EENG 4250/ENAS 8750
Introduction to VLSI System Design

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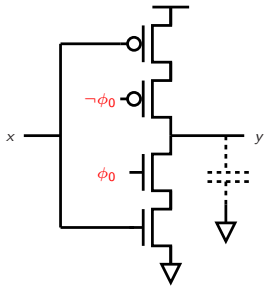
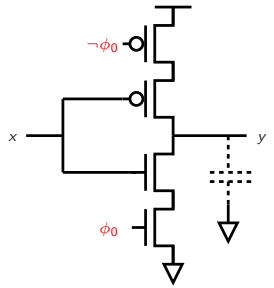
Charge sharing





Which is better?

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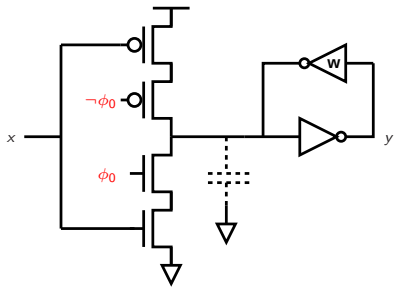
Charge sharing

Problem: *dynamic* gate



Example weak gate:

- weak nfet: $3\lambda \times 12\lambda$
- weak pfet: $3\lambda \times 8\lambda$

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Drive strength

Recall:

$$I \propto \frac{W}{L}$$

W term from parallel paths; $1/L$ term:

- Sub-threshold, diffusion dominates;

$$I \propto \frac{dN}{dx} \propto \frac{1}{L}$$

- Above threshold, drift dominates;

$$I \propto E = -\frac{dV}{dx} \propto \frac{1}{L}$$

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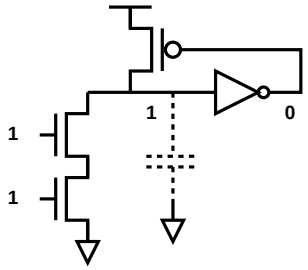
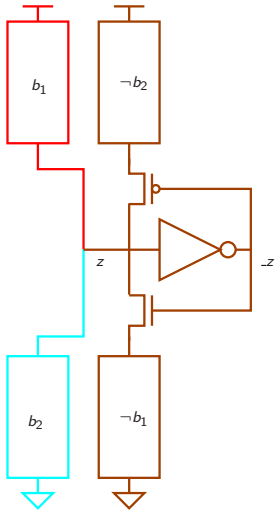
Opposing transistors



- Voltage moves toward *Vdd* through pfets
- Voltage moves toward *GND* through nfets

Depends on the relative magnitude of the current.

Combinational feedback



Inverter behavior

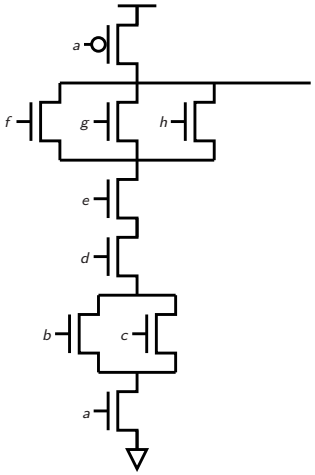
At some point, the output of the inverter will change and turn off the pfet;

What determines this?

- W/L ratio of the transistors in the inverter!

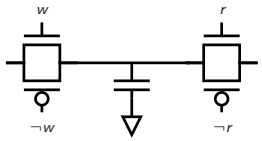
Typical curve?

Estimating charge sharing



Registers

Store state on capacitors:



Problems? Issues?

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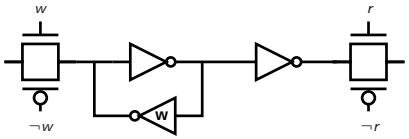
Registers

Add a staticizer:



Problems? Issues?

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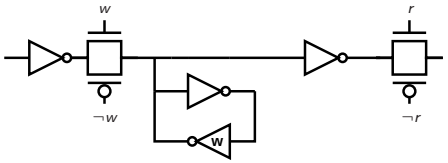
Registers

Safer design:



Problems? Issues?

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Faster logic

We'd like to compute with nfets;

In particular, lots of parallel nfets...

Restoring combinational logic: results in long series pfet chains.

How do we fix this?

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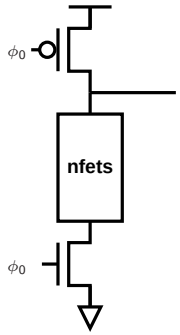
Precharge logic

Idea: each section of combinational logic has active and idle periods.



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