# Precharged logic

Dynamic Logic Gate

- Precharged logic uses stored charge to help evaluation.
- Precharge node, selectively discharge it.
- Take advantage of higher speed of n-types.
- Requires multiple phases for evaluation.

Domino logic

- Uses precharge clock to compute output in two phases:
  – precharge;
  – evaluate.
- Is not a complete logic family—cannot invert.
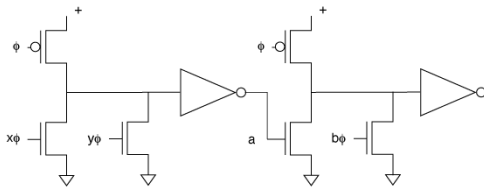
Domino gate structure
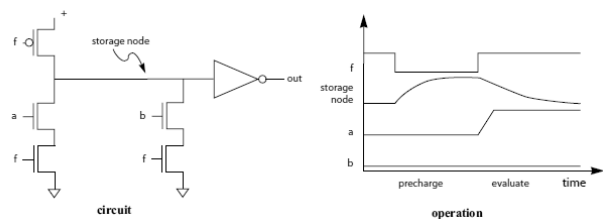
Domino phases

- Controlled by clock ϕ.
- Precharge: p-type pullup precharges the storage node; inverter ensures that output goes low.
- Evaluate: storage node may be pulled down, so output goes up.

Monotonicity

- Domino gates inputs must be increasing monotonically

  – 0 -> 0
  – 0 -> 1
  – 1 -> 1
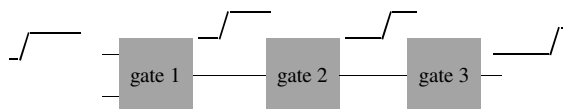 – But not 1 -> 0

Domino buffer

- Output inverter is needed for two reasons:
  – make sure that outputs start low, go high so that domino output can be connected to another domino gate;
  – protects storage node from outside influence.

Domino effect

Gate outputs fall in sequence:

gate 1   gate 2   gate 3

Output buffer

- Inverting buffer isolates storage node. Storage node and inverter have correlated values.

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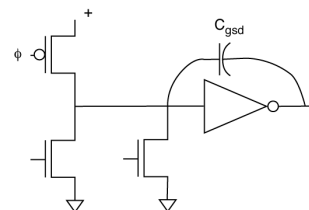
Using domino logic

- Can rewrite logic expression using De Morgan's Laws:
  - $(a + b)' = a'b'$
  - $(ab)' = a' + b'$
- Add inverters to network inputs/outputs as required.

Domino and stored charge

- Charge can be stored in source/drain connections between pulldowns.
- Stored charge can be sufficient to affect precharge node.