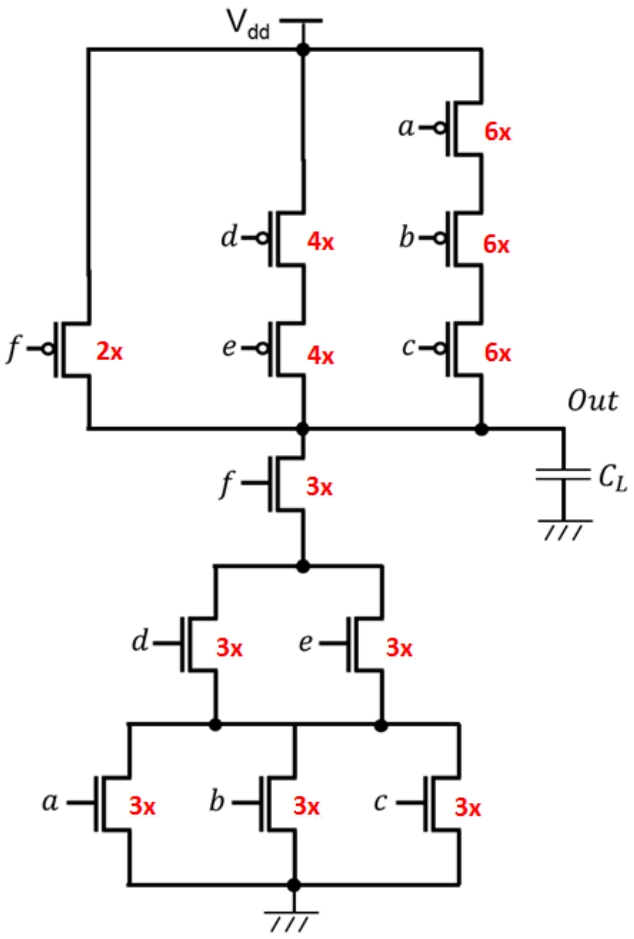
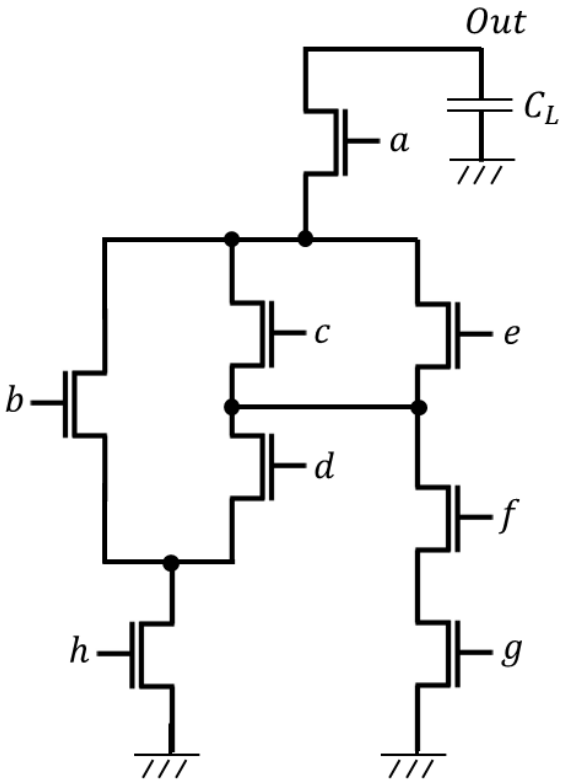
Homework Assignment 8
(Due 4:10pm, Feb. 12, email to daehyun@eecs.wsu.edu)

(1) **[Design, 10 points]** Solve Problem #4 of the EE434 2015 Spring Midterm Exam 1.

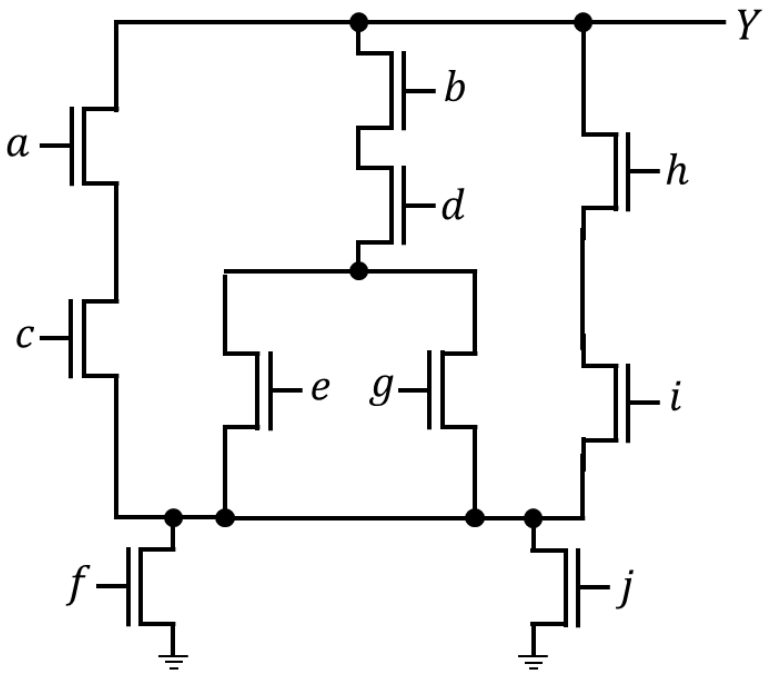


(2) **[Design, 10 points]** Solve Problem #4 of the EE434 2016 Spring Midterm Exam 1.



The worst-case path: (a-e-f-g) or (a-e-d-h) or (a-c-f-g) or (a-c-d-h), so we upsize all these transistors by 4X. Path (a-b-h) needs to be R_n, so b can be 2X.
a, c, d, e, f, g, h: 4X
b: 2X

(3) [**Design, 10 points**] Solve Problem #3 of the EE434 2017 Spring Midterm Exam 1.



The longest path is b-d-e-f. Each of them is upsized to 4X. Then, we get a=c=h=i=8/3.
a: 8/3X
b: 4X
c: 8/3X
d: 4X
e: 4X
f: 4X
g: 4X
h: 8/3X
i: 8/3X
j: 4X

Total width: (34+2/3)X
(If we upsize a-c-f first, a=c=h=i=f=j=3X. Then, b=d=e=g=4.5X. Total width = 36X, which is worse than the above one.)

(4) [**Design, 20 points**] Solve Problem #5 of the EE434 2015 Spring Midterm Exam 1.

Constraint: $\left(\frac{R_n}{a}+\frac{R_n}{b}\right)C_L = R_nC_L \Rightarrow \frac{1}{a}+\frac{1}{b}=1$

$W = ak + b = ak + \frac{a}{a-1}$

1) $W' = k + \frac{(a-1)-a}{(a-1)^2} = k - \frac{1}{(a-1)^2} = 0 \Rightarrow \boxed{a = 1+\frac{1}{\sqrt{k}} \Rightarrow b = 1+\sqrt{k}}$

2) $ak + b = c$ => Two functions, $b = -ak + c$ and $b = \frac{a}{a-1}$, should meet at a single point (confirm this by drawing their graphs).

=> $-ak + c = \frac{a}{a-1}$ should have a single root. => $ka^2 - (k + c - 1)a + c = 0$ has a single root. => $(k + c - 1)^2 - 4kc = 0$ => $(k - c - 1)^2 = 0$ => $c = k + 1 \pm 2\sqrt{k}$ =>
$a = 1 \pm \frac{1}{\sqrt{k}}$ => $a > 1$, so $\boxed{a = 1 + \frac{1}{\sqrt{k}} \Rightarrow b = 1 + \sqrt{k}}$