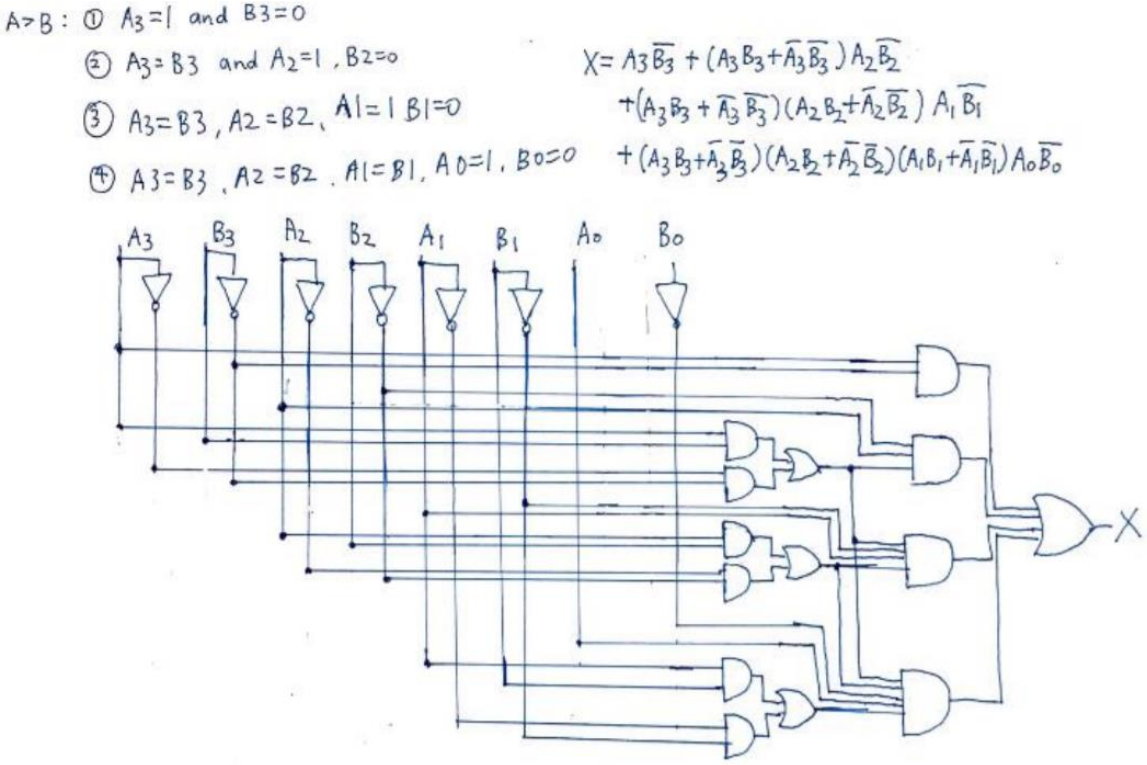
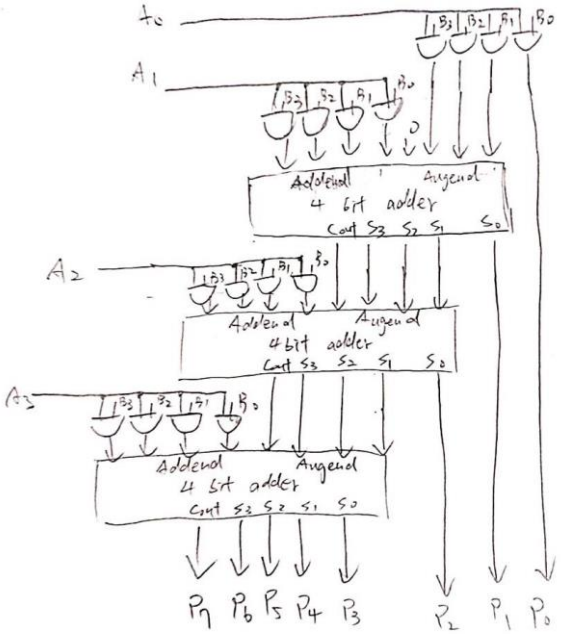
HW4-2 solution

1. Design a combinational circuit that compares two 4-bit unsigned numbers A and B to see whether A is greater than B. The circuit has one output X, so that X = 0 if A ≤ B and X = 1 if A > B.



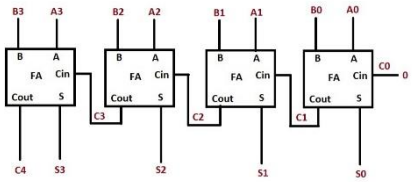
2. Design a 4x4 multiplier using four-bit adders (Ripple-Carry adders) and other logic gates.



$A_3A_2A_1A_0 \times B_3B_2B_1B_0$

$= P_7P_6P_5P_4P_3P_2P_1P_0$

4 bits adder block



3. Design a three-way magnitude comparator that outputs true if its three inputs are in strict order: a<b<c. a, b, and c are all three-bit unsigned numbers.

$a<b<c \Rightarrow (a<b)\ \text{AND}\ (b<c)$

$a<b: a_2'b_2 + (a_2b_2 + a_2'b_2')a_1'b_1 + (a_2b_2 + a_2'b_2')(a_1b_1 + a_1'b_1')a_0'b_0$

$= a_2'b_2 + \overline{a_2 \oplus b_2} \cdot a_1'b_1 + \overline{a_2 \oplus b_2} \cdot \overline{a_1 \oplus b_1} \cdot a_0'b_0$ (參考講義 P.58)

$b<c: b_2'c_2 + (b_2c_2 + b_2'c_2')b_1'c_1 + (b_2c_2 + b_2'c_2')(b_1c_1 + b_1'c_1')b_0'c_0$

$= b_2'c_2 + \overline{b_2 \oplus c_2} \cdot b_1'c_1 + \overline{b_2 \oplus c_2} \cdot \overline{b_1 \oplus c_1} \cdot b_0'c_0$

$\therefore \text{Output } F = (a_2'b_2 + \overline{a_2 \oplus b_2} \cdot a_1'b_1 + \overline{a_2 \oplus b_2} \cdot \overline{a_1 \oplus b_1} \cdot a_0'b_0) \cdot$
$(b_2'c_2 + \overline{b_2 \oplus c_2} \cdot b_1'c_1 + \overline{b_2 \oplus c_2} \cdot \overline{b_1 \oplus c_1} \cdot b_0'c_0)$

4. Design a 4->2 priority encoder with input D[3:0] and output A[1:0] where D0 has the highest priority and D3 has the lowest priority.