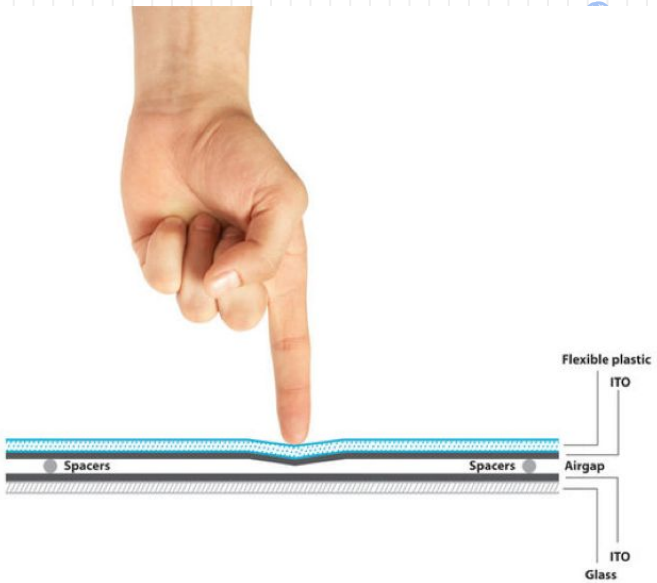
EECS16A Touchscreen 2

Resistive Touchscreen

- Investigate a resistive touchscreen
  - Something that actually was used for a long time!
- Use voltage as a signal to determine position of touch
  - How?

Resistive Touchscreen

- Physical touch results in physical contact between top and bottom layers
- Voltage dividers allow us to compute touch location



Resistive touchscreen

EX: Nokia N900, Nokia N97 Mini, LG Optimus, LG GW620, Nintendo DS

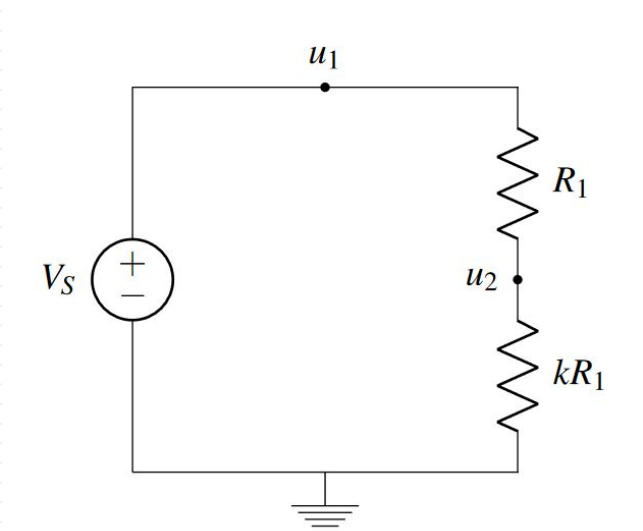
TM

Tools for today:

- Launchpad - measuring device & providing power
- Voltage dividers
  - How we will detect location
- Falstad
  - Circuit simulation, has virtual Power Supplies and Multimeters

Touchscreen Theory (Note 13/14)

- **What's the voltage at the top?**
- **What's the voltage at the bottom?**
- Voltage at u2?



Touchscreen Theory (Note 13/14)

- **What's the voltage at the top?**

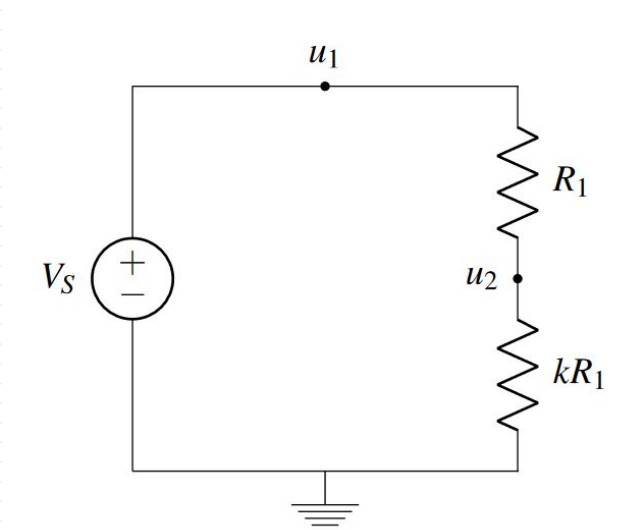
Vs

- **What's the voltage at the bottom?**

0

- Voltage at u2?

Voltage Divider!



Touchscreen Theory (Note 13/14)

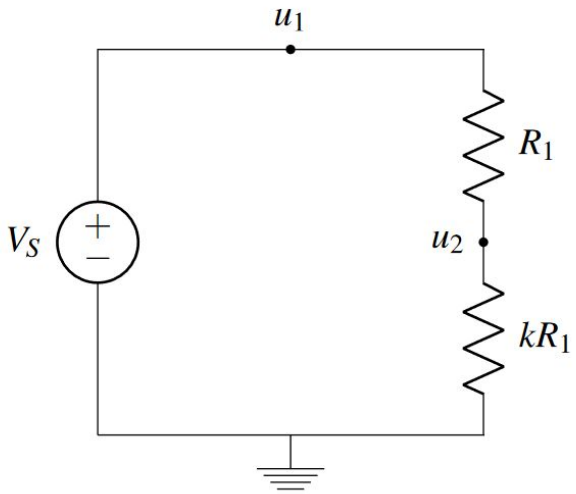
- Voltage divider:

$$u_2 = V_s * \frac{kR_1}{kR_1 + R_1}$$

$$u_2 = V_s * \frac{R_1(k)}{R_1(k+1)}$$

$$u_2 = V_s * \frac{k}{k+1}$$

Independent of the value of R!



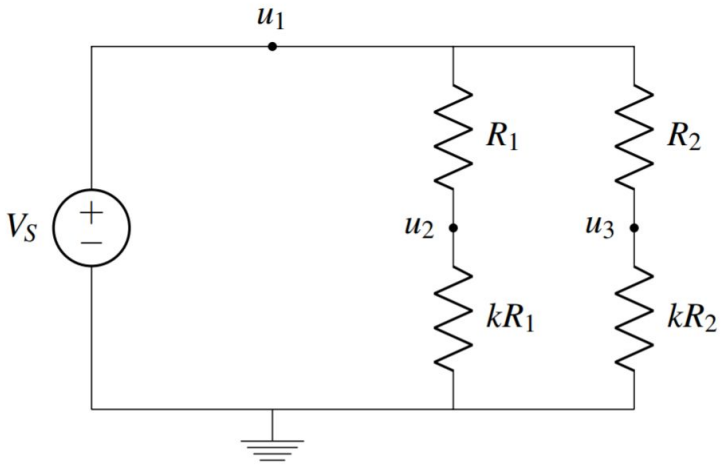
Building it up

- What are the voltages at u2 and u3?

$$u_2 = V_s * \frac{k}{k+1}$$

$$u_3 = V_s * \frac{k}{k+1}$$

- **What's the voltage difference?**



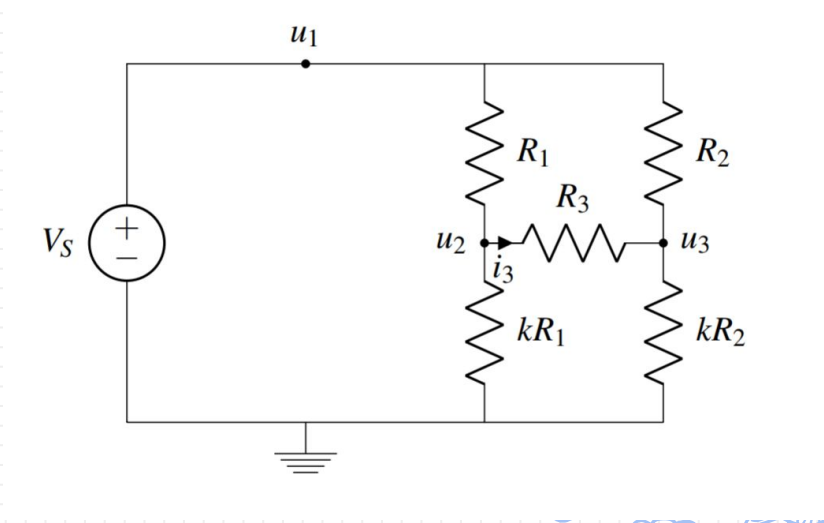
The Rs cancel out! All the matters is the proportion between the top and bottom resistors.
In fact, **u3 and u2 are at the SAME VOLTAGE**

Building it up

- We know that u2-u3=0
- **How much current goes through R3?**

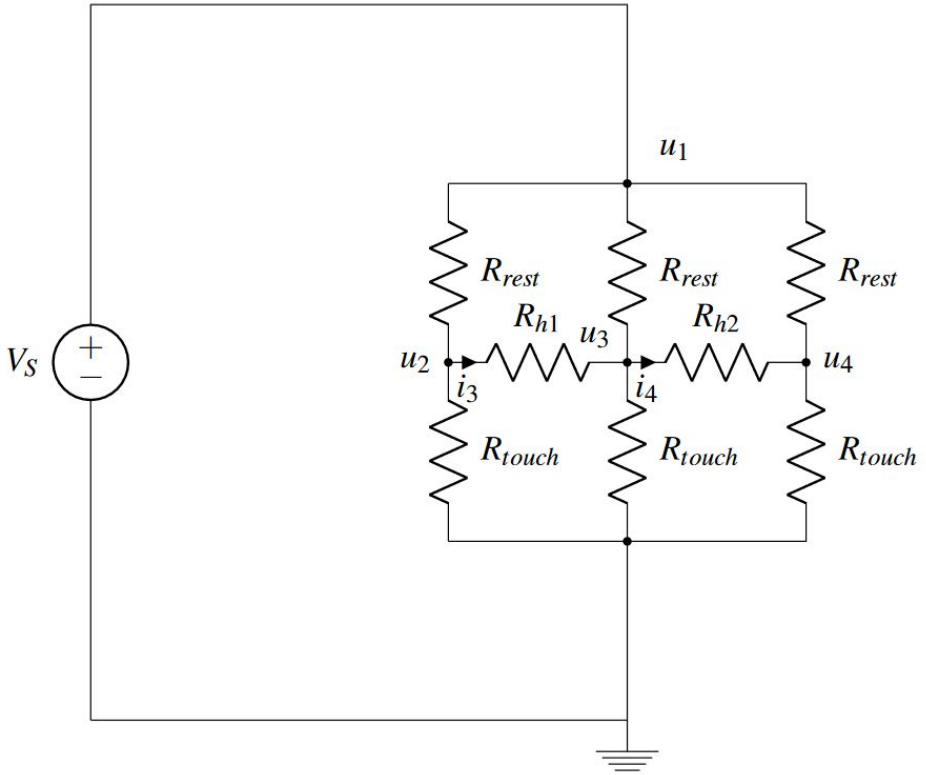
$$u_2 = V_s * \frac{k}{k+1}$$

$$u_3 = V_s * \frac{k}{k+1}$$



Building it up

- Add one more resistor divider…
- We get our touchscreen!



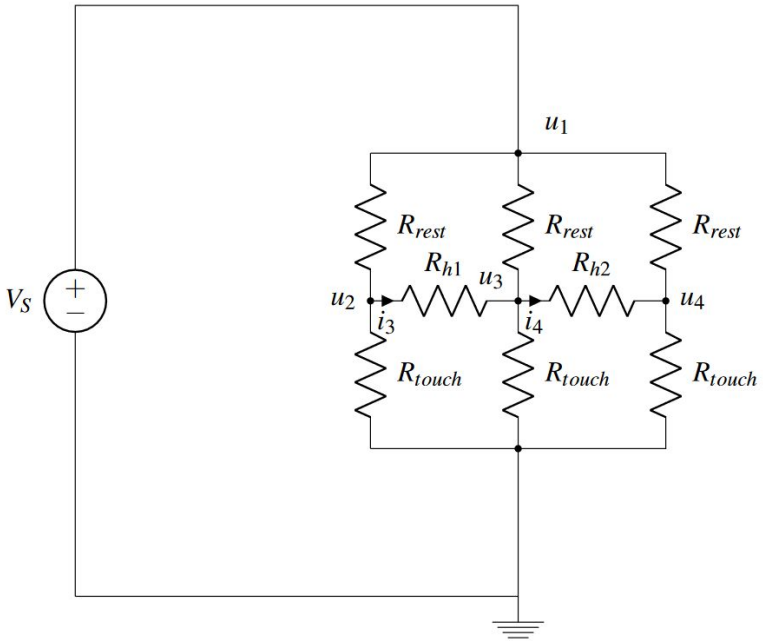
Poll time!

What is the voltage at u4?

- 0V
- Same as u2
- None of the above

How much current is flowing through Rh2?

- 0A
- Non-zero current



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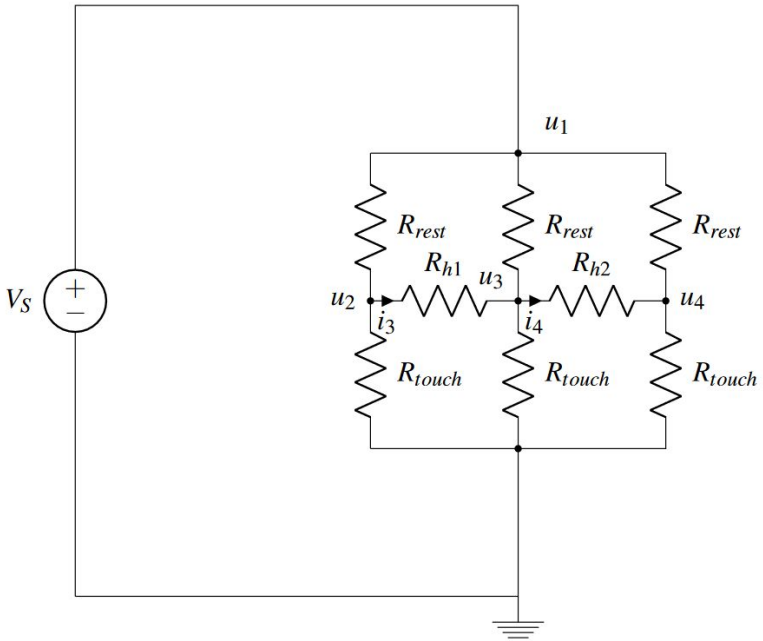
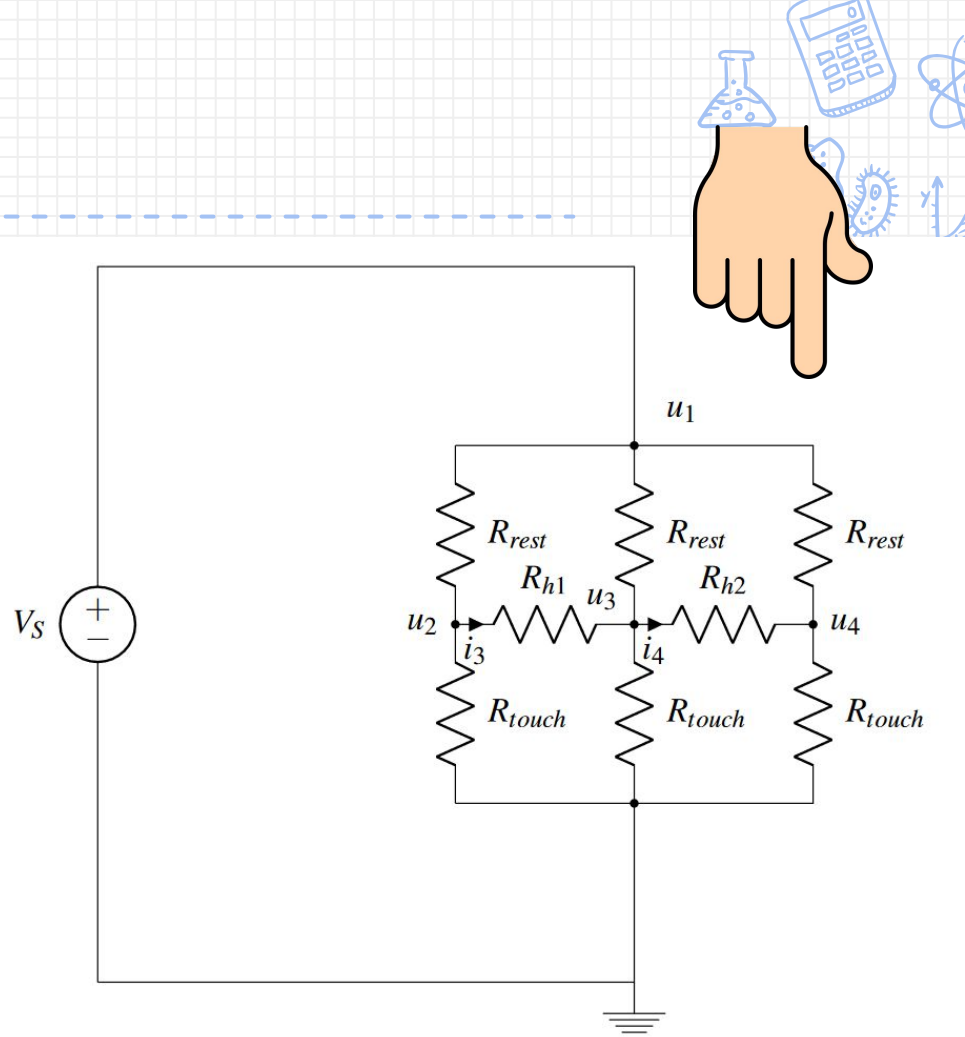
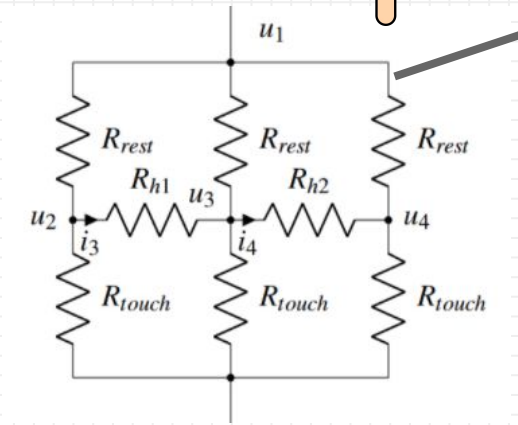


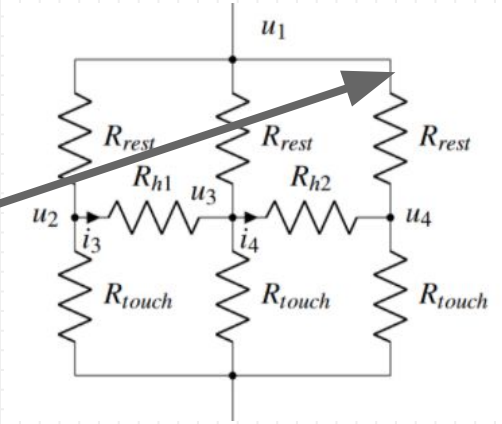
Building it up

- But how do we measure the voltage?
- Our finger can press down on a point, but we need the voltage measurement!



Building it up



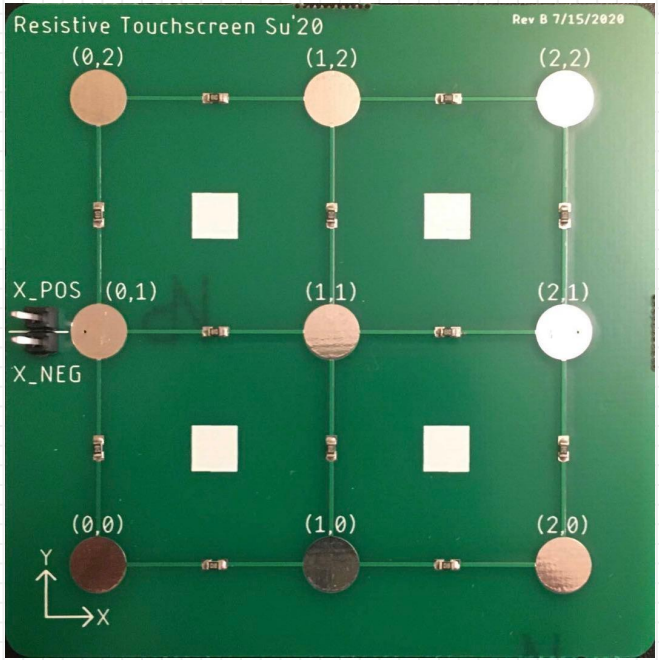


Measure here!

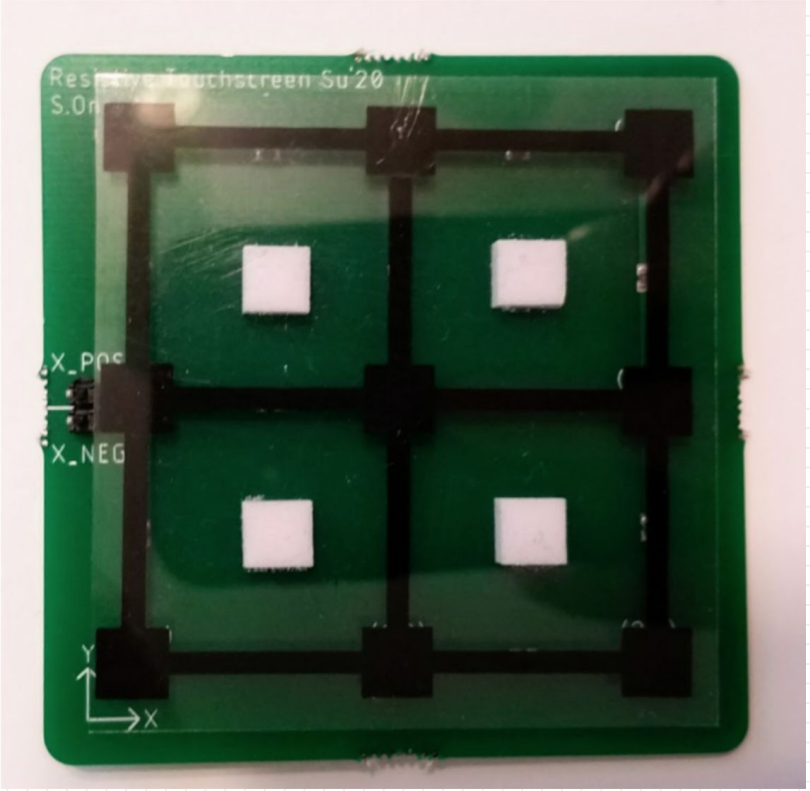
- We can add another (ungrounded) mesh!
- If we connect the mesh at the point we touch, we get the voltage!
- Why specifically a mesh? We'll see in a bit.

Resistive Touchscreen - 2 Layers

Bottom Layer: Resistive Layer



Resistive Touchscreen - 2 Layers



Top Layer:

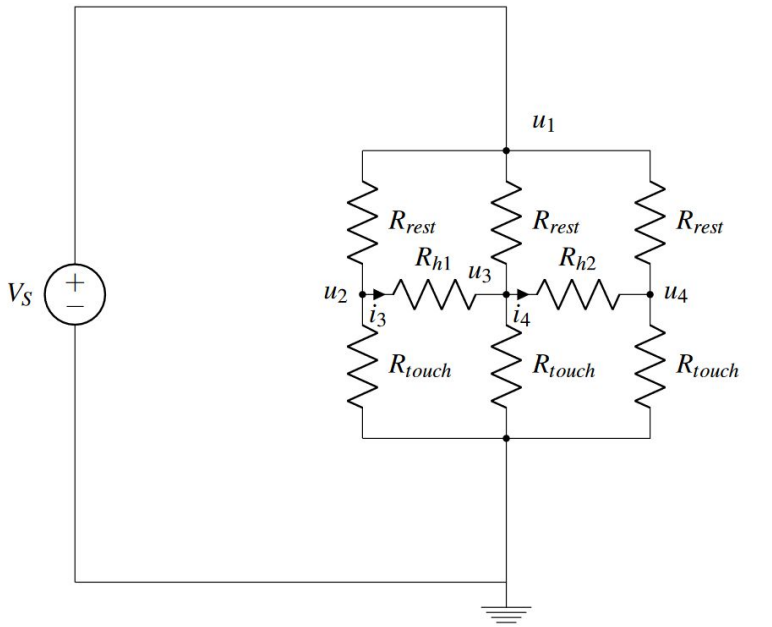
Flexible Resistive Layer

What's the difference?

- Nothing
  - The ink is a bunch of resistors
    - The resistor values don't matter because we showed only the proportions matter for this circuit
  - Their circuit diagrams are the same
- One is flexible so we can actually move it to make contact
- We use two so that we can measure with one and apply voltage to the other without changing our circuit

Computing a Location

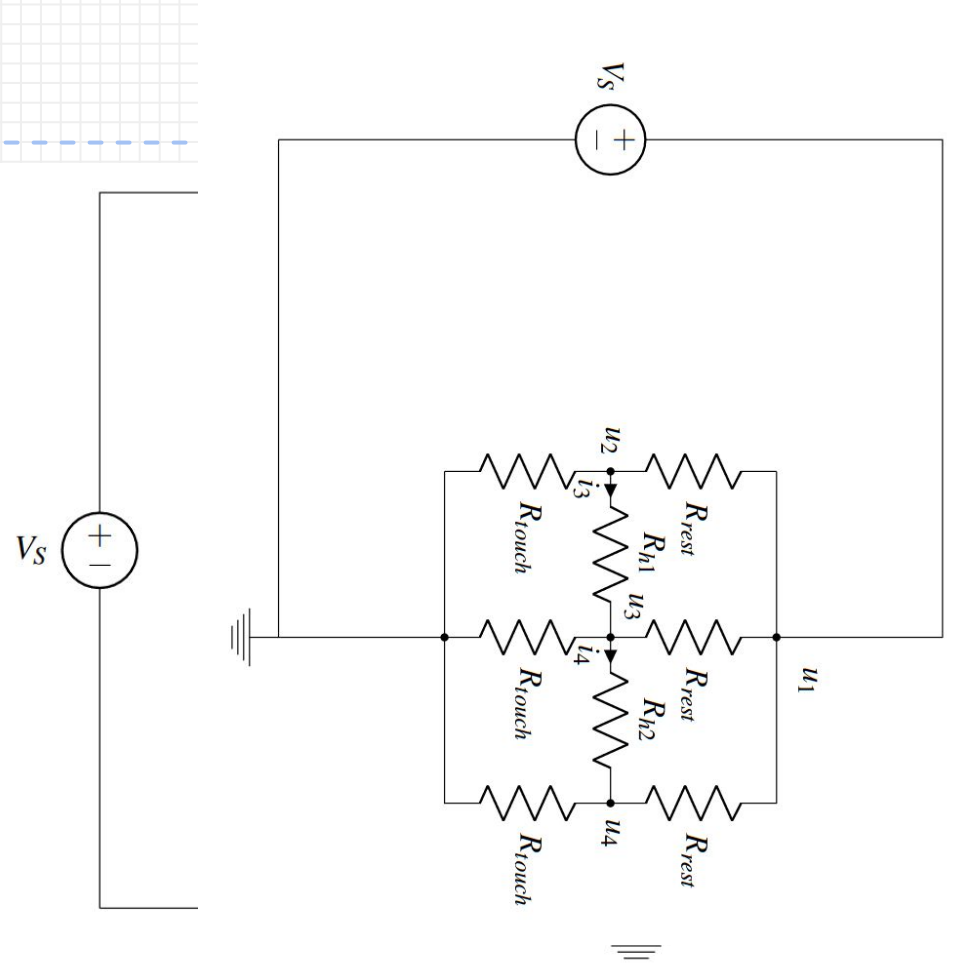
- Measure some voltages, compute location based on value
- **Can you find any two horizontal locations that would output the same voltage?**
- **What about vertical?**



Computing a Location

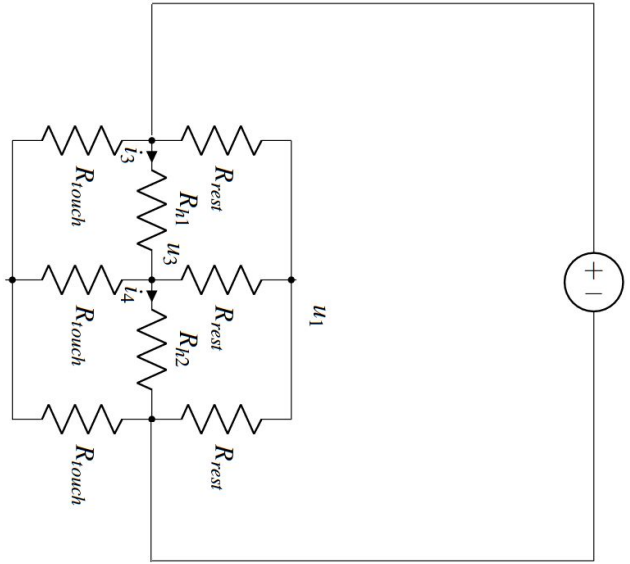
- We can only determine vertical position
- What about the other orientation?

What if we turned it sideways?



Computing a Location

- Let’s turn it sideways
  - Apply voltage so we power the horizontal direction
  - Find “vertical” location in horizontal orientation
- This gives horizontal location



Computing a Location

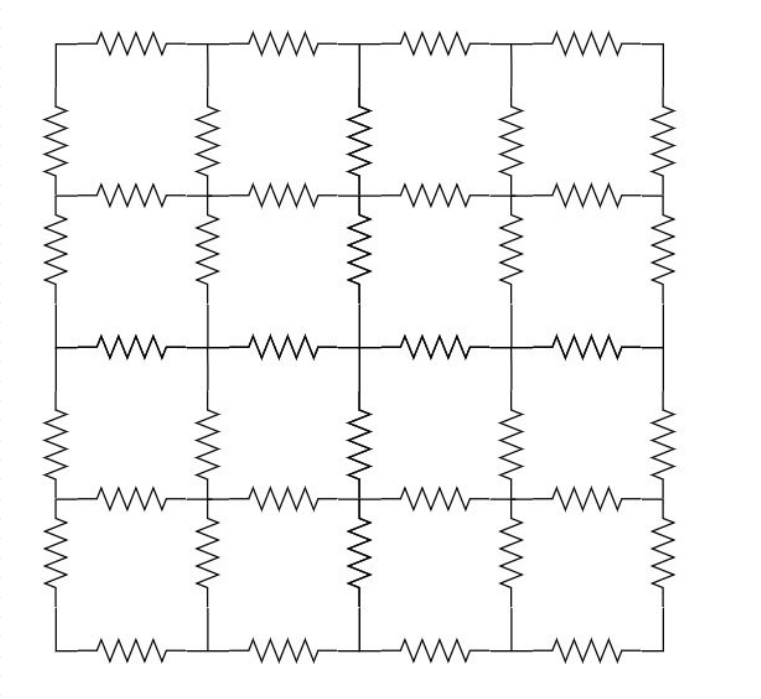
- If we take two readings, one in each dimension can uniquely determine our location in 2D
- More on this in the lab notebook

Taking the Limit

- 9 touch points is kinda... meh
- **How do we get more?**

Taking the Limit

- Add more resistors!

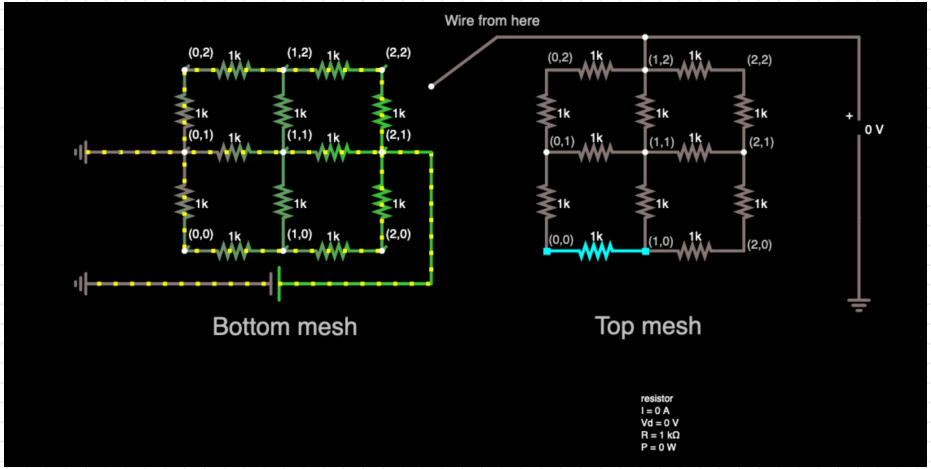


Taking the Limit

- But what if I don’t want to increase the size of the circuit?
  - Add more, but make the resistors smaller!
- What happens as the resistors approach infinitely small sizes?
  - Isn’t that just a resistive sheet?
  - This is how all resistive touchscreens work
  - Review lecture note 12, note 13, note 14

Simulating Touchscreens

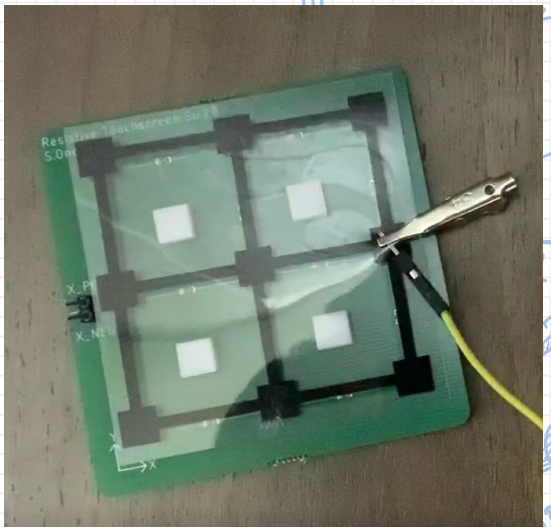
- Falstad simulator (http://tinyurl.com/y8pms37j)
  - Will be used in this lab to simulate resistive dividers in upper and bottom plates



Pointers

- If you do NOT have pre-stripped breadboarding wires:
  - Strip wires using wire cutter (if you have one)
  - Use male-male jumper wires (recommended option, if you do not have a wire cutter)
  - Strip wires using scissors/kitchen knife (at your own risk)
- Watch instructional videos in the notebook if you are doing option 2 or 3
- If none of these options work, you can still get checked off!

Stripped breadboarding wire



Option 2: use male-male jumper wire