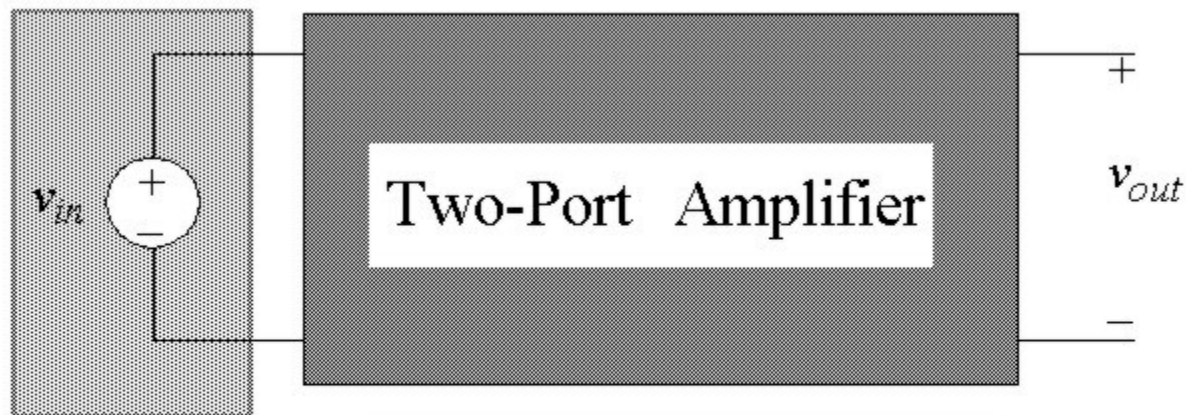# Lecture 25

- ## Last time:
  - Two-port small-signal models of amplifiers

- ## Today :
  - Finish methods for finding two-port model parameters
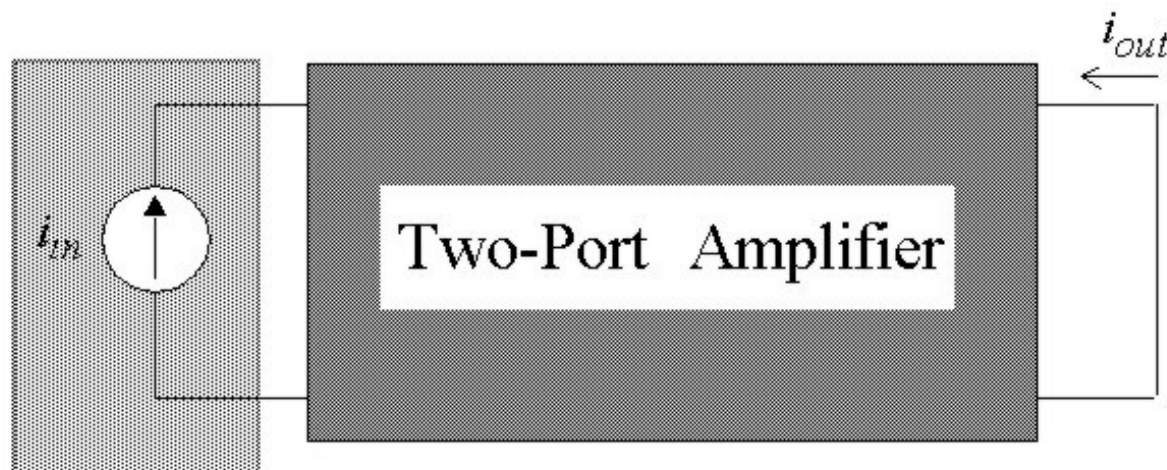 - Start common-source amplifier

Finding the Voltage Gain A_v

Key idea: the output port is open-circuited and the source resistance is shorted

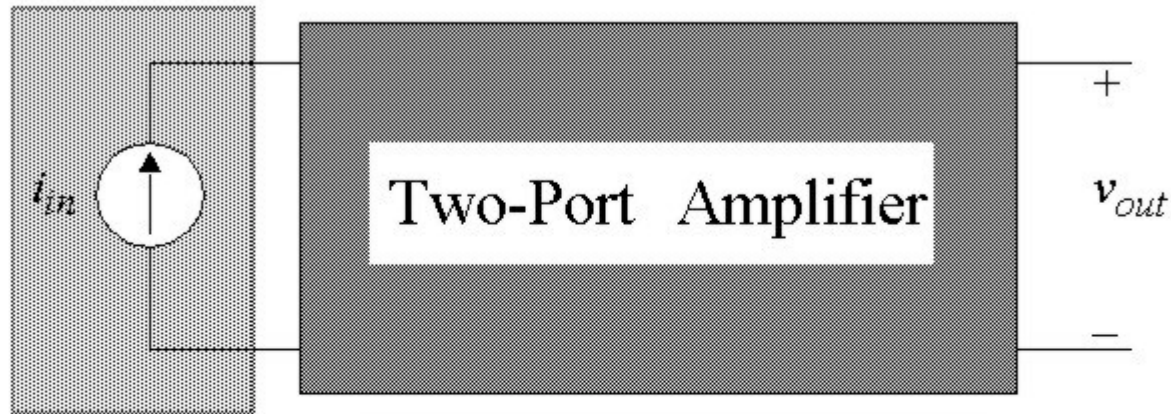$$A_v = \left. \frac{v_{out}}{v_{in}} \right|_{R_S = 0,\ R_L \to \infty}$$

Finding the Current Gain A_i

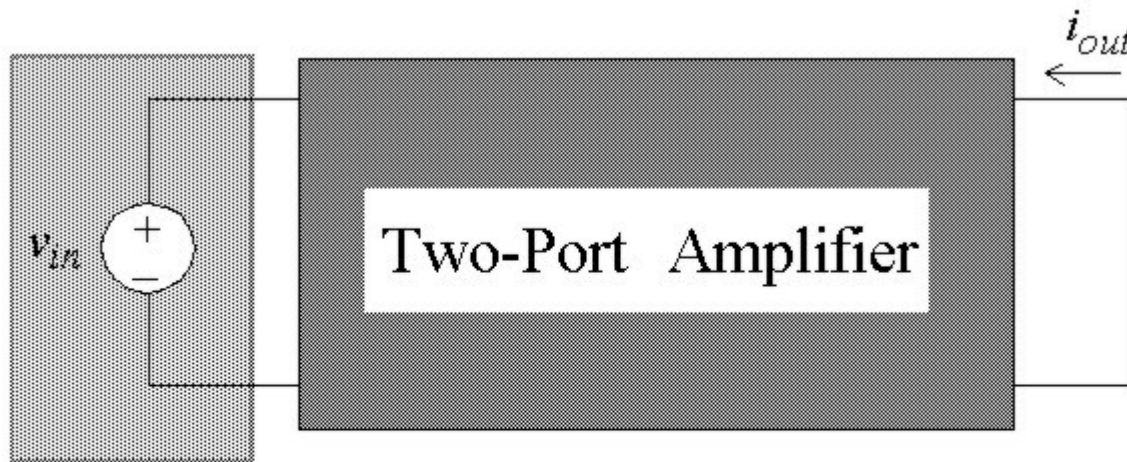Key idea: the output port is shorted and the source resistance is removed

$$A_v = \left. \frac{i_{out}}{i_{in}} \right|_{R_S \to \infty,\ R_L = 0}$$
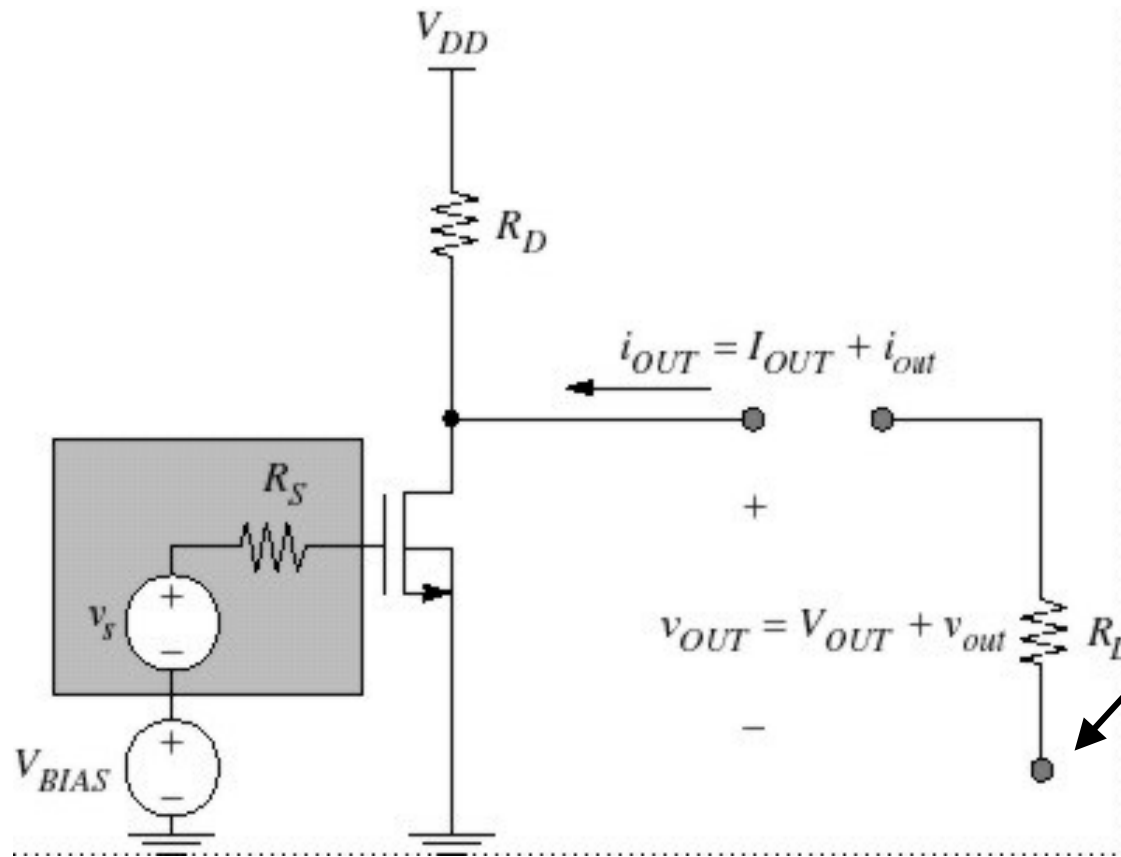
Finding the Transresistance R_m

$$R_m = \left. \frac{v_{out}}{i_{in}} \right|_{R_S \to \infty, \, R_L \to \infty}$$
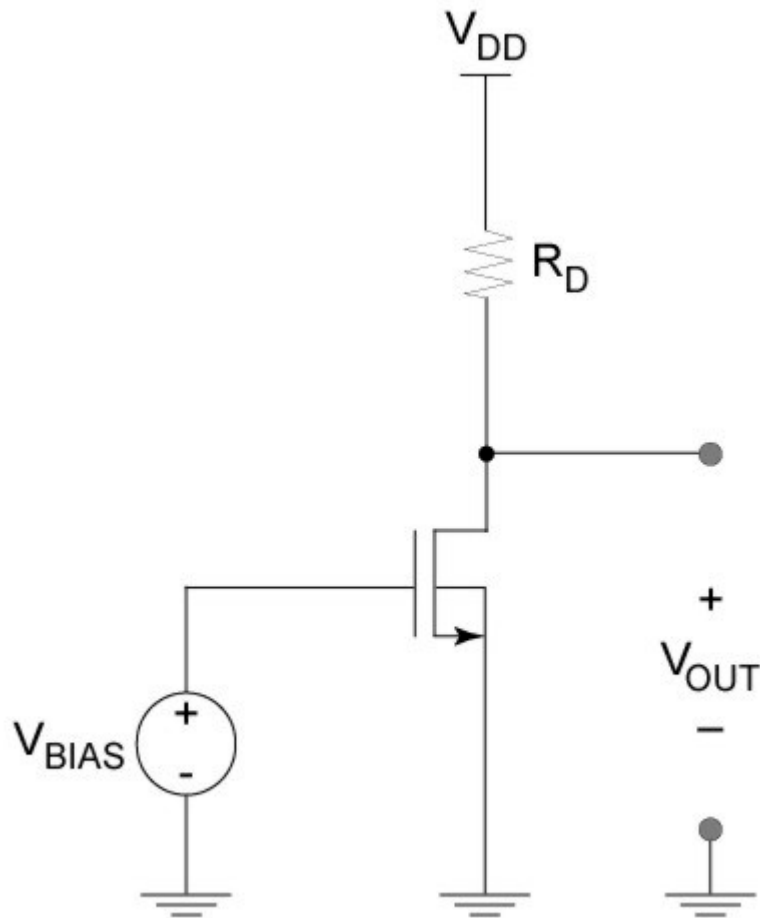
Finding the Transconductance G_m

$$G_m = \left. \frac{i_{out}}{v_{in}} \right|_{R_S = 0, \, R_L = 0}$$
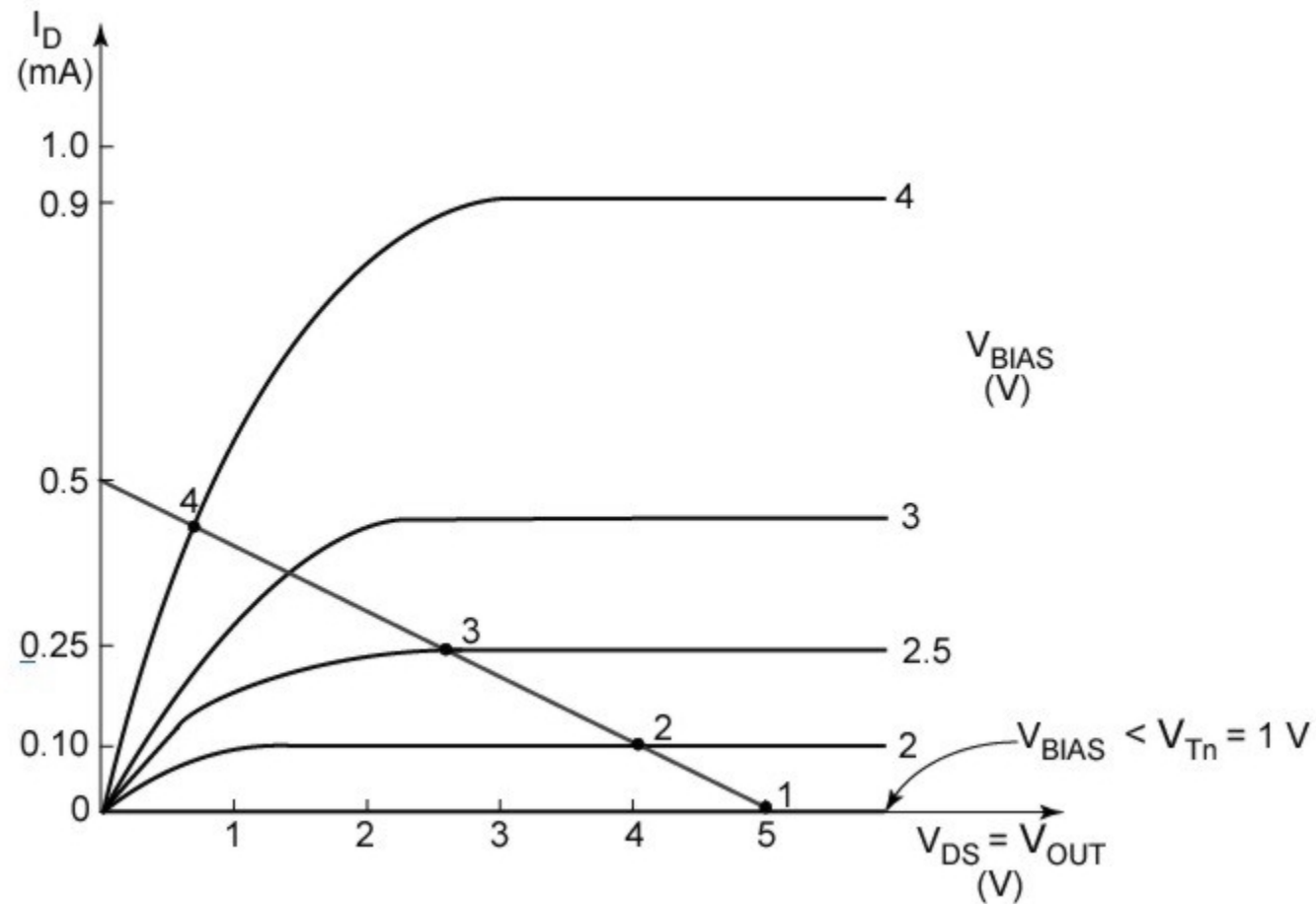
First Example: the Common-Source Amplifier (again)

V_{DD}

R_D

$i_{OUT} = I_{OUT} + i_{out}$

R_S

v_s

V_{BIAS}

$+$

$v_{OUT} = V_{OUT} + v_{out}$ R_L

$-$

What about the load resistor?

DC Bias

Load line analysis:

Load-Line Analysis to find *Q*

DC Transfer Function

V_{OUT}

V_{BIAS}
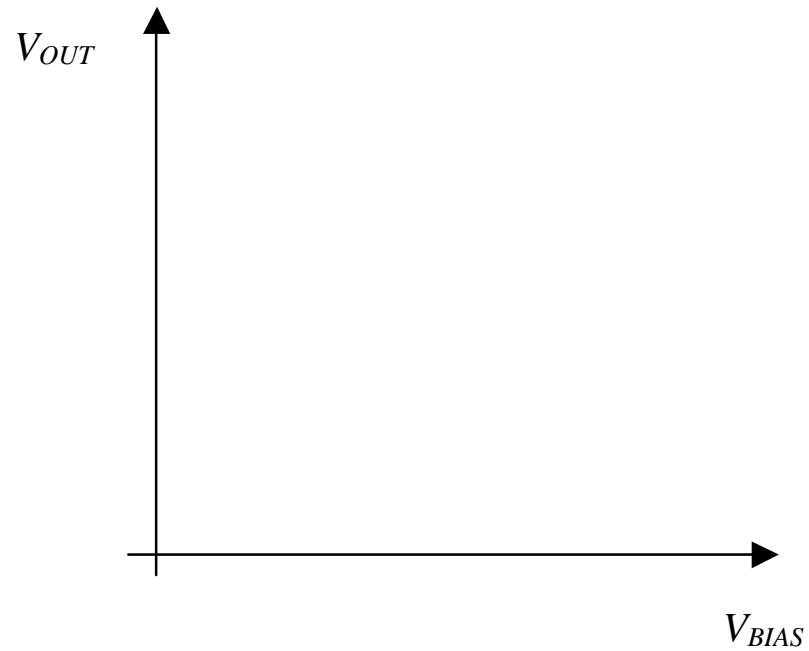
Small-Signal Analysis
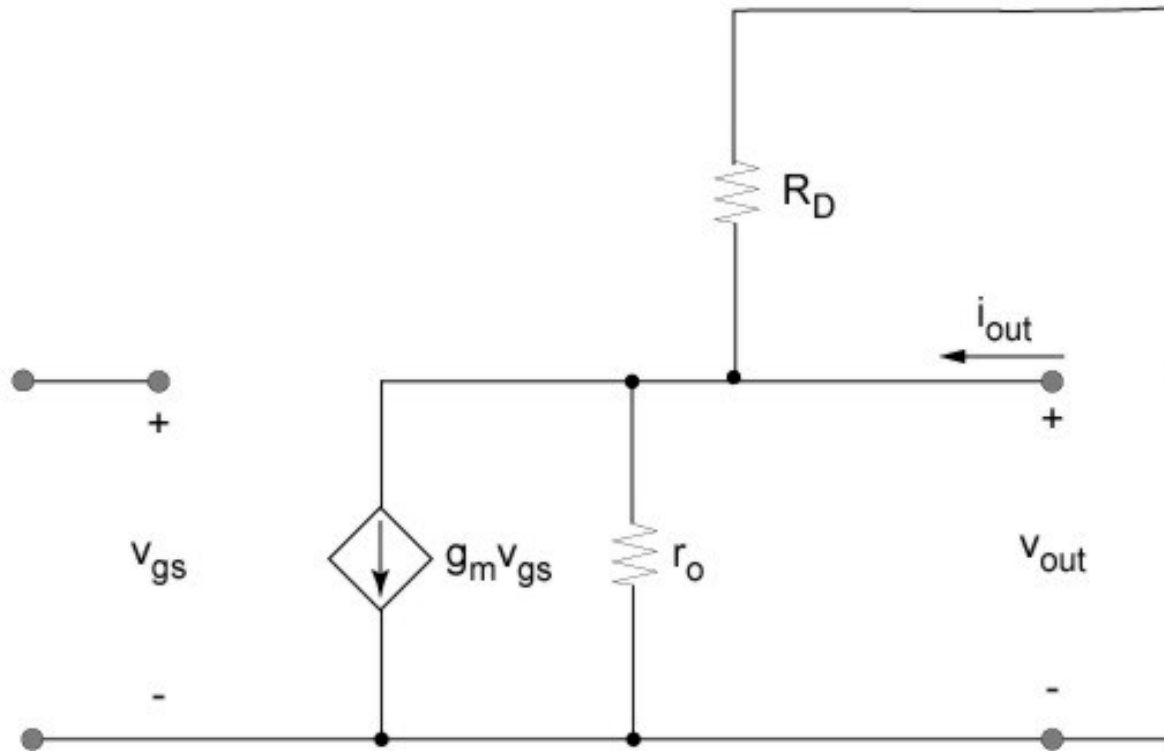
Two-Port Parameters:

Find R_{in}, R_{out}, G_m

Two-Port CS Model

Reattach source and load one-ports: