8/4/13

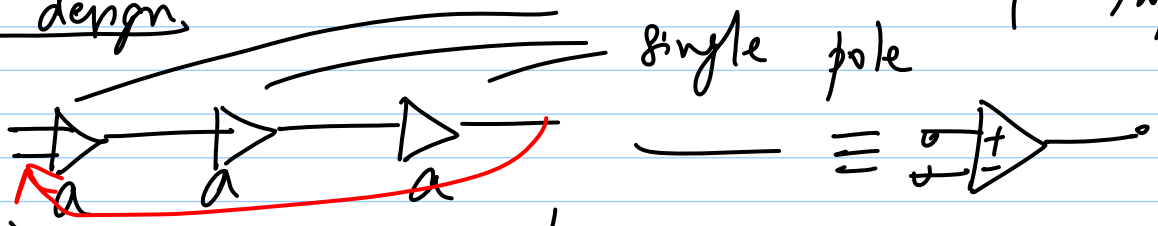
# Lec 39

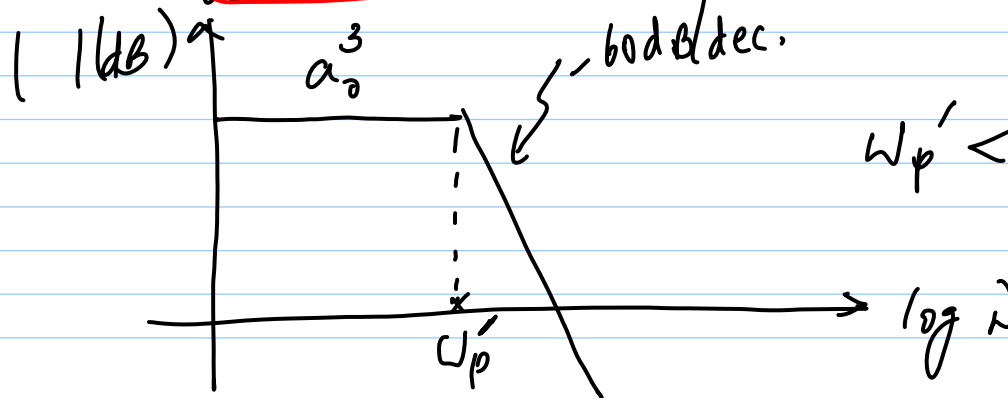
Next Tuesday – 16/4/13 Quiz 2

## 3-stage Opamps

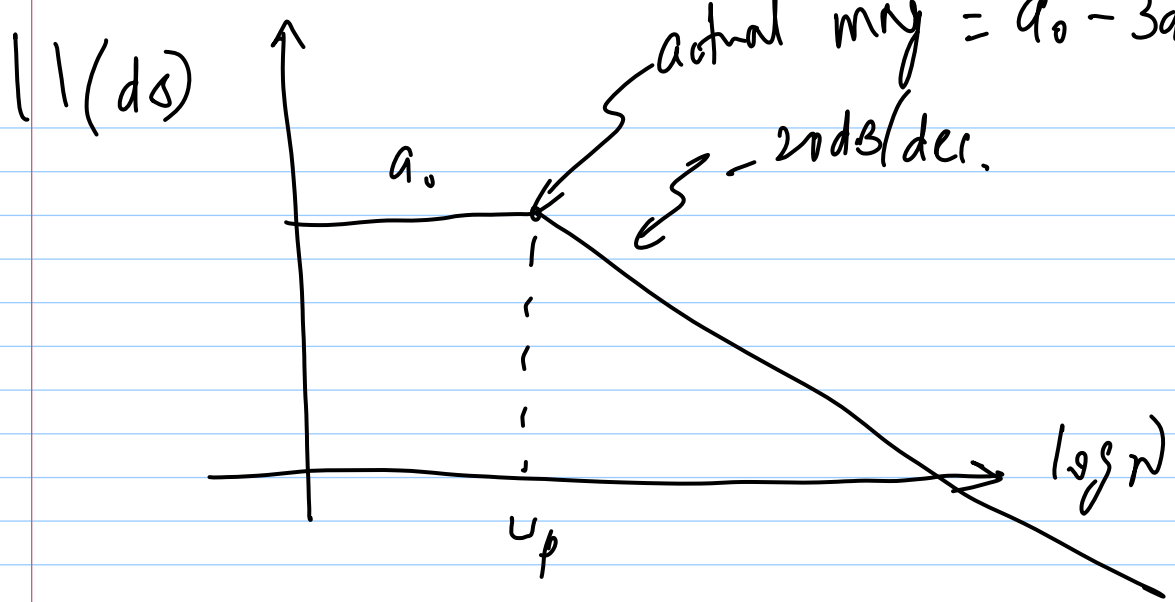
Hacker design.

$a = \frac{a_0}{(1+s/\omega_p)}$ single pole



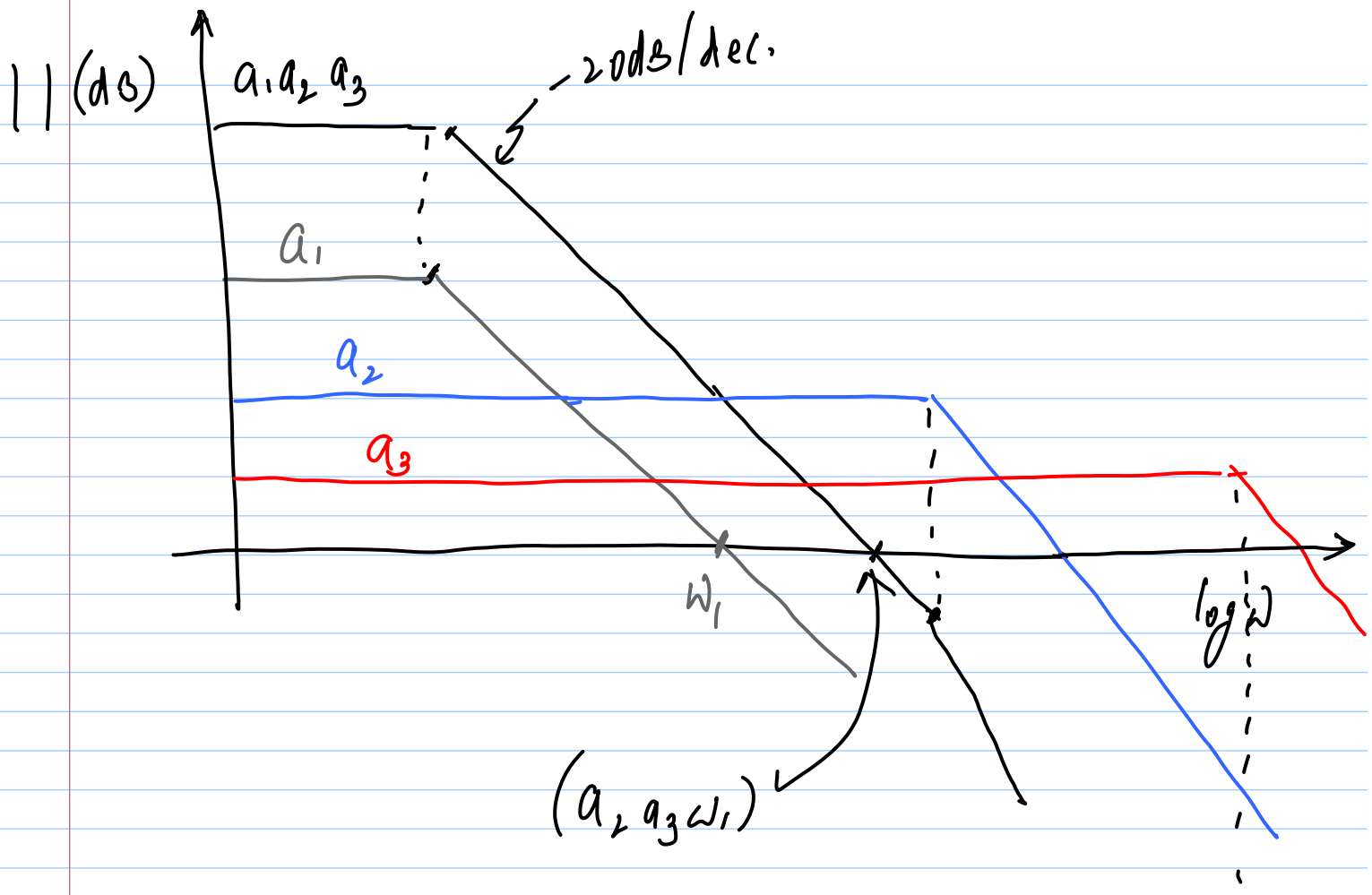



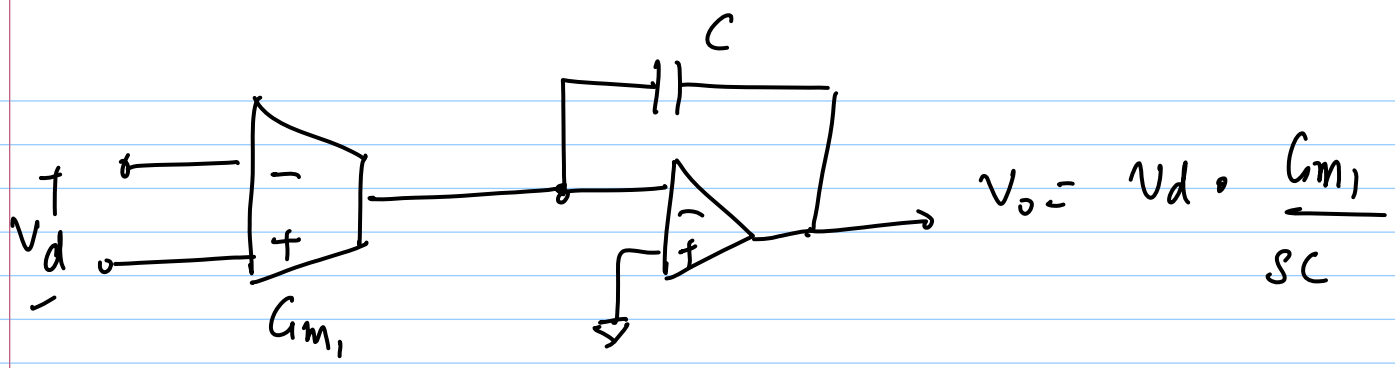

$\omega_p' < \omega_p$




$$A(s) = \frac{A_0}{(1+s/\omega_p)^3}$$

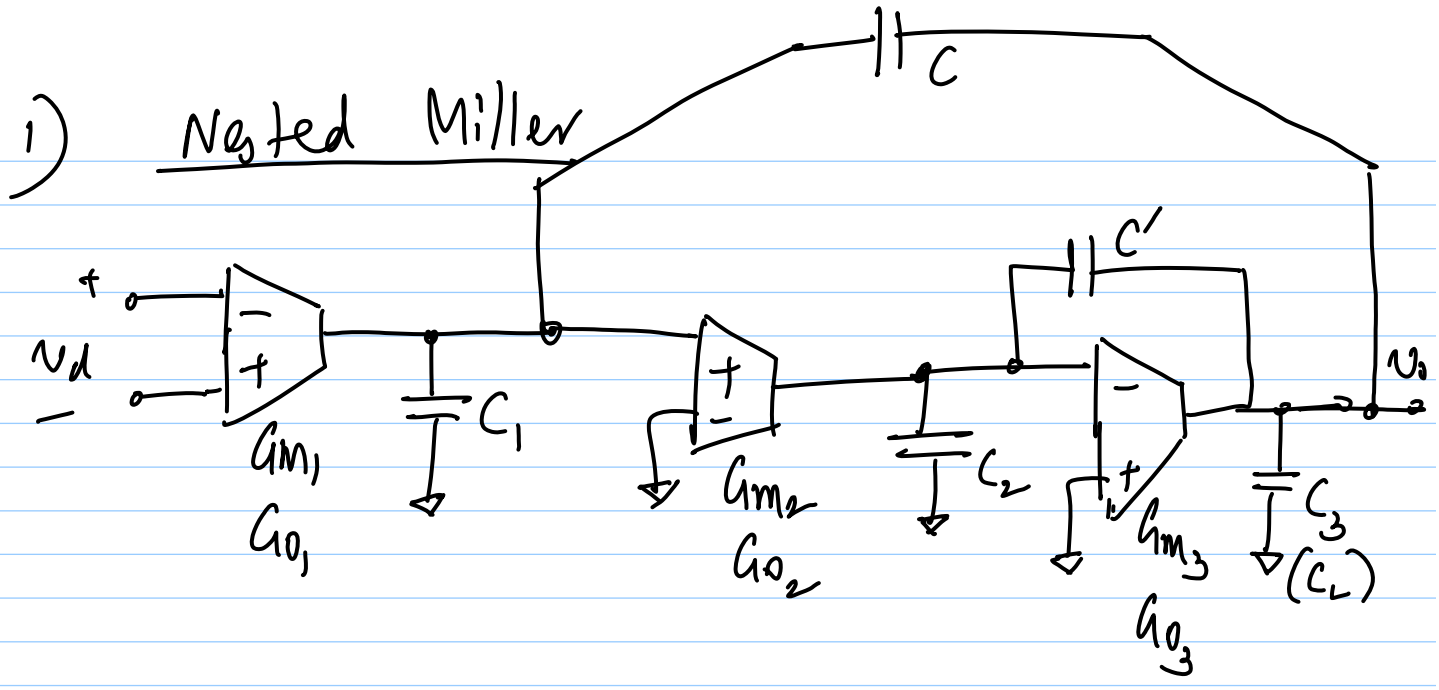
for stable system $A_0 = 8$ $(a_0 = 2)$




2-stage opamp

1) Nested Miller




$$\text{DC gain } (A_0) = \frac{G_{m_1} G_{m_2} G_{m_3}}{G_{o_1} G_{o_2} G_{o_3}}$$

$$\omega_u = \frac{G_{m_1}}{C} \; ; \; \omega_d = \omega_u / A_0$$

N.D. poles $p_2'$ & $p_3'$

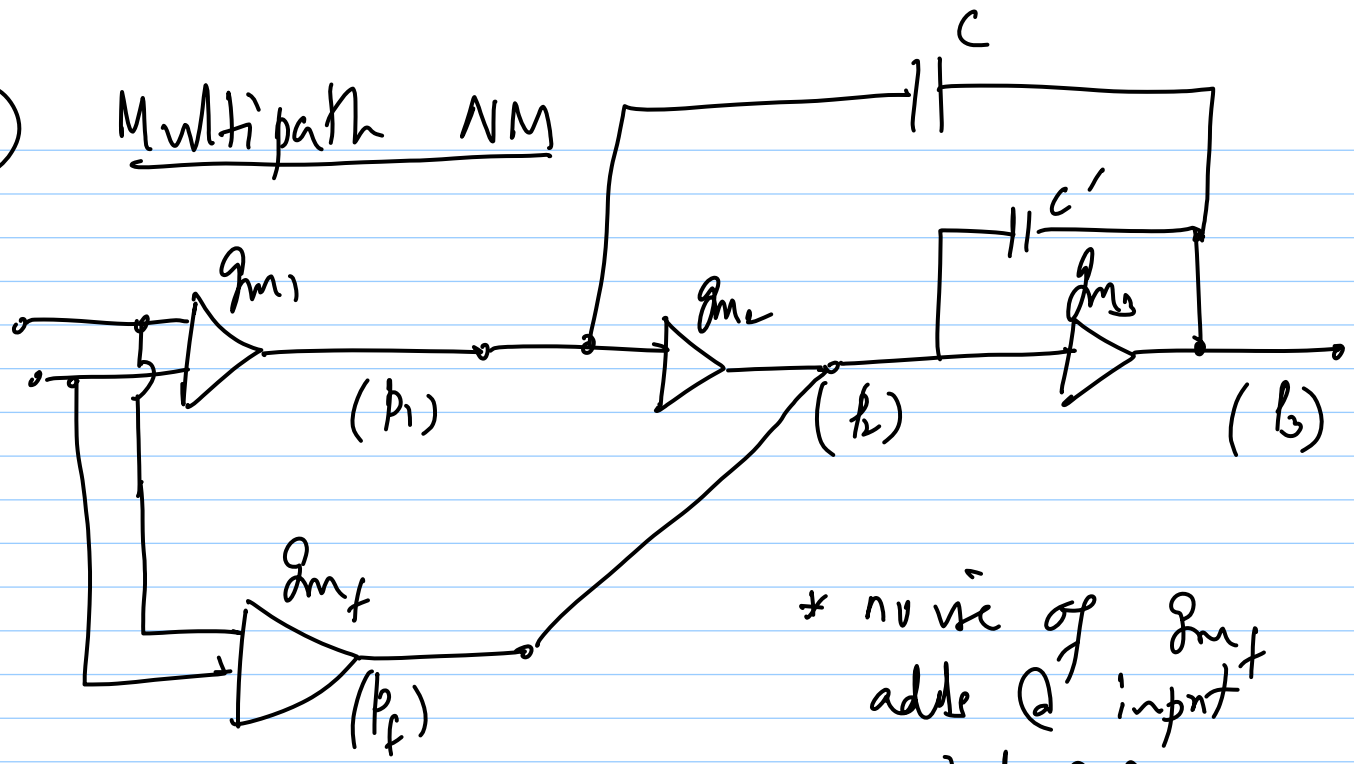
Conditions

$$\frac{G_{m_1}}{C} < \omega_u' < p_3' \longrightarrow G_{m_3} \cdot \frac{C'}{C' + C_2}$$

$$\left(\omega_u\right) \qquad \left(\frac{G_{m_2}}{C'}\right) \qquad \frac{C'C_2}{C' + C_2} + C_3$$

→ 3-stage opamp is typically slower than 2-stage opamp

2) Multipath NM




feed forward path

* nuisance of $g_{mf}$ adds 2nd input
* nested f-f.