Constructive Logic (15-317), Fall 2016
Assignment 0: Say hi to logic!

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Welcome to 15-317, Fall 2016 edition! In this introductory homework assignment, you will practice some basic principles you'll need for the rest of the course. As a special exception to the usual rules, for this homework assignment, you may collaborate with other students in the class on the answers to all of the questions as long as you do your write-up individually.

We STRONGLY SUGGEST that you typeset this homework assignment in LaTeX so that you learn how to typeset your proofs now, while the problems are easier and you are perhaps less busy. You can find the code for this assignment on the course web page; you can use it as a starting point.

This assignment is due at the beginning of class on the above date and it must be submitted electronically at autolab. Submit your homework as a `tar` archive containing two files: `hw0.pdf` (your written solutions) and `hw0.tut` (your Tutch solutions).

One and one is one[1]

If I am hungry, I eat something. I am hungry. What can you conclude?

This is one of the most common rules of inference and we call it *modus ponens*. It can be stated with schema variables as: $(A \wedge (A \supset B)) \supset B$.

Task 1 (1 points)**.** Give a proof of *modus ponens* in constructive logic using the inference rules given in lecture (be sure to name each rule when you use it).

$$(A \wedge (A \supset B)) \supset B$$

What if we change the statement above to: If I am hungry and I am hungry, I eat something. Can you still conclude that I will eat something if I tell you I am hungry?

[1] For the appropriate definition of "and".

In constructive logic, once the truth of a statement is established (i.e., there is a proof of it), than it can be used as many times as we like. Prove the following formulas using the inference rules given in lecture (be sure to name each rule when you use it).

Task 2 (3 points)**.**

$$(A \wedge ((A \wedge A) \supset B)) \supset B$$

Task 3 (3 points)**.**

$$(A \wedge (A \supset B)) \supset (B \wedge B)$$

Task 4 (2 points)**.** For each of the formulas above, find readings of A and B such that you not agree with the resulting statement (e.g. A = the moon is round and B = the moon is made of cheese). Does this mean that the formula is false for this reading? Why or why not?

Say hi to tutch!

In this homework you will be introduced to the proof checker *tutch*. If you were ever wondering whether using that inference rule was quite right or not, wonder no more! Tutch can check the correctness of your natural deduction proofs[2].

In order to use tutch, you have two options:

1. Use it on Andrew machines via the command: `/afs/andrew/course/15/317/bin/tutch <file>`.
2. Installing your own local copy of tutch (see `http://www2.tcs.ifi.lmu.de/~abel/tutch/`).

Task 5 (1 point)**.** Type the following proof in a file named `hw0.tut`, check it with `tutch` and submit it with your written solutions on autolab:

```
proof andComm: A & B => B & A =
begin
  [ A & B;
    A;
    B;
    B & A ];
  A & B => B & A
end;
```

You can also run `tutch -r hw0.req hw0.tut` to compare your solution against the requirements file provided in the autolab handout.

[2]Provided that you type them in the correct syntax.