
Homework 1 — Due: Tuesday, September 6, 2022

I plan issue homework assignments each week, on Tuesday, to be due the next Tuesday (before it becomes Wednesday). I will try to pick a modest list of exercises that pertain to what was covered in the previous week. They will certainly not be exhaustive by any means, nor are they all guaranteed to be extremely simple. Use them as a guide to help you figure out what you might want to study more.

Please submit your work on Brightspace, in PDF format only.

1. There is a nice, open-source checker for Fitch-style formal proofs that has been written by Kevin Klement. I have installed it here. Access this link and play with it until you understand how to it to edit Fitch-style proofs. Then,

   (a) Select TFL (Truth-Functional Logic) syntax, and from the sample exercise set available on the site, choose two of the exercises from "Chapter 15, Exercise C" and two from "Chapter 17, Exercise B", solve and check them using the proof checker, and submit your solutions.

   (b) Select FOL (First-Order Logic) syntax, and from the sample exercise set available on the site, choose two from "Chapter 32, Exercise E" and two from "Chapter 34, Exercise A", solve and check them using the proof checker, and submit your solutions.

2. Prove carefully, using the Principle of Mathematical Induction, that $n^2 + n$ is always even for all natural numbers n. Write your proof as an English paragraph. Also, express your proof as closely as you can using a Fitch-style diagram. Your objective in this should be to show clearly as possible the scopes of assumptions and the manipulation of quantifiers. If necessary, you may appeal to "algebra" in the justification of some steps.

3. The *set difference* of A and B is the set $A-B$ of all elements of A that are *not* elements of B. Making explicit use of the definitions:

   $$A \cap B \equiv \{X.\ X \in A \wedge X \in B\}$$

   $$A - B \equiv \{X \in A.\ X \notin B\}$$

   prove the following:

   $$A - (B \cap C) = (A - B) \cap (A - C).$$

   Write your proof in a structured, Fitch-like style, showing as clearly as possible the uses of introduction and elimination rules for quantifiers.