Lecture 16

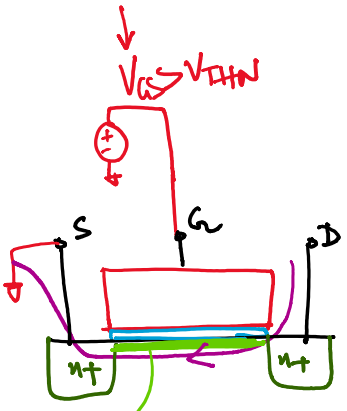
Wednesday, February 21, 2018 10:32 AM

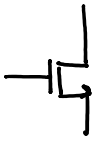
CMOS Technology

↳ Complementary MOS (FET)

↳ MOS

↳ N-type & P-type transistors

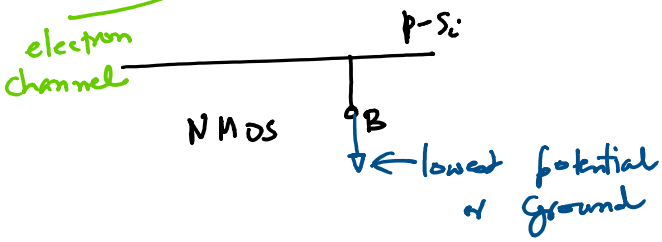


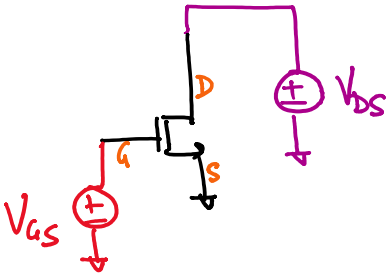


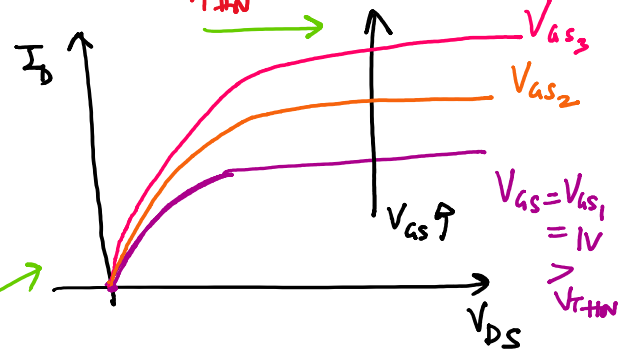
a) Accumulation

b) Depletion

c) Inversion





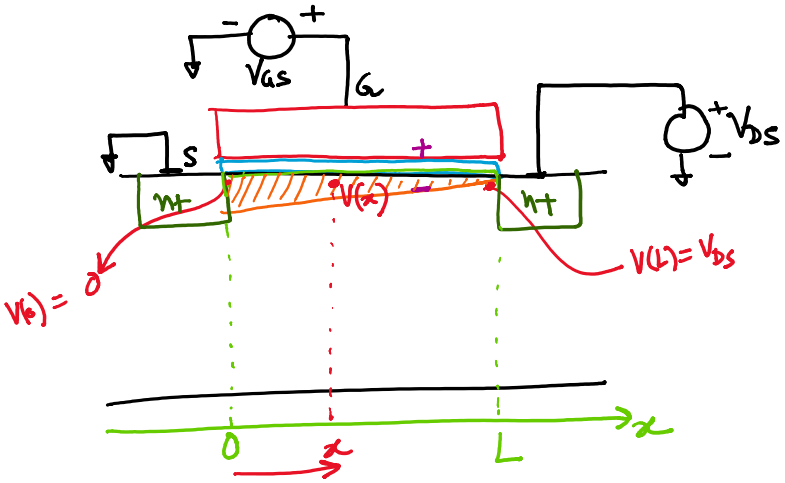


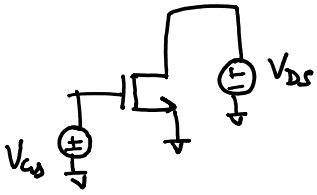
Derive Equations for $I_D = f(V_{GS}, V_{DS})$

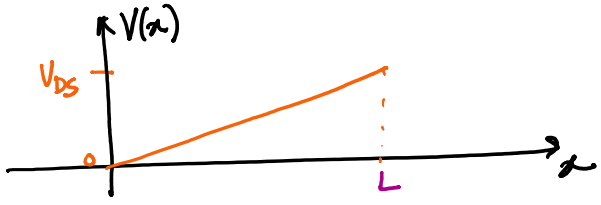
Voltage drop across the gate oxide across the channel

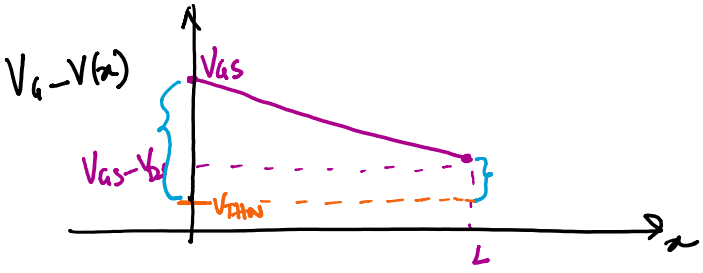
Wednesday, February 21, 2018 12:18 PM

L ≡ Length









* To form a channel under gate oxide,

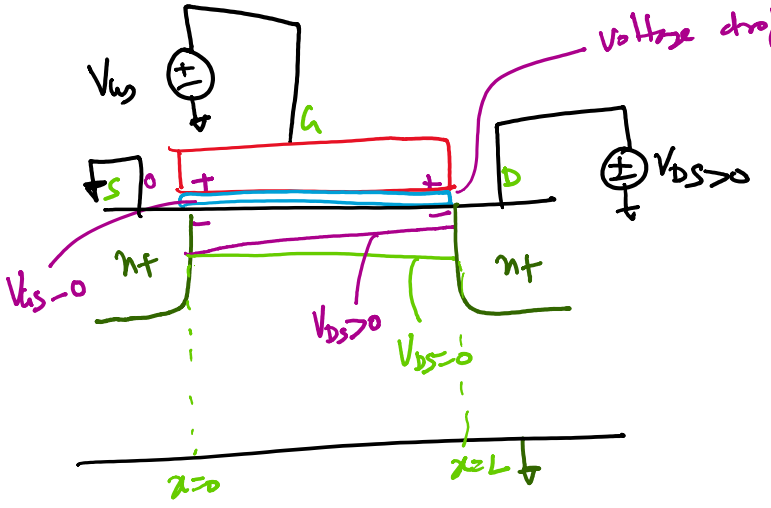
$V_{GS} - V(x) > V_{THN}$ (Inversion)

Channel charge density varies across its length

Wednesday, February 21, 2018 12:18 PM

* for $V_{DS} > 0$, the $V_{GS} - V(x)$ gradually drops across the channel

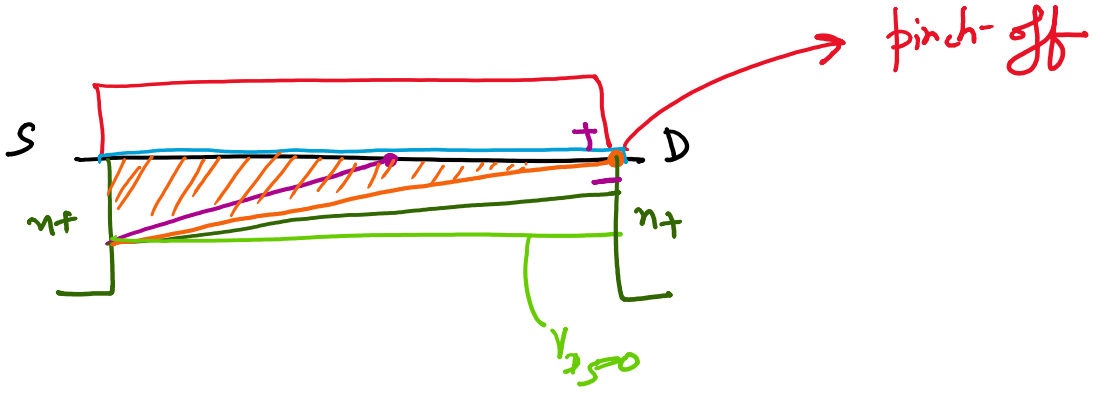
↳ The density of electrons in the channel follows the trend of $V_{GS} - V(x)$, and falls to a minimum at $x = L$



"thinner" channel for $V_{DS} > 0$ at the drain end of the channel.

Channel Pinch-off

Wednesday, February 21, 2018 12:19 PM

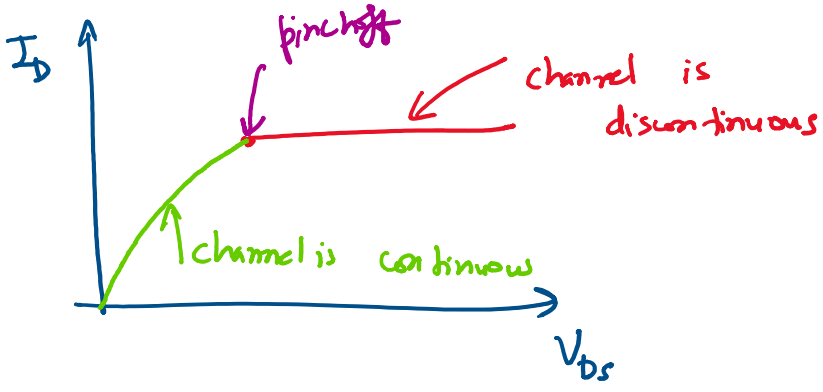


$V_{GS} - V_{DS} > V_{THN}$ for inversion

$\Rightarrow \quad V_{DS} < V_{GS} - V_{THN}$

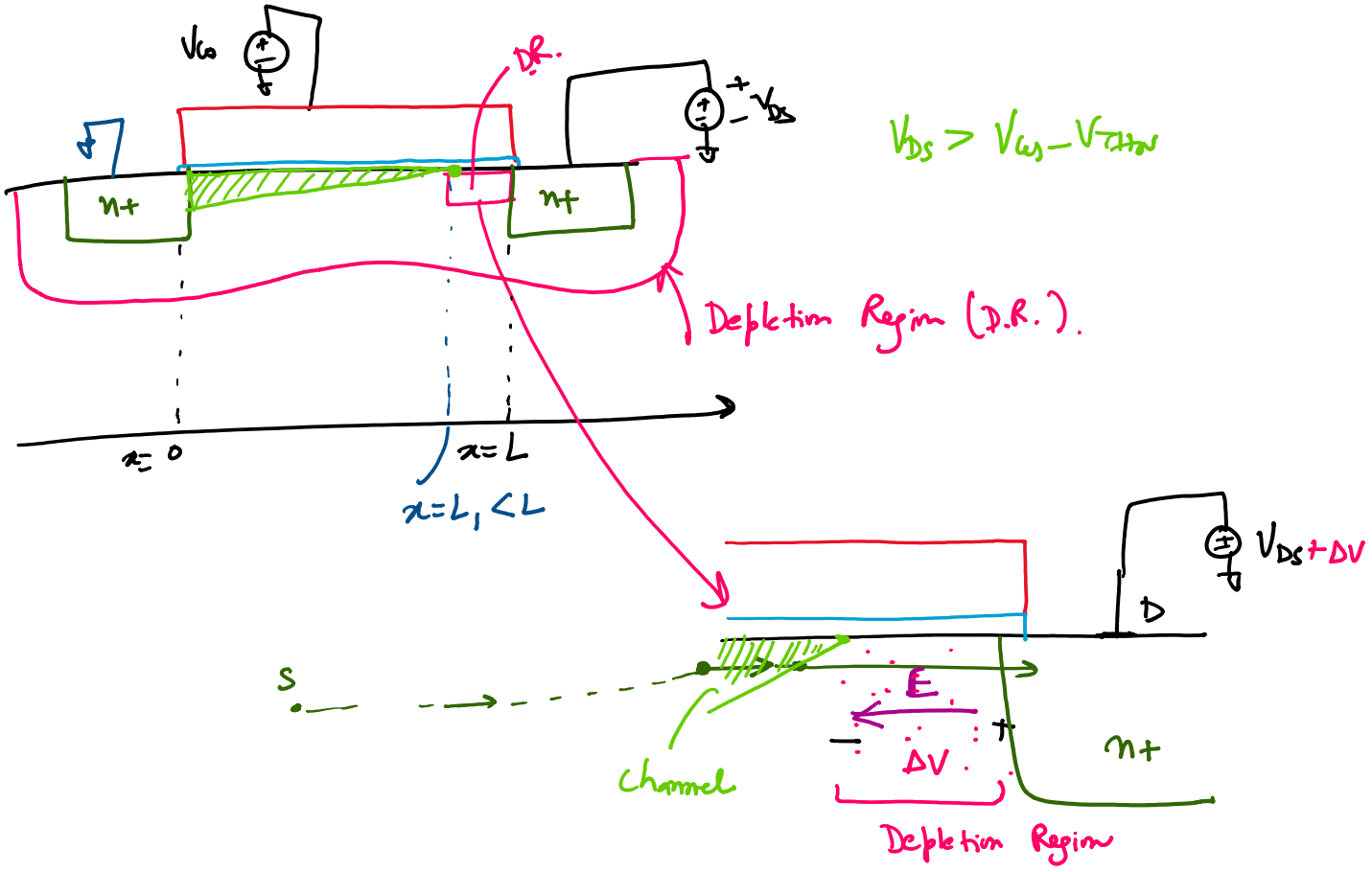
The moment V_{DS} exceeds $V_{GS} - V_{THN}$, pinchoff of the channel occurs.

* Beyond pinchoff, the channel is no longer continuous between Drain & Source.



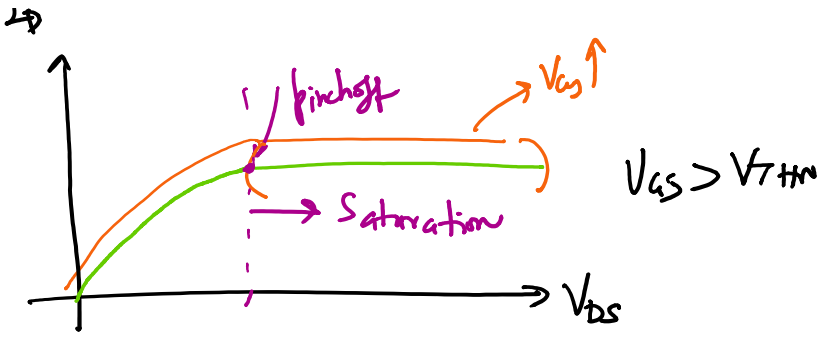
Why does the drain current saturate beyond Pinchoff?

Wednesday, February 21, 2018 12:19 PM

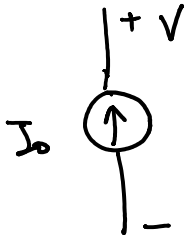


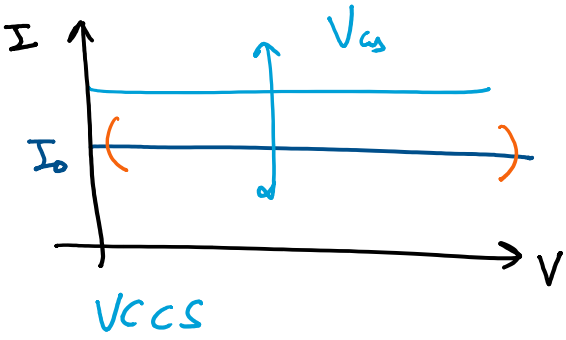
Most of the voltage drop is across the depletion region (D.R.)

* once the electrons (from Source) reach the end of the channel, they experience high E-field in the D.R.
  - ↳ rapidly swept off to the drain terminal
  - ↳ still we have current flow
  - ↳ drain terminal voltage (V_{DS}) no longer affects this current significantly.
  - ↳ SATURATION of current



$V_{GS} > V_{Thn}$





VCCS