Charge Sharing Walk-Through

Phase 1:

Phase 2:

\[ Q_{\text{out}} = \text{Uout} \cdot (C_{\text{eq}} + C_{\text{ref}}) \]

\[ Q_{\text{out}} = C_{\text{eq}} \cdot V_{\text{eq}} + C_{\text{ref}} \cdot V_{\text{ref}} \]
\[ Q_{\text{out}} = \frac{C_{\text{eq}}}{C_{\text{eq}} + C_{\text{ref}}} \cdot V_e \]

**How about more complicated problems?**

For the switch capacitor circuit below, calculate the value of all node voltages at the end phase 2, as a function of the voltage source \( V_s \) and the capacitors \( C_1, C_2 \).

**Step 1: Label capacitor polarity**

**Step 2: Redraw the circuit during the two phases**
Step 3: \( \text{(Important)} \)

Identify all "floating" nodes during phase 2. Those are the nodes where we will apply charge conservation (sharing).

\( u_3 \) is our only floating node!
Step 4: Identify all capacitor plates connected to my floating node (phase 2). Calculate the charge on these plates during phase 1.

\[ Q_{C_1}^{\text{f1}} = + C_1 V_{C_1}^{\text{f1}} + C_2 V_{C_2}^{\text{f1}} \]
\[ = C_1 (V_1 - 0) + C_2 (0 - 0) \]
\[ = C_1 \cdot V_1 \quad (1) \]

Step 5: Calculate the total charge on the floating node during phase 2.
\[ Q_{e_2} = +C_1V_{e_1} + C_2V_{e_2} \]
\[ = C_1(u_3 - u_e) + C_2(u_3 - 0) \]
\[ = C_1(u_3 - V_s) + C_2u_3 \quad (2) \]

Step 6: Equate the charges from phase 1 and phase 2 — charge conservation

(1), (2): \[ C_1 \cdot V_s = C_1(u_3 - V_s) + C_2 u_3 \]

\[ \Rightarrow 2C_1 V_s = (C_1 + C_2) u_3 \]

\[ \Rightarrow u_3 = \frac{2C_1}{C_1 + C_2} \cdot V_s \]