AUTODESK. UNIVERSITY

Unlock the Hidden Super Powers of Dynamo

Tadeh Hakopian

Design Technology Manger / Developer | @tadeh_hakopian

Session ID 468512

INTRODUCTION


POW!

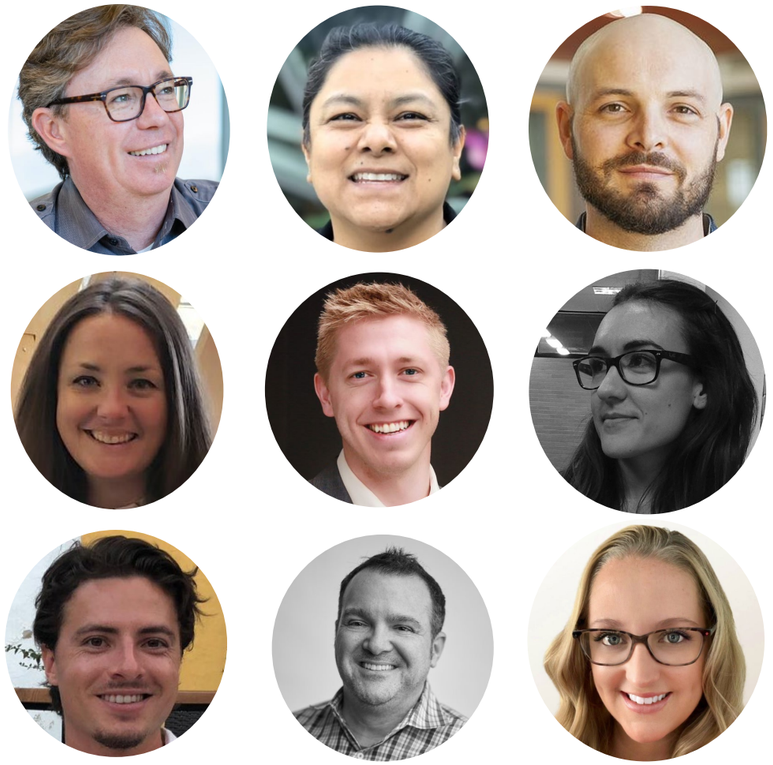
ABOUT ME

About the speaker

Tadeh (Todd-A) Hakopian

Tadeh leverages BIM, VDC and Design Technology to provide his teams with impactful tools for project success. He has over 8 years of experience in the AEC field developing methods and practices to enhance project outcomes. With a background in Architecture he has worked with designers, engineers and contractors in all phases of building design and construction. Over the years he has been a part of large, complex projects in Commercial, Sports, Education, Healthcare and Residential sectors. His current focus is on design automation, data insights in projects and comprehensive workflows that come full circle in planning project life cycles. He is an active speaker at conferences and his local community meetups. Current Professional Goals Help move the AEC profession into new horizons using value driven solutions and innovative research.

HMC Digital Practice



About HMC Digital Practice

HMC Architects internal group of innovators and subject matter experts for digital technology

Mission is to support the designers in our company by using new tools and methods

Group operates company wide to support and improve performance of project teams

Main focus areas – Data Analytics, Process Automation, Integrated software workflows

DYNAMO’S SECRET IDENTITY

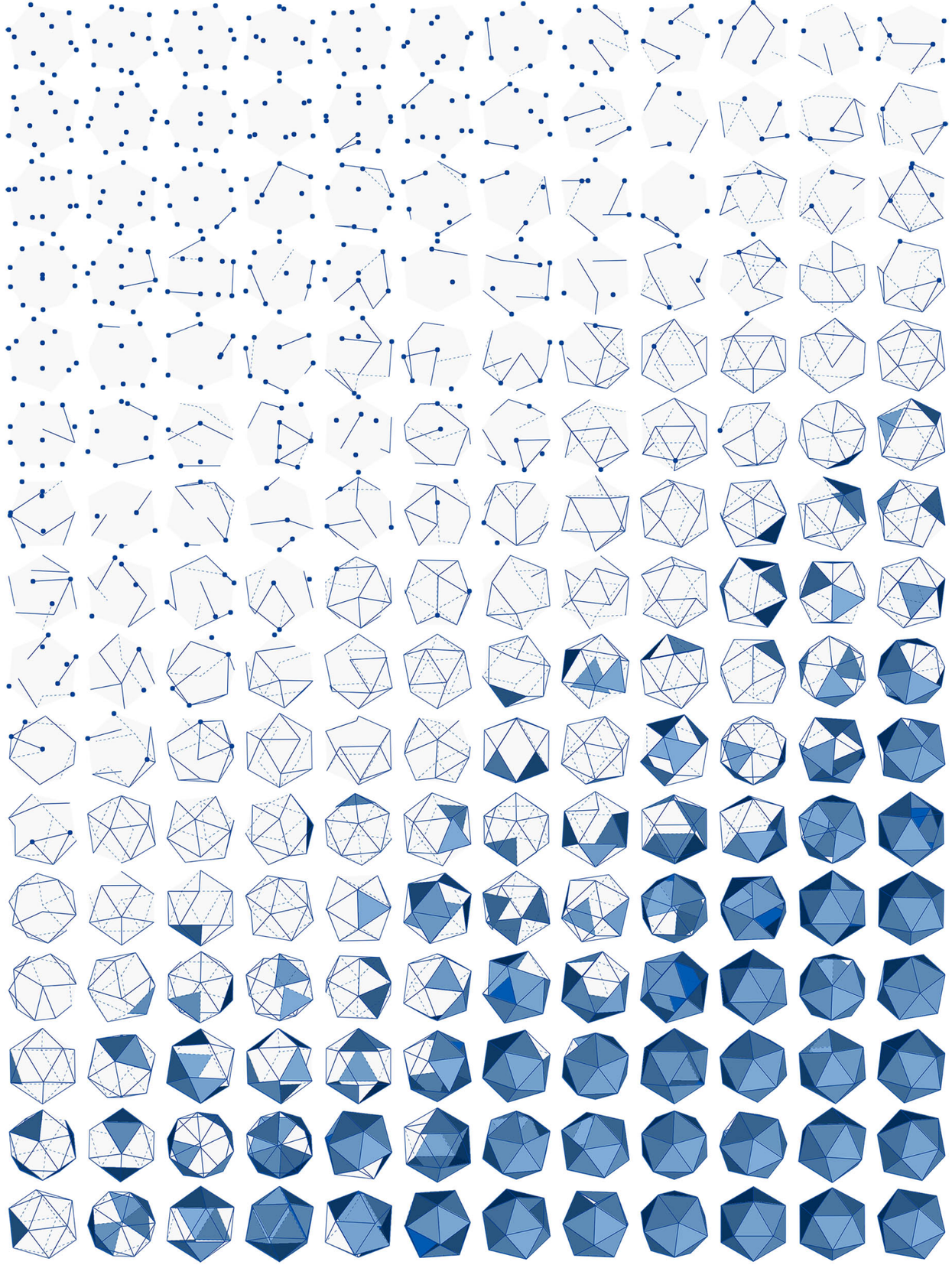
OBJECTIVES AND CONTENT

Learning Objectives

- Learn how Dynamo can use machine learning and generative design.
- Learn how to connect your Dynamo script to web APIs and access information for online databases.
- Learn how to create specialized geometry formations with packages to expand modeling capability.
- Learn how to document your scripts by exporting your files to GitHub for anyone to use online with special nodes.

Description

Dynamo for a long time has been the go-to tool of Revit users to quickly script solutions to time-consuming routine problems. However, there is much more that Dynamo can do beyond scripting. There is a whole world to explore with packages and integrations which you may not be aware of. See what is possible with AI, geometry manipulation, coding, generative design in Autodesk software, and document updates, as well as accessing web APIs with Dynamo. If you think you know Dynamo, then you've only scratched the surface. Check out this class to see the true potential of Dynamo and visual scripting.



WHAT WE WILL COVER

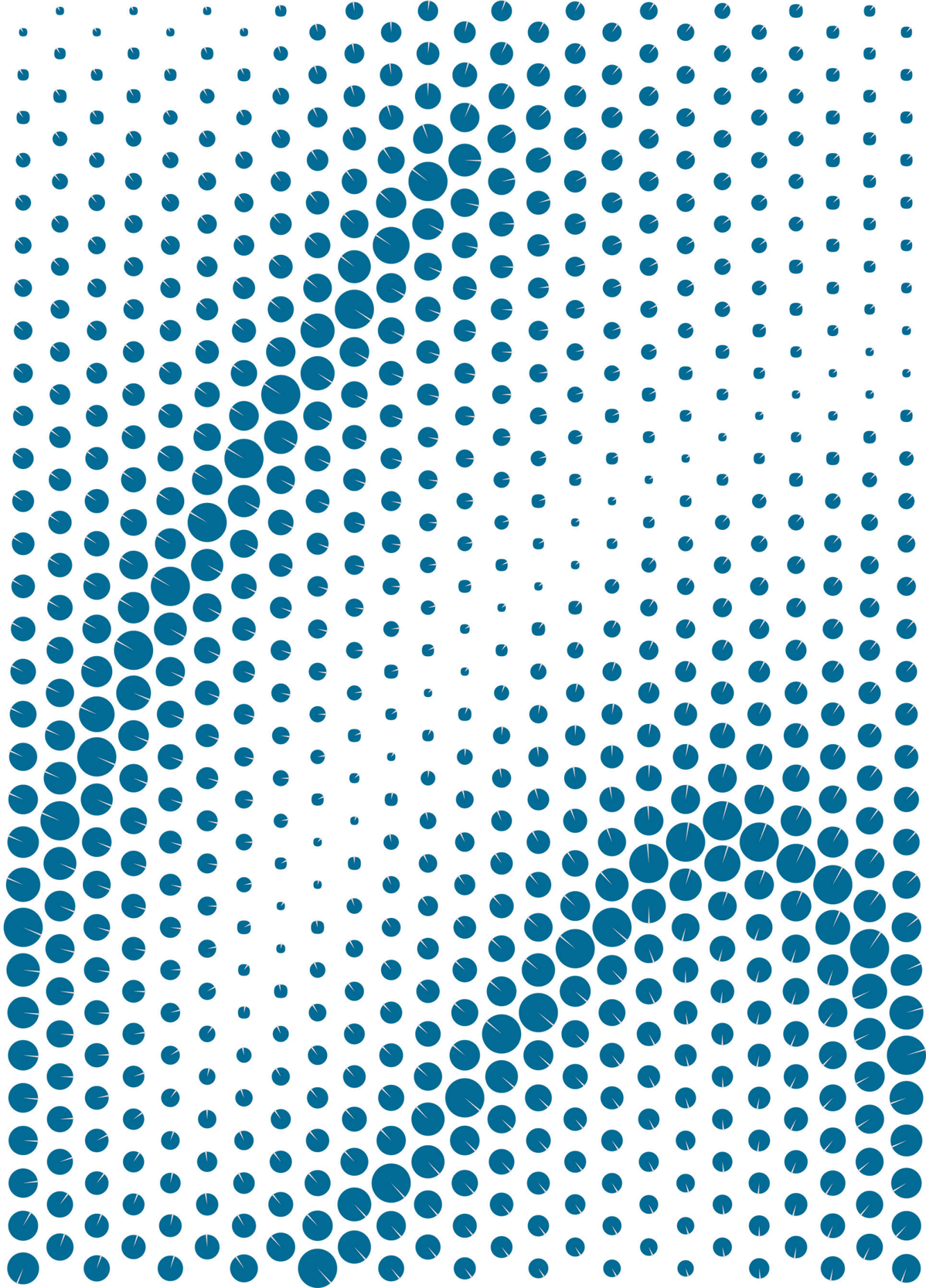
Disclaimer:

This is a starting off point to learn more

For more information please check out the referenced links

Sections:

- Geometry
- GIS / Maps
- Coding in Dynamo
- Data Science / Machine Learning
- Github docs
- External software integration
- Cross platform integration



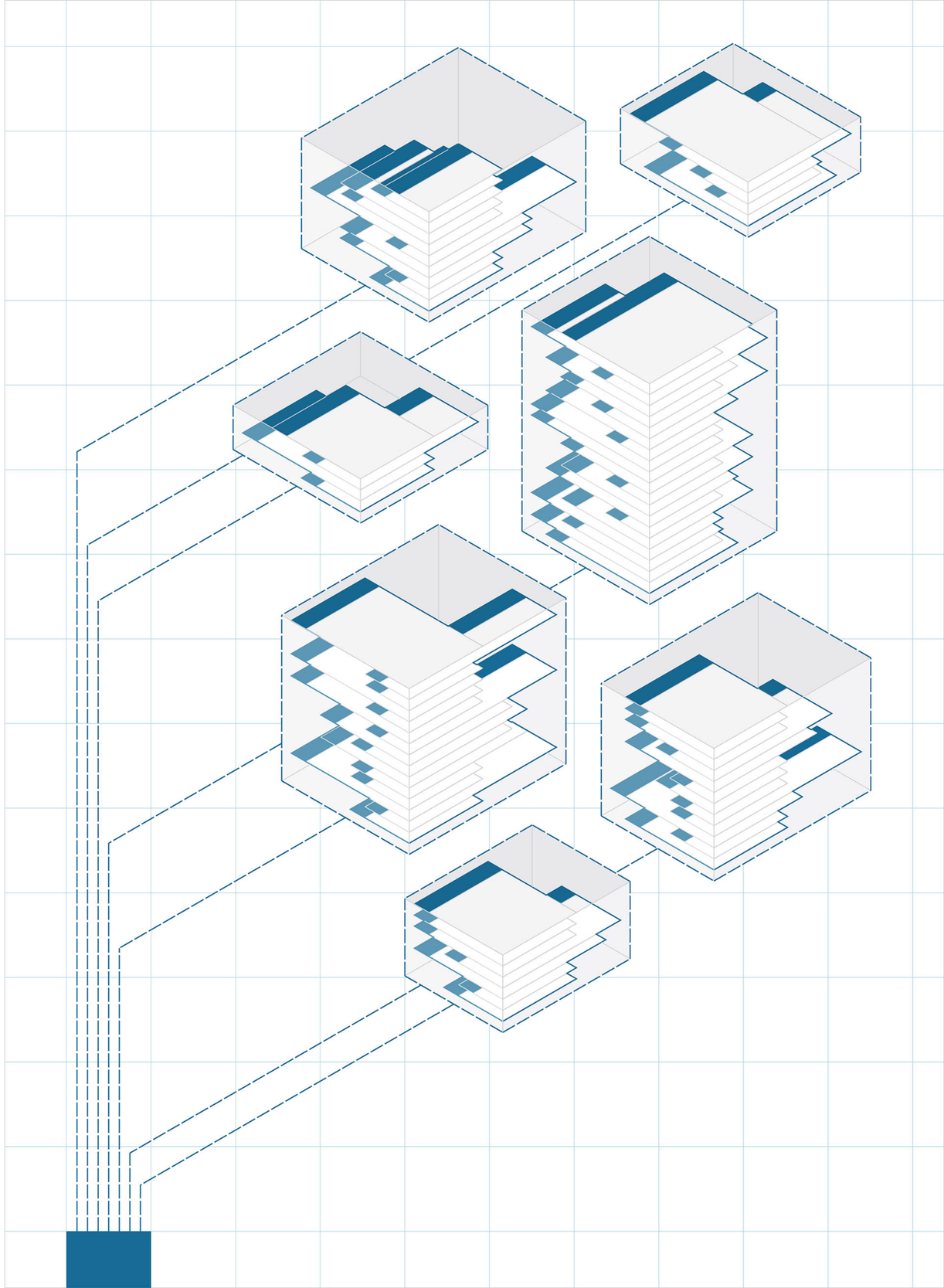
WHAT IS IT REALLY ABOUT?

Packages – Custom nodes from external developers to expand upon what Dynamo can do

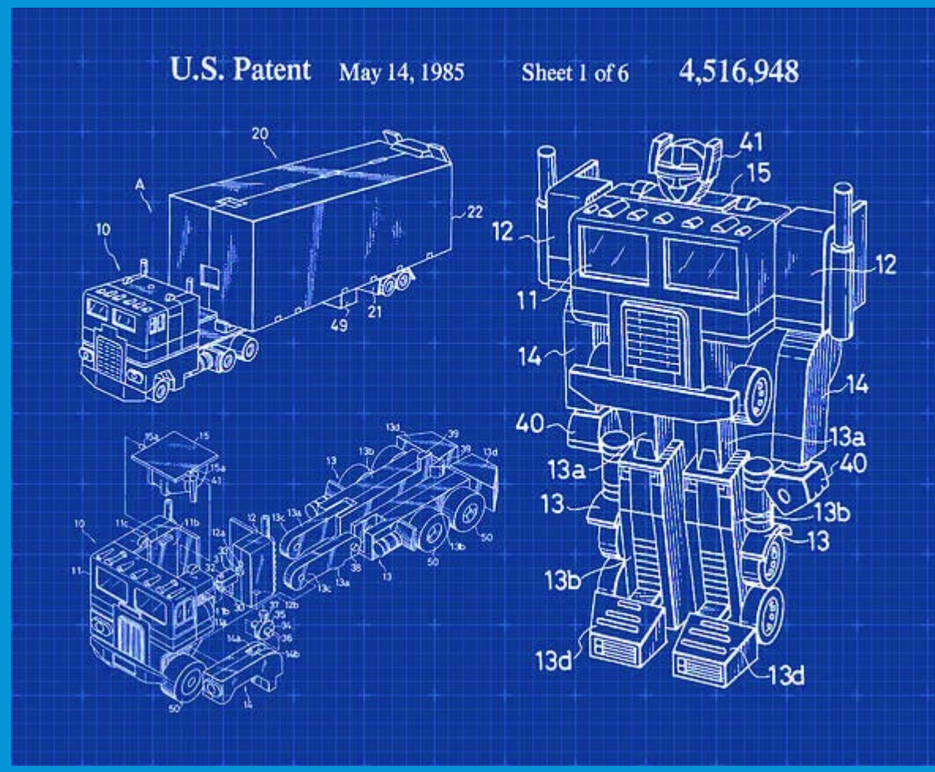
View Extensions – Additional window tools in the Dynamo UI that can launch additional services and connections to external software without having to use nodes

Imports – Bringing content into Dynamo from an external source

Open Source – Revealing the source code for anyone to access and edit, Dynamo itself is an example of this



GEOMETRY & TRANSFORMATIONS



TITLE

DynaShape

WHAT IS IT

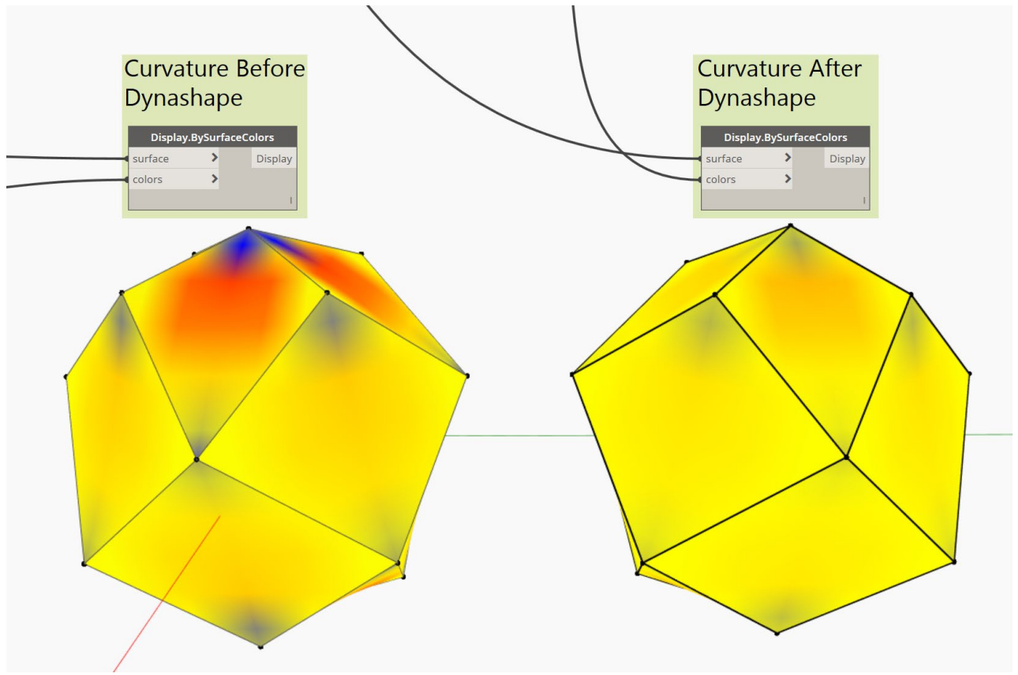
Open-source Dynamo plugin for constraint-based form finding, optimization and physics simulation

ORIGIN

Long Nguyen

REPO

https://github.com/LongNguyenP/DynaShape

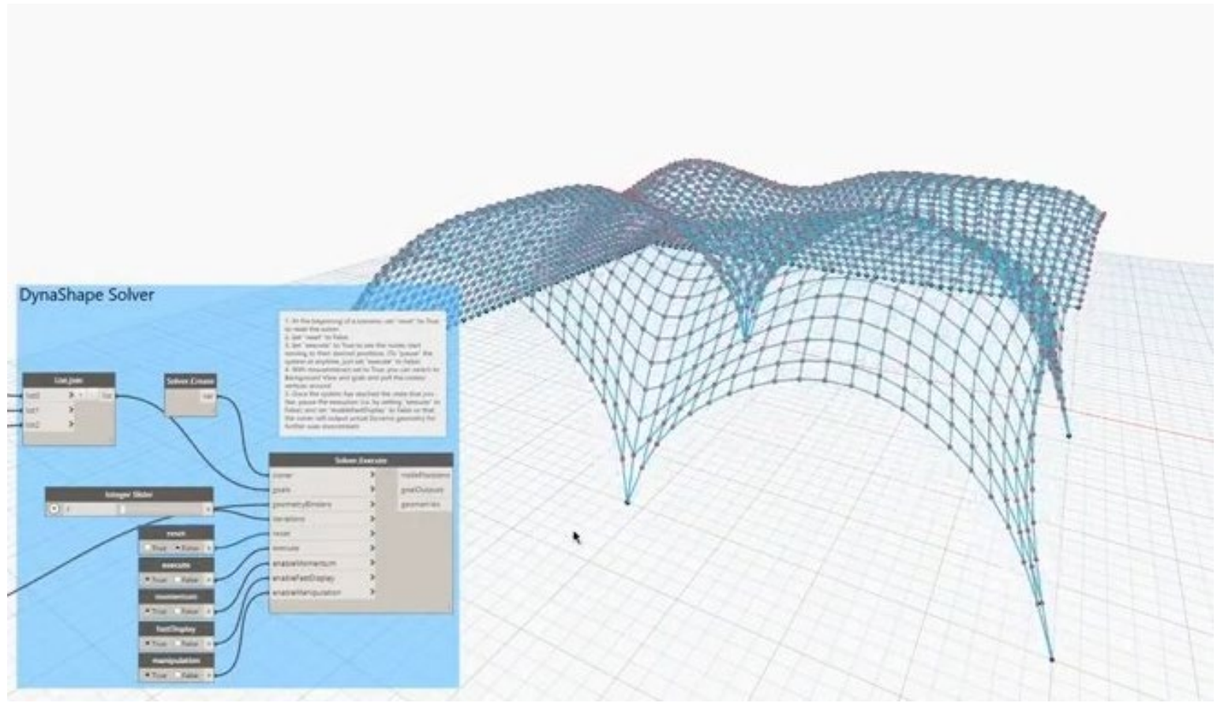


USE CASE

DynaShape is a Dynamo package for constraint-based form finding, optimization and physics simulation. The core algorithm is based on ShapeUp 85. This provides an important theoretical foundation by formally describing how different geometric constraints can be defined in a unified and extensible framework, how they can be solved/optimized simultaneously and under what conditions the solution can be guaranteed.

MORE INFORMATION

https://forum.dynamobim.com/t/dynashape/11666



TITLE

Topologic

WHAT IS IT

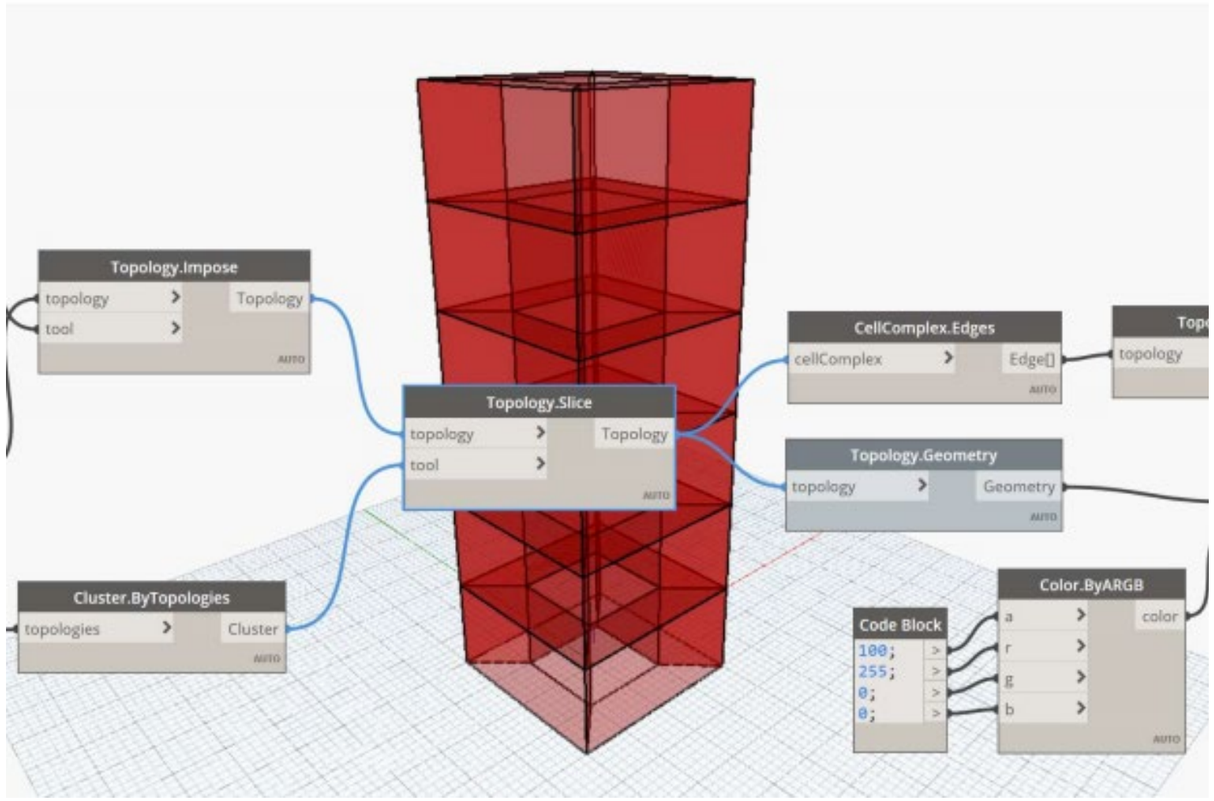
Topologic is a software modelling library enabling hierarchical and topological representations of architectural spaces, buildings and artefacts through non-manifold topology.

ORIGIN

Dr. Wassim Jabi and the Topologic Team

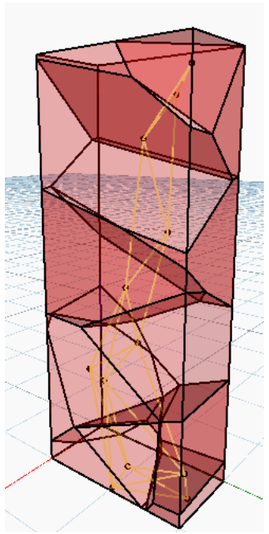
REPO

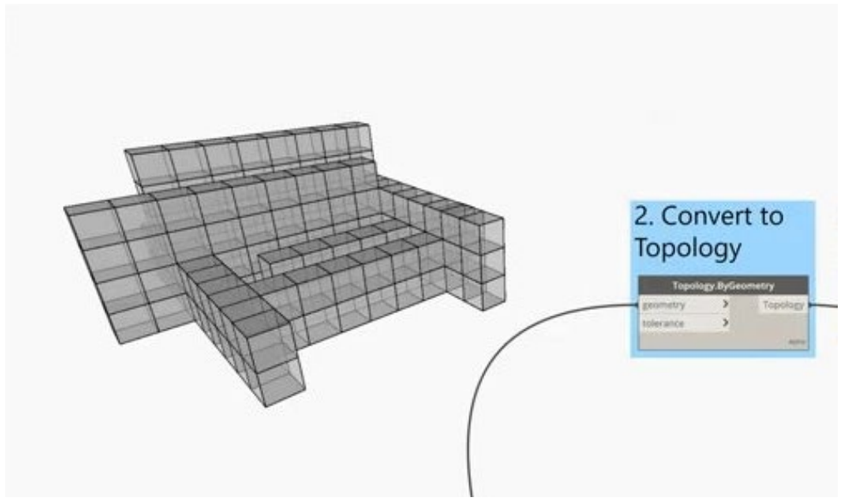
https://github.com/NonManifoldTopology/Topologic



USE CASE

Toplogic can be used to support energy modelling - say dimensioning the windows on different sides of a hospital to avoid summer overheating Topologic can be be used to plot paths such as fire egress routes, the least disruptive route for a new service pipe or the most congested location in a city layout





MORE INFORMATION

https://topologic.app/learning/

TITLE

Project Refinery

WHAT IS IT

An Autodesk generative design beta for the architecture, engineering and construction industry that gives users the power to quickly explore and optimize their Dynamo designs

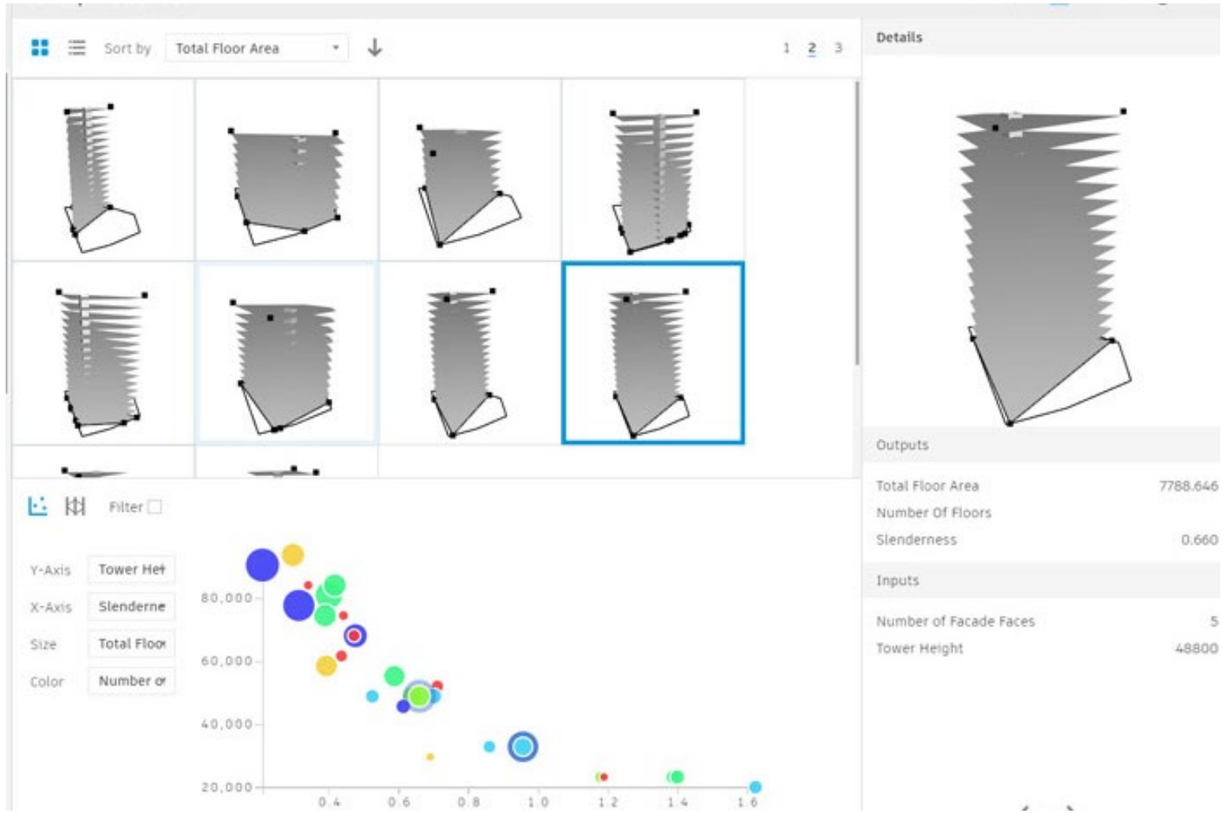
ORIGIN

Autodesk

REPO

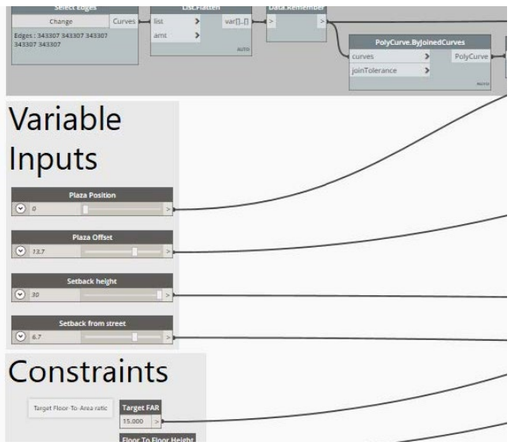
https://www.autodesk.com/campaigns/refinery-beta

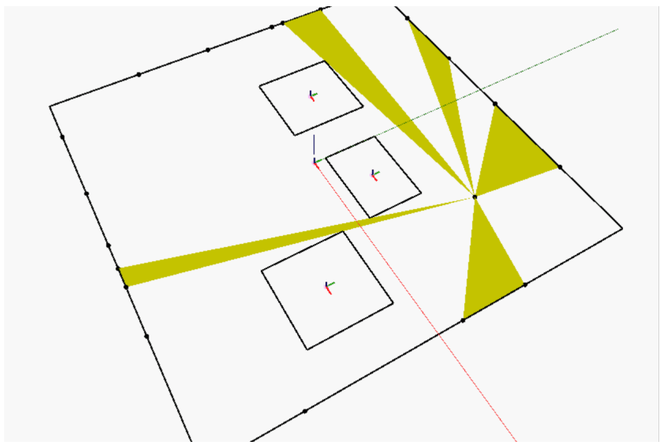
https://dynamobim.org/refinery-toolkit/



USE CASE

Generative design is used to provide practitioners the ability to quickly explore, optimize, and make informed decisions to complex design problems. Think of generative design software as an assistant that helps with creating, testing, and evaluating options. This approach is especially useful when you have many variations to consider in order to access a few optimized results. Refinery can accelerate design exploration providing a selection of optimized results based on the user input and preferences.





MORE INFORMATION

https://www.autodesk.com/autodesk-university/article/Design-Automation-Generative-Design-AEC-2020

https://www.youtube.com/watch?v=F3dlYANY4zo&feature=youtu.be&t=5290&ab_channel=SwissDataScienceCenter

https://www.generativedesign.org/

GEGORAPHIC INFORMATION SYSTEMS

TITLE

DynaMaps

WHAT IS IT

View extension and node package which provides the most straightforward workflow to get site data into Dynamo

ORIGIN

Mostafa El Ayoubi

REPO

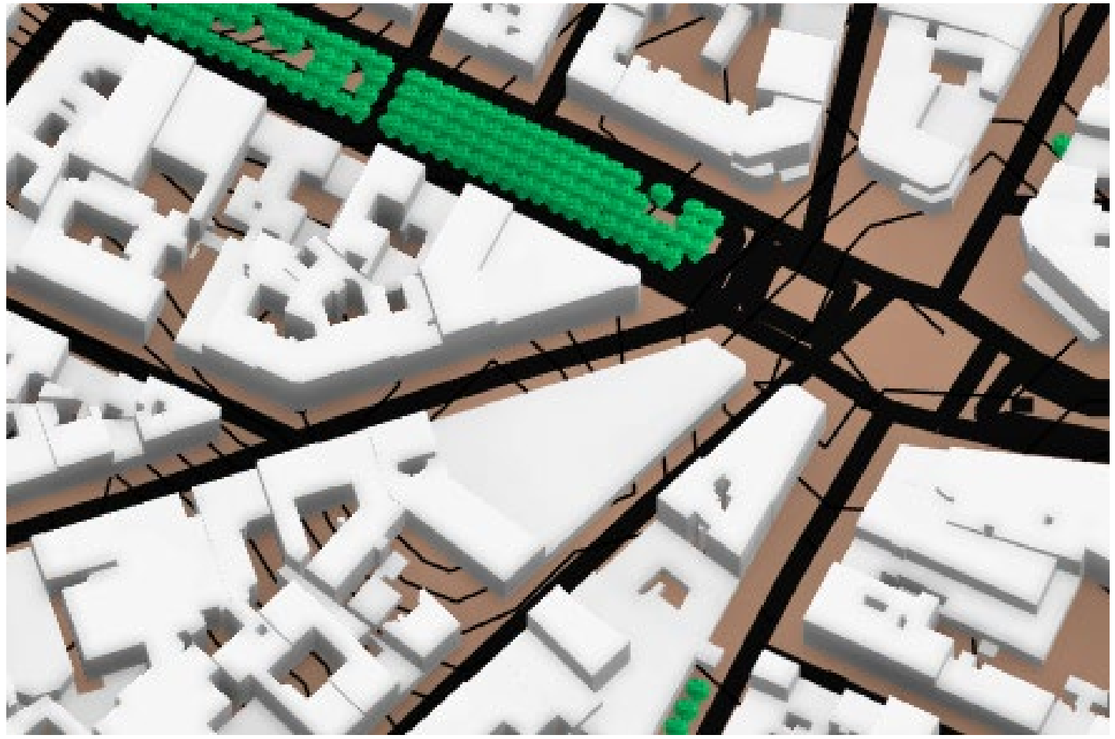
https://github.com/MostafaElAyoubi/Data-shapes

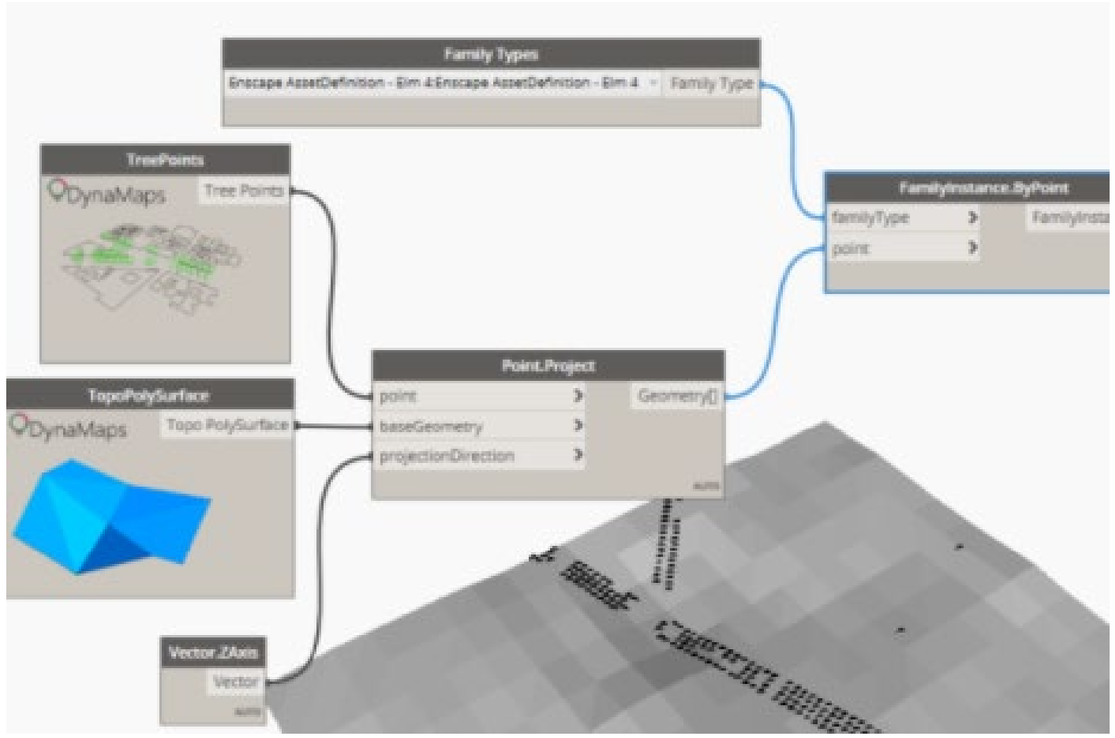
USE CASE

Placing site content like buildings and topography into your Revit model with the DynaMaps package nodes. Load and create site model data into Revit without having to link files and rebuild content yourself.

MORE INFORMATION

https://dynamobim.org/dynamaps/





TITLE

GIS2BIM

WHAT IS IT

Access GIS content from online database and load them into your Revit model with Dynamo nodes

ORIGIN

Maarten Vroegindeweij

REPO

https://github.com/DutchSailor/GIS2BIM

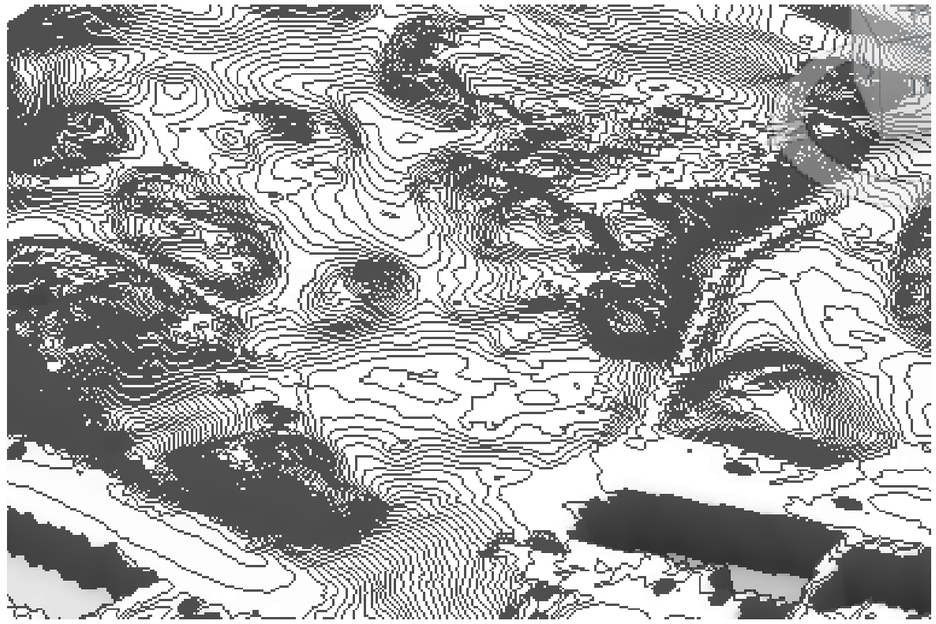
USE CASE

GIS2BIM is a collection of custom nodes for the Dynamo visual programming environment. It imports 2D and 3D GIS-information to Autodesk Revit-models.

MORE INFORMATION

https://github.com/DutchSailor/GIS2BIM/wiki/Workflows

http://dutchrevitblog.blogspot.com/



TITLE

Google Maps in Dynamo

WHAT IS IT

Add Google map images into your documents

ORIGIN

Konrad Sobon

REPO

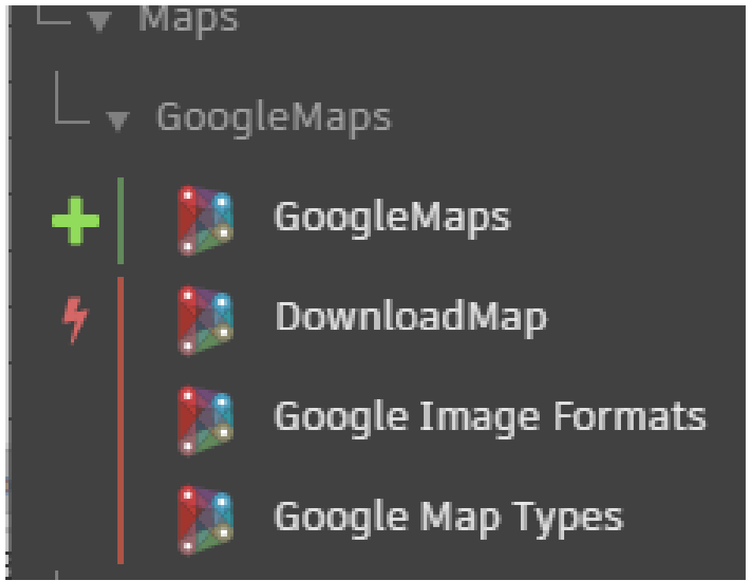
https://github.com/ksobon/archilab

USE CASE

Take the Google maps API and get it into your model with a special node package from Archi-lab. Classic use of Dynamo that cuts down time and complexity of a task with a simple script and information that can be immediately used on your projects.

MORE INFORMATION

https://archi-lab.net/google-maps-static-api-in-dynamo/



CODING

TITLE

DesignScript

WHAT IS IT

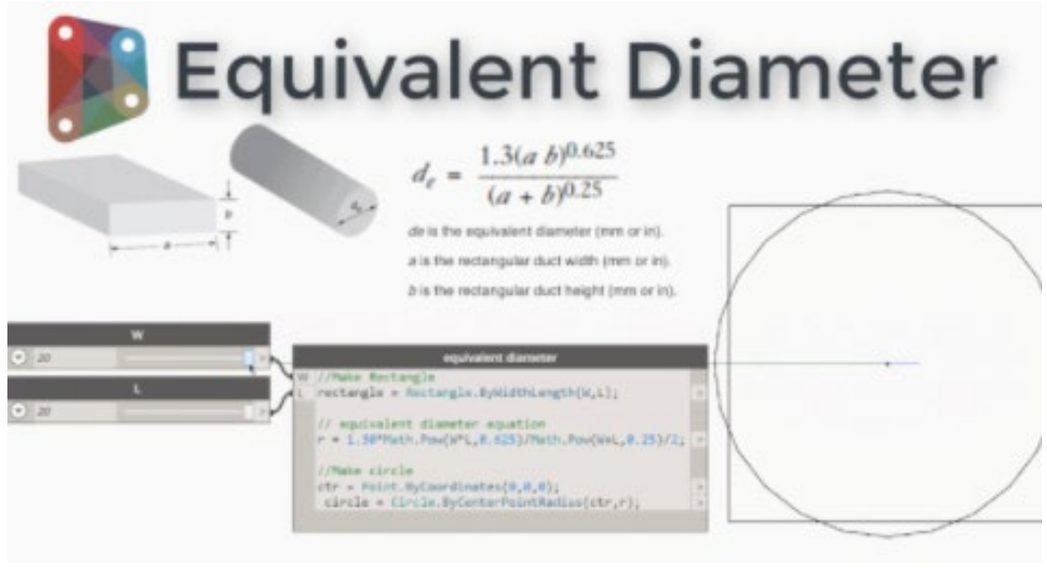
DesignScript is a novel language for exploratory design useful for compacting scripts and customizing functions in Dynamo

ORIGIN

Dynamo Team

REPO

https://github.com/DynamoDS/designscript-archive



USE CASE

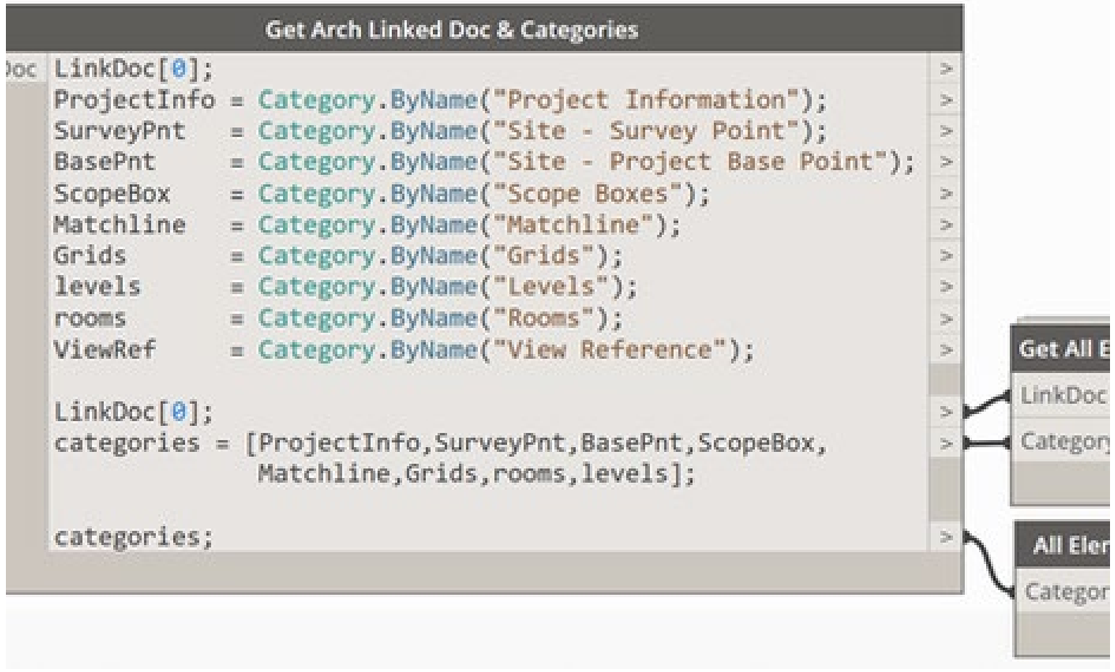
DesignScript enables a 'soft transition' between visual data flow programming and text based scripting by implementing a series of intermediate programming techniques. This provides a gentle learning curve which allows the gradual introduction of more advanced programming concepts and notation. DesignScript enables the pragmatic world of design automation and production to be connected to the world of computer science and algorithmic thinking.

MORE INFORMATION

https://primer.dynamobim.org/07_Code-Block/7-2_Design-Script-syntax.html

https://dynamobim.org/wp-content/links/DesignScriptGuide.pdf

http://www.designscript.io/



TITLE

Zero Touch Nodes

WHAT IS IT

Using C# code directly into your Dynamo Scripts

ORIGIN

Dynamo Team

REPO

https://github.com/DynamoDS

```
namespace ZeroTouchExample
{
    public class ZeroTouchExample
    {
        public static double MultByTwo(double inputNumber)
        {
            return inputNumber * 2.0;
        }
    }
}
```

USE CASE

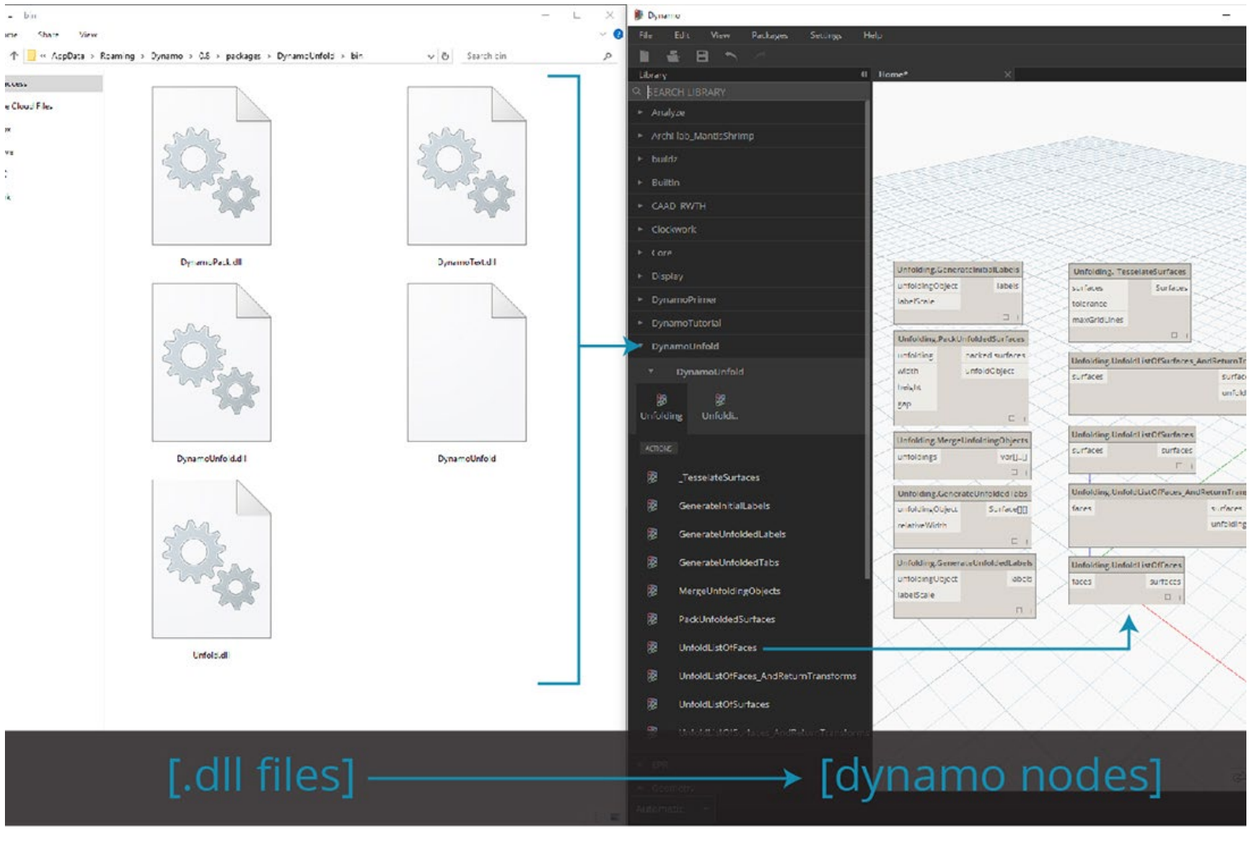
Zero-Touch Importing refers to a simple point-and-click method for importing C# libraries. Dynamo will read the public methods of a .dll file and convert them to Dynamo nodes. You can use Zero-Touch to develop your own custom nodes and packages, and to import external libraries into the Dynamo environment.

MORE INFORMATION

https://primer.dynamobim.org/11_Packages/11-5_Zero-Touch.html

https://developer.dynamobim.org/03-Development-Options/3-4-zerotouch-nodes.html

https://github.com/DynamoDS/Dynamo/wiki/Zero-Touch-Plugin-Development



TITLE

Python Node

WHAT IS IT

Using Python code directly into your Dynamo Scripts

ORIGIN

Dynamo Team

REPO

https://github.com/DynamoDS

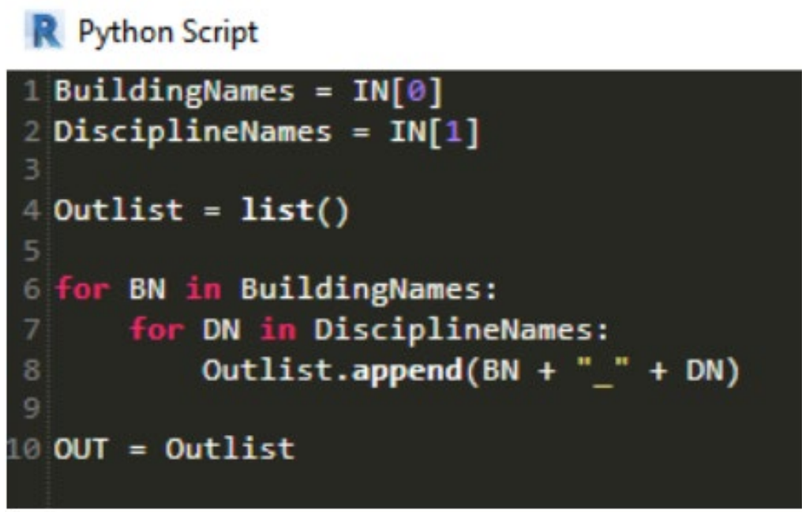
USE CASE

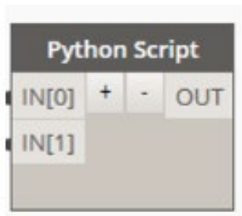
The plan behind the Dynamo Project is to widen the scope of platform implementation. As Dynamo adds more programs to the platform, users will gain access to platform-specific APIs from the Python scripting environment. While Revit is the case study for this section, we can anticipate more chapters in the future which offer comprehensive tutorials on scripting in other platforms. Additionally, there are many IronPython libraries accessible now which can be imported into Dynamo!

MORE INFORMATION

https://primer.dynamobim.org/10_Custom-Nodes/10-5_Python-Revit.html

https://github.com/Amoursol/dynamoPython





TITLE

Algorithms in Dynamo

WHAT IS IT

New improvements to the Dynamo software

ORIGIN

Dynamo Team and Developer Community

REPO

https://github.com/DynamoDS

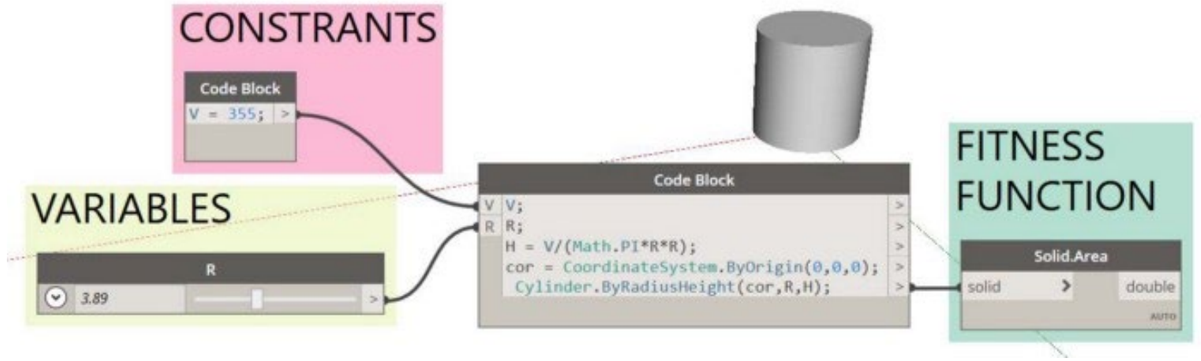
USE CASE

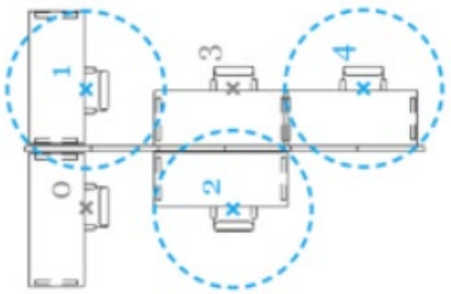
The use of algorithms provides a number of benefits. One of these benefits is in the development of the procedure itself, which involves identification of the processes, major decision points, and variables necessary to solve the problem. Developing an algorithm allows and even forces examination of the solution process in a rational manner. Identification of the processes and decision points reduces the task into a series of smaller steps of more manageable size. Problems that would be difficult or impossible to solve wholesale can be approached as a series of small, solvable subproblems. The required specification aids in the identification and reduction of subconscious biases. By using an algorithm, decision making becomes a more rational process.

MORE INFORMATION

https://www.referenceforbusiness.com/encyclopedia/A-Ar/Algorithms.html

https://dynamobim.org/occupancy/





Code Block

```
// Central point of a bounding box
// as projected to the specified z-height
def BoundingBoxCenter(bbox:var, z:var)
{
    minPt = BoundingBox.MinPoint(bbox);
    maxPt = BoundingBox.MaxPoint(bbox);
    x = (maxPt.X + minPt.X)/2;
    y = (maxPt.Y + minPt.Y)/2;
    return = Point.ByCoordinates(x, y, z);
};
```

TITLE

DynaWeb

WHAT IS IT

package providing support for interaction with the internet

ORIGIN

Radu Gidei

REPO

https://github.com/radumg/DynaWeb

USE CASE

DynaWeb was designed as a package to make other packages, so it provides building blocks enabling you to build Dynamo integrations with just about any web service out there. After making DynaSlack & DynAsana, it became clear that writing a ZeroTouch-based package for every web service I or the community would want to integrate with was simply not scalable or sustainable, no matter how much code was re-used. DynAsana is an abstracted DynaSlack and DynaWeb is an even more abstracted & modularised DynAsana.

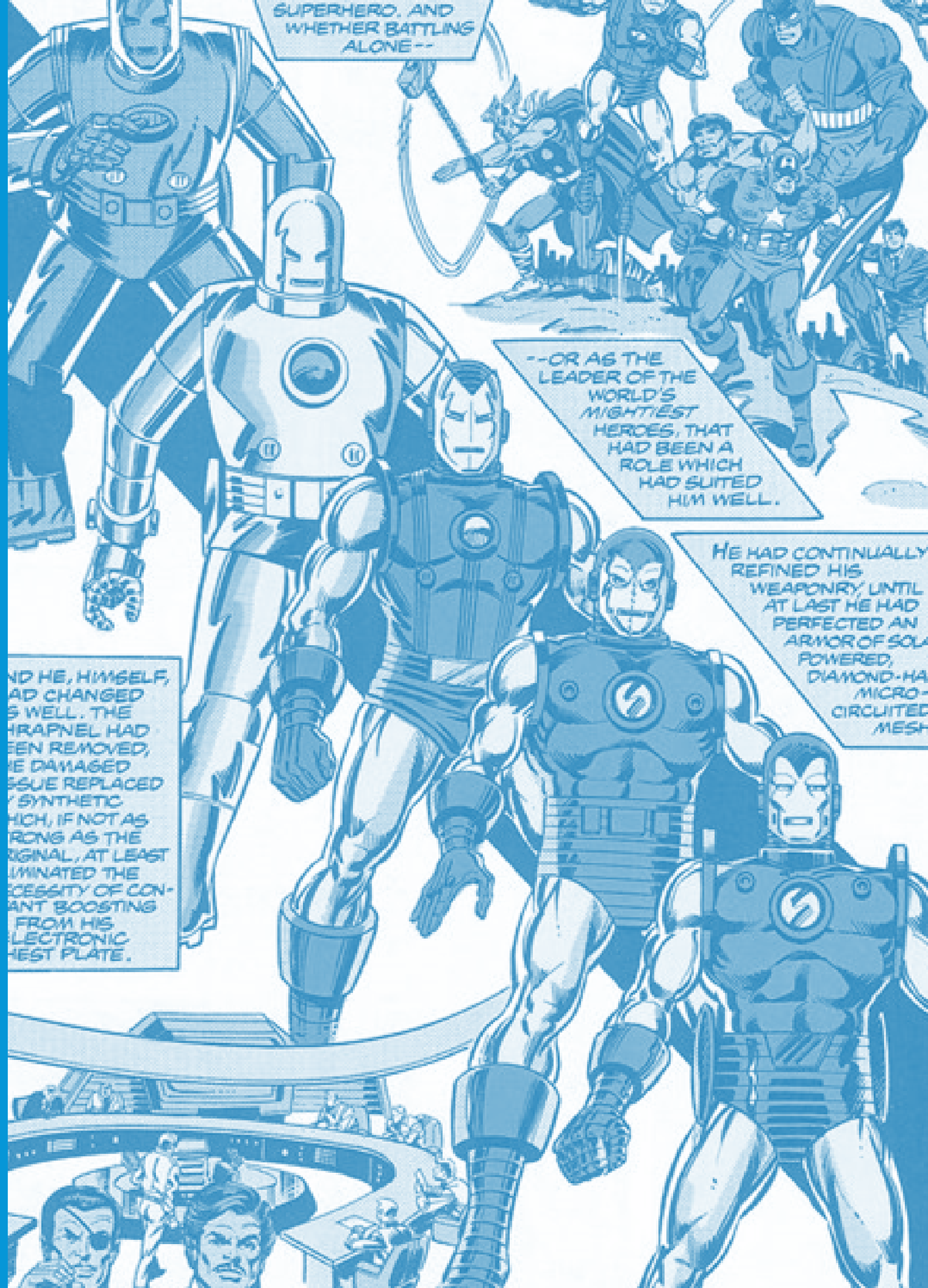
MORE INFORMATION

https://radumg.github.io/DynaWeb/

https://www.bim42.com/2020/07/dynaweb-1


```
{
 "id": "rec05TzOsAsrWLXD4",
 "fields": {
   "Code": "201",
   "Material": "Steel",
   "Width": 915,
   "Height": 2134,
   "Fire Rating": "3/4 Hours",
   "Level": "02 - Floor",
   "Frame Finish": "Polyester powder coated",
   "Doorstop": "Floor mounted door stop"
 },
 "createdTime": "2020-06-26T14:50:25.000Z"
}
```

UPGRADES


SUPERHERO, AND WHETHER BATTLING ALONE--
--OR AS THE LEADER OF THE WORLD'S MIGHTIEST HEROES, THAT HAD BEEN A ROLE WHICH HAD SUITED HIM WELL.
HE HAD CONTINUALLY REFINED HIS WEAPONRY UNTIL AT LAST HE HAD PERFECTED AN
ND HE, HIMSELF, AD CHANGED S WELL. THE HRAPNEL HAD EEN REMOVED, E DAMAGED SSUE REPLACED SYNTHETIC HICH, IF NOT AS RONG AS THE RIGINAL, AT LEAST LIMINATED THE CESSITY OF CON- ANT BOOSTING FROM HIS LECTRONIC HEST PLATE.

TITLE

Dynamo 2.8 And Beyond!

WHAT IS IT

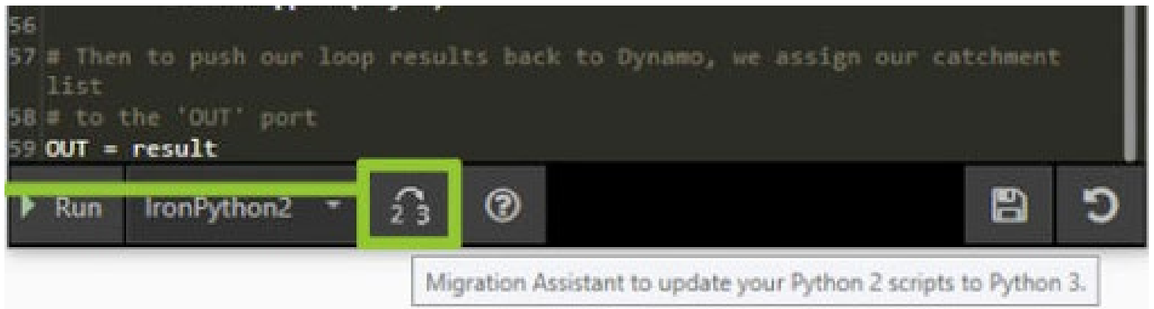
New improvements to the Dynamo Core software expanding the future of the software

ORIGIN

Dynamo Team

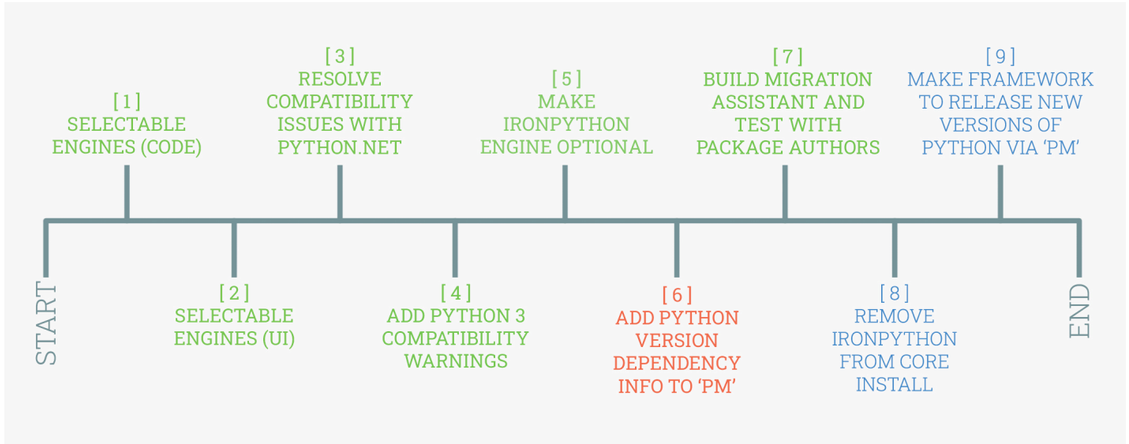
REPO

https://github.com/DynamoDS/Dynamo/releases



USE CASE

A slew of new features to improve and streamline the Python 3 experience, including better messaging, a migration assistant, more in-product help, whitespace characters, the ability to print to the Dynamo console, recognition of any potential missing IronPython2.7 engine native inside the Workspace References extension, a few targeted improvements to Geometry that allow greater control for the graph author on PolyCurves and NurbsCurves, as well as a respectable amount of bug and crash fixes that all make a much more stable and consistent Dynamo.



MORE INFORMATION

https://dynamobim.org/dynamo-core-2-8-release/

TITLE

Data Science Packages with Cpython

WHAT IS IT

Access popular python3 libraries with the Cpython interpreter

ORIGIN

Dynamo Team

REPO

https://github.com/DynamoDS

USE CASE

Simplifying workflows requiring data extractions from a model to analysis

MORE INFORMATION

https://dynamobim.org/dynamo-core-2-8-release/

https://jupyter.org/

https://numpy.org/

TITLE

DynaHub

WHAT IS IT

Dynamo Extension to interact with GitHub. Enable Dynamo to pull graphs from GitHub + version control

ORIGIN

Andrea Tassera

REPO

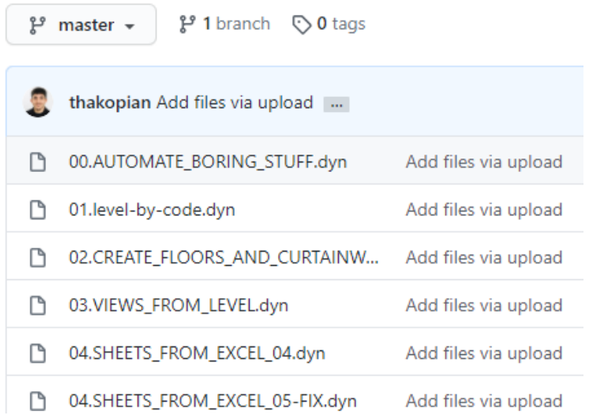
https://github.com/Dre-Tas/DynaHub

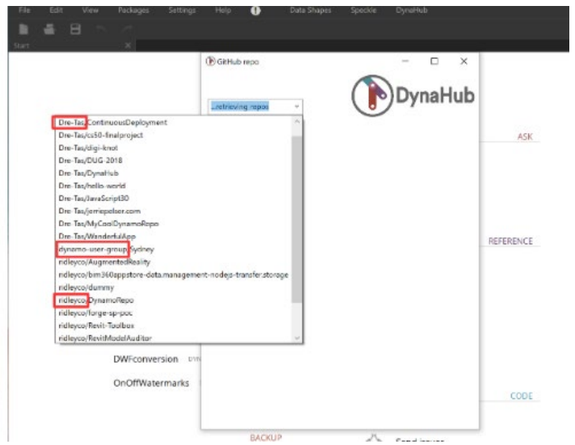
USE CASE

GitHub is widely used in software engineering for facilitating collaboration and consistency of code over time. However, it has never been applied in computational design. DynaHub—an open-source Dynamo extension that connects Dynamo to GitHub—bridges a gap by letting you push and pull automations and packages from a centralized and accessible repository. Any user or organization, through their GitHub account, can use the Dynamo scripts stored in their own repository, knowing that they are using the most recent and validated version.

MORE INFORMATION

https://www.autodesk.com/autodesk-university/class/Dynamo-GitHub-DynaHub-Adopting-New-innovative-Repository-Dynamo-Content-2019#handout





ROGUE(S)

TITLE

Hypar

WHAT IS IT

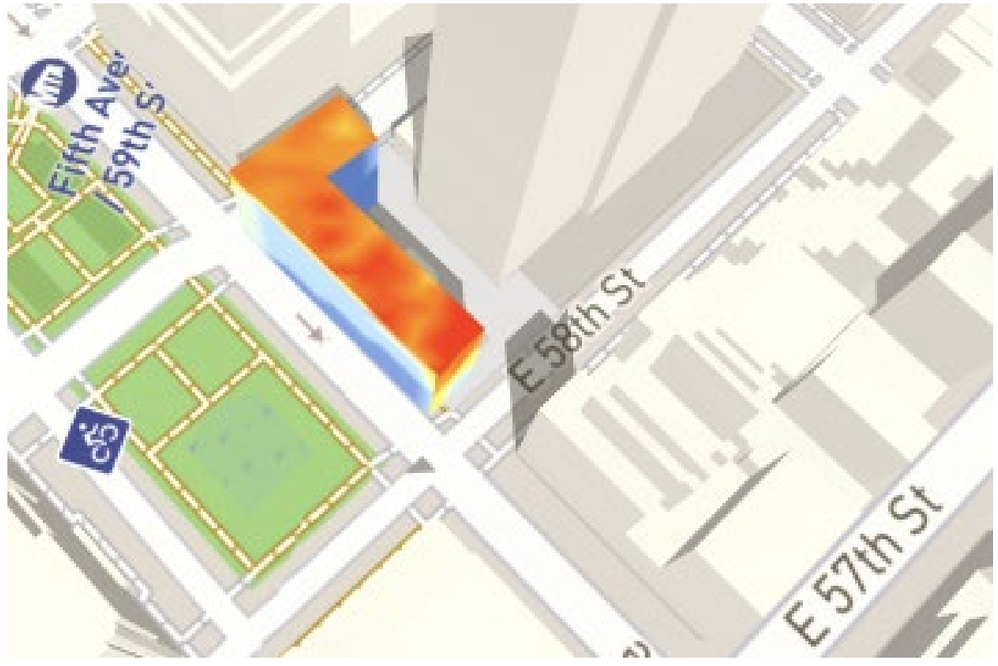
platform for designing, generating, and sharing building systems

ORIGIN

Hypar Team

REPO

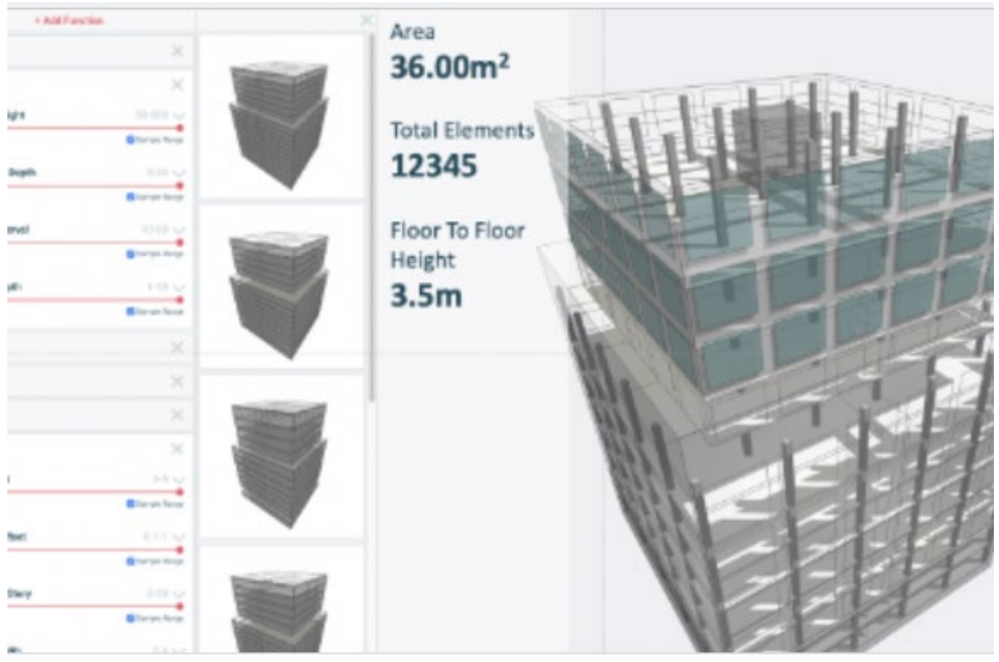
https://github.com/hypar-io



USE CASE

Platform to generate, visualize and analyze buildings to make better decisions faster. You can easily add your own processes and expertise so you don't start from square one with each new project.

Quickly generate proposals by combining different building systems that intelligently interact. Include analysis and simulation tools created by industry experts to predict and drive performance. Take designs from concept to construction, system by system.



MORE INFORMATION

https://www.autodesk.com/autodesk-university/class/White-Blank-Page-MEP-Conceptual-Design-Dynamo-and-Hypar-2019#presentation

TITLE

Proving Grounds

WHAT IS IT

Enterprise customization with open source tools

ORIGIN

Proving Grounds team

REPO

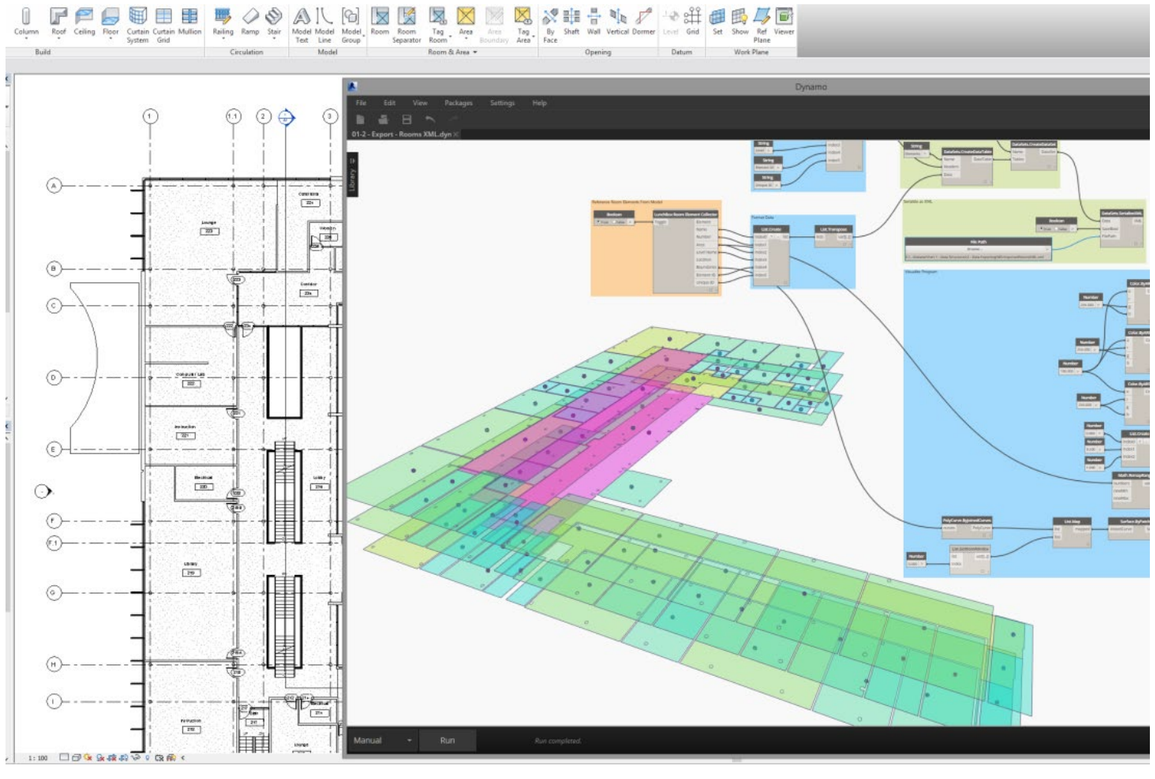
https://provinground.io/tools/

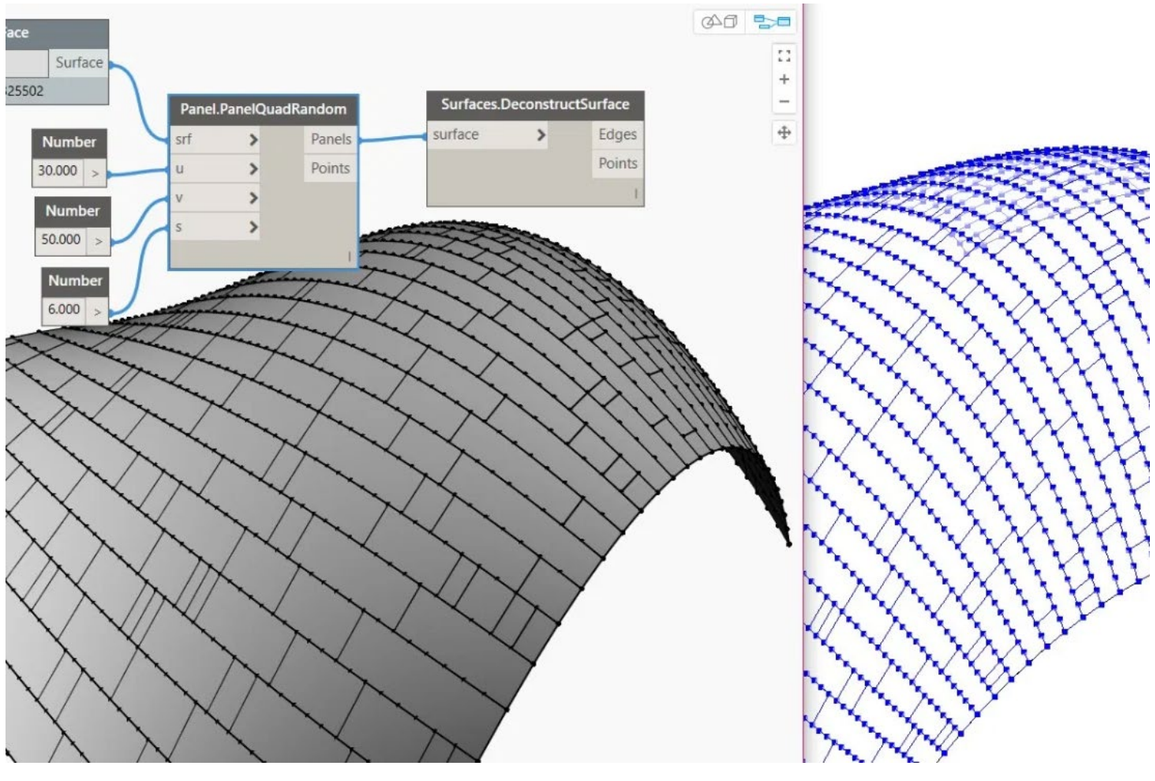
USE CASE

The plugins include new component nodes for managing data and geometry for activities such as generative form making, paneling, rationalization, and interoperability

MORE INFORMATION

https://provinground.io/tools/





TITLE

TestFit IO

WHAT IS IT

A generative design and co-creation tool that allows a user to get a site TestFit in seconds for multifamily development.

ORIGIN

TestFit team

REPO

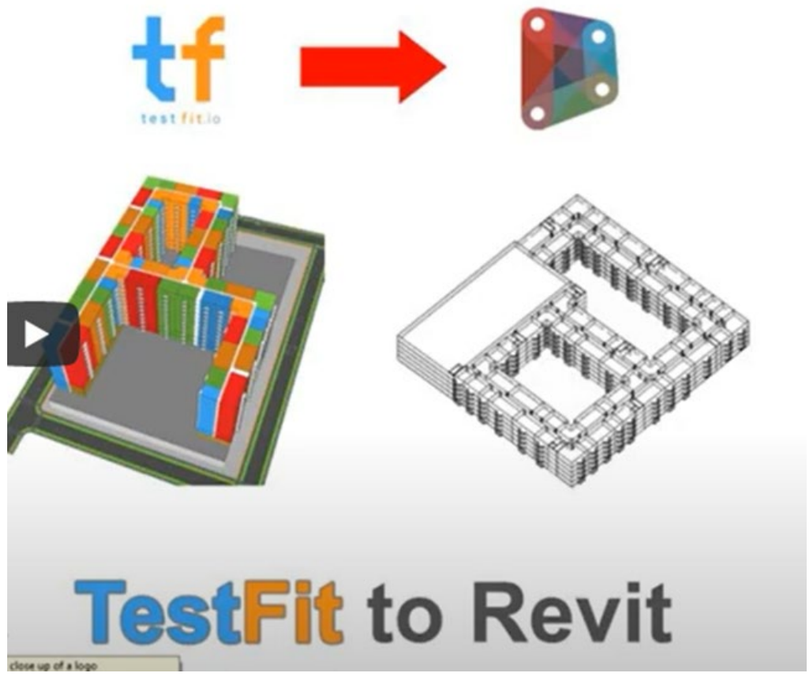
https://blog.testfit.io/testfit-home

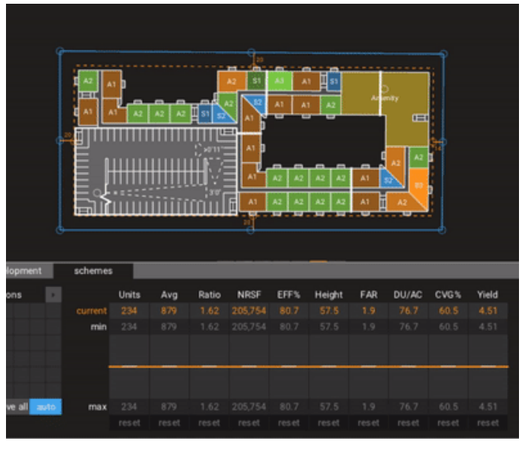
USE CASE

TestFit users are architects, brokers, contractors, developers, or anyone wanting to do feasibility studies.

MORE INFORMATION

https://provinggground.io/tools/





TITLE

PyRevit

WHAT IS IT

Rapid Application Development (RAD) Environment for Autodesk Revit

ORIGIN

Ehsan Iran-Nejad

REPO

https://github.com/eirannejad/pyRevit

USE CASE

pyRevit (with lowercase py) is a Rapid Application Prototyping (RAD) environment for Autodesk Revit. It helps you quickly sketch out your automation and addon ideas, in whichever language that you are most comfortable with, inside the Revit environment and using its APIs. It also ships with an extensive set of powerful tools that showcase its capabilities as a development environment.

MORE INFORMATION

https://www.youtube.com/c/pyRevit/playlists

https://www.notion.so/pyRevit-bd907d6292ed4ce997c46e84b6ef67a0

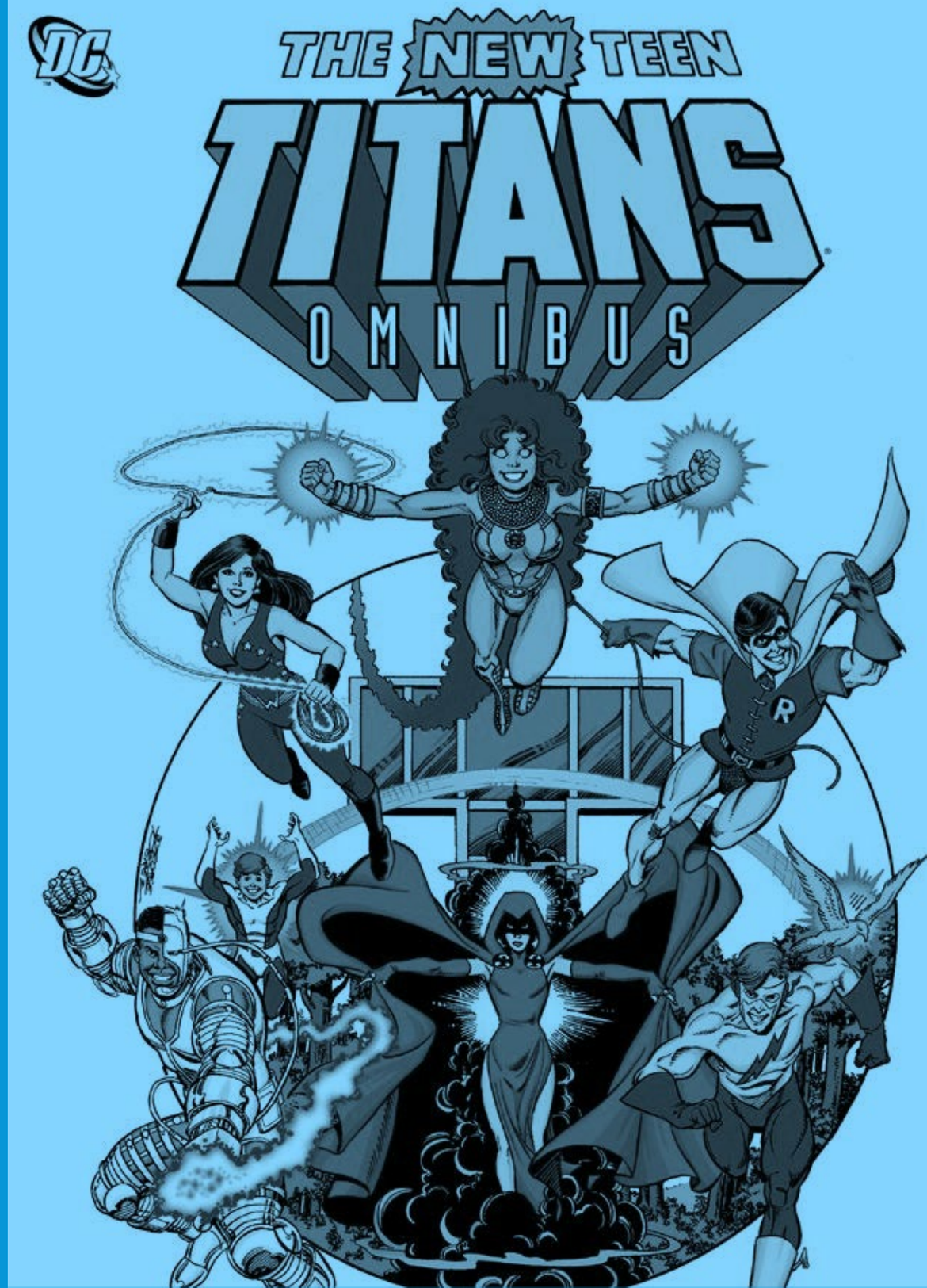
Open Project on Github

Open Revision History Page

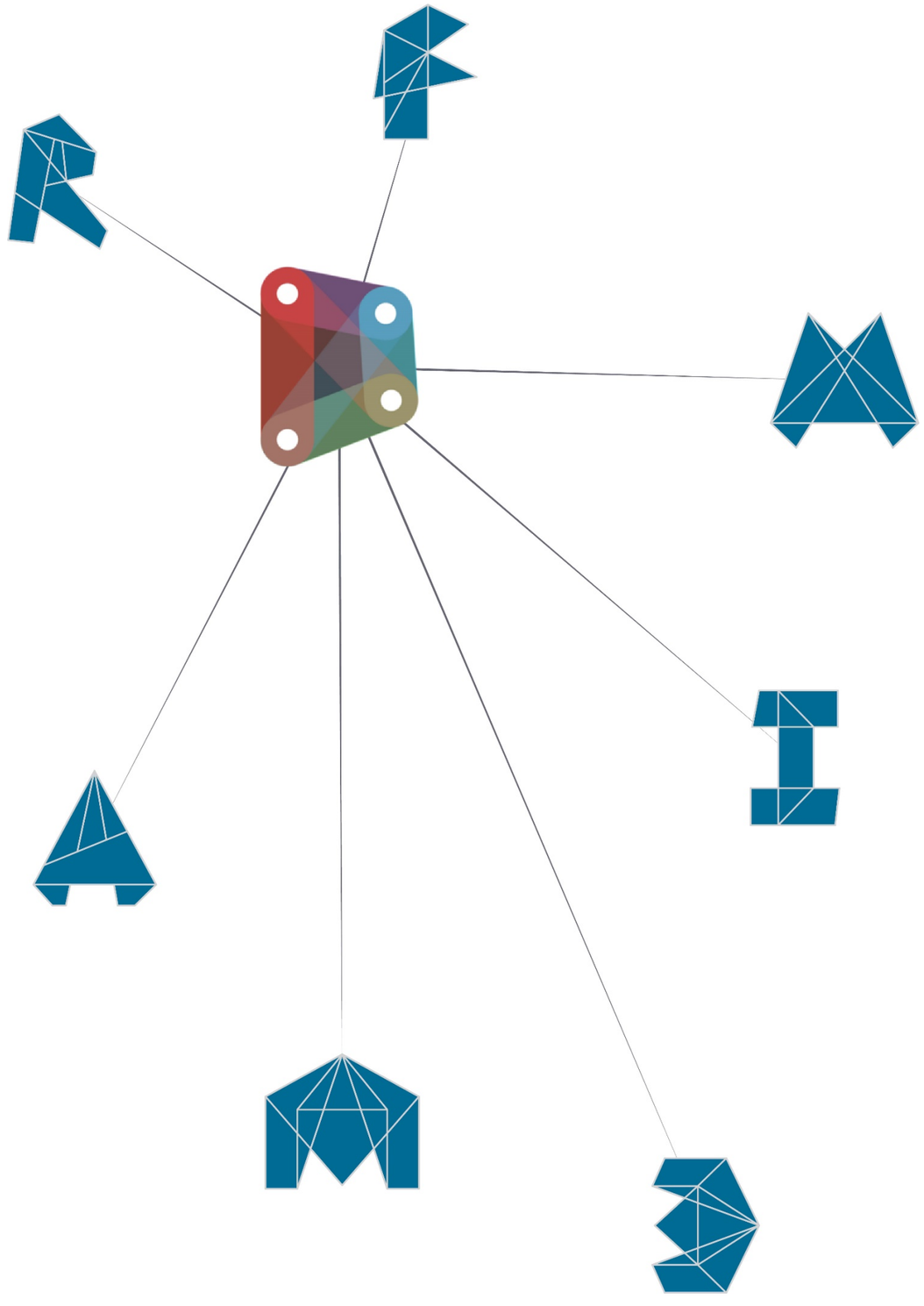
Credits

</> with ♥ in Portland, OR

NEW HEROES



CONNECTING THE SERVICES



WHAT IS AVAILABLE NOW

DYNAMO SANDBOX

FORMIT

DYNAMO REVIT

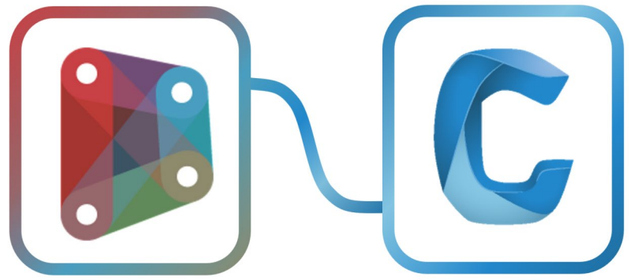
DYNAMO STUDIO

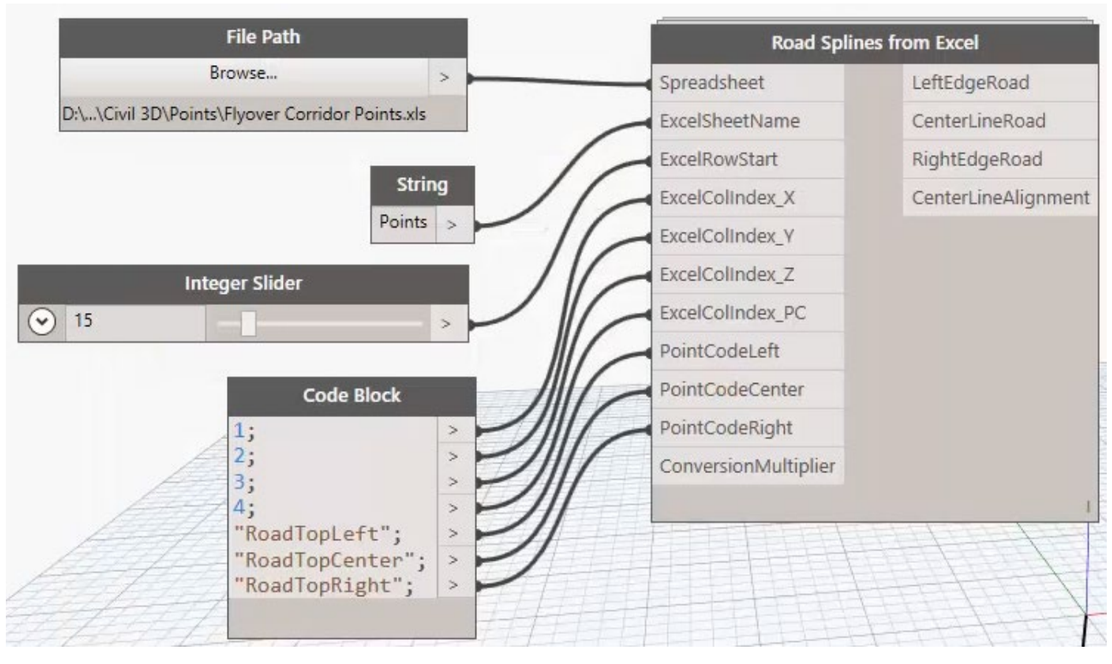
Civil 3D

ADVANCE STEEL

ALIAS DESIGN

More coming soon!





WHAT MIGHT BE POSSIBLE… TO BE CONTINUED

unity

AUTODESK
FORGE®

UNREAL
ENGINE

Node-RED

SPECIAL THANKS

EVERYDAY HEROES – PACKAGE MAKERS

All the workhorse packages, Contributors and the Dynamo team who are the real heroes!

- Archi-lab
- Bang!
- Parametric Monkey
- Clockwork
- Data-Shapes
- Juggernaut
- Lunchbox
- Monocle
- Rhythm
- Springs
- Simplex
- And Many More!

List of packages
https://www.autodesk.com/autodesk-university/class/Dynamo-Packages-Have-You-Tried-These-Yet-2018#presentation

THE DYNAMO TEAM

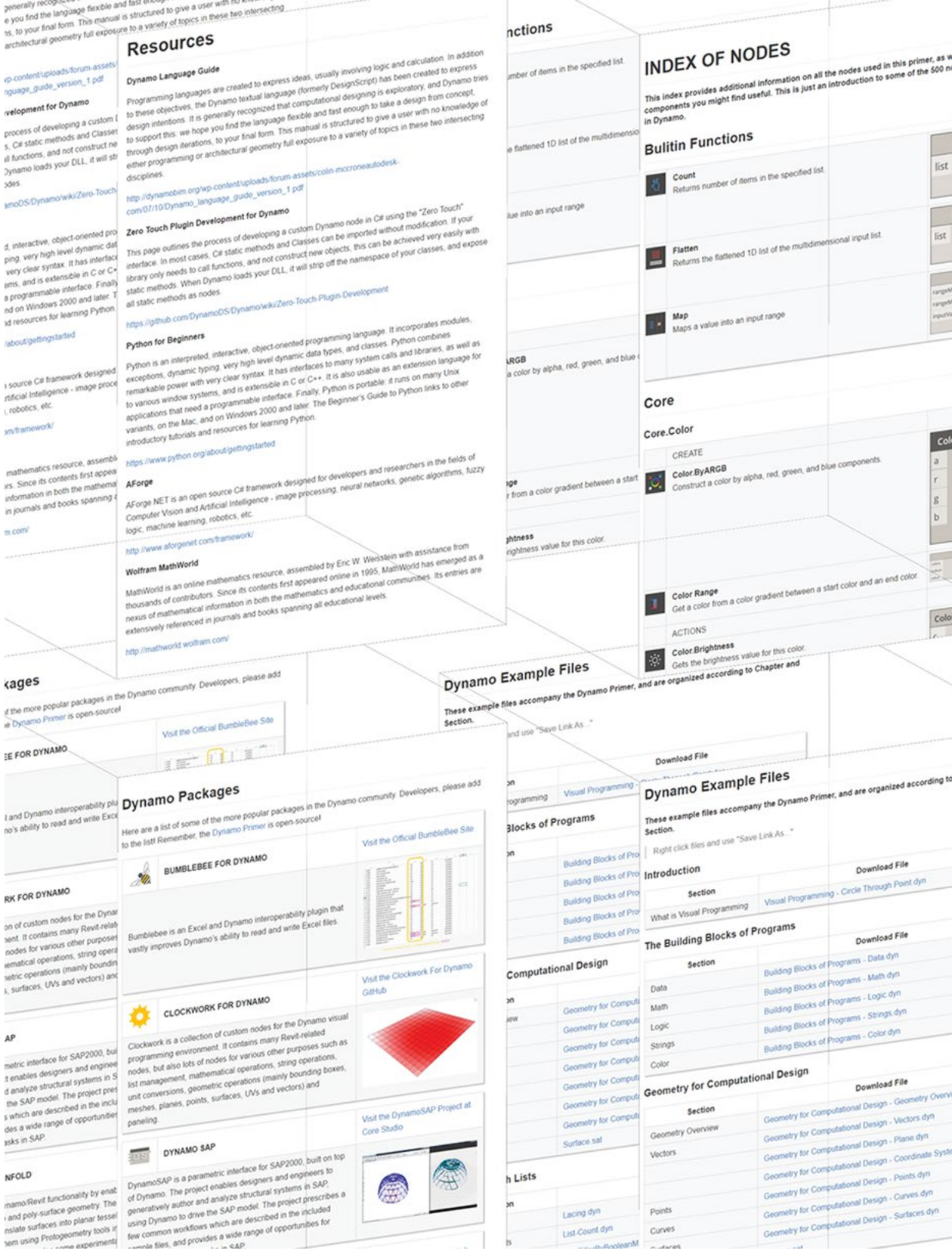
A very special thanks to the Dynamo Team at Autodesk for improving their product and supporting the community

Not all heroes wear capes

KNOWLEDGE

USE THE PRIMER!

- It’s a great resource for learning Dynamo and covers just about everything
- Dynamo is a journey of a 1000 nodes that begins with your first step
- Learn more and try things out
- Create your own open source package and share them
- Improve the existing software available
- Share what you are doing and being supportive of others
- Spread the knowledge!



The next hero could be you!

CONTACT INFORMATION

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Github: https://github.com/thakopian

AUTODESK