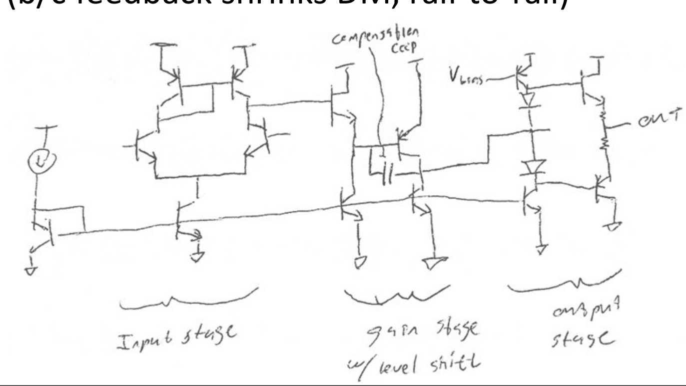
E151 Lecture 23 – Op-Amp Design

Matthew Spencer
Harvey Mudd College
ENGR151

1

We Can Make an Op-Amp from Our Pieces

- Already have differential input and 0 output impedance (for large vO)
- Need infinite gain and DC coupling (use level shifts to achieve that)
- Input common mode range (b/c feedback shrinks DM, rail-to-rail)
- Input bias current
- Input offset voltage
- Output swing (rail-to-rail)
- Mirror biasing is handy



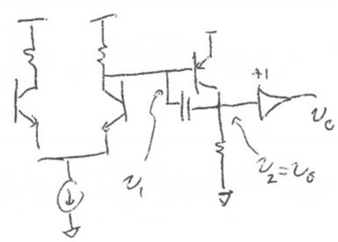
2

Compensation Capacitance and Slew Rate

- Op-amps always in feedback (why we care about input CM range)
- If you hear feedback, always think stability → CC makes look 1st order
- But big caps limit dV/dt at op-amp output, called slew rate

– slewing behavior

– straight lines (ramp) except where slope small



$$\frac{dv_o}{dt} = \frac{dv_2}{dt} \to v_2 = v_1 + CQ$$

SO

$SR_{output} = I_{out}/C_L$

OR

$SR_{CC,mirror} = I_{tail}/C_C$

OR

$SR_{CC,resistor} = I_{tail}/2C_C$

3