

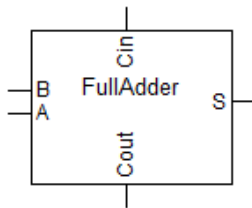
CSC 137 Cokgor Homework 2 (5 points)

In this homework, you will be designing the addition and subtraction circuits for an Arithmetic Logic Unit (ALU) capable of doing arithmetic on signed integers in 2's complement representation.

1) Watch the following video to learn how to create your custom part in LogicWorks:

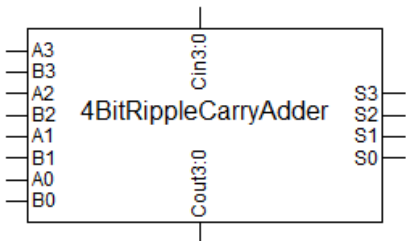
https://youtu.be/rrRfu01_rp4

2) Design the logic circuit for a 1-bit full adder (refer to the lecture notes *Combinational Logic - Large Designs*) and use this circuit to create a full adder building block as a custom part in LogicWorks. Your custom part might look like this.



Test your part to make sure it works as intended, otherwise the rest of your circuit will not work (Make sure you design your own part.)

3) Using this Full Adder component, design a 4-bit ripple carry adder. Refer to the lecture notes, *Combinational Logic - Large Designs*, on how to implement a ripple carry adder. Use your design to make a custom 4-bit-ripple-carry-adder part in LogicWorks. Your part might look like this:



Test your part to make sure it works as intended, otherwise the rest of your circuit will not work (Make sure you design your own part.)

4) Design an Arithmetic Logic Unit with the following properties;

- The ALU will have two functions: 4-bit addition and 4-bit subtraction.
- The function to be performed will be selected by a single control input, F. If F= 0, the ALU will perform Addition, if F=1, the ALU will perform subtraction.
- The ALU will have an *overflow* output. The output will be 1 when the result of the adder overflows. Otherwise, it will be 0.

Remember:

When adding:

- If both operands are positive and output is negative, overflow occurred.
- If both operands are negative and the output is positive, overflow occurred.

When subtracting:

- If the first operand is positive and the second is negative, if the output of the adder unit is negative, overflow occurred.

- If first operand is negative and second operand is positive, if the output of the adder unit is positive, overflow occurred.

Hints:

- 1) Refer to the ALU example in the lecture notes, *Combinational Logic - Large Designs*, to get design ideas.
- 2) There is a 4-bit 2:1 multiplexer part in LogicWorks (its name is Mux-2x4 T.S.). Connect the EN input to the Ground to enable it.

Homework Submission:

Submit your LogicWorks files (.cct) for your

1. full adder,
2. 4-bit full adder, and
3. ALU.