COMP2611: Computer Organization

Arithmetic Logic Unit

Arithmetic Logic Unit

Review of the 1-bit ALU
- 1-bit ALU
- 1-bit ALU for the MSB
- Overflow detection

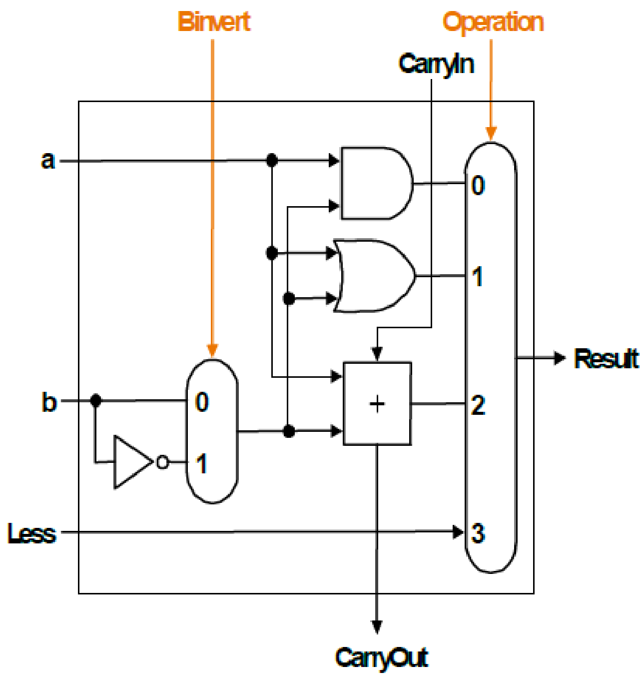
An extended 32-bit ALU
- Ripple carry Add/Sub
- SLT implementation

Exercises

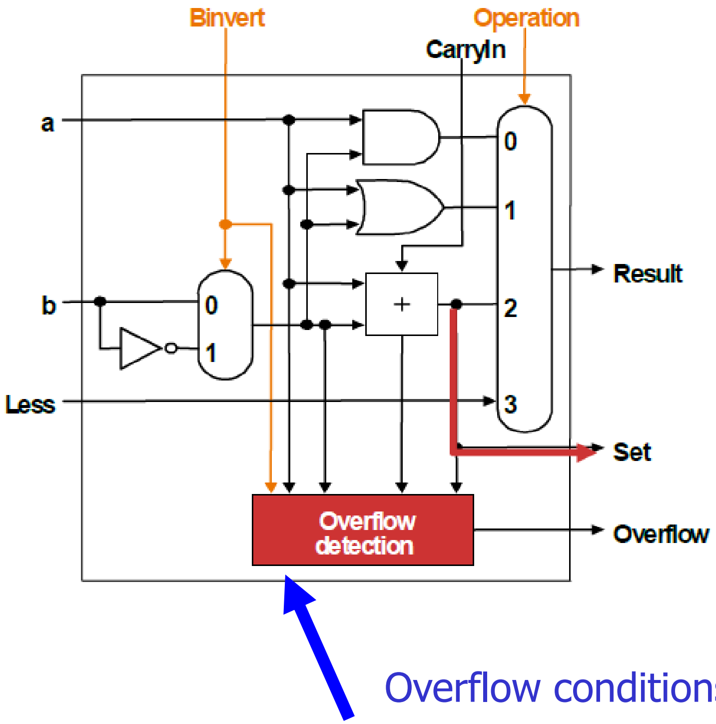
1-bit ALUs

A 32-bit ALU can be constructed using the following 1-bit ALUs

- ❑ 1-bit ALU for bits 0 to 30



- ❑ 1-bit ALU for the Most Significant Bit (MSB):



Overflow conditions

Operation	Sign Bit of X	Sign Bit of Y	Sign Bit of Result
X + Y	0	0	1
X + Y	1	1	0
X – Y	0	1	1
X – Y	1	0	0

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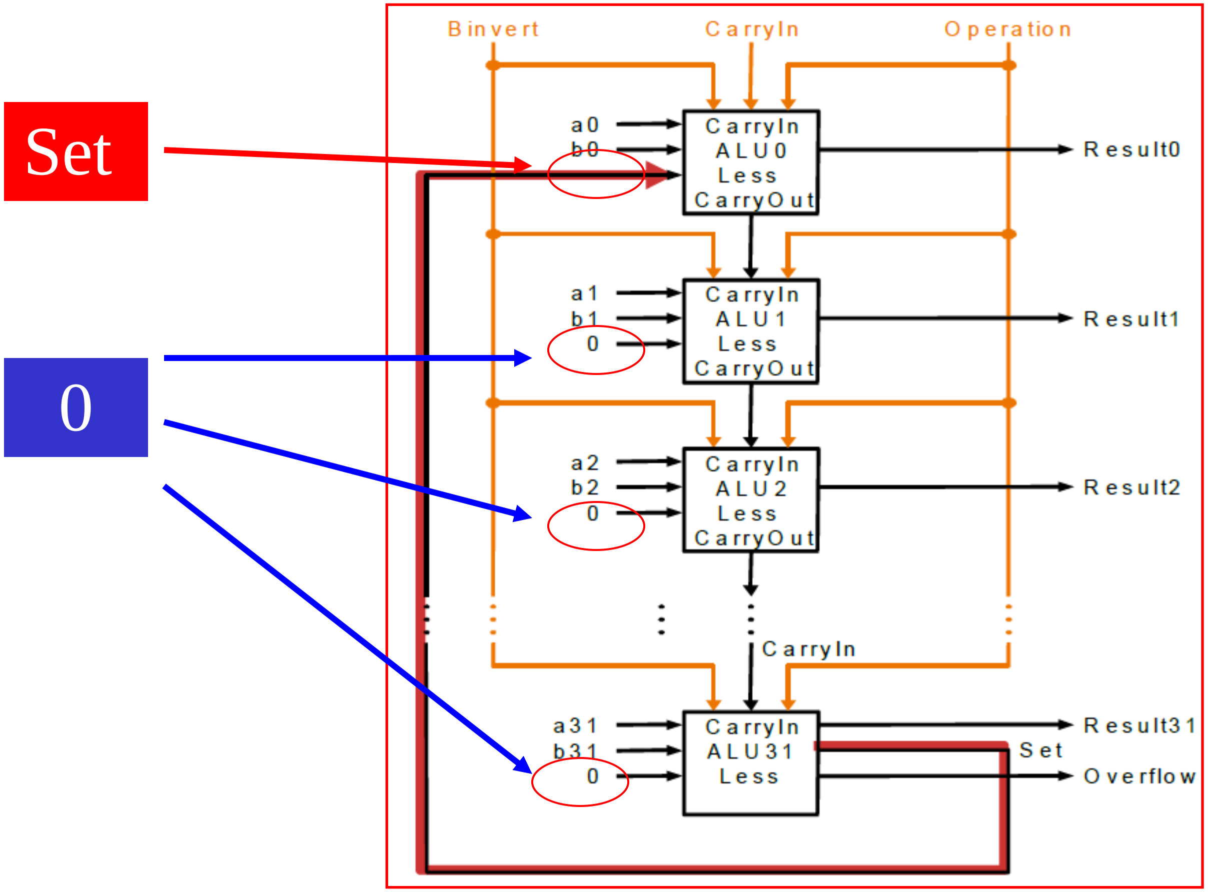
A 32-bit ALU that supports ADD, SUB, AND, OR, SLT

- An extended 32-bit ALU (supports SLT) can be formed by connecting 32 1-bit ALUs as follows. Note the 0's at the "Less" input for ALU1-ALU31, note also the set signal from ALU31 to ALU0.



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Exercises

Question 1: By referring to slides 4 and 5, explain how SLT operation can be performed. State the values for the control signals Binvert, CarryIn and Operation.

Exercises

Question 2: By referring to slides 4 and 5,derive the logic expression in the Sum of Product form (SoP) for overflow conditions.

Question 3: The SLT operation depends on the result of A-B, and set whenever the sign bit of the operation is asserted. Describe a scenario such that this approach does not work correctly.

Question 4: By referring to the modified 32-bit ALU below, explain how the condition A==B is detected. State the values for the control signals Bnegate and Operation.