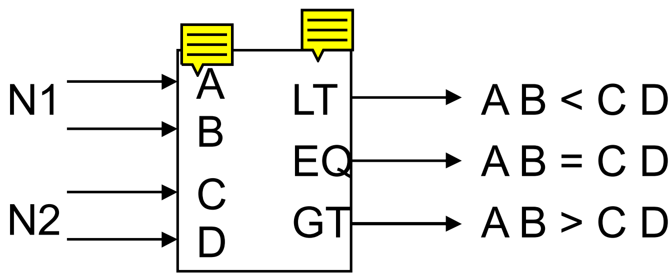
Comparator

Two-Bit Comparator

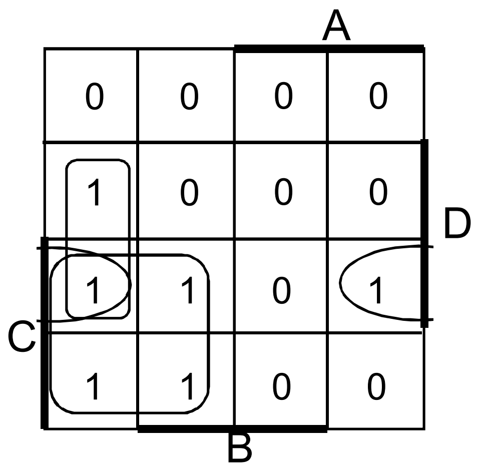


A	B	C	D	LT	EQ	GT
0	0	0	0	0	1	0
		0	1	1	0	0
		1	0	1	0	0
		1	1	1	0	0
0	1	0	0	0	0	1
		0	1	0	1	0
		1	0	1	0	0
		1	1	1	0	0
1	0	0	0	0	0	1
		0	1	0	0	1
		1	0	0	1	0
		1	1	1	0	0
1	1	0	0	0	0	1
		0	1	0	0	1
		1	0	0	0	1
		1	1	0	1	0

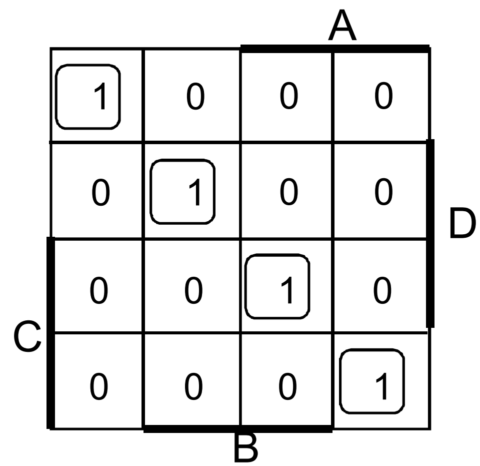
block diagram
and
truth table

we'll need a 4-variable Karnaugh map
for each of the 3 output functions

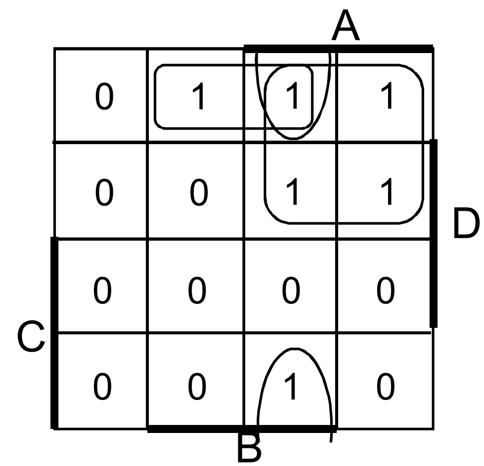
Two-Bit Comparator (cont'd)



K-map for LT



K-map for EQ



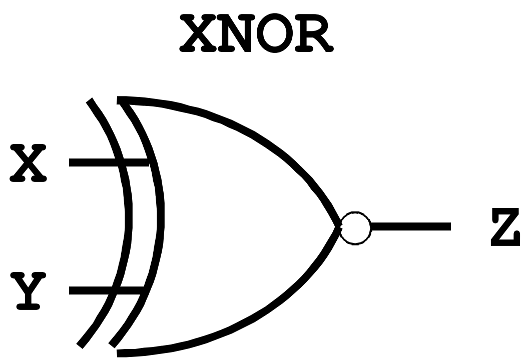
K-map for GT

LT = A' B' D + A' C + B' C D

EQ = A'B'C'D' + A'BC'D + ABCD + AB'CD' = (A xnor C) • (B xnor D)

GT = B C' D' + A C' + A B D'

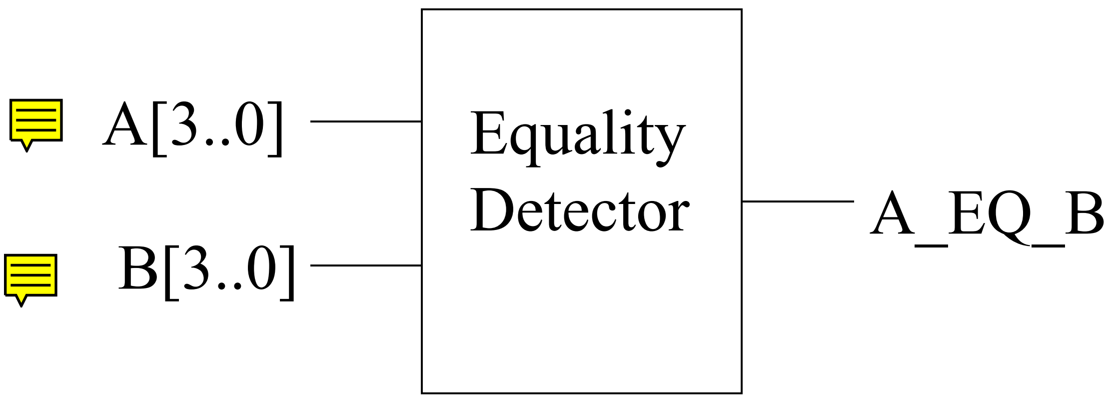
Equality Comparator



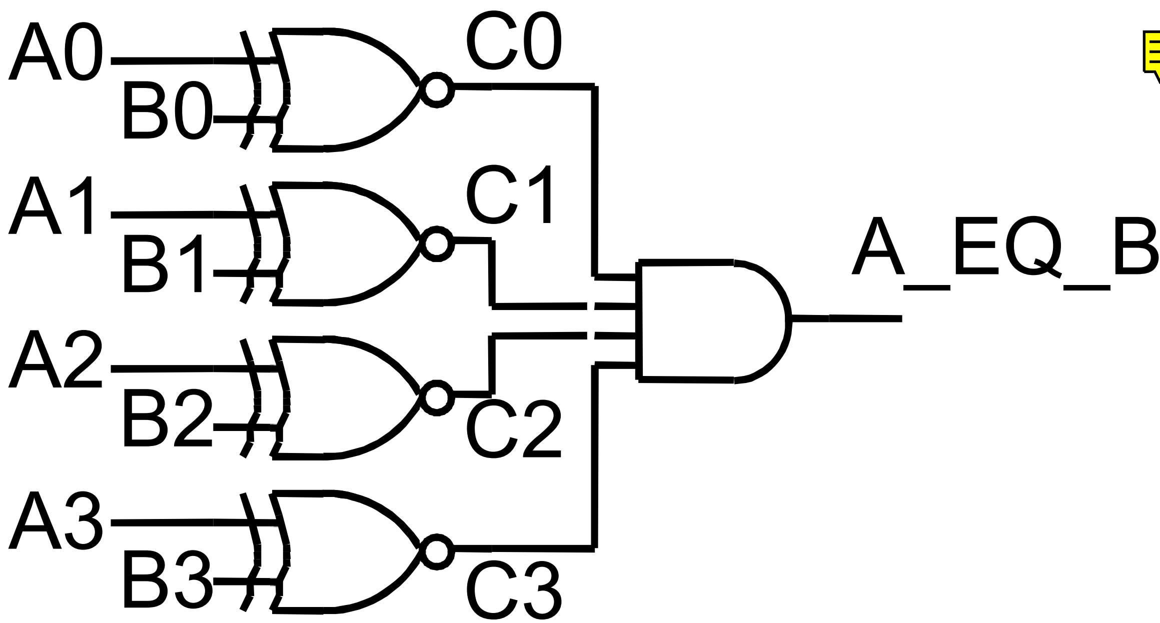
Z = X XNOR Y

X	Y	Z
0	0	1
0	1	0
1	0	0
1	1	1

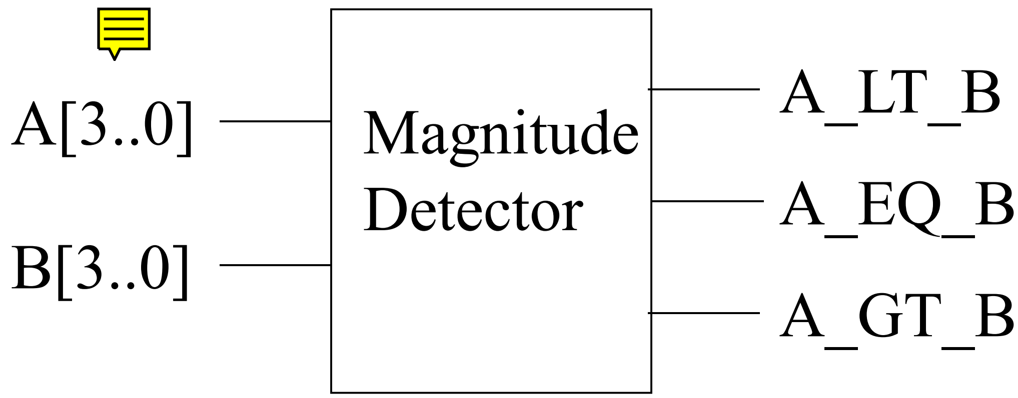
4-bit Equality Detector



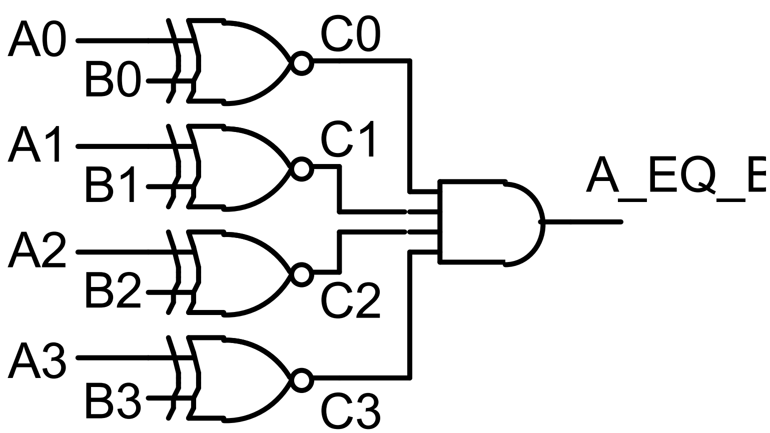
4-Bit Equality Comparator



4-bit Magnitude Comparator



Magnitude Comparator

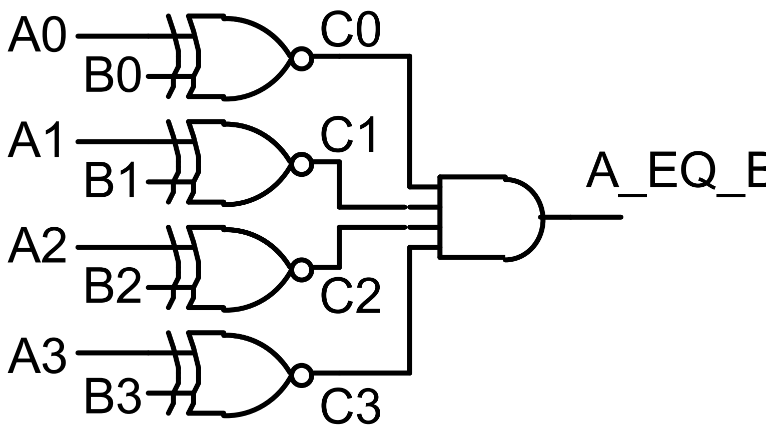


How can we find A_GT_B?

How many rows would a truth table have?

$$2^8 = 256!$$

Magnitude Comparator



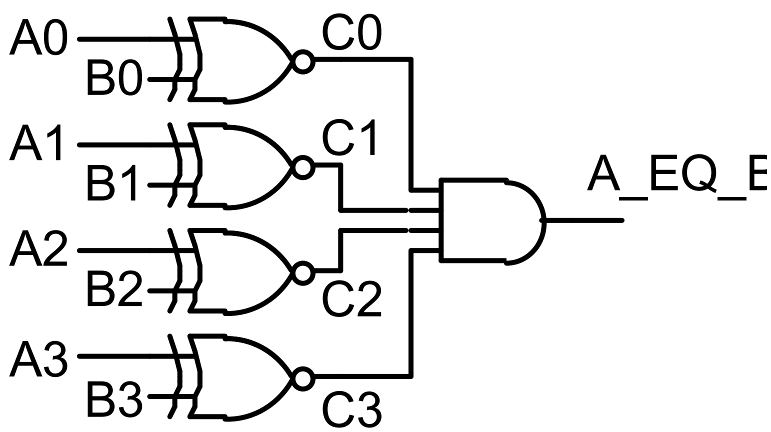
Find A_GT_B

If A = 1001 and
B = 0111
is A > B?
Why?

Because A3 > B3
i.e. A3 . B3' = 1

Therefore, one term in the logic equation for A_GT_B is A3 . B3'

Magnitude Comparator



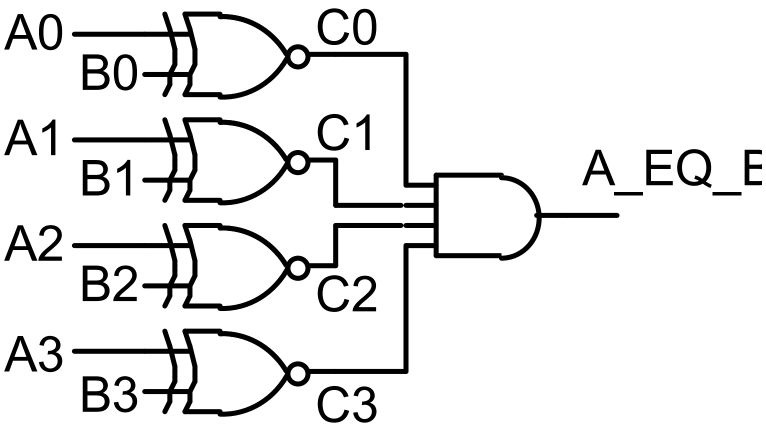
A_GT_B = A3 . B3’
+ …..

Because A3 = B3 and
A2 > B2
i.e. C3 = 1 and
A2 . B2’ = 1

If A = 1101 and
B = 1011
is A > B?
Why?

Therefore, the next term in the logic equation for A_GT_B is C3 . A2 . B2’

Magnitude Comparator



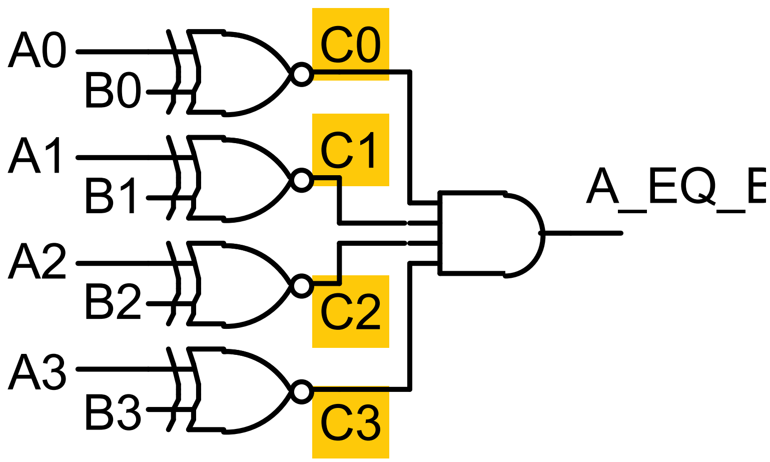
A_GT_B = A3 . B3'
+ C3 . A2 . B2'
+ …..

If A = 1010 and
B = 1001
is A > B?
Why?

Because A3 = B3 and
A2 = B2 and
A1 > B1
i.e. C3 = 1 and C2 = 1 and
A1 . B1' = 1

Therefore, the next term in the logic equation for A_GT_B is C3 . C2 . A1 . B1'

Magnitude Comparator



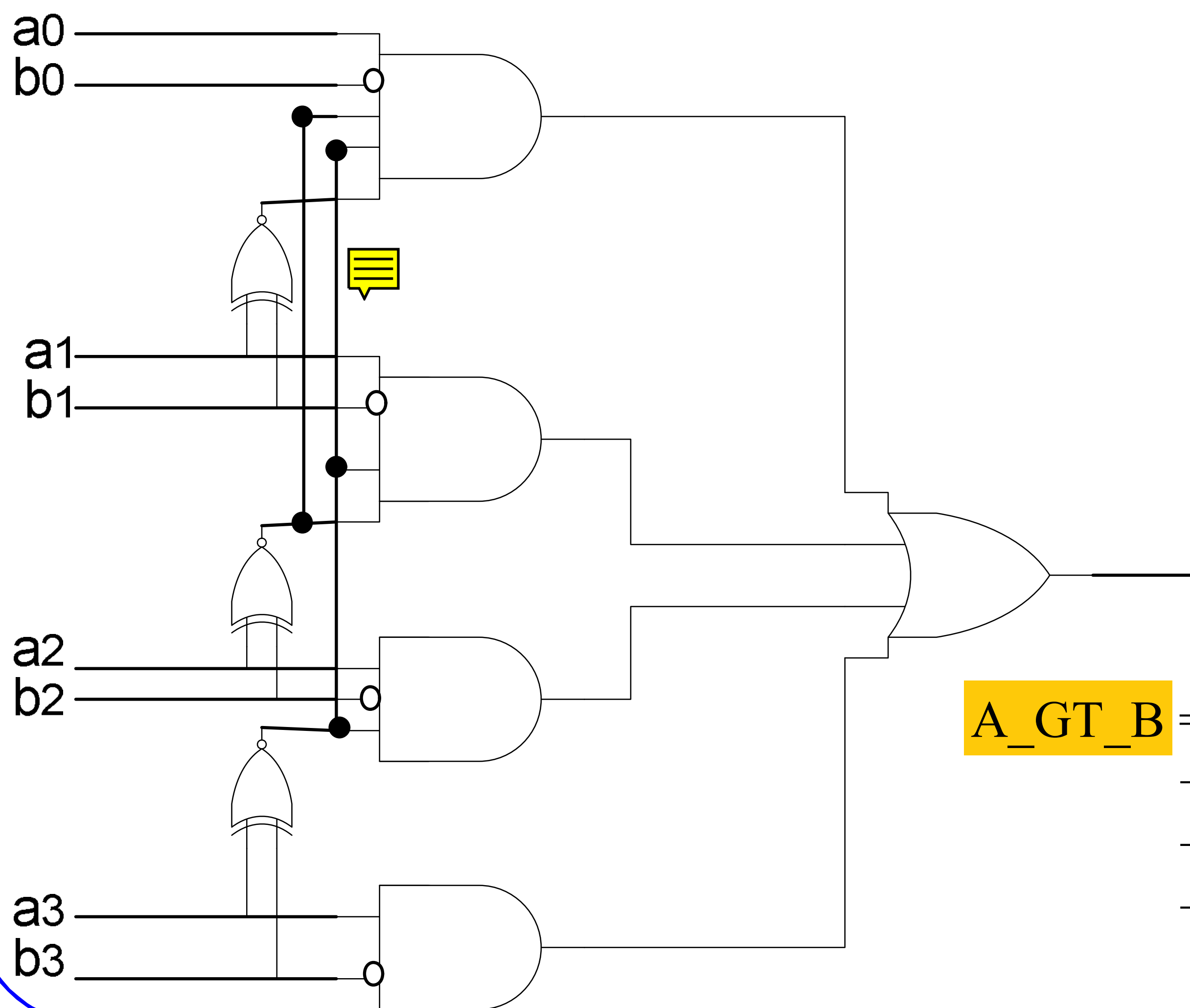
$$
\begin{aligned}
A\_GT\_B = & A3 \,.\, B3' \\
& + C3 \,.\, A2 \,.\, B2' \\
& + C3 \,.\, C2 \,.\, A1 \,.\, B1' \\
& + \;\ldots\ldots
\end{aligned}
$$

If A = 1011 and
B = 1010
is A > B?
Why?

Because A3 = B3 and
A2 = B2 and
A1 = B1 and
A0 > B0
i.e. C3 = 1 and C2 = 1 and
C1 = 1 and A0 . B0' = 1

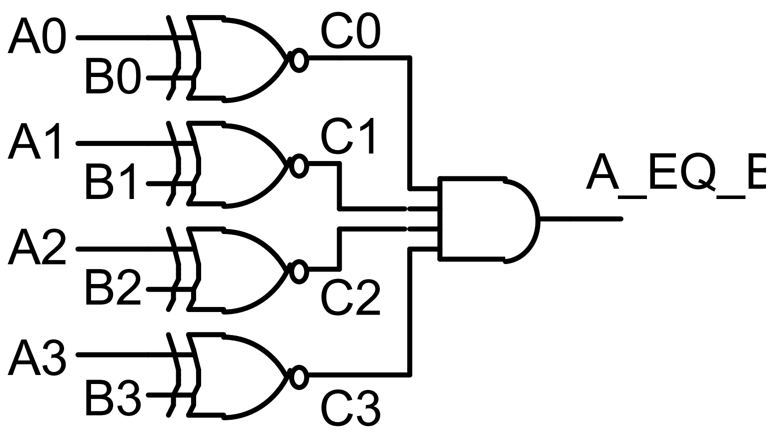
Therefore, the last term in the logic equation for A_GT_B is C3 . C2 . C1 . A0 . B0'

Magnitude Comparator



$$A\_GT\_B = A3 \cdot B3' + C3 \cdot A2 \cdot B2' + C3 \cdot C2 \cdot A1 \cdot B1' + C3 \cdot C2 \cdot C1 \cdot A0 \cdot B0'$$

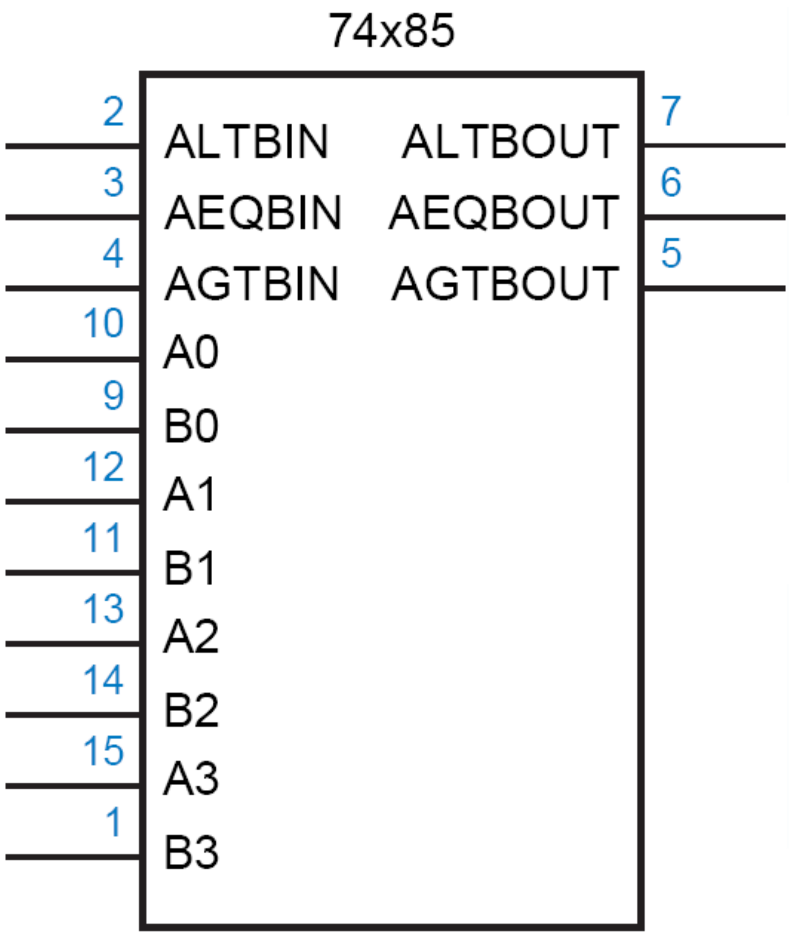
Magnitude Comparator

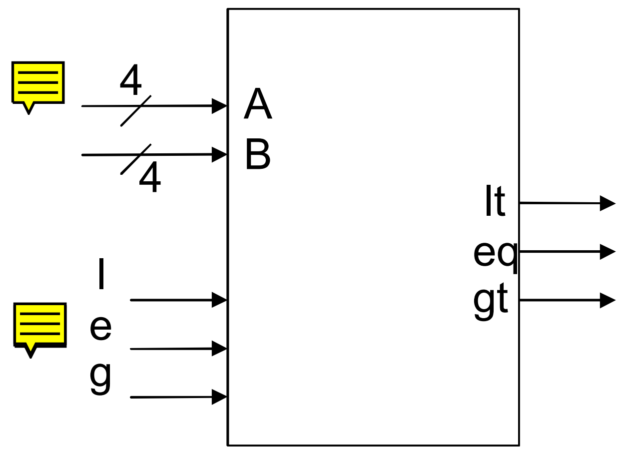


Find A_LT_B

$$
\begin{aligned}
\text{A\_LT\_B} = & \ A3' . B3 \\
& + C3 . A2' . B2 \\
& + C3 . C2 . A1' . B1 \\
& + C3 . C2 . C1 . A0' . B0
\end{aligned}
$$

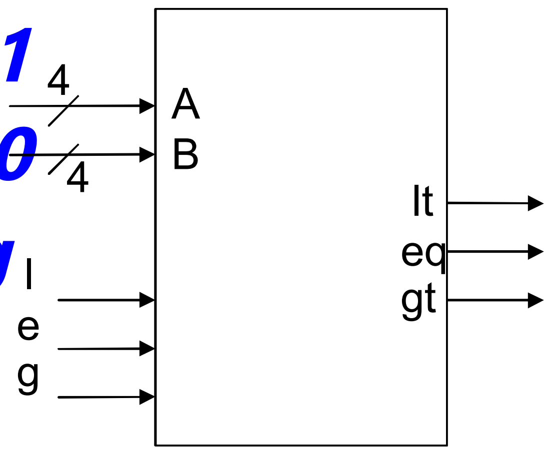
TTL 74x85


74x85
2
ALTBIN
3
AEQBIN
4
AGTBIN
10
A0
9
B0
12
A1
11
B1
13
A2
14
B2
15
A3
1
B3
7
ALTBOUT
6
AEQBOUT
5
AGTBOUT


4
A
4
B
l
e
g
lt
eq
gt

TTL 74x85

- ***if (A>B)   lt=0, eq=0, gt=1***
- ***if (A<B)   lt=1, eq=0, gt=0***
- ***if (A=B)   lt=l, eq=e, gt=g***

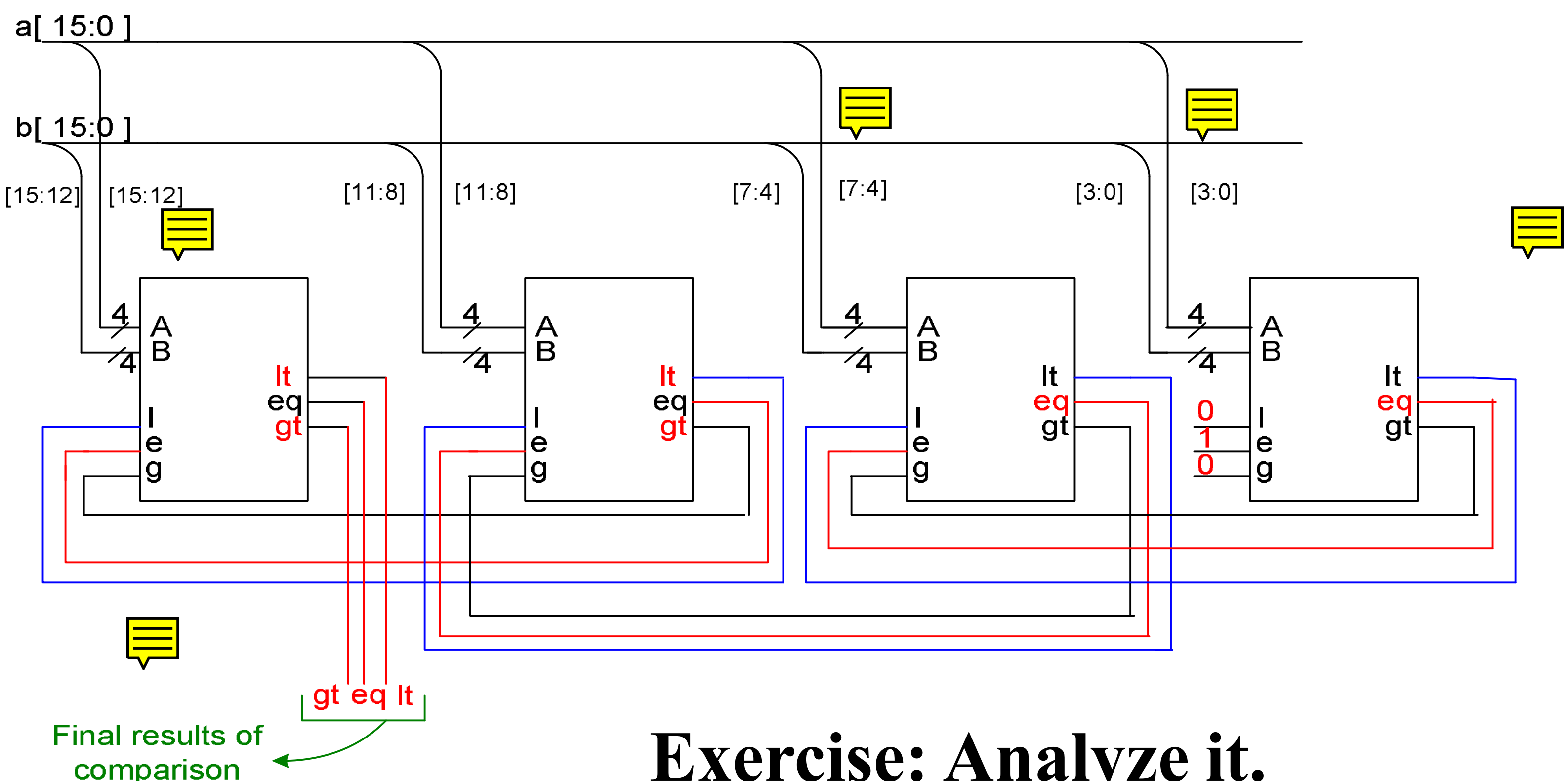


- The three l, e and g inputs are used when cascading.

Comparator (continued…)

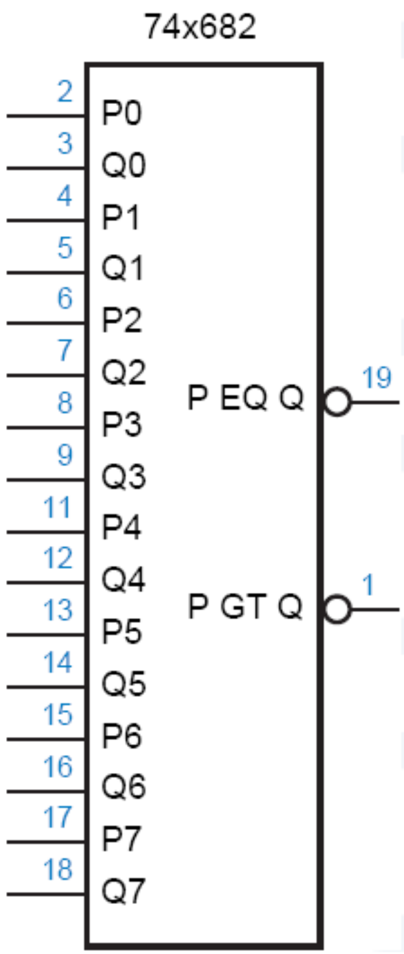
- Let us now cascade four of the 74x85 to construct a 16 bit comparator.

tahlil ba khodetoon



Exercise: Analyze it.

TTL 74x682



➢ 8-bit Comparator

- Arithmetic conditions derived from 74x682 outputs?
- And their circuits?

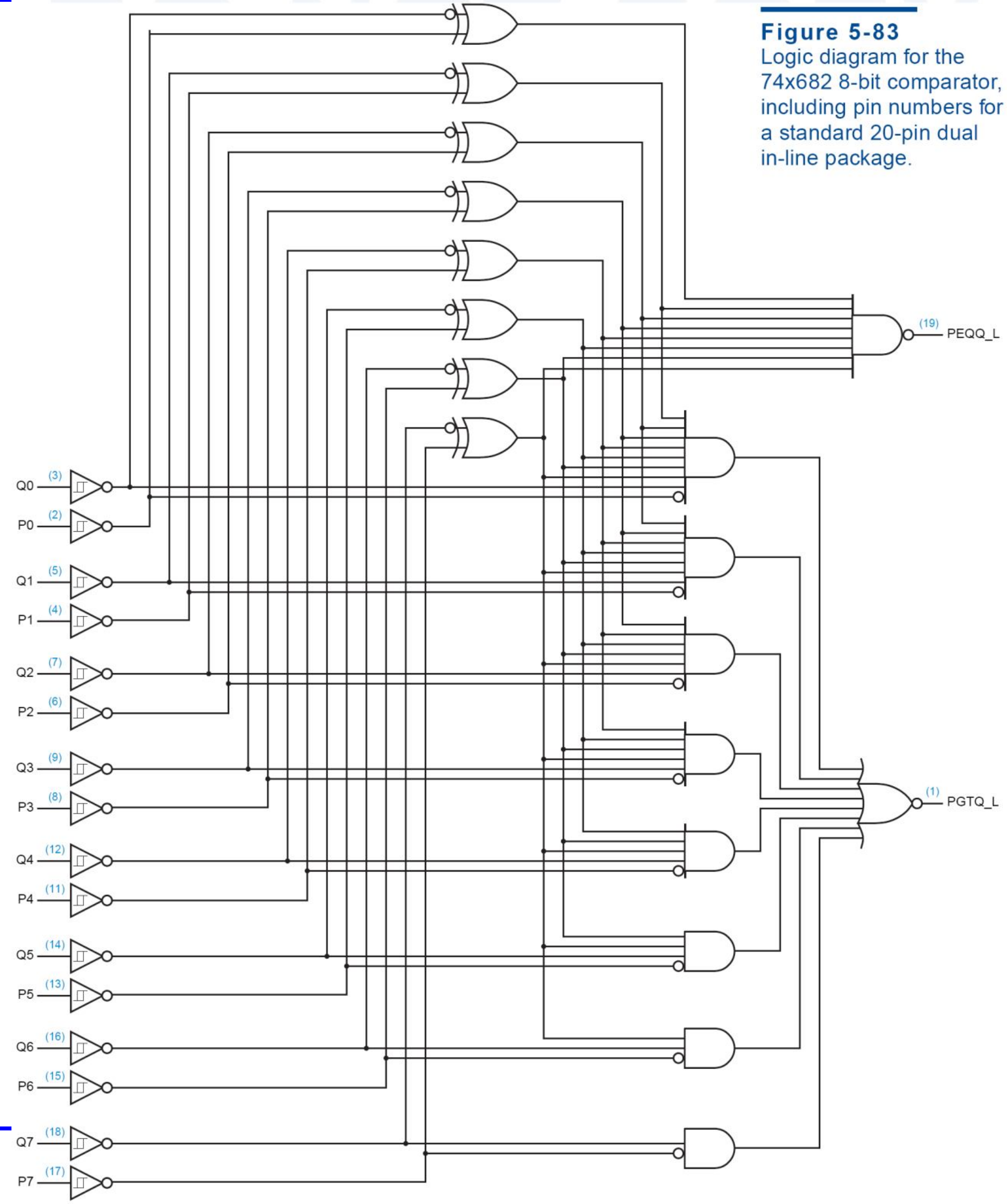


Figure 5-83
Logic diagram for the 74x682 8-bit comparator, including pin numbers for a standard 20-pin dual in-line package.

Maximum Finder

- **Design a maximum finder**