# ECEn/CS 224
# ALU Homework Solutions

## Background

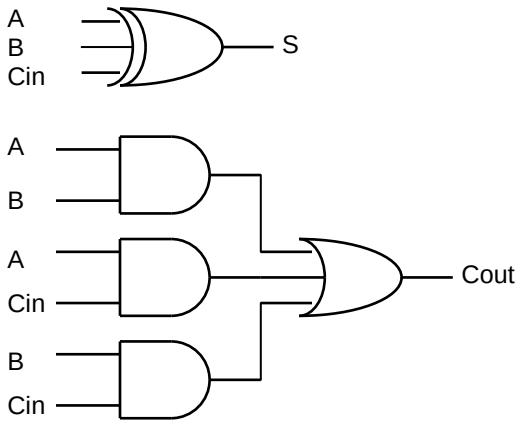
In the LC-3 there is an ALU which performs the functions PASS, ADD, AND, NOT. The last three should be self-explanatory. The PASS function simply passes the first input through to the output. Assuming inputs A and B as well as control signals C1 and C0, the behavior of the ALU is outlined in the table below.

| Control | | Function Select | Function |
|---|---|---|---|
| **C1** | **C0** | | |
| 0 | 0 | PASS | Out = A |
| 0 | 1 | ADD | Out = A + B |
| 1 | 0 | AND | Out = A • B |
| 1 | 1 | NOT | Out = A’ |

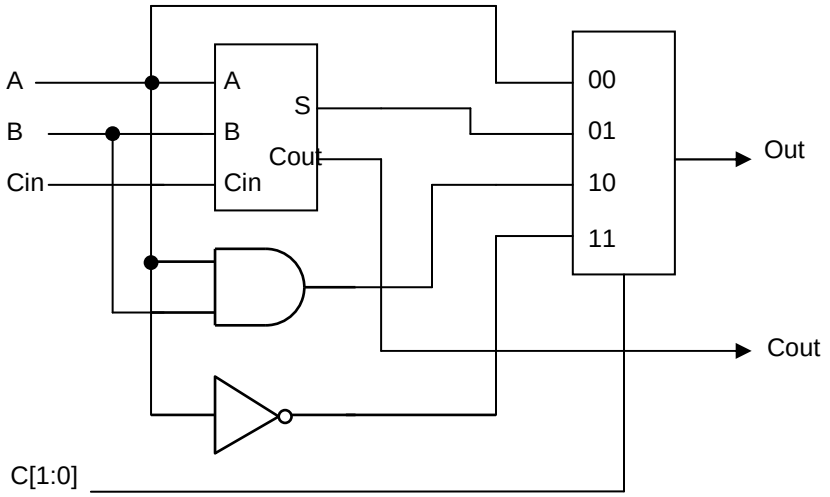
One way to build an ALU is to build a bit-slice. That is, you build one bit worth of ALU first. Then, you combine n of those together to make an ALU that works on n-bit values. Further, a good way to design such an ALU is to simply implement each function independently (AND, ADD, NOT, PASS) and then combine their outputs together using a 4:1 MUX.

## Problems

1. Begin by drawing the schematic of the the full adder as described in section 8.6 of the text.



2. Now incorporate your single bit adder into a single bit ALU. This ALU contains a 4-to-1 mux with inputs of **A**, **A+B** (addition), **A AND B**, and **NOT A**. Draw the Logic Diagram for this single bit ALU. The inputs should include **A**, **B**, **Cin**, and **C[1:0]** (control). The outputs should include **Out** and **Cout**.




3. Now draw a symbol for this 1-bit ALU and show how you would combine 4 of them into a 4-bit ALU.