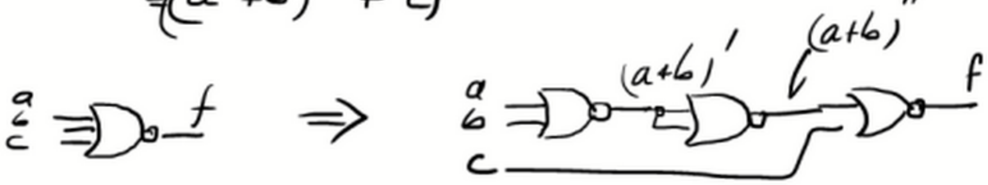
→ This is another common question!

- What if you are told to use only <u>NOR</u> of 2 inputs?

You better take this approach to transform any n-input NOR from ⑥ to 2-input NORs

a	b	c	f
∅	∅	∅	1
∅	∅	1	∅
∅	1	∅	∅
∅	1	1	∅
1	∅	∅	∅
1	∅	1	∅
1	1	∅	∅
1	1	1	∅

$$f = m_0 = a'b'c' = (a' \cdot b' \cdot c')'' = (a + b + c)' =$$
$$= ((a+b)'' + c)'$$



- What if you are told to use in a circuit only NAND of 2 inputs?

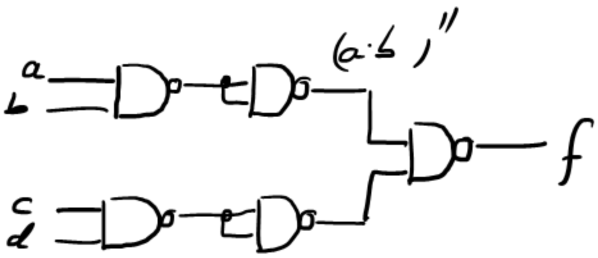
Let's do it the same way: 1) obtain a circuit like ⑤ that contains only NAND

2) Let's convert any n-input NAND into a circuit based only in 2-inputs NAND gates

a b c d	f
∅ ∅ ∅ ∅	1
∅ ∅ ∅ 1	1
∅ ∅ 1 ∅	1
⋮	⋮
1 1 1 ∅	1
1 1 1 1	∅

$f = (abcd)'$ (4-inputs NAND)

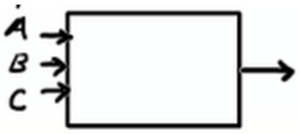
$$f = M_{15} = (a' + b' + c' + d')'' = (a \cdot b \cdot c \cdot d)'$$
$$f = ((a \cdot b)'' \cdot (c \cdot d)'')'$$



↗ This 2^4 combinations logic function contains only 1 maxterm

So, up to 5 2-input gates are required to replace a 4-input gate

This is another example of a circuit using only NAND2 or only NOR2



$y = \sum_3 m(0,3,5,6)$ → Example truth table

only NAND → Transform n-input NAND to NAND2 and redraw → Circuit_A

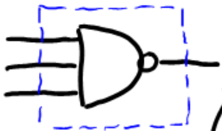
only NOR → Transform n-input NOR to NOR2 and redraw → Circuit_B

$y = \sum_3 m(0,3,5,6) = (m_0 + m_3 + m_5 + m_6)''$
$= (A'B'\cdot C' + A'BC + AB'C + ABC')''$

$y = ((A'B'C')' \cdot (A'BC)' \cdot (AB'C)' \cdot (ABC')')'$ → Only NAND

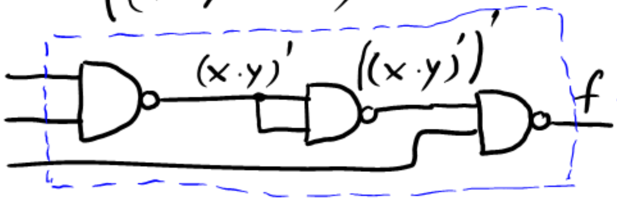
$(A'B'C')'$: 3-input NAND

→



$f = (x\cdot y\cdot z)' = ((x\cdot y)''\cdot z)'$
$(((x\cdot y)')'\cdot z)' =$

So, it is equivalent to use AND

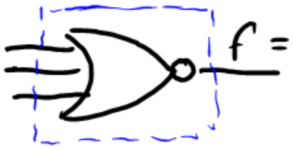


$Y = (m_0'' + m_3'' + m_5'' + m_6'')''$ → Circuit only-NOR

$(A'BC)'' = (A'' + B' + C')' = (A + B' + C')'$

NOR3 and NOR4

NOR 3



$f = (x+y+z)'$
$\hookrightarrow ((x+y)'' + z)'$
$(((x+y)')' + z)'$

So, it is equivalent to use NOR2