OP-AMPS

Review Ideal Op-Amps
And
Begin Inverting Amplifiers

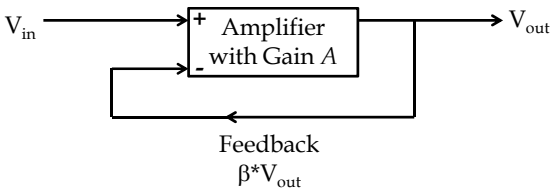
Review

- High open-loop gain and negative feedback forces differential input voltage to be zero
- High input resistance forces input current to be zero
- Use these assumptions to analyze the closed-loop gain

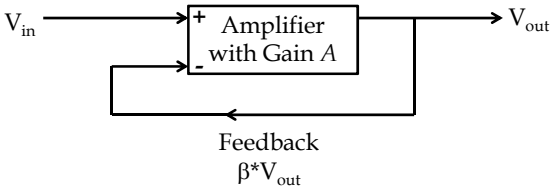
Sidenote: Office hour 1-2 pm on Fridays in Cobleigh 539, except today it will be from 2-3 pm.

Review of Negative Feedback

- Feedback – signal or voltage from output is superimposed on input
  - Typically done to achieve a desired performance



Gain



- With Feedback our gain is no longer just the open-loop gain A of the amplifier or $Gain_{OL} = \frac{V_{out}}{V_{in}} = A$
  - We know $V_{out} = A * (V_{in} - \beta V_{out})$
  - Rearrange to find $Gain_{negfeedback} = \frac{V_{out}}{V_{in}} = \frac{A}{1 + A\beta}$

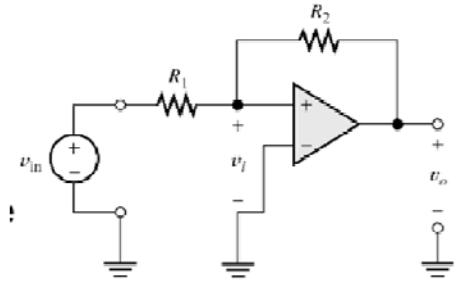
Summing-point constraint

- With a negative feedback system, the feedback ensures that the output voltage of the ideal op-amp is the value required to force
  - The differential input voltage to zero
  - The input current to zero

I-clicker Question

- The wire connecting the output of the op-amp to the input should be connected to the
  a) noninverting (+) input
  b) inverting (-) input
  c) both inputs
  d) either input – they are essentially the same

What happens if we have positive feedback?



- The input and output voltages increase in magnitude until the output voltage reaches one of its extremes (limited by power supply).

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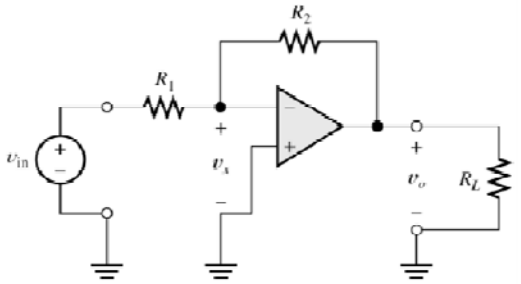
Steps to analyze an ideal op-amp circuit

- Verify that negative feedback is present
- Assume the differential input voltage and input current are forced to zero
- Apply standard circuit-analysis principles, such as Kirchoff's and Ohm's laws to solve.

Basic Inverter



Closed Loop Gain

$$A_v = \frac{v_o}{v_{in}} = -\frac{R_2}{R_1}$$

- It is negative and only depends on R1 and R2.
- It does not depend on RL.

- Inverter: input impedance $Z_{in} = v_{in} / i_1 = R1$
  output impedance = 0

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