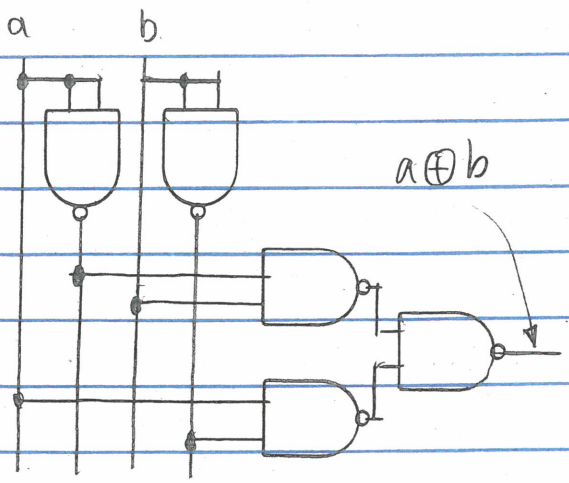
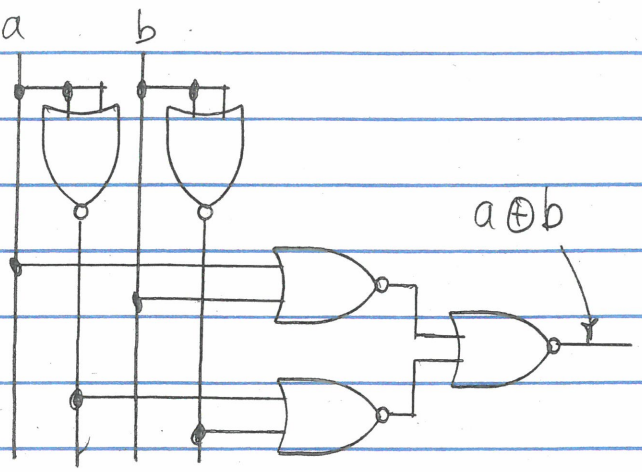
EECS 140/141 HW 4 S'20.

1.a)

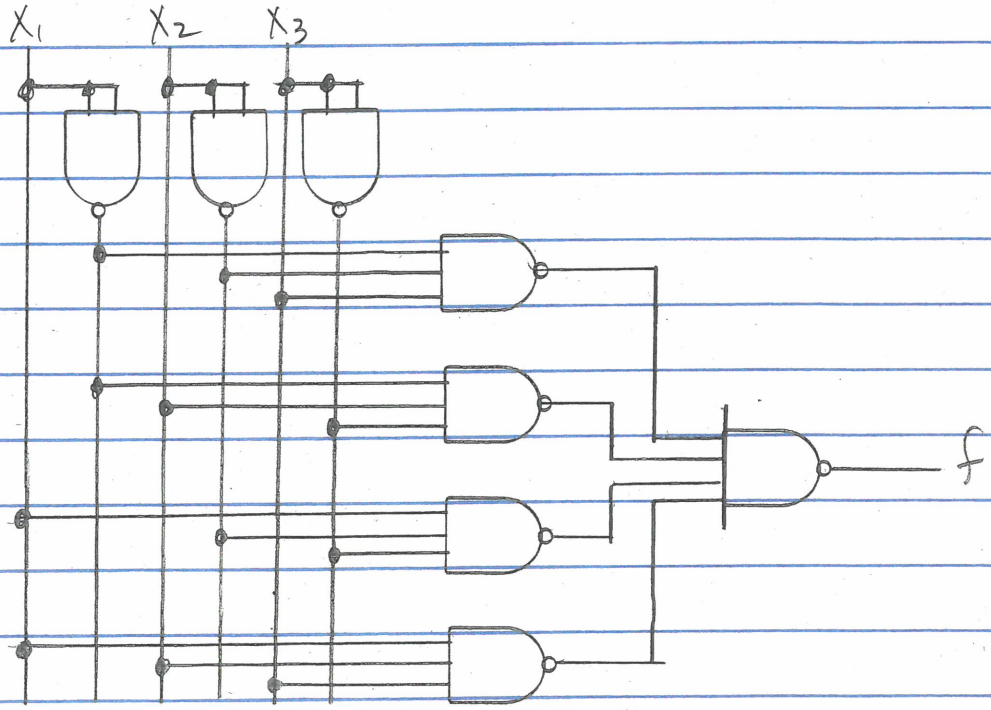


b)



These are easy due to the "standard" SoP or PoS form.

2.a)



b) Each k-input NOR requires 2k transistors

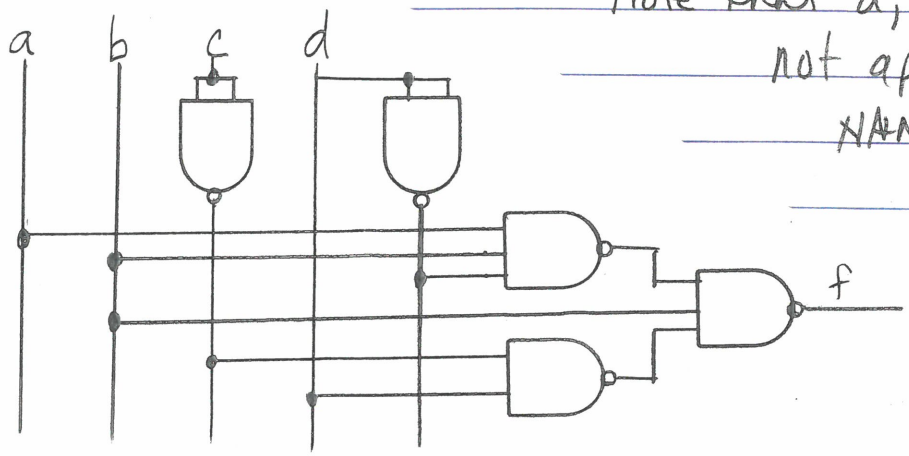
Total transistor count = $3(2\cdot2)+4\cdot(2\cdot3)+1(2\cdot4)=44$

vs. 48 for AND/OR(NOT)

3. $f(a,b,c,d) = b\bar{d}a + \bar{b} + \bar{c}d$

Must double-invert $\bar{b}$ input to OR gate; first inversion produces $\bar{\bar{b}} = b$ and 2nd inversion is how OR is converted to NAND. So, bring b directly into NAND that replaces OR.

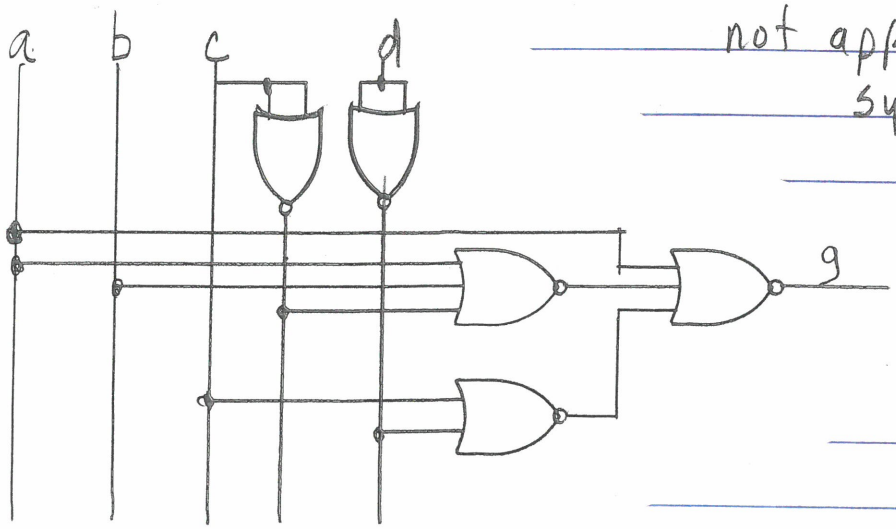
Note that $\bar{a}$, $\bar{b}$, and c do not appear in the NAND-only synthesis.



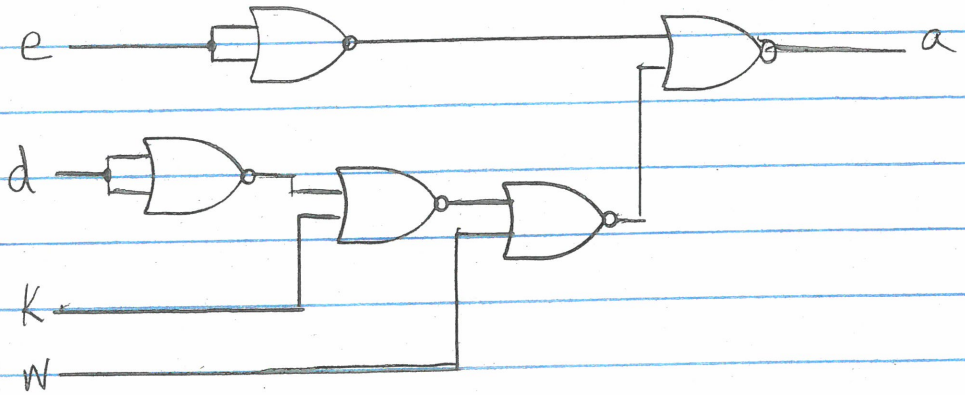
4. $g(a,b,c,d) = (\bar{a})(a+b+\bar{c})(c+\bar{d})$

Must double-invert $\bar{a}$ input to AND gate; first inversion produces $\bar{\bar{a}} = a$ and 2nd inversion is how AND is converted to NOR. So, bring a directly into NOR gate that replaces AND.

Note that $\bar{a}$, $\bar{b}$, and d do not appear in the NOR-only synthesis.



5. Double-invert e into AND; double-invert OR output.
Double-invert d into AND; move NOT on k to AND input.
Result:

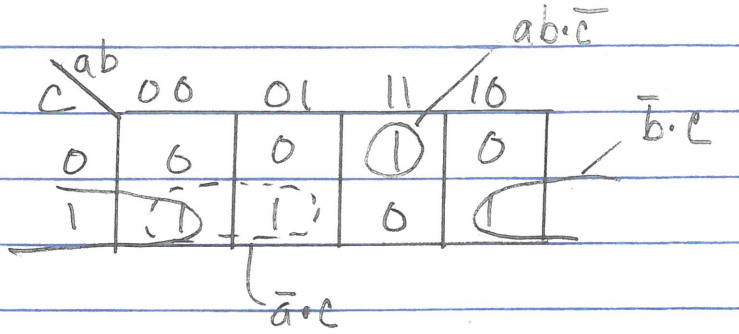


6a) CSoP is $f = \bar{x}_1 \bar{x}_2 x_3 + \bar{x}_1 x_2 \bar{x}_3 + x_1 \bar{x}_2 \bar{x}_3 + x_1 x_2 x_3$
$= m_1 + m_2 + m_4 + m_7$

x_3 \ x_1x_2	00	01	11	10	
0	0	1	0	1	No 4-groups! } CSoP is
1	1	0	1	0	No 2-groups! } min-cost SoP!

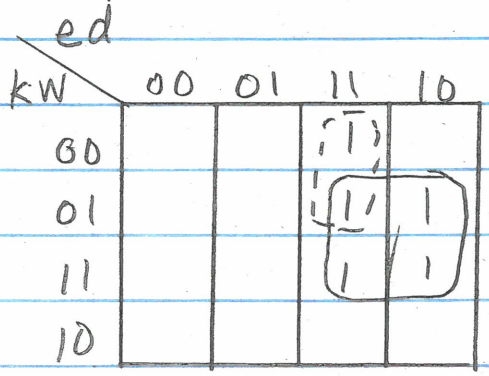
b) Since min-cost SoP is same as CSoP, costs are <u>same</u>.

7. $f = M_1 + M_3 + M_5 + M_6 = \bar{a}\cdot\bar{b}\cdot c + \bar{a}\cdot b c + a\cdot\bar{b}\cdot c + ab\cdot\bar{c}$



$f = \bar{a}\cdot c + \bar{b}\cdot c + ab\cdot\bar{c}$

8. K-map from T, T.



$a = ew + ed\bar{k}$