriv` (your natural deduction proofs).

One and one is one

Write derivations using Dcheck for the following four judgements, using the `ND` system. Your solutions should go in `hw1.deriv`, and will be automatically graded when you submit to Gradescope. Examples of how to write derivations for Dcheck can be found on the course website, under Software.

Task 1 (2 points).
$$(A \supset (B \supset A)) \; true$$

Task 2 (2 points).
$$((A \wedge B) \supset C) \supset (A \supset (B \supset C)) \; true$$

Task 3 (3 points).
$$(A \wedge ((A \wedge A) \supset B)) \supset B \; true$$

Task 4 (3 points).
$$(A \wedge (A \supset B)) \supset (B \wedge B) \; true$$

Some practice with disjunction

Write derivations using Dcheck for the following two judgements, using the `ND` system. Your solutions should go in `hw1.deriv`, and will be automatically graded when you submit to Gradescope. Examples of how to write derivations for Dcheck can be found on the course website, under Software.

Task 5 (3 points).
$$(A \vee B) \supset (B \vee A) \; true$$

Task 6 (3 points).
$$((A \vee B) \wedge (A \supset B)) \supset B \; true$$

Proof Problems

In this section, you will look at some example derivations, each of which may be correct or may have one or more errors. For each task, write whether the derivation is correct or not. If it is not correct, write at least one problem with it.

Task 7 (3 points).

$$\cfrac{\cfrac{\overline{B \; true}}{A \vee B \; true} \vee I_2 \quad \cfrac{\cfrac{\overline{A \; true}^{\,u}}{B \supset A \; true} \supset I^x}{(B \supset A) \vee (A \supset B) \; true} \vee I_1 \quad \cfrac{\cfrac{\overline{B \; true}^{\,v}}{A \supset B \; true} \supset I^y}{(B \supset A) \vee (A \supset B) \; true} \vee I_2}{(B \supset A) \vee (A \supset B) \; true} \vee E^{u,v}$$

Task 8 (3 points).

$$\cfrac{\cfrac{}{A \vee B \; true}^{\,u} \quad \cfrac{\cfrac{\overline{A \; true}^{\,v}}{B \supset A \; true} \supset I^x}{(A \supset B) \vee (B \supset A) \; true} \vee I_2 \quad \cfrac{\cfrac{\overline{B \; true}^{\,w}}{A \supset B \; true} \supset I^y}{(A \supset B) \vee (B \supset A) \; true} \vee I_1 \;\; \vee E^{v,w}}{\cfrac{(A \supset B) \vee (B \supset A) \; true}{(A \vee B) \supset ((A \supset B) \vee (B \supset A)) \; true} \supset I^u}$$

Task 9 (3 points).

$$\cfrac{\cfrac{\cfrac{\overline{(A \vee B) \supset C \; true}^{\,u} \quad \cfrac{\overline{B \; true}^{\,b}}{A \vee B \; true} \vee E_2}{C \; true} \supset E}{A \supset C \; true} \supset I^a \quad \cfrac{\cfrac{\overline{(A \vee B) \supset C \; true}^{\,u} \quad \cfrac{\overline{B \; true}^{\,b}}{A \vee B \; true} \vee E_2}{C \; true}}{B \supset C \; true} \supset I^b}{\cfrac{(A \supset C) \wedge (B \supset C) \; true}{((A \vee B) \supset C) \supset ((A \supset C) \wedge (B \supset C)) \; true} \supset I^u} \wedge I$$