

Optional Ungraded [No Credit] Activity 1

Proof-Writing

ECE 120 Introduction to Computing

University of Illinois Urbana-Champaign

Fall 2025

Instructions

1. **Take it easy!** This is an optional ungraded [no credit] activity designed to support and engage you throughout your journey in ECE 120.
2. State any assumptions you make.
3. Try to be as complete and precise as possible.
4. Submit your work on Gradescope.

Suggestions

While writing your answers and/or proofs, try to think about the following:

1. What is it that you are given? What is it that you are assuming? What is it that you are trying to prove?
2. How exactly does a step follow from the previous step? Assume nothing is apparent, even algebraic simplifications. Your reasoning should be clear and convincing.
3. If you are using a result from the class then state it clearly before using it. You should identify where exactly you need that result, cast your problem into the setup of the result, and then use it.
4. If you are using a result from outside the class then you should prove it before using it

Questions

1. Prove that $A \equiv B \pmod{m}$ if and only if $A = B + mk$ for some integer k .
2. The two's complement of a binary number is commonly computed by flipping all the bits of the number and then adding 1. Prove mathematically that the same result could be obtained by **subtracting 1 from the number then flipping all bits**.

Example:

- (a) Flipping then adding 1: $5_{10} = 0101_2 \longrightarrow 1010_2 \longrightarrow 1011_2 = -5_{10}$
- (b) Subtracting 1 then flipping: $5_{10} = 0101_2 \longrightarrow 0100_2 \longrightarrow 1011_2 = -5_{10}$