- Magnitude Comparator (Comparator)

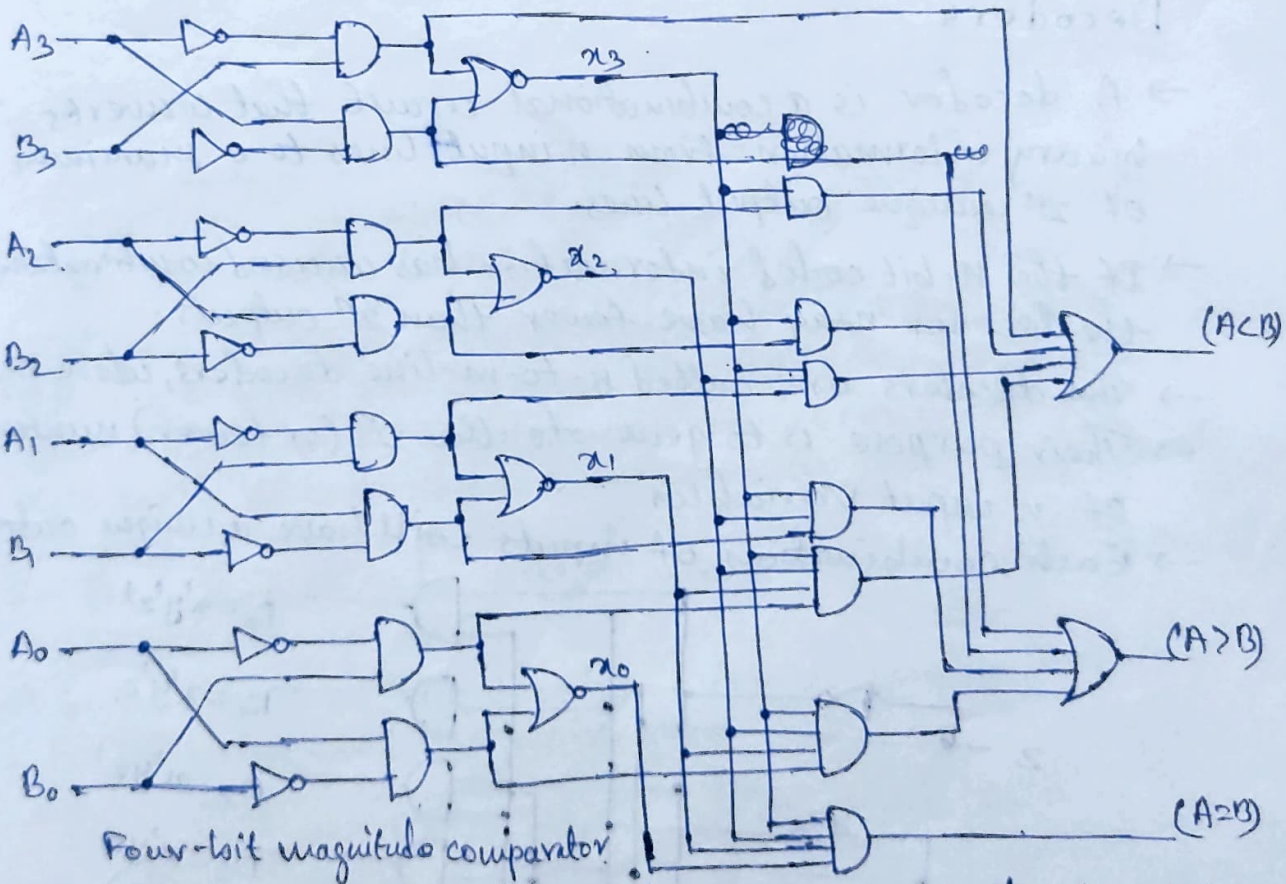
→ A magnitude comparator is a combinational circuit that compares two numbers A and B and determines their relative magnitudes.

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

→ Consider two number, A and B with four digits each.
→ Write the coefficients of the numbers in descending order of significance.

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

→ 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 $x_i = A_i B_i + A_i' B_i'$ for $i = 0, 1, 2, 3$
where $x_i = 1$ only if the pair of bits in position i are equal.



Four-bit magnitude comparator

→ The equality of the two numbers A and B is displayed in a combinational circuit by an output binary variable that we designate by the symbol (A=B).

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

→ The binary variable (A=B) is equal to 1 only if all pairs of the two numbers are equal.
→ To determine whether A is greater or less than B, we inspect the relative magnitude 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 comparision continues until a pair of unequal digits is reached.

→ The sequential comparision can be expressed logically by the two Boolean functions:

$$(A>B) = A_3B_3' + x_3A_2B_2' + x_3x_2A_1B_1' + x_3x_2x_1A_0B_0'$$

$$(A<B) = A_3'B_3 + x_3A_2'B_2 + x_3x_2A_1'B_1 + x_3x_2x_1A_0'B_0$$

→ The symbols (A>B) and (A<B) are binary output variables that are equal to 1 when A>B and A<B, respectively.