#	Question	Answer(s)
1	Are professor Waller's office hours recorded?	unfortunately no. but if you're unable to make those, there are many other TA OHs that you can attend. We're happy to help you through anything :)
2	for the EECS major, only 16a and 16b are required if you're taking the cs route right?	the lower div requirements are EECS16A, EECS16B, EECS70, and then CS61ABC
3	is short circuit and wire the same?	Yes
4	So can a capacitor become a wire if it stores enough charge?	While the capacitor is charging up, it looks like wire. Once its completely charged, it looks like a open circuit.
5	When does the charges in the capacitor release?	Generally when we connect the capacitor to another element (like another capacitor, a resistor), or short the two terminals of the capacitor, there could be charge released. But it depends on the conditions (like voltage, charge, etc.) of the elements.
6	What is the definition of in series and in parallel in capacitors?	"series" and "parallel" describe how the components are arranged, so its the same as for resisitors. series capacitors are in a chain. parallal capacitors are next to each other, connecting to the same nodes.
7	is she cutting out for anyone else too?	
8	what are the green things?	live answered
9	She drew the red capactive plates in between the conductive plates? are they supposed to be the same. thing?	The red ones are just symbols showing there is some capacitance, so they are not physical capacitor plates. The yellow/green/black ones are physical plates.
10	Why do we have C2?	live answered
11	so the green conductive plates don't span all of the screen? there's one for each pixel?	Yes, actually they are spanning one of the two dimensions. We are seeing it now.
12	do we have one green per pixel?	Yes. That green plate helps us form C1 and C0, which we need for each pixel
13	How does the green plate signal where your finger is?	The finger will change the capacitance between the two electrodes.
14	does the conductive plate in the bottome span all of the screen?	It also spans one of the two dimensions.
15	Does c2 in the 2d case go all around the pixel being touched?	yes, it goes from your skin down to the blue plate.
16	So why do touchscreens need bezels?	short answer is we need some room on the ends to fit our electronics to do measurements. We'll build up those circuits in this lecture
17	is the green going inside the screen basically?	yes
18	What is the row colored in blue? is it the ground?	It's the bottom conductive plate, and we connect it to the ground.
19	so for this 4 by 4 screen, there would be a total of 8 conductive plates, 4 for the x coordinates, and 4 for the y coordinates?	yes
20	so we have 8 wires?	for the 4x4 pixel example, yes there are 8 conductive plates
21	are the horizontal and vertical strips touching where they intersect in the 2d model?	no, we need there to be some space between them, so they form a capacitor
22	a real life circuit model would have multiple of these single pixel circuits in series right since we don't only touch one pixel?	If we are not touching on a pixel, the circuit will only have C0. When we touch on a pixel, our finger will make the C1 and C2.
23	how will we measure anything if there is no energy source	Right now, we are just building up a physical model with capacitors. We will introduce the measurement circuits shortly.
24	How is that parallel? looks like series to me?	live answered
25	How can you model the finger as a wire? Wouldn't your finger have resistance?	Our finger is not just a wire here. It forms part of the plates for C1 and C2. Physically, there is some resistance, but doesn't affect our physical model here.

26	why would cnot still be in the circuit without touch:	Cnot is the capacitance between the green and black electrodes. The electrodes are still there without touch.
27	So fingers are conductive?	parts of fingers are conductive, parts are resistive. Conveniently, for this model, we only need to care about the capacitance.
28	How come Ceq = C0?	live answered
29	Why is there no c2 when there isn't touch	One of the plates of C2 is the finger. So when the finger is not there, C2 does not exist.
30	c2 isn't a seperate capacitor right? it is just a capacitance value?	It is a separate capacitor, between your finger and the blue conductive plate
31	so we are constantly checking every pixel / group of pixel?	Yes
32	So is f open when there's no touch, and closed when touched?	F is the finger. So when there's no touch, F does not exist.
33	Is C0 = Ceq's value that we got from with touch?	Nope, Ceq when there is touch = C0 + C1C2/(C1 + C2), Ceq when there is no touch = C0.
34	Wouldn't we be able to tell if there was a touch at a pixel just by checking if the capacitance of that pixel ≥ c0?	That's absolutely correct, we will see how we compare the capacitance by measuring some voltages.
35	Does the magniture of C delta matter? It seems that as long as there is a change in capacitance, we detacted a touch.	Good point. In practice, we want to design the dC to be somewhat significant, so we can make some definite statement that the capacitance changed. This helps us deal with noise in the system.
36	so we detect touch by change in Capacitance?	yes!
37	shouldnt the equation have V_0 in it?	Yes! Here we are assuming V_0 = 0 (the capacitor does not have initial charge).
38	where did the first equation Is = C *dV/dt come from?	That equation is a property of capacitors. The current through a cap Ic = C * dV/dt
39	Why doesn't the current source work?	It's hard to make a current source in practice.
40	Sorry, what's wrong with attempt 1 again?	Nothing is mathematically wrong. Its just hard to build current sources. In general, we like voltage sources.
41	what is the problem with Vc being equal to Vs?	Vc does not depend on Ceq, so it doesn't tell us anything about Ceq. We cannot measure Ceq with that circuit.
42	Would adding a resistor make things too complicated?	Not necessarily, but compared to most ways that you could add it in, this is better.
43	why didn't the first attempt work?	It works theoretically. The problem is that it's hard to build a current souce in practice.
44	When do you know to open s1	When we charge Ceq up to Vs, we can open s1. Here we assume there's no resistors in the circuit so capacitors are charged instantly. In real applications we will measure/calculate how much time we need to wait for the charging.
45	Wouldnt they want to flow to the opposite charge ends?	conceptually that's right, but there is no path for them to do that
46	are we guaranteed that each switch will flip at exactly the same time? otherwise wouldn't we have some unwnanted current flow in between?	you have the right idea there. Designing timing of the switches is a huge topic in the large class of these circuits. For now, assume we have "perfect" timing, so no current leaks between the switches
47	Why won't phase 2 correctly measure it	We don't know if there is any initial charge on Cref, so we cannot determine the final state when Ceq and Cref are connected together.
48	wait s3 is closed or open in phase 1	s3 is closed in phase 1
49	would it make a difference if S3 is open instead of closed in phase 1?	we want to make sure Cref is initially charged 0V, so we want to close S3 in phase 1
50	why do we need attempt 5 again?	i think we just need to discharge the final capacitor

51	how is Cref discharging anything, like where does the charge go	When we connect the two plates of Cref together, the positive charge and negative charge will neutralize each other.
52	How did we know we should add switch 3?	The goal is to discharge Cref initially, and we can do that with s3.
53	why is charge floating?	Because the voltages on Ceq and Cref have to be the same since they are in parallel. This will be achieved by charge floating from one to the other.
54	HOW is it q at beginning and steady state for Ceq	The charge from phase 1 Q=Vs * Ceq is going to be shared between Ceq and Cref in phase 2. So it shouldn't be the same Q on Ceq.
55	Shouldn’t Vout equal Ceq + Cref?	Vout is a voltage, Ceq + Cref is a capacitance, they cannot equal each other since they have different units.
56	Wouldn’t there be some power discharged too?	Yes, the power discharged can be calculated by the difference between the power stored in the capacitors in the initial and final states.
57	This equation is based on the conservation of charge, right?	yes. The charge from phase 1 should be the same as phase 2
58	why couldnt we use the first approach with the current source again?	It's hard to build a current source in practice.
59	Wouldn't V_out be like increasing for a bit and then flat out ? Do we just consider the flat out value	We will not deal with the transition states in this course. If you consider the transition state, Vout will decay from Vs to the final value in an exponential way. It will not go up though.
60	Shouldn’t vref be cref?	live answered
61	Didn't we say we don't have Cref when there is no touch? So why is the equation Vout = (Co)/(Co+Cref) * Vr?	We have Cref with no touch. It will be Co the changes with touch.
62	what was delta C again?	delta C is the change in capacitance from adding touch
63	Where is the Creference in the touchscren model?	Its not part of the model. the touchscreen model we built up is just the Ceq we have
64	Why does sticking the ends together discharge the capacitor?	This is short circuit the capacitor, so the voltage across it becomes 0, so no charge on it.
65	What is that C subscript again? not the ref or the 0, under if touch?	C delta. Its the change in capacitance from touching it
66	Do capacitors have a positive and negative end	In this course our model doesn't have positive/negative. But in practice some of the capacitors do have positive and negative, due to the physical structure and materials in the capacitor. Typically the positive end is longer than the negative end, and there will also be labelings on the capacitor.
67	would Cref and Ceq be the same	not necessarily. Ceq comes from the physical touch screen. Cref is a design choice, depending on the output voltage you want.
68	sorry I meant would the voltage of Ceq and Cref be the same	At the end of phase 2, yes they should have the same voltage
69	we measured vout by putting the voltmeter on cref?	
70	Why does the voltage reading keep dropping?	