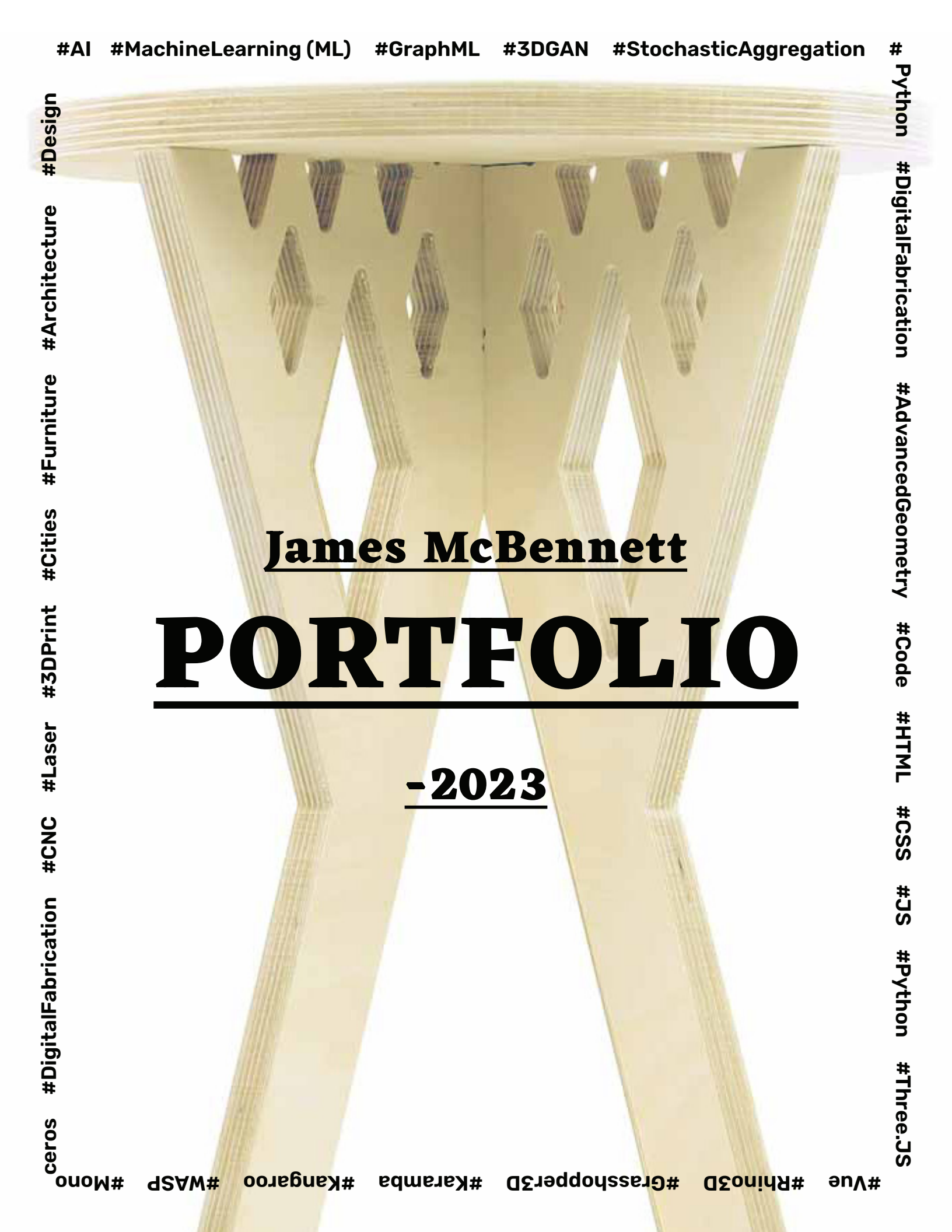
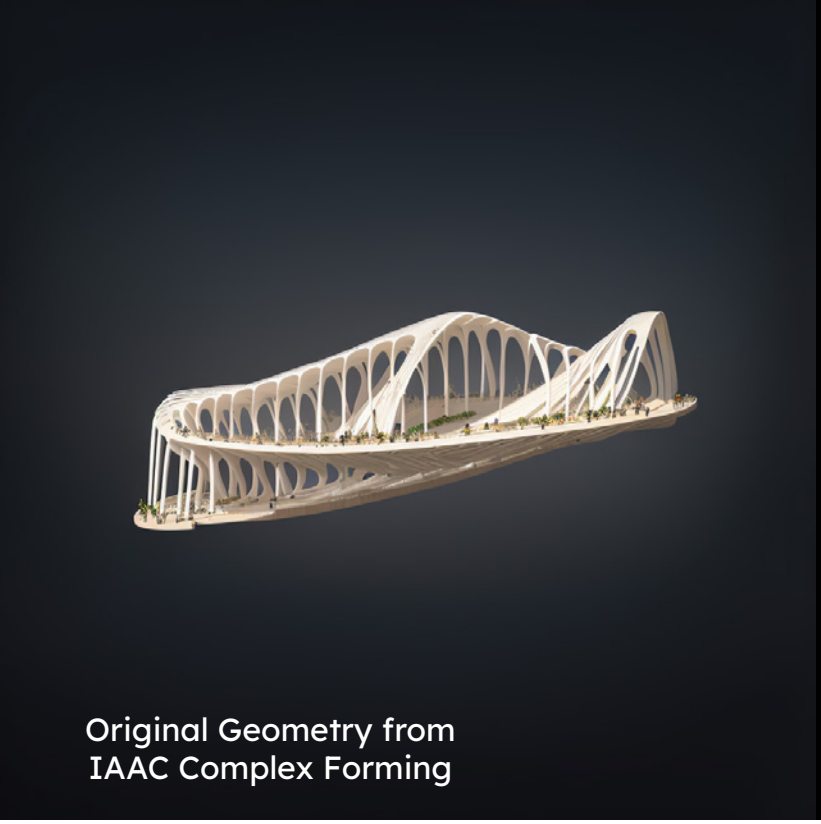
#AI #MachineLearning (ML) #GraphML #3DGAN #StochasticAggregation #Python #DigitalFabrication #AdvancedGeometry #Code #HTML #CSS #JS #Python #Three.JS #Vue #Rhino3D #Grasshopper3D #Karamba #Kangaroo #WASP #Monoceros #DigitalFabrication #CNC #Laser #3DPrint #Cities #Furniture #Architecture #Design



James McBennett

PORTFOLIO

-2023

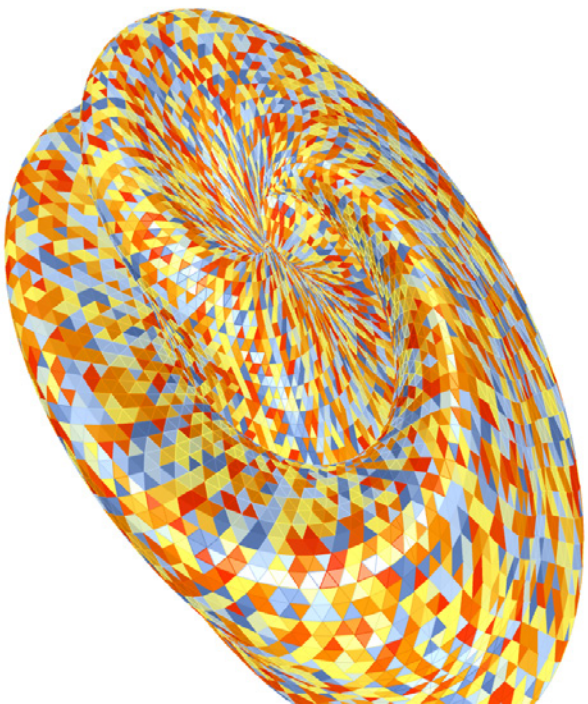


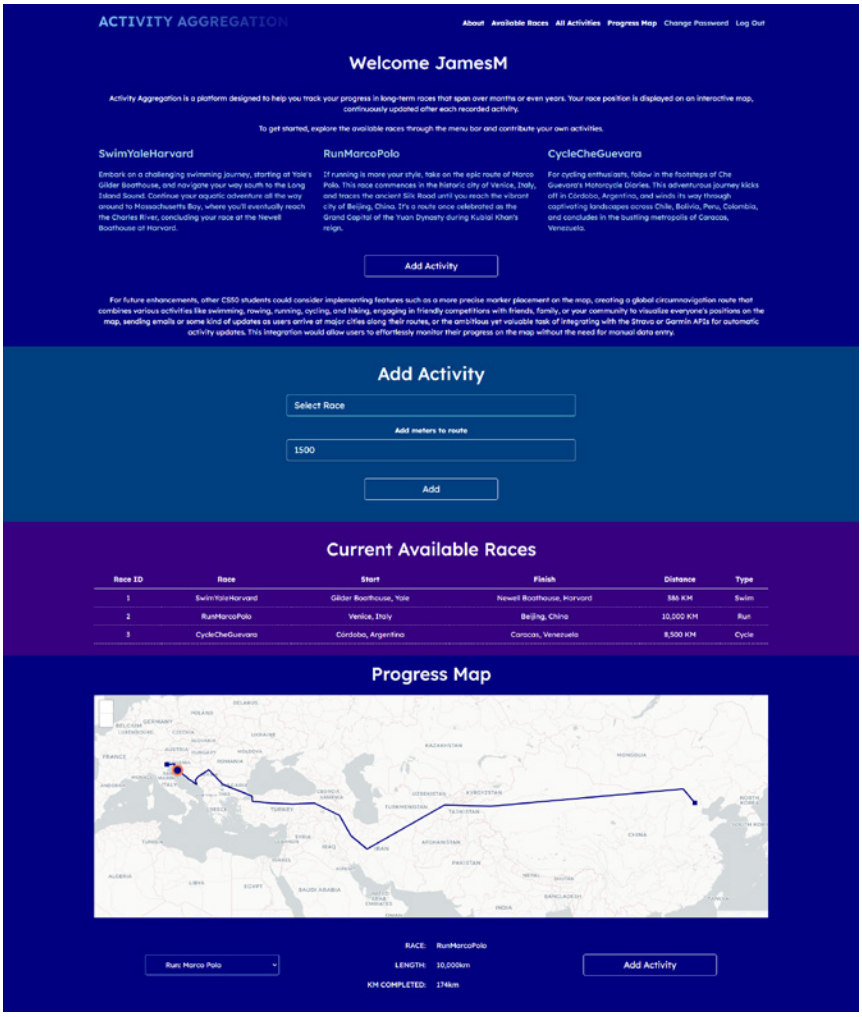
Original Geometry from
IAAC Complex Forming

Workshop

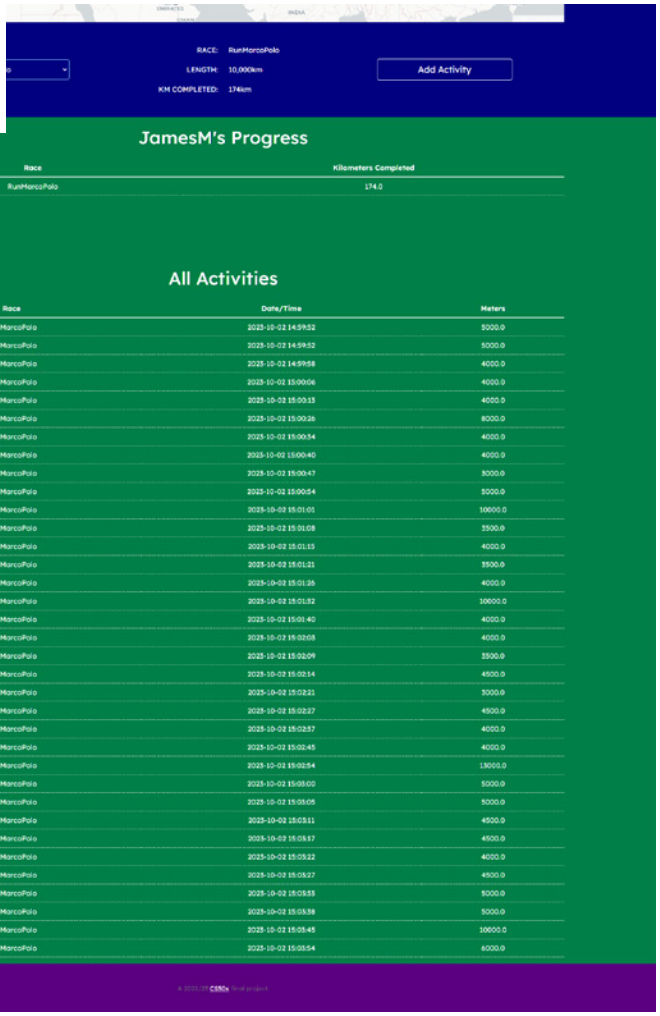
Stable Diffusion NeRF, Gaussian Splats

Taught by George Guida, Daniel Escobar, Carlos Navarro





CS50x



C, Python, Flask, HTML, CSS, SQL

Final Project: Activity Aggregation

A Flask-based website with an SQL database, enabling users to register accounts and log their recent running, swimming, and cycling activities. The platform aggregates these entries to show a user's position in a leaflet. js map on epic journeys such as Marco Polo's historic route on the Silk Road from Venice to modern-day Beijing or Che Guevara's legendary Motorcycle Diaries journey through South America. Potential upgrade would be connecting to Strava's API for automatic activity tracking.

WEB GRAPH ML

IAAC MaCAD 2022/23 Thesis

by Ren Rainville & James McBennett

Thesis Advisor: David Andrés León

Special thanks to David Andrés León, Justyna Szychowska, Dai Kandil, Sara Kessba, and Lucas Sentis Fuster.

This thesis focuses on using graph machine learning (GML) for node and edge classification on the web. Users outline their building geometry using the leaflet.js map below that is then processed using Rhino.Compute and a trained graphSAGE model. The result is returned and displayed in Three.js. The example below uses this methodology for ***PREDICTING EGRESS FOR MULTI-STORY RESIDENTIAL BUILDING***

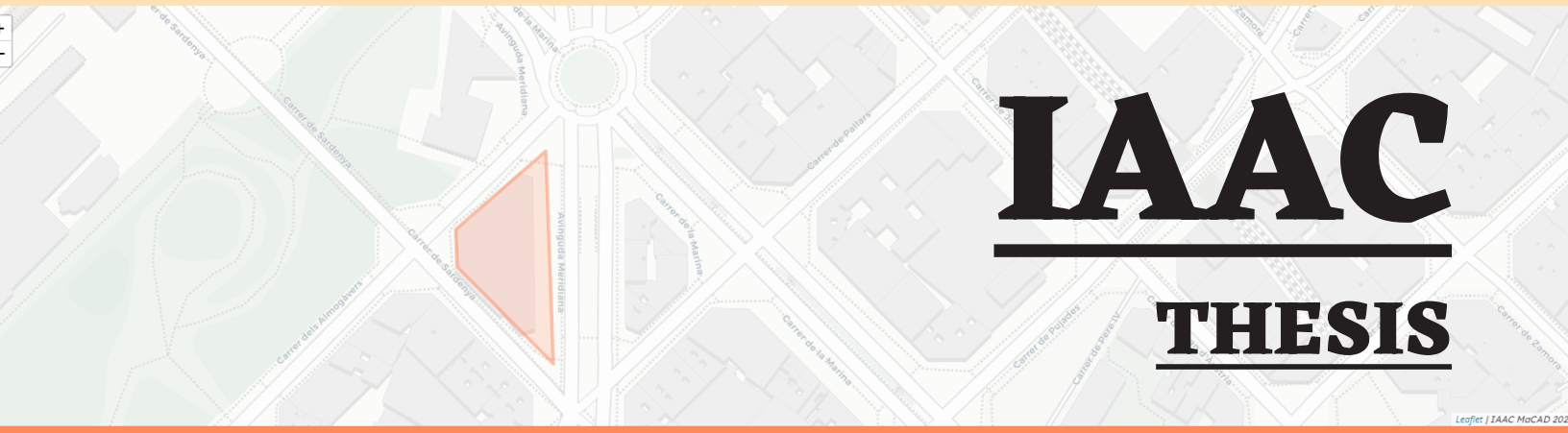
We have applied knowledge gained from two ***IAAC MaCAD 2022/23*** *courses.*

CLOUD-BASED DATA MANAGEMENT *emphasized front-end development using HTML, CSS, and JavaScript to interface with Rhino.Compute to control Rhino3D or Grasshopper3D geometry within a web browser.*

GRAPH-MACHINE LEARNING *utilized graphs composed of edges and nodes to represent buildings. Machine learning techniques were employed to train a model for predicting node and edge classification.*

THESIS

Barcelona, Spain | Search



Thesis | Linear Building | Courtyard Building | Delete Building | - 3 + Floors | Single / Double Corridor

COURTYARD BUILDING

[22.709508516496847, 54.144838039332384]
[-25.170637518284682, 12.529384009101708]
[-24.27568151763456, -7.6071260055260375]
[26.736810519422395, -59.067096042908055]

This button sends a JSON containing your inputs to the backend. JSON is a lightweight data storage interchange format that uses key-value pairs.

CALCULATE GRAPH

Load times may take up to 1 minute. Longer requests are currently not allowed.

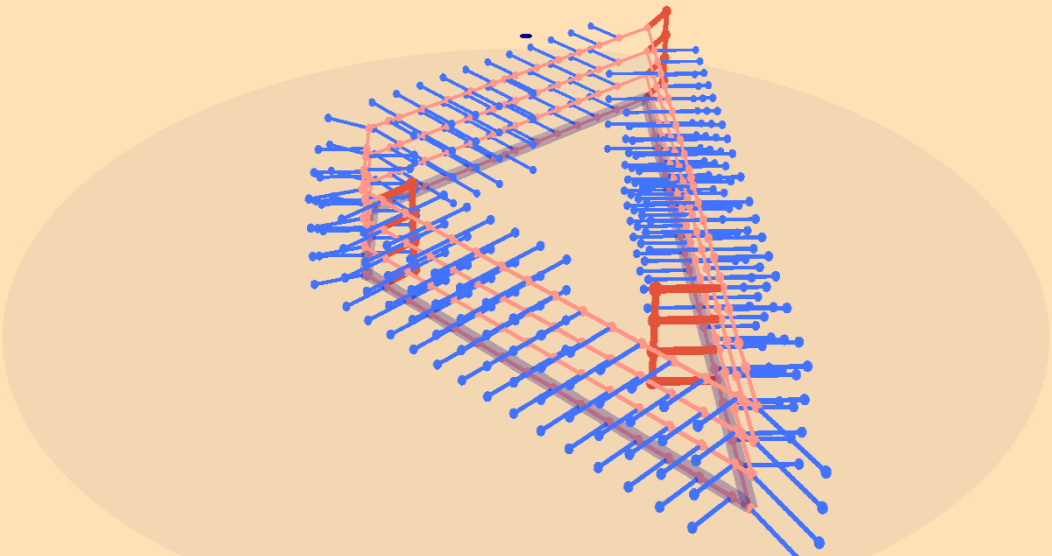
It will return another JSON containing all of the nodes and edges, each classified as Units, Egress, or Corridor. A graph is displayed below built in three.js using this data.

Units Egress Corridor

Input Geometry Ground Plane North

Estimated Longest Dimension: 104 meters

Scroll page along edges



IAAC

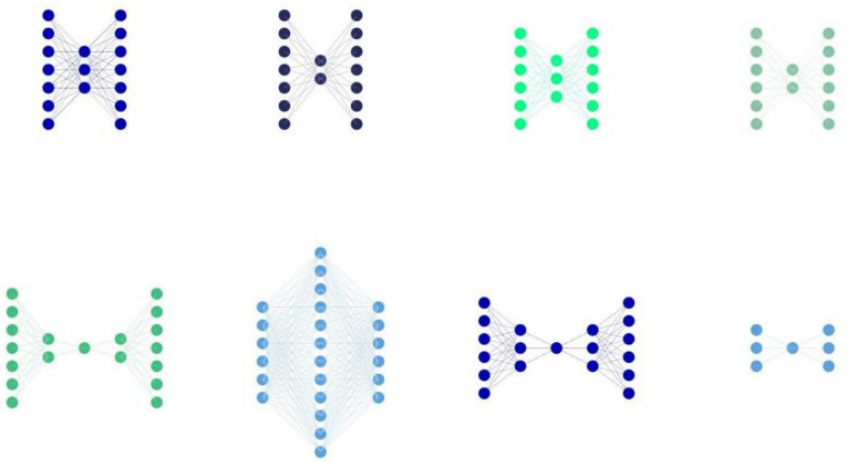
MISSISSIPPI 2102

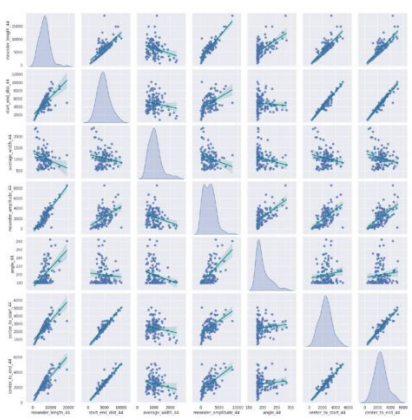
Data Encoding / Machine Learning

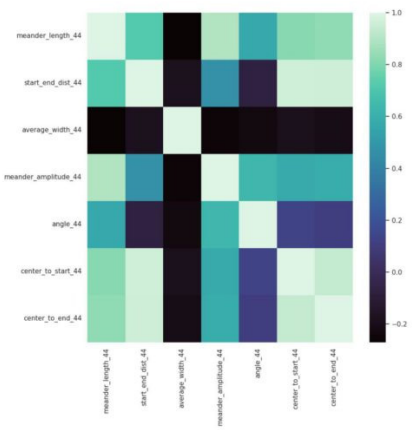
2023

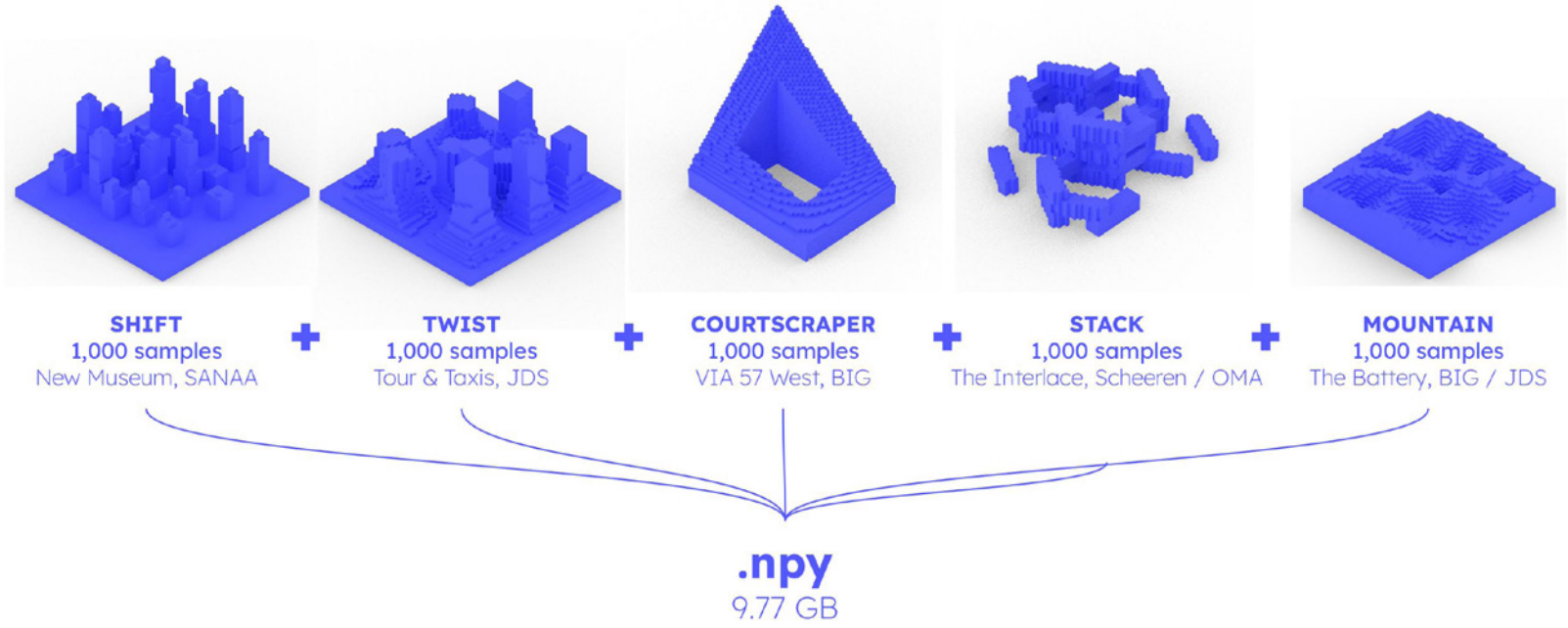
With JANA SEMAAN
Taught by GABRIELLA ROSSI

Harold Fisk's 1944 map series of the Lower Mississippi was combined in a dataset with the latest river path from Google Maps to predict the Mississippi's course in 2102.





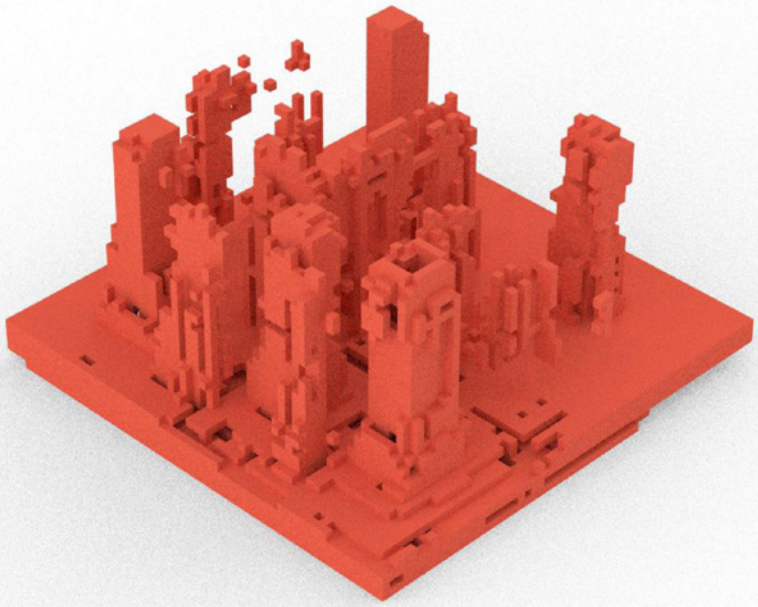




ALL-NIGHTER vs. 3DGAN
Generative Planning

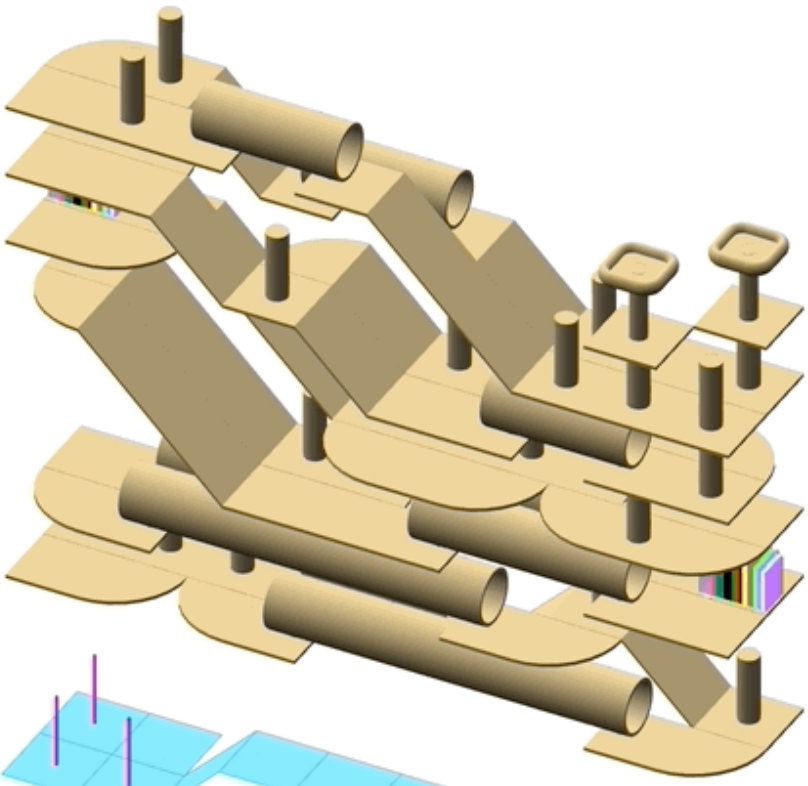
With LUCAS SENTÍS FUSTER
Taught by OANA TAUT

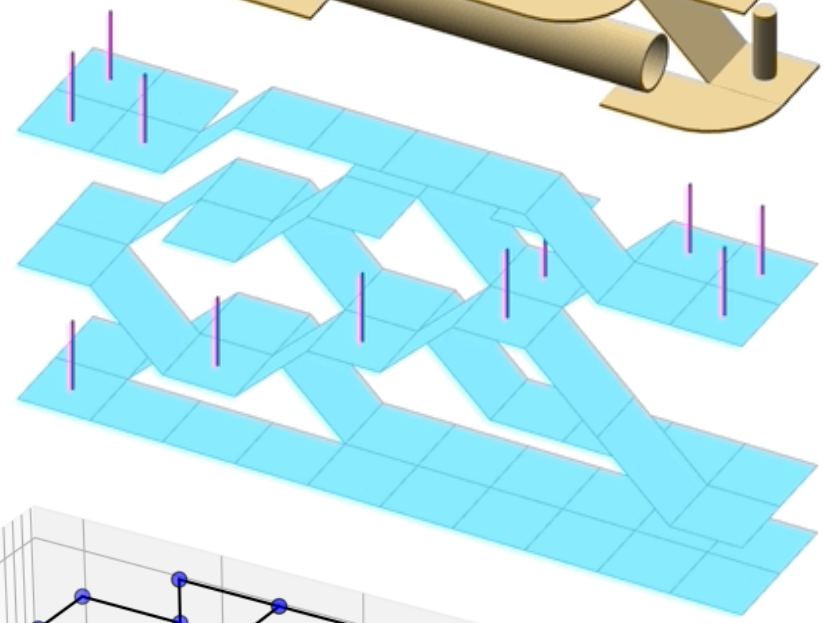
We asked ourselves what kind of architecture is the most suitable for AI? The Superdutch was our conclusion as it is already reduced to diagrams and blue foam models suitable for brute force prototyping and variation. Five design series were created, each with 1,000 samples. These samples were converted to voxels using a grid of 64 x 64 x 64. Various models were trained both with a single series and a combined series, then the interpolation of latent space of these various models was explored.

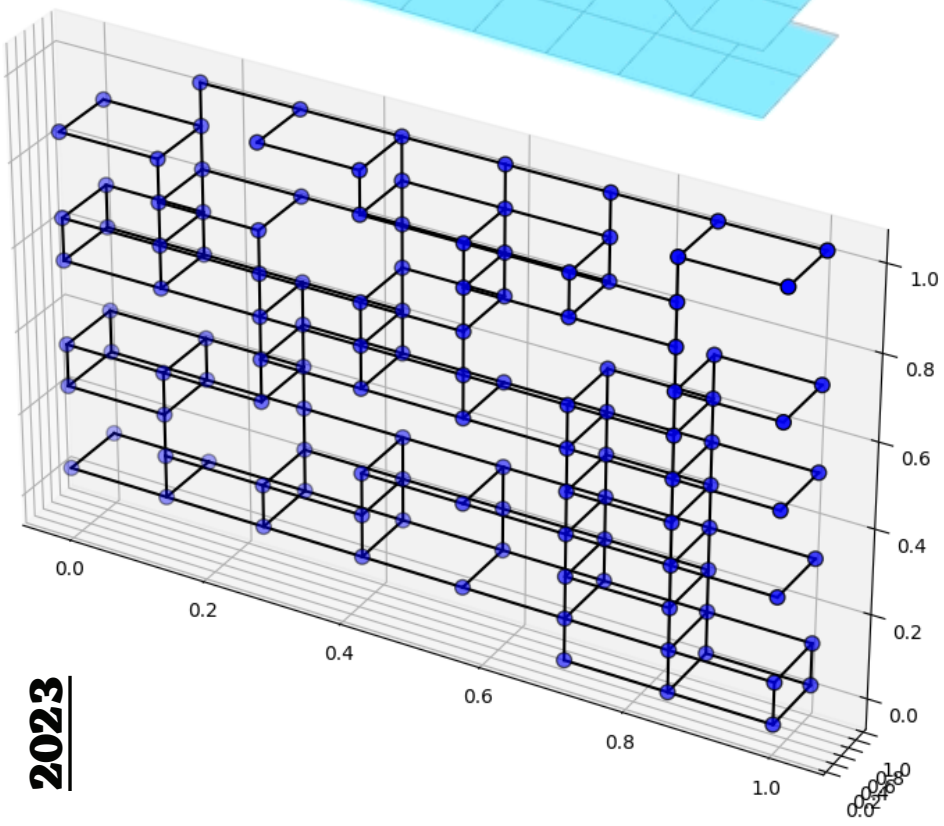


IAAC

2023







CATS & BOOKS

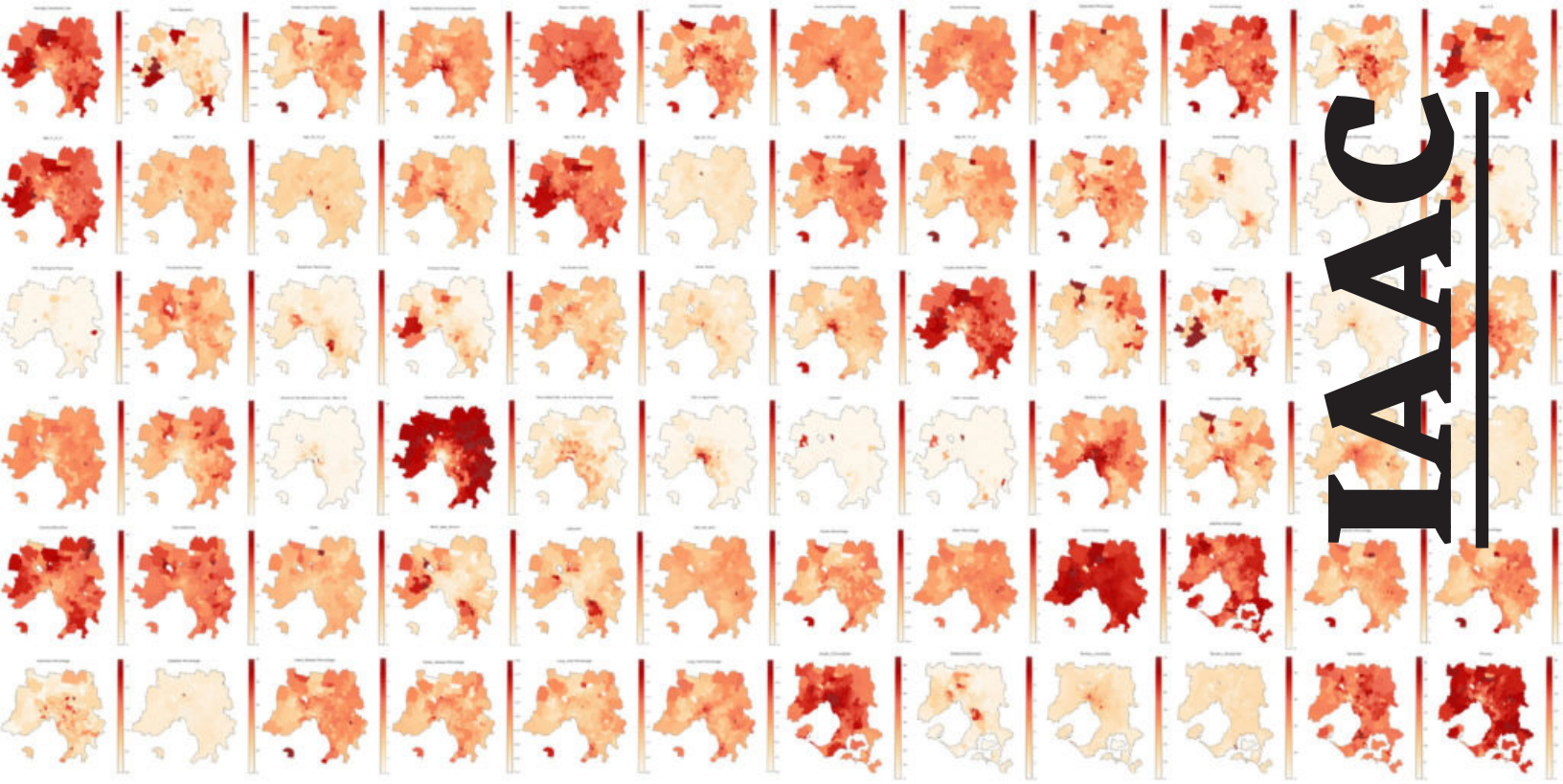
Graph Machine Learning

With ANTON KLYSHNIA
Taught by DAVID ANDRES LEON and DAI KANDIL

We created a hybrid bookshelf and cat climber using the Monoceros plugin (WFC) and tested if Graph Machine Learning could short circuit the long calculation time. Displacement from Karamba3D was taken for classification. 1,000 samples were created and classified into good, moderate, and bad, then grouped into training (600), validation (200), and test graphs (200). A model was trained over 10,000 epochs but unfortunately the samples were too biased with structural failures to find success.

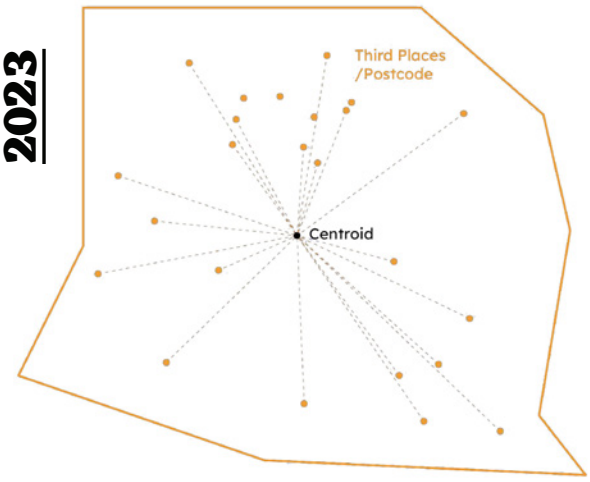
IAAC

2023



IAAC

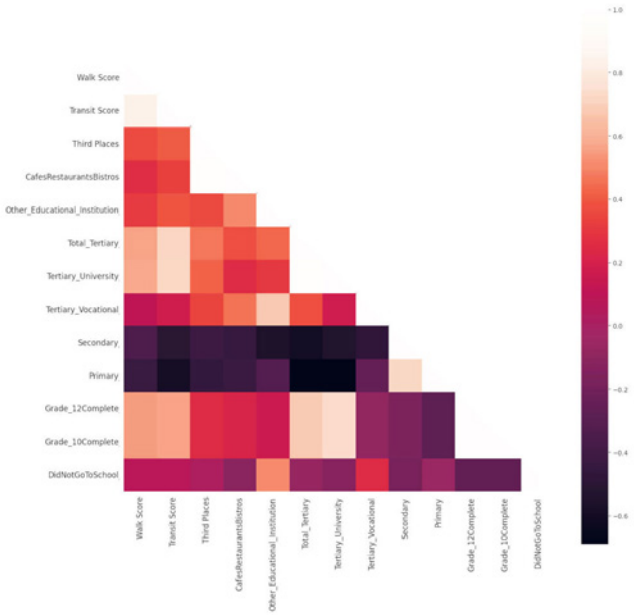
2023

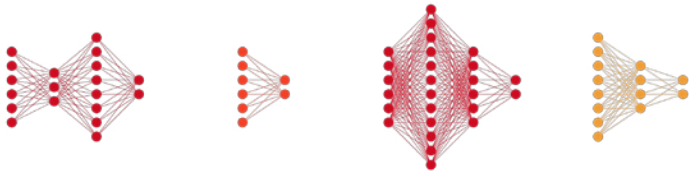


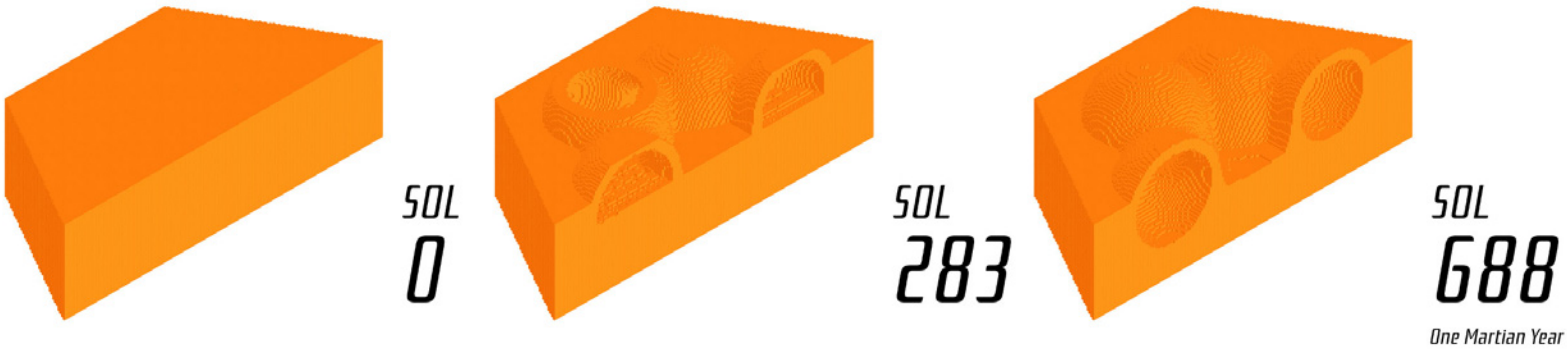
LONELINESS IN GREATER MELBOURNE Studio

With JANA SEMAAN, SANJANA CHAGANTI AND SARA KESSBA
Taught by ANGELOS CHRONIS

There are different types of loneliness, each with different causes. One type that is common in suburbanized cities with aging populations is the result of citizens who no longer have places to connect. Third places such as cafes, restaurants, clubs, religious spaces, and libraries provide a space for connection. Our project analyzes Greater Melbourne's postcodes for their success or failure at providing adequate third spaces and shows failing postcodes and how they might improve.







IAAC

MARS HABITAT

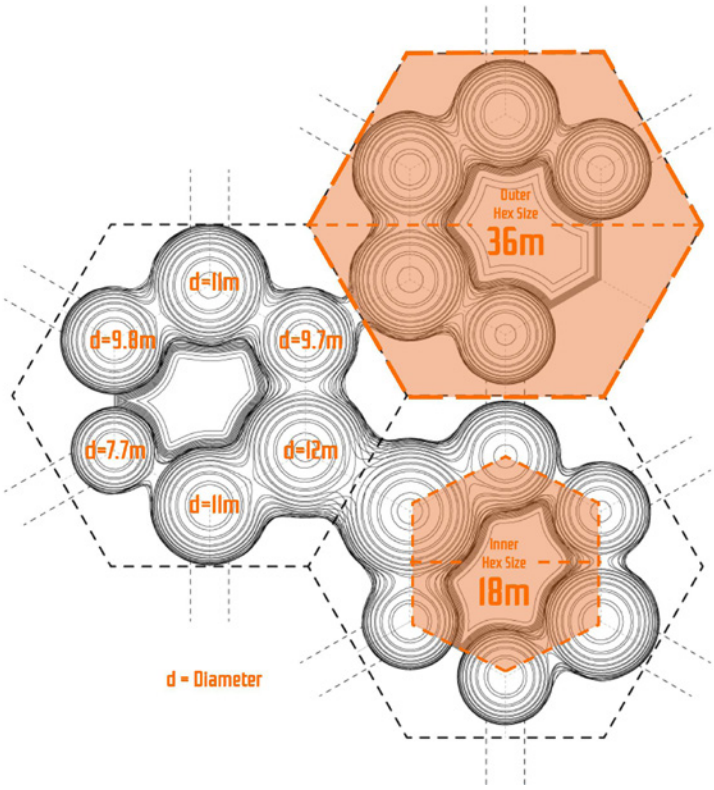
Studio

With REN RAINVILLE AND RAGHAD HAMMOUR

Taught by GERMAN OTTO BODENBENDER and OLIVER THOMAS

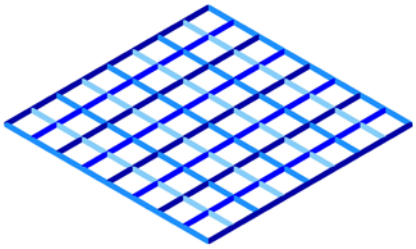
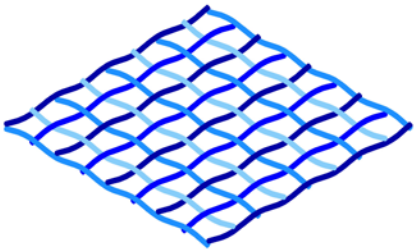
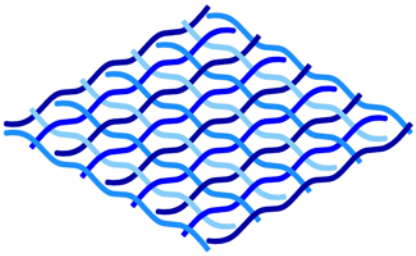
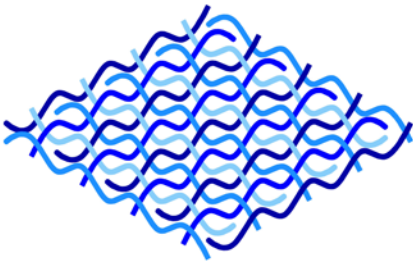
Mine(Us) Plus focuses on the temperature difference 2m above the Martian ground surface versus 2m below. The cost of heating accommodation on Mars above ground is astronomically high. Therefore, we partially bury our project underground balancing the energy costs of digging down with the energy costs of building up. Before any human mission, hexapod robots travel to Mars to subtractively carve space below, carrying material to 3D print above resulting in a metaball spherical geometry.

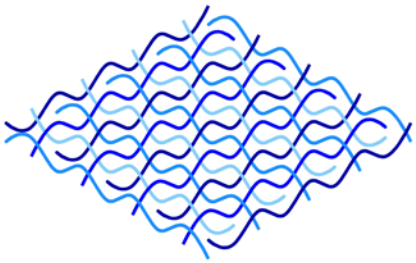
/imagine astronaut feeling cold, zoom out, full body, linoprint, black and white, 30mm, 4k, –ar 3:2



68
Inhabitants

2023



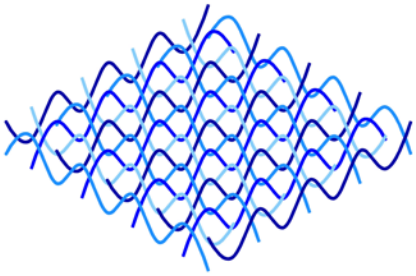
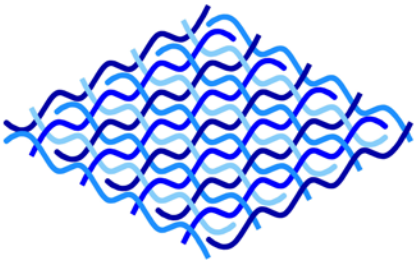
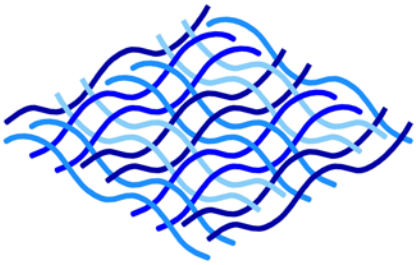
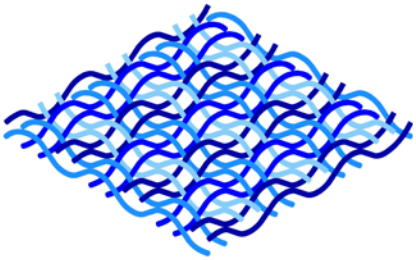
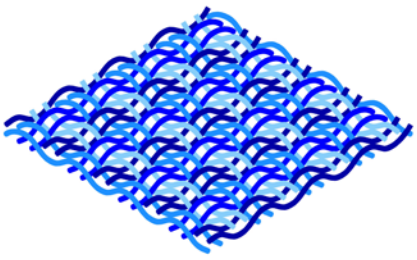
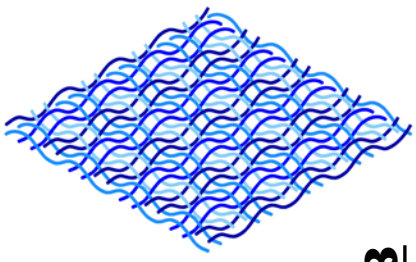
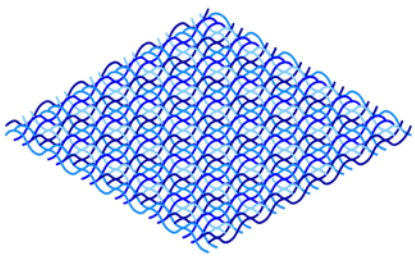
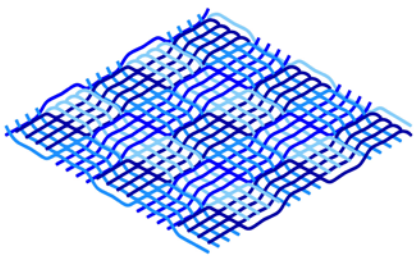
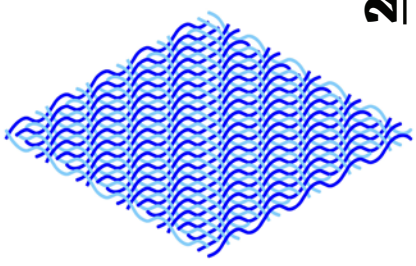
IAAC

WEAVING IN HOPS

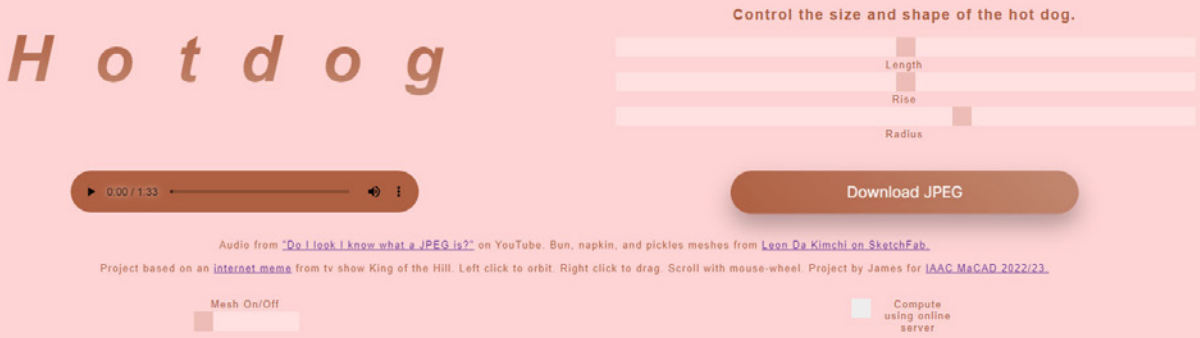
Cloud-Based Data Management

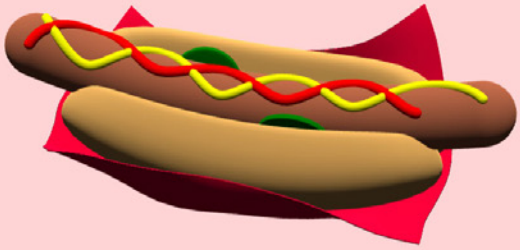
Taught by DAVID ANDRES LEON and JUSTYNA SZYCHOWSKA

This grasshopper definition was built to work with Hops. Users can vary between Tabby, Twill, and Satin weaves as well as change other parameters such as density and thread size.

2023





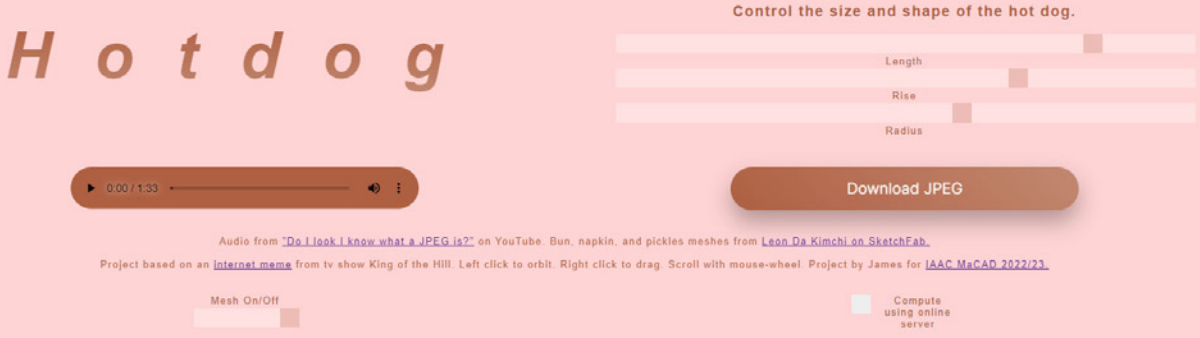
IAAC

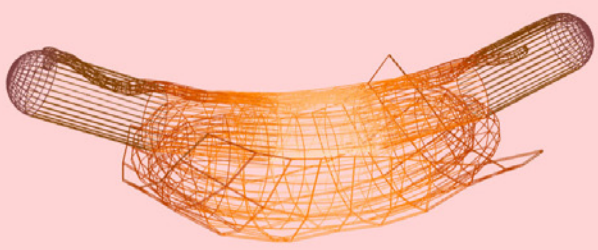
HOTDOG.JPG

Cloud-Based Data Management

Taught by DAVID ANDRES LEON and JUSTYNA SZYCHOWSKA

Unable to get the hot dog jpeg song out of my head all week, I created a parametric hot dog with Rhino.Compute for the next assignment.





2023

Taught by DAVID ANDRES LEON and JUSTYNA SZYCHOWSKA

My final project “death = !random” addresses parking minimums and their influence on the American suburb. It highlights how they prevent density by law and cause unnecessary death by law.

Left: Bottleneck navigator was used to speed model up from 2.1 s to 1.2 s.

DEATH = !RANDOM

Cloud-Based Data MGMT

IAAC

2023

death = !random

Death is not random.

% Crosswalks: 30

▼ Change the Grid

▼ Remove Parking Minimums

PARKING MINIMUMS ARE LAW

▼ With Parking Minimums

▼ Without Minimums

▼ More About Parking Minimums

▼ Video

Results from your parameters

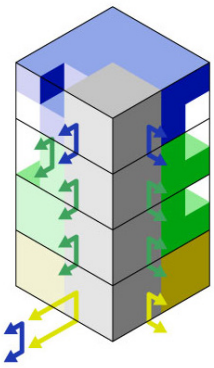
Deaths per year: 154
in a city of 1 million people

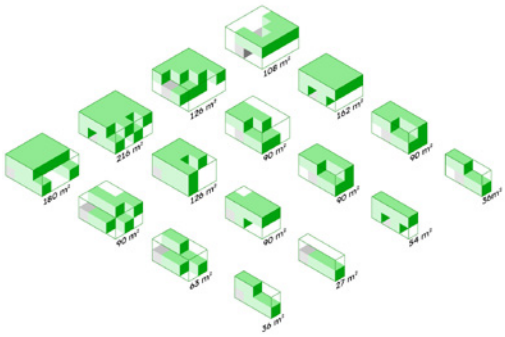
Speed of traffic: 62 km/h

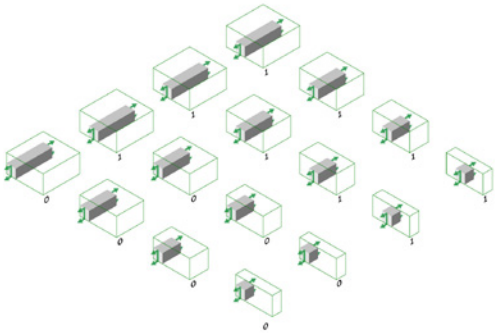
Land as roads: 23%
Land as parking: 54%
Total car spaces: 44,812
Land as buildings: 13%
Land as sidewalks: 8%

How to use

Increasing the percentage of crosswalks on the top-left is one way you can decrease the speed of traffic which also lowers the number of deaths per year. Change other sliders on the left-hand side to further alter the speed of cars that will increase or decrease the safety of people. What choices will you make?







IAAC

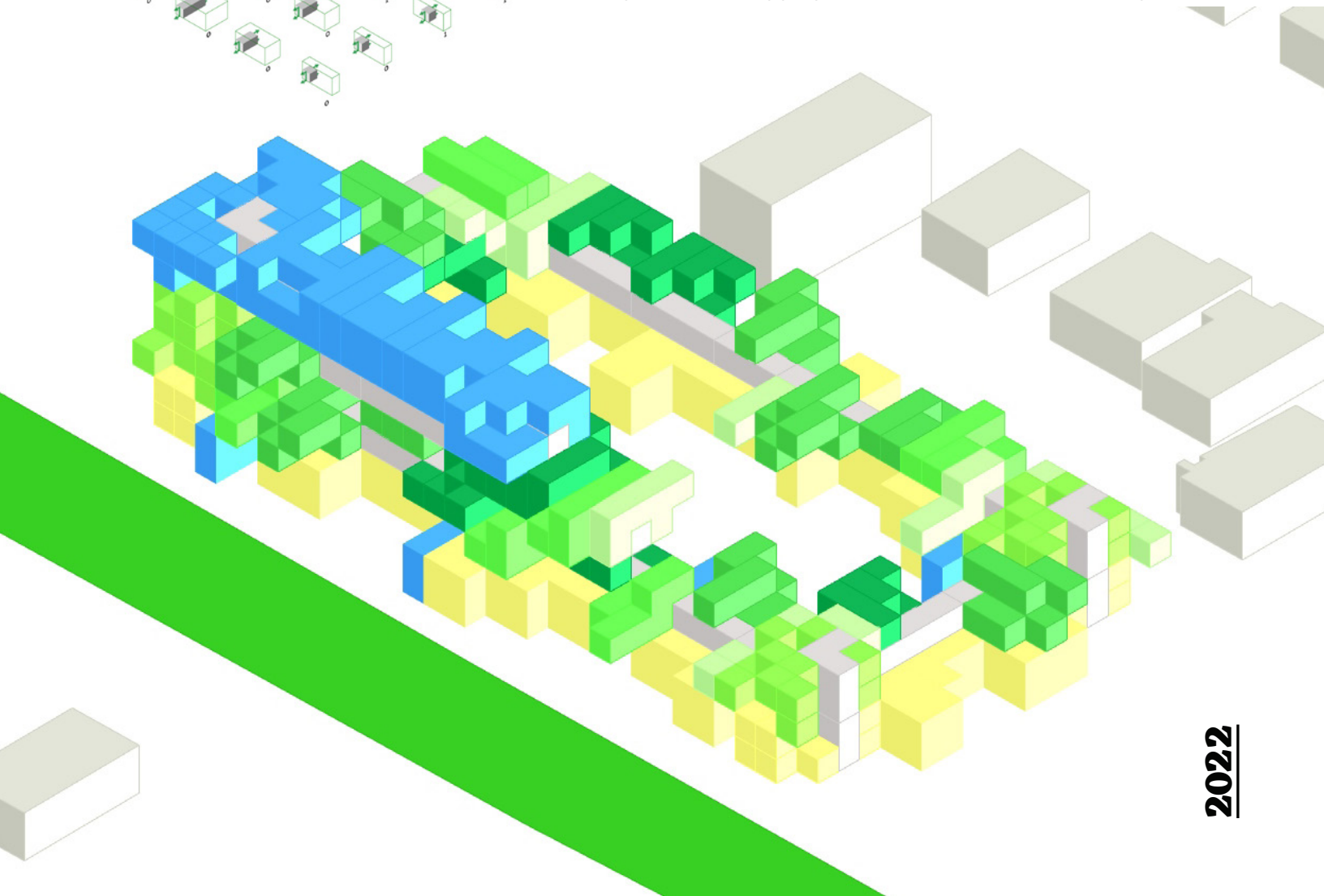
PROGRAM AND RANGING (PAR)

Studio

With MANUEL PARDO and NINAD CHAVAN

Taught by RODRIGO AGUIRRE

Influenced by Radar and Sonar, we came up with a tool called PAR, Program and Ranging, that was used to analyze the surrounding area of our site in Dallas, TX and suggest the necessary program that should be placed on that site in order to increase the number of people in Dallas who have the option to go car-free. This was a data centric approach that took the generated results and aggregated those programs on the site using stochastic aggregation (WASP) of a parts catalog.

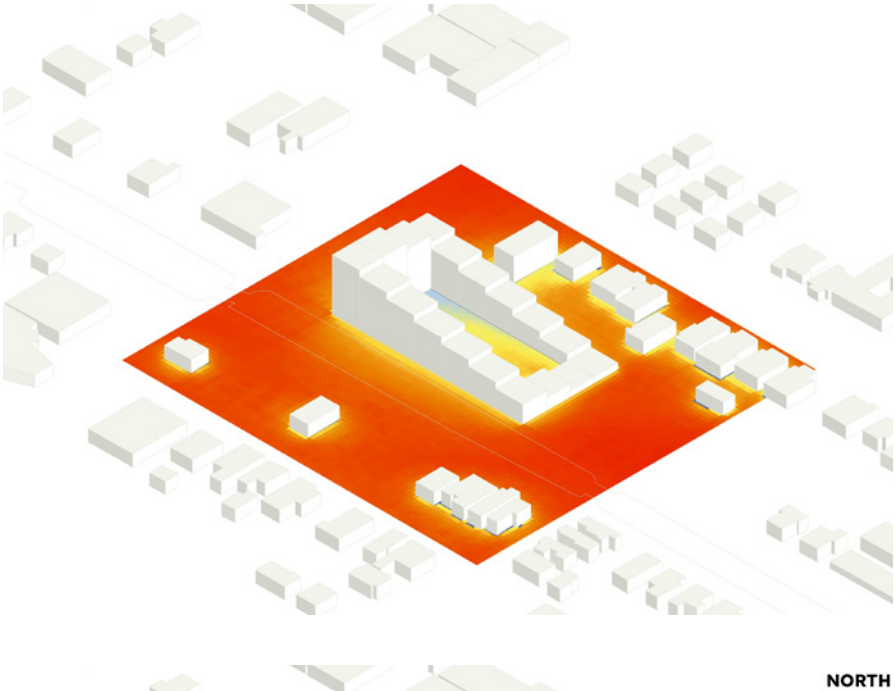


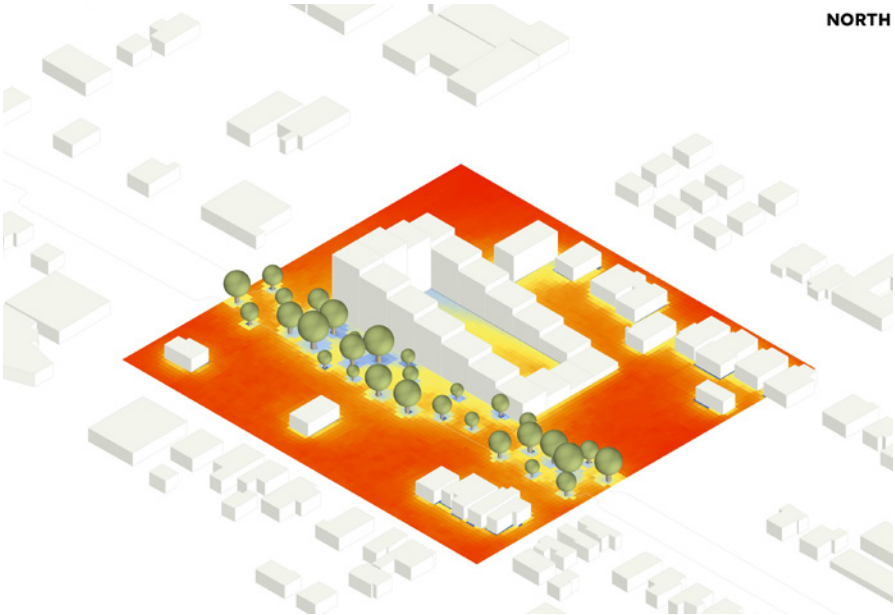
2022

IAAC 2022

PROGRAM AND RANGING

Environmental Optimization

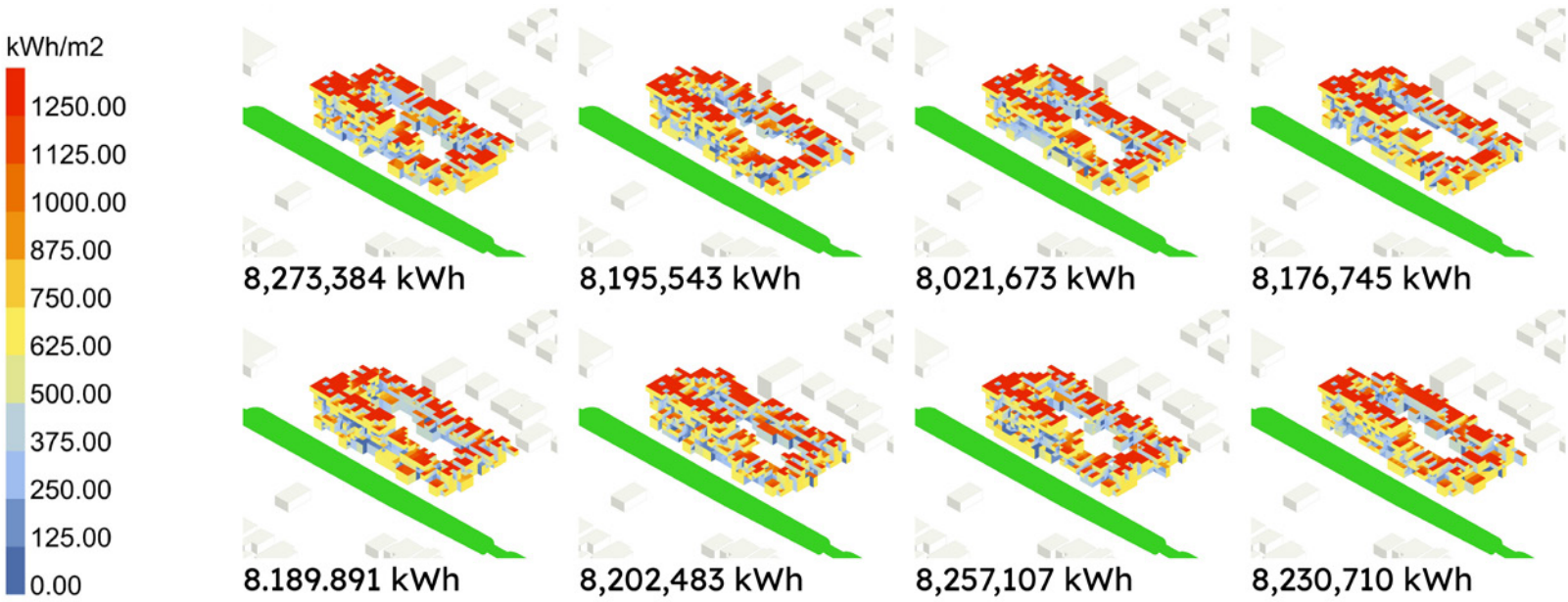


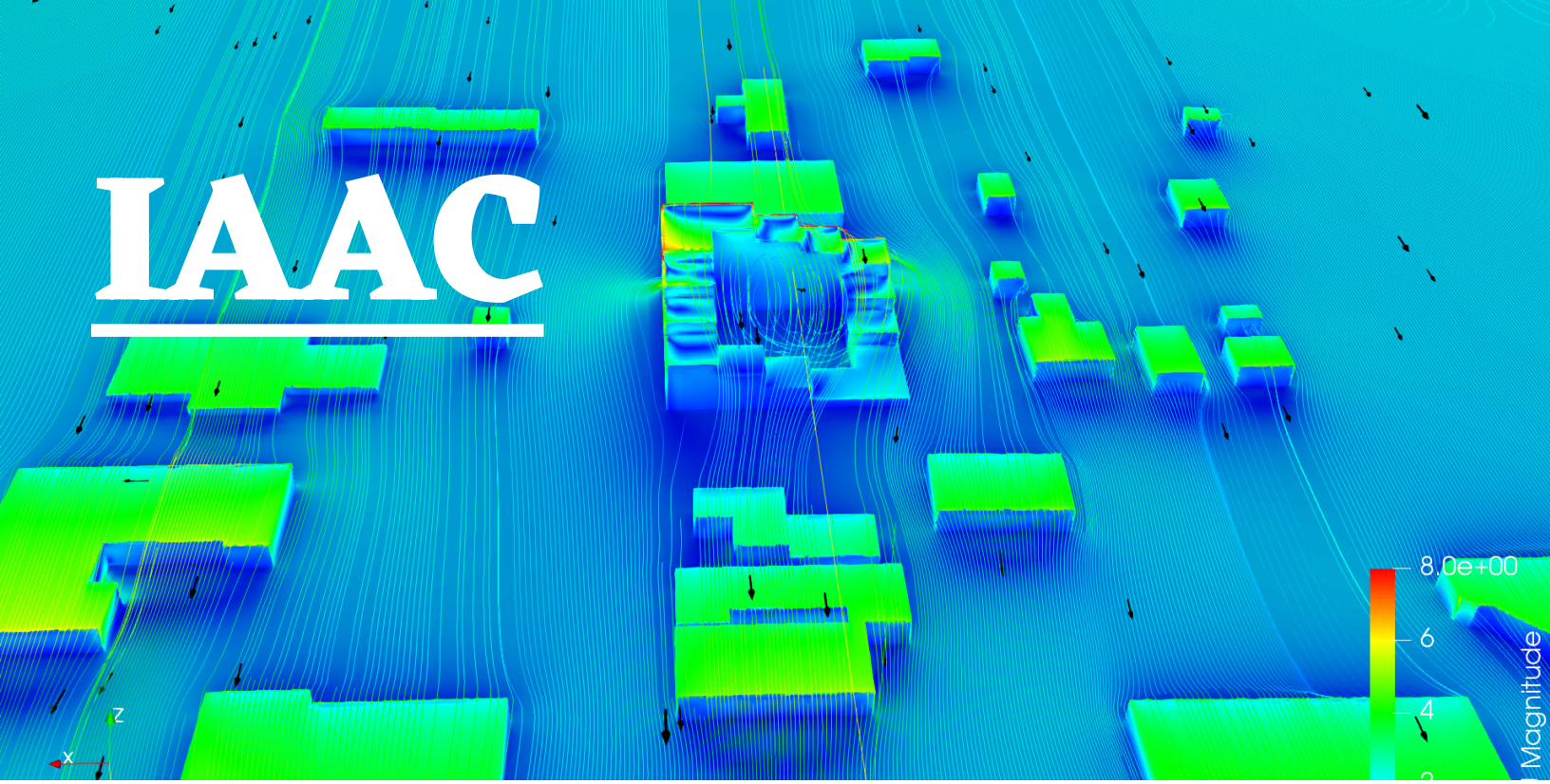


Taught by ANGELOS CHRONIS, ARIS VARTHOLOMAIOS, ALEX CHRISTODOULOU, EKATERINA VITITNEVA, and LENKA KABOŠOVÁ

With MANUEL PARDO and NINAD CHAVAN

Ladybug Thermal Comfort, Daylight Hours and Total Radiation were first used to analyze and optimize a courtyard block. These scripts were then applied to studio.





WIND ANALYSIS

Environmental Optimization

BlueCFD (Above)

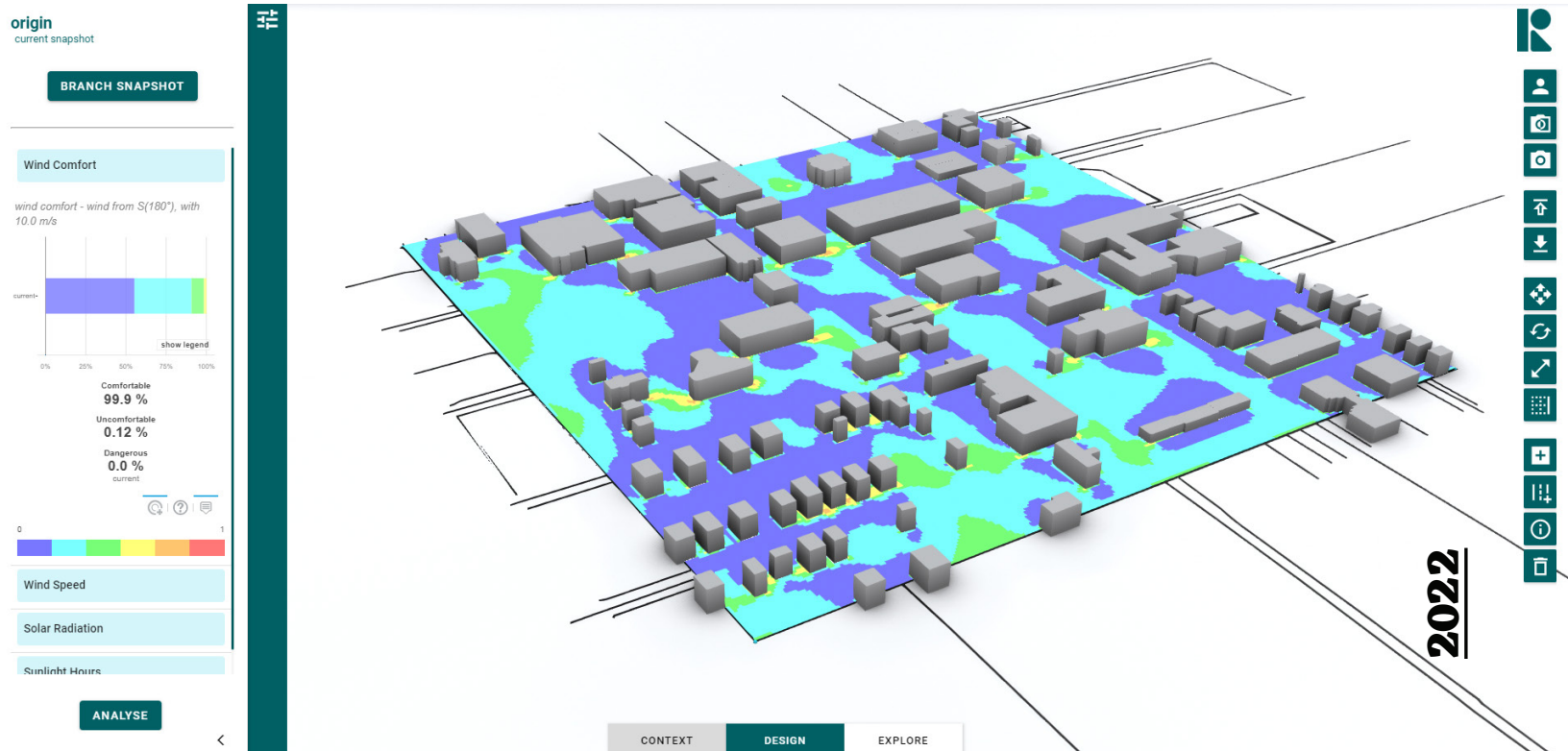
2 DAYS

to Calculate Wind

InFraRed (Below)

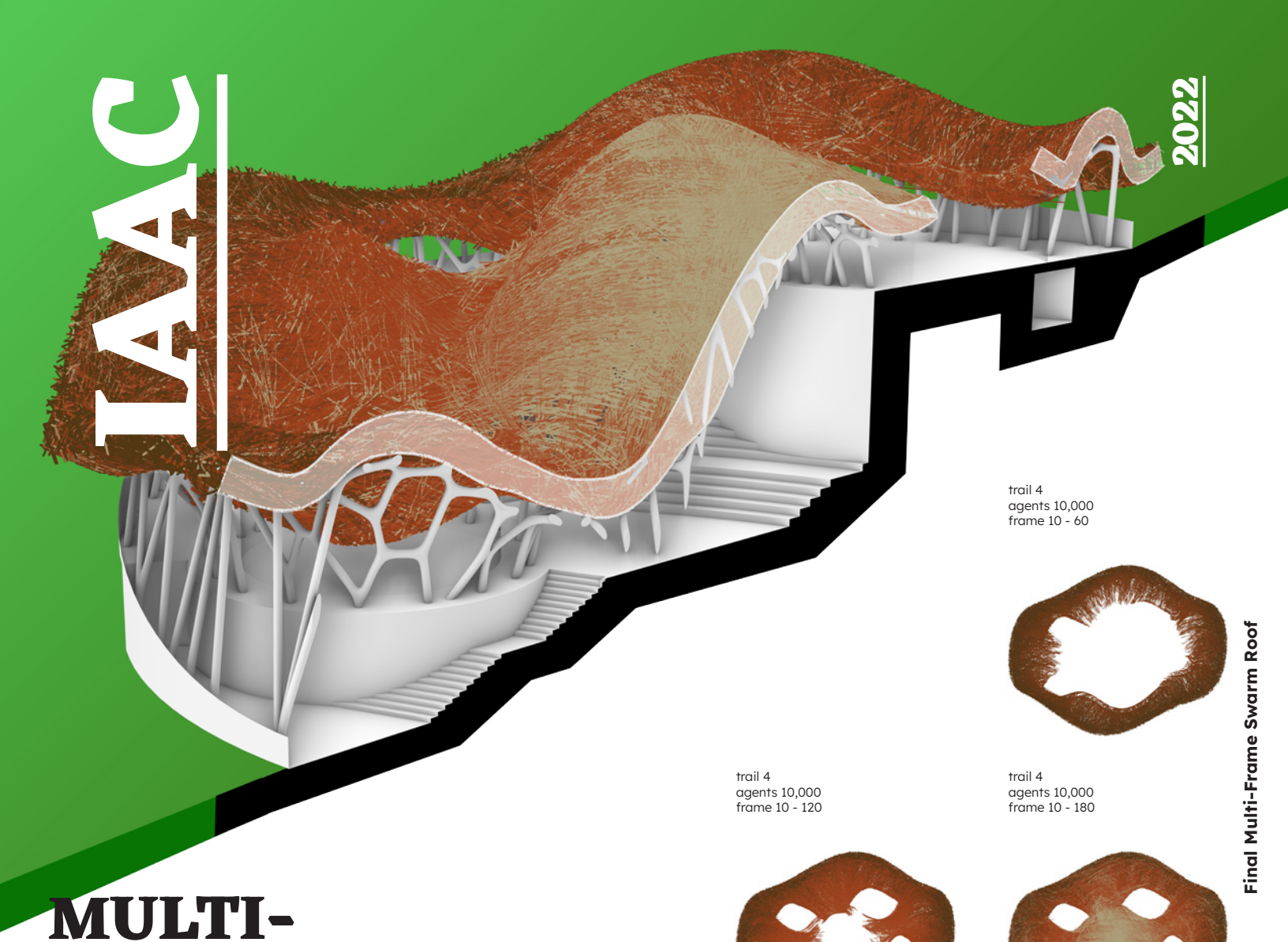
2 SECS

to Calculate Wind



IAAC

2022



MULTI-FRAME SWARMS

Complex Forming

Taught by HESHAM SHAWQY and ERIDA BENDO

Multi-Frame Swarms explored creating swarms in Houdini contained within a mesh constraint that was creating using grasshopper and kangaroo. The swarm output was used to inform rooftop elements. Multiple frames of a swam were used.

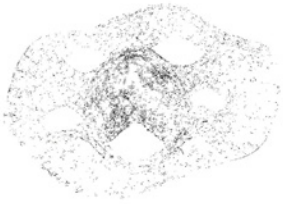
trail 4
agents 10,000
frame 10 - 60

trail 4
agents 10,000
frame 10 - 120

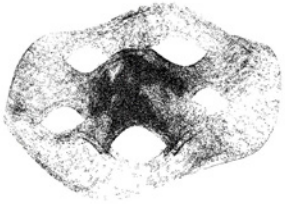
trail 4
agents 10,000
frame 10 - 180

Final Multi-Frame Swarm Roof

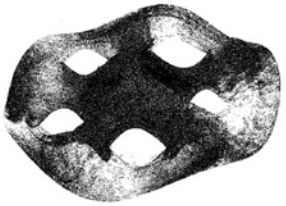
trail 2
agents 10,000
frame 150



trail 2
agents 100,000
frame 150

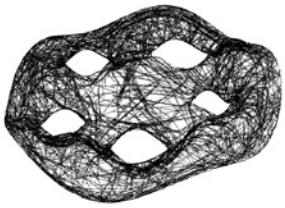


trail 2
agents 1,000,000
frame 150

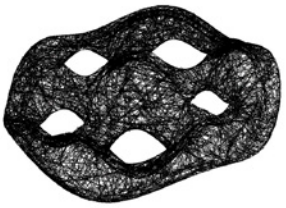


trail 40
agents 1,000
frame 200

trail 200
agents 1,000
frame 200



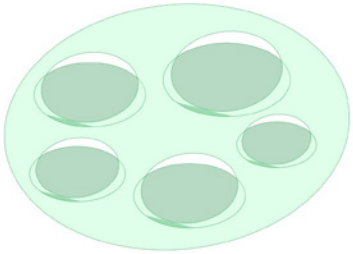
trail 400
agents 1,000
frame 400



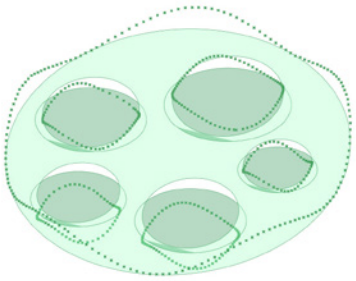
Early Testing Swarms in Houdini/VEX

1. create internal courtyards

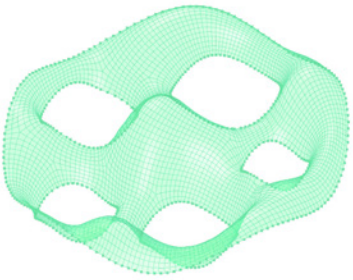
2. adjust to slope of the site



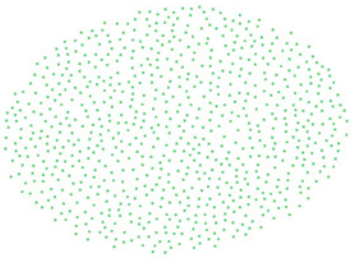
3. adjust roof boundary using sine curves



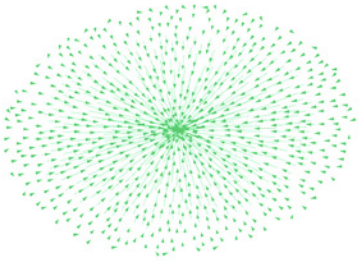
4. form-find roof using Kangaroo/Grasshopper



5. scatter points

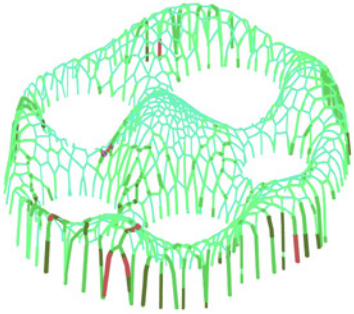


6. increase density of points away from facades

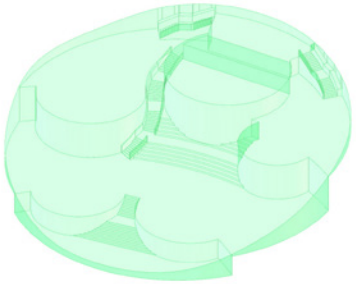


7. project voronoi to roof mesh

8. cross-section optimize using Karamba3D



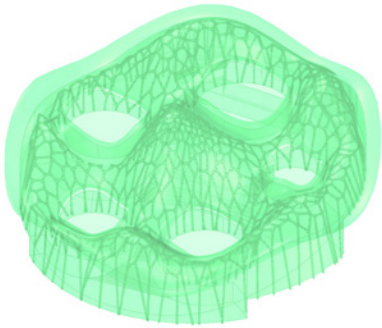
9. create base from program



IAAC

MULTI-FRAME SWARMS

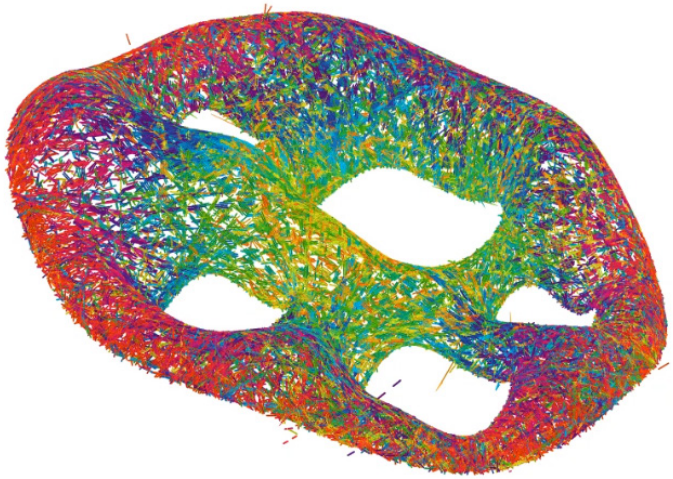
Complex Forming



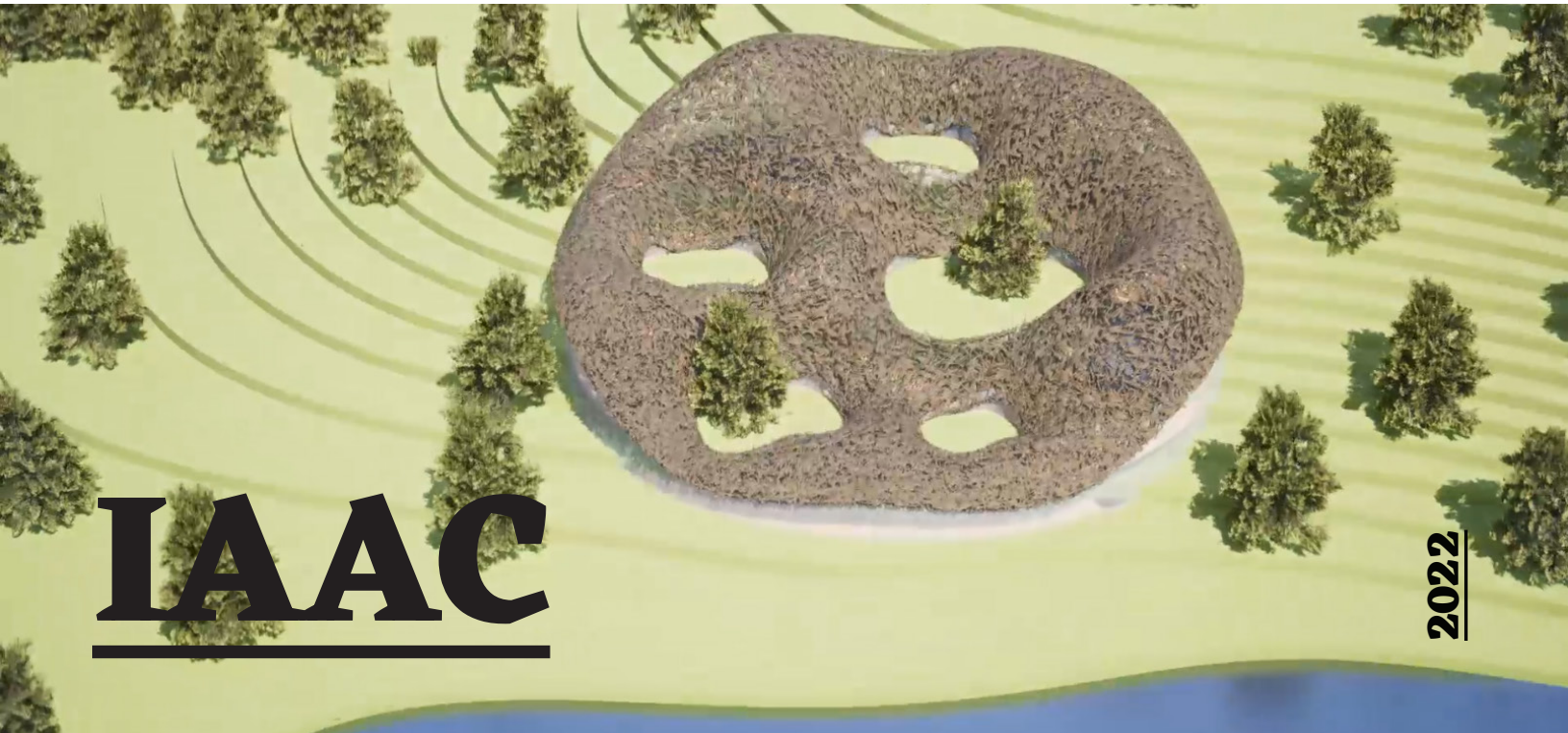
2022

MULTI-FRAME SWARMS

Complex Forming

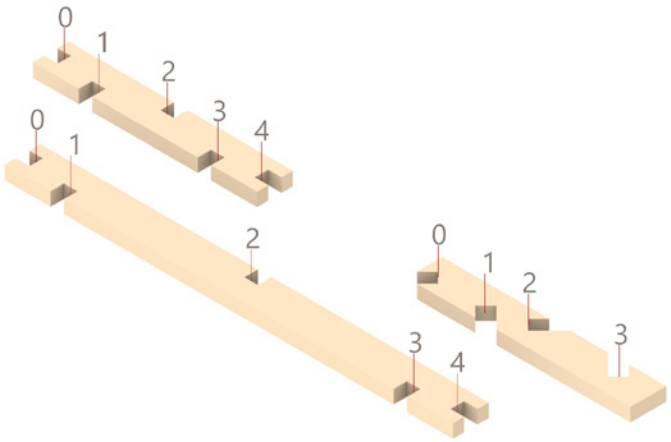


Kangaroo + WASP + Unreal Engine



IAAC

2022

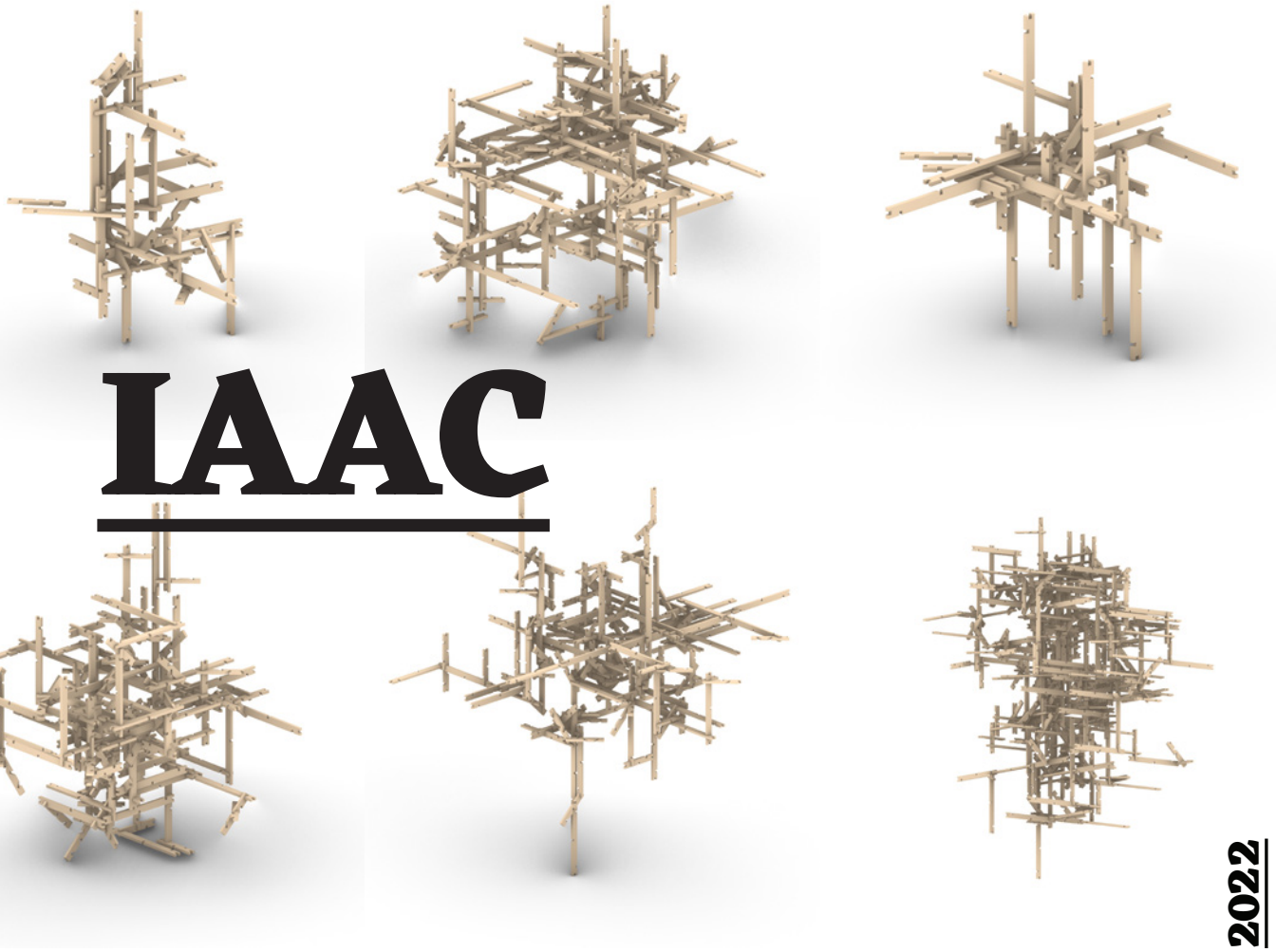


STOCHASTIC AGGREGATION

Complex Forming

Taught by HESHAM SHAWQY and ERIDA BENDO

The WASP plugin by Andrea Rossi allows for “stochastic” (random) “aggregation” assembling parts from a rule based model. Here three plywood pieces could be aggregated into an infinite number of variations and mesh constraints.



IAAC

2022

UNREAL ENGINE + KANGAROO

Complex Forming

Taught by HESHAM SHAWQY
and ERIDA BENDO

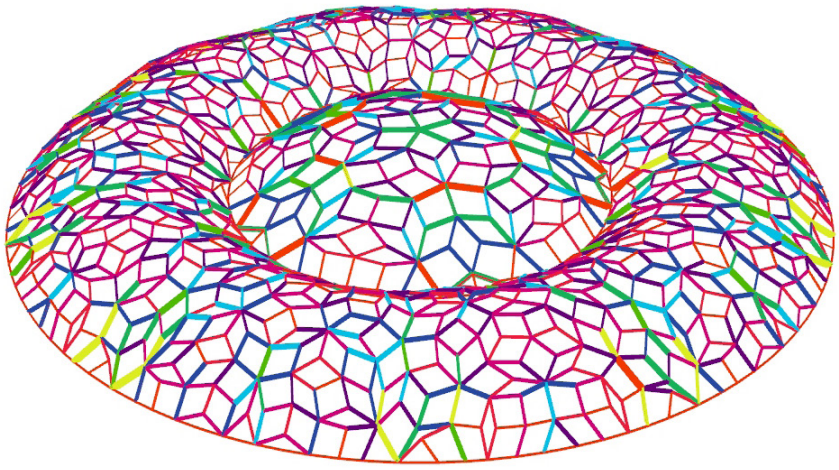
IAAC

2022

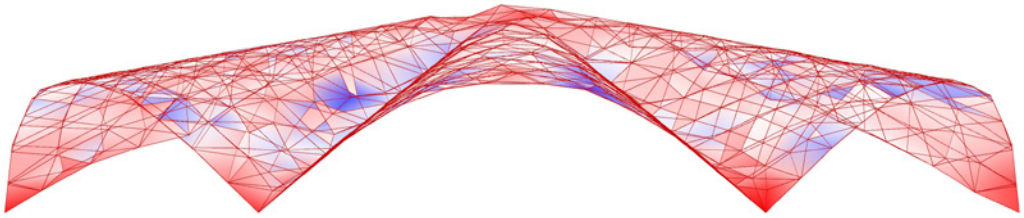
IAAC

Structural Optimization

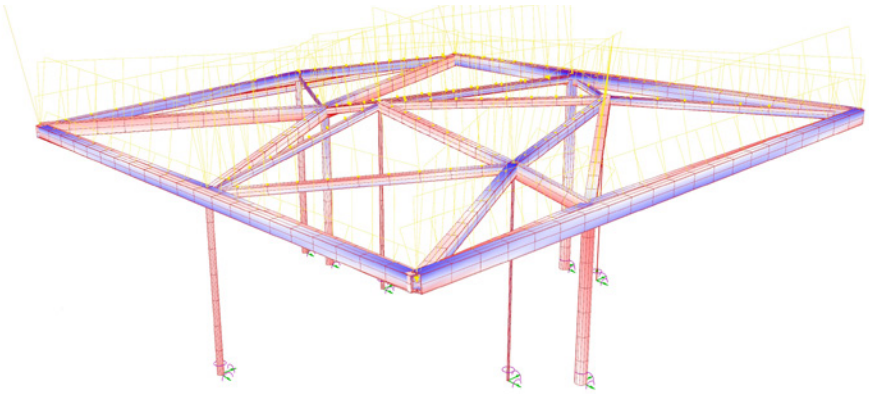
Taught by CLEMENS PREISINGER & MATTHEW TAM
on their plugin Karamba for structural optimization in Grasshopper3D.



Cross-section Optimization



Shells



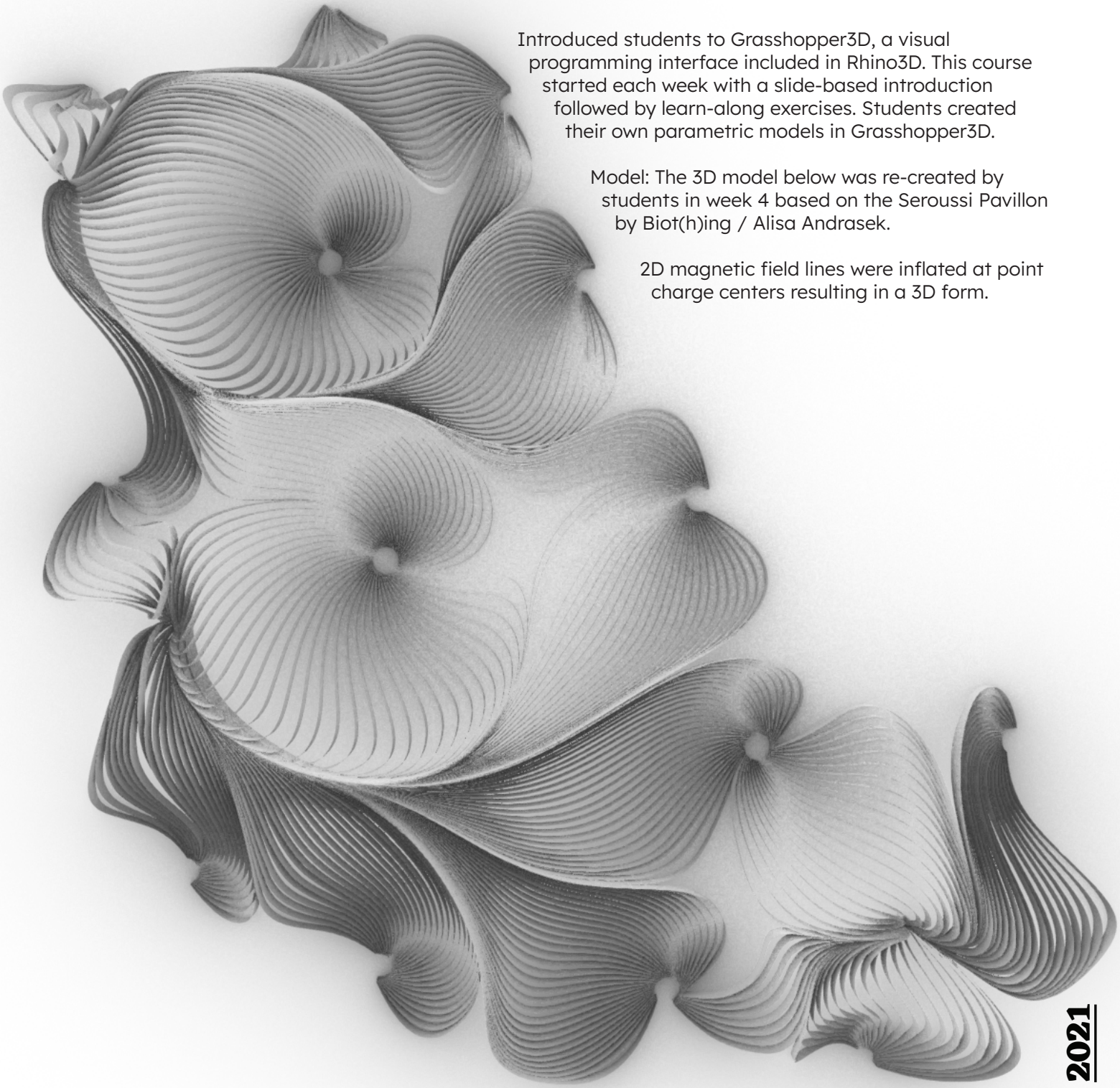
Galapagos (Single Objective Optimization)

2022

TEACHING ONLINE COURSE

HACKADAY-U

Designing with Complex Geometry



Introduced students to Grasshopper3D, a visual programming interface included in Rhino3D. This course started each week with a slide-based introduction followed by learn-along exercises. Students created their own parametric models in Grasshopper3D.

Model: The 3D model below was re-created by students in week 4 based on the Seroussi Pavillon by Biot(h)ing / Alisa Andrasek.

2D magnetic field lines were inflated at point charge centers resulting in a 3D form.

2021

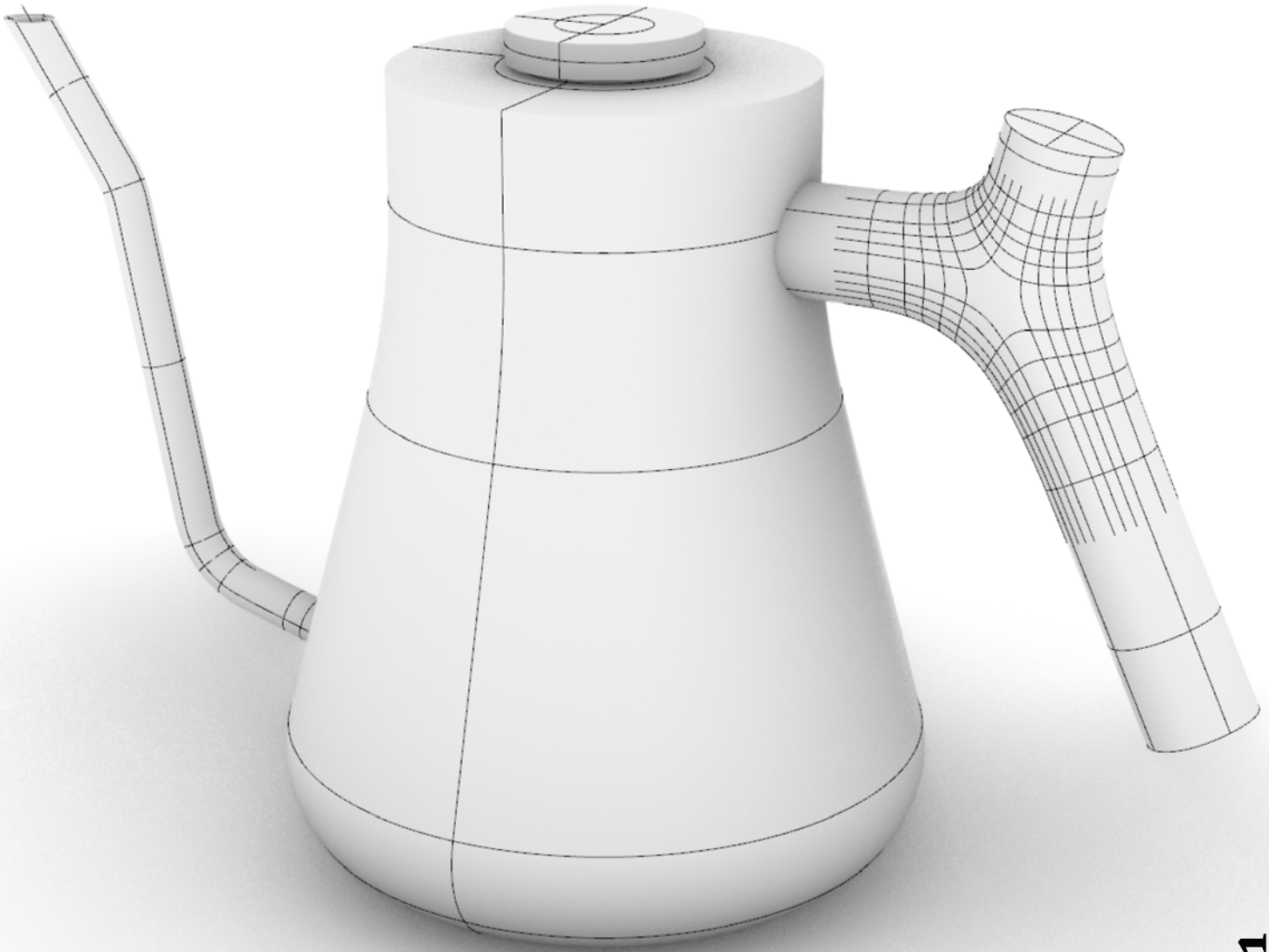
TEACHING ONLINE COURSE

HACKADAY-U

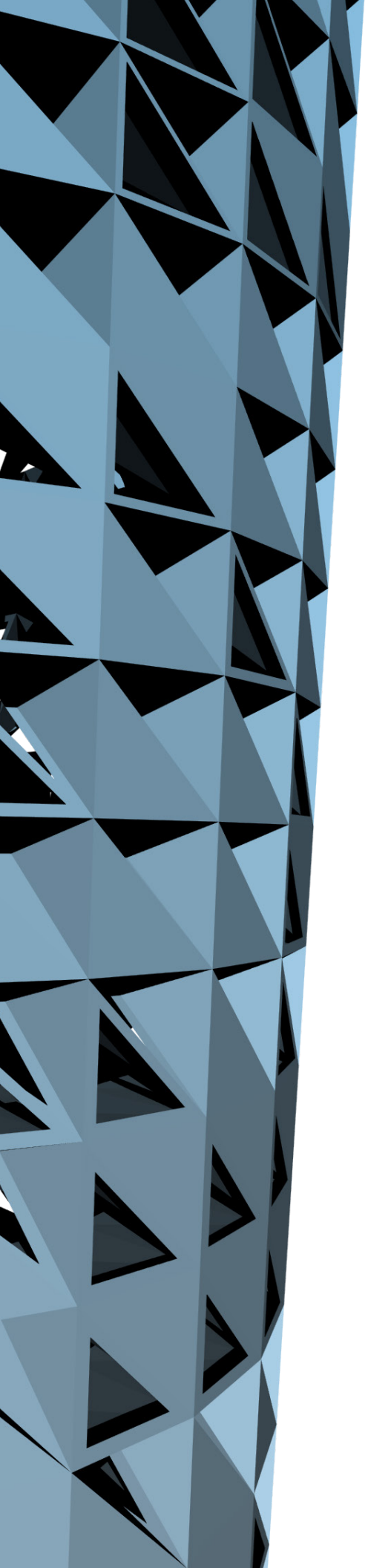
Design Fundamentals

Introduced students to Rhino3D, a NURBS based 3D software. This course started each week with a slide-based introduction followed by learn-along exercises. Students created models in Rhino3D.

Model: Stagg Kettle by Fellow



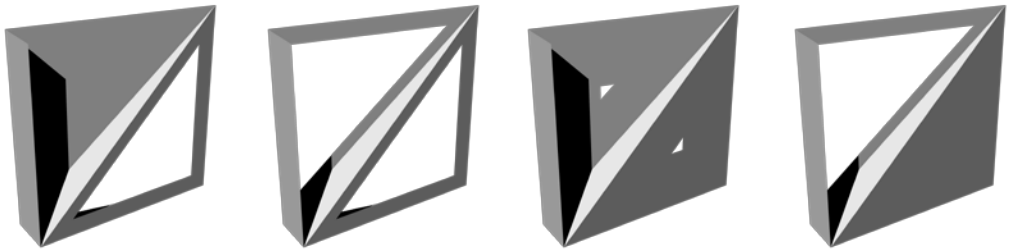
2021

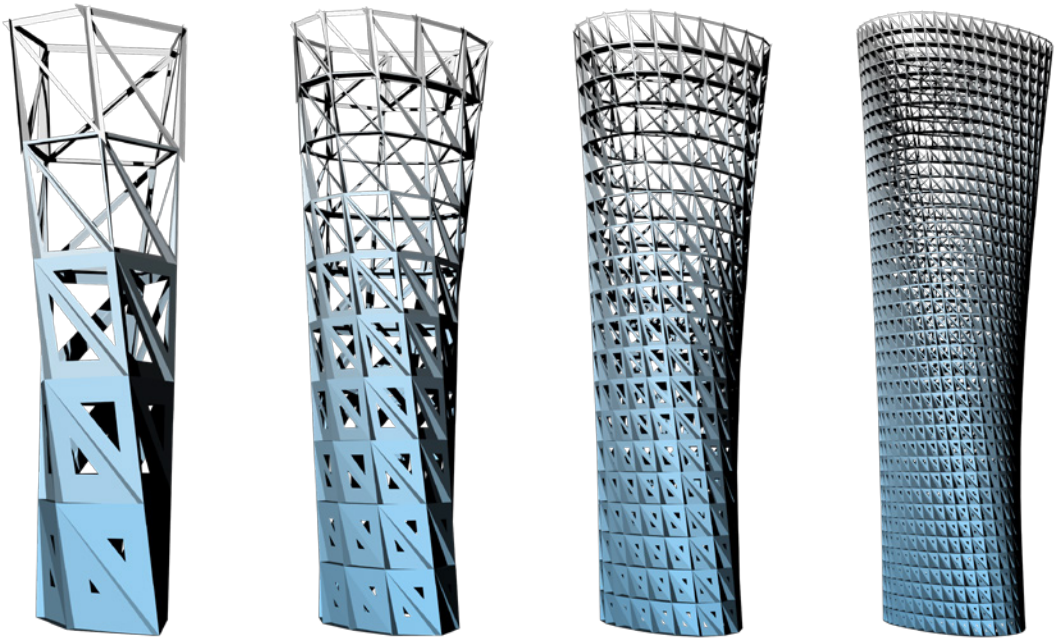


University of Michigan

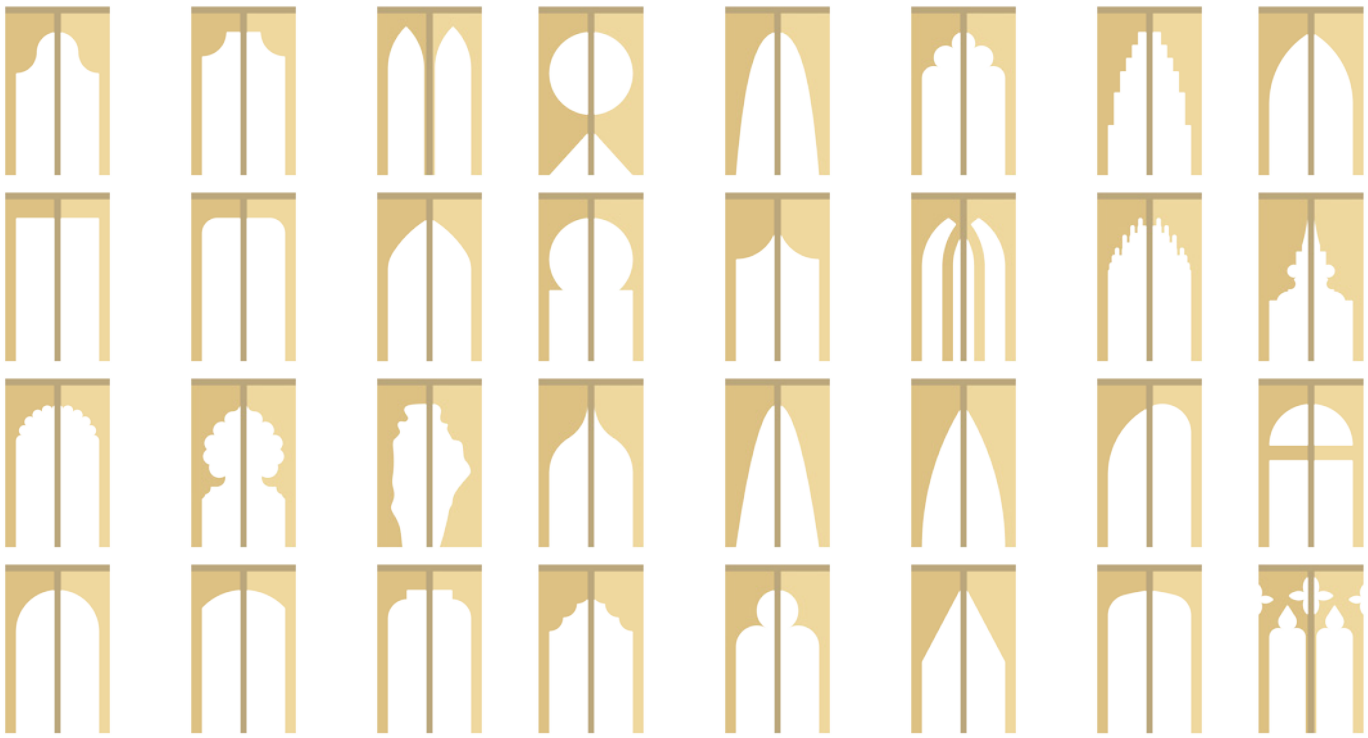
PYTHON & RHINO3D

Final project from online course I took taught by Prof. Glenn Wilcox.





2021

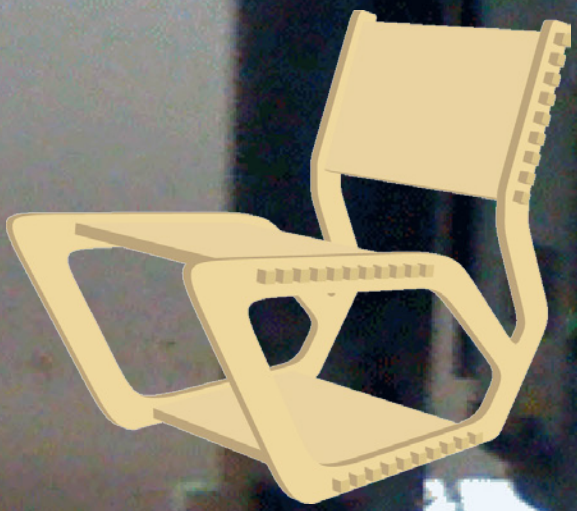


ARCH

E-commerce + CNC should allow more variation than we're typically used to. I am currently creating several series of CNC furniture projects each with 32 variants.

birchsandwich.com

2016



TEACHING AT UCD

I taught an M.Arch media studies course on Digital Fabrication with Emer O'Daly and a similar course at the UCD summer school.

This image is from my summer school class. Students were challenged to remix an expensive design object in MDF while learning skills in laser cutting, CNC, and Rhino3D. This chair is based on Marc Newson's white marble Extruded Chair costing $39,000. This version was fabricated in MDF for $25.

2012

Natural High: Neza York

Egyptian architect Hassan Fathy (1900-1989) believed citizens should be capable of building their own homes instead of waiting around for experts. The biggest challenge is constructing complex formwork. Fathy utilized the pointed Nubian vault that didn't require formwork and allowed anyone to build. The Camera Obscura project at Mitchell Park by SHoP Architects is similar in that it was digitally fabricated to be assembled by anyone. "Even a ten-year-old could it," Gregg Pasquarelli claimed.

So what is the future of architecture built by amateurs? Can people with no experience construct an earthquake-proof ten-story skyscraper with rainwater harvesting and natural cooling? Amateurs used to be able make large buildings.

This project explores digital geometry, digital fabrication, and online communities to coordinate a new self-built intelligent mud-brick skyscraper city in Nezahualcóyotl (Neza), the eastern part of Mexico City.

It is paint by numbers for making cities with digitally fabricated bricks.

3DVoronoi geometry is used at an urban level, building level, and component level.

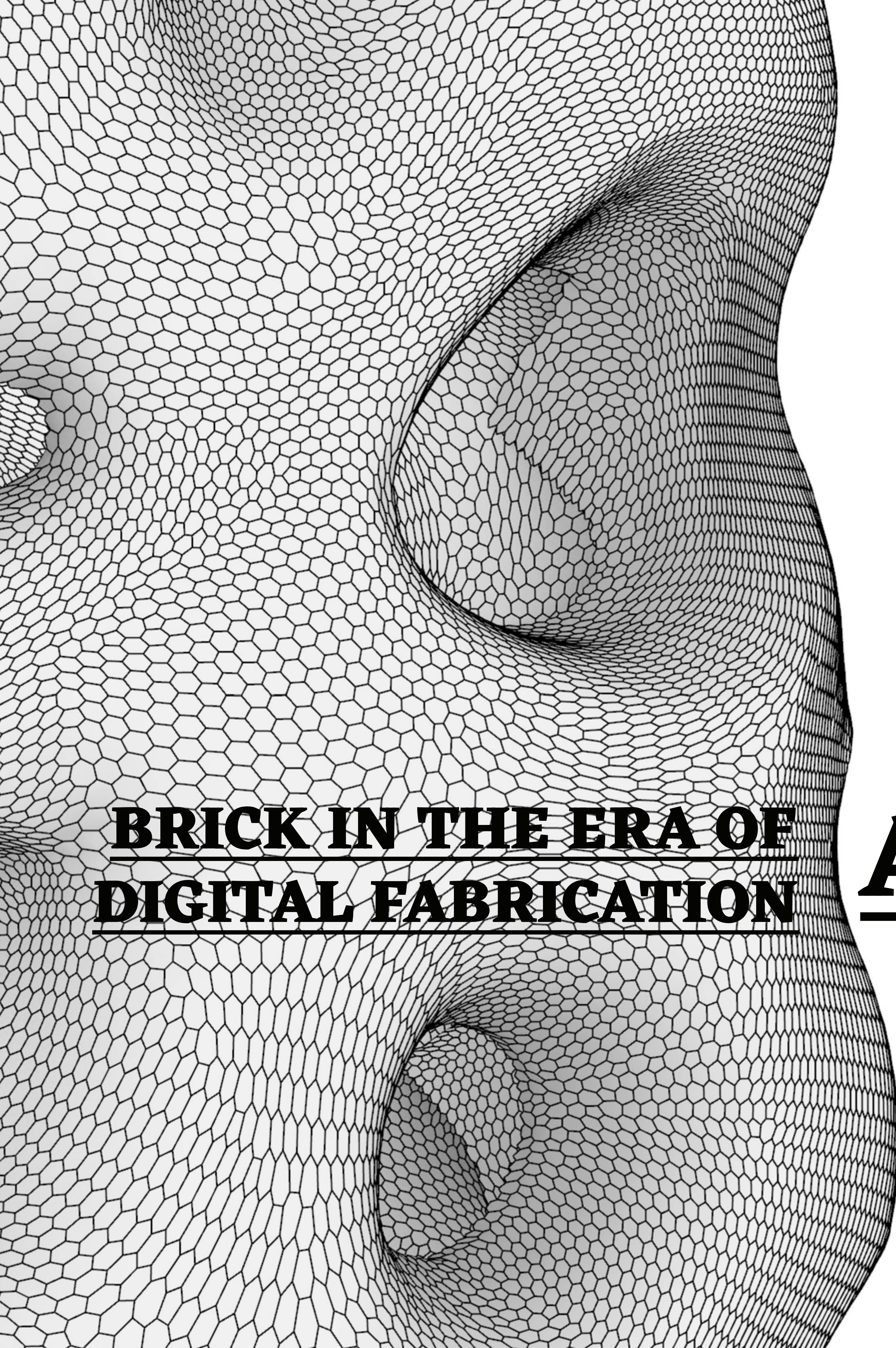
The mega block urban plan of Neza is reorganized favoring shorter highly-networked streets.

Spaces within the building are voronoi cells linked together creating a strong overall structure.

Brick geometries are far more complex than those of the six-sided brick. The geometry is focused on the negative space between the bricks to allow for intelligent networks of fiber reinforcement.

AA

2009-11

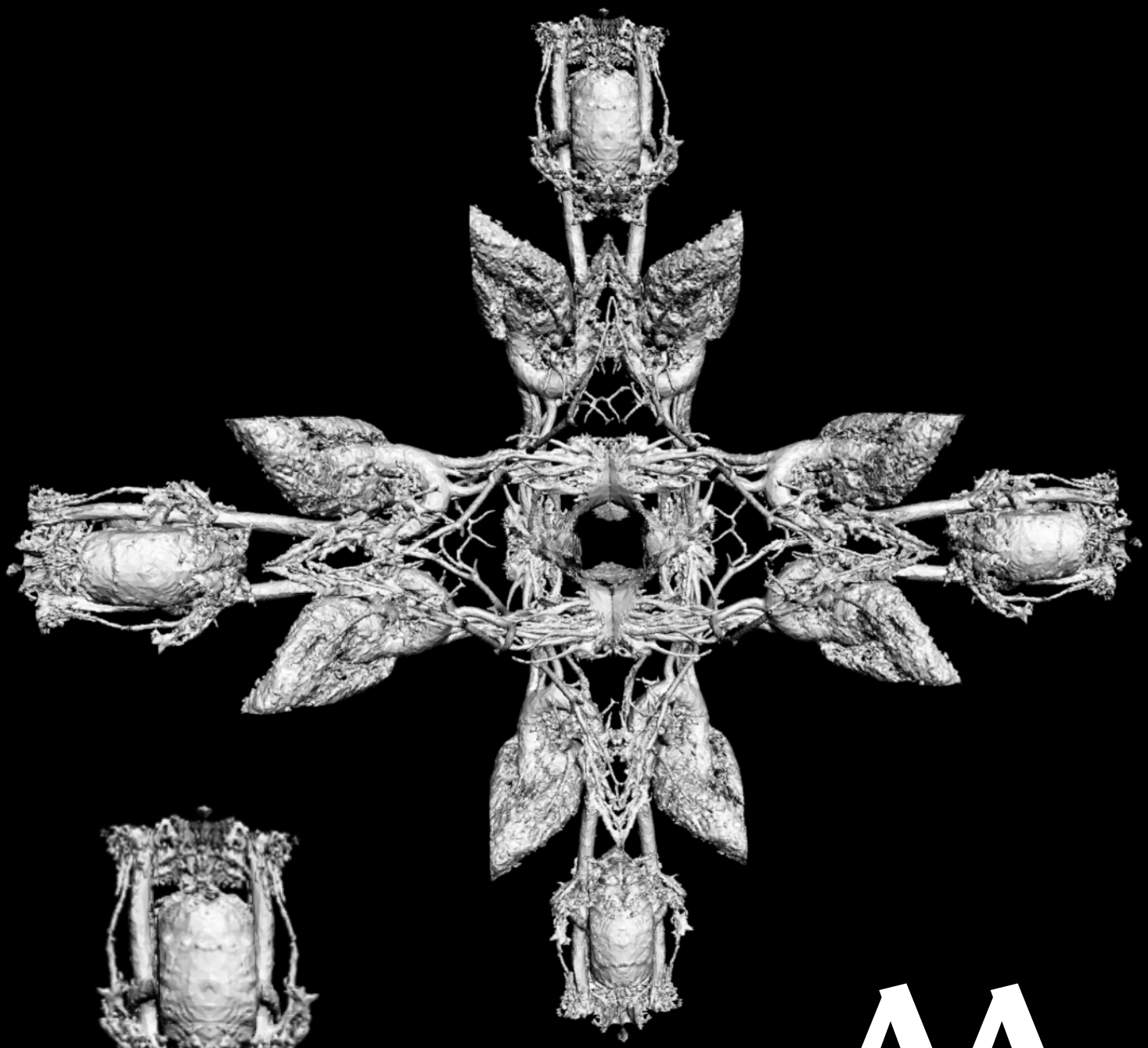


BRICK IN THE ERA OF DIGITAL FABRICATION

AA

History & Theory project exploring architectural components.

2009-11



AA

Embodied Landscapes:

Using Voxels

Media studies course taught by Tobias Klein. MRI data was brought through a variety of 3D software

The class was based on Tobias' final thesis from the Bartlett (UCL)

2009–11

INTERN OMA

In the busy Middle Eastern skyline of iconic towers, the only thing that stands out is an anti-icon. This enormous cube steals the limelight using the primitive shape of a cube. The building consists of four towers wrapped in a facade forming large semi-interior volumes shaded from the hot desert sun.

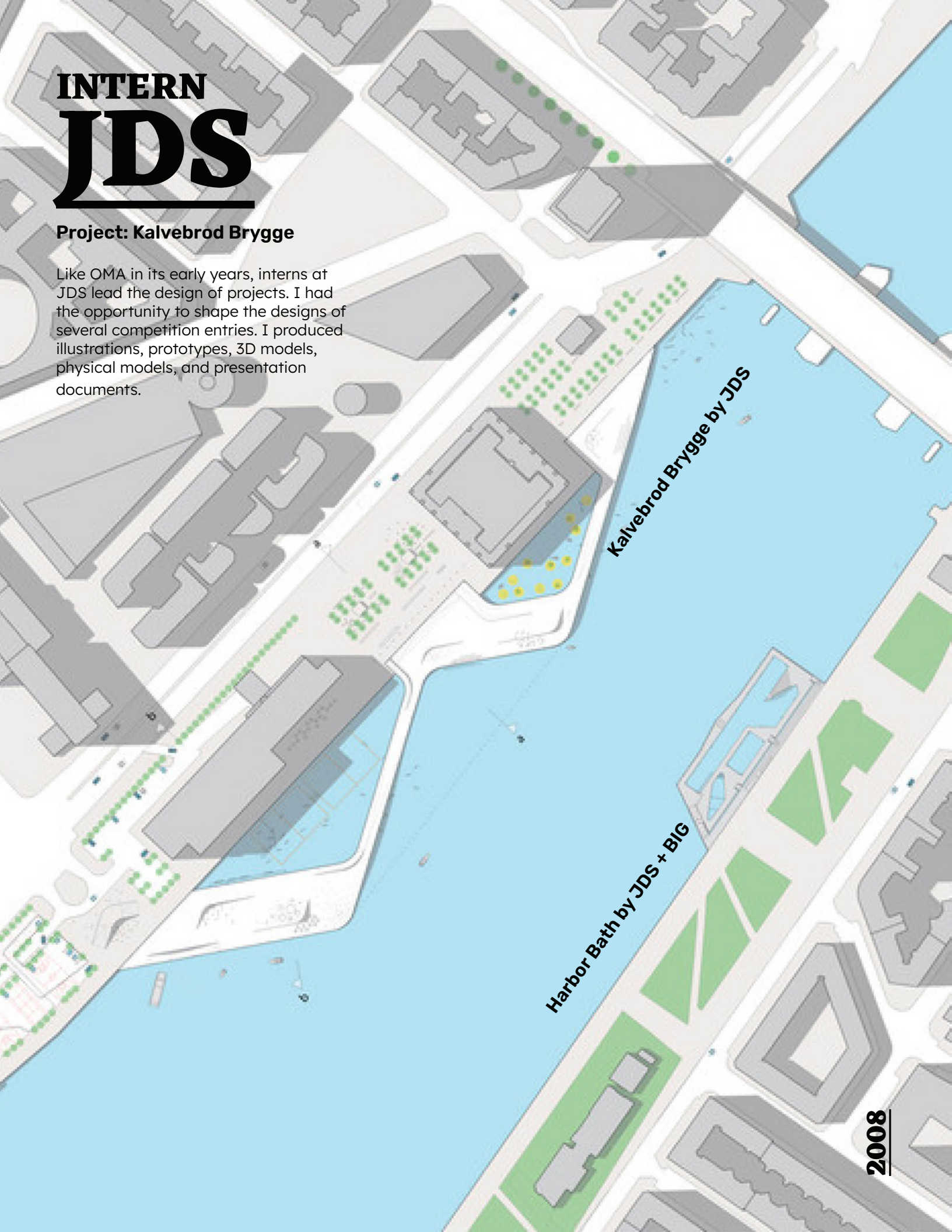
Project: Education City, Qatar
Photo: Iwan Bann

2009

INTERN
JDS

Project: Kalvebrod Brygge

Like OMA in its early years, interns at JDS lead the design of projects. I had the opportunity to shape the designs of several competition entries. I produced illustrations, prototypes, 3D models, physical models, and presentation documents.

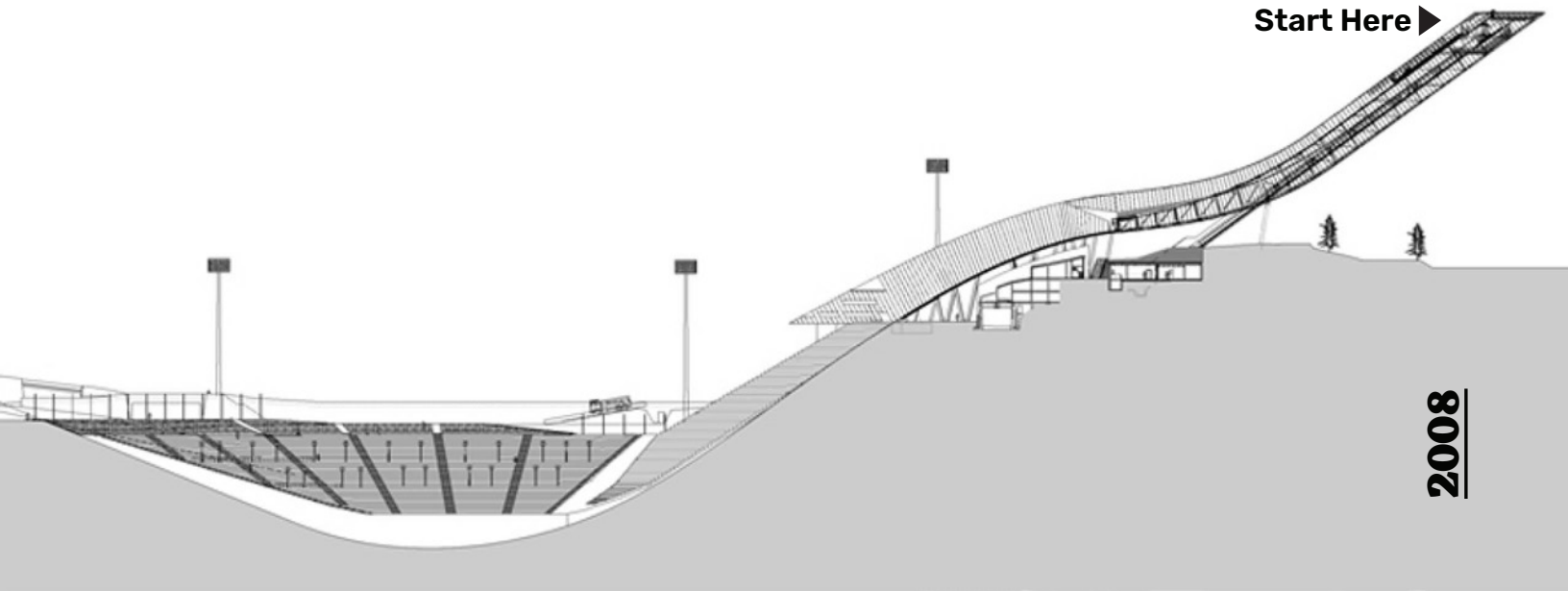


2008

INTERN JDS

Project: Holmenkollen Ski Jump
Photo: Hufton & Crow

Start Here ▶



2008

INTERN
KPF

Project: Smithfield Market

2007-08

BSc. Arch
UCD
Final Year

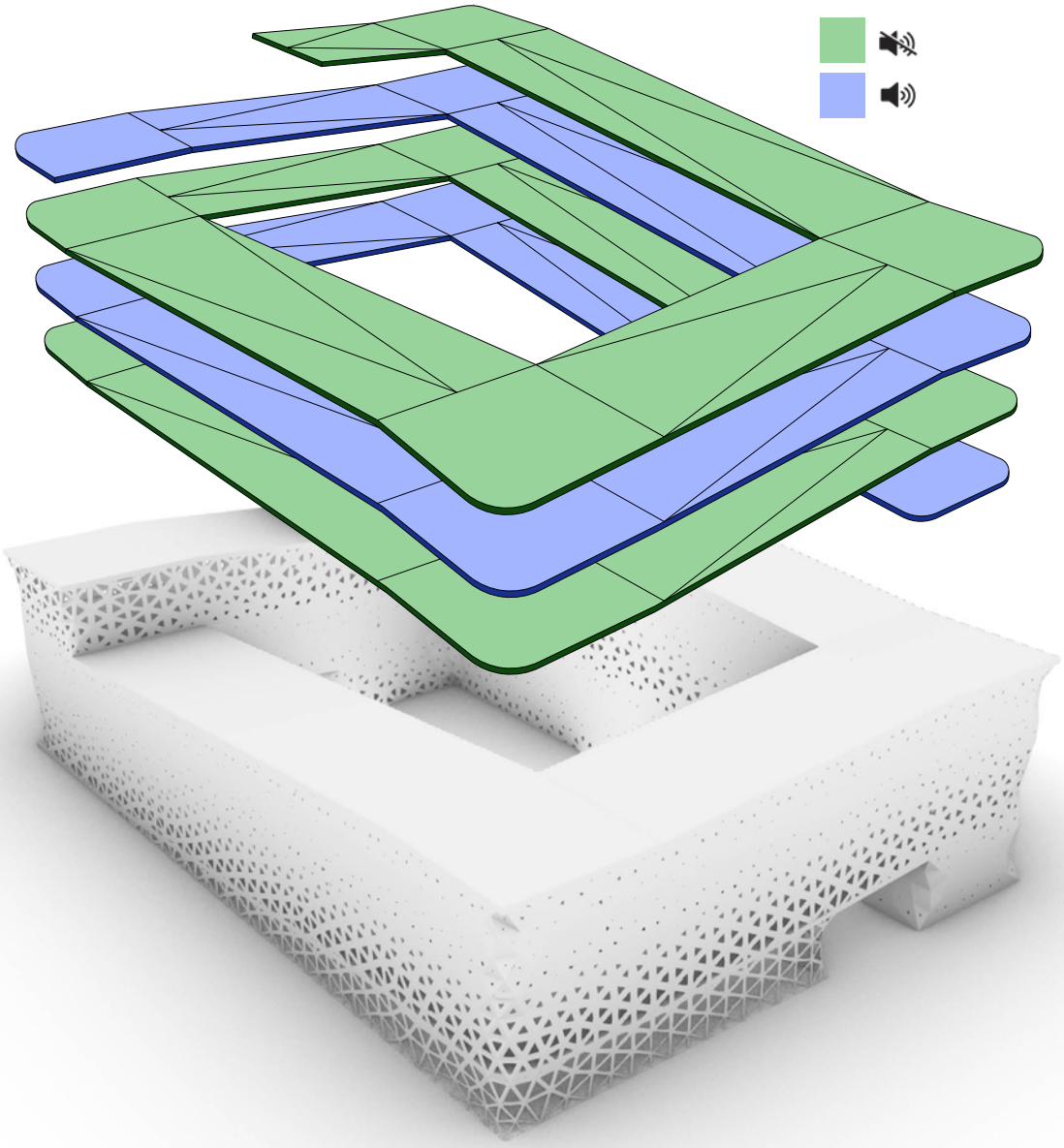
Cork City Library

This library was influenced by Dutch design projects, such as the Seattle Public Library by OMA.

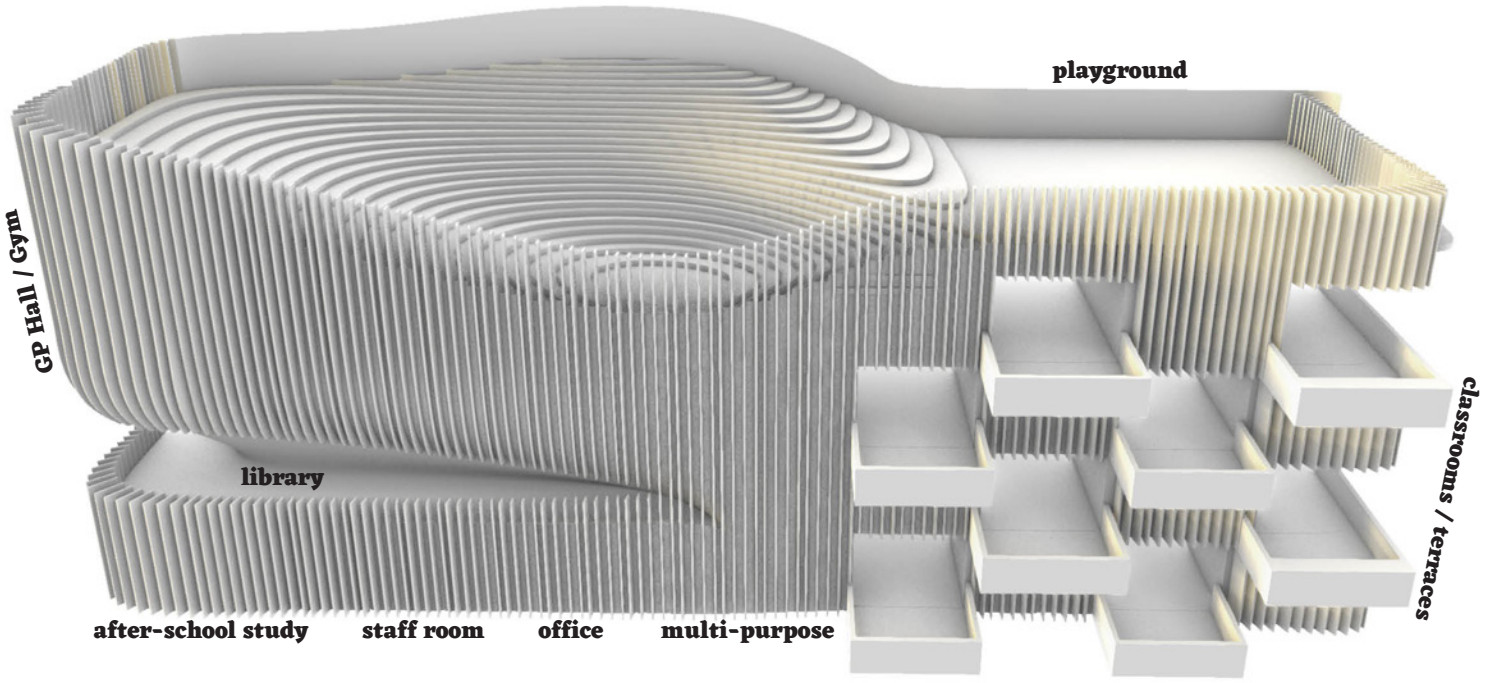
Libraries contantly ask guests to be quiet when in reality much of their building can never be truly silent. I separated the brief into noisy and quiet places. Noisy spaces such as the book stacks were placed on the blue ramp. Silent study spaces were the green ramp.

The Dewey Decimal Classification System was organized architecturally with higher numbers intuitively uphill on the ramp and lower numbers downhill. Bookshelves can also be moved to open up spaces for other uses such as book clubs or events.

The facade differentiates the amount of light needed for a variety of uses inside the library. Study spaces are bright while book stacks are protected from excessive direct sunlight.



2004-07

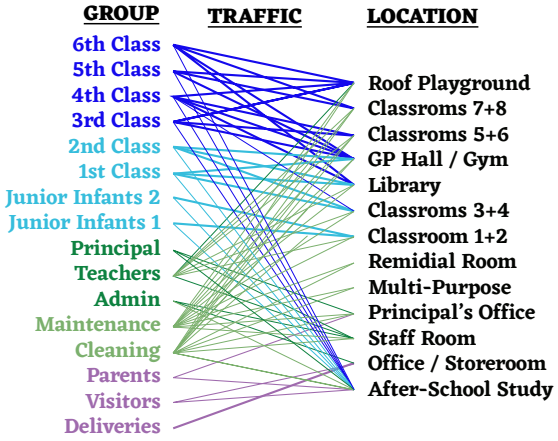


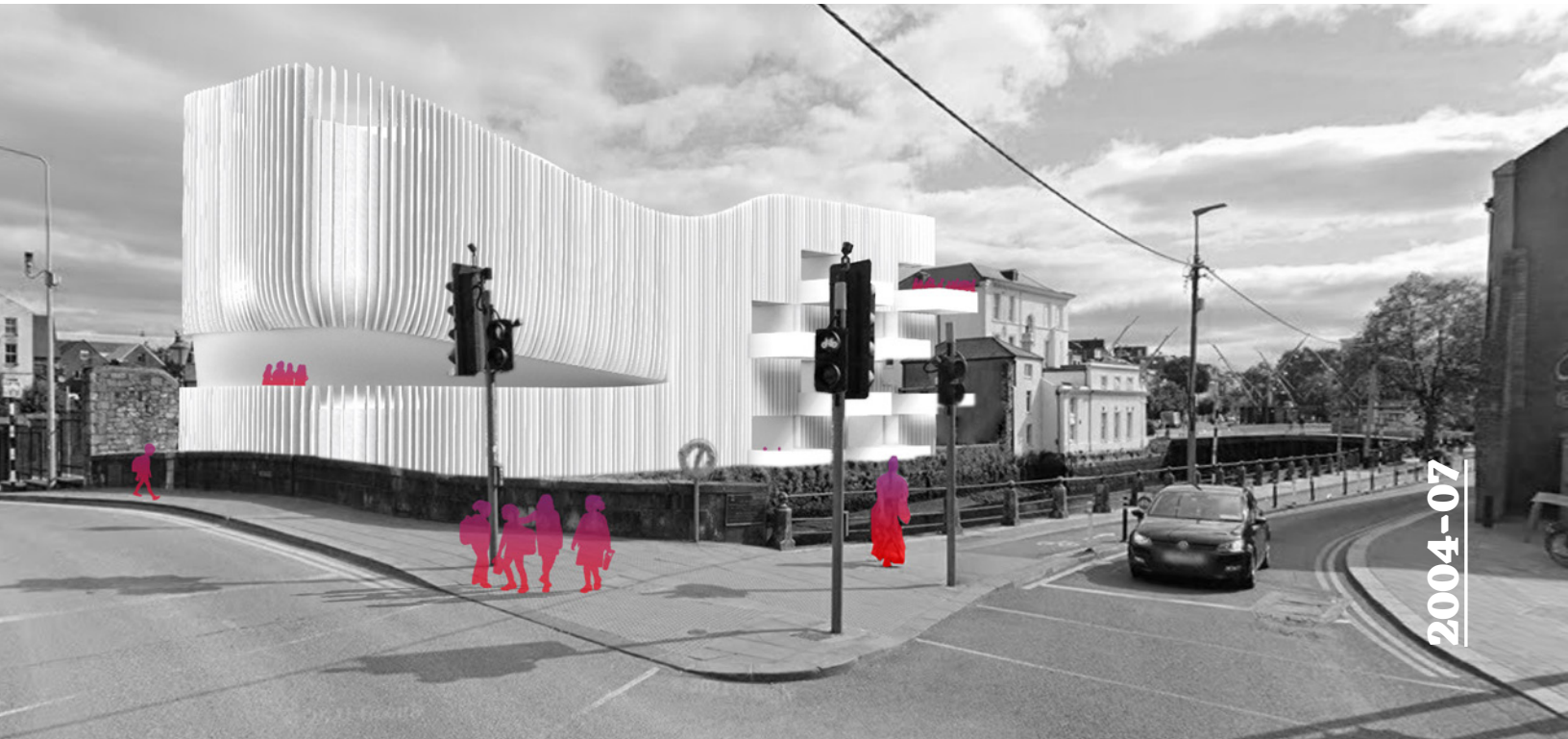
BSc. Arch
UCD
Final Year

Cork City School

Influenced by The Open Air School in Amsterdam by Jan Duiker. Open-air spaces were prioritized in order to improve children's health in fighting tuberculosis.

Diagramming was used as a primary design tool to organize the brief.





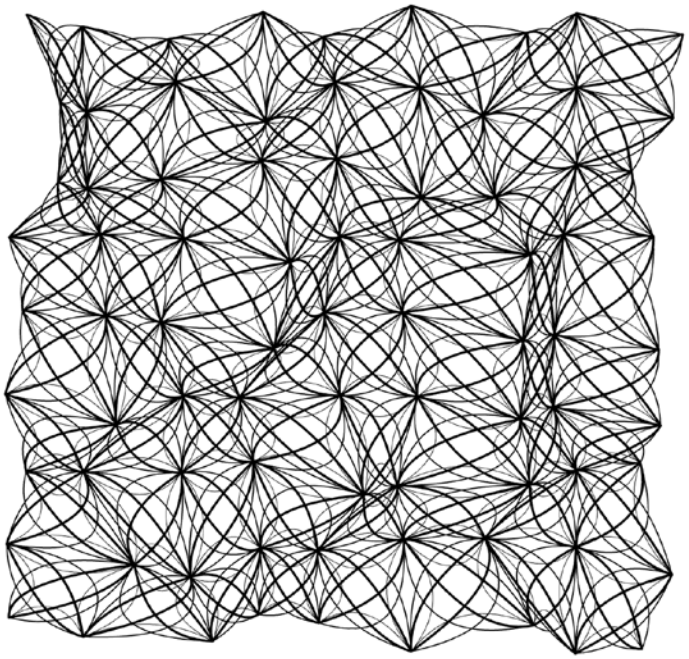
#AI #MachineLearning (ML) #GraphML #3DGAN #StochasticAggregation #Python #DigitalFabrication #AdvancedGeometry #Code #HTML #CSS #JS #Python #Three.JS #Vue #Rhino3D #Grasshopper3D #Karamba #Kangaroo #WASP #Monoceros #DigitalFabrication #CNC #Laser #3DPrint #Cities #Furniture #Architecture #Design

James McBennett

TEACHING PORTFOLIO

The following ten slides are from online courses that I taught in 2020-21 for HackadayU.

1. DESIGN FUNDAMENTALS
2. INTRODUCTION TO ADVANCED GEOMETRY

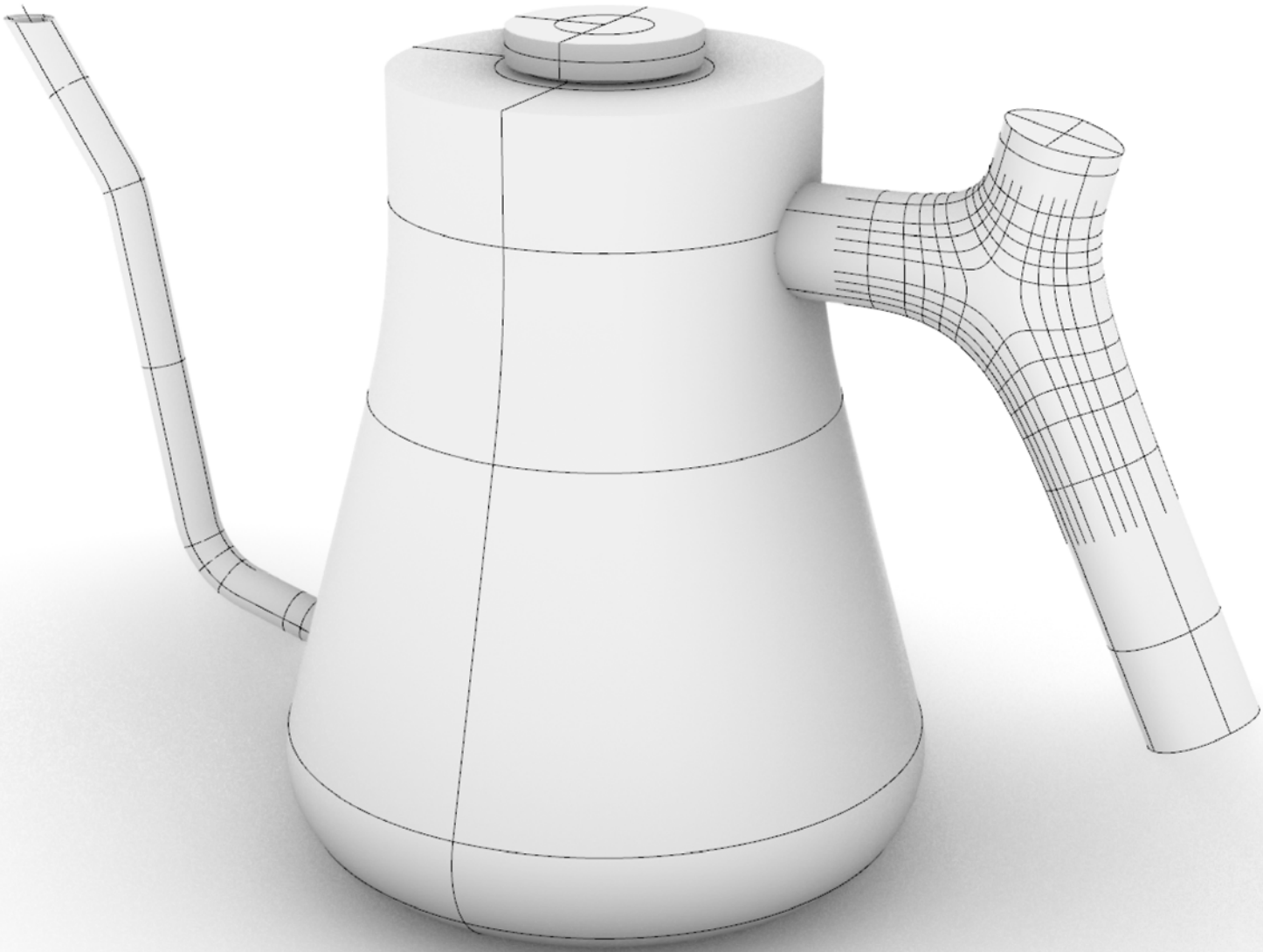


Software: Rhino3D

Design Fundamentals

I introduced students to 3D modeling with NURBS surfaces, solids, meshes, and subdivision (SubD) through a variety of exercises.

Model below is the Stagg Pour-Over Kettle by Fellow that students recreated by following along in class. They then used what they learned to create their own projects.

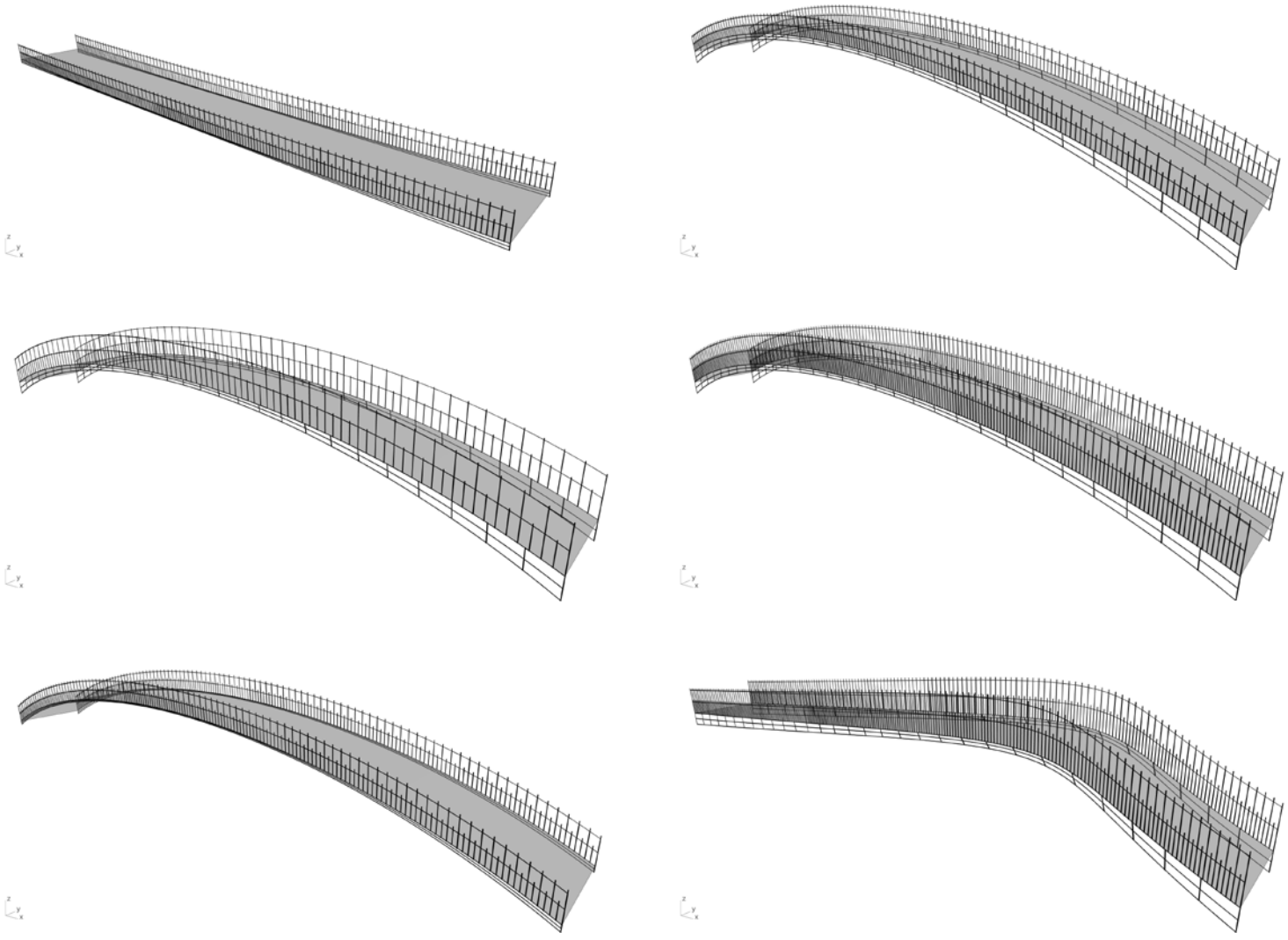


Optional: Five-lecture Pre-Course

Software: Grasshopper3D

Introduction to Advanced Geometry

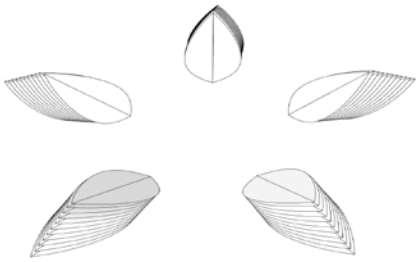
The first exercise in Grasshopper3D was based on the Ha'penny Bridge in Dublin, Ireland. Variables were used to parametrically move the rise of the bridge and the spacing of structural elements.

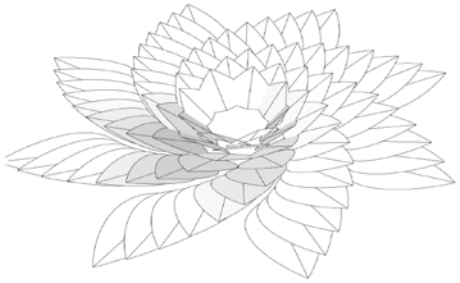


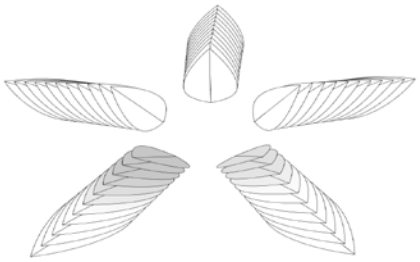
Week 1

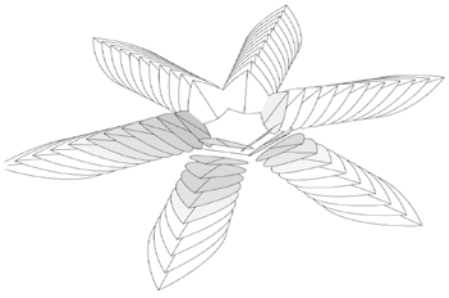
Flowers

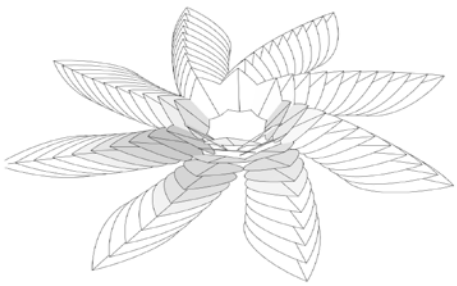
The second week introduced students to thinking about designing using lists of data. Simple inputs can result in complexity but need to be well-managed. Students were introduced to rule-based workflows that were tested with relatively small amounts of data before rapidly increasing the variables, resulting in more complexity.







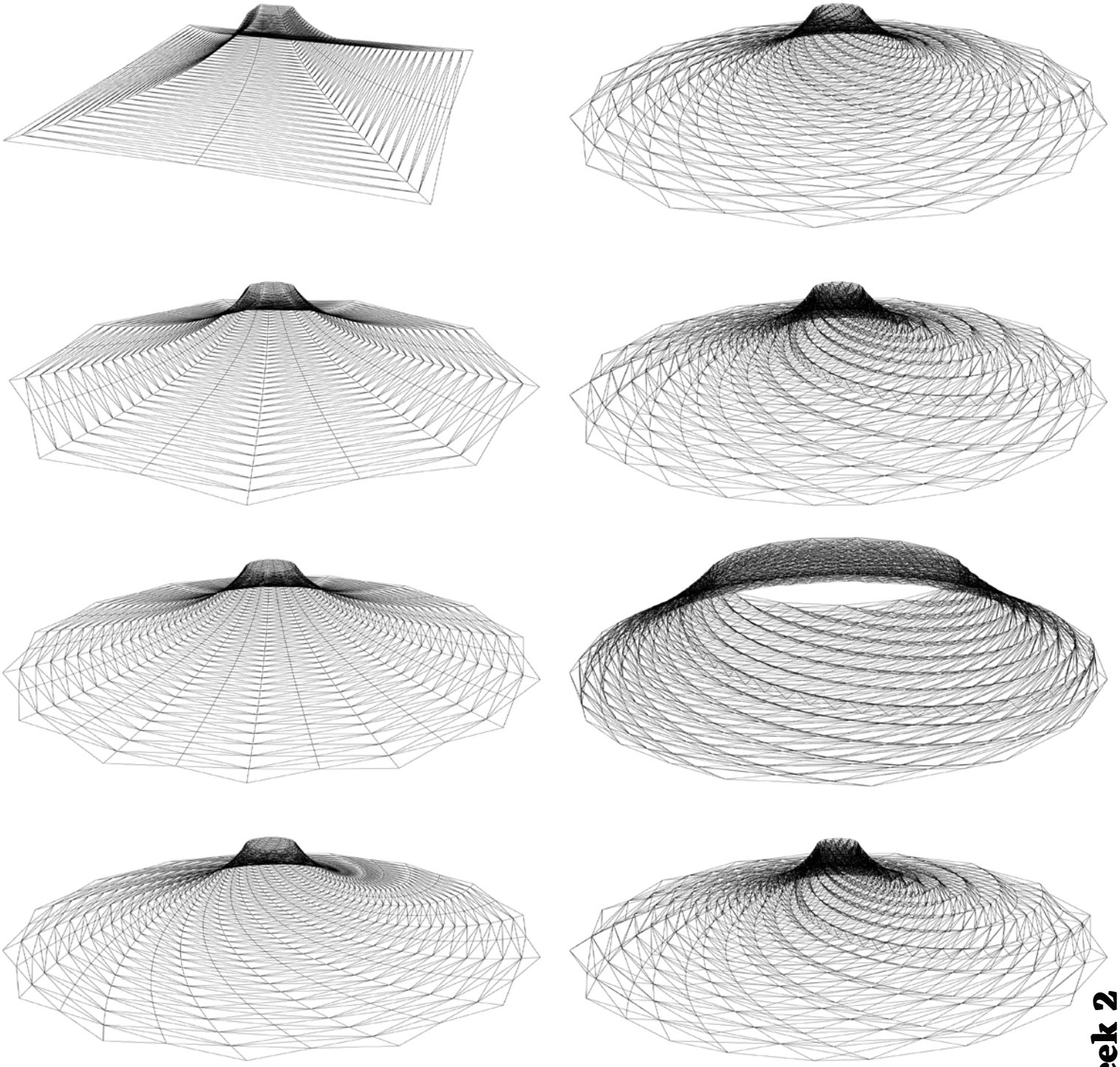




Software: Grasshopper3D

Galaxia

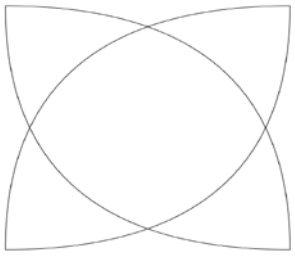
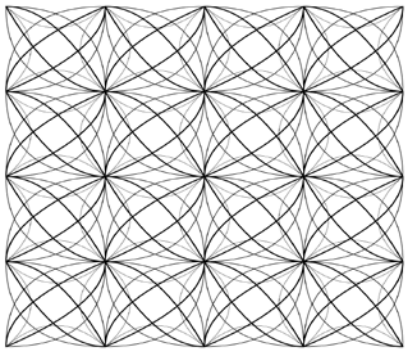
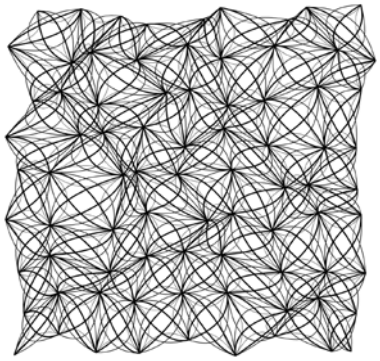
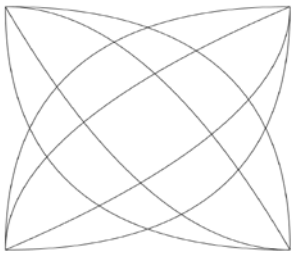
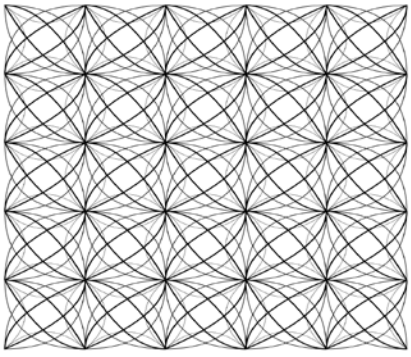
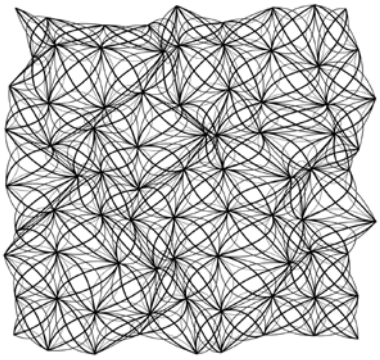
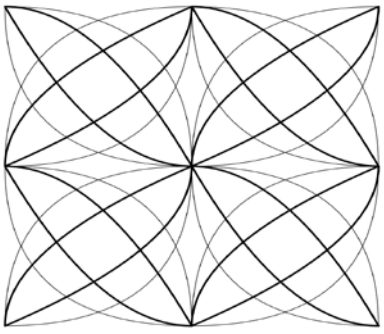
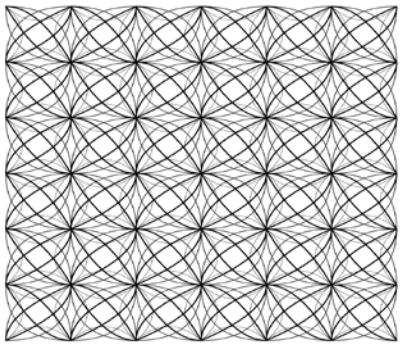
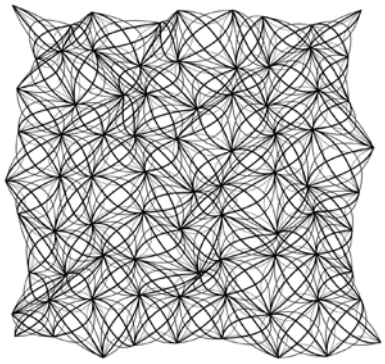
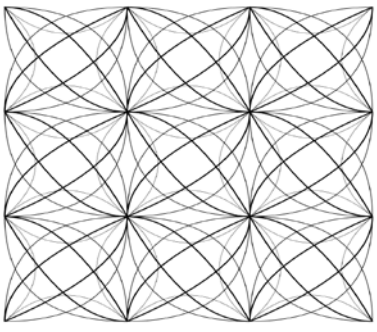
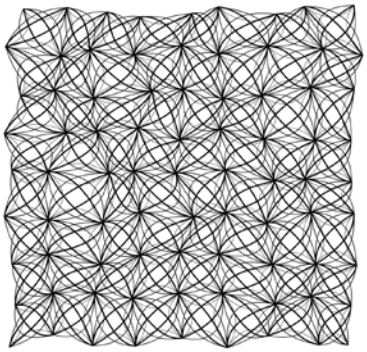
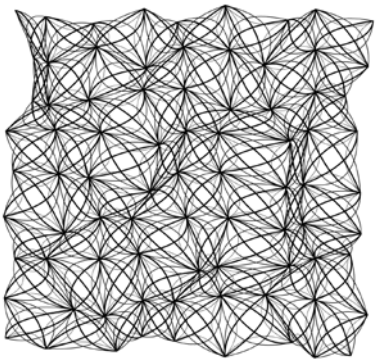
The second exercise from the second week was to create a parametric model from Burning Man's Temple 'Galaxia' from 2018 by Arthur Mamou-Mani, my first instructor in digital geometry at the Architectural Association in London.



Software: Grasshopper3D

Deforming Grids

The third week focused on using a base geometry such as a square grid to form more complex data structures. These can be quickly manipulated by deforming the original grid geometry.

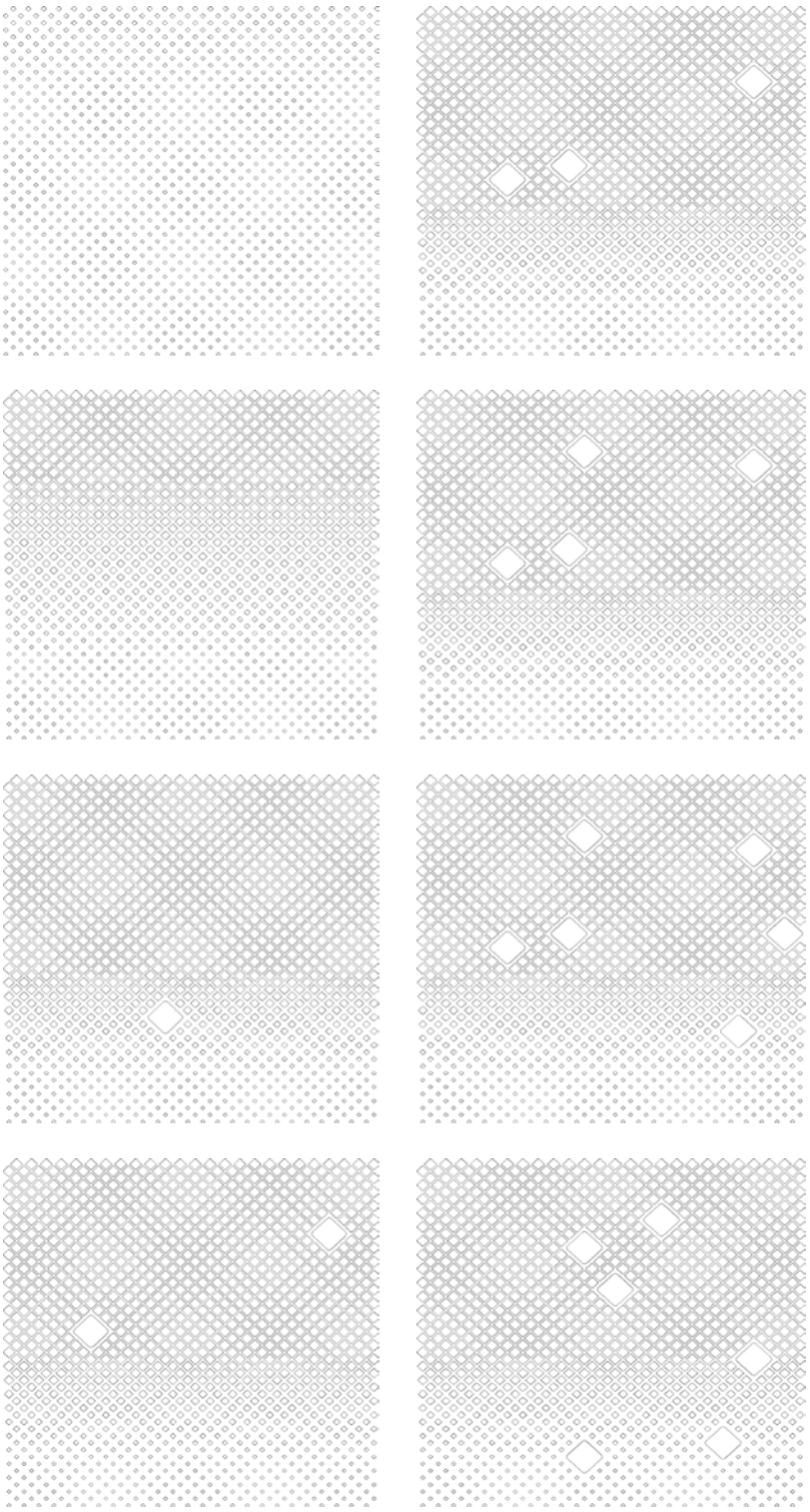













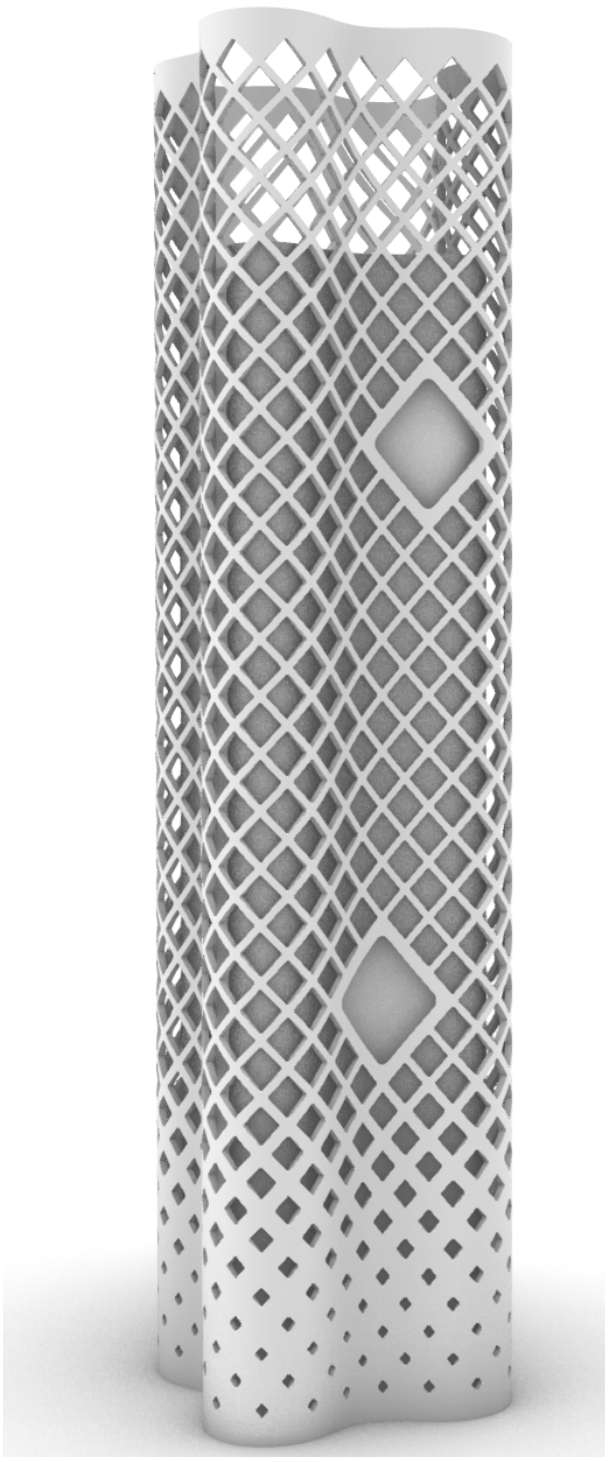
Week 3

Software: Grasshopper3D

SurfaceMorph

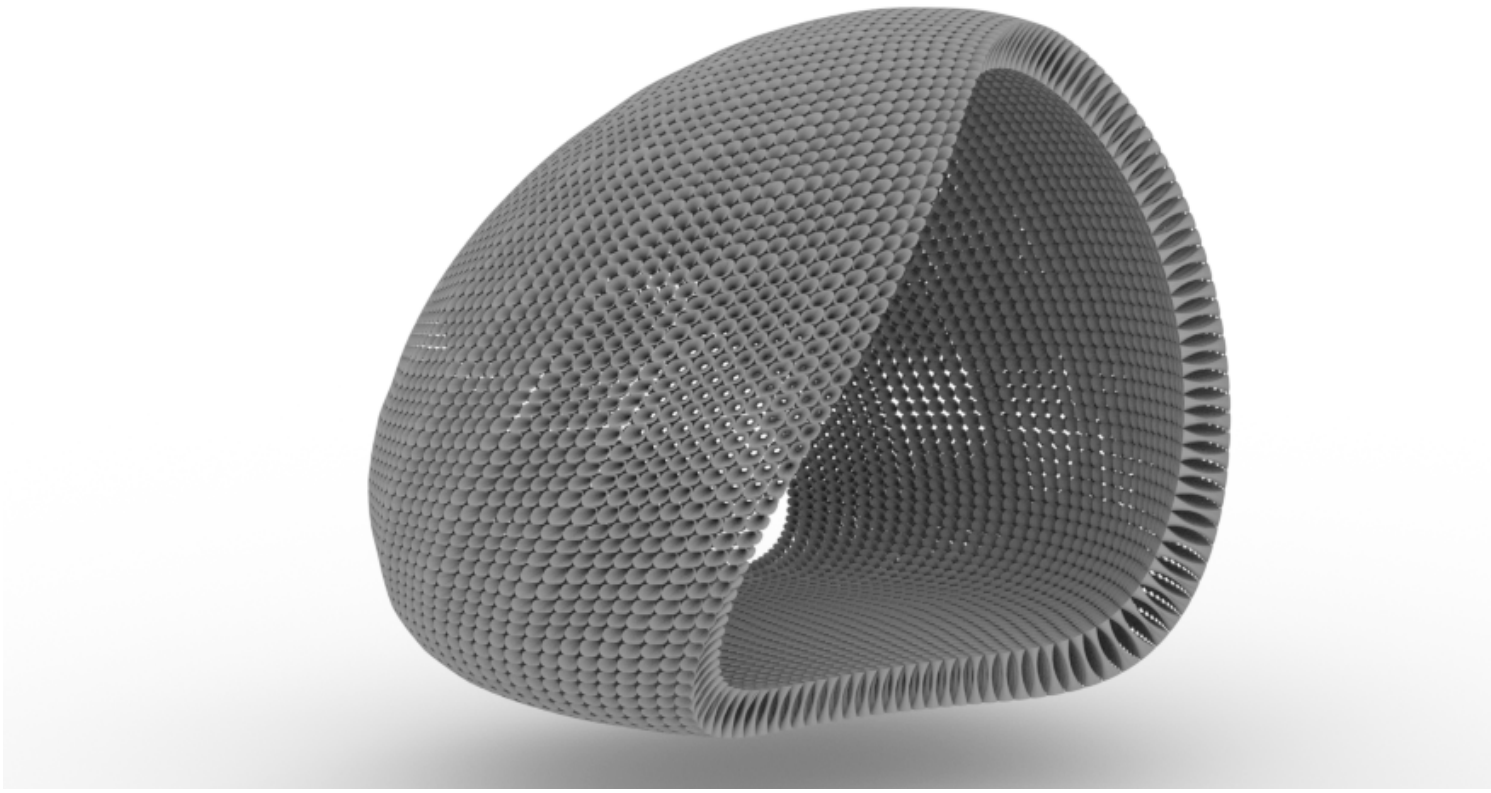
The second exercise from the third week looked at gradients, attractors, and surface morphing. This example was based on O-14 by Reiser+Umemoto (RUR).





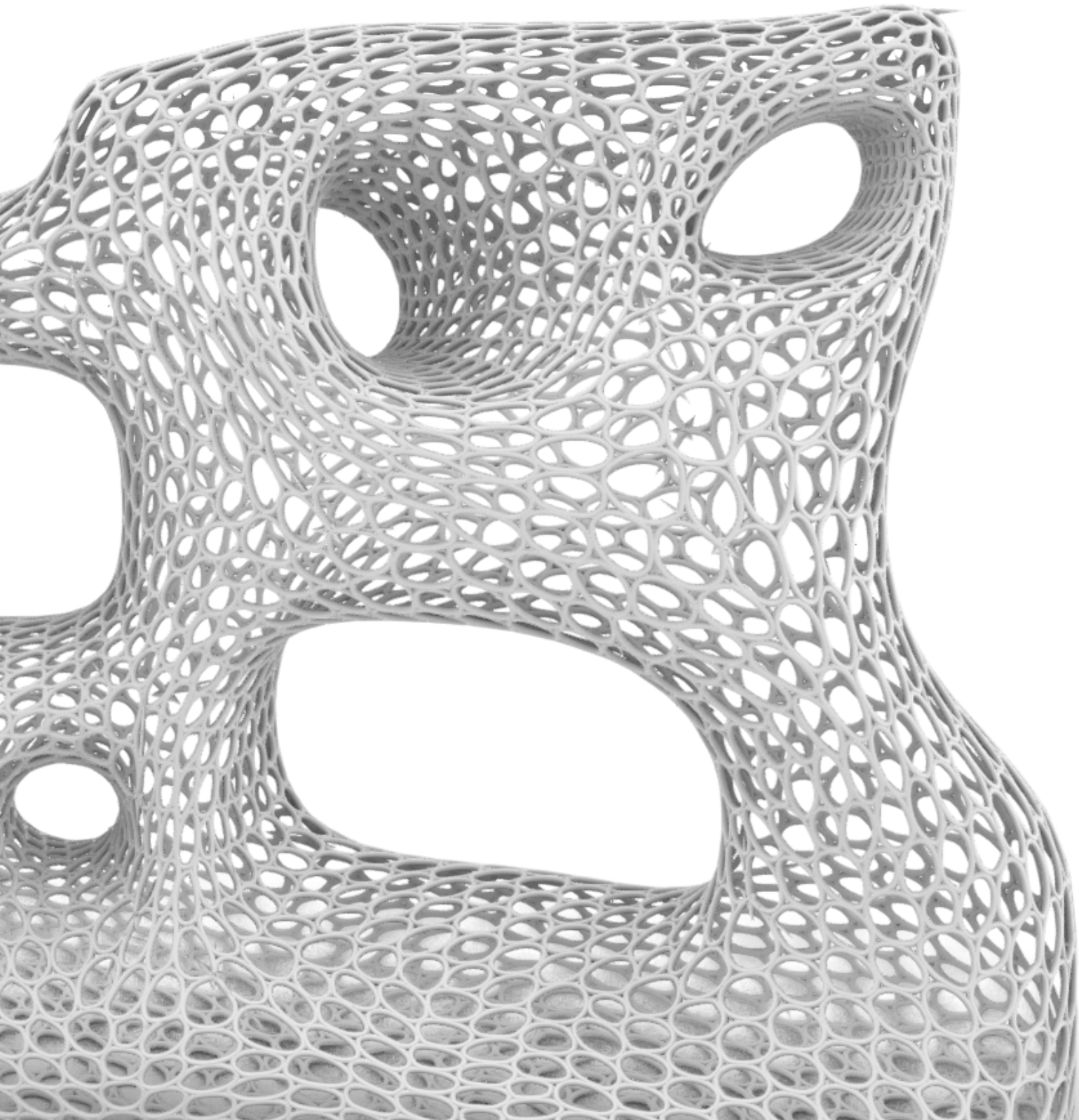
Surfaces + Meshes

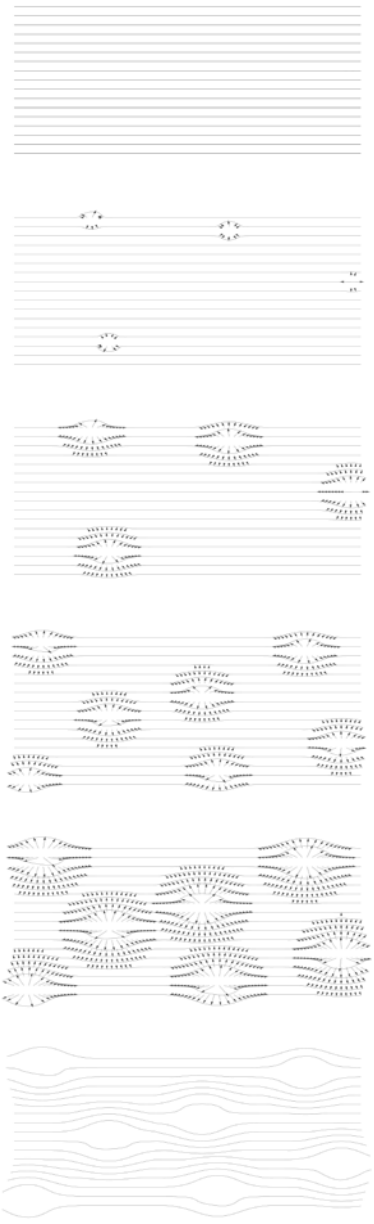
The Egg Pavilion by Michiel van der Kley used multiple types of geometry to create a complex project. Learning surfaces, solids, subdivision, and meshes, students were taught the importance of knowing multiple types of geometry in order to use the most appropriate type in their own projects.



SubD + Meshes

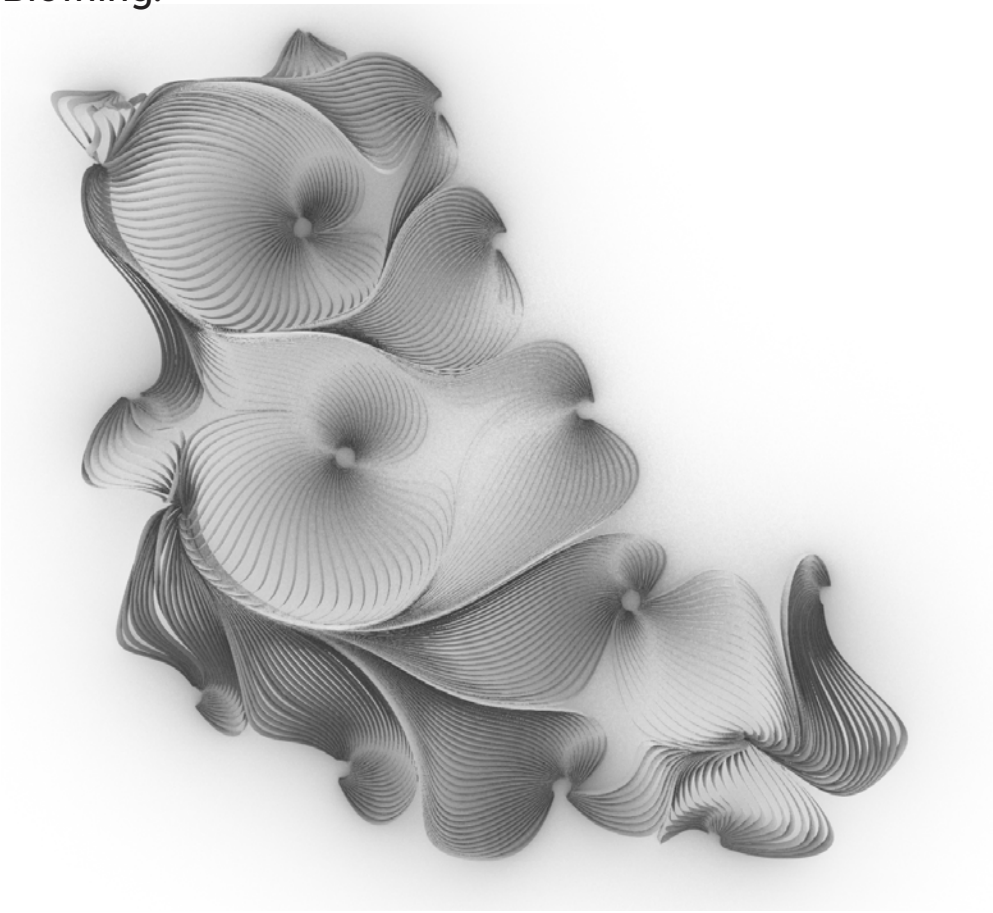
Branching Morphogenesis by Jenny Sabin Studio was not modeled on a computer but made by hand with zip ties. Students created a version of her project in Grasshopper3D using SubD and mesh geometry.





Magnetic Fields

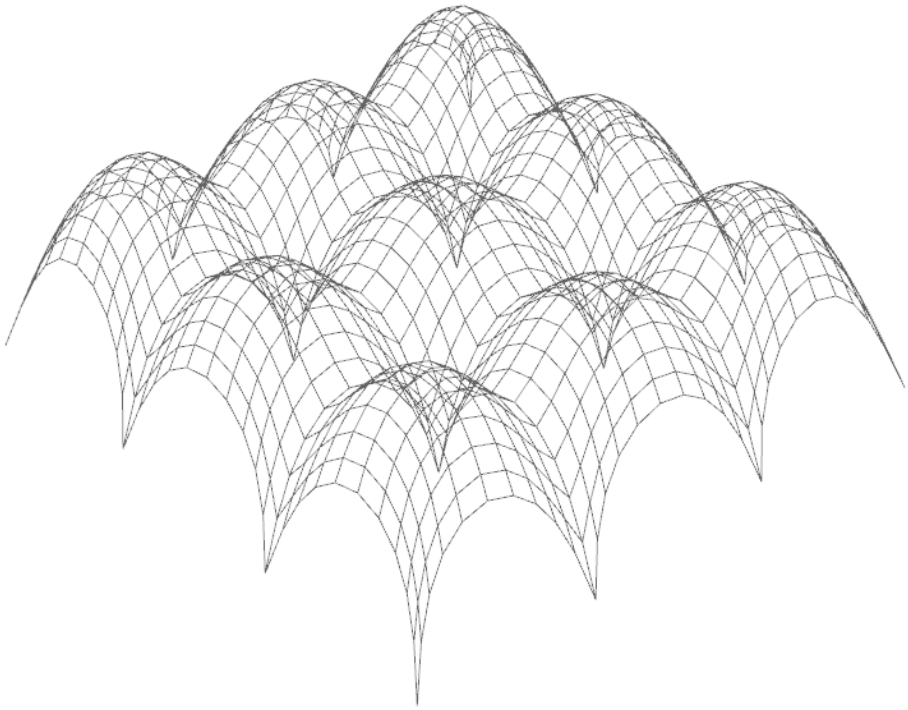
Vectors were introduced in the fourth week using the introductory example on the left before progressing to modeling the Seroussi Pavilion by Alisa Andrasek / Biothing.

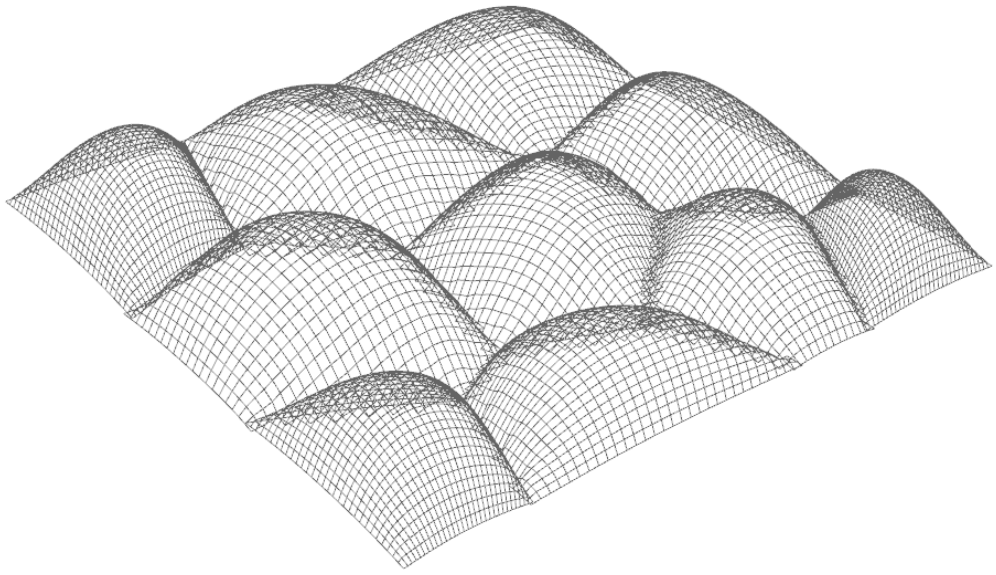


Software: Grasshopper3D, Kangaroo, Unreal Engine

Physics Engine

The last lecture in the final fifth week focused on using Kangaroo to calculate Gaudi's hanging chain models with digital tools. New levels of complexity far beyond what Gaudi achieved are now possible.





Fulcrum

ISSUE 57 - NOVEMBER 14, 2012 - DIGITAL FABRICATION

designed digitally, made locally.

j.mcbennett

Fulcrum: *Could you describe the concept behind your company Fabsie?*

James McBennett: When I looked at the AA pavilions I saw downloadable files that could be repeated anywhere in the world.

While other people perhaps saw advanced manufacturing, I was interested in the recent innovations to the music, broadcasting and publishing industries around digital data, believing these pavilions were digital files too. Fabsie, which launches soon, is based on the power of digital information: its ability to be sent anywhere, control local machines and make anything. We aim to host and promote design files for digitally manufactured ready-to-assemble furniture. Another aspect that interested me was about control, and how designers have less and less, at the hand of the middlemen and manufacturers. Inspired by other fields where companies are removing needless middle men (like AirBnB, Print-on-Demand, or other web platforms) and passing the benefits to small users. That user can employ the platform to create new things.

When I look at the designs people have sent in already, they're so much simpler and more innovative than ready-to-assemble furniture. Some of the stuff assembles in ten seconds and is very robust, as opposed to IKEA for example, which assembles slowly, and is generally weak. Equally, people are testing complexity, and where assembly can become much more detailed than existing products. Some of the files are things IKEA could never do... so the new spectrum is to go way simpler than anything before, then way more complicated, and allow designers more control over their work, while instantly being able to find a global marketplace, where the stuff is locally made and fabricated on-demand.

A lot of things are improving all simultaneously: whether that's the involvement of the designer, or the quality of the design work itself.

F: *One of the things the idea of fabricate-on-demand services changes radically concerns common material culture. This type of mass-variation, (of the type of products and mode of production) you're advocating reduces further the shared objects of society.*

When I was a child, there was a recognisable, and relatively small, field of commonly designed objects: telephone booths, post boxes, plastic pens... the advent of industrial bespoke threatens to transform that drastically.

JM: Those objects didn't arise from an anonymous design culture, they arrived because the craftsman was closer to the needs of the end-user.

For example, the C18th voyeuse chair was made solely for the casino. It had a padded bar at the back, so when the player was looking forward to the table, the person leaning in behind — there are always people looking over your shoulder at a card table — would rest on the padded bar. That chair is so specific in its use, the form was later turned around to become the English conversation chair, another very specific use. When I think of mass-produced objects, I remember the promise of having more options than ever before. But then I think back to those bespoke casino chairs and I think, no, mass-production can only offer less options, not more. Large production runs don't like variation. The minimum order quantities of 20th century fabrication techniques didn't allow for the bespoke, not in a way that was possible in the 19th or earlier centuries.

F: *That's very much in line with Mario Carpo's thinking (Fulcrum #47) — he speaks about the 20th century as almost an anomaly in the way in we made objects, in which consumer confidence in an object was transferred from the skill of the artesan to the homogeneity of the company. In a way, our return to this interest in mass-customisable is a return to the historical evolution of objects...*

JM: Do you believe this mode of production is coming back?

F: *Oh yes. I would argue that the period of mass-production, of Fordist techniques, and modularisation, was a necessary deviation in order to develop more sophisticated tools for the production of unique objects.*

JM: I completely agree. Of course, Chris Anderson, who wrote *Makers* argues that cottage industries are a returning mode of production, with CNC tools as new Spinning Jennys... One of my favourite lines is Marshall McLuhan's "we shape the tools, and thereafter the tools shape us". He was speaking about television and radio mostly, but the line has been applied to the Internet, and so on... from a manufacturing point of view, the tools we created for massproduction, the assembly lines, etc, really did change us into a throw-away consumer culture. We created them, they shaped us, but now we can redeploy the past in creating a future with a different path. Consumers appreciate products more when they play a role in making them, sometimes known as the IKEA effect. One of the softer sides of this process is parametric modelling, which is a giant opportunity to allow consumers customise products. Beyond that is the new ways we communicate. It is now conceivable, thanks to the democratising effect of the Internet, to contact a person who designs for you, without any notion of it being an elitist relationship.

The idea of a relationship with a designer, who is making something for you personally, somewhat disappeared from furniture design during the C20th, although it still largely exists in architecture.

F: *There's something quite old-fashioned about the personal relationship we have with architects... The tools of digital fabrication exist today largely in schools. Do you envisage these technologies will become ubiquitous enough to arrive in the home?*

JM: I'm not a big fan of the home idea. If everything was about plastic, with one manufacturing technique, then maybe you could envisage there was going to be some form of plastic 3D printer in every home. That's feasible in that scenario. But the world's not made of one material, and I think what's more likely is that in each local neighbourhood you will have a set of machines ranging in size.

A CNC wood mill — you don't want that in every home, it's a big machine, it takes up an entire room, it's not necessary or practical to put in every home.

An aluminium mill, a water-jet cutter, these are big, noisy, industrial machines. Even the [digital fabrication] shop *Unto This Last*, on Brick Lane, has a lot of noise problems with their neighbours from having a CNC mill in the centre of London. So I don't think every machine is going to be in every house... and I don't see the Star Trek model of a "replicator" — where you say 'Earl Grey, hot' and it makes you a glass, water, hot tea, all in one instant, by assembling matter... well, I don't see it yet anyway... These machines are largely in schools, yes. The next step up from that are fab labs, which we're beginning to see, there's about a 1000+ in the world, and that's growing rapidly.

Beyond maker spaces, one thing I see with Fabsie is that we can build a network on the spare capacity of existing machines. Any maker space, any furniture manufacturer, any commercial entity, could harness down time in the way black cabs use online apps like Hailo to see a list of placed orders, and then decide whether to take a job or not.

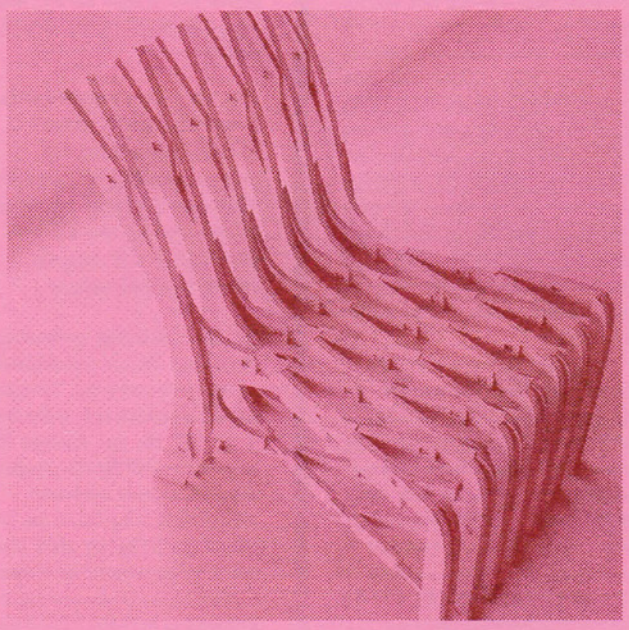
At the scale of furniture production, we're discussing a model as part of a truly distributed economy, as opposed to a hierarchical or nodal system. The combination of global access to digital files, and the local digital manufacturing machines needed to create the object, makes possible a universal distribution that no longer privileges where the design is from, or where the product can go.

The economy that will develop around these machines will also mean a lot of manufacturing can return to developed countries — the economies of scale, labour, and material costs, will no longer heavily impact production location. The change from Made in England to Made in China will then turn to Made Five Miles from your House.

James McBennett studied architecture at the AA, and is co-founder of digital manufacturing company Fabsie. www.fabsie.com

bespoke

industrial



industrial-bespoke

Clockwise: Louis XVI Voyeuse Chair (1780s) ; Eames Lounge Chair Wood (R. & C. Eames, 1947); Scissor Chair, (Phil Seaton with Fabsie, 2012)