Lecture 2: Device Models I (bipolar)

Announcements:
- The course website was up and running, yesterday
  ≈ Just google ee140 to get to it
- Discussion sections start next week
  ≈ Discussion Section 102 Time and Location
  ≈ Th 4-5 p.m., 293 Cory
  ≈ This is also now up on the official online schedule of classes
- Updates to the course information sheet handed out last time:
  ≈ TA office hours will be held in 382 Cory
  ≈ Lingqi Wu email: change to wulingqi@berkeley.edu

Lecture Topics:
- Review (so fast)
  ≈ Bipolar Junction Transistor Modeling
    - Basic Structure & Physics
    - Large Signal Models
    - DC Operating Point
    - Small Signal Models
    - Frequency Shaping Elements
    - Layout
    - Unity Gain Frequency
- Last Time: Reviewed op amps

Example: Find the DC operating point.
- want $I_C$, $V_C$ of $V_{BE} = 0.7$V

\[ I_C = \frac{V_{CE} - V_{BE}}{R_{ref}} = \frac{10 - 0.7}{10k} = 0.93 \text{mA} \]

Check: $V_{CE} > 0.2V \checkmark$ (it's forward active)
\[ V_0 = V_{BE(CM)} + I_C R_{EF} = 0.7V + (0.93m)(2k) = 2.58V \]
For $Q_S$ to be $PA$, need:

$$V_o < V_C - V_{BEV} - V_{CE(off)}$$

$$10 - 0.7 - 0.2 = 9.1\,V$$

* $V_o = 2.5\,V < 9.1\,V$

What if $R_E = 20k\Omega$:

$$V_o = 0.74(0.93\,mA)(20k) = 9.3\,V$$

$Q_S$ is saturated.

$$V_o = V_C - V_{BE(on)} - V_{CE(off)} = 9.1\,V$$

$$I_{CS} = \frac{V_o - V_{BE(on)}}{R_E} = \frac{9.1 - 0.7}{20k} = 0.042\,mA$$