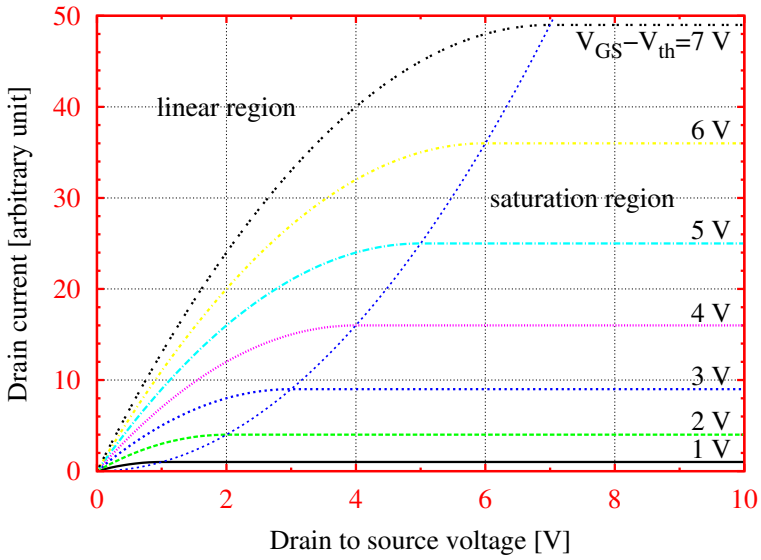


V_{GS}	V_{DS}	Mode	I_{DS}
$> V_{th}$	$< V_{GS} - V_{th}$	Resistive	$\mu_n C_{OX} \left(\frac{W}{L}\right) \left((V_{GS} - V_{th}) V_{DS} - \frac{(V_{DS})^2}{2} \right)$
	$> V_{GS} - V_{th}$ & $< V_{DSAT}$	Saturation	$\frac{\mu_n C_{OX}}{2} \left(\frac{W}{L}\right) (V_{GS} - V_{th})^2$
	$> V_{DSAT}$	Velocity Saturation	$\nu_{sat} C_{OX} W \left(V_{GS} - V_{th} - \frac{V_{DSAT}}{2} \right)$
$< V_{th}$		Subthreshold	$I_S \left(\frac{W}{L}\right) e^{\frac{V_{GS} - V_{th}}{nkT/q}}$

1. Consider an NMOS transistor with L_{eff}=25nm and V_{ds}=1V

   (a) What is the electrical field (F) in V/μm in the channel between source and drain?

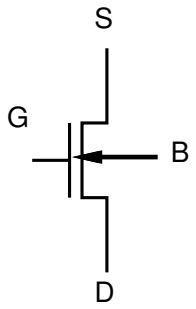
   ($F = V/L$)

   (b) With an electron mobility of μ_n=500 cm^2/ (V $\cdot$ s), what is the velocity of the electron in this field? (in m/s)?

   (velocity $v = \mu \times F$)

   (c) At what V_{ds} voltage does the velocity reach 10^5 m/s ?

2. How many capacitance values might we need to represent a 4-terminal transistor? (fourth terminal is body)

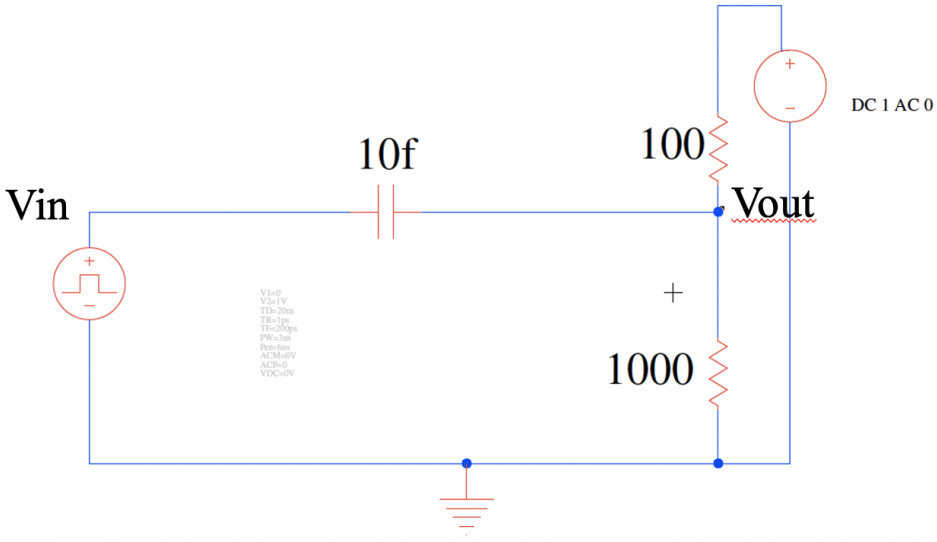


Hint: How many terminal pairs are there?

Terminal Pair	Capacitance

Use in class for notes to summarize cases and capacitances.

3. Assuming a step input from 0 to 1V by the pulse generator on the left, what does the voltage on $Vout$ as a function of time look like?



Hints: What is the initial voltage? What is the steady-state voltage as $t \to \infty$?