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using f from previous lecture,

→ with 2-level implementation

if delay in each gate is 2ns

total delay = 4 ns

→ after factoring

total delay = 6ns

(critical path) longest path

factoring <u>may</u> reduce the cost of an implementation, but <u>may</u> cause longer delay

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Functional Decomposition

$$f = \bar{x}_1 x_2 x_3 + x_1 \bar{x}_2 x_3 + x_1 x_2 x_4 + \bar{x}_1 \bar{x}_2 x_4$$

$$= (\bar{x}_1 x_2 + x_1 \bar{x}_2) x_3 + (x_1 x_2 + \bar{x}_1 \bar{x}_2) x_4$$

$$\Rightarrow g = \bar{x}_1 x_2 + x_1 \bar{x}_2$$

$$= g x_3 + \bar{g} x_4$$

$$g = \bar{x}_1 x_2 + x_1 \bar{x}_2$$

$$\bar{g} = \overline{\bar{x}_1 x_2 + x_1 \bar{x}_2}$$

$$= (x_1 + \bar{x}_2)(\bar{x}_1 + x_2)$$

$$= x_1 \bar{x}_1 + x_1 x_2 + \bar{x}_1 \bar{x}_2 + \bar{x}_2 x_2$$

$$= x_1 x_2 + \bar{x}_1 \bar{x}_2$$

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$f = \bar{x}_1 x_2 x_3 + x_1 \bar{x}_2 x_3 + x_1 x_2 x_4 + \bar{x}_1 \bar{x}_2 x_4$

calculate cost (need the inverters):

2 inverters = 2

4 3-input AND = 12

1 4-input OR = 4

inputs = 18

+

gates = 7

original cost = 25

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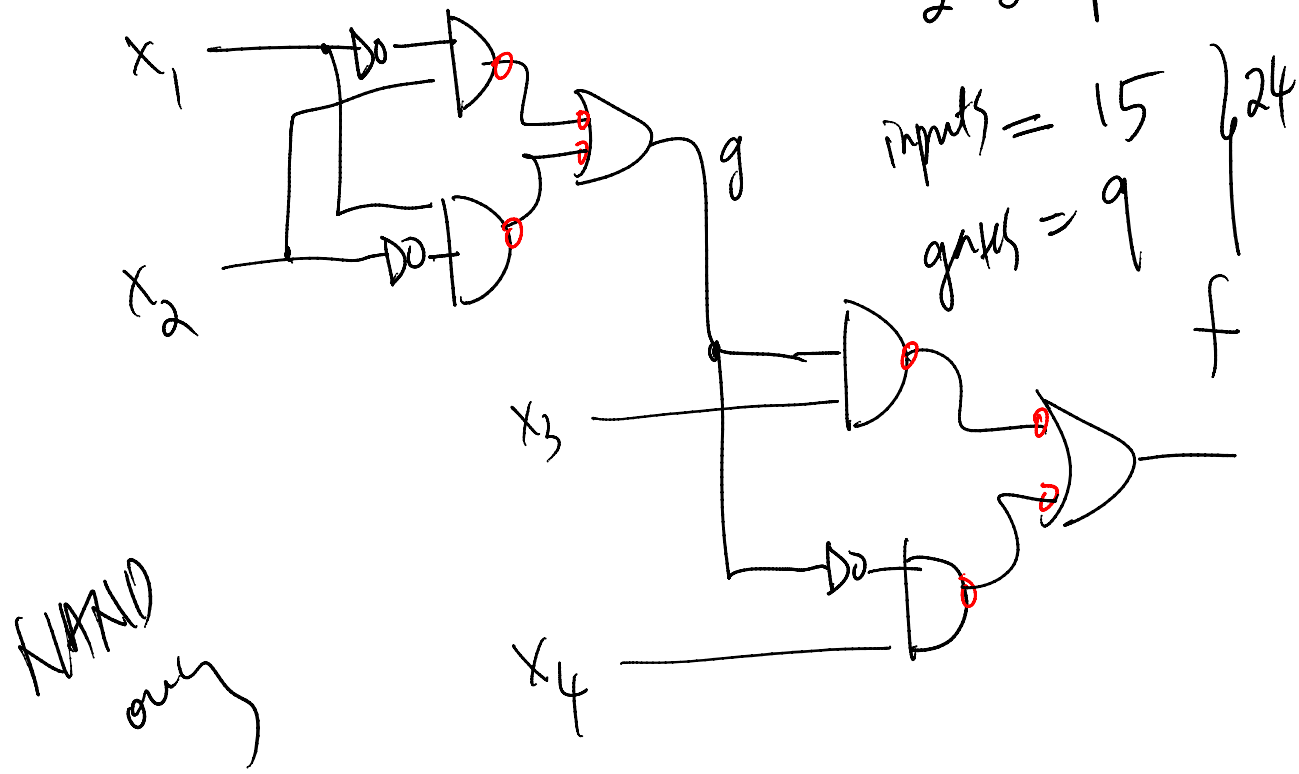
$f = g x_3 + \bar{g} x_4$

$g = \bar{x}_1 x_2 + x_1 \bar{x}_2$

3 inverters = 3
4 2-input AND = 8
2 2-input OR = 4
inputs = 15 } 24
gates = 9



NAND only