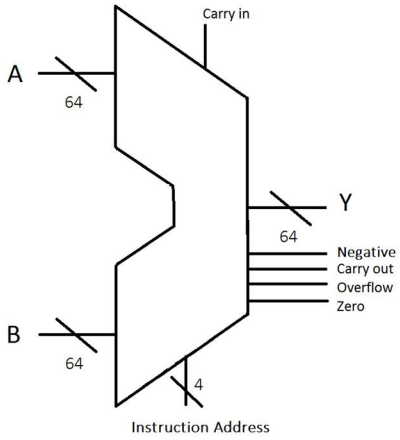
November 7, 2016
Session 2015

Design and implement a 64-bit arithmetic and logic unit (ALU) with a 4-bit address bus using Verilog HDL. The ALU should be able to perform the multiple operations on the two 64-bit input numbers against the instruction addresses shown in the table below. The ALU should accept two 64-bit numbers as its input and output a 64-bit number as the result of operation performed. The ALU should also accept a 'carry in bit' and output a 'carry out bit', an 'overflow bit', a negative bit (a bit that goes high when output goes negative) and a 'zero bit' (a bit that goes high when output is equal to zero).



Sr. No.	Instruction address (Hex)	Operation
1	0x00	Move A to output (O=A)
2	0x01	Move B to output (O=B)
3	0x02	Addition (O=A+B)
4	0x03	Addition with Carry (O=A+B+Cin)
5	0x04	Subtraction (O=A-B)
6	0x05	Subtraction with Carry (O=A-B+Cin)
7	0x06	Reverse Subtraction (O=B-A)
8	0x07	Reverse Subtraction with Carry (O=B-A+Cin)
9	0x08	Compare (A-B: Result is not written on output, only flags are updated)
10	0x09	Bitwise AND (O=A&&B)
11	0x0A	Bitwise OR (O=A||B)
12	0X0B	Bitwise EOR (O=A^B)
13	0X0C	Logical Left Shift through Carry
14	0X0D	Logical Right Shift
15	0X0E	Rotate Left
16	0x0F	Rotate Right

The above table contains some of the basic operations from the instruction set of ARM controller.

Sr. No.	Flag	Logical Instruction	Arithmetic Instruction
1	Negative	No Meaning	Bit-31 of the result has been set. Indicates a negative number in signed operations
2	Zero	Result is all zeroes	Result of operation is zero
3	Carry out	After shift operation '1' was left in carry flag	Result is greater than 32-bits
4	Over Flow	No meaning	Result is greater than 31 bits. Indicates a possible corruption of the sign bit in signed numbers

This table of Flag operations has been taken from the datasheet of an ARM Controller.

Instructions regarding project:

- Make the project using Verilog HDL.
- You are not allowed to use gate level modelling on any level.
- Give the inputs in decimal form in the text fixture file.

Instructions regarding grading:

- Project is to be submitted by each student separately. This is an individual assignment.
- Project carries 10% marks of the lab session (1 credit hour).
- Partially running projects will be accepted as well and graded accordingly.
- Project has to be submitted in the respective lab sessions of the week starting from 14th November to 18th November.
- A one-page, hand-written report containing the algorithm has to be submitted along with the project.
- For any help you can visit me in office hours or discuss in your respective lab sessions.

Digital Systems Laboratory