Magnitude Comparator

The comparison of two numbers is an operation that determines whether one number is greater than, less than, or equal to the other number.

A magnitude comparator is a combinational circuit that compares two numbers A and B and determines their relative magnitudes.

The outcome of the comparison is specified by three binary variables that indicate whether A > B, A = B, or A < B.

The circuit for comparing two n-bit numbers has 2^(2n) entries in the truth table and becomes too cumbersome, even with n = 3

A comparator circuit possesses a certain amount of regularity.

Digital functions that possess an inherent well-defined regularity can usually be designed by means of an algorithm—a procedure which specifies a finite set of steps that, if followed, give the solution to a problem

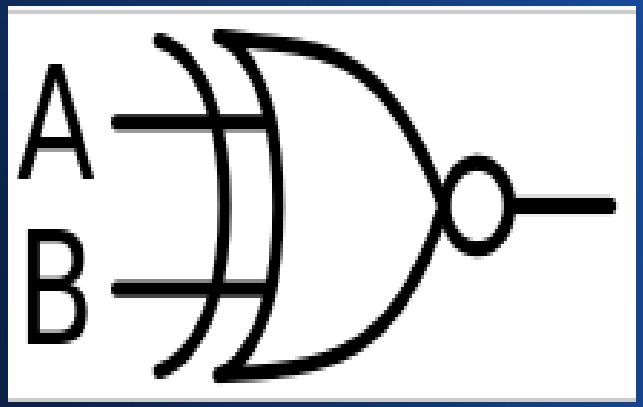
XNOR gate

The XNOR gate (sometimes spelled "exnor" or "enor"and rarely written NXOR) is a digital logic gate whose function is the inverse of the exclusive OR (XOR) gate.

The two-input version implements logical equality

XNOR Truth Table

Input		Output
A	B	
0	0	1
0	1	0
1	0	0
1	1	1



$$A = A_3\ A_2\ A_1\ A_0$$
$$B = B_3\ B_2\ B_1\ B_0$$

The two numbers are equal if all pairs of significant digits are equal: $A_3 = B_3, A_2 = B_2, A_1 = B_1,$ $A_0 = B_0$

When the numbers are binary, the digits are either 1 or 0, and the equality of each pair of bits can be expressed logically with an exclusive-NOR function as

$$x_i = A_i B_i + A_i' B_i' \quad \text{for } i = 0, 1, 2, 3$$

$$(A = B) = x_3 x_2 x_1 x_0$$

$$(A > B) = A_3 B_3' + x_3 A_2 B_2' + x_3 x_2 A_1 B_1' + x_3 x_2 x_1 A_0 B_0'$$

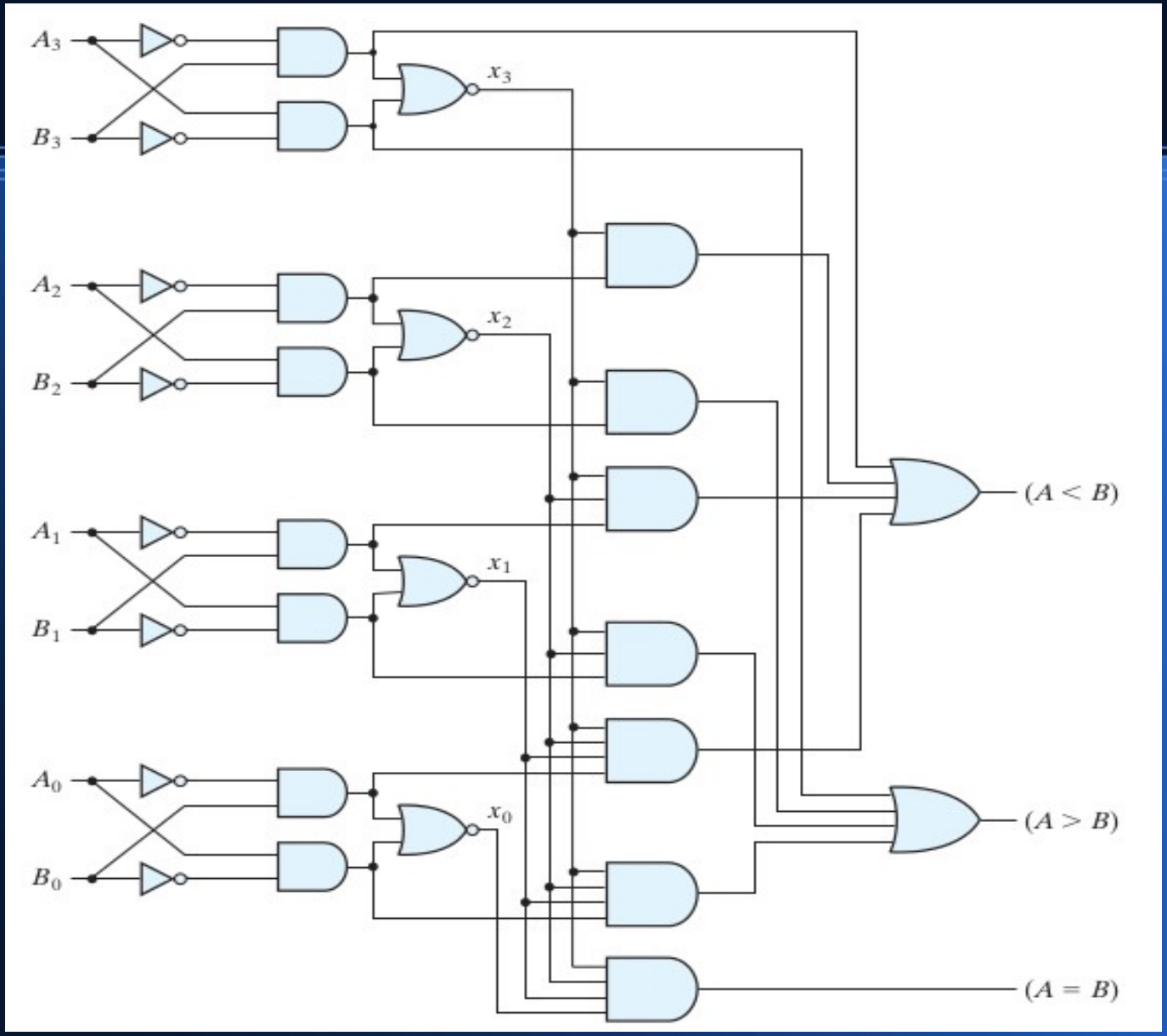
$$(A < B) = A_3' B_3 + x_3 A_2' B_2 + x_3 x_2 A_1' B_1 + x_3 x_2 x_1 A_0' B_0$$

To determine whether A is greater or less than B, we inspect the relative magnitudes of pairs of significant digits, starting from the most significant position.

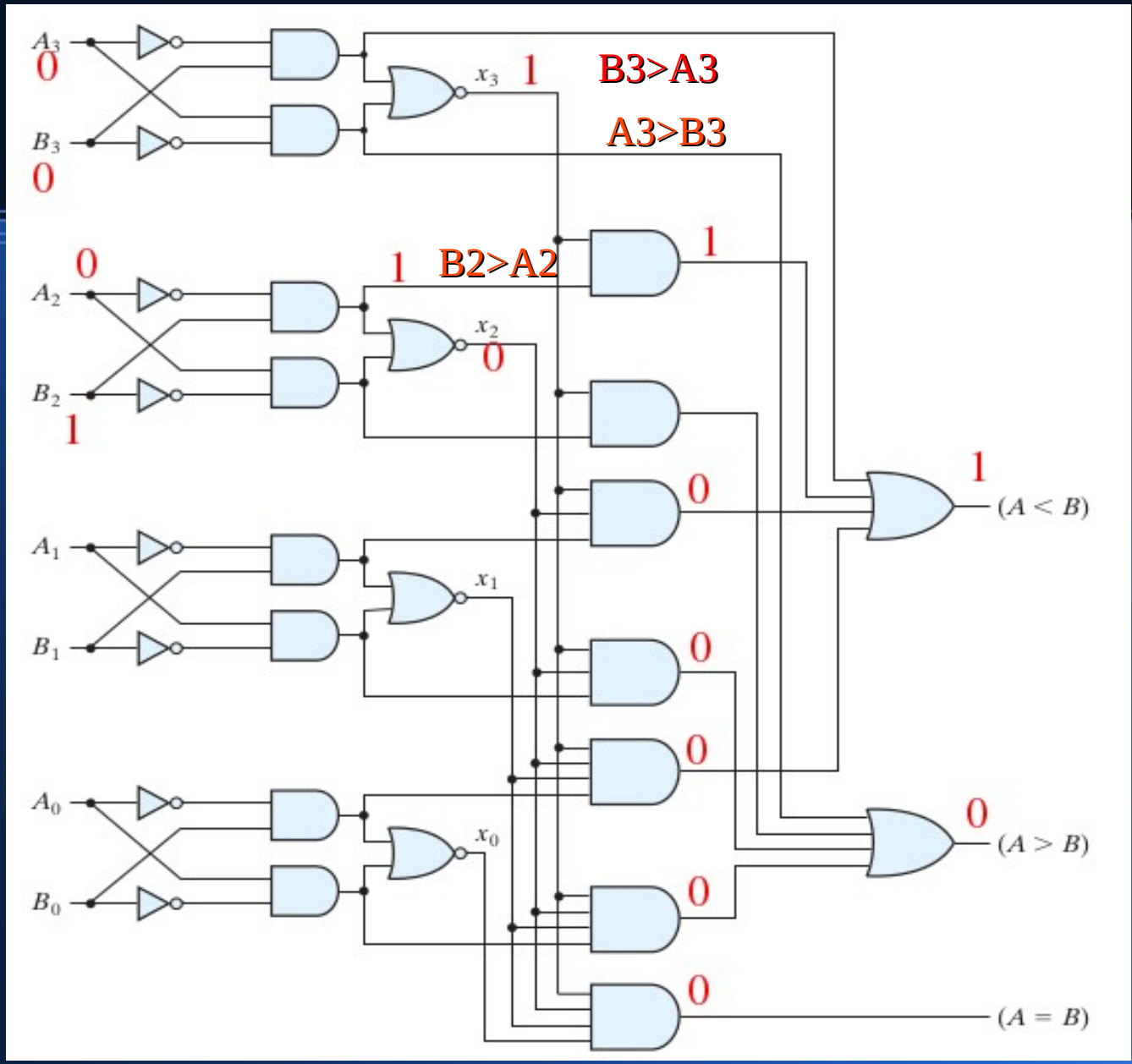
If the two digits of a pair are equal, we compare the next lower significant pair of digits.

The comparison continues until a pair of unequal digits is reached

Four-bit magnitude comparator



A	B
0	0
0	1
x	x
x	x


A_3
0
B_3
0
x_3
1
B3>A3
A3>B3
0
A_2
1
B2>A2
1
B_2
1
x_2
0
A_1
B_1
x_1
A_0
B_0
x_0
1
$(A < B)$
0
$(A > B)$
0
$(A = B)$