Tyler McKean | Lab 2 - ALU Design | Pre lab objective

design ALU that implements 11 functions

List of functions
- Add
- Subtract
- AND
- Two's Complement
- OR
- XOR
- NOT
- Shift Left
- Shift Right
- Rotate Left
- Rotate Right

- ALU accepts two 4-bit input values
  - one from switches
  - one from pushbuttons
- result output displayed as a single hexadecimal value on 7-segment display

Inputs
- 4-bit input values: Onboard switches
  - A: in STD_LOGIC_VECTOR (3 down to 0)
- 4-bit input values: Onboard pushbuttons
  - B: in STD_LOGIC_VECTOR (3 down to 0)
- 4-bit function value: PMOD 4-switch peripheral module

Output
- Seven-segment display
  - ↳ Hexadecimal result from function operation

Output: OUT STD_LOGIC_VECTOR (3 down to 0)

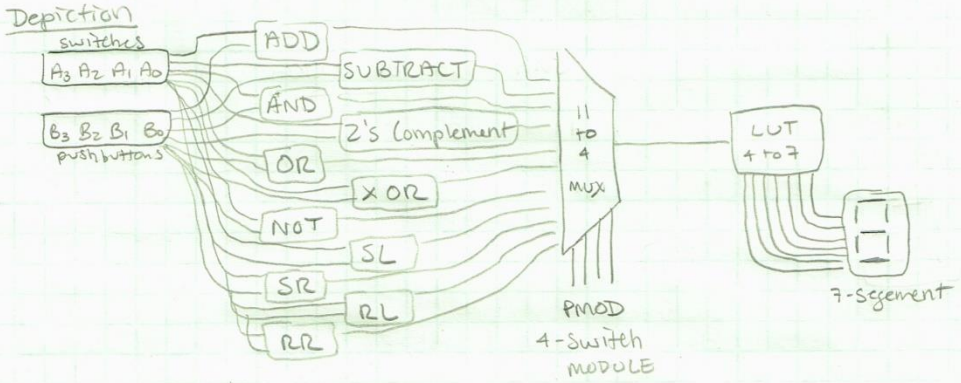
Internal Components

Name	I/O	Functionality
Add	A,B → Output	Bit addition of A and B result goes to output
Subtract	A,B → Output	Bit subtraction of A from B result goes to output
AND	A,B → output	AND operation of A and B result goes to output
2's Complement	A or B → Output	Perform Two's Complement on either A or B, result goes to output
OR	A,B → output	OR operation on A and B result goes to output
XOR	A,B → output	XOR operation on A and B result goes to output
NOT	A or B → output	NOT operation performed on either A or B, result goes to output
Shift left	A → output B is # of shifts	Shift left operation on A to output B determines # of shifts
Shift Right	A → output B is # of shifts	Shift Right operation on A to output B determines # of shifts
Rotate Left	A → output B is # of rotations	Rotate Left operation on A to output B determines # of rotations
Rotate Right	A → output B is # of rotations	Rotate Right operation on A to output B determines # of rotations

Interconnection of components

- Create a structural design that contains all 12 inputs, 1 output, and all 11 function components.
  - ↳ Create if statements or case statements to assign function modules to particular PMOD 4-switch values
    for example, when PMOD => 0001, Add A and B
    when PMOD => 0010, Subtract A from B
    and so on.
- The values of PMOD 4-switches would range from 0001 to 1011 with each binary count assigned to a particular function.

Depiction



Test Plan

- Create 11 testbenches to varify each function works as expected
- Create testbench for ALU structural design to varify design works as a whole
- Could inspect the subset of combinations that result in each Hex value displayed to the 7-segment (truth table provided below)

Questions

- Should a set of inputs, switches or pushbuttons, take priority over another? (In the case of NOT or 2's complement)
- What should be done about carry bits or potential of negative results from some of operations?

	W	X	Y	Z		A	B	C	D	E	F	G
0	0	0	0	0		1	1	1	1	1	1	0
1	0	0	0	1		0	1	1	0	0	0	0
2	0	0	1	0		1	1	0	1	1	0	1
3	0	0	1	1		1	1	1	1	0	0	1
4	0	1	0	0		0	1	1	0	0	1	1
5	0	1	0	1		1	0	1	1	0	1	1
6	0	1	1	0		1	0	1	1	1	1	1
7	0	1	1	1		1	1	1	0	0	0	0
8	1	0	0	0		1	1	1	1	1	1	1
9	1	0	0	1		1	1	1	1	0	1	1
A	1	0	1	0		1	1	1	0	1	1	1
b	1	0	1	1		0	0	1	1	1	1	1
C	1	1	0	0		1	0	0	1	1	1	0
d	1	1	0	1		0	1	1	1	1	0	1
E	1	1	1	0		1	0	0	1	1	1	1
F	1	1	1	1		1	0	0	0	1	1	1