

Subtraction

Lecture 26

Section C.5

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Fri, Nov 1, 2019

- 1 Binary Subtraction
- 2 Modifying the Ripple Adder
- 3 Assignment

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Binary Subtraction

8-Bit Subtraction

0010 1110	0010 1110
-0100 1001	+1011 0111
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0111 0111	1110 0101

- Replace the “subtrahend” with its two’s-complement and add.

Binary Subtraction

8-Bit Subtraction

	00111 1101
0010 1110	0010 1110
-0100 1001	+1011 0110
-----	-----
0111 0111	1110 0101

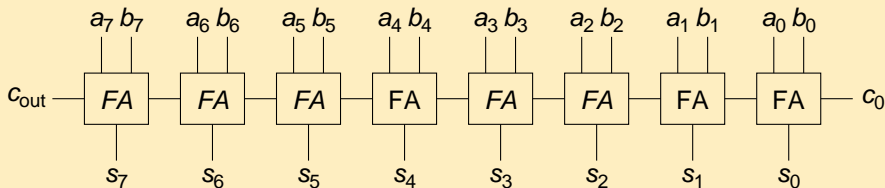
- Or we can “invert” the subtrahend and let the carry-in bit be 1.
- Note:
 - Carry-in bit = 0 for addition.
 - Carry-in bit = 1 for subtraction (with inversion).

Outline

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The Ripple Adder

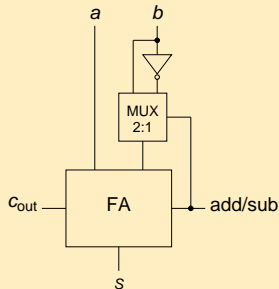
The Ripple Adder



- Recall the ripple adder
- We will modify the ripple adder so that it can both add and subtract.

The Modified Ripple Adder

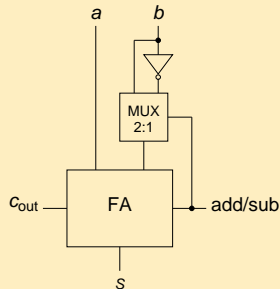
The Modified Ripple Adder



- The carry-in bit (now the add/sub bit) will play two roles.

The Modified Ripple Adder

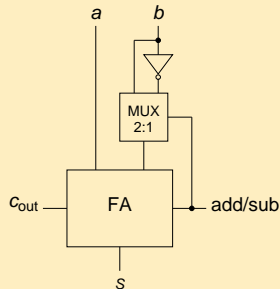
The Modified Ripple Adder



- The carry-in bit (now the add/sub bit) will play two roles.
- We will continue to use it as the carry-in to the addition.

The Modified Ripple Adder

The Modified Ripple Adder



- The carry-in bit (now the add/sub bit) will play two roles.
- We will continue to use it as the carry-in to the addition.
- We will also use it as the select bit to decide whether to invert b .

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A 32-bit Inverter

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- How do we “build” a 1-bit inverter?

A 32-bit Inverter

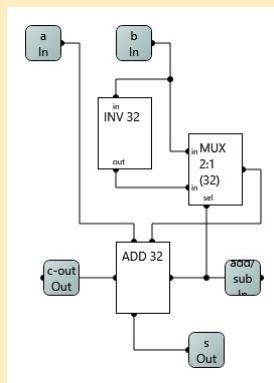
- To invert b , we will start with a 1-bit inverter and build recursively up to a 32-bit inverter.
- How do we “build” a 1-bit inverter?
- Build a 2-bit inverter from two 1-bit inverters.

A 32-bit Inverter

- To invert b , we will start with a 1-bit inverter and build recursively up to a 32-bit inverter.
- How do we “build” a 1-bit inverter?
- Build a 2-bit inverter from two 1-bit inverters.
- Continue up to a 32-bit inverter.

The 32-bit Adder/Subtractor

The 32-bit Adder/Subtractor



- Rather than make each n -bit adder an adder/subtractor, we will use the standard 32-bit adder and combine it with the 32-bit inverter.

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- Read Section C.5.