NATHAN MILLER: My name's Nate. And if you are not here to learn about data mining stuff out of Revit with Dynamo, too bad. Quick show of hands-- architects? Oh man. Engineers? Contractors? Owners? Just the one.

I think there might be more than one. There you go. There's another one.

What's going to be interesting about this class is that the topic and the subject matter spans across the industry. It's really about, how can we start to think about uses of BIM, uses of computation, uses of data, to inform the entire process? I think a lot of the examples, just given the nature of my background, are very architectural in nature.

But more and more, I think the thrust of a lot of this information is really about how data can make its way through the design process into the construction process, and through owner operations. And it's really about getting access to your data, freeing it, in a way, from me the constraints of a particular file format, and using computation to really extend the ability to leverage this stuff.

So a quick note about me-- I'm the founder of a new company called Proving Ground, been around for about six months. Formerly, I was with a company called Case.

We typically had a fairly sizable presence at AU every year. I am not a freshman. I got demoted this year. I don't know what happened. I don't know what's going on.

But my focus as a professional is looking at these kinds of opportunities for using data in the process, whether that's kind of thinking about it more strategically in an organization, or helping to educate teams to take advantage of the tools that are at their disposal, or add in a little bit of additional firepower to your project to help you customize some workflows, and span a number of different things. But data is really the glue that ties everything together.

So the obligatory learning objectives slide-- this class is really going to talk about examples for leveraging BIM data in practice. And that means going beyond using BIM for what we think of as documentation or production. But how can we actually use this to get new insights into our process, and make better decisions, I think, ultimately, is the goal for a lot of the data driven agendas out there.

We're going to look at techniques for formatting and extracting data. I'm going to, at a certain

point, jump out of PowerPoint. And we'll get a little hands on with Dynamo end and Revit. I really want to demystify the idea that this stuff is hard.

I think more and more, the tools that are at our disposal are making this stuff pretty accessible. And no longer do you need to be an ace computer programmer, or a database technician, to really get into this stuff. I think the beauty of tools like Dynamo, and the computational design approach, is that it's democratizing a lot of these ideas.

I'm going to talk a little bit about data visualization, and how this idea that there's this very raw, in many ways intimidating idea of data as this endless table of numbers, and text, and strings data visualization is a tool that allow us to get insight into this information and start to make decisions from it. And, finally, of course, there's the technical side, using Dynamo and Revit to connect to external data sources. We'll be going through a little bit of that.

So why is this important? I think this idea that-- you've probably heard this, or some form of this phrase, data being the new oil for the digital economy. Data is this ever-present thing. People are wanting to tap in to data, different data sources, to gain insights into their problems, to make better decisions both on the level of projects, but also better business decisions. So can we actually use the information that's there to improve our process overall?

Has anyone seen this pyramid before? It's called the DIKW period, not a very creative name. But it's very important to think about.

It's not just about data. Data is this foundational thing. It's this raw resource.

Data alone is not enough to improve our process. We need to actually think about it in terms of these different stages. How can we apply context of this data to where it is no longer data, it is information? So it's got a bit of a perspective to it.

How can we start to apply meaning to where we then have knowledge about something that we didn't have knowledge about before? And, finally, how can we act on it? How can we gain insight this thing, this raw resource?

I promise this will end soon. This is what people think about when they think of data. Those are [? Aashray ?] design conditions.

And then cutting away, this is the exact same data set visualized in a kind of geographic perspective, looking at temperatures, design conditions, wet bulb, dry bulb, mapped out. But

all of a sudden, this idea of taking data, filtering it through this process to where we're now able to see it and understand it, look for patterns, taking something that is very complex and using this process of data mining and data visualization to get a new view into it. And maybe it starts to reveal something that we never saw before.

This can apply to buildings. This is a dashboard using one of my favorite tools called Excel. You guys are going to get very used to Excel in this class.

But, again, it's about taking this idea of something that is complicated, a building program with a number of sub-departments- whose got the phone? I'm just kidding. Sub-departments, layers of information, area information of course, but then filtering it through this process to where we can understand it a little bit better. So this is then taking it through a computational design process. This is arraying the various buildings, mapping them out, so we can start to understand that data set in three dimensions.

And then also use the process of customizing workflows with data to get a different kind of picture than we're used to. We're all familiar with the idea of spaces. But what about relationships? This is a custom data visualization using a computational design tool to look at relationships between levels, departments, sub-department, to where we get a spider web view not so much concerned about relative sizes. But how do these different pieces in a very complex program interrelate with each other?

We can start building-- and I think one of the interesting things about the computational design paradigm. Obviously, there's tools like Dynamo out there. There's tools like Grasshopper. Dynamo users? I didn't ask that at the front.

Regular Dynamo users? I asked that last year. And I think I just saw more hands shoot up this year. That's good.

I like to think of these tools as gateway drugs. These are the things that allow us to get into the world of programming, the world of coding, the world of automation. This is a custom app that I wrote that looks at energy analysis data between a multitude of design options and creates a custom interface for visualizing this in the form of a graph.

A lot of my professional background when it comes to programming really stemmed from first learning about what it meant to put together a logic diagram and things like that using tools like Dynamo and Grasshopper. When it comes to the subject matter that I'll be talking about today,

this is an interesting paradigm, this video here. This is a prototype for a programming tool looking at various data visualization overlays, tracking areas across multiple buildings, changing programmatic relationships, projecting things in 2D.

But this overlay of early stage modeling, conceptual modeling, a conceptual understanding of the building problem, overlaid with data and visualizations that can give us immediate feedback about what we've actually done. I think the big potential for a lot of this to take a series of-- I can't tell you enough how many times I've seen and heard the story of, OK, first modeled are thing in SketchUp.

Then we modeled it in Revit. And then we needed to somehow figure out how to measure the design, and make sure we were on track. And then once a change happened, cycling that all the way back through. As we begin to rethink our process with these data-driven tools, and these new technologies at our disposal, these things can be tied together, and knitted together in a very interesting where feedback is ever more powerful. So let's talk about liberating our data. So the subject of this class, really, is about using tools like dynamo to extract data out of Revit, and use it for different purposes.

This is a diagram-- and I'll be taking you guys through this in a live demo-- about accessing a Revit model using Dynamo as a processing tool. This is a tool that we can position in the workflow as a thing that can get us access to data in different ways, and use it as a way to filter it and funnel it into different formats.

So using Dynamo, we can push it to Excel. I'll be looking at Excel very closely in this talk. I'll show you the out of the box functionality for pushing and pulling data from Excel. But there's all sorts of format that we can start to push and pull data from.

One of the tools that I've built on top of Dynamo that's freely available is called Lunch Box. And this allows you to start to convert things into other formats-- XML, JSON, connecting directly with other databases, and start to use that data, that workflow, to integrate these different sources, because we all don't use just one data source. We're constantly having to funnel information from different points in the process. So we can think about Dynamo as a tool that can start to integrate this.

And then going beyond that paradigm, going beyond just pushing and pulling file formats, what are the real opportunities to use data to get different views that we haven't seen before? So it's one thing just to use Excel, and push things back and forth, or convert things to XML. From

a data perspective, that's interesting.

But from a design perspective, from a building process perspective, the idea of using that as a means to gain insight into the information, using different tools. A couple of my favorite tools right now-- Tableau, it's a business intelligence tool. It usually allows you to start to mine, and look at, and visualize data from very large data sets. Microsoft Power BI, Excel itself can be set up to start to understand, visualize, and gain insight into your information.

So this is a diagram that I like to show as it relates to the change in representation that I think we're experiencing as an industry. We're very comfortable with things off to the left hand side-- plan, have an understanding of three-dimensional building information. Dynamo, in the middle here, a tool for processing that in a different way-- visualizing it, getting access to the different components of the model. In this case, we're extracting rooms, color coding those rooms, this different three-dimensional overlay. Dynamo is this graphical algorithm editor that lets us connect and create relationships.

And then finally, on the right, something that certainly I never had training in-- I'm an architectural designer by training. Never really got comfortable this idea of using tables, using databases, and using that as part of my design process. And so where Dynamo is really kind of giving me some footing here is really thinking about the stuff on the right as being as much of a design tool as the stuff on the left.

And once we start stitching these things together, we have a very powerful idea of a data-driven workflow. So, again, we're comfortable with this-- plan. We're using Revit schedules, and then nodes.

So a couple things, just to give you guys a preview of what we'll be walking through in more of a live demo-- idea of going from a node to a spreadsheet, connecting directly into a tool like Excel to populate a table. We can start to use dynamo to mine the model, to get different objects, different attributes, out of that object, and construct our own schemas to create an externalized representation of that data that can be linked back and forth.

There's, obviously, a number of tools on the market that let you do this. It's not just a Dynamo thing. There's various database connection links.

There's tools like, I think, the Revit DB link, BIN link, that kind of start to hint at this. What becomes interesting about Dynamo is the idea that you can actually customize how you start

to process this information. It's not just about a one or two way dump. You can actually start to use Dynamo to do calculations on the data before you start to push it out, and really start to customize your process.

The same can be true of using the same data source. Again, this is the same node, off to the left hand side. Pushing it to a SQL database-- there is a plug-in that I've authored freely available open source called Slingshot.

And what that allows you to do is start to format SQL strings to where you can make direct database connections right out of the Dynamo environment into a database like MySQL or ODBC database. We can also think about connections to other types of formats. This is another set of tools built on top of Lunch Box that will help you start to format and convert your Revit data to things like JavaScript Object Notation, JSON, a language that is often used by web APIs. You can kind of envision that these tools can help you facilitate connecting to the web and different other file formats. XML, another popular one, and a tool like Dynamo can help you start to fluidly think through these data problems.

And then the upside to all of this is getting different views. This is pushing everything to Excel and creating a dashboard that lets us look at building areas. We're taking this data, using pivot tables, pivot charts, to get us insight into this externalized data. A Revit schedule will not show you this. But a tool like Excel or Tableau could start to provide hints at it.

This is Tableau. I mentioned it before. It's a personal favorite tool of mine when it comes to data visualization. I like it because what's interesting about it is it doesn't come from the world of architecture. It comes from the world of finance, accounting, big data analysis, being applied to, in this case, a data set for a building program. It allows us to rapidly slice and dice, and understand a building program in a different way.

And this is kind of constructing that series of relationships, columns, and rows, switching between different representations of the same set, parsing that set down, drilling down into single areas, getting different kinds of visualizations. These are relative area sizes packed together so you can start to look at. And this is all being funneled out of Revit.

This is the same data that's existing in the model, but now presented in a very different way. I'll come back to this. There's a party tonight-- free drinks, come

So let's get down to brass tacks here when it comes to the actual workflow. I need to do a

quick monitor reconfig. I'm sure all you have seen this model. It's great building. I use this for just about everything-- data set analysis, and testing, and all that stuff.

So this is Revit. It's a plan view of a 3D building information model. There's the actual design in 3D.

And what I'm going to do is actually walk through a couple of workflows for getting data out of this model, pushing it through Dynamo into Excel, into XML, and kind of hopefully make the idea of using Dynamo for this purpose a little less intimidating, but also hopefully-- and overall just kind of hopefully make this not so much a black box. I think when we start thinking about tables and databases, we think of very intimidating, cylindrical icons, and abstract SQL queries, and things like that.

So this is Dynamo. I'm sure you've seen this quite a bit at AU this year. I think there's something like 30 plus classes with this tool, everything from using Dynamo to construct complex geometric assemblies, to I think I saw an example of building a race car, or doing some optimization in other environments. In this case, we're going to look at it just as a data filtering tool.

Change my background-- so Dynamo has a lot of out of the box tools when it comes to Excel. It comes out of the box with very simple tools for reading and writing two Excel files. We've got tools for geometry. We've got tools for doing calculations.

And then on top of that, we have a multitude of plug-ins for extending Dynamo. The one that I'll be focusing on the most in this talk is a tool called Lunchbox. And what Lunchbox does is it's basically a collection of tools that I've built over time.

There's not, necessarily, one theme. It can do cool stuff with panelization. But then there's all these workflows for extracting data out of Revit.

I built this as a toolbox for myself, first and foremost. It helps me navigate the complexity of what I do in my day to day work. And it's been released for free. And most of it is open source. So all of you are free to take a look, and use it, provide feedback.

So one of the collections of tools that this comes with is a series of Revit element nodes. And these are designed to be very quick tools for extracting different data points out of a Revit model, and bring it into Dynamo to where we can start to use it for different purposes. The one that I'll focus on is the room element collector. The room element collector will reach into our

Revit model, access the room objects that are placed, and then start reporting out some pretty standard things about those rooms, but report it out in a way that will allow me to start to automate and process this information in a different way.

So in order to call out and reach into the Revit model, I need to first create a bit of a switch here. This is a Boolean user interface node that will trigger a transaction in the Revit model. So what it's doing is it's reaching into the model.

And it's pulling in the objects. And what you'll see in the background here are the room elements. This is the same data that's in the model. These are all the boundaries for every room.

So we're getting a geometric look at everything. But we're also getting access to the underlying data about these rooms. We have the element itself.

So if you wanted to extract a custom parameter that's exposing that, you can actually build on top of this node, if you wanted to. But it gives you some common information you might want-- name, number, area, level, location, boundaries. Things that you can't get to in Revit are represented here, like element ID, unique ID. Stuff that was previously maybe only available to a programmer that's building an add-in is exposed through this interface, which is kind of cool.

So I want to somehow connect this to Excel. So now that I've got some information coming out of there, I'm going to go the office category, and just find the right to file node. And it's a pretty unintimidating tool.

It's asking us for a file path. What's the Excel file that we want to push information to, or create on the fly? It's kind of cool. It'll actually auto generate an Excel workbook. It'll to create the sheet. So you get to name the sheet, specify where it ends up on the worksheet, and then it pushes the data. So in order to get from here to here, we need to use Dynamo to do some formatting. We're going to parse the information that's coming out of Revit and format it in such a way that we can use it inside of Excel.

So the first thing I need to do is just combine this all into a single data list. So I'm getting my name, number, area, all this stuff separately. I'm just going to do a quick combination of some of this information.

I'm just going to pull in the name. And for those of you who aren't familiar with Dynamo,

Dynamo lets you start to create these relationships using a node wiring diagram. Then we're kind of making connections that way.

I've got name, number, and area. I'm going to pull in things that we normally couldn't get to, like element ID, unique ID. And I'm getting that information represented now as a series of combined lists. There's my name.

There's my room number. There's my area, element ID, unique ID. It's all being presented there.

What I want to do is transpose this information and get it to where I'm organizing it by rows and columns. Right now, if I were to push this right into Excel, my data would not be formatted correctly. I actually want to collapse and organize this data to where every room object is represented as its own list.

So there's this tool just called Transpose. As you start to get in and start leveraging Dynamo, more and more of this will be one of your-- it's one of my favorite nodes. Isn't that a weird thing to say? It's like your favorite node? I operate in this world too much. I love the transpose node.

But we can see what it does. We now have a structured piece of information where we can very clearly see each individual room object pulled out into its own sublist-- so name, number, all that stuff is collapsed into a single list. And we can iterate through every room.

When we bring something into Excel, we also want some typical user interface there to help us understand what each column of information on our table means. We need to format things like headers. So I can use a similar set of techniques here. I'm just going to copy and paste this list.create node out and disconnect some of this stuff.

And in the same order that I've connected everything in from my element collector into the list.create, I'm going to create a header row for my data. Name is straightforward, kind of telling Excel, telling Dynamo, what I want each of these things to be, and unique ID.

So we've got our name, number, area, element ID, and unique ID. I now want to combine this into the single data set that I'm dealing with here. So I'm going to do just a quick Add Item to Front. So, again, a parsing technique-- I'm taking an item that I want to add, a master list.

And now we've done a little bit of formatting here. And we can now push this to Excel. There's all sorts of stuff you can be doing in between this. You don't have to just take the data as it is.

If I wanted to start doing calculations on the data set, add extra fields that Revit might not be calculating, Dynamo can be positioned as this calculation tool, this processing tool, if you will, for some of this information before it goes out.

So I'm going to pass this into the data input. And now I need to fill in some of these other inputs. So I need a file path.

I need to save my Excel file out, save it to my desktop. If this file doesn't exist, the tool will automatically create one. I need to create a couple of inputs here for the sheet name.

I'm going to call this rooms, start row, start column. This is just basically telling you-- we'll see the results of all this here in a second. It's basically telling us where in the worksheet, where in the grid of fields do we want this data to end up?

And after we've satisfied all of these inputs, we can see that Excel has launched down here. And our data is now exported out. We have it all now represented as a series of rows and columns.

So I asked before, Excel junkies? I'm going to turn you all into Excel junkies here in a second. Pivot table users?

I bet you didn't think you were going to get a Microsoft Excel tutorial at Autodesk University 2015. So we've got this raw data that's coming out-- this name, number, area, whatsoever. This is kind of terrible to look at, right?

It's not very interesting. We're not getting any kind of insight into this table. We've just externalized the data.

If I go to the Insert tab, there's this tool called Pivot Table. This allows you to construct summaries of data in a very fast way. I'm going to go to an existing worksheet and find a position on this new worksheet for what's called a pivot table, which is a table. It's a summary table that's live linked to the data.

So pivot tables kind of give you this interface. When you start dealing with other tools like Tableau, I'll show you Microsoft BI as well, very similar in terms of how you set up, and select fields, and start creating these things. And I'm going to choose name.

And what it's done is it's taken all of the rooms that we have, which some are-- you can see we

have four instruction rooms, things like that. Then it's collapsed them down. So these are all the unique types of room that we get. There's our area.

If we want to start to expand this to where we want to see the room number that falls under each of these categories, we can start slicing that way. So, again, this is all live linked to that room sheet. What we can also do is start creating filters on top of this, start interacting with these pivot tables.

I'm going to go to the Analyze tab and choose Insert Slicer. And I want to slice by name. And we're now given this UI that lets us select a room type.

And what it'll do is it'll filter our list for you. So there's all the administration rooms. There's all our advisers, cafeteria, all that stuff.

But beyond that, we can then start building on top of that, creating connections into the charts if we want to start to visualize beyond its tabular representation. Then go to the Analyze tab and create a pivot chart. And, again, it's all tied together.

We can drill down and just find what the advisers are. Oh no! This is an Autodesk conference, not a Microsoft conference, so luckily. Revit and Dynamo has not crashed, ladies and gentleman. Excel, Excel, poor Excel.

So that's some of the stuff we can do. We can start to pull this data out. We can star to visualize it.

We're pushing things into Excel at this point. But there's all sorts of different things we can start to format this data for. So this Excel is one avenue.

Inside of Lunchbox, I've started to design and create all these other types of connections that we can use to filter data out to different formats. There's some extended Excel tools. Under the List category in Lunchbox, I have what's called a data set of tools.

You're able to take data and serialize it as what are called data sets and data tables. These are .net classes that let us start to structure data as a relational database at a programmatic level. But what Microsoft.net has also exposed-- .net is a programming framework upon which things like Revit and Dynamo are built.

We can start to serialize this data as different formats. I can start to take a data table and

make, instantly, an XML file from that. I can create a JSON file and start to use that information and communicate with a web API. So I'm just going to structure a data set using what we've got.

The workflows are very similar, where we're taking headers. We're taking transposed data. And we are pushing it to these data sets.

So the first thing I need to do is I need to create a table. Much like we created a table in Excel, we're going to create what's called a data table. I want to give this table a name.

Call it Rooms, just like we did before. My headers are going to come from the same header list that I constructed earlier. And then my data can come from the same data source as before, absent of the headers.

It's very unassuming kind of output here. It just says rooms. This is actually a .net class that's capturing that same information now to what's called a data table.

I then can pass multiple tables. So if I just wanted to have a rooms table, if I wanted to have a walls table, or a facade areas table, and I'm constructing these with Dynamo, I can start to push these to a master set called a data set. So I'm just going to combine this and create a data set.

I'll pulled table in there. I'm going to create a name. The name for my data set is just going to be Revit model or something like that. We can kind of imagine multiple Revit models, multiple data sets or data tables for a Revit model-- again neutralizing, making the data structured in a way that's apart from the model.

Yeah, so in many ways if we think about how Lunchbox is-- the question was, can we filter by element category? Right now, we can think about this node here as being that filter. I've decided to pull in just rooms.

But if I wanted to pull in other aspects of the model, these nodes under the Revit category in Lunchbox let us pull in floors. They can let us pull in levels, MEP spaces, sheets. If I wanted to export a list of sheets out of the model, I could do that, structural framing-- this is a growing list. So as I need it, I build on and extend on to this. But, yeah, Dynamo is in some ways a filter. Yes?

AUDIENCE: [INAUDIBLE]

NATHAN MILLER: Happy to talk to you about that, and if you got some requirements, I can build it for you-- consulting 101. No, thing that's really powerful about this, is that I jump into this node. I mentioned these are open source. Hopefully, this doesn't scare too many people. This is Python.

So everything that's happening with this node, this user interface node, is basically the front end for this script in Python. If the question is, is it possible, or is it there yet? I would say, most of the time, the answer is yes, because we have the ability to customize from the ground up.

And this is, as I see it, going to be a growing core competency in our industry-- the ability to take our tools out of the box and begin to build these custom workflows. Autodesk can only give us so much, right? Yes?

AUDIENCE: [INAUDIBLE]

NATHAN MILLER: The question was, is there a tool that can export schedules out of Revit into Excel? I think BIM link by ID8 is one tool that lets you do that. There's a tool that Case did. I don't think it's currently available right now because of some mergers and acquisitions that recently happened. But a tool called Accelerate used to allow for idea of taking a schedule and just pushing it to Excel.

But you can start to think about that and use that within dynamo too, like the idea of referencing a schedule, pulling that stuff. I think there's a couple tools that allow for that. But in some ways, what we're doing here is creating a schedule. We're kind of using Dynamo.

This, in many ways, is almost exact representation of a standard room schedule. And we're just formatting and parsing it out. It's the same data that a schedule would have.

AUDIENCE: [INAUDIBLE]

NATHAN MILLER: So that's a yes and no. If you structure your workflow in such a way-- the question was, can you use this one script to capture multiple Revit models, Revit files, Revit project, perhaps? You can. The tricky bit is that Dynamo sits on top of one Revit document.

So you're kind of having to go through your various files. You can use the same script over and over. That's the beauty of some of this stuff, is the reusability of scripts. So if you know

you're wanting to pull key information out, you can start to structure it in that way to just reuse the script.

When you start getting into wanting to automate opening and closing Revit files, open documents, and filtering that out, you're getting into Revit API territory. And it's certainly possible. But perhaps Dynamo might not be the best tool for you at that point.

AUDIENCE: [INAUDIBLE]

NATHAN MILLER: No, so you're having to cycle through documents. Where was I? Oh, Yep?

AUDIENCE: [INAUDIBLE]

NATHAN MILLER: Any time you tell it to. So if you do a-- right now everything's in what's called automatic mode. So as changes occur to the Revit model, or as changes occur to the Dynamo graph, that information is automatically being pushed out to Excel.

However, you can always switch that to manual mode so you're kind of doing it in one click. This stuff can get what's called computationally expensive. So if you have a very large data set and you're having it update automatically, it'll run. It's kind of whenever you want it to. Right, as long as that toggle is set to true.

So we've got a data set. And once we've got it, you can see with the classes here, woo-hoo, system.data.dataset. It's being stored as part of the .net framework. And we can start to tell it to do things now with this information.

So one example being, let's serialize this as XML. So this is a node that's a part of Lunchbox. It's going to take that exact same data.

It's going to structure it as an XML file. And it's asking us for some inputs, a save Boolean. So we can tell it true or false whether or not to save this file. I'm going to set it to false. I don't need to save the file at this point.

File path-- just like we did with Excel, we can create a separate file path. So there's our XML. If I set this to true, there's our XML data. Again, searchable, it's one of those very popular file formats. You can start to integrate with other databases and so on, or a web API.

And then using a very similar node, we can start to serialize this data as what's called JSON, serialize JSON. So connecting the same data set, I'll create a separate Boolean toggle. I'll create a separate file path. I can save this out as yet another file format [INAUDIBLE] [? class.JSON. ?]

Here's what a JSON looks like. And we can see the data represented in this structured format. And we can save that out as well.

So the question then becomes, what do you want to connect to? The idea is we use this to make any connection we want. It then places emphasis on, OK, now what do we want to actually do with this data? And that's the goal for a lot of these tools is to, again, liberate the data to where we have freedom to start to mine it, and extract it, and use it for different purposes.

This is Power BI. I'll leave you with a couple of thoughts here. Then we can take more questions. This is-- I've just been starting to get into this. So I'm no expert by any means. It's a Microsoft [INAUDIBLE], like a 365 user.

You can have access to this for free. It's really interesting. What I've done is uploaded a room data set.

And this becomes a cloud-based way to construct dashboards, and start to mine different data sets. It can connect to Excel. It can connect to other SQL databases. It's very similar to Tableau, in some ways, Mime another one. It's an interesting tool.

I like it because it's got this ability to ask questions of the data in natural language. So I've got a room data set. So I want to know, what is the total square area of my building? Or what is the area per building?

It's gone into the data. It's found a representation that is most appropriate for that data. And this is something, where if I get in here and start hovering over, [INAUDIBLE]. This is all coming out of Revit.

And it's coming out of Revit through a tool via Dynamo. And we're then using-- again, to that diagram, using this externalized data, using the upside, to get insight into it. What's the area per room?

What's that?

AUDIENCE: [INAUDIBLE]

NATHAN MILLER: We could do more than that, right? So we're asking questions of the data. And that's where, I think, data driven design is really about. It's about asking questions and getting an answer, using the tools to get an answer, an informed answer based on this stuff.

But you can start to really build out interesting dashboards using this. So this is a report. I'll generate a report here.

This is building. I'm going to get area. I've got that set up. I'm going to create another one. I'll get area by building.

So I get the graphic representation. Click out of that. I'll do a pie chart. Let's look at area. Let's look at building area. And then let's look at it by department.

What's interesting is it's all integrated. So if I click on building one, it's showing me what's in building one. It lets me start to create this user interface that's allowing me to interact with building information in a new way, and start to design how we want to see it.

Bar graph here, as we look at it by area of building and department, add room. Let's look at it by room. So if I then want to see what are my rooms in building two, it start to dynamically update that.

And all of this stuff is interactive. So if I go in here and click on any of these graphs, or if I want to see what's going on here in that room, it's going to filter all of my graphs. And it's going to become bi-directional-- really powerful stuff.

And this is out of the box functionality, all enabled, again, by these connection points. So we're about 10 minutes away from the end. Any questions?

AUDIENCE: [INAUDIBLE]

NATHAN MILLER: What's that? So this is Microsoft web service called Power BI. So if you go to powerbi.microsoft.com, you can sign up for an account, you can get in there and start exploring.

AUDIENCE: [INAUDIBLE]

NATHAN MILLER: Oh, yeah, so getting the data in is super straightforward. If I go to-- yeah, sure. I can add a

data set. And it lets me connect to a file.

We can connect to a database. There's online services. If you've got an organization, you can share dashboards between different folks.

AUDIENCE: [INAUDIBLE]

NATHAN MILLER: I just connect to the exported Excel data table. The question was, did I link to the Revit model directly? No, I linked to the exported Excel data that was being funneled out of Dynamo.

So that's where this cycle becomes interesting, where if we go back to this diagram Dynamo becomes positioned as this tool that's allowing us to externalize the Revit data, process it in a way that can allow us to connect to a service. Power BI is one example.

But by neutralizing the data, we make that data available for use in other environments, like Power BI, Tableau, [? Vine. ?]

AUDIENCE: [INAUDIBLE]

NATHAN MILLER: OK, yeah?

AUDIENCE: [INAUDIBLE]

NATHAN MILLER: Quite a bit further. Yeah, so the question was when I came to this-- back it up here-- this, let me see if I can fast forward, this thing. So this was a customized-- no. I don't get the cursor on my screen, because I've got it shared here. I'll pause it.

This is an example of using a computational design tool like Dynamo to parse a piece of program data and construct a different kind of geometric representation of it. It's like a custom, three-dimensional visualization.

This is an order of magnitude beyond what we just looked at, which is just maybe a handful of nodes to export the data. We're talking about customizing and a set of geometric relationships. So it's quite a bit further.

I don't have a picture. I wish I had a picture of the graph. I don't at the moment.

AUDIENCE: [INAUDIBLE]

NATHAN MILLER: Right, yeah, so if I look at-- for example, I'll show you an example here. Where'd my mouse go? Where'd my mouse go? There it is.

Display settings, apply, keep changes. So we're visualizing all of these rooms in the background of Dynamo. We're talking about, at that point, using a lot of the available geometry nodes to start to take the information out of, say, a Revit room list and reconstruct a different kind of computational geometry with the other components that are there.

And it just gets visualized in the background. [INAUDIBLE] like this. You can override colors. You can start to do all that stuff.

AUDIENCE: [INAUDIBLE]

NATHAN MILLER: Pushing data back into Revit? So I'll show you-- there was a Dynamo intro course that was taught on the first day of AU on Monday. And I gave a quick tutorial on pushing data in.

I'll show you an example of this. I'll just go to a blank architectural file. And within this blank architectural file, let's say we have a building program inside of Excel. Another data source, you might have received it from a client. Or it might be in some other data-- maybe it's in JSON format. Maybe it's in XML.

Maybe it's something out there that you want to integrate into your Revit model. So we can use Dynamo to go that other direction. This is a good one maybe. I'm going to close out of some of this stuff.

That crash earlier may have mucked some things up for me. Boo, Task Manager. Yeah, that looks like Excel is closed.

Can you say that again?

AUDIENCE: [INAUDIBLE]

NATHAN MILLER: Yeah, so on my blog, I just released a set of tutorials on a lot of the Excel workflows-- so connecting and importing rooms, exporting information out, a lot of stuff I just went over in a much more methodical way, as like a cumulative-- it's like two hours of just going through nuts and bolts type of stuff.

And then throughout my blog, there's exercises on any definitions and things like that on

Slingshot, things of that nature. Let's see if I can get this thing to fly. Yes, there we go.

So this is an example of going the other direction. It's a bit incomplete. But what we have is referencing a program. This is a spreadsheet of some program. This is not coming from Revit.

This is hypothetically something that is coming from somewhere else. It might be coming from a client. It might be something that as a planning-- you might have a planning department that is going through and creating these kinds of programs.

And then using the Excel read, we can read this data in to Dynamo. We can do some parsing. What I'm doing is, as I step through this, I'm doing some parsing.

I'm dropping the header row. There's a header row that I don't really need because that's not going to really inform the creation of anything. We can start to make these decisions about, this is useful information when we look at the table, but not useful information when we get into Dynamo. So we have to make those kinds of decisions.

Then we can start breaking things down by column, parse this out. And what you have here is a tool that will take a list of information from Dynamo from Excel and generate a room list inside of Revit. And then we can start to modify parameters.

This is telling me I don't have a parameter by that name. So I'm kind of erroring out because I didn't set up my file with a parameter for sub-department. But what we're showing here is this column, this column, and this column all being pulled in.

And so what you have-- if I go to place a room, for example-- there's everything from Excel, just by running that Dynamo script, going the other direction.

AUDIENCE: [INAUDIBLE]

NATHAN MILLER: It didn't populate the model. It doesn't know where those rooms are. You're kind of doing that model setup. You know you might be getting all of this information about you might want to just have pre-populated-- and if I go in here and place one of these, for example, there's no boundary to it, of course.

It's just making sure that some of those objects are initially populated with the right kind of data. And, of course, with Dynamo, you can kind of do a lot of that stuff, if you wanted to get into placing elements in, positioning things at various insertion points within a model. For

example, if this data set came with coordinate locations for where you want things to be, it can start to populate that. You could devise a computational algorithm that helps you rearrange blocks, for example, based on various adjacency, or things by same department, things like that. It's kind of, how far do you want to go with something like Dynamo?

Yes?

AUDIENCE: [INAUDIBLE]

NATHAN MILLER: When it came to the web interface I showed?

AUDIENCE: [INAUDIBLE]

NATHAN MILLER: Right, so that's like extracting, going through building by building, populating a single table with that information, and then sending it up and analyzing it. You could structure that any number of ways.

You could start to create your own schema, if you will, of a table per building, and start querying the data based on that. It's all about the flexibility, I think.

AUDIENCE: [INAUDIBLE]

NATHAN MILLER: The way it's set up right now, it's only going into the live model with Dynamo. Yep?

AUDIENCE: [INAUDIBLE]

NATHAN MILLER: So I use both, basically in most of my workflows. So the question was, the distinction between something like Rhino and Grasshopper versus using something like Dynamo and Revit. I'm kind of an all of the above type of person.

And, to me, it's about-- I'm very comfortable using something like Grasshopper from an abstract geometric design perspective. You can do a lot geometrically with the tool. It's got a huge knowledge base out there.

I think what I'm interested in, one of the tools that I've been building out quite a bit in recent years, has been a tool called Rhynamo. I'm so creative with my names. Rhynamo is a tool that lets you read and write Rhino files directly out of Dynamo.

So if you're generating something inside of Rhino, and you've created a design concept where you've got some data stored inside of Rhino, I think there's a class tomorrow morning by Brian [? Ringley ?] who will be covering a couple of Rhino to Dynamo related workflows, using Rhynamo, among other tools. But it allows you to access the Rhino file as a database, pull it right into Dynamo, and start manipulating and using that geometry with Revit.

And the other way around, so if you wanted to export all those room boundaries, or level datums, or grids, out of Revit, you could author the Rhino file. So you can start to think about these as a shared system, of sorts. Yes?

AUDIENCE: How does Dynamo work with [INAUDIBLE]?

NATHAN MILLER: So when it comes to editing with the family, you can-- like, for example, launch Dynamo from within a conceptual mass, or from within another family environment, and start to use it to construct geometry. I tend to not use it as much for that, personally. I tend to use it more for Revit element control, and data extraction, and things like that. But it's certainly possible to start to customize parametric systems within the conceptual massing environment.

So that's it. Party tonight at The Rockhouse, eight to midnight. Bring a friend. Thanks, guys.