



# 813 – Don't Sweat the Small Stuff

**Using Dynamo Scripts to Automate Your Work**



# INTRODUCTION



## ESSENTIALS

- **To get started**
- Get Revit
- Get Dynamo
- Get Archi-lab package
- Have Excel spreadsheet

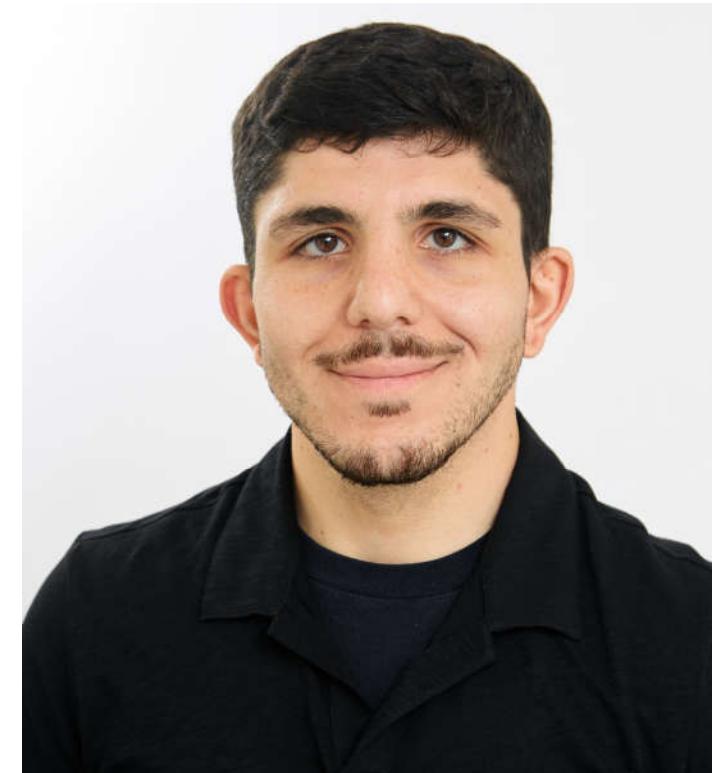
## ESSENTIALS

- When we think of coordinates we think of grids and Cartesian graphs
- There's points in space that you can connect to define shapes
- In a 3D world you have XYZ coordinates to define space and objects in space
- Therefore you expect a survey of these points to spell out where you are designing into

## SPEAKER BIO

### TADEH HAKOPIAN (Todd-A Ha-Co-Pea-On)

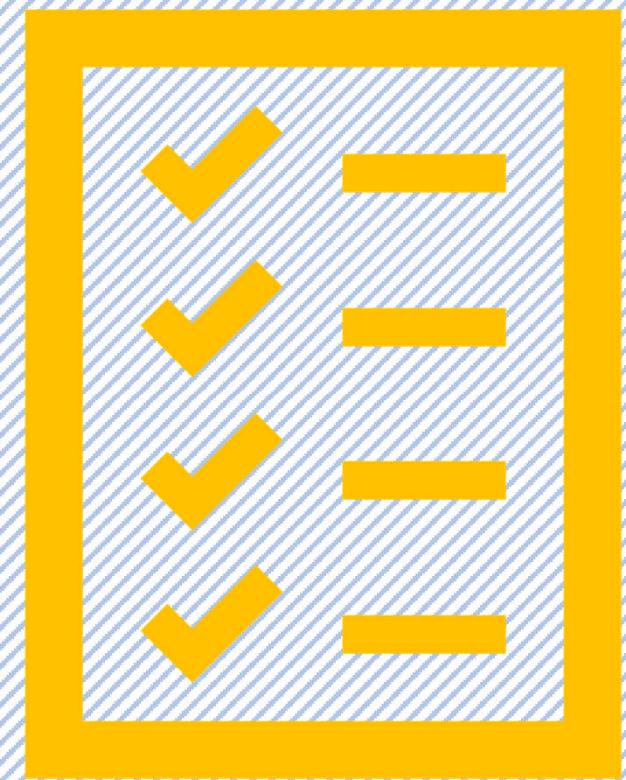
- BIM Coordinator and Job Captain at HKS
- Eight years of experience in AEC industry with focus on Design Technologies
- Architectural Design
- Estimating and Planning
- Concept design
- Construction Documents
- Field Operations
- Research and Staff Training



## GOALS

- Identify the **repetitive** tasks day to day – tagging, data updates, dimensions, materials, etc
- Use **Dynamo with some Python scripts** to manage that process for you
- **Review your model** data with visualizations
- Create a **repeatable**, effective workflow for your project

# ESSENTIALS



## ESSENTIALS

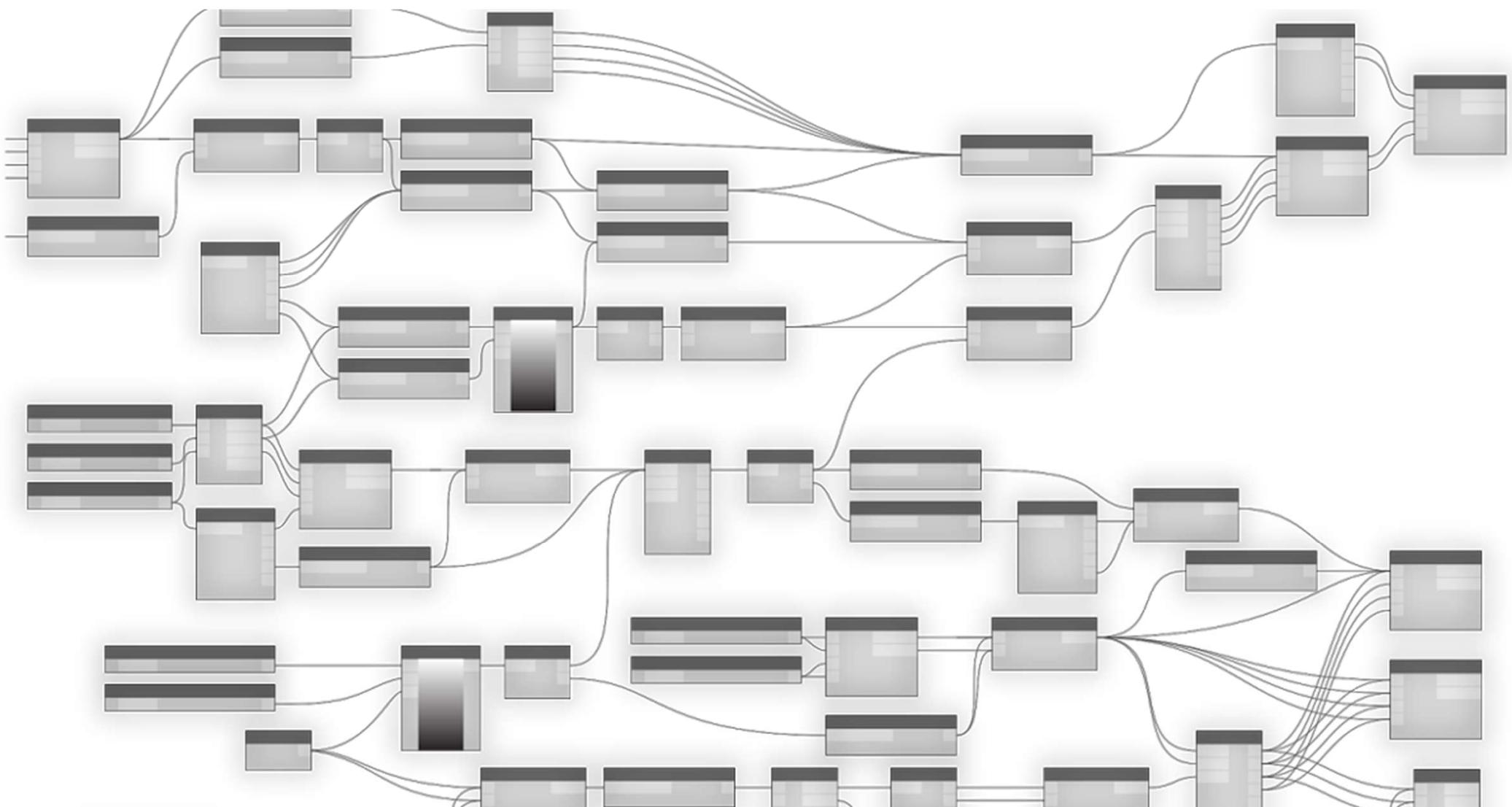
- My Inspiration is to create a workflow that can get a lot of things done quickly with Dynamo
- I worked on a large tower project means a lot of repetition throughout the project
- Set up the project for the user to let them start designing
- Try to cut the setup time from 6 hours to less than 1 hour
- The scripts are simple and built around a workflow that can replace manual work

## ESSENTIALS

- **To get started**
- Get Revit
- Get Dynamo
- Get Archi-lab package
- Get Excel

## ESSENTIALS

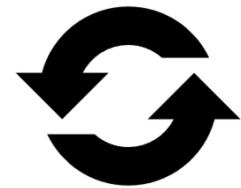
- **Don't know any Dynamo?**
- Dynamo Primer
- Dynamo User Groups (DUG)



## ESSENTIALS

- How to decide what needs to be automated?

**DO YOU DO IT ALL THE TIME?**



**IS IT REPETITIVE AND TIME CONSUMING?**



**IS IT REQUIRED ON ALL YOUR PROJECTS?**



## ESSENTIALS

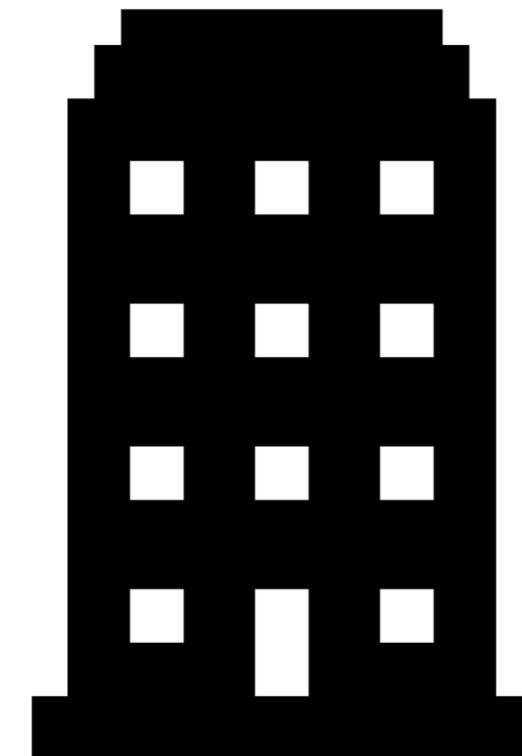
- **Class Scripts**
- Scripts will be simple – anyone can do them
- Minimal number of packages required
- Most entry level users can try these out and modify them

# SCRIPTS



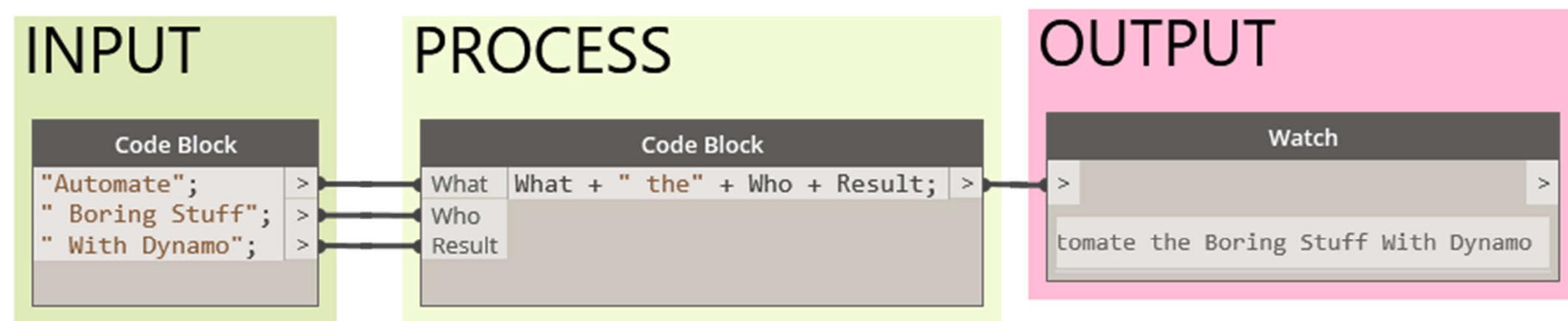
## SCRIPTS

- Let's make a tower
- All the hallmarks of tedious work are there – many floors and sheets, many repeatable elements to draw, settings to make, etc.



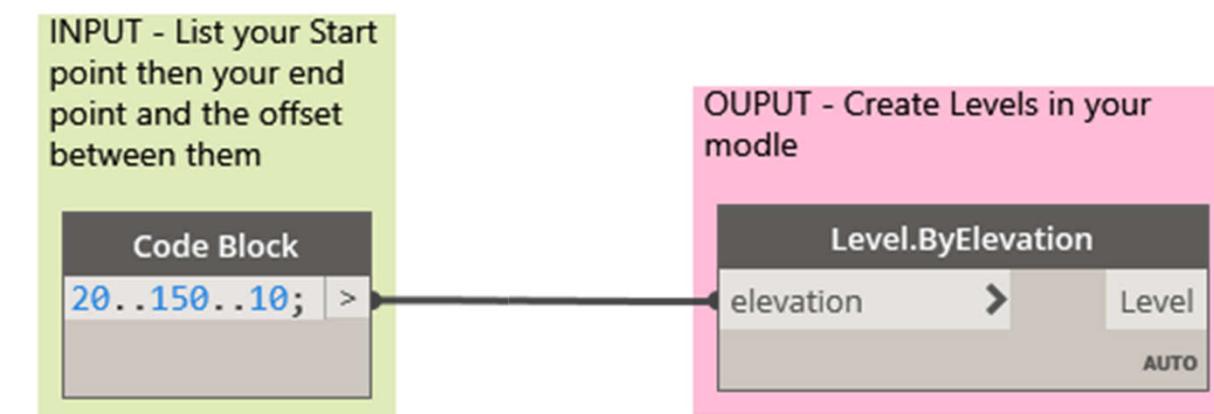
## SCRIPTS

- First Create a Workflow
- Start Backwards with what you want to achieve “OUTPUT”
- Then Determine where to begin “INPUT”
- The steps to connect the two and create results are “PROCESS”

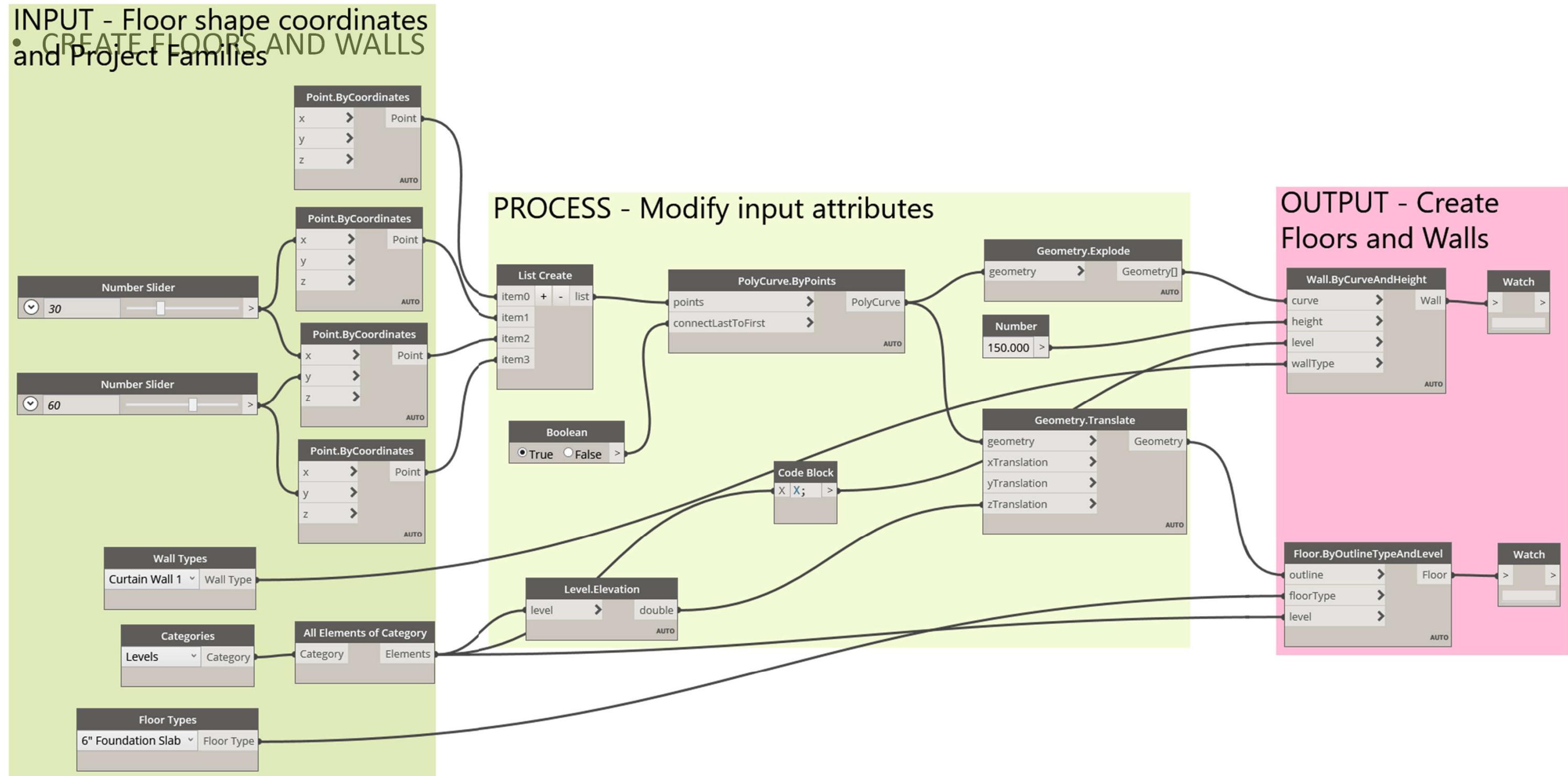


## SCRIPTS

- CREATE LEVELS

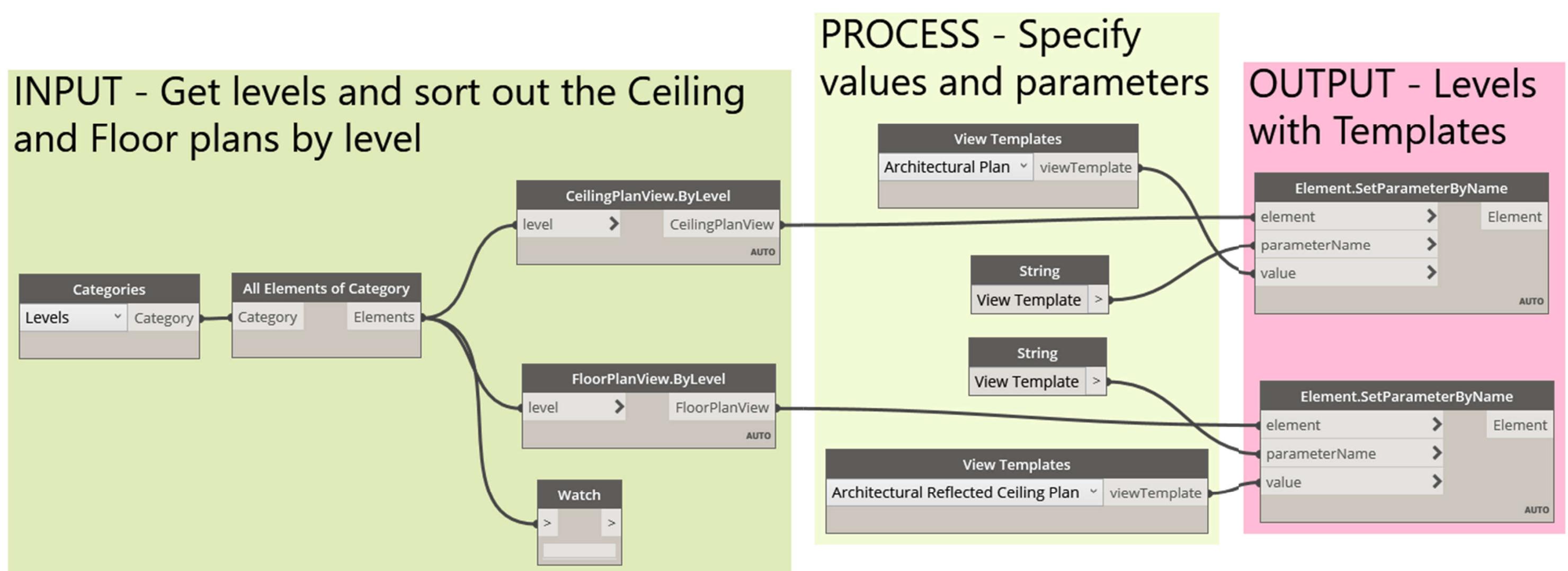


## SCRIPTS



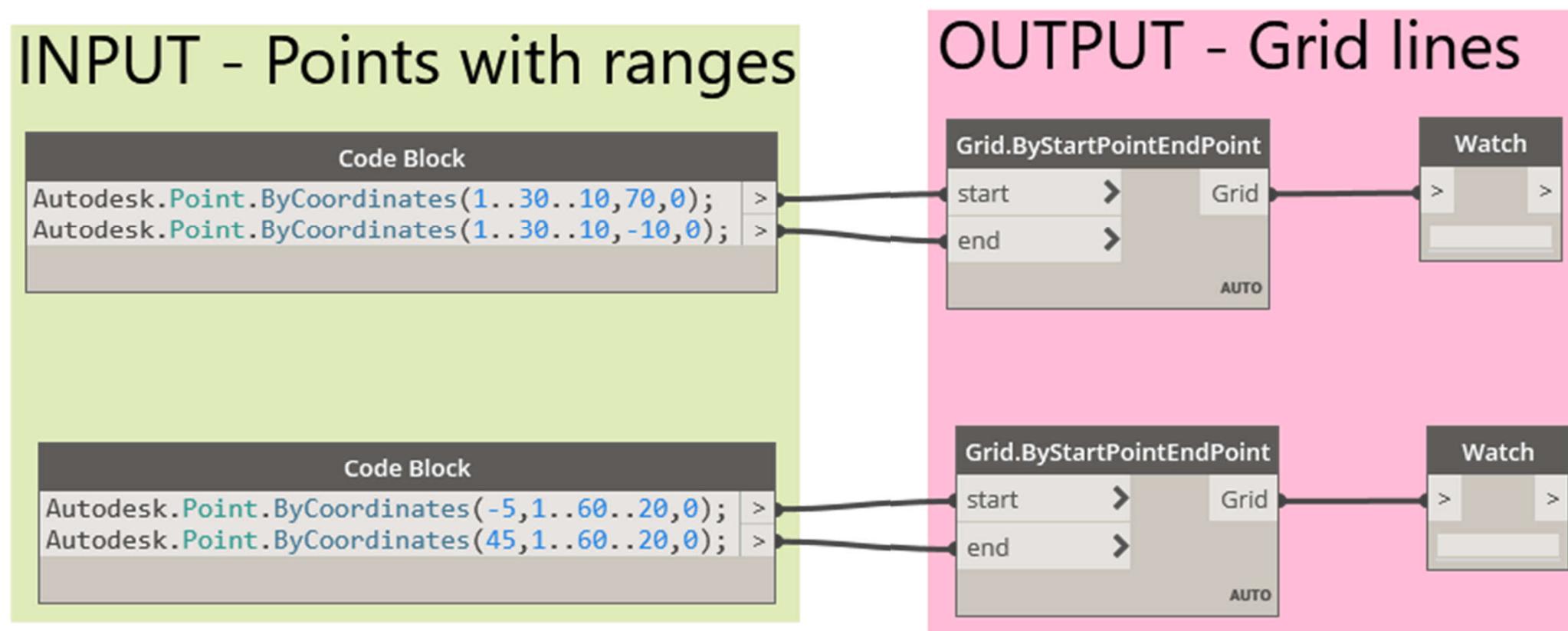
## SCRIPTS

- CREATE VIEWS



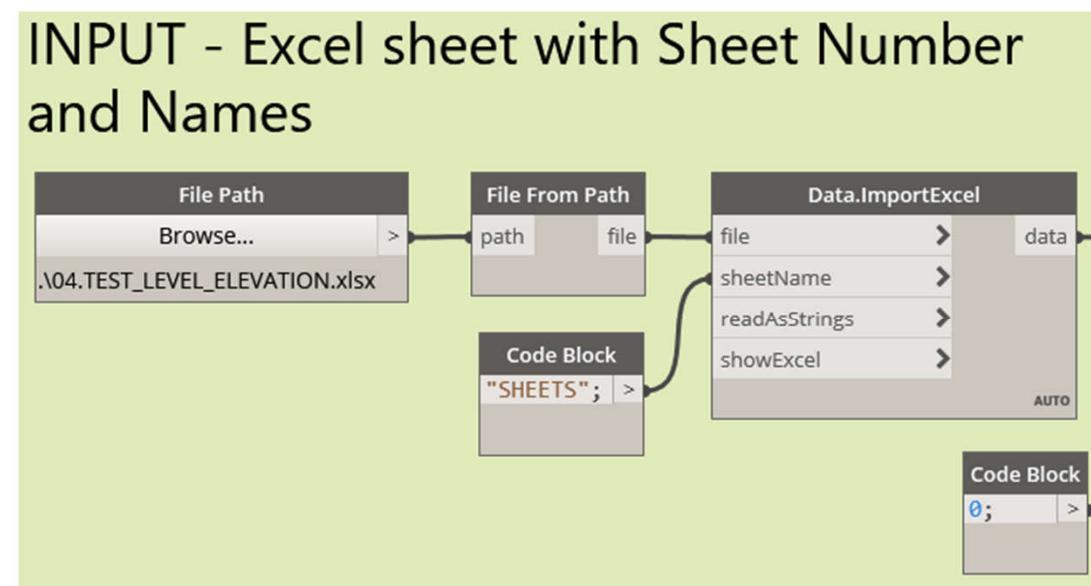
## SCRIPTS

- CREATE GRIDS

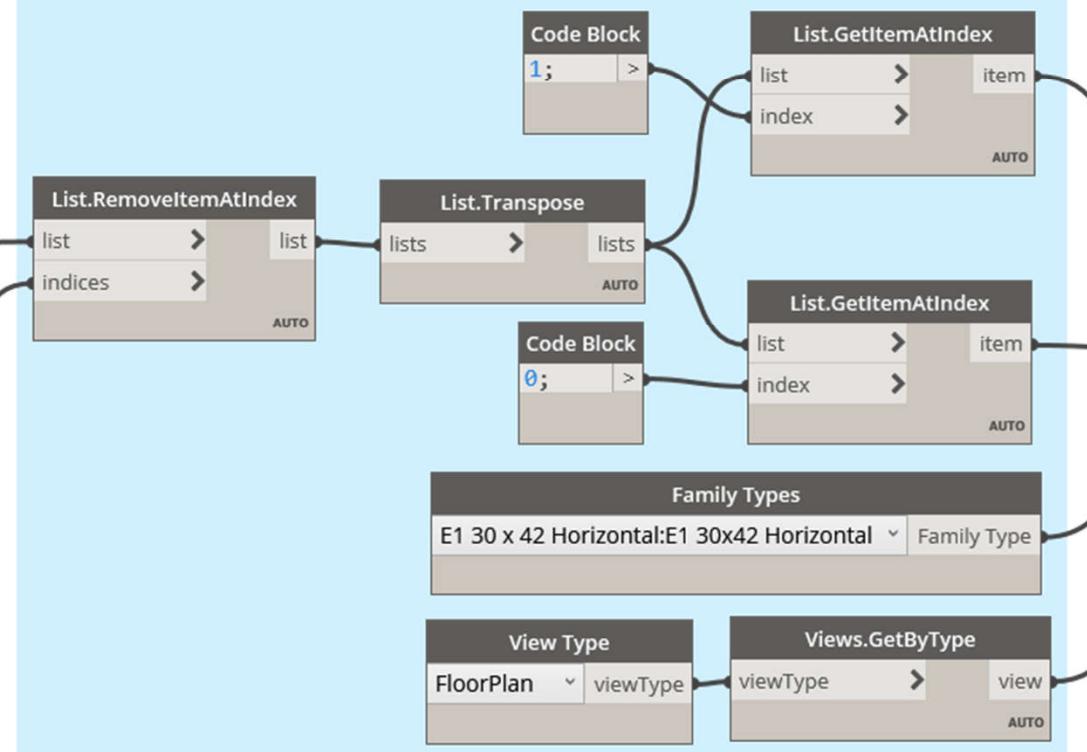


## SCRIPTS

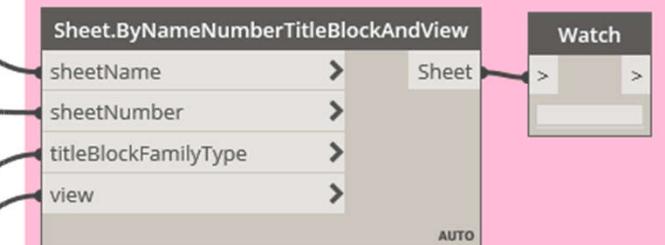
- CREATE SHEETS



**PROCESS - Sort the Excel Columns into separate lists for each parameter**

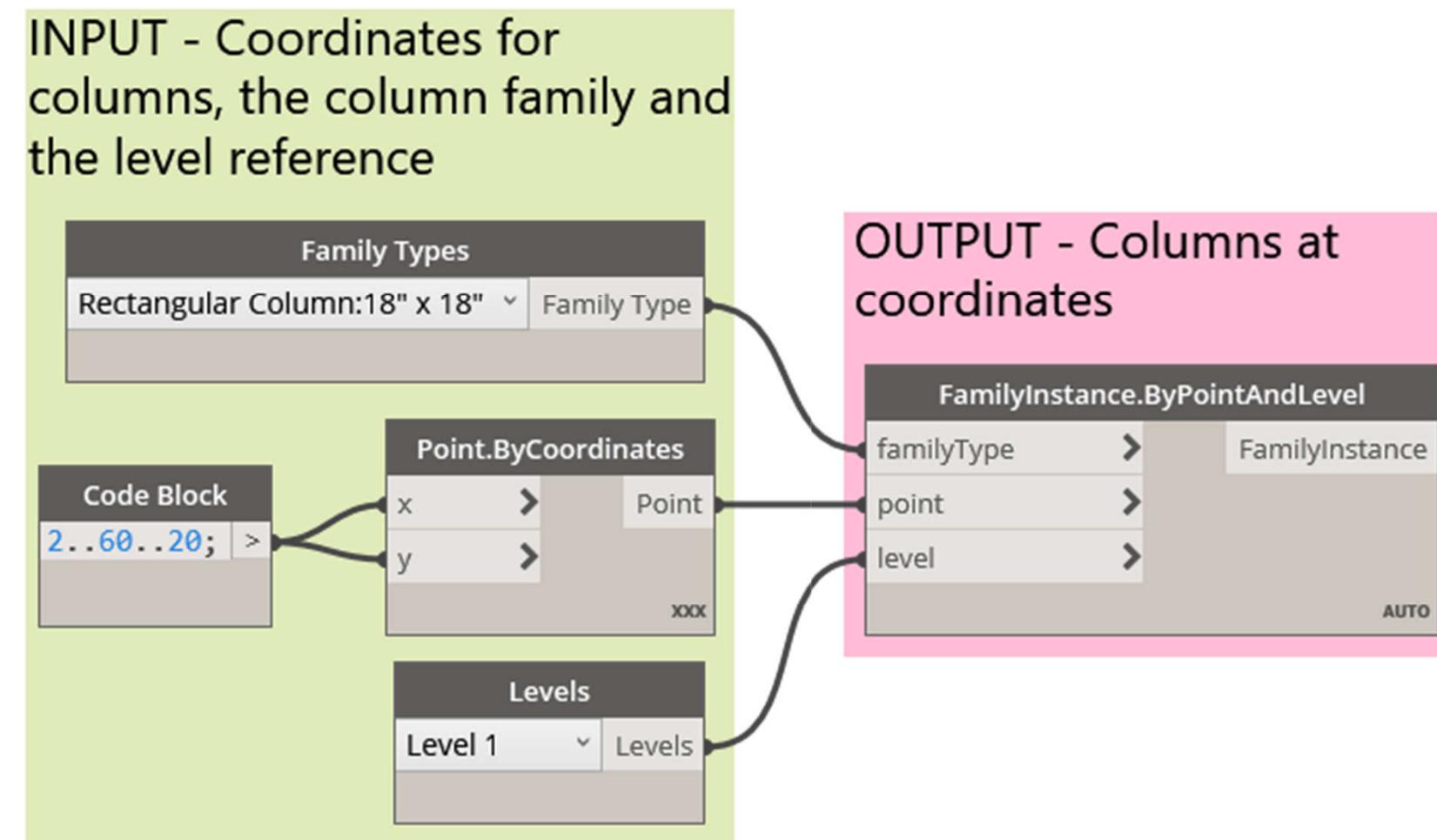


**OUTPUT - Create sheets based on Excel information, Titelblock family and Floor plan views**



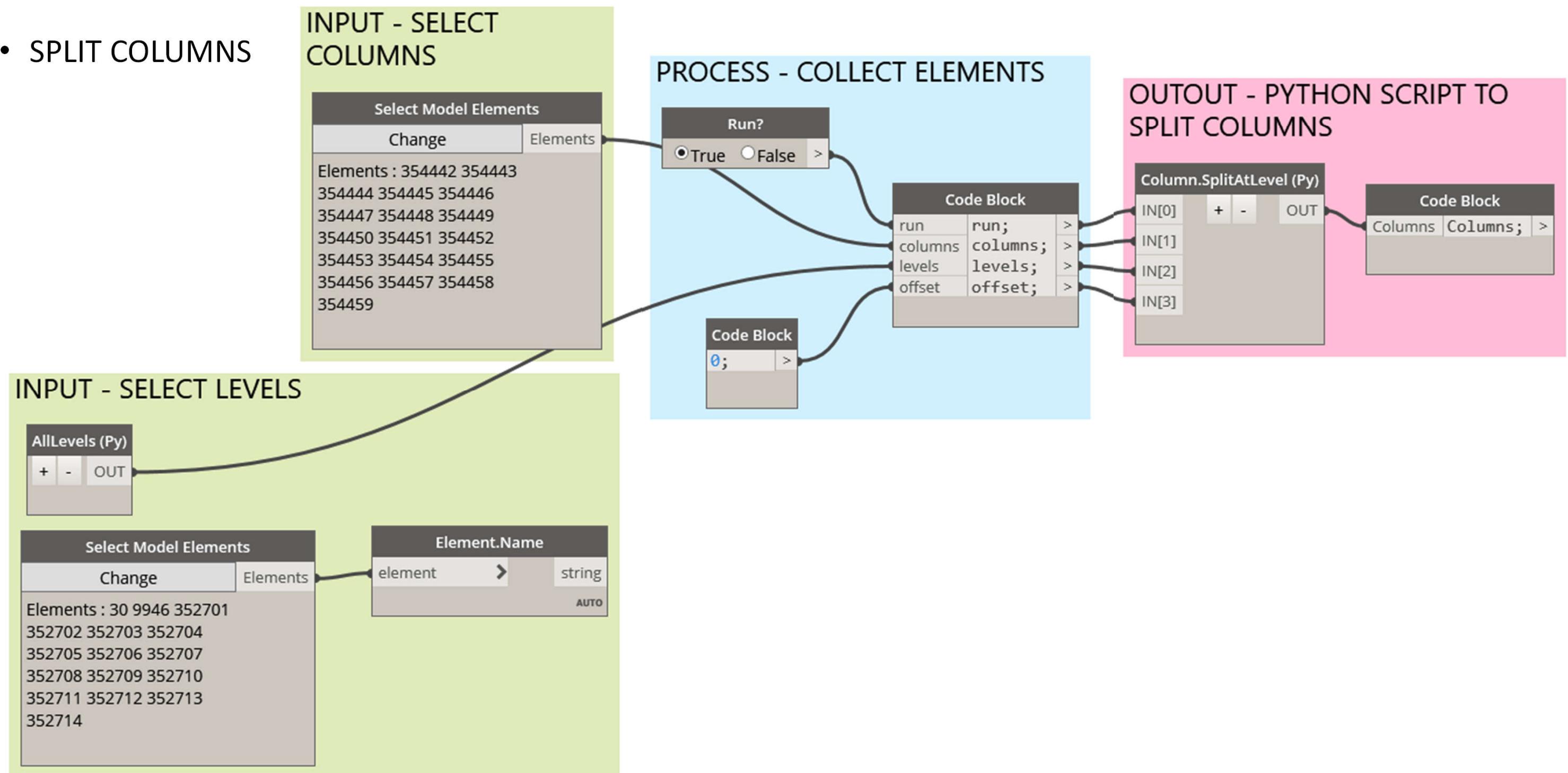
## SCRIPTS

- CREATE COLUMNS



## SCRIPTS

- SPLIT COLUMNS

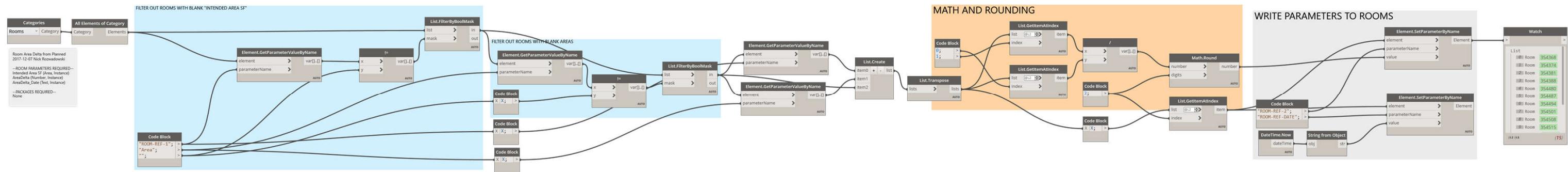


## SCRIPTS

```
16 clr.AddReference("RevitAPI")
17 from Autodesk.Revit.DB import *
18
19 # Convert to list if not list...
20 def tolist(obj1):
21     if hasattr(obj1,"__iter__"): return obj1
22     else: return [obj1]
23
24 # Gets the centreline of the column...
25 def GetColumnCentreline(e):
26     crv = None
27     fs = e.Symbol
28     fm = fs.Family
29     if not fm.GetCategory() == DirectShape:
30         if not fm.IsInPlace:
31             if e.IsSlantedColumn:
32                 try:
33                     crv = e.Location.Curve.ToProtoType()
34                 except:
35                     return
36             else:
37                 loc = e.Location.PointToPoint()
38
39                 bLev = (e.Document.GetElement(e.get_Parameter
40                     (BuiltInParameter.FAMILY_BASE_LEVEL_PARAM).AsElementId
41                     ()).Elevation + e.get_Parameter
42                     (BuiltInParameter.FAMILY_BASE_LEVEL_OFFSET_PARAM).AsDouble()) *
43                     ft2mm
44
45                 tLev = (e.Document.GetElement(e.get_Parameter
46                     (BuiltInParameter.FAMILY_TOP_LEVEL_PARAM).AsElementId()).Elevation
47                     + e.get_Parameter
48                     (BuiltInParameter.FAMILY_TOP_LEVEL_OFFSET_PARAM).AsDouble()) *
49                     ft2mm
50
51                 crv = geom.Line.ByStartPointEndPoint(geom.Point.ByCoordinates
52                     (loc.X,loc.Y,bLev), geom.Point.ByCoordinates(loc.X,loc.Y,tLev))
53
54     return crv
55
56 # Convert Level to DS Plane...
57 def LevelToPlane(l):
58     pt = geom.Point.ByCoordinates(0,0,round(l.Elevation * ft2mm,0)+offset)
59     n = geom.Vector.ZAxis()
60     return geom.Plane.ByOriginNormal(pt,n)
61
62 # Get the nearest level above in list of levels to given elevation...
63 def NearestLevelAbove(elev,lvls):
64     lvlAbv = None
65     for l in lvls:
66         if round(l.Elevation*ft2mm,0) > elev:
67             lvlAbv = l
68             break
69     return lvlAbv
70
71 # Get the nearest level in list of levels to given elevation...
72 def NearestLevel(elev, lvls):
73     return min(lvls, key=lambda x:abs(round(x.Elevation*ft2mm,0)-elev))
74
75 # Calculates the location to split column with parameterised column length
76 # (between 0 & 1)...
77 def CalculateSplitParameter(col,lvls):
78     # Switch out for mathematical method to speed up computation...
79     # abs(NewColBaseElevation-LevelAboveElevation)/NewCol length should give split
80     # parameter...
81     if col:
82         crv = GetColumnCentreline(col)
83         elev = round(crv.StartPoint.Z,0)
84         l = NearestLevelAbove(elev,lvls)
85
86         x = geom.Geometry.Intersect(crv,LevelToPlane(l))
87         if x:
88             x = x[0]
89             return geom.Curve.ParameterAtPoint(crv,x)
90
91     return None
92
93
94 # Start Transaction to allow for Document modification...
95 TransactionManager.Instance.EnsureInTransaction(doc)
96 for c in columns:
97     # Ensure only Structural Columns are used (modify if Arch Columns can
98     # be required)
99     if c.Category.Name == Category.GetCategory
100         (doc,BuiltInCategory.OST_StructuralColumns).Name:
101             arr = []
102             arr.append(c)
103             newCol = None
104             crv = GetColumnCentreline(c)
105
106             bLvlIndex = lvls.index(NearestLevel(crv.StartPoint.Z,lvls))
107             tLvlIndex = lvls.index(NearestLevel(crv.EndPoint.Z,lvls))
108
109             i = bLvlIndex
110             while i <= tLvlIndex:
111                 try:
112                     if not newCol:
113                         p = CalculateSplitParameter(c,lvls)
114                         newCol = doc.GetElement(c.Split(p))
115                         arr.append(newCol)
116
117                     else:
118                         p = CalculateSplitParameter(newCol,lvls)
119                         newCol = doc.GetElement(newCol.Split(p))
120                         arr.append(newCol)
121
122                 except Exception, ex:
123                     arr.append(ex.message)
124                     i = i+1
125                     outList.append(arr)
126
127             else:
128                 outList.append("Element is not of Category Structural Column")
129
130             TransactionManager.Instance.TransactionTaskDone()
131             OUT = outList
132
133     else:
134         OUT = "Please set Run to True"
```

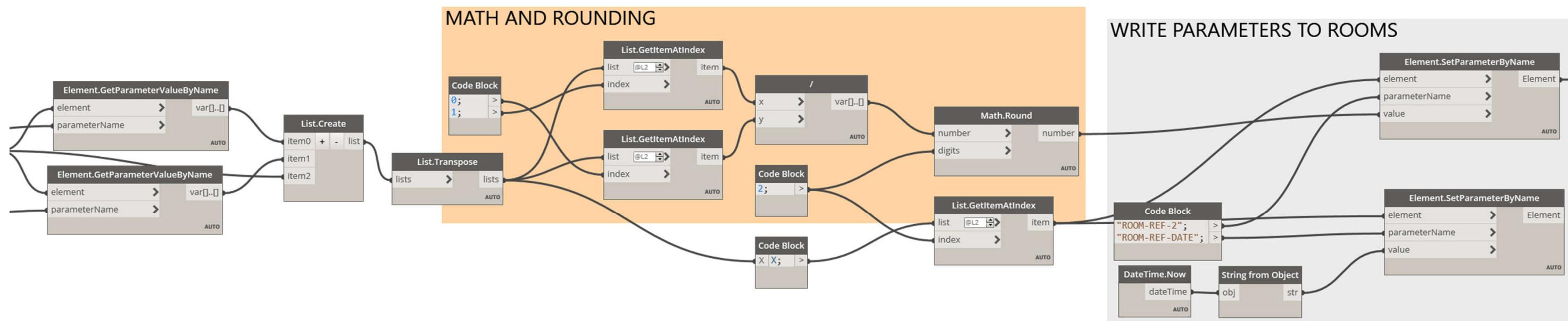
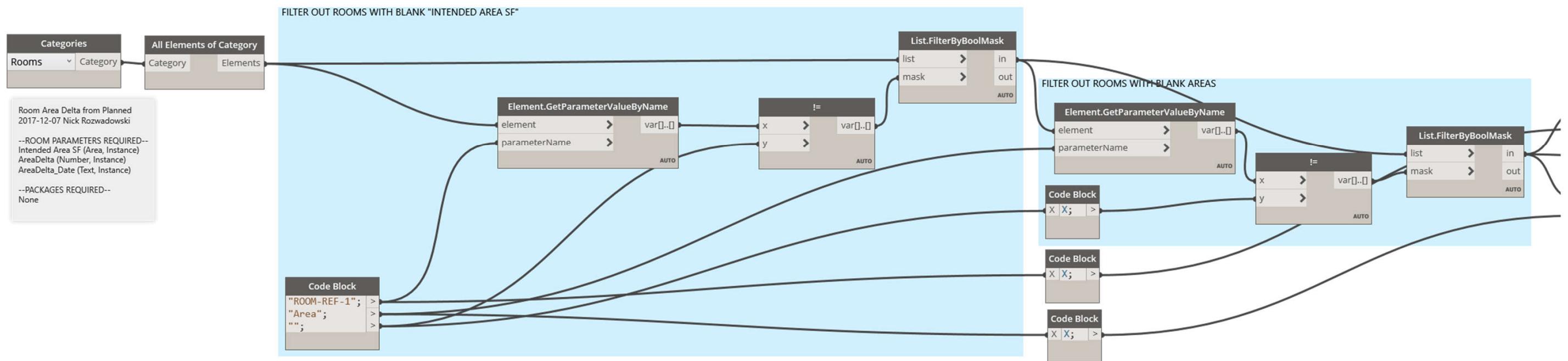
# SCRIPTS

- ROOM MATH



## SCRIPTS

- ROOM MATH



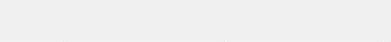
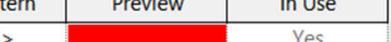
## SCRIPTS

- ROOM MATH

<Room Schedule>					
A	B	C	D	E	F
Name	Number	Area	ROOM-REF-1	ROOM-REF-2	ROOM-REF-DATE
Room	1	1800 SF	1750		
Room	2	1800 SF	1750		
Room	3	1800 SF	1750		
Room	4	1800 SF	1850		
Room	5	1800 SF	1850		
Room	6	1800 SF	1850		
Room	7	1800 SF	1850		
Room	8	1800 SF	1850		
Room	9	1800 SF	1900		
Room	10	1800 SF	1900		
Room	11	1800 SF	1900		
Room	12	1800 SF	1900		
Room	13	1800 SF	1800		
Room	14	1800 SF	1800		
Room	15	1800 SF	1700		

Scheme Definition

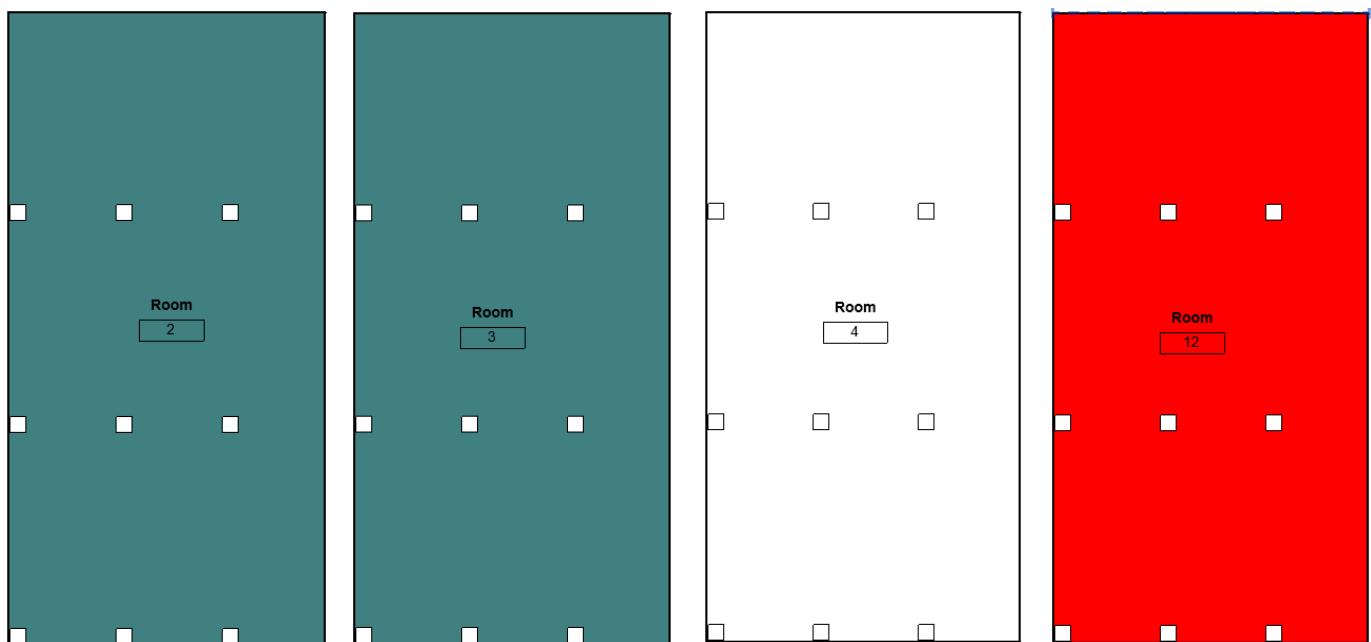
Title:  Color:  By value  By range  1234.56789

At Least	Less Than	Caption	Visible	Color	Fill Pattern	Preview	In Use
0.970000	Less than 0.97		<input checked="" type="checkbox"/>	Red	<Solid fill>		Yes
0.970000	0.97 - 1.03		<input type="checkbox"/>		<Solid fill>		Yes
1.030000	1.03 or more		<input checked="" type="checkbox"/>	RGB 064-128	<Solid fill>		Yes

Options

Include elements from links

<Room Schedule>					
A	B	C	D	E	F
Name	Number	Area	ROOM-REF-1	ROOM-REF-2	ROOM-REF-DATE
Room	1	1800 SF	1750	1.03	3/20/2019 6:01:25
Room	2	1800 SF	1750	1.03	3/20/2019 6:01:25
Room	3	1800 SF	1750	1.03	3/20/2019 6:01:25
Room	4	1800 SF	1850	0.97	3/20/2019 6:01:25
Room	5	1800 SF	1850	0.97	3/20/2019 6:01:25
Room	6	1800 SF	1850	0.97	3/20/2019 6:01:25
Room	7	1800 SF	1850	0.97	3/20/2019 6:01:25
Room	8	1800 SF	1850	0.97	3/20/2019 6:01:25
Room	9	1800 SF	1900	0.95	3/20/2019 6:01:25
Room	10	1800 SF	1900	0.95	3/20/2019 6:01:25
Room	11	1800 SF	1900	0.95	3/20/2019 6:01:25
Room	12	1800 SF	1900	0.95	3/20/2019 6:01:25
Room	13	1800 SF	1800	1	3/20/2019 6:01:25
Room	14	1800 SF	1800	1	3/20/2019 6:01:25
Room	15	1800 SF	1700	1.06	3/20/2019 6:01:25



## SCRIPTS

- CREATE WORKSETS

# NEXT STEPS

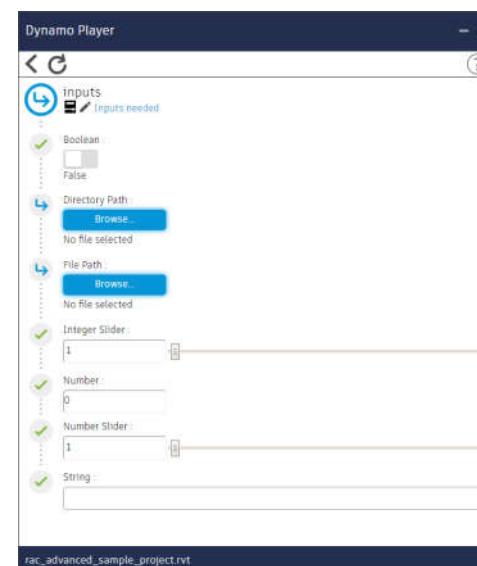


## NEXT STEPS

- **What else can you automate?**
- Placing objects
- Reviewing Warnings
- Creating Filters
- Importing Geometry
- Calculate Values
- Export Content
- Auto-Dimension
- Auto-Tag
- Copy Elements
- Renumber spaces
- Rename rooms
- Batch upgrade
- Create pipes from lines
- Change text case
- Create Scope boxes
- Create Elevations
- Check View Range
- Report Worksets
- Visualize Geometry
- Coordinate Settings
- Clear parameters
- Filter Elements
- Remove lines
- Create finish floors
- Etc
- And Then Some

## NEXT STEPS

- Dynamo Player – don't even open the script just run it
- Design Script – don't even load the nodes just type them in
- Python nodes – Run loops to get the best results instead of a single run through based on manual settings
- Generative Design – Create outputs based on your inputs and select the best results for your design
- Integrate workflows – Grasshopper, Sketchup, Bluebeam, Excel, Formit, Etc

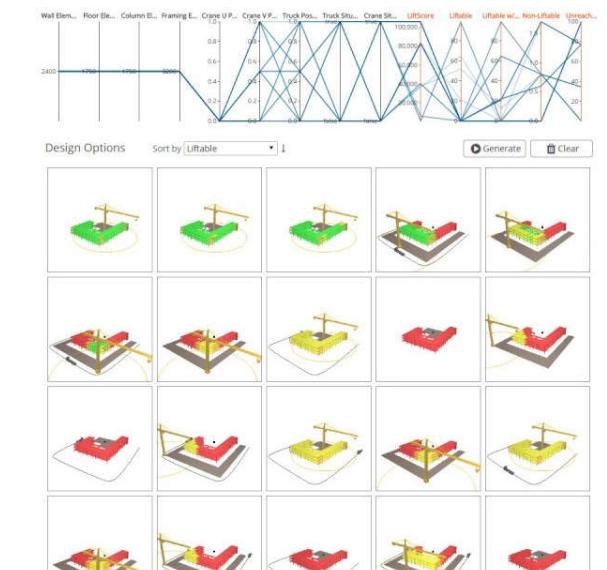


**Code Block**

```
t2 t1 = Point.ByCoordinates(t2<1>, t2<2>, 0);
t5 t3 = Vector.ZAxis();
t6 t4 = Point.ByCoordinates(t5<1>, t6<2>, 0);
t7 = t4.DistanceTo(t1);
t8 = t1.Translate(t3, t7);
t9 = NurbsSurface.ByControlPoints(t8, 3, 3);
t10 = 5;
t11 = t9.Thicken(t10);
```

**Edit Python Script...**

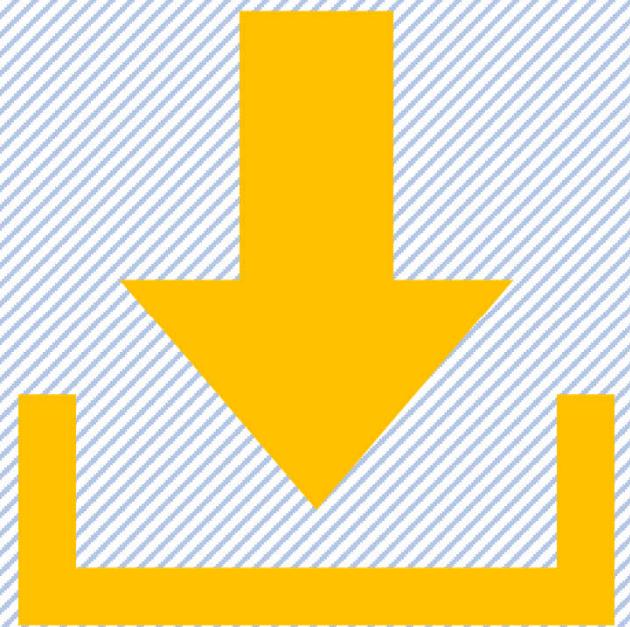
```
1 #Copyright(c) 2016 www.learndynomo.com
2 #Please contact at jeremy@learndynomo.com
3
4 import clr
5 clr.AddReference('RevitAPI')
6 clr.AddReference("RevitServices")
7 clr.AddReference("RevitNodes")
8 import RevitServices
9 import Revit
10 import Autodesk
11 from Autodesk.Revit.DB import *
12
13 from RevitServices.Persistence import DocumentManager
14 from RevitServices.Transactions import TransactionManager
15
16 doc = DocumentManager.Instance.CurrentDBDocument
17
18 toggle = IN[0]
19
20 elements = []
21 names = []
22 lst = []
23
```



## NEXT STEPS

- Things to keep in mind
- There's a lot of back and forth to get your scripts running
- Dynamo and related tools are a learning curve to be patient
- Make notes on your scripts to keep track of what you're doing
- Share your information as much as possible to build the knowledge among users and broaden capabilities for everyone

# TAKEAWAYS



## TAKEAWAYS

- Lessons Learned
- Focus on reducing time on project setup by targeting repetitive tasks
- Determine what you want to produce, where to start and how to get there
- Start from the most simple steps and build from there
- Research and ask for help when you need to
- Organize your scripts and share your content

## TAKEAWAYS

- Sources used for this presentation
  - Dynamo BIM Forums
  - Dynamo Primer
  - Autodesk Knowledge Network
  - ArchSmarter - <https://archsmarter.com/save-time-revit-dynamo/>
  - Matthew Anderle and Ron Allen - <https://medium.com/autodesk-university/improve-your-team-efficiency-20-practical-uses-of-dynamo-for-revit-f5f4a6313ab8>
  - Paul Wintour & Scott Crichton - [http://d2p83z8mja0pcr.cloudfront.net/wp-content/uploads/2017/06/21122922/S3\\_1\\_Hand\\_LAB\\_Everyday-Dynamo\\_PWintour.pdf](http://d2p83z8mja0pcr.cloudfront.net/wp-content/uploads/2017/06/21122922/S3_1_Hand_LAB_Everyday-Dynamo_PWintour.pdf)



THANKS FOR COMING!

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