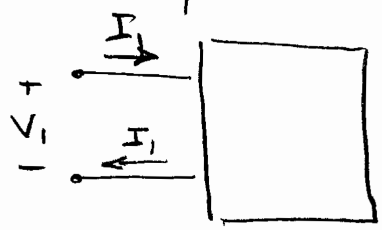
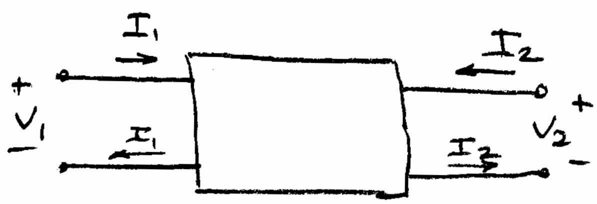
7. TWO-PORT NETWORKS $\boxed{\text{DC+L Chapt 19}}$

- One-port networks have a single current-voltage interface

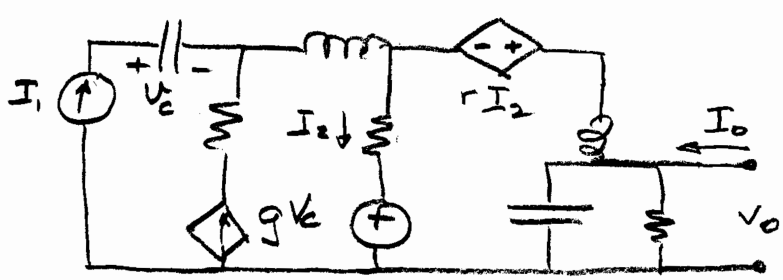


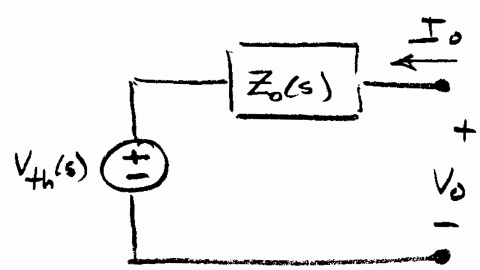
Two-ports have two such interfaces:



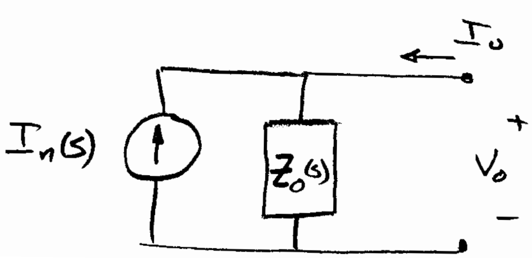
Examples include amplifiers and transformers.

- Recall that Thévenin and Norton equivalent circuits greatly simplify the representation of complicated one-ports:



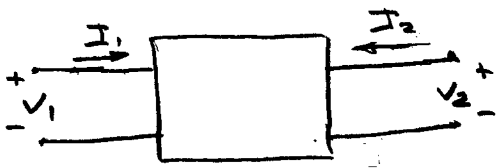


$$V_o(s) = V_{th}(s) + Z_o(s)\, I_o(s)$$



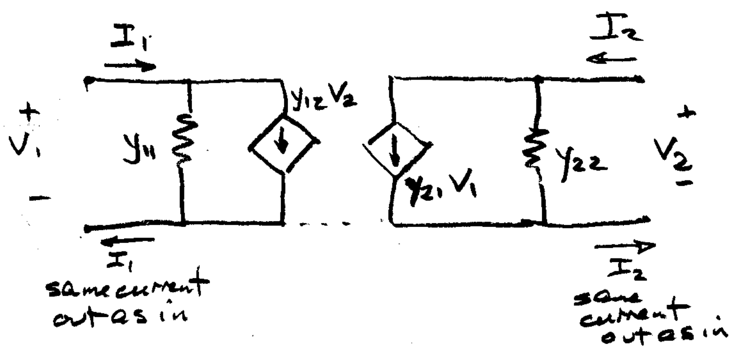
$$I_o(s) = -I_n(s) + Y_o(s)\, V_o(s)$$

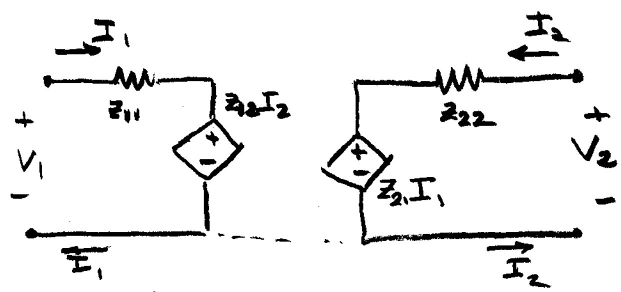
- In the same spirit, we can represent a complicated two port by simplified models. Of several possible, here are a couple:



$$\begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} y_{11} & y_{12} \\ y_{21} & y_{22} \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \end{bmatrix}$$

$$\begin{bmatrix} V_1 \\ V_2 \end{bmatrix} = \begin{bmatrix} z_{11} & z_{12} \\ z_{21} & z_{22} \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix}$$



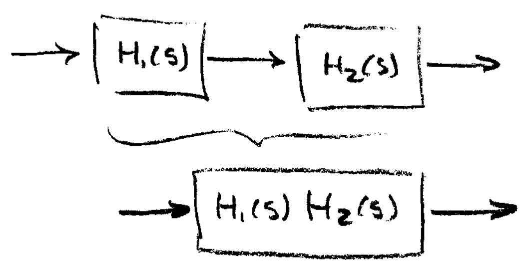


- As well as the Y and Z matrix elements, we are interested in the input and output impedances and the voltage or current gains.

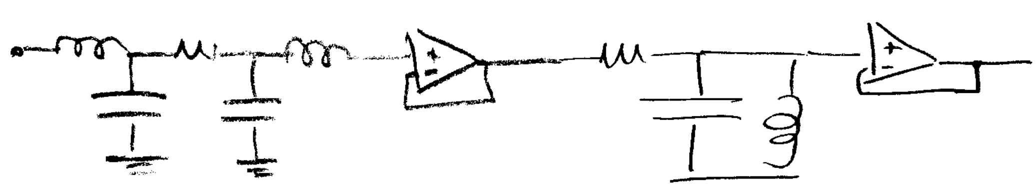
- All parameters can be Laplace transforms.

- This representation also makes explicit the interconnectedness of the two ports. Connection of an external circuit to either port will be felt at the other.

— Our cascade models



hold for transforms, but not for circuits — unless there is buffering by an op amp or transistor



- The two-port models we'll develop are also used extensively in circuit simulators like SPICE, as a means of calculating the behaviour of complex circuits.

$\boxed{\text{Review elementary circuit analysis DC+L Chapt 3}}$