BRAD TALLIS: Wanted to welcome you guys. My name is Brad Tallis. I'm a Fusion 360 technical specialist and a street team member, so I'm kind of dual roles right now. Basically, this class is going to be about using direct modeling in Fusion 360 to take your models to the next level. I don't know if any of you guys really know this or not, but Fusion 360 not only has parametric modeling, but it also has direct modeling in there, along with freeform and all the other cool stuff. And today what I'm going to be talking about is this direct modeling technologies.

So basically, we're going to learn how to make changes to history-based or history-free models. For example, imported geometry. It might be a SolidWorks model, might be a Pro/E model, or even an Inventor model. We're going to learn how to defeature those. We're going to learn how to heal corrupt models. You don't know how many times I hear from customers where they've had this part for 10 years, and the person that made it is no longer with the company, and they just want to move that rib five millimeters or something like that. They don't know how to do that. And then the last section is kind of an interesting one. I'm going to show you how to basically use direct modeling techniques to actually model in a parametric modeler. And hopefully you'll see how quickly you can get your idea out of your head and onto the screen using some of these techniques.

So I only have four slides. I'm not a slide person. This is going to be pretty much all live demo. So at the end of this class, hopefully you'll be able to know how to use direct modeling to move and make changes to features on a model. You're going to recognize and remove features, use direct modeling techniques to heal corrupt models. You're going to hear me use the term wound and heal quite a bit. You can also use some interesting technology there. And then using direct modeling techniques to create these in-context designs. OK?

So we're going to start out with just making changes to geometry using direct modeling. I know it's kind of late in the afternoon. Feel free to clap or go, "Woo-hoo!" or whatever if you see something really kind of cool. We want to keep this kind of lively, so if you have any questions, interject. This is your guys' demo.

AUDIENCE: Is booing allowed?

BRAD TALLIS: Booing is not preferred, but accepted. So how many have used Fusion before? Everybody. Anybody not used Fusion? OK, a couple.

AUDIENCE: Boo.

[LAUGHTER]

BRAD TALLIS: No. So what I'm going to show here-- this is a part. You can kind of see, there's actually no timeline along the bottom of my screen. So there's pros and cons with parametric modeling, and there's pros and cons with direct modeling. One of the cons with direct modeling is it's a light switch. I'm going [CRUNCHES] into direct mode and I'm losing all of my history. You're basically losing all that information. So you kind of have to decide, do I want to lose this history-- because it can't keep track of all that-- or do I want to be able to do some really cool direct modeling techniques and make changes to the model? So that's what we're going to be talking about here.

So this could be an imported model. It could be like a SolidWorks model, Inventor, or whatever. Doesn't matter. And as I'm looking at it, there's actually some-- it looks fine to me, but there's some really kind of weird oddities that we're going to go through and fix. So the first thing you're going to notice is there's these little, small ribs right here, OK? All the other ribs are kind of larger, and all that kind of stuff. Maybe I don't need those anymore. Typically, what I've seen people do is they'll create a sketch, and they'll draw a rectangle and they'll machine that away, right? Kind of destroy that geometry. Well, using direct modeling techniques, I can just click these faces, and I'm going to show you guys-- hopefully you know this trick. If you click and hold for about a second, you get this Probe-type command that comes up. So I can come down here and basically probe through my model. So you can kind of see it's selecting those faces. So you just click and hold for about a second. So I'm just probing through to that other face. Minimizes the having to rotate around. And you're going to see me do that again.

Now, here's the interesting part about direct modeling. You kind of have to think about, what is the computer going to try and do? If I hit Delete right now, is this face going to grow that way, or is this face going to grow that way, or is it going to complain? And if I hit Delete right now, it's going to complain, because it doesn't know, do I go that way or do I go this way? So I actually have to add one more face. So I'm going to come in here and I'm going to delete that face. So I basically have four faces selected now. And I just hit the Delete key on my keyboard. I want to delete those faces, and sure enough they go away. Thank you.

[APPLAUSE]

Good news is, it gets better. OK. So I'm going to do that again on this other side, just to kind of repeat the process. I'm holding my Control key to do multiple selections. Click and hold for about a second to do this probe. I love that command. And then I'm going to select that face. Now, what's going to happen, by deleting this face, this face is going to have to grow to the next boundary, if you want to call it that. So this face is going to extend and grow to there. So watch what happens when I hit the Delete key. Sure enough, you can see that face extended to that other boundary.

AUDIENCE: What if you wanted those surfaces to be offset?

BRAD TALLIS: So, then you would have to do this a little bit differently. Yeah. So you would have to choose which one you want or do some kind of a machining function there. Here's another kind of a weird oddity. There's this ramp right here, and then this edge right here. I can just click on that face, hit the Delete key, and we've just made that all the same level. So maybe this is at 45 degrees, and this is at 45 and 1/2 degrees, or whatever it might be. Who cares? I'm going to click on that face, hit the Delete key, and you can kind of see how it removes that face and extends or grows out that other face. OK?

This is kind of weird. As I look at this location right here, you notice it doesn't look like those edges are tangent. Now, if I look down here, this one is. So whoever modeled this didn't do a great job at this intersection or whatever. So how do I fix that? Do I put another blend in here? No, I'm just going to click that face, hit the Delete key. And what did it do? It actually had to grow those faces so it kind of made it a sharp corner now, right? Then I could come in here and create a fillet, and basically, I'm recreating that fillet. So let's just make it 10 millimeters in this case. And I'm going to talk about measuring here in a little bit. But I've now made that. So that's no longer a weird, non-tangent intersection, right? Only commands I've used so far is the Delete key.

Let's move on. Something like this. I want to get rid of this little shelf right here. I don't need that in my geometry. You don't know how many times I've seen, in other systems, where people would basically draw a profile heal and extrude it to this face, and then they'd have to copy this profile, machine that back up through and all that kind of stuff, right? You're basically adding some material back in there, kind of using your Bondo basically, and then re-machining through it. Well, if I just come in here and select those two faces and hit the Delete key, it fixes it, right? No sketches, no recreation or anything like that.

AUDIENCE: Is that something that wouldn't work if you were in the design history mode?

BRAD TALLIS: Actually, that's a really good question. I think that would work even if you were capturing history, yeah. In fact, what you're seeing right now can all be done-- John, that's a really good question-- can all be done in the history mode, doing this deleting faces and removing blends and stuff like that. Where direct really comes into play is like moving ribs-- which we're going to be doing next, actually-- moving geometry. You really can't do that very easily in history mode. So yeah, excellent question. Could this be done in history mode? Absolutely. Yes.

AUDIENCE: The only difference is those would be features.

BRAD TALLIS: Yep.

AUDIENCE: [INAUDIBLE] Exactly.

BRAD TALLIS: So what about, like, this slot right here. Could we get rid of that? Check this out. Just draw a selection box around it like so, hit the Delete key. We've just healed that geometry. Pretty snazzy. I'm going to undo that guy. Let's take it to the next level. I want to move this cylindrical feature, if you want to call it that, up or down a little bit. So I'm going to draw a box around it, right mouse click. I'm going to use the Move command. Here is the difference when you're in history mode versus direct mode. When you're in history mode, you can move bodies on components, that kind of stuff, but you can't move faces, such as a slot. I want to move that slot over half an inch or whatever. In direct mode, you get this new little icon. And if I hover over it, it says move faces. So we're actually going to move all of these as faces. And notice, I drew a box all the way around it. And if I just grab this guy and move it up or down, we're now changing where that's going to be.

Now I'm going to show you another trick. I hope you guys know about this. This is probably one of my favorite commands. If you click this little down arrow next to the distance, you'll notice it says Measure and Re-anchor. Check this out. I'm going to re-anchor to this face right here. And you'll notice, now says 18. So it's actually measuring. It saying that it's 18 millimeters from here up to that center point. So maybe I want that screw boss to be exactly 20 millimeters off that face, so I'm going to just come in here and type in 20, and you'll see it jump up a little bit. I'll say OK, and I've just moved that up.

Now, there's no sketch to go to to make this change. How would you have done that, right? Well, you can use the direct modeling. You're going to hear me say this a lot, let's take it to the

next level. Check this out. I'm going to draw a box-- watch what I'm selecting. I'm actually going to draw a box all the way down to those vertical walls, like so. Right mouse click, say Move. I want to rotate this whole thing around this surface or this blend or whatever you want to call it, so I'm going to click on Set Pivot, because you'll notice by default, it's kind of doing the bounding box-- kind of the center of this bounding box right there. I'm going to say Set Pivot, going to click on that edge there, and then I have to say OK, I'm done setting my pivot. Check this out.

So you can make changes very easily by just selecting all of those faces. Not only the cylindrical ones, but the vertical ones on that standoff, we can rotate that. Maybe it needs to get tweaked two degrees to the right. Maybe the other part this attaches to was changed or whatever, and you want this to line up. So you're able to do that very, very easily.

Same thing. Let's look at this. Here there's some support ribs right here, but they kind of terminate over here, and I'm thinking it would be better if they actually were more lined up with these other standoffs for support reasons and stuff like that. So I'm going to do kind of the same thing. I'm going to click that face. Click again to probe through. Right mouse click and say Move. Now I want to rotate it around like an axis, so I'm going to actually rotate it around either of these curves here. So I'm going to say Set Pivot. I'm going to zoom up just-- oops, too far. I'm just going to click on that edge, and so I'm just basically saying rotate around that edge. And I love the live preview. I can now grab this and move, and you can kind of see how that's going to update accordingly. So I can now move that over, and actually, I snapped to it six degrees. I wanted to say six degrees. And we've just moved that rib over. I didn't have the machine it away. I didn't have to recreate anything or anything like that.

So let's just do the same thing on this other side. Let me go ahead and probe through to that other. Oop, I didn't-- have to be more of an angle, so I'll just go ahead and do that. Grab that face. Notice, depending on the angle, it's almost like a laser beam going through your part. So there's a lot of different faces I could actually probe through to. So I'm going to grab that guy, move, set my pivot, and let's just grab that edge and start to rotate. And I'm just going to type in six degrees, because I know that's what I want it to be, and we've now just made kind of-- I don't want to call it a major design change, but a substantial design change to this.

AUDIENCE: In that mini toolbar, is there a way I can say I want that angle to be a certain angle relative to [INAUDIBLE] type surface?

BRAD TALLIS: You can re-anchor it to something, but I think it's more for distance. You can also take measurements. You're going to see me use that later on. But that's an excellent question. I could actually have thrown a construction plane on there, projected some construction geometry to take measurements from. I'm kind of just doing the clicking and dragging type stuff. But the thing I really want to emphasize is I've been in the CAD industry for about 20 years. Hundreds, if not thousands of customers-- you don't know how many times I've seen them hack and whack, is what I call it. They're just trying to piece this thing back together or actually starting again from scratch, because the model is so corrupt or whatever, they can't do anything with it. They start all over. That just drives me crazy.

So the last thing I'm going to do on this is, let's pretend we've run a simulation, and I've noticed that this-- kind of a thin rib here, and it's only supported by one rib, and I actually want to make it two ribs. So yes, I could machine this away, and create a new sketch and all that kind of stuff, but why do it the hard way? Check this out. I'm going to come in here. And let's just grab those two faces, and this is kind of interesting. I don't even have to click the blends or anything. I'm just going to grab those two faces, say Move, set my pivot. I kind of want to go around maybe that edge there. Going to rotate just a little bit, drag that over like so. Let's just go, maybe 35 degrees. Now what can I do? Well, let's use the Mirror command. And in this case, I am going to draw a box that kind of goes over the whole thing, including the blends or whatever. What's my mirror plane? I'm just going to click my middle plane there. Say OK, and we're done. That quick. Any questions on that?

[APPLAUSE]

Thanks. I appreciate that. It's not necessary. I just think it's really interesting. People don't really know that this technology exists, and that's what this whole session is about, so I'm really glad you guys and gals are attending.

I'm going to jump into the next one here. So what this is, I actually went out to GrabCAD and did a search for a SolidWorks model. It could be Pro/E, it could be whatever. Doesn't really matter. I just went out and did a search for a SolidWorks model. You can kind of see here. Sure enough, was created in SolidWorks. Which version? Doesn't matter. To save time, I've already downloaded it and then I uploaded it into our project. So I just said Upload, pick that model, and it pushed it into our project. So this is that exact SolidWorks model.

Notice, imported geometry comes in with no history. Everybody's history is proprietary. PTC is

not going to share how they do their history. SolidWorks isn't going to share how they do their history. So that comes in as what I would call a dumb model. What can we do with it? Well, I like this bearing block. I want to use it as a start, but it's not the final thing I want to use. I don't want this logo on there, so I'm going to draw a box around it and hit the Delete key. I didn't have to select 96 faces or however many there were. We just got rid of the logo. And I also want the grease Zerk to be at the top. So I say Move. Notice it allows me to move bodies, components, sketches, et cetera. I'm going to click on Move Faces and just draw a box around it. Notice where the set pivot shows up at. I want it to be more in the center. And I love this. Fusion recognizes these edges from somebody else's geometry, right? So I can just click on one of those guys, start to rotate. Let's just go maybe 35 degrees, and we've just moved the grease Zerk to the top of the bearing.

I don't want this curved front face. I'm going to grab those curved faces, hit the Delete key. It has to heal that geometry. Let's do the same thing on the other side. I'll grab those four faces, hit the Delete key.

Here's another neat trick I don't know if you guys know about. If I come under Create, there's a command here called Find Features. This is actually pretty cool. I'm really impressed. I've used other software's Find Features, and Fusion does a pretty good job with this. I'm going to click on Find Features, and I could filter these out. I could only search for fillets, or only chamfers or whatever. But for fun, I'm just going to draw a box around the whole thing, and we're going to search for the whole thing. Watch what happens over here. When I say OK, in about a second or two, it actually went through and it found different features automatically and stuff like that. So, for example, this fillet 12, if I hover over it, you can see that it's that fillet. I'm just going to double-click on it, and it says it's a 2-millimeter fillet. Let's make it a one. So yeah.

[APPLAUSE]

You don't need the history right? You guys can go like this [SPUTTERS] if you want. For example, here this little blend. You notice how it gets small at the top? Maybe we want it to have a cordal blend. So I could come in here, I could actually grab that guy and say Delete. It's gone. I could click on this guy, do it manually, hit Delete. I've just removed that blend-- or those blends, I should say. There was multiple ones there. Click on that face-- or that edge, I'm sorry-- and hit fillet. And instead of a constant radius, let's do a cordal blend of one. And you'll notice, now, it actually does a constant blend all the way around. Yeah.

AUDIENCE: Can you edit that fillet and then go to--

BRAD TALLIS: Oh yes, absolutely. So I deleted on both sides, but I could have edited-- oh, I see what you're saying. Actually, that's a really good question. I've never tried that. I don't-- that's a good question.

AUDIENCE: [INAUDIBLE]

BRAD TALLIS: No, see, you'll notice, it just shows what the fillet is, yeah. But you saw how quickly we're able to recreate it if necessary. Yeah.

AUDIENCE: Is there a reason why we wouldn't ever be able to have a feature that would let us switch fillets and chamfers?

BRAD TALLIS: I totally agree with you. I don't know why there's not an option as of yet. Typically, when you do the Push-pull command, when you click on an edge, that kind of defaults to fillet, because that's more commonly used. I think that's the reasoning behind it. But that's a good thing to enter into the Idea Station. I don't know if-- how many of you know about the Idea Station? Yep. Built right into Fusion. Go into the Help, Submit an Idea. And this is-- R and D's looking at this. I'm digressing slightly. I came from another CAD company of 20 years. You know how many of my enhancements made it into the product? Zero. I worked for Autodesk less than two months, and two of my enhancements made it into the June 20 release. Autodesk is listening to you and the customers. And it's not because I'm an Autodesk guy that they did it. It made sense.

Here's another one that I really like, is when you click on an edge, it tells you the edge length, or if you click on a radius, it tells you the radius. We used to have to go up to the measure or the inspect and do that. This was a customer. They said, "How come I can't just click on an edge and have it show up at the bottom?" Yeah. Was that yours? I know it, makes total sense.

I've been editing this in direct modeling mode. Now I want to start capturing some history. We allow you to do that. This is kind of that toggle switch I was talking about. If I right mouse click up here, you can see that it says Capture Design History. OK? So I do that, and my timeline appears. You're going to see an icon here that says it's a base feature. It's a dumb model, what we call a base feature. OK? So now I could do things like maybe I want to chamfer this slot. So I just come in here and say Chamfer, and so do a 1-millimeter chamfer, and I'll do that on both sides. Say OK, and you'll notice there it captured that chamfer feature.

So think about-- maybe you're doing, like, FEA analysis and you want to defeature this model, you defeature it. You analyze it. Now you want to put-- maybe let's analyze the larger blends, 5 millimeters or higher. You could throw those back on there if you want to, for example. And you can capture that. You can come back and tweak that. Instead of a 1-millimeter chamfer, I could come in and make it a 2-millimeter chamfer, for example. And it's just like you're used to in the parametric modeling. Any questions on that part? That make sense?

So I'm going to switch back. I'm going to come in here and say do not capture design history. And it's going to tell me, hey, all of this stuff in your history is going to get removed. This is that big light switch that I was talking about, right? I always imagine that big prongs [CRUNCHES] kind of thing. So I'm going to say continue. I'm back in direct modeling mode. I can still do things like create a sketch and chop stuff through here if I want. Blah, blah, blah. Press Pull. I just do-- I can still do techniques like this and blend that or chamfer it or whatever. It's just not capturing it down in the timeline, but you'll notice that it is kind of capturing it here in the browser. So I could come back, change that chamfer. I could double-click on it and you can see the options there, for example. OK? If I switch back into history mode, no chamfer there, right? We turned that off. We blew that away. OK?

AUDIENCE: Is it a good point where as if you edit that, then it'll show back up, because it's an editable feature.

BRAD TALLIS: So.

AUDIENCE: [INAUDIBLE] Like if you were to go in to edit that chamfer, [INAUDIBLE]

BRAD TALLIS: Yeah, and this is kind of a-- I don't say this is a good example, because I wouldn't go back and forth and back and forth and back and forth, kind of a thing. That's not the design process. I'm just showing you, you could bring in Pro/E data, SolidWorks data, whatever it is, edit it to your heart's content. Make changes to it. Defeature it, whatever. Move the grease Zerk to the top. But then if you wanted to, you could say OK, now I want to start capturing some history-type stuff. My sketches, my shells, whatever it might be. You can capture that.

AUDIENCE: So what's the difference if your features are at the bottom versus in the browser?

BRAD TALLIS: Well, with the timeline, you can kind of reorganize and suppress and do all that kind of stuff. Over here, it's more just showing you did a chamfer.

AUDIENCE: [INAUDIBLE]

BRAD TALLIS: I don't think so, no. Yeah. It's not a step in time, it's just basically, so-- like I said, there's pros and there's cons, depending. But the thing I really want you to leave with this part here is, remember, this came from a totally different CAD tool. I don't know how it was created, who created it, when it was created, what version was it created in, but we're able to work with it just like it was created in Fusion. OK?

I'm going to jump over to this guy. So this-- actually, the name kind of gives away. This is a Pro/E part. And nothing against Pro/E, but as I look at this model, there's some really weird stuff going on. Like why two little blends right there? Why there's an edge right here in the middle there? Why do we have three edges here, one here, and two over here? It doesn't make any sense to me.

I want to start defeaturing this, so I'm going to go ahead and I can see, like over here, I've got kind of a weird blend or something like that. So I'm going to just select these faces. I want to remove this blend. Should be simple. I'll hit the Delete key. Eeh. Won't let me do it. OK? This is where this wound and heal methodology is going to come into play.

So that to me, looked basic. It should remove that. How come it didn't? Well, because somewhere on this part, there's some weird stuff going on. And it could even be-- in this case it's not, but-- you can see these blends wrap all the way around and go over here, and they come around here, and then they taper off to nothing there. There's some weird corners going on here. So the fact that I just want to delete, basically, this face, it could be something over here, it could be something way down here that's causing it to not let me do that, because remember, it's trying to heal.

I'll be brutally honest, this is a very corrupt model. There's some weird stuff going on. So how would I fix this problem? So this is a neat little trick. What I call the wound and heal. Basically, what we want to do is we want to carve away what could potentially be the problem, and it might be this little feature there. It could be-- why is this blend kind of come to-- instead of a sharp point, it kind of comes to that, I don't know. That's kind of weird. Versus a sharp point over here. So it could be any of these problem areas. So we're going to carve that away. So the easiest way to do that is we're going to create a sphere and subtract that. Basically cut that geometry out. It's going to make more sense when I show it.

To create the sphere, we need to use a command like a construction plane. We need to have something to draw that sphere on, OK? I have found out that this Plane Along a Path is probably the easiest and quickest method, so it'll make sense when I do this. I'm going to say Plane Along a Path. And I'm going to click on any of these lines. It really doesn't matter. I'm going to click on that guy, and notice, it created a plane on that path where I clicked it. But I can now drag this guy and I'm going to drag him all the way over here like so.

Then I can use my Sphere command, so I come into here and I say Sphere. What do I draw the sphere on? I'm going to draw it on this plane. And we're going to do this a couple times so you'll see-- it's going to get repetitive. So I just clicked on that plane, and I typically try and get to this origin. You can kind of see it snapping to it. I just click there. And I love the fact it's even red. It's almost like it's a wound, right?

What I want to do now is enlarge this sphere so it totally captures all of the problem area. I'm going to kind of move around here a little bit. So let me show you what I mean by that. Let's say it defaulted to this. We want it to destroy that blend. We want it to destroy that face. We want it to destroy that face and we want it to destroy that face. And even, maybe, destroy this corner. So I'm going to make this large enough. That's not large enough there. It's getting most of it, but not all of it. I'm going to go like so. Now, you don't need to go like that. Not necessary. In fact, probably wouldn't work. But you just want to go large enough to basically destroy all of that problem area. Notice I got a nice, clean blend, nice, clean face, nice-- everything is nice and clean, per se, if you want to call it that.

So I'm going to do the same thing over here. Going to create a wound over here. So I'm going to do the Plane Along a Path, click on one of these, and drag it to the end.

AUDIENCE: Sphere won't go right up to the point?

BRAD TALLIS: I wish it did. Unfortunately, it doesn't. Now I'm going to show you guys a trick with this Plane Along a Path. Pick as large of a line as you can. For example, if I click that line, notice my plane is itty-bitty. Really kind of small. Kind of hard to see and all that kind of stuff. And that's because it's actually kind of scaled to the size of that line. So I tend to try and pick a larger line like this one here, or maybe even that guy there. But let's just do this one. I'll say OK. I'll throw a sphere on there. And you'll notice that I actually-- because I do this a lot, I have the Sphere command and the Plane Along a Path command on my toolbar. And then I'll just click there. Make this a little bit larger, like so.

AUDIENCE: Could you use that [INAUDIBLE] as a point?

BRAD TALLIS: No. You actually have to-- you could put a plane on that-- it has to be a plane, yeah. So I'm going to go ahead and say OK. I've just destroyed those problematic areas, so now, can I come in here and hit the Delete key? We just got rid of that geometry, and then check this out. I just click on the wound and I hit Delete, and it has to heal, right? So it had to extend this blend over. Had to extend that guy. Had to do all that kind of stuff. I'll go ahead and click on that face, hit the Delete key, and we've now removed that problem area. Where before, how would you have done it? Maybe machine a bunch of it away or something like that. Simple spheres, basically. Does that make sense?

[APPLAUSE]

Thanks. And I could come back and say, OK, now let's put it fillet in there. I'll just make it three or whatever. You can see how it actually rebuilds that blend. Notice the two weird blends? That's because this part is so crazy nuts that it's trying to figure out how to fix that blend. But this is what I would have expected over there, for example. OK?

So let's go to something like this. And what I'm showing here is not how to do it, but techniques to think about if you're having to do stuff like this. I'm purposely-- you're going to see a mistake happen here. I want to recreate all of these blends around the top instead of having all these weird lines and stuff like that, because maybe I want to manufacture this or 3-D print it or something like that. Also, as I look at this, I can see that I've got a rib in the middle. And then this one's a little off-center a little bit, and that one's way off-center. It's kind of weird. So I'd rather recreate my ribs. So let's go ahead and just draw a box around this rib here, and hit the Delete key. Boom, it's gone. Just like that. I love this. You can tell I'm a direct modeling geek. I'm going to hit Draw Box around that, and hit Delete. So I've left the ones that I want. We're going to recreate that a little bit later.

Now let's remove the blend. And I find the easiest way to do this is basically look at it from the side. I'm just going to draw a box around it like so. OK? Now, you'll notice, it's selected the top face. Do I want to delete that top face? No. So I'm going to hold down my Control key and click on it and unselect it. I selected-- I don't know how many faces that is, let's just say 30 faces, just by drawing a box. Now, I'm going to delete this. I hit the Delete key. Yay. And guess what? It sat there for a while and it didn't work. You're going to run into this when you're doing defeaturing and stuff like that. Why did it not work? Probably because this part is pretty

corrupt. Probably has to do with these other faces that are touching this blend.

So to do this correctly, I'm actually going to have to remove all of the blends at the same time. OK? So how am I going to do that? I'm just going to come in here. I'll do the exact same thing. I'll draw a box around these guys here. Turn that guy off. And then kind of looking at the top, I'm just going to hold down my Shift key and draw a box around those vertical blends. So I just basically Shift-selected all of that geometry. OK? So I'm going to do the same thing here. I'll kind of draw a box like that. I'm just kind of walking my way around, making sure I get all of those faces. Shift key, like so.

Now, you might be asking, well, how do you know that it's those blends that's the problem? You really don't. You just have to assume, because that chain of blends didn't delete, something else is wrong with it, and it's typically something that's touching it, OK? So I and went ahead and selected all of those-- did I get-- did I get that guy? No. One more. Sorry. I shouldn't get distracted here. So select those. Now I'm going to hit the Delete key. And it worked. OK?

What about these last few blends? Let's just draw a box around those. I could probably-- I could draw a box. I'm just going to go ahead and Control-select these guys real quick. And grab that guy there, that guy there. Hit the Delete key. And I actually got rid of all of it. So it deleted everything around, and now I can come back and regenerate that if I want to, OK? I can actually undo-- I don't know why-- it must have selected an extra face.

Now I want to come back and recreate. So let's go ahead and say-- clicked too fast. I'm going to blend this edge. I come here and say fillet. I want to make that a three. I'm just going to go ahead and kind of click around. Because I'm in the Fillet command, I can actually select through my model. I don't even have to rotate. I kind of have to know where the edges are. And I just did that. I'll say, OK. I'm going to put a 1-millimeter fillet around the top, and look how beautiful that fillet looks. There's no extra edges or lines or anything like that, right?

And then finally, I'm going to come in here and create a pattern, a circular pattern. What do I want to pattern? I'm just going to draw a box around that. Select my axis. Let's do three of them. I'll say OK. And oop, I deleted the blend. Sorry about that.

I think it's-- oh, I know why. I got burned by something I even mentioned before. Sometimes you want to remove the blends-- in fact, I'm going to do that. You want to remove the blends before you do a lot of editing, and the reason that failed is because there's problematic blends

on here. I went too far forward. So I want to remove all the blends off this feature. Well, there's a lot of little, tiny faces that I can't-- I'm going to have to zoom up on or whatever. Well, no. Let's just do this. Just draw a box around it like so, and then unselect the three faces that I don't need. That guy, that guy, and that guy. Hit Delete, and I've just removed the blends off of that. OK? Now I can come in and create a pattern of it, for example.

Sometimes-- and I'm just going to kind of show you the process. I'm sort of running short on time. But sometimes the part is so corrupt that you try and do something over here, and because of a problem over here, it won't do it. It won't let you delete that feature, it won't let you delete that blend. So I call it the amputee process. Instead of the wound and heal, we're actually going to cut the limb off. And so to do something like that, I'm just going to come in here and create a sketch. And I might just do something like this, where I'm just going to draw a box, something like that. And there's a cool command in here called Split Body. I'm going to click on that guy. My splitting tool's going to be this rectangle, and I now have two totally separate bodies.

So I could actually turn this guy off. Now I could just work on this guy. Maybe just to speed things up, I'm just going to come in here. Let's say we defeature this, we remove those chamfers or whatever. I'm able to work on this particular area and not worry about, how's it recalculating everything on this part?

A neat example, I helped a customer. He was doing a grill insert, something like you'd see on a Foreman grill or whatever. It had lots of little ridges which had blends, and they were tapered in a bunch of different directions. It was very complicated. And there was a groove he wanted to move. Couldn't work. And I even had a hard time with it in Fusion. But the problem was, was all these blends were intersecting with each other. So I just cut it in quarters, and I was able to work on that one quarter and defeature that. Then I was able to work on this quarter, defeature that. And then, after everything was fixed, I came in here and said Combine. Combine that part and that part, join them together. I'll say OK, and it's all one happy part again. It's kind of cool. So that's a neat trick, especially you have a very complicated part. Kind of section it if you can and work on that. Any questions on that?

AUDIENCE: Yeah. On the [INAUDIBLE] recognize feature, [INAUDIBLE] would that work on some of those messy--

BRAD TALLIS: That's an excellent question. I'm glad you asked that. So the question was, could I have done

the Find Features on this, and would it have found those ugly blends? And the answer is no. It thinks they're surfaces, right, because they're so odd and stuff like that. Yes, it'll find some blends. It'll find holes and stuff like that, but that was the first thing I did on this model, was try and find features, and it found, like, three. It's kind of interesting.

So the last one here-- this one's kind of interesting. This is using direct modeling techniques to help create a model. So I've been tasked to create a bracket that's going to connect these two parts together. And typically, with the parametric methodology, you kind of have to know, what's the final thing going to look like? How's this going to interact? What size is it going to be? Blah, blah, blah. You kind of have to know what that is.

Well, in this case, I kind of want to just doodle. I just want to get my idea on the screen and use the existing geometry to help me with my design. So I'm going to just start by creating a sketch. So I'll come here and say Create Sketch, and I know that it has to connect these two parts together, so I'm going to project that circle and that circle. Now, I use the P key on my keyboard, Project. As you get more comparable with the software, I recommend E for Extrude and P for Project. That kind of stuff. If you need to know where it is, it's right here under Sketch Project, and you can see the little P icon.

So I just projected that. Now I'm going to R for Rectangle. And actually, I'm going to do-- I lied. I'm going to do a center rectangle. And I kind of want to add some material here, so I'm just going to draw a rectangle. Am I typing in dimensions? Nope. I'm just kind of drawing some stuff.

I know I want to have a rectangle over here somewhere, so maybe I'll just start here. I want it to kind of line up with the back. You guys know that trick, where you kind of hover for half a second and it creates that snap guide automatically for you, which is kind of cool? And then I want to connect this together, but I've done these as centered rectangles. So I'm going to just delete that and drag that up. Something like that. Basic shapes. Rectangle, rectangle, rectangle. OK? And I'm done. I'm going to stop my sketch.

Now I'm going to extrude these profiles. Make sure I get that guy in there too. I use Press Pull all the time. You could go to Extrude. I'm going to use Press Pull and start to drag, and now it's cutting through geometry, so it shows up as a cut. I'm just going to come in here and say, make that a new body. And I want it to be symmetric around that mid plane, and I am going to type in dimensions. I'm going to say, I want it to be 100 millimeters. So I've just started with a

large chunk of metal like you might on a mill or something like that, right? Kind of that basic shape. And now we're going to machine it away. So click on that top face, right mouse click. Let's just do a rectangle. I just come in here. And maybe I know, in this case, I want it to be 70 millimeters by 180 or something like that. I can add in the intelligence as I'm working along here. But you're going to notice that it's not necessary the whole time.

So let's do the 70 by 180 again, like so. Stop my sketch, and Press Pull. So Press Pull is a really cool command. If I lift up, it's an extrusion. If I push down, it's a mill. And here's something really kind of cool. This is as of last weekend, they've added this new functionality. You'll notice it's machining through this angled plate right here, and it's going to machine whatever's visible. You actually had to go and turn the light bulb off and all kind of stuff. It was kind of annoying, I'll be honest. Hopefully Carl's not listening. But now we have this Objects to Cut. Yeah, it's being recorded, yeah. So I just open up this Objects to Cut and I can turn off that break. And it only cuts through-- I know. I'm going to clap for this one because--

[APPLAUSE]

I'm really excited about that. So you don't have to deal with the light bulbs and stuff like that. So I'm just going to machine through. How far? Far enough. I'm not going to go to a particular distance. I don't have to-- what was that dimension? I'm not having to write down stuff on a Post-it note to memorize or remember or anything like that. So I just did something like that, machined it away.

Now, this break, I'm making a clevis right here. So I need to remove some geometry. I click there. Let's create a sketch, and I want to use existing geometry. I'm going to use this light gray part, so I'm just going to project. And I just have to hover over it and I kind of see that guy there. I just projected that. I can use my rectangle and catch to that point.

And this might seem really weird. You're going, what are you smoking? This is kind of that freeform-type, just get my idea on the screen. So I'm going to say, OK. Grab these profiles. Again, I can pick through by just holding down-- oops, I didn't mean to do that. Click and hold. Profile, that kind of a thing. Oops. Darn it. I didn't want to move that. Clicking too fast. Let me do it this way. Click. Click. Here we go.

Now, you'll notice I overextended this rectangle. Why? Any ideas why? Any guesses? There's no wrong answer, by the way.

AUDIENCE: To make sure you got everything?

BRAD TALLIS: Yeah, basically to make sure I've got everything. What if this bottom face was tapered one degree? You would create a sliver or something like that. So I always kind of over exaggerate and then do the Press Pull-- I don't know why it was giving me that. And I'll just drag that back. Objects to Cut. I don't want it to cut through the break, so now you can kind of see it's not cutting through the break. I'm just kind of machining that all the way back. And again, far enough.

Now, here's a neat little trick. If you actually-- I don't want that. If you click on a face, you can actually catch or snap to that face. I just kind of like going extra distances to make sure. So I'm going to go ahead and say OK. And I've now machined-- oops-- machined that area out. OK? The hole is exactly where it needs to be. I'm not having to position parts or whatever. In fact, here's why-- exactly why I go a little bit farther. You can kind of see it didn't go far enough, so I'm going to just go that extra distance. Say OK.

Let me grab this edge here. Let's just add a chamfer on these edges. Let's just do, maybe, like a 10 millimeter or something like that. Say OK. But as I'm looking at it, this clevis is a little bit long. So let's just do a Press Pull. Grab those faces, and move that up until I get kind of the distance where I want. Again, just kind of saying, I don't need them to be overly long, but just kind of tweak with it a little bit. Now it's 8.649. I could come in here and just say, go 8 millimeters. Be more precise if I want to.

AUDIENCE: Why wasn't the chamfers [INAUDIBLE]

BRAD TALLIS: Pardon?

AUDIENCE: When you moved out those two block faces over here, why did the chamfers get longer or shorter, depending on--

BRAD TALLIS: They didn't. They moved up with it. If I--

AUDIENCE: Shouldn't the chamfer pieces [INAUDIBLE]

BRAD TALLIS: Excellent question. I'm moving these faces. Fusion is smart enough to say, you put a chamfer on that edge, and you're basically moving that edge. So it's keeping that chamfer instead of doing what you might see in other software, where they get bigger and smaller. Now it sizes your chamfer.

AUDIENCE: Wouldn't the project dimension on that chamfer, or [INAUDIBLE]

BRAD TALLIS: It doesn't matter. It's a feature. I can come back to this chamfer and instead of making it 10, I could make it 12.

AUDIENCE: [INAUDIBLE] If you had not put in the number, would it have change the chamfer when you try to remove [INAUDIBLE]

BRAD TALLIS: Yeah. You have to put it as chamfer or whatever. If it was just angled faces, then it would kind of grow. And I'm kind of digressing here, but you can actually, by changing offset to modify existing features, you can kind of do different things. But I think it's awesome that it's smart enough to say, don't change my geometry. Keep everything normal.

AUDIENCE: So you can override that if you wanted.

BRAD TALLIS: Yes. Yeah, you could. I'm going to just draw a rectangle here. I can't see-- let me go ahead and just create a quick sketch on that face. I'll do a rectangle. I can't really see my geometry. I know there's some stuff in there. I'm just going to draw a box. I don't care what size it is. I'll say, OK. Let's machine this guy through. I'm just going to drag back far enough. I'm going to say Objects to Cut. I only want to cut this body here. And now you can see that I've created a wonderful opening, right? But it has nothing-- there's no geometry, no dimensions or anything like that.

But I can come in here and say, you know what? Let's pull this face down so it's a little bit closer. This is probably my favorite thing. You've already seen it, but this reanchor. So I'm going to move this face to the right a little bit, and it's telling me, you've just moved it 10 millimeters from where it was. You've gone 10 millimeters over. I'm going to come in here and say, reanchor to this face right here. And I want a 2-millimeter gap. So I'm just going to come in here and type in two. Even though I moved it to the right, we've reanchored it to that face. I'm saying, make it 2 millimeters from that face, so it's actually bringing it all the way back, and I've now got a 2-millimeter gap there.

So let's do the same thing here. Press Pull. I just kind of start it a little bit. I'll say reanchor. I'll click on that guy there, and do the minus 2, for example. OK? And now I have that opening pretty much exactly where I want. Didn't have to do dimensions. Basically saying, I want the clearance to be 2 millimeters, OK?

So I'm going to kind of continue drawing pretty quick here. So I'll just create my sketch. Let's go ahead and project maybe this back face to help me out. That's kind of cool. I'll just draw a rectangle here, something like that. Maybe I'll draw a rectangle here, something like this. Notice one's a little bit narrower than the other and all that kind of stuff. Now I do want to be precise, so I'm going to throw a dimension from here to here, and I want that to be 20 millimeters. So I type in 20, and that rectangle updates. It's pretty standard.

This is another cool trick. I place my dimension-- I want it to be exactly the same as this one, so I just click on that guy, and it references that dimension. I don't know if you guys knew that or not. So I'll hit OK, and you're going to see that that's 20. If I were to make this 30, they would both update, and stuff like that. So kind of a neat little trick.

AUDIENCE: Is that persistent, or is it just grabbing the number?

BRAD TALLIS: No, it's persistent. So it's actually using that formula. And you can even type in, move half an inch plus 5 millimeters and stuff like that. It's really kind of slick. So now I'm going to machine this away, just like so. I'm not doing any complicated commands here, right? I'm just basically drawing basic shapes. Rectangles and stuff like that. Before you ask, yes, I'm purposely making a mistake here, and we're going to fix that. So let's just make that maybe 15 or whatever.

As I'm looking at my concept model, I've kind of got the basic shape. We've kind of machined some stuff away. It looks like it's sticking inside my part. I love this. I come in here, I say Section Analysis, I just click on a face. I can section through my model. I'm just going to kind of go into that hole a little bit, and it gives me a very visual confirmation, yeah, this ain't going to work. All I have to do is get near that, and it's going to allow me to work in almost like 2 and 1/2 D. I can grab those faces, Press Pull, and just drag-- let me do both of them, sorry. Drag them both at the same time, and I can visually see-- I can move these up until there's no clash. Looks like about 17, so let's just go minus 17 in this case. I'll say OK. Turn off my section, and I've just basically fixed that problem area.

How many sketches have I created? Thanks. One sketch, right? Three rectangles at the very beginning. Now we're just kind of working directly on the model. So we're going to finish this thing up, and then I'm going to do some pretty cool stuff. I think you'll like it. So 20, something like that. Let's just do something like that. Maybe I throw a chamfer on here. Something like that. I'll say OK.

Now, I know that I want this to fit inside a sheet metal enclosure, OK? Now, I've started with a big chunk of metal, but I need it to fit inside of something. So I'm going to just come in here and use this Split Body again. Split that body. What am I going to split with? I can just click on this face over here. It's going to extend that over, and check this out. I'm going to say OK. And we've now-- if I expand my bodies, I have two separate bodies. I don't need that one anymore. Let's remove that out of there. And there we go. Yeah.

AUDIENCE: Can you say the difference between remove and delete?

BRAD TALLIS: Oh, excellent question. So I'm going to undo back. So I have these two bodies. If I right mouse click, you notice this says Delete and Remove. And yes, there is a difference. If I were to say Delete, you might get a warning or something like that that's saying, this is referencing something else and all kind of stuff. You're basically deleting it at kind of like the feature level, I think. Remove says, I don't need that. We're going to throw it away. I don't care if there was a sketch associated with it. It's going to stay attached to the other one. You're basically saying-- it's almost like turning the body off, but you're physically throwing it away. I use remove 99.9% of the time.

AUDIENCE: And Remove becomes a feature.

BRAD TALLIS: Correct, yes. So watch down here. If I say Remove, you can see there is that. So you can turn that on or off or whatever. So that's why I said it's almost like hiding it, but you're kind of-- OK.

So I now have this. Now, I have not-- John's probably sitting there going, you don't have any tolerances or dimensions or whatever. All this kind of stuff. Sorry to pick on you. But now I want to start to engineer this. I've got my idea on the screen. Now I want to engineer it, and this is where that reanchor really comes into play. I'm going to Press Pull. Start to drag. Let's reanchor this guy over to here, and it is 320.046. No tolerances or whatever. But I can come in and say, you know what? Do I need this arm to be that long? Let's kind of crank it back a little bit. It looks like around the 240s, 250s. So I'm just going to come in here and type in 250, say OK. And this length from here to here is exactly 250 now. OK? Didn't have to go drive a sketch or anything like that.

When I projected this, I didn't leave any gap. They're touching. There's no clearance. I want to give it some clearance. I'll come in here, say Press Pull, let's grab-- I'm going to do, I think, a new offset. I'm going to grab that guy there. I love this. I can drag that like so, and add in some clearance. How far? I want to go half mil on either side, so I type in minus 0.5, and I now have

a small gap in there. OK?

Let's throw, maybe, a fillet on this top edge here. Let's just do, maybe, like 6 millimeters or something like that. This looks a little wide to me. Does it need to be that wide? So I'm going to do a Press Pull. I can probe through to that other face if I want to. Notice how the blends update. Instant feedback what that's going to look like. I'll go ahead and reanchor this guy, so I'm going to say the overall width right now is about 60. Let's make it 50. And it shrinks it down. Well, let's make it 55. And I'm tying down these dimensions now, right?

And then lastly, I want to see how this thing works. So I'm going to come in here and make this a component. So if you want to move something, you need it to be a component. And then it's built exactly where it needs to be, right? I built it in context with the other geometry. I'll come in here and say, As Built Joint. That guy and that guy are going to work together. It says it's rigid. No, we want it to be revolute. And I'm just going to pick on that circle there, and it kind of gives me a preview. It's going to revolve around that. I'll say OK. Repeat my last command, that guy and that guy. We'll want it to be revolute. It's going to revolve around that guy. Say OK. We grab this and the thing works. And we're done. With one sketch. We used existing geometry. We used the size of the holes on these other parts. We used the size of the sheet metal enclosure and all that kind of stuff. Yeah

AUDIENCE: Is there a way-- I know you could do a section. Is there a [INAUDIBLE] tell you if there is a internal collision?

BRAD TALLIS: Yes. Yeah, and do you want to talk about that real quick?

AUDIENCE: Yeah. We have two types of colliding. You can either [INAUDIBLE] so an analysis for finding the collisions, so it's static. It'll just scope the model and tell you where those interferences are at. And there's one, if you're moving parts, which is more important if you're doing stock or something.

BRAD TALLIS: So in this case, two interferences were found. So yeah, you can do the static, and then you can also do what's called contact sets. Yeah, in fact, this is-- excellent question, because if I push this down, I want to know, is that going to collide or whatever? How far are my limits and all that kind of stuff? But the fact that I was able to model it, make it the shape that I wanted it to, and see how it's going to interact, and then I could come in here just for fun, and say, let's go ahead and create a circular pattern. I'll just say, continue. We want to pattern this

component around a particular axis. Something like that. Say three of them, and we're done, right?

So let me jump back to my slide deck really quick. We went through modifying geometry, where we're able to defeature, remove ribs, change the angle of ribs, change the angle of features, all that kind of stuff. We brought in geometry from other CAD systems. Pro/E, SolidWorks, doesn't matter. We were able to defeature it and reuse it. I didn't have to start from scratch. I was able to fix corrupt geometry, really weird blends, and I needed this to be a solid model, so I could actually print it or whatever. Direct modeling is awesome for that. And defeaturing for FEA. Remove all your blends, run your analysis. Maybe you come back and say, let's put a 5-millimeter blend on there and run the analysis. It's very easy to do that. And then lastly, I kind of showed this weird way of using direct modeling techniques to create this in-context design.

I put two links-- I don't know if you want to take a picture of it, but this is basically a link to the green part and the gray part. You're welcome to download that and play around with it. Try moving that boss up and down and changing the angle of the ribs and all that kind of stuff. I'll leave that up for a minute or two. And I apologize, these links are not in the downloaded slide set or whatever. I just added these like an hour ago. I was like, oh, I should probably put the links in there.

I would appreciate it, if you enjoyed the class-- I hope you did-- that you fill out a survey or whatever. We're going to be around for a little while at the Fusion 360 answer bar or whatever. If you have any questions, want to see other things, definitely stop by. And with that, I want to say thank you.

[APPLAUSE]

Any questions you guys might have? Yes.

AUDIENCE: All the features you were moving back and forth were on straight surfaces. Does that works where [INAUDIBLE] compound surfaces?

BRAD TALLIS: Yeah, that's a really good question. If I had like a screw boss over here, I could directly move that over, and it's going to extend down to always be touching that surface. So yeah, it's actually kind of cool. You can do some pretty neat things with it. Can you tell it to-- basically, you're going to move it in a planar direction, and it's going to do whatever it can to stay

touching that surface.

AUDIENCE: [INAUDIBLE]

BRAD TALLIS: You could use it for slicing and stuff. I do a demo where I create-- these keys on your keyboard have a shape. I just start with a rectangle and another surface, and I just-- a line, basically, that to that, so you can do stuff like that. So yeah.

AUDIENCE: Can you do any XYZ scaling?

BRAD TALLIS: Like scaling the whole model?

AUDIENCE: Yeah, like if I realize that I made this thing, and just it needs to be 2 inches longer--

BRAD TALLIS: We can't do it by-- you can do it by formula, but you could scale-- there is the Scale command, and you could even do anisotropic scaling in Fusion.

AUDIENCE: I mostly use Inventor. You can't really do that in Inventor.

BRAD TALLIS: Yeah, I don't know Inventor, unfortunately. OK, with that, thank you very much for your attendance, and I hope you have a good rest of your A.U.