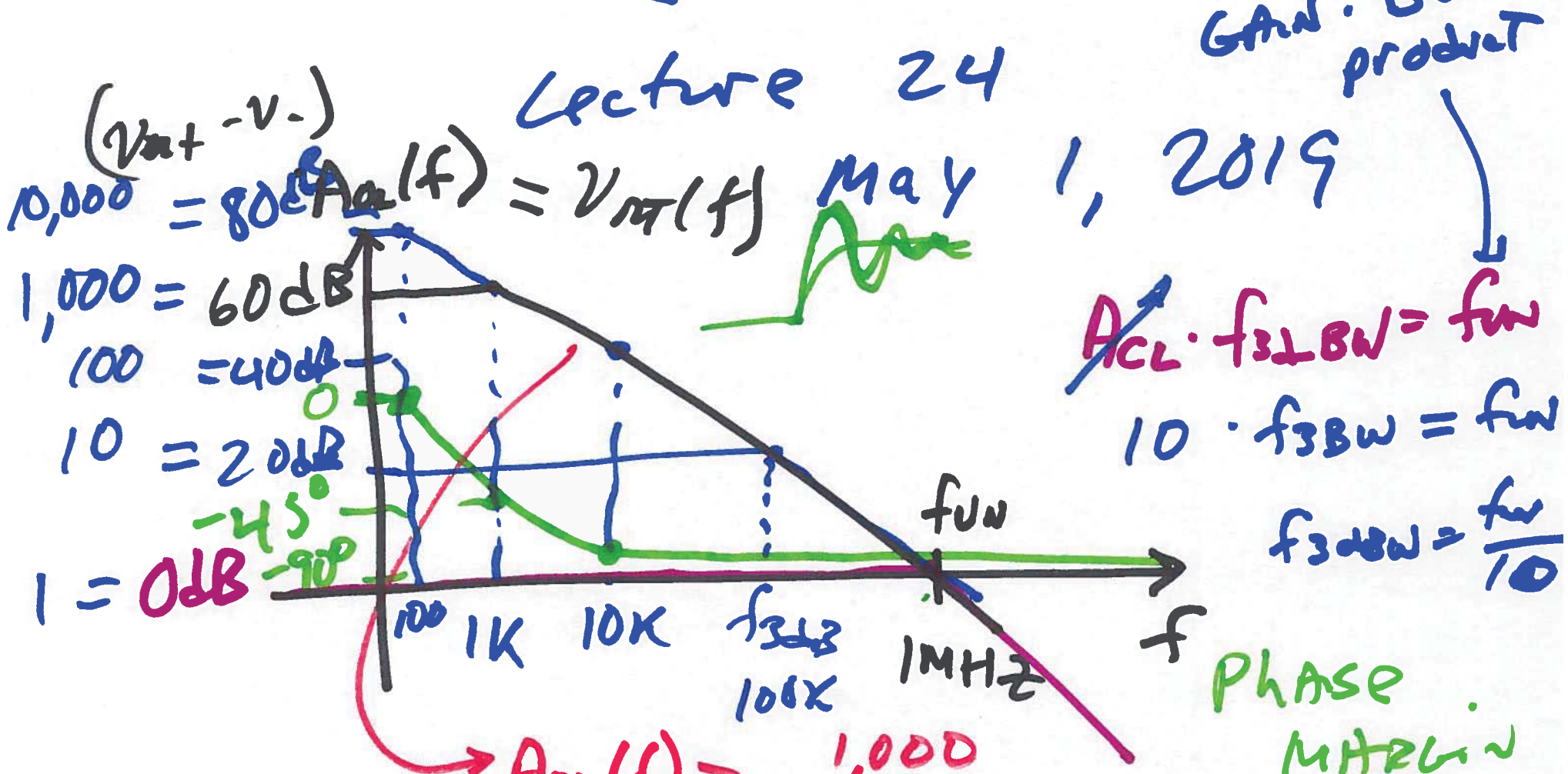
EE420/ECG 620
Analog IC Design
Lecture 24
May 1, 2019



GAIN · BW product

$A_{CL} \cdot f_{3dBW} = f_{UN}$

$10 \cdot f_{3BW} = f_{UN}$

$f_{3dBW} = \frac{f_{UN}}{10}$

$$A_{OL}(f) = \frac{1{,}000}{1 + j\frac{f}{1K}}$$

PHASE MARGIN = 90°

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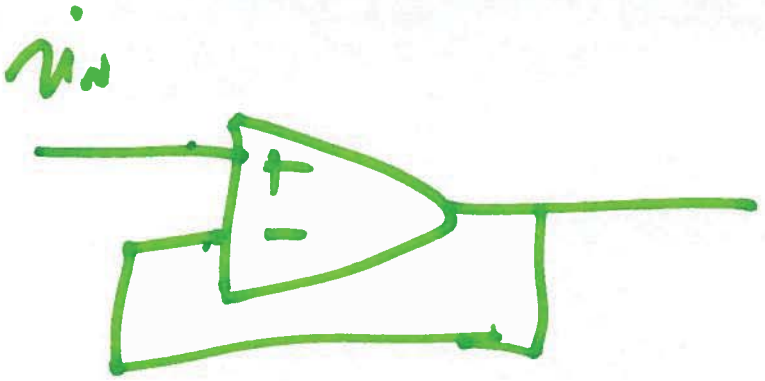


$$v_{OUT} = A_{OL}(f) \cdot (v_{IN} - v_{OUT})$$

$$v_{OUT} = \frac{1000}{1 + j\frac{f}{10^3}} \cdot (v_{IN} - v_{OUT})$$

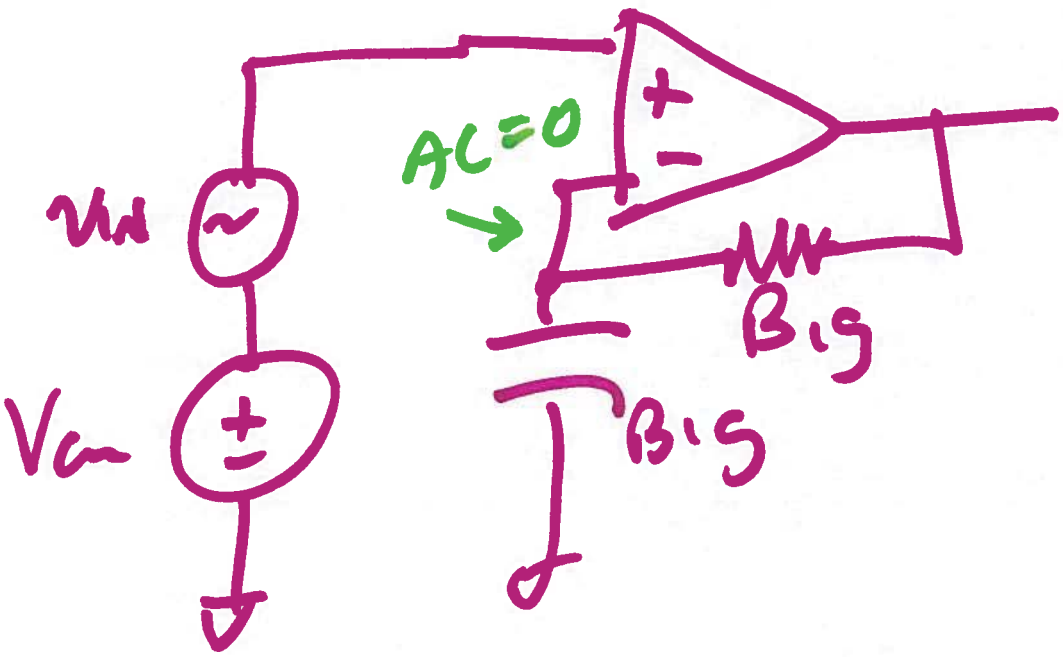
$$v_{OUT}\left(\frac{1000 + 1 + j\frac{f}{10^3}}{1 + j\frac{f}{10^3}}\right) = \frac{v_{IN}\,1000}{1 + j\frac{f}{10^3}}$$

$$\frac{v_{OUT}}{v_{IN}} = \frac{1{,}000}{1{,}000 + 1 + j\frac{f}{10^3}}$$

$$\frac{V_{OUT}}{V_{IN}} \simeq \frac{1}{1 + j\frac{f}{10^3 \cdot 10^3}}$$

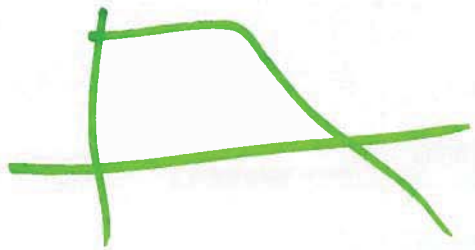
AcLoop feedback

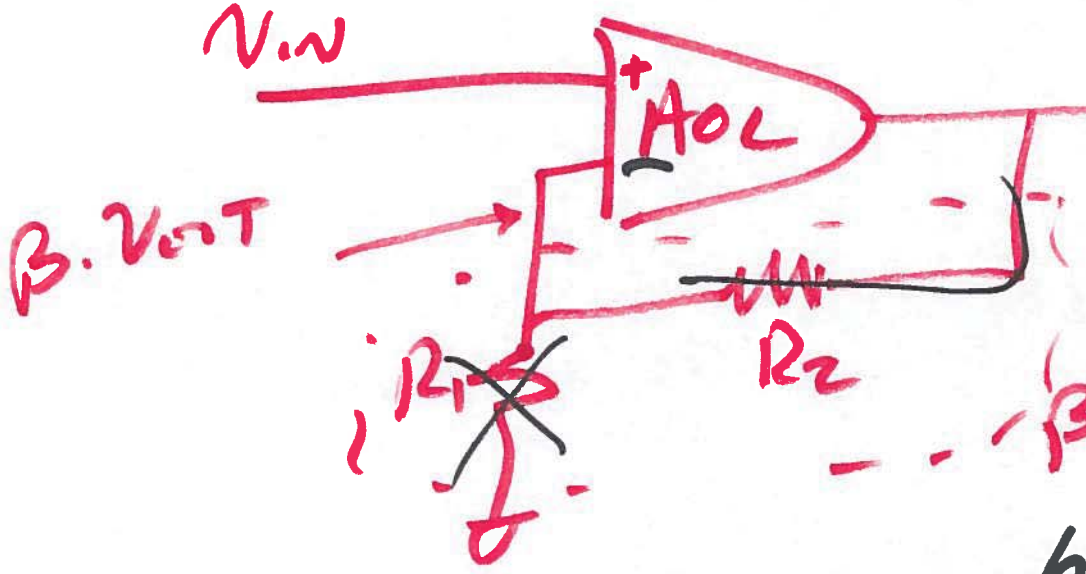
$$= \frac{1}{1 + j\frac{f}{1\,MHz}}$$



V_{cm}

$+ V_{in} \cdot A_{OL}(f)$





$$\beta = \frac{R_1}{R_1 + R_2}$$

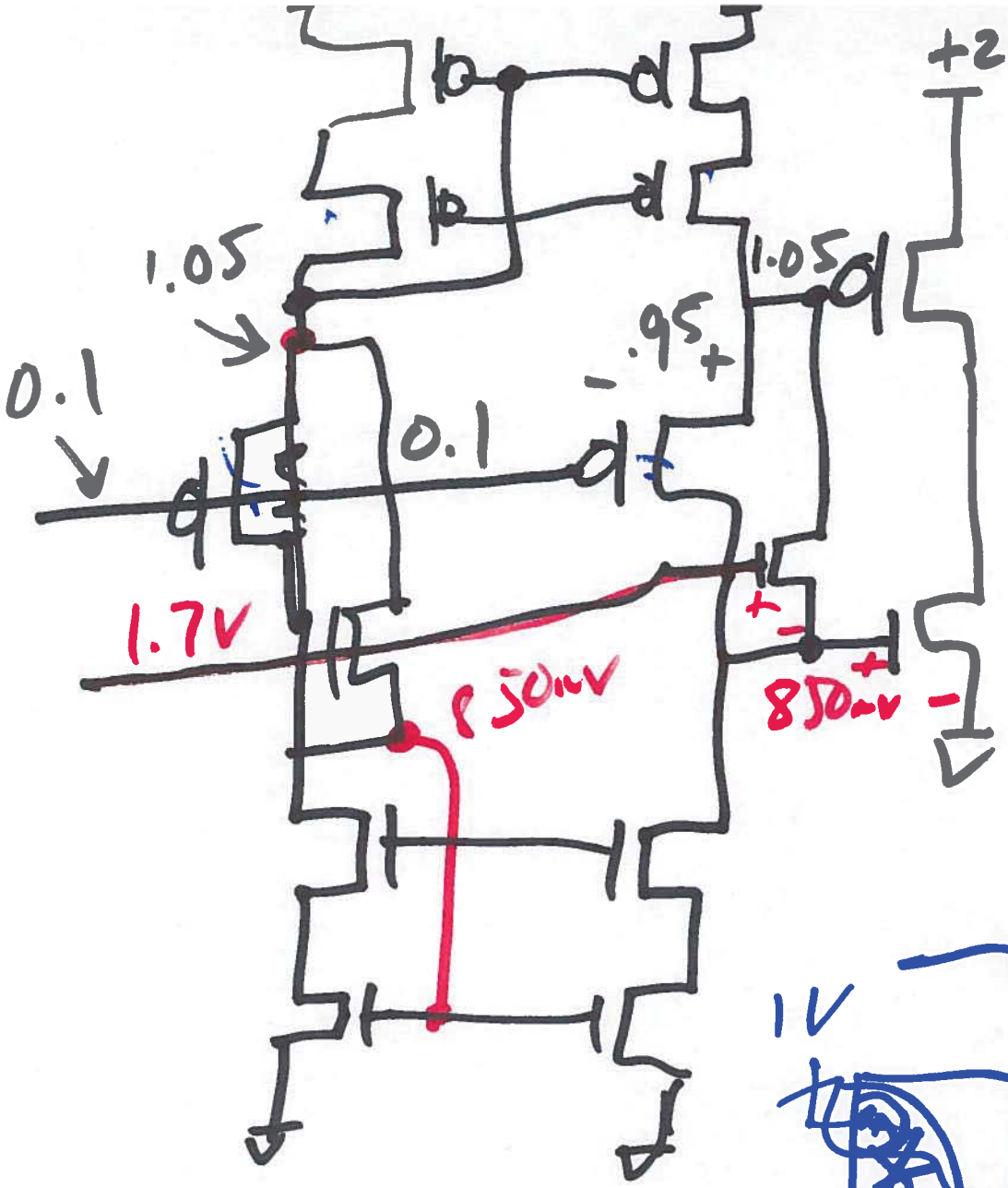
$$V_{OUT} = (V_{IN} - \beta V_{OUT}) A_{OL}$$

$$V_{OUT}(1 + \beta A_{OL}) = A_{OL} \cdot V_{IN}$$

$A_{OL} \to \infty$

$$\frac{1}{\beta} \Leftarrow \frac{1}{\frac{1}{A_{OL}} + \frac{R_1}{R_1 + R_2}\beta} = \frac{V_{OUT}}{V_{IN}} = \frac{A_{OL}}{1 + \beta A_{OL}}$$

$\beta A_{OL} \gg 1$ $\quad A_{CL} = \frac{1}{\beta}$



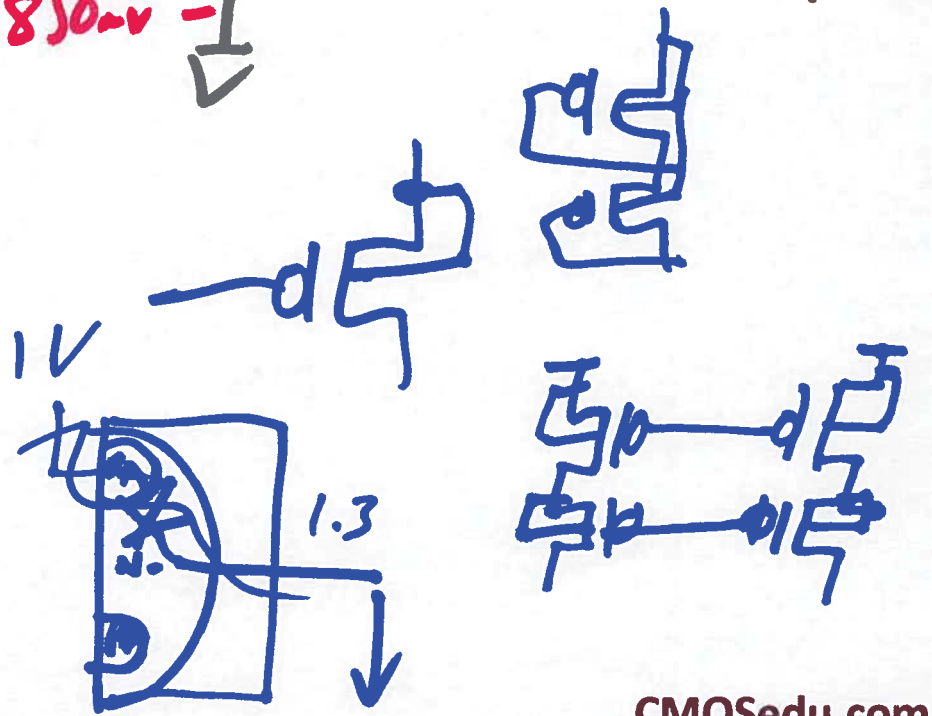
$V_{GS} = V_{TKN} + 0.05$

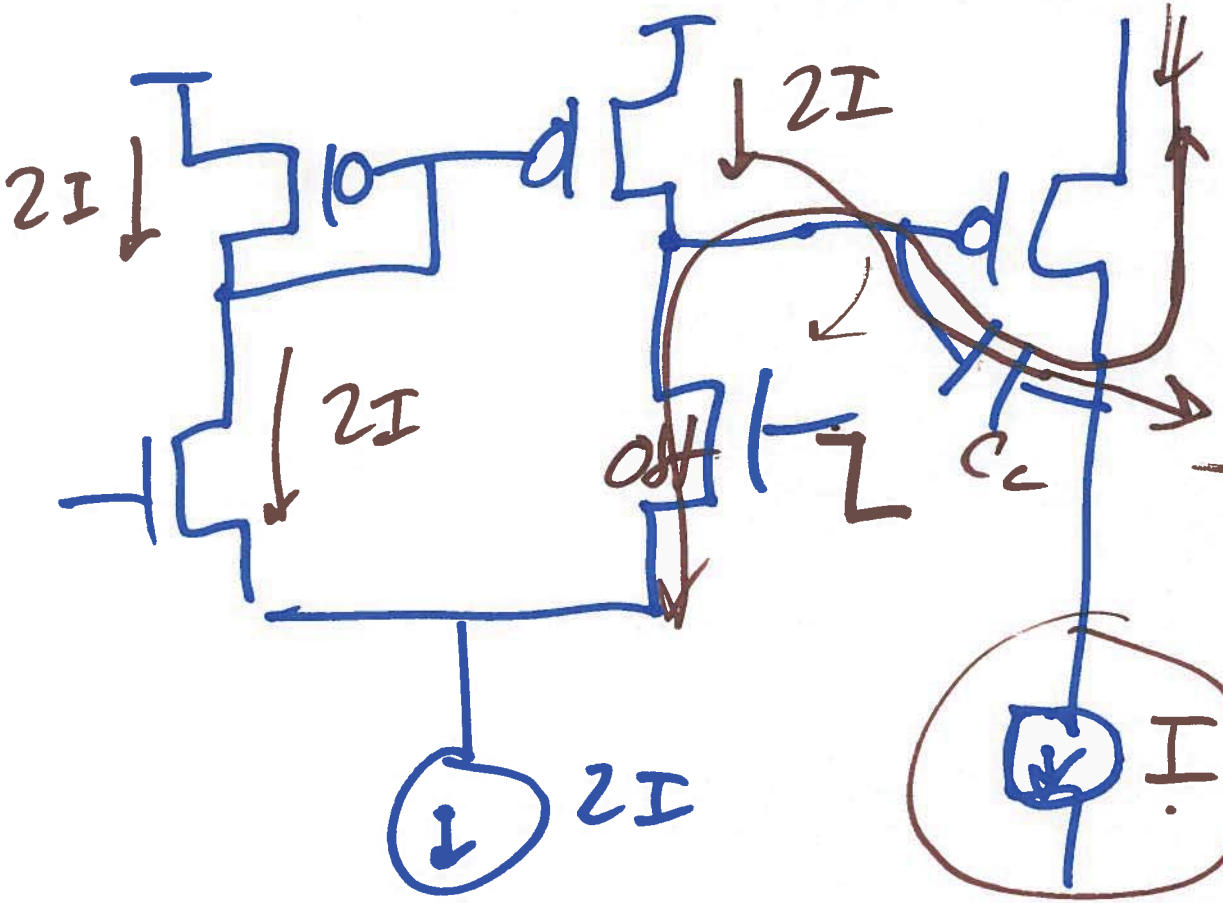
$V_{DS,SAT}$

$= 50mV$

$V_{SG} = V_{THP} + 0.05$

$950mV$





$10\mu A = I$ $\quad \frac{10V}{1s}$

$C = 1pF$ $\quad \frac{1s}{10^{-12}}$

$\frac{I}{C} = \frac{10\mu}{1pF} = \frac{10^{-6}}{10^{-12}}$

$\frac{I}{C} = \frac{dV_{OUT}}{dt}$

$SR = \frac{10V}{4s} = \frac{1V}{100ns} = \frac{10mV}{10ns}$

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