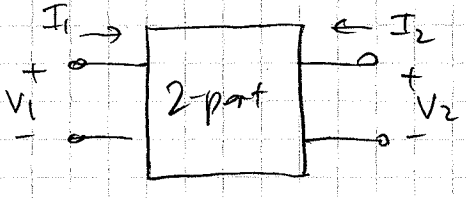
Two-Port Network Parameters (Appendix B)

ECE 3110: Lecture # 21

→ Used to characterize a linear two port network.
- four variables of interest



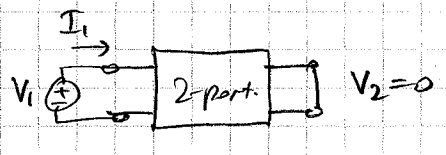
→ Four different types of network parameters, depending on which variables are being "excited" and which are being observed.

y-parameters – assume V_1, V_2 are being set and I_1, I_2 are being observed:

$$I_1 = y_{11} V_1 + y_{12} V_2$$
$$I_2 = y_{21} V_1 + y_{22} V_2$$

→ To find parameters: for $y_{11} = \left.\frac{I_1}{V_1}\right|_{V_2=0}$

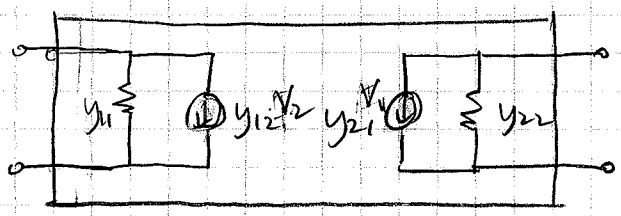
- short V_2, apply V_1 and measure I_1:



Similarly, for $y_{12} = \left.\frac{I_1}{V_2}\right|_{V_1=0}$ – short V_1, apply V_2 and measure I_1.

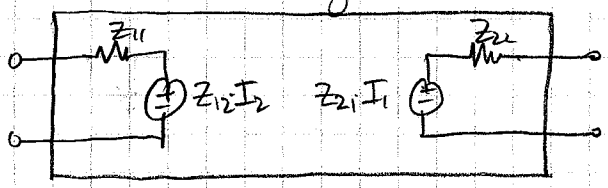
→ Same idea for y_{21}, y_{22}.

→ Internal representation:



z-parameters – assume I_1, I_2 being set and V_1, V_2 being observed:

$$V_1 = z_{11} I_1 + z_{12} I_2$$
$$V_2 = z_{21} I_1 + z_{22} I_2$$



Others are a mix of currents & voltages:

h-parameters (we used these to model β)

$$V_1 = h_{11} I_1 + h_{12} V_2$$
$$I_2 = h_{21} I_1 + h_{22} V_2$$

g-parameters

$$I_1 = g_{11} V_1 + g_{12} I_2$$
$$V_2 = g_{21} V_1 + g_{22} I_2$$

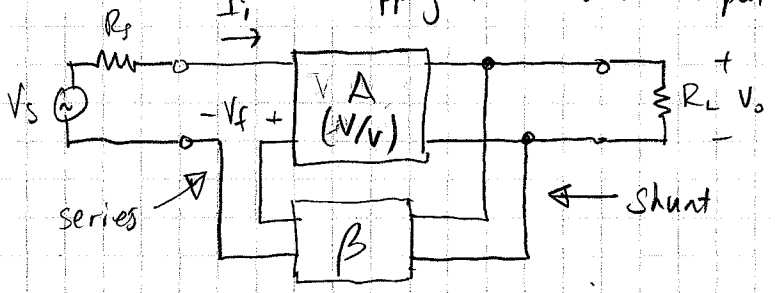
→ If you know one set you can convert to any other.
→ Choose whichever is computationally most convenient.

→ We have spent a lot of time talking about abstract concepts of feedback, stability, and compensation.
→ Now we will spend some time examining actual circuit topologies that use feedback.

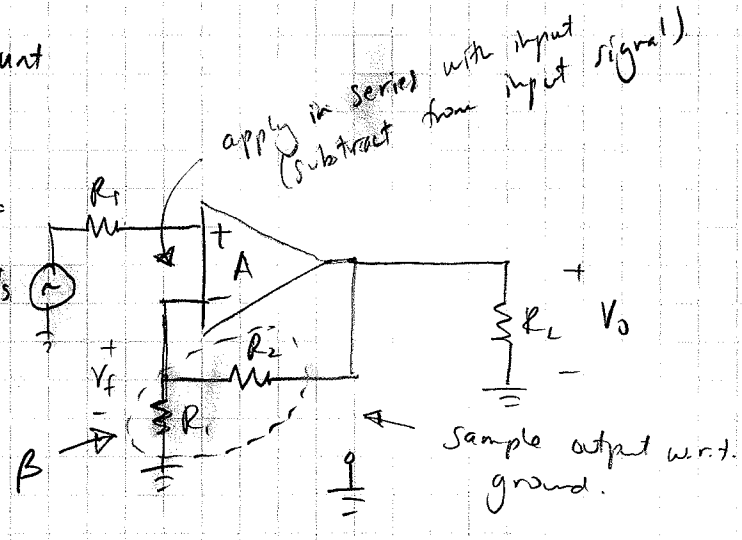
Feedback Topologies

① Voltage Amplifiers - voltage input, voltage output

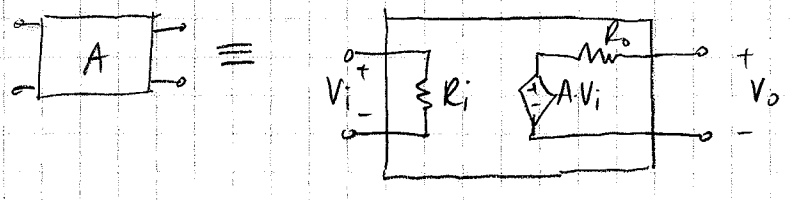
→ Series-shunt feedback
↑ sample output voltage in shunt (parallel) configuration
↑ apply in series with input signal.



Example: Non-inverting Op-amp circuit:

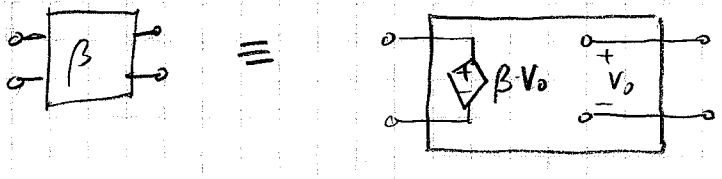


→ Recall that a voltage amplifier (block A above) can be modeled as a VCVS with some input & output resistances:



→ Applying feedback has effects on three properties of the amplifier:
① Input resistance (increases)
② Output resistance (decreases)
③ Gain (reduces & stabilizes w.r.t. ΔA).

Let's examine these effects, model β block as follows:



- here we assume that β is unilateral (gain in one direction only) and does not load the output.