Computer Design - Supervision 1

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1 ALU Design

ALUs are combinatorial circuits crucial to every processor - they do quite a lot of the work of the processor! Your first task is to design an 8-bit ALU, implementing the following operations:

- Add
- Subtract
- Shift Left - bit shifted in is carry
- Shift Right - bit shifted in is carry
- And
- Or
- Not
- Negate

The ALU should receive two 8-bit inputs, a 3-bit wire encoding the operation and a 1-bit carry flag. It should output an 8-bit output and the flags typically found in modern processors:

- N - Set on Add/Subtract/Negate when result is negative
- Z - Set when the result is zero
- C - Carry flag from Add, Subtract or Shift Left/Shift Right
- V - Overflow flag, when adding two's complement numbers

Start by designing the logic for the adder and subtractor, followed by and, or, not and negate. Then build the rest of the ALU using 8-to-1 multiplexers. Draw the overall design and then implement it in SystemVerilog.

2 Instruction Set Design

Q1 Describe in as much detail as you can the differences between RISC and CISC.

Q2 Describe in detail the following architectures:

- Load-Store
- Stack-Based
- Register-Memory

Q3 Write a function computing the nth fibonacci number. Sketch how it could be compiled to all of the previous three architectures - either use a real implementation, such as ARM or x86, or invent your own instructions.