

Start with the Sign Bits

Let's try a little harder first...

If we compare two non-negative numbers,

- the approach IS the same.
- Right?

Maybe we can just use some extra logic to handle the sign bits?

Consider All Possible Combinations of Sign Bits

Let's make a table based on the sign bits:

A_s	$\mathbf{B}_{\mathbf{s}}$	interpretation	solution
0	0	$A \ge 0 \ AND \ B \ge 0$	use unsigned
			comparator
0	1	$A \ge 0$ AND $B < 0$	A > B
1	0	$\mathbf{A} < 0 \text{ AND } \mathbf{B} \geq 0$	A < B
1	1	A < 0 AND B < 0	unknown

Interpret 2's Complement as Unsigned	Negative Numbers Can be Compared Directly
Remember our "simple" rule for translating 2's complement bit patterns to decimal? The pattern $\mathbf{A} = \mathbf{a}_{N-1}\mathbf{a}_{N-2} \dots \mathbf{a}_1\mathbf{a}_0$ has value $\mathbf{V}_{\mathbf{A}} = -\mathbf{a}_{N-1}2^{N-1} + \mathbf{a}_{N-2}2^{N-2} + \dots + \mathbf{a}_02^0$ Let \mathbf{A} be negative $(\mathbf{a}_{N-1} = 1)$. Interpreted as unsigned , the same bits have value $\mathbf{V}_{\mathbf{A}} + 2^N$.* *The statement is true by definition of 2's complement, actually.	What happens if we feed two negative 2's complement numbers into our unsigned comparator?We compare $V_A + 2^N$ with $V_B + 2^N$.And we get an answer: <, =, or >.Let's say that we find $V_A + 2^N < V_B + 2^N$.In that case, $V_A < V_B$, so we have the right answer for 2's complement.The same result holds for other answers.
ECE 120: Introduction to Computing © 2016 Steven S. Lumetta. All rights reserved. slide 5	ECE 120: Introduction to Computing © 2016 Steven S. Lumetta. All rights reserved. slide 6

We Need Special Logic for the Sign Bits

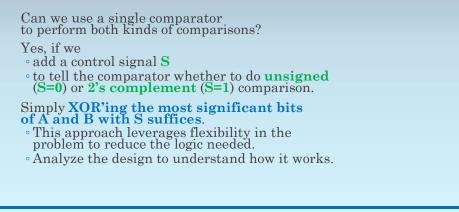
Now we can complete our table:

$\mathbf{A}_{\mathbf{s}}$	$\mathbf{B}_{\mathbf{s}}$	interpretation	solution
0	0	$A \ge 0 AND B \ge 0$	use unsigned
			comparator
0	1	$A \ge 0 AND B < 0$	A > B
1	0	$\mathbf{A} < 0 \text{ AND } \mathbf{B} \geq 0$	A < B
1	1	A < 0 AND B < 0	use unsigned
			comparator

Simply Flip the Wires on the Most Significant Bit

Can we just flip the wires on the sign bits? For $A_s = 0$ and $B_s = 1$, \circ we feed in $A_{N-1} = 1$ and $B_{N-1} = 0$, and \circ the unsigned comparator produces A > B. For $A_s = 1$ and $B_s = 0$, \circ we feed in $A_{N-1} = 0$ and $B_{N-1} = 1$, and \circ the unsigned comparator produces A < B. What about when $A_s = B_s$? Flipping the bits then has no effect! Answers are also correct in those cases.

One Comparator with a Control Signal can Do Both



ECE 120: Introduction to Computing

© 2016 Steven S. Lumetta. All rights reserved.

slide 9