

Hands-on Lab 4: Sensing Part 1

EECS 16B Fall 2022

Slides: <http://links.eecs16b.org/lab4-slides>



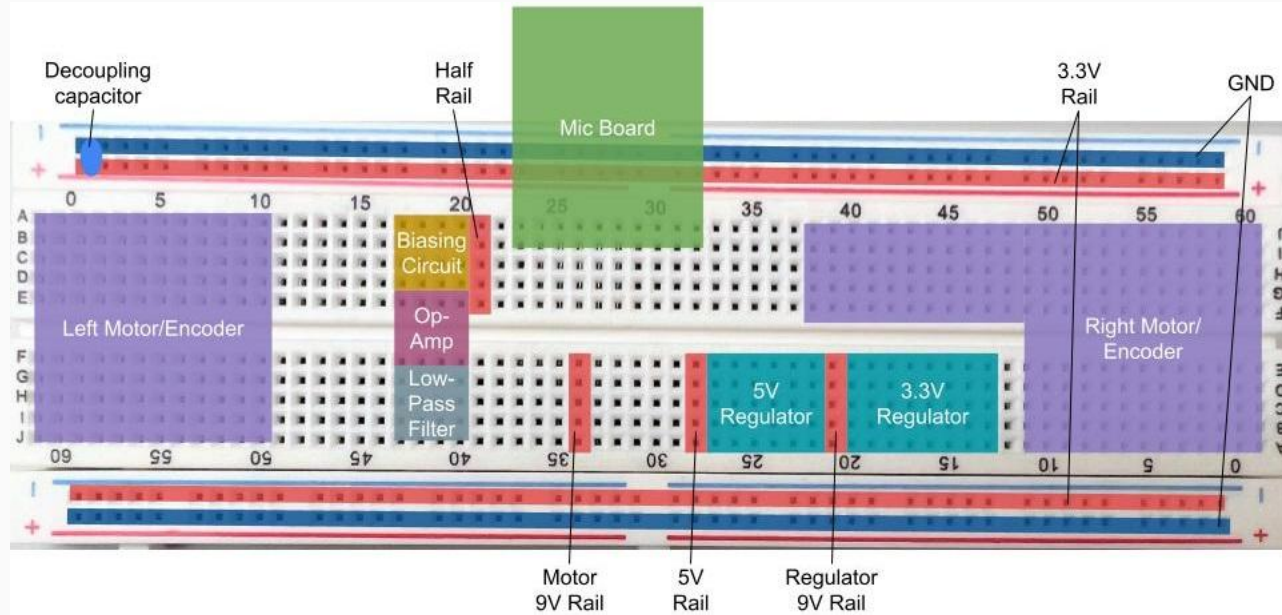
Administrivia

- Lab Checkoff grades coming soon™
- **[EACH STUDENT]** Upload your SID to the “Lab Checkoffs” Gradescope assignment
 - **Lab computers:** open “Git Bash” and run “cd \$USERPROFILE/Desktop && echo SID > sid.txt”
 - **macOS:** open “Terminal” and run “cd \$HOME/Desktop && echo SID > sid.txt”
 - **General Windows:** open “Command Prompt” and run “cd %userprofile%\Desktop; echo SID > sid.txt”
 - Replace SID with your unique Berkeley Student ID

Lab 4 Overview

- Build and test regulator circuits
 - Eventually, the car will run untethered to DC power supply. Will run on 9V batteries.
 - Need to convert 9V from batteries to 3.3V and 5V voltages for our circuits.
- Build and test mic board circuitry
 - Build biasing circuit
 - Tune mic board
 - Measure the frequency response of the speaker-microphone system

BREADBOARD LAYOUT



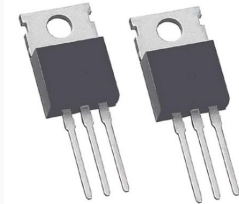
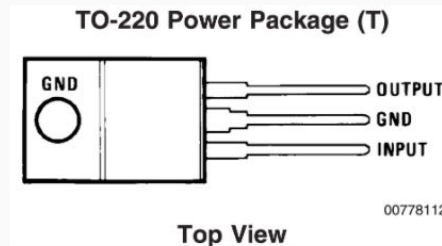
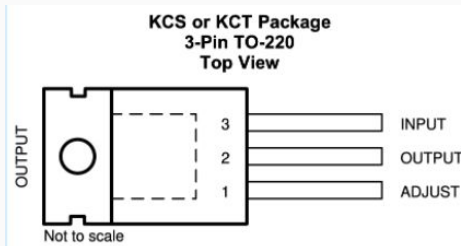
Part 1: Voltage Regulator Circuits

A regulate-d journey

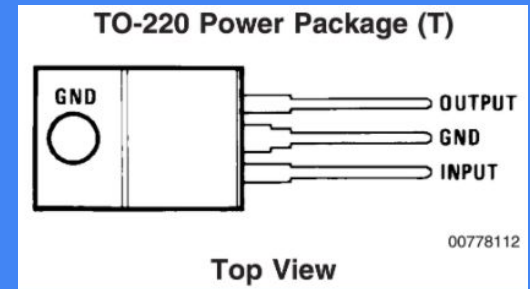
(sorry, ~~engineers~~ Shrey can't make jokes)

New Component: Regulators

- In order to later allow S1X33N to be powered by 9V batteries, we will need to create 9V -> 3.3V and 9V -> 5V circuits for our rails and mic board
 - For today, these will be powered using the power supply!
- Make sure the metal tabs on top **don't touch!**
 - They are conductive and will short your circuit if they're too close together.
- **9V from power supply goes to reserved 9V rows on breadboard, NOT positive rails**

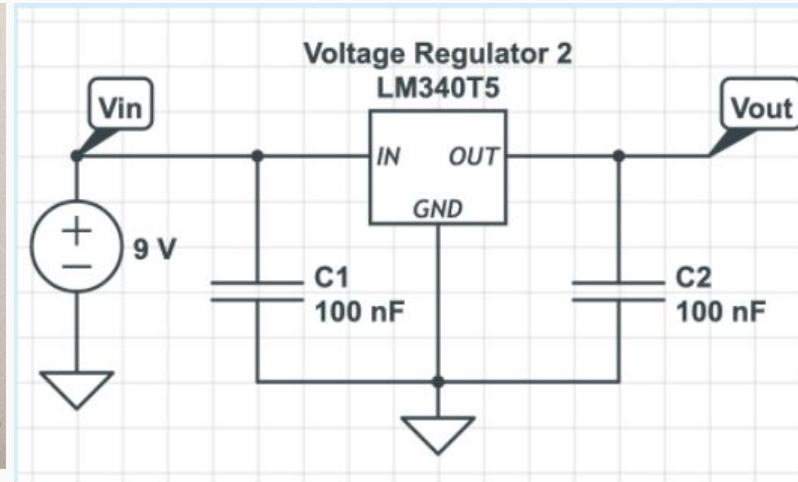
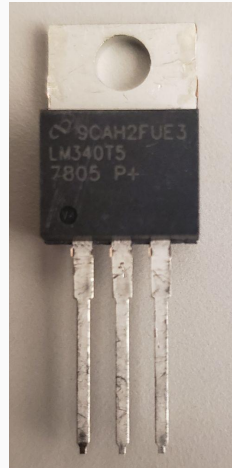


9 -> 5 V regulator



- **LM340T5**
- The diagram shows the metal tab at the back

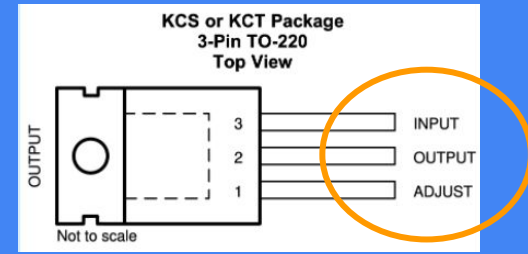
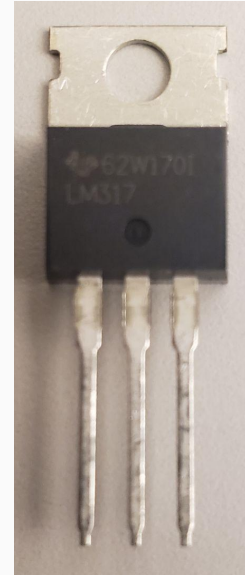
Note that the 5V and 3.3V regulator have different ordered pins!



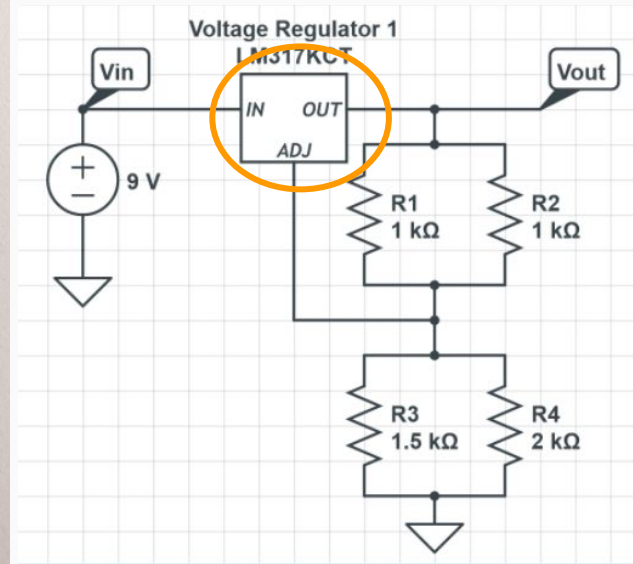
9 -> 3.3 V Regulator

- **LM317KCT**
- The diagram shows the metal tab at the back
- **Output of 3.3V regulator goes to breadboard positive rail**

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caution!

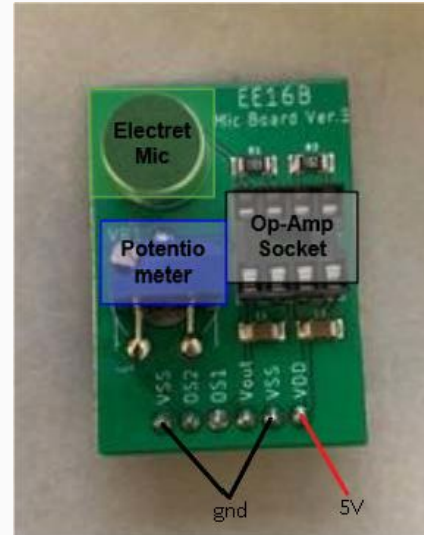


Part 2: Mic Board Circuitry

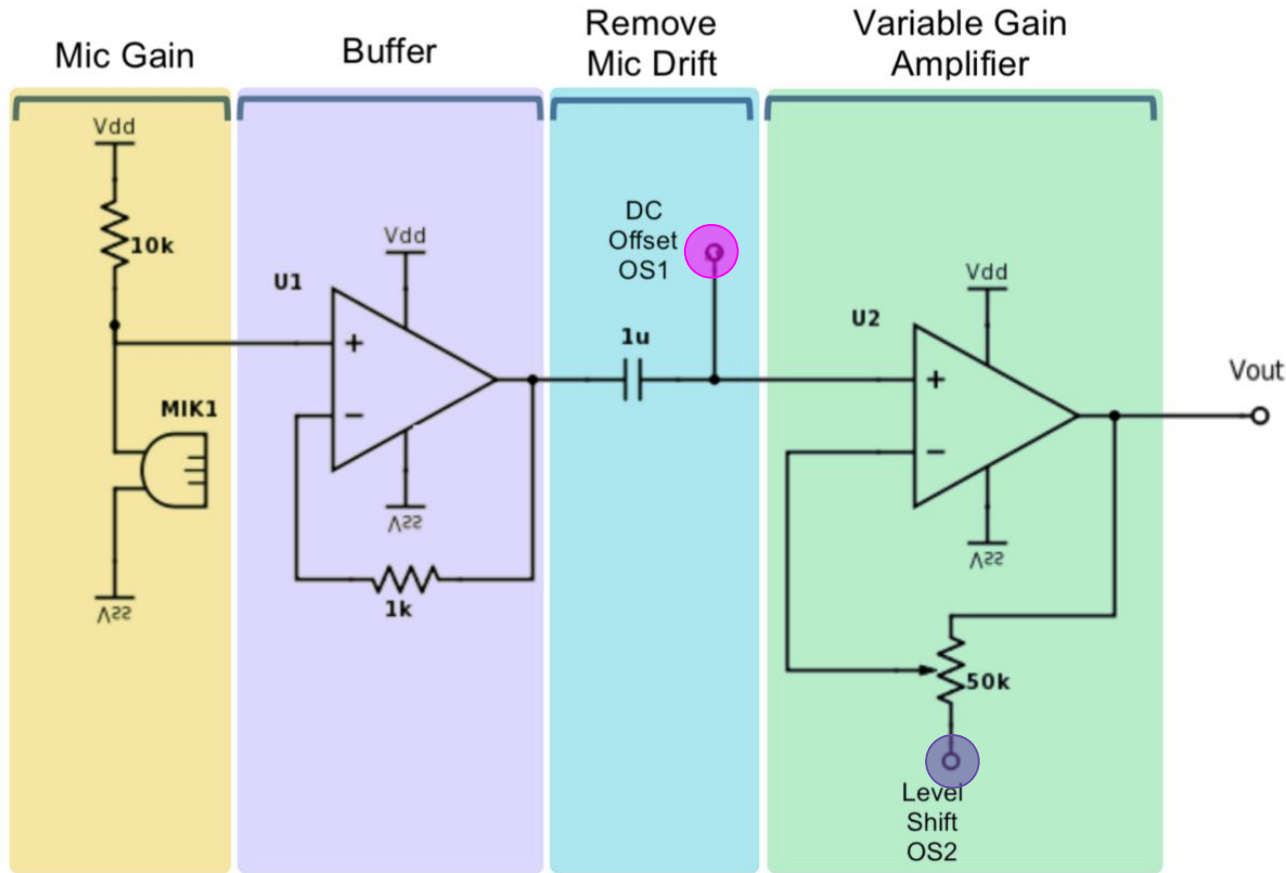
A loud journey

What's a Mic Board?

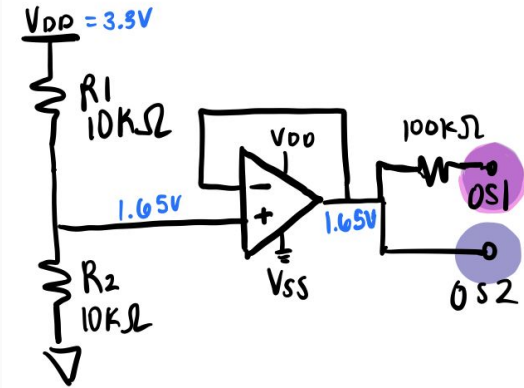
Mic board circuits pick up voice and sound signals and then convert them into electrical signals, which are amplified.



Mic Board Schematic

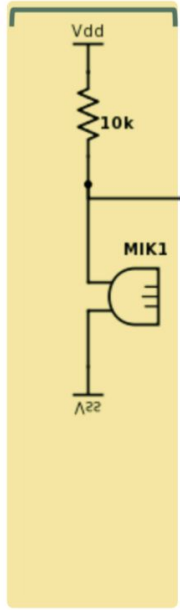


We're building this!



Mic Board Schematic

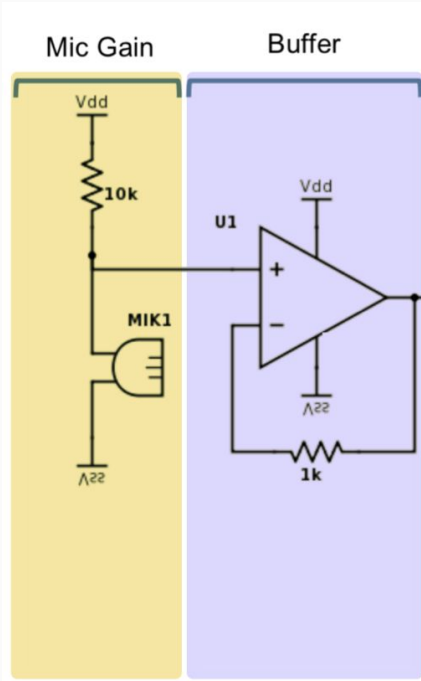
Mic Gain



1. Mic Gain

- Our mic is a variable current source, but we convert it to a voltage signal by placing it in series with a 10K resistor.

Mic Board Schematic



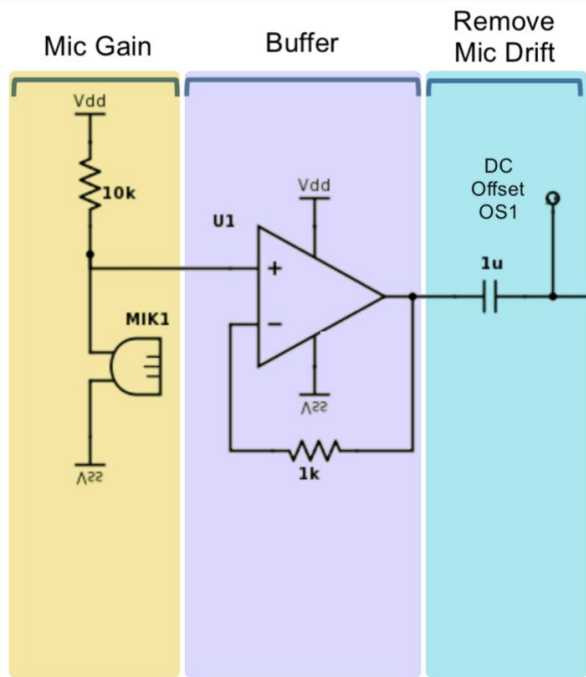
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2. Buffer

- This keeps the rest of the circuit from affecting our mic board signal

Mic Board Schematic



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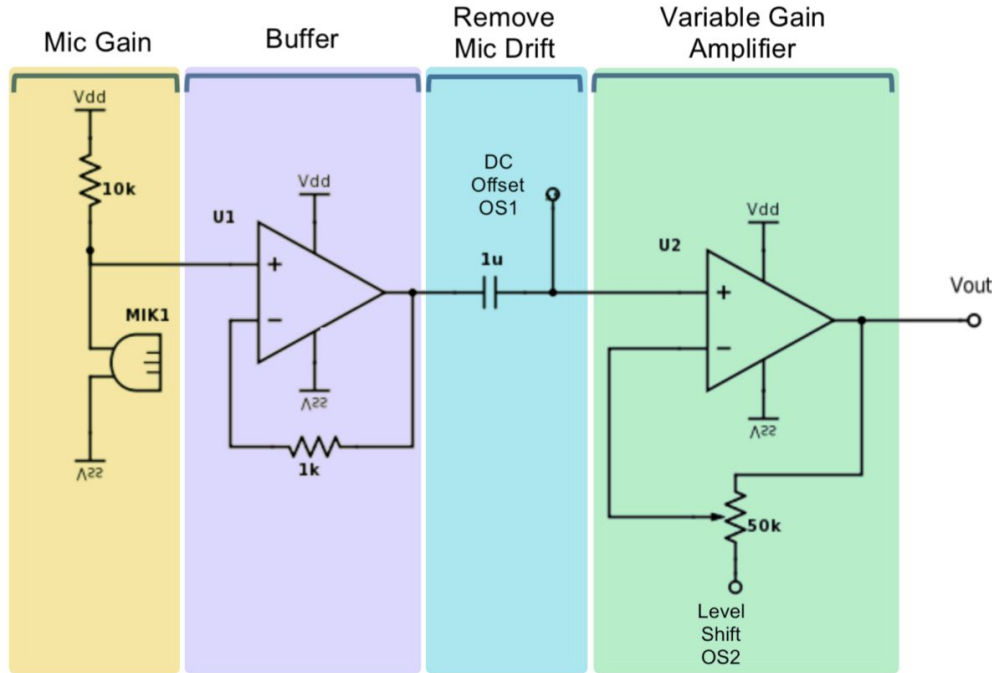
2. Buffer

- This keeps the rest of the circuit from affecting our mic board signal

3. Removing Mic Drift

- The 1 μ F capacitor is a *coupling capacitor*, meaning it serves as a short to AC voltage but blocks DC voltage. Used to remove unpredictable mic offset so we can add our own via OS1
- **OS1** - centers signal at 1.65V. Connected through a 100k Ω resistor, since OS1's voltage isn't equal to our signal.

Mic Board Schematic



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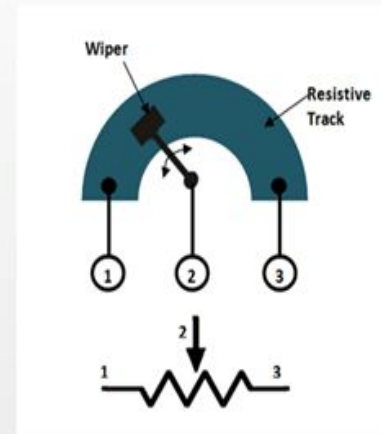
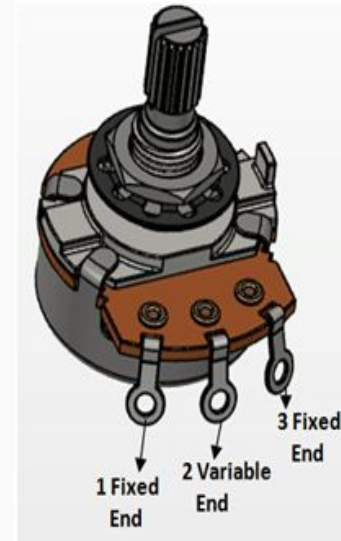
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4. Non-inverting amplifier

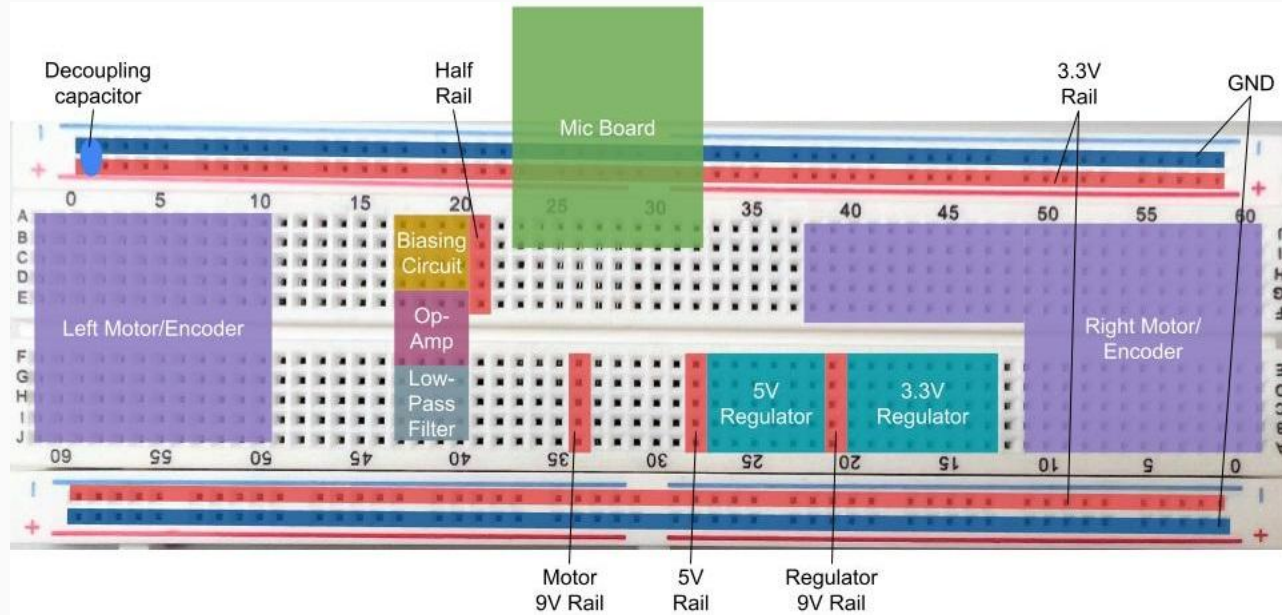
- Uses a potentiometer for variable gain
- **OS2** - serves as a virtual ground so we don't amplify the 1.65V offset

Review: Potentiometers

- Wiper divides resistive material, creating two resistors with variable length
- Resistance is proportional to length, so wiper changes the **resistance ratio**!
- Resistors form a **voltage divider**



Reminder: BREADBOARD LAYOUT



Important Forms/Links

- Help request form: <https://eecs16b.org/lab-help>
- Checkoff request form: <https://eecs16b.org/lab-checkoff>
- Extension Requests: <https://eecs16b.org/extensions>
- Makeup Lab: <https://makeup.eecs16b.org>
- Slides: <links.eecs16b.org/lab4-slides>
- Anon Feedback: <https://eecs16b.org/lab-anon-feedback>