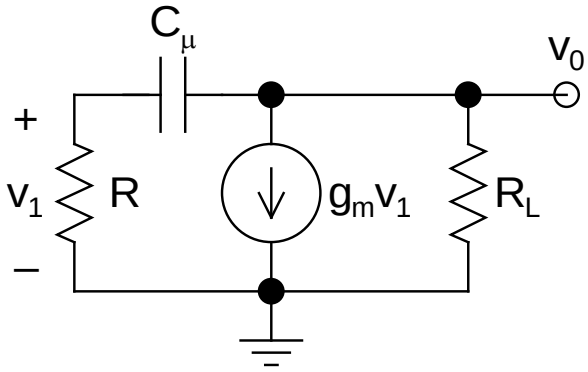
- ***CE***:
  - Refer to the ***high-frequency equivalent*** given in the ***exact analysis***
  - ***2 capacitors***: C_π and C_μ

    $\Rightarrow$ ***2 time constants***: τ_1 and τ_2
  - C_π:
    - C_μ ***opens up***
    - ***By inspection***:

      $R_\pi^0 = R_S \,||\, r_\pi$

      $\Rightarrow \tau_1 = R_\pi^0 C_\pi$

- ***C_μ***:
  - ***C_π opens up***
  - This is one ***Standard Form***, known as the ***Three-Legged Creature***
  - Show that:



$$R_\mu^0 = R + R_L + g_m R_L R \quad \left(R = R_S \,||\, r_\pi\right)$$

$$\Rightarrow \tau_2 = R_\mu^0 C_\mu$$

- Thus, $\tau_{net} = \tau_1 + \tau_2$, and $f_H = 1/(2\pi\tau_{net})$
- Note the ***amazing simplicity*** of the analysis

- Putting ***values*** of our previous ***example***:

$$R_{\pi}^{0} = 838.7\ \Omega,\ \ \tau_1 = 8.4\ \text{ns}$$

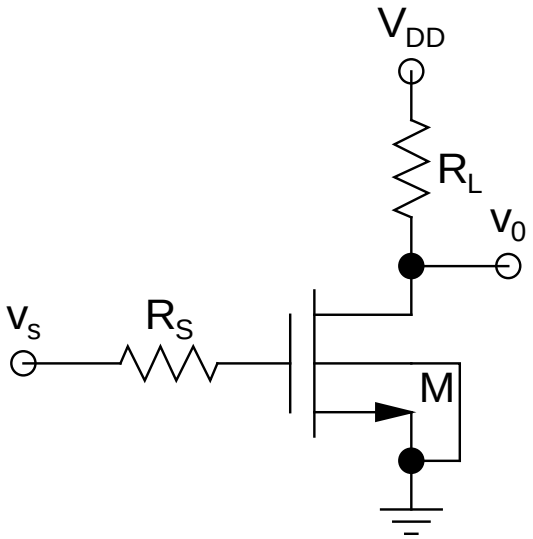
$$R_{\mu}^{0} = 67.4\ \text{k}\Omega,\ \ \tau_2 = 33.7\ \text{ns}$$

$$\Rightarrow \tau_{\text{net}} = 42.1\ \text{ns}\ \ \text{and}\ \ f_H = 3.8\ \text{MHz}$$

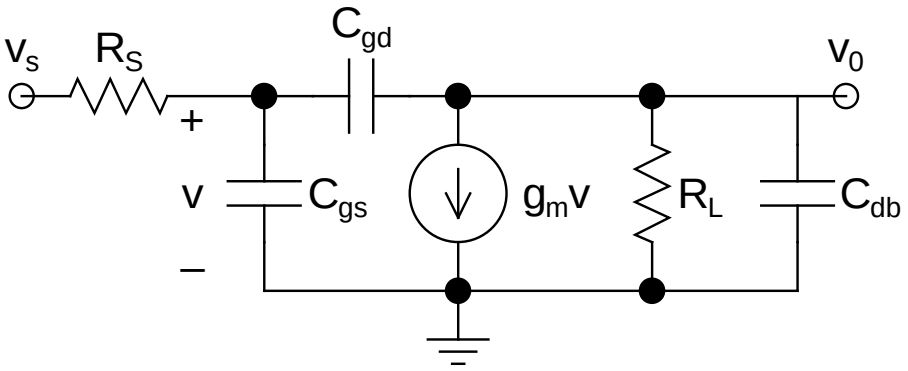
- This is ***identical*** to the ***result*** obtained from the ***exact analysis***, however, at a ***fraction*** of the ***effort***!
- Also, τ_2 ***is the dominant time constant***

  $\Rightarrow$ f_H ***is primarily dictated by*** C_{μ}

- ***CS***:



ac Schematic



High-Frequency Equivalent

➢ ***C_{sb} absent*** (***Why***?)

- ***3 capacitors***: C_{gs}, C_{gd}, and C_{db}

  $\Rightarrow$ ***3 time constants***: τ_1, τ_2, and τ_3

- C_{gs}:
  - C_{gd} ***and*** C_{db} ***open up***
  - ***By inspection***:

    $$R_{gs}^{0} = R_S$$

    $$\Rightarrow \tau_1 = R_{gs}^{0} C_{gs}$$

- C_{gd}:
  - C_{gs} ***and*** C_{db} ***open up***
  - ***By inspection***, it can be ***identified*** as a ***Three-Legged Creature***

- Thus:

$$R_{gd}^{0} = R_S + R_L + g_m R_S R_L$$

$$\Rightarrow \tau_2 = R_{gd}^{0} C_{gd}$$

➢ ***C_{db}***:

- ***C_{gs} and C_{gd} open up***
- ***By inspection***:

$$R_{db}^{0} = R_L$$

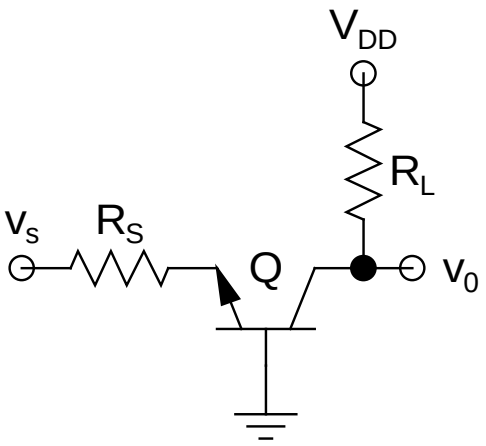
$$\Rightarrow \tau_3 = R_{db}^{0} C_{db}$$

➢ Thus:

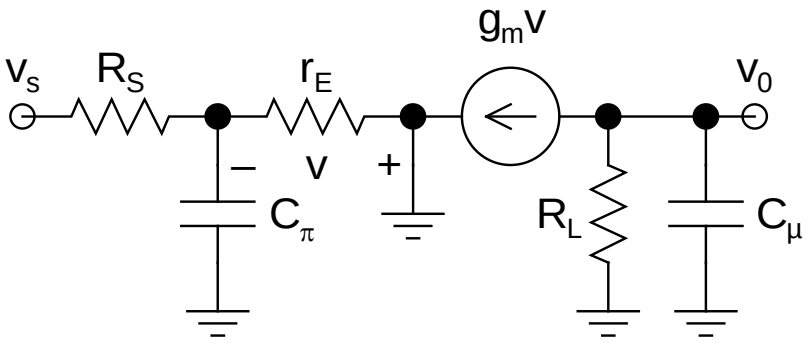
$\tau_{net} = \tau_1 + \tau_2 + \tau_3$, and $f_H = 1/(2\pi\tau_{net})$

➢ ***Mind-bogglingly simple*** - isn't it?

- ***CB***:



ac Schematic



High-Frequency Equivalent

➢ ***Note that there is no input-output coupling capacitor present in this circuit***

⇒ ***Miller effect will be absent***, and the ***circuit will have very high*** f_H