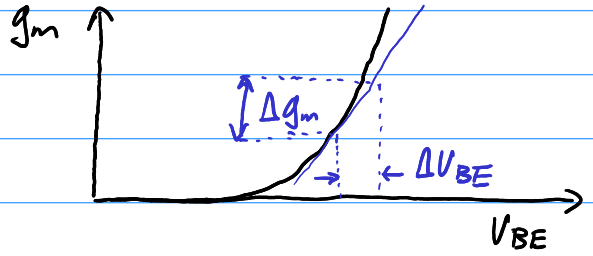
4.19 Given $I_C = 1\ mA$.
What is the largest change in V_{BE} to limit variations in g_m to $\pm 10\%$?

$$g_m = \frac{I_C}{V_T} = \frac{I_S}{V_T} \exp\left(\frac{V_{BE}}{V_T}\right)$$



consider the tangent to the curve.

$$\Delta g_m \approx \frac{\partial g_m}{\partial V_{BE}} \Delta V_{BE}$$

$$= \frac{I_S}{V_T} \exp\left(\frac{V_{BE}}{V_T}\right) \cdot \frac{1}{V_T} \cdot \Delta V_{BE}$$

$$= \frac{I_C}{V_T^2} \Delta V_{BE}.$$

Require $\left|\frac{\Delta g_m}{g_m}\right| \leq 0.1$

$\therefore \left|\frac{I_C \Delta V_{BE}}{V_T^2 I_C / V_T}\right| \leq 0.1$

$\left|\frac{\Delta V_{BE}}{V_T}\right| \leq 0.1$

$\therefore |\Delta V_{BE}| \leq 2.6\ mV.$