Anthony Ding

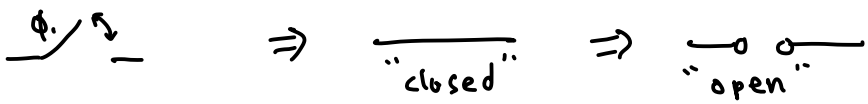
Week 8 Cribsheet

NOTES: 17, 17B

CHARGE SHARING

When useful: to analyze circuits with capacitors and switches

switch: a circuit elt that "switches" between short / open



key principles of charge sharing: ★ important:

- charge cannot move through capacitor plates
- charge is conserved in <u>floating nodes</u>

floating node: a node that always ends in { open circuit / capacitor }

↳ aka. charge cannot enter or leave

Set of phases $\phi_1, \phi_2, \ldots$. Each one closes / opens some switches

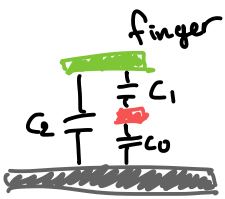
STEPS

1. label capacitors with voltages and polarities (+/-)
2. draw the circuit versions in each phase ϕ_i
3. identify the floating nodes in these phases
4. amount of charge on floating nodes is invariant, write eqns
5. use eqn in step 4 to solve for desired quantity

CAPACITIVE TOUCHSCREEN

at each pixel:

without touch

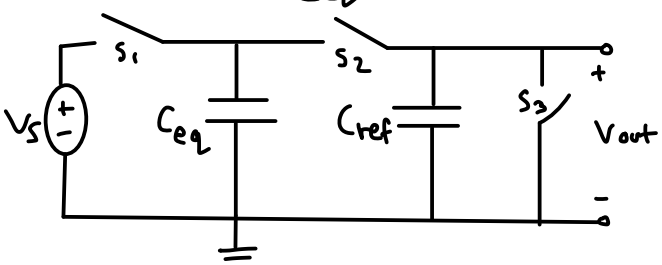


with touch

$\rightarrow C_{eq} = C_0 + C_1 \| C_2$

each combination of red/gray bars represents a (x,y) pixel

Circuit to measure C_{eq}: (can solve w charge sharing)



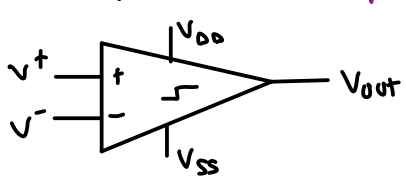
	Φ_1	Φ_2
S_1	closed	open
S_2	open	closed
S_3	closed	open

Solving for C_{eq}, we get $V_{out} = \frac{C_{eq}}{C_{eq} + C_{ref}} V_S$

(V_{out} is an observable property and C_{ref}, V_S constant)

want to know whether C_{eq} has changed (indicating touch)

connect V_{out} to a comparator:



$$V_{out} = \begin{cases} V_{DD} & \text{if } V^+ > V^- \\ V_{SS} & \text{if } V^+ < V^- \end{cases}$$