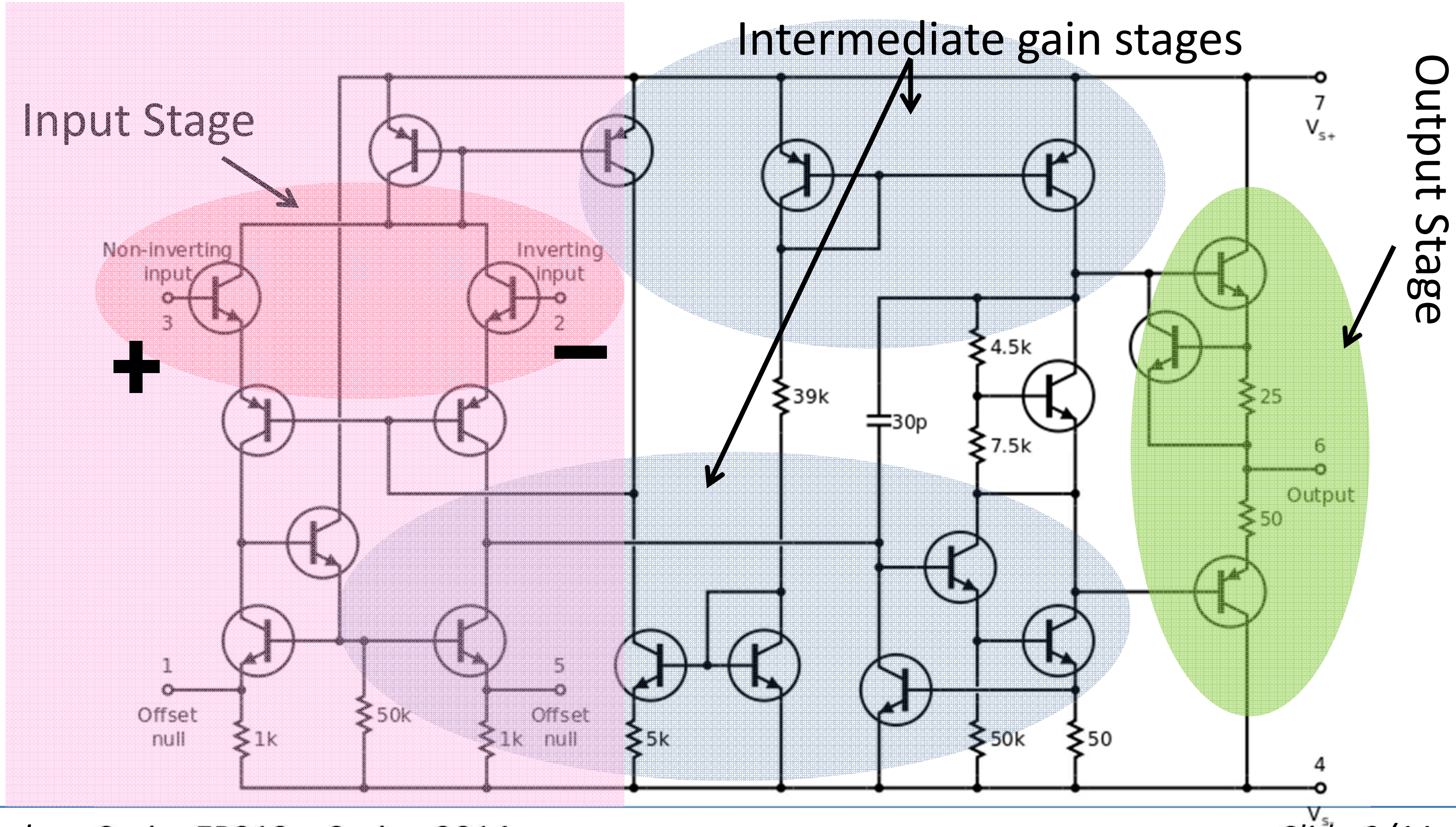
Lecture 5
Opamp imperfections

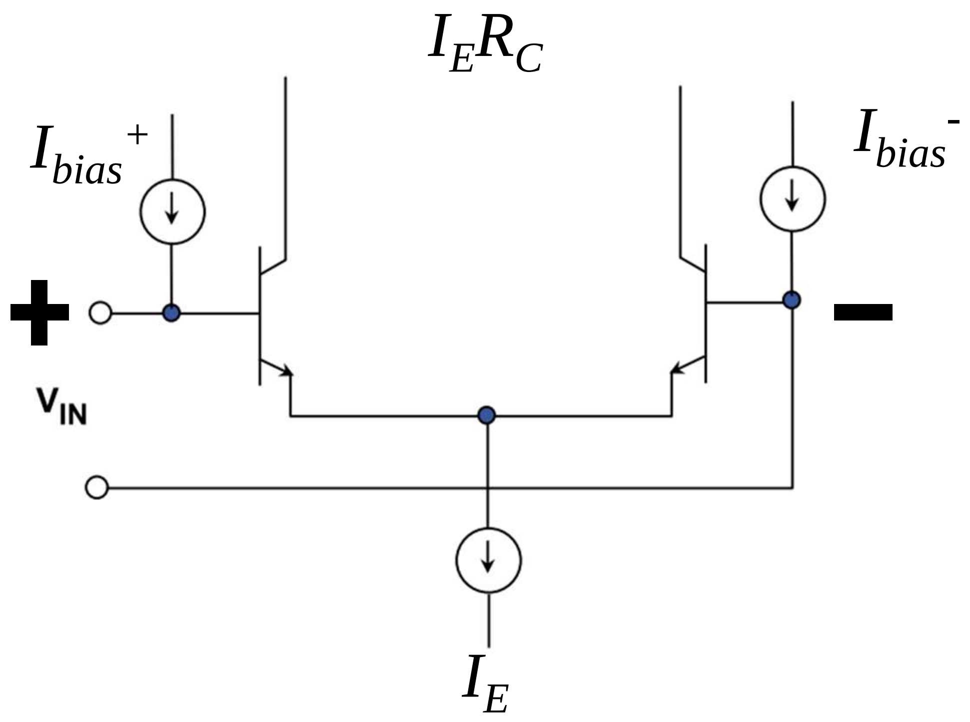
<u>Reference:</u>
Analog Devices, Opamp basics tutorial:
http://www.analog.com/static/imported-files/tutorials/MT-038.pdf

Consider opamp internals

<u>OpAmp integrates precision matched actives+passives in one IC</u>



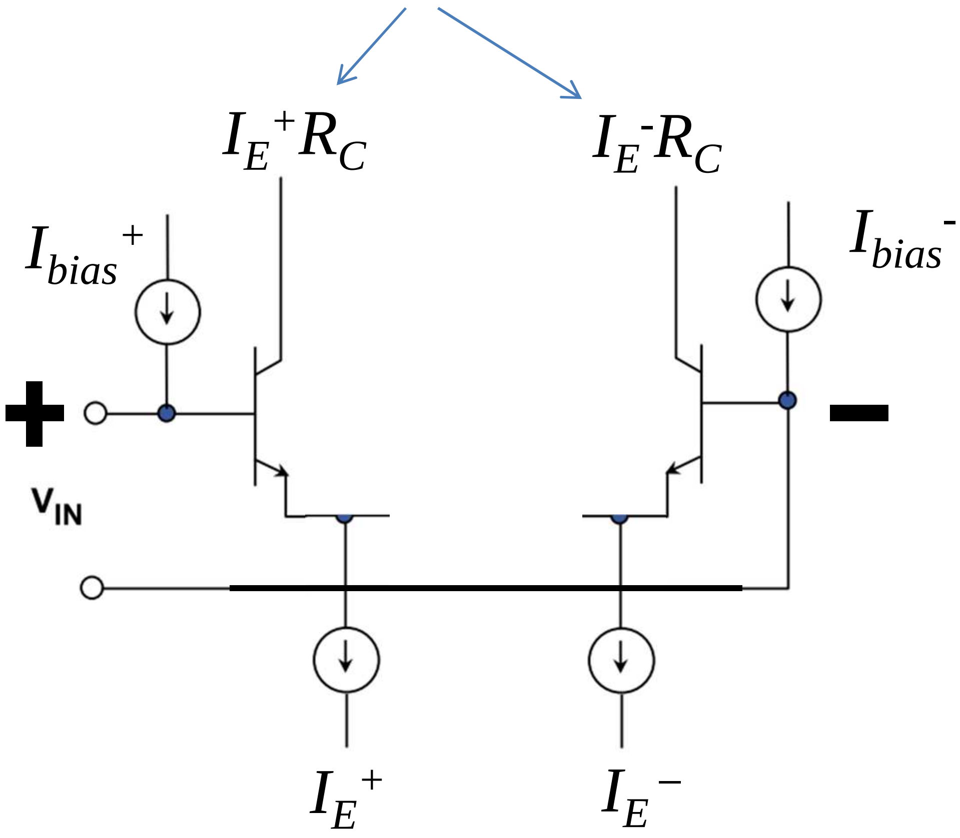
Simplified input stage



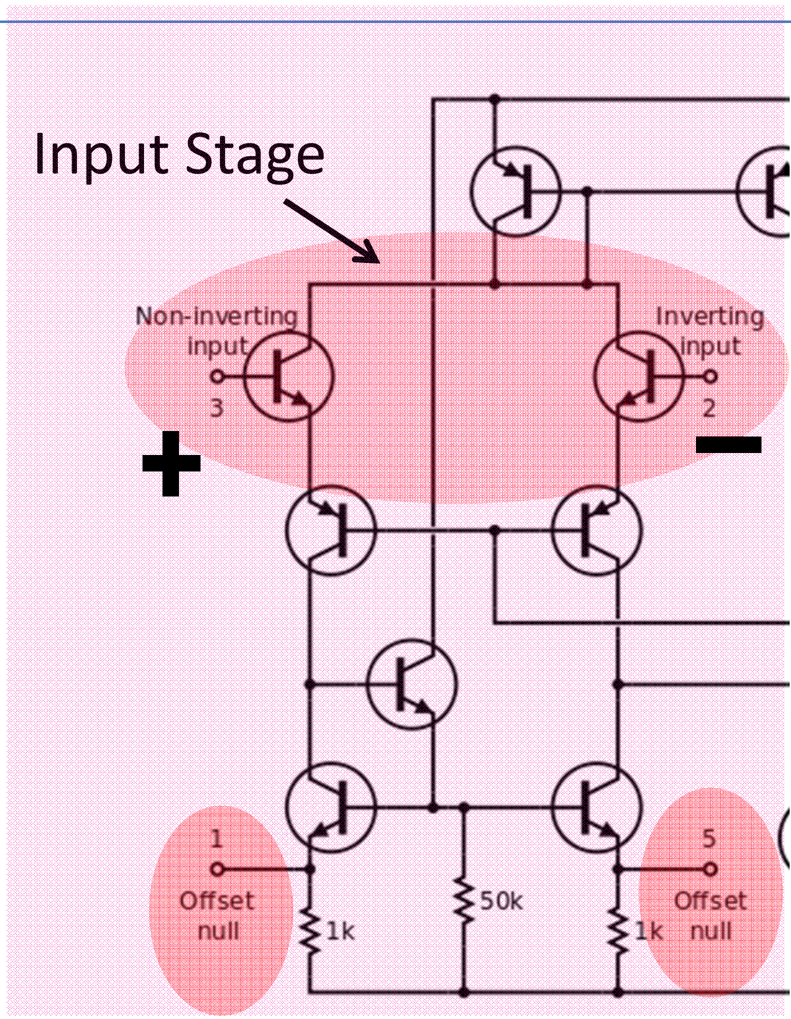
Imperfection 1: V_{os}

Input offset voltage V_{os}

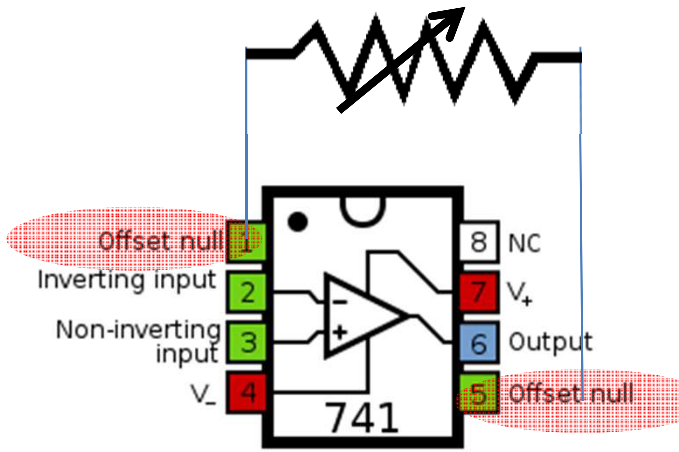
If I_E^+ and I_E^- are different, voltages at the collector terminals will be different



You can *compensate* V_{os}



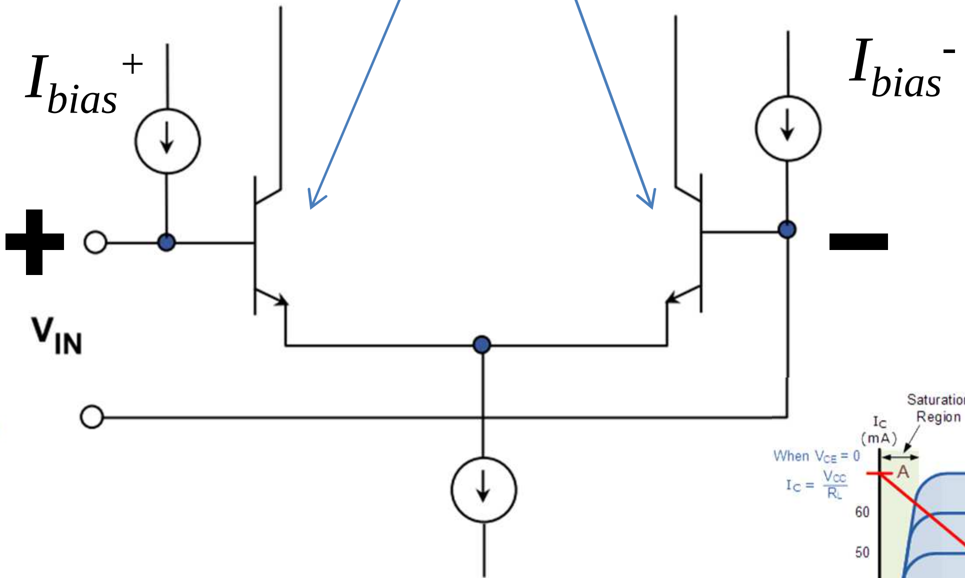
Adjust I_E^+ *&* I_E^-

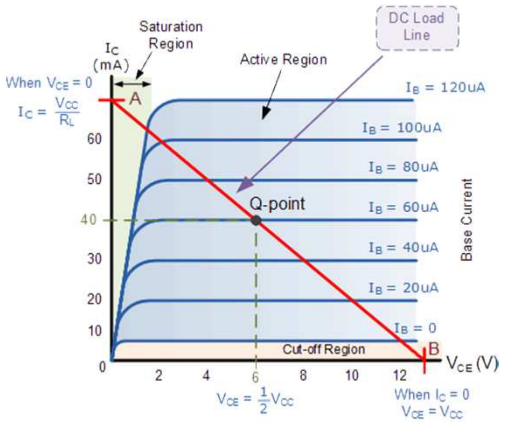


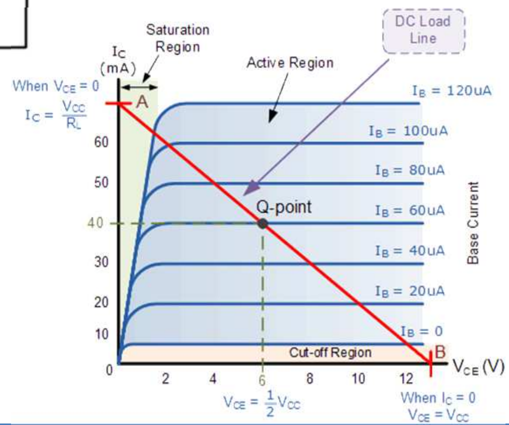
Imperfection 2: I_{bias}

$$I_{bias}^{+} \neq I_{bias}^{-}$$

Sets the two transistors at two different Q points

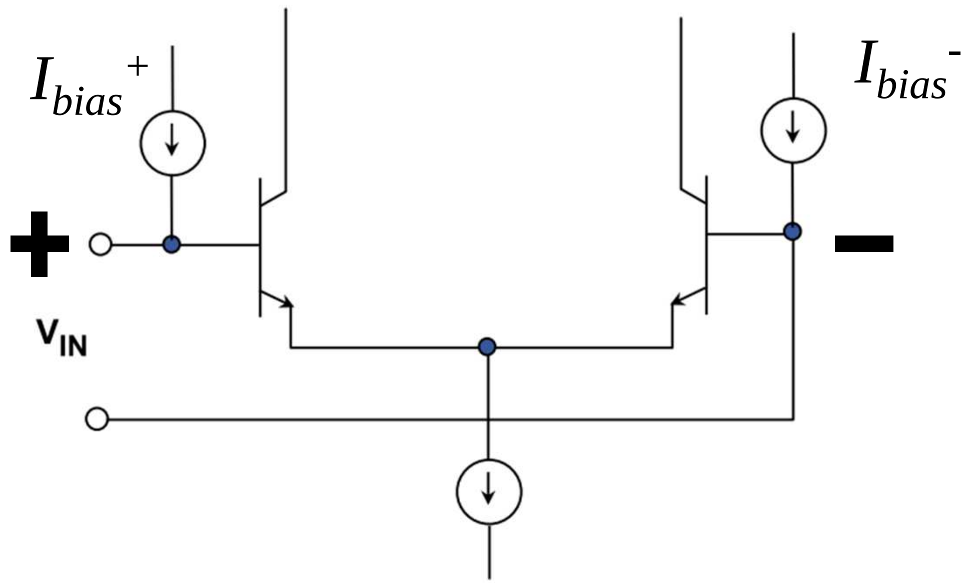






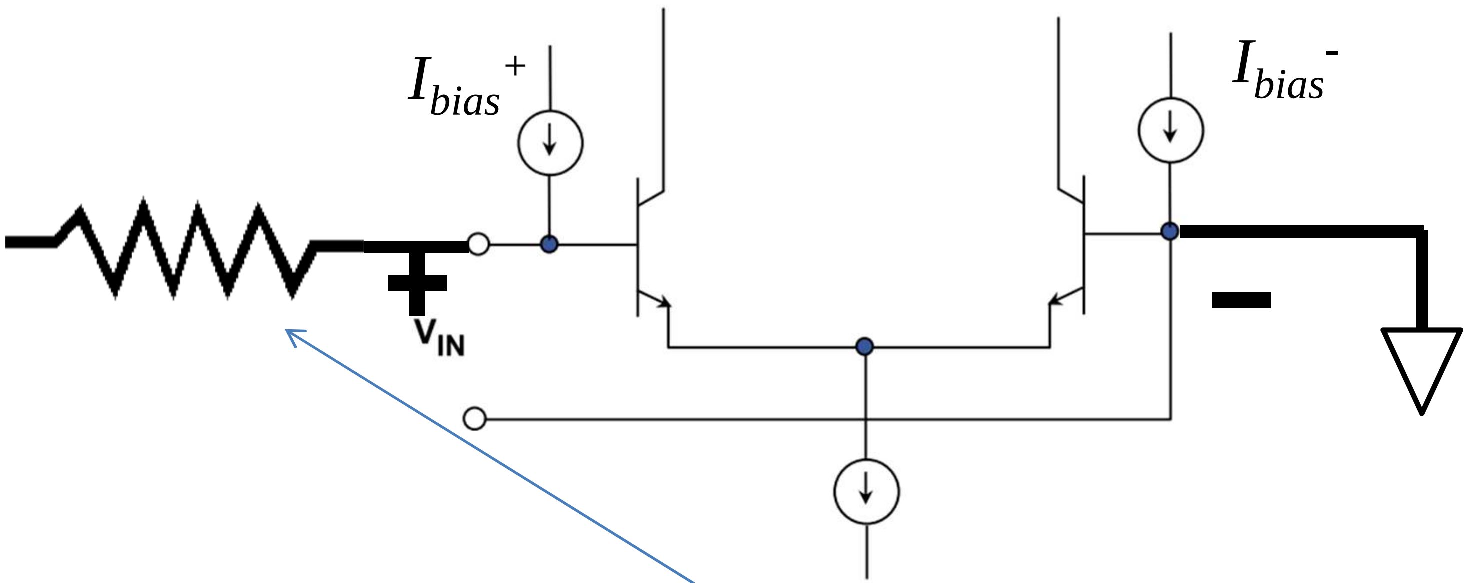
Cannot compensate for I_{bias}

<u>Good news</u>: I_{bias} is usually very very small



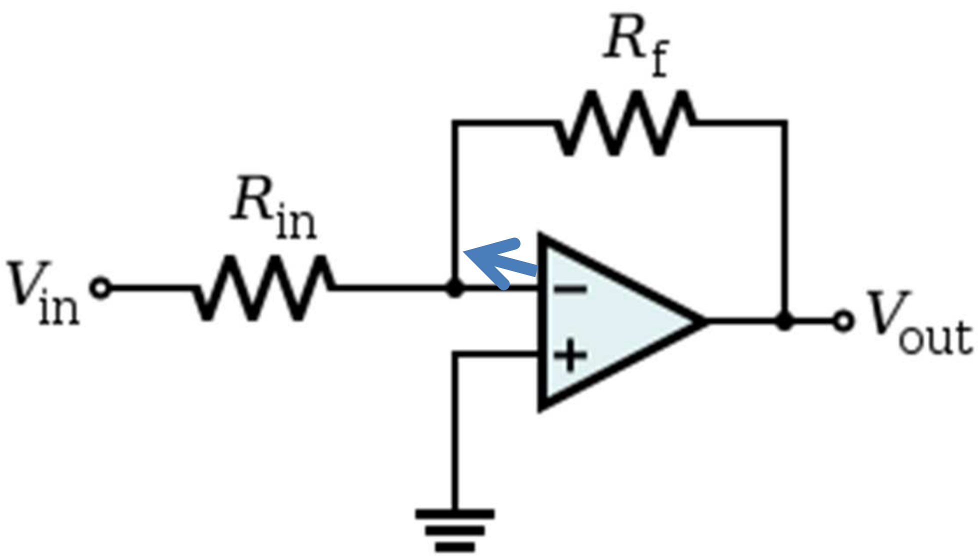
I_{bias} can be bad in a poor circuit

<u>*Bad news*</u>: I_{bias} *multiplies* R_{in}



Depending on R_{in},will cause a *fake* $I_{bias}^{+}R_{in}$ appear as v_{+} even if $v_{in}=0$

Must 'bias compensate' a circuit

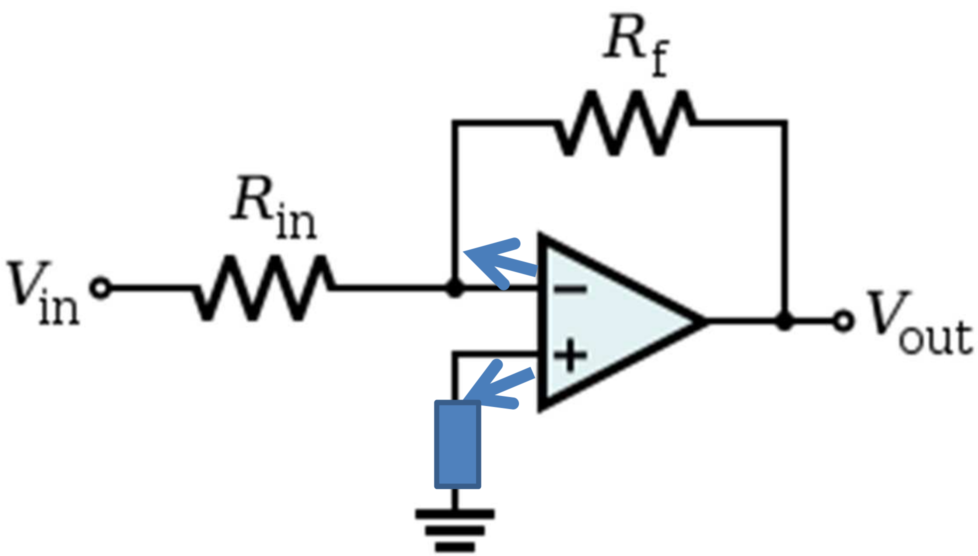


1. At DC, with $V_{in} = 0$, what is the effective R 'looking out' from - ?

2. If there is I_{bias}^{-}, what is effective V_{in} ?

3. If $I_{bias}^{+} \approx I_{bias}^{-}$ what must you do at the + terminal to cancel (2)

Must have equal DC resistance 'looking' out of each input terminal



1. *Calculate effective R 'looking' out from '-' terminal*

2. *Put in equivalent R_{eff} in the other '+' terminal*

3. *R_{eff}*I_{bias}^{+} voltage drop cancels R_{eff}* I_{bias}^{-} at $V_{in} = 0$*

Preparation for Lab 5

- Read up on background of V_{os} & I_{bias}
- Techniques for measuring V_{os} & I_{bias}
  not trivial! - measure an intrinsic property of the device without applying V_{in}